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Prevalence and correlates of preoperative anxiety among patients undergoing surgery in low and middle-income countries: A systematic review and meta-analysis

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Abstract

Objectives: This review aimed to determine the pooled prevalence of preoperative anxiety and its correlates among patients undergoing surgery in low and middle-income countries.

Methods: We searched PubMed, SCOPUS, CINAHIL, Embase, and PsychINFO to identify peer-reviewed studies on the prevalence and correlates of preoperative anxiety among patients undergoing surgery using pre-defined eligibility criteria. Studies were pooled to estimate the prevalence of preoperative anxiety using a random-effect meta-analysis model. Heterogeneity was assessed using the Q- and I^2- statistics. Funnel plot asymmetry and Egger's regression tests were used to check for publication bias.

Result: Our search identified 2110 studies, of which 27 studies with 5,575 participants were included in the final meta-analysis. The pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle-income countries was 55.7% (95% CI: 48.60-62.93). Our sub-group analysis found that a higher pooled prevalence of preoperative anxiety was reported in Srilanka (77%, 95% CI: 68.75-85.25, I^2=96.6, P<0.001). Also, a higher pooled prevalence of preoperative anxiety was reported among studies with moderate methodological quality (57.2%) (95% CI: 48.49-65.97, I^2= 94.2%, P<0.001).

Conclusion: In our meta-analysis, the pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle-income countries was considerably high, which needs due attention. Routine screening of preoperative anxiety among patients scheduled for surgery is therefore critically important.

Strength and limitations

- The restriction applied to include studies published only in the English language is one of the limitations of the current review.
- Also, the interpretation of the present finding needs cautions; due to the presence of significantly higher heterogeneity among studies.
- However, the strength of this study includes two independent investigators conducted a screening of articles to minimize the possible reviewer bias, and we also conducted a sensitivity analysis to know further the influence of a single study in the overall pooled estimates.

Keywords: Preoperative anxiety, surgical patients, Prevalence, Systematic review, Meta-analysis, Low and middle-income countries

Introduction

Anxiety is defined as a subjective state of emotional uneasiness, distress, apprehension, or fearful concern associated with autonomic and somatic features and causes impaired functioning or activity (1). Anxiety can also be a normal emotional human reaction to circumstances of danger accompanied by physiological and psychological elements (1, 2). Surgery is one of the standard medical procedures that could increase anxiety irrespective of the type of surgery (2, 3). Surgery is a life-threatening procedure that causes the person to perceive himself under a direct physical restraint. Patients scheduled for surgery may experience fears and anxieties such as nervousness, fear of being unable to wake up from anesthesia, fear of postoperative pain, and fear of death (4). As a result, preoperative anxiety is becoming a significant mental health problem for many patients undergoing surgery (5, 6).

Different epidemiological studies revealed the varying magnitude of preoperative anxiety among patients undergoing surgery. For example, a global level systematic review and meta-analysis reported a 48% pooled prevalence of preoperative anxiety among patients undergoing surgery (7). A facility-based study conducted in Netherland found 27.9% and 20.3% of preoperative anxiety in patients undergoing hip and knee surgery, respectively (8). Other epidemiological studies found that the prevalence of preoperative anxiety ranges from 47% to 70.3% in India (9, 10) and 62% to 97% in Pakistan (11-13).

The magnitude of preoperative anxiety among patients undergoing surgery varies depending on the reasons and type of surgery, gender of the patient (12), patient interaction with medical staff, previous experience of surgical procedures, and sensitivity to stressful circumstances (14, 15). Also, factors such as fear of surgery, fear of anaesthesia, sociodemographic characteristics of the patient (age, educational status, and partner status), types of surgery, fear of postoperative pain, and fear of death were significant predictors of preoperative anxiety (16-22). However, the frequently mentioned major causes of preoperative anxiety were fear of the outcomes of surgery (29.3%), followed by fear of the progress after surgery (19.5%) and complications after surgery (11.4%) (23).

Increased preoperative anxiety levels may be a reason for patients to decline planned surgical procedures (24, 25). High levels of preoperative anxiety negatively affect the surgical operation and contribute to adverse surgical outcomes (26, 27). Literature showed that preoperative anxiety might cause slow, complicated, and painful postoperative recovery (27-29). Severe levels of anxiety before the surgical procedure have resulted in autonomic disturbances such

as increased heart rate, raised blood pressure, and arrhythmias (30), affecting the outcomes of surgical procedures (31). Before the surgical procedure, patients who developed anxiety were found to require higher doses of anesthetic medications, had a higher level of postoperative pain, increased consumption of analgesic drugs, increased morbidity, prolonged recovery, and hospital stay (32-34). Appropriate management of anxiety by clinicians may provide a better pre-operative assessment, less pharmacological premedication, smoother induction and maybe even better outcome (35).

Based on the above evidence there was a substantial difference in the reported prevalence of preoperative anxiety among patients undergoing surgery across studies. Also, there is no previously conducted systematic reviews and meta-analysis on the topic of interest, particularly in low and middle-income countries. Furthermore, identifying the significant correlates of preoperative anxiety is vital to reduce the burden or prevent the onset and subsequent consequences. Therefore, this review aimed to examine the prevalence and thematically quantify and present correlates of preoperative anxiety among patients undergoing surgery in low and middle-income countries and formulate recommendations for future health care services in the area.

Methods

Search strategy

A systemic review and meta-analysis was conducted using studies that examined the prevalence and correlates of preoperative anxiety among patients undergoing surgery in low and middle-income countries. The strategy for literature search, selection of studies, data extraction, and reporting of results for the current review was designed following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (36) (**supplementary file 1**). The protocol for the current review was registered in PROSPERO (CRD42020161934).

Five electronic databases (PubMed, SCOPUS, CINAHIL, Embase, and PsychINFO) were systematically searched to identify studies that report the prevalence of preoperative anxiety among patients undergoing surgery in low and middle-income countries. Searching in PubMed was performed using the following terms: ((Prevalence OR Magnitude OR Epidemiology OR Incidence OR Estimates OR Associated factors OR Determinants OR Correlates OR Predictors) AND ((Preoperative Anxiety OR Anxiety OR Anxiety symptoms OR Anxiety

disorder OR General Anxiety disorder) AND (Surgical patients OR patients undergoing surgery OR surgery)). Database-specific subject headings associated with the above terms were used to screen studies indexed in SCOPUS, CINAHIL, Embase, and PsychINFO databases. Besides, we observed the reference lists of published studies to identify potential other relevant articles for this review.

Eligibility Criteria

In the current review, we have included observational studies conducted on determining the prevalence and correlates of preoperative anxiety among patients undergoing surgery in low and middle-income countries, and written in the English language. Eligible studies included for this review had to fulfil the following criteria: first, the type of study has to be observational (cross-sectional, nested case-control, cohort studies, follow-up studies). Second, the study participants were patients (age ≥18 years) who have a schedule to undergo surgical procedures under anesthesia, regardless of their sex. Third, measurement of anxiety was done using standard diagnostic or validated screening tools.

Exclusion Criteria

Studies that reported pooled preoperative anxiety, had a poor quality score on the New Castle Ottawa Scale (NOS), duplicate studies, conference proceedings, commentaries, abstracts, reports, short communications and letters to editors were excluded.

Data extraction and study quality assessment

Data were extracted using a specific form designed to extract data that authors developed. The data extraction form included the following information: Name of the author, year of publication, country, study design, sample size, type of surgery, and the number of positive cases for preoperative anxiety and prevalence of preoperative anxiety. AB conducted the primary data extraction, and then NM assessed the extracted data independently. Any disagreements and discrepancies were resolved through discussion with the third author BD.

The methodological qualities of each included article were assessed by using a modified version of the Newcastle-Ottawa Scale (37). The methodological quality and eligibility of the identified articles were evaluated by two reviewers (AB and NM) and disagreements among reviewers were resolved through discussion with the third Author (BD). Finally, studies with a scale of ≥ 5 out of 10 were included in the current review.

Analysis

For the first objective, estimating the pooled prevalence of preoperative anxiety, the prevalence report extracted from all the included primary studies were meta-analyzed. For the second objective, identifying the significant factors associated with preoperative anxiety, reports of measures of associations (OR, r, β or RR) were analyzed narratively. While interpreting the association between significant factors and preoperative anxiety, adjusted estimates were the first choice. However, for studies that missed reporting adjusted estimates, crude estimates will be considered.

We have examined publication bias by visual inspection of a funnel and conducting Egger's regression tests (38, 39). A p-value <0.05 was used to declare the statistical significance of publication bias. Studies were pooled to estimate pooled prevalence and 95% CI using a random-effect model (40). We have assessed heterogeneity using Q and the I^2 statistics (41). I^2 statistics is used to quantify the percentage of the total variation in the study estimate due to heterogeneity. I^2 values of 25, 50 and 75% were considered to represent low, medium and high heterogeneity, respectively (42). Due to heterogeneity, we conducted a subgroup analysis based on the methodological quality of studies, country, and type of surgery. Also, sensitivity analysis was conducted to evaluate the presence of outlier estimates of preoperative anxiety. All the extracted data were analyzed using STATA 16.

Patient and public involvement

No patient involved

Results

Identification of studies

We have identified a total of 3110 studies from 5 databases in our initial electronic searching. After removing duplicates, reviewing titles and abstracts, 211 studies were considered eligible for full-text review. After excluding 185 articles in full-text review and adding 1 article that we get through reference searching, 27 studies were included in this systematic review and meta-analysis (**Figure 1)**.

Characteristics of included studies

Among 27 studies (5,575 population), all (100%) studies employed cross-sectional study design, 9 (81.2%) studies published in the past five years (21, 22, 30, 43-48). Of the total 27 studies, 6 studies were conducted in Ethiopia, five studies were from Brazil, and three studies

were from each of the following countries; Nigeria, Pakistan and India. The sample size of the included studies ranges from 30 in Nigeria (48) to 591 in Brazil (49). The prevalence of preoperative anxiety ranges from 34% in Nigeria (50) to 87.5% in India (51). Of the 27 included studies, 16 (59.2%) and 11 (40.8%) were from middle-income and low-income countries respectively (**Table 1**).

Table 1: Characteristics of studies included in the current systematic review

Author	Publication Year	Country	Sample size	Study design	Type of surgery	Cases	Prevalence (%)	Anxiety Measures (Cut-off point)	NOS score
Bedaso A. et al (43)	2019	Ethiopia	407	Cross-sectional	All surgery	191	47	STAI (≥ 44/80)	8
Takele G.et al (44)	2019	Ethiopia	237	Cross-sectional	All surgery	132	56	PITI-20 Item (≥16/60)	7
Woldegerima YB. et al (21)	2018	Ethiopia	178	Cross-sectional	All surgery	106	60	STAI (> 44/80)	7
Mulugeta H. et al (22)	2018	Ethiopia	353	Cross-sectional	All surgery	215	61	STAI (> 44/80)	9
Adesanmi A. et al (30)	2015	Nigeria	51	Cross-sectional	All surgery	26	51	STAI (> 44/80)	6
Nigussie S. et al (5)	2014	Ethiopia	239	Cross-sectional	All surgery	168	70.3	STAI (≥ 44/80)	7
Ebirim L., Tobin, M (50)	2010	Nigeria	125	Cross-sectional	All surgery	43	34	VAS (≥45/100)	6
Srahbzu M. et al (45)	2018	Ethiopia	423	Cross-sectional	Orthopaedic surgery	168	39.8	HADS-A (≥ 18)	7
Ryamukuru, David (46)	2017	Rwanda	151	Cross-sectional	All surgery	110	72.8	PITI-20 Item (≥15/60)	6
Mellouli et al (47)	2018	Tunisia	332	Cross-sectional	All surgery	224	67.5	APAI score (>10)	6
Dagona, Sabo Saleh (48)	2018	Nigeria	30	Cross-sectional	All surgery	16	53.3	APAI-H (NA)	6
Mthias AT et al (52)	2011	Srilanka	100	Cross-sectional	Elective Surgery	77	77	APAI score (≥11)	8
Carneiro AF et al (53)	2009	Brazil	96	Cross-sectional	Cardiac Surgery	42	43.8	HADS-A (≥9)	8
Ramesh C et al (54)	2017	India	140	Cross-sectional	Cardiac Surgery	118	84	STAI (≥ 40/80)	9
Gonçalves et al (55)	2016	Brazil	106	Cross-sectional	Cardiac Surgery	43	40.6	BAI (NA)	7
Maria Luiza MA et al (56)	2007	Brazil	114	Cross-sectional	Cosmetic Surgery	85	74.5	STAI (> 36/80)	8
Caumo W et al (49)	2001	Brazil	591	Cross-sectional	Elective Surgery	141	23.99	STAI (≥ 39/80)	8
Jafar MF et al (11)	2009	Pakistan	300	Cross-sectional	Elective Surgery	186	62	STAI (NA)	7
Maheshwari D, Ismail S (12)	2015	Pakistan	154	Cross-sectional	Elective CS	112	72.7	VAS (≥50)	8
Ali A et al (57)	2013	Turkey	80	Cross-sectional	Gall bladder surgery	31	38.75	BAI (>17/63)	9

Ayman M Y et al **(58)**	2017	Palestine	320	Cross-sectional	All surgery	184	57.5	APAI score (>11)	8
Tajgna K et al **(51)**	2018	India	160	Cross-sectional	All surgery	140	87.5	DASS-21 (NA)	9
Le Xu et al (59)	2016	China	53	Cross-sectional	Gastric Cancer surgery	11	20.75	HADS-A (≥18)	9
Sntos LJF et al (60)	2014	Brazil	41	Cross-sectional	Rectal Surgery	16	39	BAI (≥10/63)	8
Khalili et al (61)	2019	Iran	231	Cross-sectional	All Surgery	109	47.2	STAI (≥40/80)	7
Arshi et al (62)	2018	Pakistan	363	Cross-sectional	All surgery	228	62.8	VAS(≥45/100)	6
Bansal T et al (62)	2017	India	200	Cross-sectional	Emergency CS	110	55	STA (≥40/80)	7

Abbreviations: VAS: Visual Analogue Scale; PITI: Preoperative Intrusive Thought Inventory; STAI: State-Trait Anxiety Inventory; APAI: Amsterdam preoperative Anxiety and Information scale; BAI: Beck Anxiety Inventory; DASS-21: Depression Anxiety and Stress Scale; BAI: Beck Anxiety Inventory; CS: Caesarean section.

The methodological quality of studies

We used the modified Newcastle Ottawa Scale (NOS) (37) to evaluate the methodologic quality of the studies included in the current review. Among the 27 studies included in the present review, 16 studies were of high (NOS score ≥ 8), and 11 studies were of moderate methodologic quality (NOS score 6-7) **(Supplementary file 2)**.

Meta-analysis

The pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle-income countries was estimated to be 55.7% (95% CI: 48.60-62.93) with considerable heterogeneity between studies (I^2= 97%; P<0.001). Consequently, a random-effects meta-analysis model was employed to estimate the overall pooled prevalence (**Figure 2**).

Further, to explore the possible sources of heterogeneity we employed a random-effect univariate meta-regression model considering the sample size, publication year, and NOS quality score as moderators. However, none these continuous variables (i.e., sample size (Coefficient= -0.015, P= 0.533), publication year (Coefficient= 0.984, P= 0.202), and NOS quality score (Coefficient= -2.65, P= 0.412)) found to have significant association with heterogeneity.

Publication bias

Inspection of the funnel plot looks symmetric and shows no significant publication bias (**Figure 3**). Besides, eggers regression test suggested absence of publication bias (B= -2.79, SE= 2.013, P= 0.165).

Sub-group and sensitivity analysis

Due to the reported high heterogeneity index among studies, a subgroup analysis was conducted using characteristics like country, type of anxiety tool used, quality of studies and economic level of a country. Among studies that assessed the prevalence of preoperative anxiety among surgical patients, the subgroup analysis based on the country where the studies conducted revealed that higher pooled prevalence of preoperative anxiety was reported in a study conducted in Srilanka (77%, 95% CI: 68.75-85.25, I^2=96.6, P<0.001), followed by India (75.6%, 95% CI: 56.72-94.49, I^2= 69, P=0.040) and Rwanda (72.8%, 95% CI: 65.7-79.89). Besides, a higher pooled prevalence of preoperative anxiety was reported in a study that used Depression Anxiety and Stress Scale (DASS) (87.5%, 95% CI: 82.37-92.62), followed by

studies that used Amsterdam preoperative Anxiety and Information Scale (APAI) tool as an anxiety assessment tool (64.9%, 95% CI: 55.78-74.10, I^2= 83.4%, P<0.001).

To further explore the source of heterogeneity among studies included in the review, we have also conducted a subgroup analysis using the quality of studies as a moderator. The pooled prevalence of preoperative anxiety was higher in the studies with moderate methodological quality (57.2%) (95% CI: 48.49-65.97, I^2= 94.2%, P<0.001) compared to those studies with high methodological quality (54.8%) (95% CI: 44.28-65.28, I^2= 97.8, P<0.001). Finally, a higher pooled estimate was reported in studies conducted in middle-income countries (55.7%) (95%CI: 48.60-62.93, I^2= 98, P<0.001) compared to studies conducted in low-income countries (54.9%, 95%CI: 47.69-62.17, I^2= 92.6, P<0.001) (**Table 2**).

Table 2: Subgroup analysis of the prevalence of preoperative anxiety among patients undergoing surgery by country, type of anxiety tool, quality of studies and economic level of a country.

Sub group	Number of studies	Estimates		Heterogeneity across studies	
		Prevalence (%)	95% CI	I^2 (%)	P-value
Country					
Ethiopia	6	55.6	35.13-44.46	94.1	<0.001
Nigeria	3	44.6	31.86-58.16	69.6	0.037
Rwanda	1	72.8	65.7-79.89	-	-
Tunisia	1	67.5	62.46-72.53	-	-
Brazil	5	44.4	23.76-64.95	97.1	<0.001
Srilanka	1	77	68.75-85.25	96.6	<0.001
India	3	75.6	56.72-94.49	69	0.040
Pakistan	3	65.4	59.4-71.39	-	-
Turkey	1	38.8	28.07-49.4	-	-
Palestine	1	57.5	52.08-62.9	-	-
China	1	20.6	9.83-31.67	-	-
Iran	1	47.2	40.76-53.63	97	<0.001
Anxiety tool used					
STAI	11	57.8	45.80-69.78	97.9	<0.001
PITI	2	64.3	47.85-80.78	91.7	0.001
VAS	3	56.6	37.16-76.17	96.1	<0.001

HADS-A	3	35.3	23.77-46.90	82.6	0.003
APAI	4	64.9	55.78-74.10	83.4	<0.001
BAI	3	39.6	33.29-46.02	0%	0.964
DASS	1	87.5	82.37-92.62	-	-
Quality of studies					
High	16	54.8	44.28-65.28	97.8	<0.001
Moderate	11	57.2	48.49-65.97	94.2	<0.001
Economy level of a country					
Low Income	11	54.9	47.69-62.17	92.6	<0.001
Middle Income	16	55.7	48.60-62.93	98	<0.001

Moreover, we have conducted a leave-one-out sensitivity analysis to identify the influence of one study on the overall pooled estimate. The overall estimate of this study did not appear to be affected by the removal or addition of a single study at a time, suggesting the robustness of our pooled estimate. Thus, the pooled prevalence of preoperative anxiety ranges from 54.5% to 57.2% (**Figure 4**).

Correlates of preoperative anxiety among patients undergoing surgery

The results extracted from studies conducted on the significant correlates of preoperative anxiety among patients undergoing surgery are presented in **Table 3**. Risk factors that have been adjusted in the studies included in this review were inconsistent across studies conducted in low and middle-income countries (5, 12, 21, 22, 43-47, 49, 52, 54, 55, 60, 61, 63-65).

Of the total studies included in the review, ten studies (22, 44, 45, 49, 52, 54, 55, 61, 63, 65) reported the increased odds of preoperative anxiety symptoms among female patients when compared to male patients. Similarly, being young age (12, 21, 46, 61, 64) has significantly increased the odds of preoperative anxiety symptoms in patients waiting for scheduled surgery. Preoperative anxiety was significantly associated with fear of death, dependency, and disability (21, 43).

Further, patients who did not receive adequate preoperative information were more likely to have clinically significant preoperative anxiety levels compared to patients who did receive high-level information (5, 12, 22, 44, 47, 61). Not surprisingly, low income appeared to increase the odds of developing preoperative anxiety symptoms in patients waiting for surgery

(5, 12). Likewise, having a family history of mental illness (45), history of cancer and smoking (49), lower educational attainment (63, 64) were found to be associated with preoperative anxiety symptoms in patients waiting for surgery.

Moreover, statistical adjustment for some other risk factors varied for respective studies included in this review. Factors such as getting low social support, fear of unexpected outcome of surgery (43), being non-partnered (5), urban residence, inadequate awareness of anaesthesia adverse effect (61), number of days of hospitalization (57), having chronic medical illness (45), gastrointestinal problems (60) were found to have a significant positive correlation with preoperative anxiety after adjusting for other factors.

Table 3: Correlates of pre-operative among patients undergoing surgery

Author	**Key results on correlates of preoperative anxiety**
Bedaso A. et al (43)	Having strong social support (AOR = 0.16, 95%CI = 0.07-0.34), harm from doctor or nurse mistake (AOR = 5.03, 95%CI = 2.85-8.89), unexpected result of the surgery (AOR = 3.03, 95%CI = 1.73-5.19), unable to recover (AOR = 2.96, 95%CI = 1.18-4.87), and need of blood transfusion (AOR = 2.76, 95%CI = 1.65-4.62) were significantly associated with preoperative anxiety.
Takele G.et al (44)	Being female (AOR 3.30, 95% CI 1.30, 8.34), Orthopaedics surgery (AOR 4.24, 95% CI 1.23, 14.05), Not having information (AOR 2.48, 95% CI 1.11, 5.56), postponement of surgery (AOR 5.53, 95% CI 1.28, 23.91) and not listening music (AOR 3.41, 95% CI 1.45, 7.98) were factors significantly associated with preoperative anxiety.
Woldegerima YB. et al (21)	Significant association with preoperative anxiety found in fear of death (AOR = 2.40, 95% CI = 1.08–5.32), family concern (AOR = 2.15, 95% CI = 1.03–4.50), fear of dependency (AOR = 2.75, 95% CI = 1.57–7.20) and fear of disability (AOR = 2.75, 95% CI = 1.22–6.21). High preoperative anxiety was associated with age 18–30 years (AOR = 6.92, 95% CI = 1.39–33.82), age 31–45 years (AOR = 5.72, 95% CI = 1.61–20.28), no income (AOR = 3.21, 95% CI = 1.01–10.27), low income (AOR = 3.06, 95% CI = 1.18–7.93). Rural residency (AOR = 0.38, 95% CI = 0.16–0.89) was associated with lower risk for preoperative anxiety.
Mulugeta H. et al (22)	Pre-operative anxiety has a significant association with female patients [AOR 2.19, 95%CI (1.29–3.71)] and patients who lack preoperative information [AOR 2.03(95%CI (1.22–3.39))].
Nigussie S. et al (5)	Being Single (β=5.288, 95%CI: (2.149, 8.428), P<0.001), Divorced marital status (β=5.629, 95%CI (0.053, 11.205), P<0.048), Income (β=0.002, 95%CI: (0.001, 0.004), P=0.001), Time of operation(afternoon) (β=-2.770, 95%CI (−4.906, −0.633), P=0.011) and patients with no preoperative information (β= -2.337, 95%CI (−4.656, −0.018), P=0.048)
Srahbzu M. et al (45)	Being female (AOR=1.9995%CI(1.11,3.57)), having a chronic medical illness (AOR=3.0795%CI(1.36,6.92)), having a family history of mental illness (AOR=2.24 95%CI (1.05,5.4.91)), lower extremity injury (AOR=2.93 95%CI (1.38,6.21)) and having severe pain (AOR=2.75 95%CI (1.32,5.74)) for anxiety had a significant association with preoperative anxiety (P <0.05).

Ryamukuru, David (46)	Patients who waited for orthopaedic surgery are 10 times more likely to have clinically significant preoperative anxiety levels compared to patients who waited for urology surgery (OR: 10.22; 95% CI 1.144 - 91.304; P= 0.037). The old patients had low preoperative anxiety levels compared to patients with young age (OR: 0.22; 95% CI 0.075 - 0.650; P=0.006).
Mellouli et al (47)	High grade of surgery (AOR: 9, 95% CI: 3.4-23.8) and high level of information requirement (AOR: 1.5, 95% CI: 1.3-1.7) were the main predictors of preoperative anxiety.
Mthias AT et al (52)	Those who had experienced surgery before were less anxious (p<0.05). Females who had surgery before were less anxious than those who had never experienced surgery (p=0.011)
Ramesh C et al (54)	There was a significant association found between female gender and high level of state anxiety with a Pearson chi-square value of 11.57(p < 0.001)
Gonçalves KKN et al (55)	Women had scores (22.13±23.41) significantly (p=0.003) higher than men (10.76±14.71). We observed a significantly higher difference (p=0.012) in anxiety in the group of patients who had undergone previous heart surgery (24.4±28.05 X 13.14±15.74) and among smokers (19.27±23.57 Vs 11.28±12.19; p=0.039).
Caumo W et al (49)	Pre-operative anxiety was significantly associated with a history of cancer (AOR=2.26; 95%CI (1.43–3.57), Female gender (AOR: 2, 95% CI (1.24–3.26)) and History of smoking (AOR=7.47; 95% CI: (1.47–37.81)
Fathi M et al (65)	Correlation between state and trait anxiety was more prominent in females (r= 0.80, P< 0.001) and Older patients(r= 0.226, P<0.001).
Maheshwari D, Ismail S (12)	Pre-operative anxiety had significant association with age ≤25 years (AOR: 3.11, 95%CI: 1.03-9.32, P= 0.04), nulli and primiparous (AOR: 2.87, 95%CI: 1.38-5.98, P=0.05), general anaesthesia in previous surgery (AOR: 4.29, 95% CI: 1.93-9.53, p<0.01), no previous surgery (AOR: 14.72, 95%CI: 3.13-69.28, P<0.01) and source of information from non-anaesthetist (AOR: 0.18, 95%CI: 0.07-0.45, P= 0.0005)
Ocalan R et al (64)	Correlation tests identified a significant relationship between preoperative anxiety and patients' age (r= −0.326, P=0.011), educational level (r=0.258, P=0.046), immediate (r=0.715, P<0.001) and late (r=0.605, P<0.001) postoperative pain.
Ali A et al (57)	A significant positive correlation was found between the days of hospitalization and preoperative score (r= 0.370, P= 0.001).
Erkilic E et al (63)	Preoperative anxiety levels were found to be significantly higher in women and less educated patients undergoing surgery (P<0.05).
Sntos LJF et al [60]	There is a moderate positive correlation between anxiety and gastrointestinal problems (r=0.3975, P<0.05) and a moderate positive correlation between anxiety and sexual problem (r=0.4017, P<0.05)
Khalili et al (61)	A significant association was reported between state anxiety and age (OR= 0.95, 95%CI= 0.93-0.97), Female gender (OR: 2.33, 95%CI: 1.26-4.29), Urban residence (OR: 3.73, 95%CI: 1.65-8.44) and Inadequate patients' awareness of anaesthesia adverse effect (OR: 3.43, 95%CI: 1.53-7.67) (p< 0.05).

Discussion

This systematic review and meta-analysis synthesized the results of twenty-seven primary studies that were conducted in low- and middle-income countries to determine the prevalence and determinants of preoperative anxiety among 5,575 surgical patients undergoing surgery.

The pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle-income countries was 55.7% The pooled estimate in the current review was higher when compared to the pooled prevalence reported in a global level systematic review and meta-analysis that included 14,652 study participants (7). Likewise, the pooled estimate of our review was higher than the estimates from different epidemiological studies conducted in high-income countries such as the Netherlands reported that 27.9% and 20.3% patients undergoing hip and knee surgery, respectively experienced anxiety symptoms prior to actual surgery (8). The variation in the socio-cultural aspect may partly explain the observed difference in the pooled estimates. Furthermore, risk factors such as genetic make-up of individuals, access to information regarding their surgical procedure, quality and availability of service in each health facility, sampling methods, and tools used to screen anxiety may contribute to the observed difference.

Surprisingly, the available epidemiological evidence virtually unchanged when the origin of the primary studies included in this review considered as a moderator. For example, the pooled prevalence of preoperative anxiety was 77% in Sri Lanka, 75.6% in India and 72.8% in Rwanda. Although evidence suggests that an individual cultural background could potentially affect the experience of anxiety symptoms, the variability of the origin of primary studies appeared to play negligible role in the pooled estimate of this study.

The subgroup analysis using the tools used to estimate the prevalence of preoperative anxiety showed slight variation in the prevalence of preoperative anxiety among patients undergoing surgery. Most notably, the prevalence of preoperative anxiety among patients undergoing surgery was slightly higher in the studies that have used Depression Anxiety and Stress Scale (DASS) to ascertain preoperative anxiety in patients when compared to Amsterdam preoperative Anxiety and Information Scale (APAI). The discrepancy may be due to variability in the psychometric properties of those measures.

Our review found that the risk of preoperative anxiety was higher among female surgical patients compared to their counterpart. Of the studies included in the current systematic review and meta-analysis, ten studies reported that being female increased the odds of developing preoperative anxiety among surgical patients (22, 44, 45, 49, 52, 54, 55, 61, 63, 65). This might be because of women's experience of some specific forms of mental health problems like premenstrual dysphoric disorder, postpartum depression, and postmenopausal mental illness, which are linked with changes in ovarian hormones that may contribute to the observed difference in risk of developing preoperative anxiety among female patients (66).

Early screening and targeted intervention of preoperative anxiety among patients undergoing surgery are recommended for future action. Further studies should be conducted to examine the possible reasons for a substantially higher burden of preoperative anxiety among patients undergoing surgery. Moreover, interventional and randomized controlled trials (RCTs) are recommended for a specific group of surgical patients.

Conclusion

In our meta-analysis, the pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle-income countries was significantly high (55.90%), which needs due attention. Therefore, routine screening of preoperative anxiety among patients scheduled for surgery is vital. Finally, providing preoperative education on the effect of anesthesia, surgical procedure, and possible postoperative pain management options is highly warranted.

Abbreviation

CI: Confidence Interval;

NOS: Newcastle Ottawa Scale;

NSW: New South Wales;

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses;

RCTs: Randomized Controlled Trials (RCTs)

Ethics approval and consent to participate

N/A

Consent for publication

N/A

Availability of data and material

All data generated or analysed during this study are included in this article.

Competing interests

The authors declare that there is no competing interest.

Funding

The authors declare that there is no funding received**.**

Authors' contributions

The author AB performed the search, quality appraisal, data extraction, analyses, and writing the draft of the initial manuscript. NM participated in quality appraisal, and data extraction. BD contributed to the consensus, revising the draft manuscript, and approved the final manuscript.

Acknowledgments

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Reference

1. Association A. American Psychiatric Association's Diagnostic and statistical manual of mental disorders (DSM-IV). 1994.
2. Bellani ML. Psychological aspects in day-case surgery. International Journal of Surgery. 2008;6:S44-S6.
3. Bailey L. Strategies for decreasing patient anxiety in the perioperative setting. AORN journal. 2010;92(4):445-60.
4. Seda Banu Akıncı SF, Dal D AU. Preoperative anesthesic evaluation. Hacettepe Med Journal. 2003;36(91-7).
5. Nigussie S, Belachew T, Wolancho W. Predictors of preoperative anxiety among surgical patients in Jimma University specialized teaching hospital, South Western Ethiopia. BMC surgery. 2014;14(1):67.
6. McCleane G, Cooper R. The nature of pre-operative anxiety. Anaesthesia. 1990;45(2):153-5.
7. Abate SM, Chekol YA, Basu B. Global Prevalence and determinants of preoperative anxiety among surgical patients: A systematic review and Meta-analysis. International Journal of Surgery Open. 2020.
8. Duivenvoorden T, Vissers M, Verhaar J, Busschbach J, Gosens T, Bloem R, et al. Anxiety and depressive symptoms before and after total hip and knee arthroplasty: a prospective multicentre study. Osteoarthritis and Cartilage. 2013;21(12):1834-40.
9. Bansal T, Joon A. A comparative study to assess preoperative anxiety in obstetric patients undergoing elective or emergency cesarean section. Anaesthesia, Pain & Intensive Care. 2019:25-30.
10. Vadhanan P, Tripaty DK, Balakrishnan K. Pre-operative anxiety amongst patients in a tertiary care hospital in India-a prevalence study. Journal of Society of Anesthesiologists of Nepal. 2017;4(1):5-10.
11. Jafar MF, Khan FA. Frequency of preoperative anxiety in Pakistani surgical patients. Journal of the Pakistan Medical Association. 2009;59(6):359.
12. Maheshwari D, Ismail S. Preoperative anxiety in patients selecting either general or regional anesthesia for elective cesarean section. Journal of anaesthesiology, clinical pharmacology. 2015;31(2):196.
13. Zeb A, Hammad AM, Baig R, Rahman S. Pre-Operative Anxiety in Patients at Tertiary Care Hospital, Peshawar. Pakistan J Clin Trials Res. 2019;2(2):76-80.

14. Robertson A, Khan R, Fick D, Robertson WB, Gunaratne DR, Yapa S, et al., editors. The effect of virtual reality in reducing preoperative anxiety in patients prior to arthroscopic knee surgery: a randomised controlled trial. 2017 IEEE 5th International Conference on Serious Games and Applications for Health (SeGAH); 2017: IEEE.
15. Duggan M, Dowd N, O'Mara D, Harmon D, Tormey W, Cunningham AJ. Benzodiazepine premedication may attenuate the stress response in daycase anesthesia: a pilot study. Canadian Journal of Anesthesia. 2002;49(9):932-5.
16. Sigdel S. Perioperative anxiety: A short review. Glob Anaesth Perioper Med. 2015;1(10.15761).
17. Bradt J, Dileo C, Potvin N. Music for stress and anxiety reduction in coronary heart disease patients. Cochrane Database of Systematic Reviews. 2013(12).
18. Ghimire R, Poudel P. Preoperative Anxiety and Its Determinants Among Patients Scheduled for Major Surgery: A Hospital Based Study. Journal of Anesthesiology. 2018;6(2):57-60.
19. Chow CH, Van Lieshout RJ, Schmidt LA, Dobson KG, Buckley N. Systematic review: audiovisual interventions for reducing preoperative anxiety in children undergoing elective surgery. Journal of pediatric psychology. 2016;41(2):182-203.
20. Hellstadius Y, Lagergren J, Zylstra J, Gossage J, Davies A, Hultman C, et al. Prevalence and predictors of anxiety and depression among esophageal cancer patients prior to surgery. Diseases of the Esophagus. 2016;29(8):1128-34.
21. Woldegerima Y, Fitwi G, Yimer H, Hailekiros A. Prevalence and factors associated with preoperative anxiety among elective surgical patients at University of Gondar Hospital. Gondar, Northwest Ethiopia, 2017. A cross-sectional study. International Journal of Surgery Open. 2018;10:21-9.
22. Mulugeta H, Ayana M, Sintayehu M, Dessie G, Zewdu T. Preoperative anxiety and associated factors among adult surgical patients in Debre Markos and Felege Hiwot referral hospitals, Northwest Ethiopia. BMC anesthesiology. 2018;18(1):155.
23. Kuzminskaitė V, Kaklauskaitė J, Petkevičiūtė J. Incidence and features of preoperative anxiety in patients undergoing elective non-cardiac surgery. Acta medica Lituanica. 2019;26(1):93.
24. Guo P, East L, Arthur A. A preoperative education intervention to reduce anxiety and improve recovery among Chinese cardiac patients: a randomized controlled trial. International journal of nursing studies. 2012;49(2):129-37.

25. Sharma N, Ooi J, Figueira E, Rosenberg M, Masselos K, Papalkar D, et al. Patient perceptions of second eye clear corneal cataract surgery using assisted topical anaesthesia. Eye. 2008;22(4):547-50.

26. Fink C, Diener MK, Bruckner T, Müller G, Paulsen L, Keller M, et al. Impact of preoperative patient education on prevention of postoperative complications after major visceral surgery: study protocol for a randomized controlled trial (PEDUCAT trial). Trials. 2013;14(1):271.

27. Upton D, Hender C, Solowiej K. Mood disorders in patients with acute and chronic wounds: a health professional perspective. Journal of wound care. 2012;21(1):42-8.

28. Gouin J-P, Kiecolt-Glaser JK. The impact of psychological stress on wound healing: methods and mechanisms. Immunology and Allergy Clinics. 2011;31(1):81-93.

29. Kiecolt-Glaser JK, Page GG, Marucha PT, MacCallum RC, Glaser R. Psychological influences on surgical recovery: perspectives from psychoneuroimmunology. American Psychologist. 1998;53(11):1209.

30. Akinsulore A, Owojuyigbe AM, Faponle AF, Fatoye FO. Assessment of preoperative and postoperative anxiety among elective major surgery patients in a tertiary hospital in Nigeria. Middle East J Anaesthesiol. 2015;23(2):235-40.

31. Yilmaz M, Sezer H, Gürler H, Bekar M. Predictors of preoperative anxiety in surgical inpatients. Journal of clinical nursing. 2012;21(7-8):956-64.

32. Maranets I, Kain ZN. Preoperative anxiety and intraoperative anesthetic requirements. Anesthesia & Analgesia. 1999;87(6):1346.

33. Osborn TM, Sandler NA. The effects of preoperative anxiety on intravenous sedation. Anesthesia Progress. 2004;51(2):46.

34. Balasubramaniyan N, Rayapati DK, Puttiah RH, Tavane P, Singh SE, Rangan V, et al. Evaluation of anxiety induced cardiovascular response in known hypertensive patients undergoing exodontia-a prospective study. Journal of clinical and diagnostic research: JCDR. 2016;10(8):ZC123.

35. Kindler CH, Harms C, Amsler F, Ihde-Scholl T, Scheidegger D. The visual analog scale allows effective measurement of preoperative anxiety and detection of patients' anesthetic concerns. Anesthesia & Analgesia. 2000;90(3):706-12.

36. Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, et al. Preferred reporting items for systematic reviewand meta-analysis protocols (PRISMA-P) 2015statement. 2015;4(1).

37. Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of non randomized studies in meta-analyses. European journal of epidemiology. 2010;25(9):603–5.(9):603.

38. Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. BMJ (Clin Res Ed) 315 (7109): 629–634. 1997.

39. Ioannidis JP. Interpretation of tests of heterogeneity and bias in meta-analysis. Journal of evaluation in clinical practice. 2008;14(5):951-7.

40. Borenstein M, Hedges LV, Higgins JP, Rothstein HR. A basic introduction to fixed-effect and random-effects models for meta-analysis. Res Synth Methods. 2010;1(2):97-111.

41. Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. Statistics in medicine. 2002;21(11):1539-58.

42. JulianPTHiggins, Simon G Thompson, Jonathan J Deeks, Altman DG. Measuring inconsistency in meta-analyses. BMJ: British Medical Journal. 2003;327(7414):557.

43. Bedaso A, Ayalew M. Preoperative anxiety among adult patients undergoing elective surgery: a prospective survey at a general hospital in Ethiopia. Patient safety in surgery. 2019;13(1):18.

44. Takele G, Ayelegne D, Boru B. Preoperative Anxiety and its Associated Factors among Patients Waiting Elective Surgery in St. Luke's Catholic Hospital and Nursing College, Woliso, Oromia, Ethiopia, 2018. Emergency medicine ana critical care. 2019;4(2020):21-37.

45. Srahbzu M, Yigizaw N, Fanta T, Assefa D, Tirfeneh E. Prevalence of depression and anxiety and associated factors among patients visiting orthopedic outpatient clinic at Tikur Anbessa specialized hospital, Addis Ababa, Ethiopia, 2017. J Psychiatry. 21: 450. J Psychiatry. 2018;21(450):2.

46. Ryamukuru D. Assessment of preoperative anxiety for patients awaiting surgery at UTHK: University of Rwanda; 2017.

47. Zammit N, Menel M, Rania F. Preoperative Anxiety in the Tertiary Care Hospitals of Sousse, Tunisia: Prevalence and Predictors. SOJ Surgery. 2018;5(1):1-5.

48. Dagona SS. Prevalence of preoperative anxiety among Hausa patients undergoing elective surgery-a descriptive study. Advances in Social Sciences Research Journal. 2018;5(11).

49. Caumo W, Schmidt AP, Schneider CN, Bergmann J, Iwamoto C, Bandeira D, et al. Risk factors for preoperative anxiety in adults. Acta Anaesthesiologica Scandinavica. 2001;45(3):298-307.
50. Ebirim L, Tobin M. Factors responsible for pre-operative anxiety in elective surgical patients at a university teaching hospital: A pilot study. The internet journal of Anesthesiology. 2010;29(2):1-6.
51. Tajgna K, Krishna DPV, editors. Assessment of Preoperative Depression , Anxiety and Stress for Patients Awaiting Surgery in a Tertiary Care Hospital2018.
52. Matthias AT, Samarasekera DN. Preoperative anxiety in surgical patients-experience of a single unit. Acta Anaesthesiologica Taiwanica. 2012;50(1):3-6.
53. Carneiro AF, Mathias LAST, Rassi Júnior A, Morais NSd, Gozzani JL, Miranda APd. Evaluation of preoperative anxiety and depression in patients undergoing invasive cardiac procedures. Revista brasileira de anestesiologia. 2009;59:431-8.
54. Ramesh C, Nayak BS, Pai VB, George A, George LS, Devi ES. Pre-operative anxiety in patients undergoing coronary artery bypass graft surgery–a cross-sectional study. International journal of Africa nursing sciences. 2017;7:31-6.
55. Gonçalves KKN, Silva JId, Gomes ET, Pinheiro LLdS, Figueiredo TR, Bezerra SMMdS. Anxiety in the preoperative period of heart surgery. Revista brasileira de enfermagem. 2016;69:397-403.
56. Alves MLM, Pimentel AJ, Guaratini ÁA, Marcolino JÁM, Gozzani JL, Mathias LAdST. Preoperative anxiety in surgeries of the breast: a comparative study between patients with suspected breast cancer and that undergoing cosmetic surgery. Revista brasileira de anestesiologia. 2007;57:147-56.
57. Ali A, Altun D, Oguz BH, Ilhan M, Demircan F, Koltka K. The effect of preoperative anxiety on postoperative analgesia and anesthesia recovery in patients undergoing laparascopic cholecystectomy. Journal of anesthesia. 2014;28(2):222-7.
58. Ayman Mohammed Ya'akba, vachkova E, NooraldinAlmasri. Prevalence of Preoperative Anxiety and its Contributing Risk Factors in Adult Patients Undergoing Elective Surgery: An-Najah National University; 2017.
59. Xu L, Pan Q, Lin R. Prevalence rate and influencing factors of preoperative anxiety and depression in gastric cancer patients in China: Preliminary study. Journal of International Medical Research. 2016;44(2):377-88.

60. Santos LJF, GARCIA JBdS, Pacheco JS, VIEIRA ÉBdM, SANTOS AMd. Quality of life, pain, anxiety and depression in patients surgically treated with cancer of rectum. ABCD Arquivos Brasileiros de Cirurgia Digestiva (São Paulo). 2014;27:96-100.

61. Khalili N, Karvandian K, Ardebili HE, Eftekhar N, Nabavian O. Predictive factors of preoperative anxiety in the anesthesia clinic: a survey of 231 surgical candidates. Archives of Anesthesia and Critical Care. 2019.

62. Kanwal A, Asghar A, Ashraf A, Qadoos A. Prevalence of preoperative anxiety and its causes among surgical patients presenting in Rawalpindi medical university and allied hospitals, Rawalpindi. Journal of Rawalpindi Medical College. 2018;22(S-2):64-7.

63. Erkilic E, Kesimci E, Soykut C, Doger C, Gumus T, Kanbak O. Factors associated with preoperative anxiety levels of Turkish surgical patients: from a single center in Ankara. Patient preference and adherence. 2017;11:291.

64. Ocalan R, Akin C, Disli Z, Kilinc T, Ozlugedik S. Preoperative anxiety and postoperative pain in patients undergoing septoplasty. B-ent. 2015;11(1):19-23.

65. Fathi M, Alavi SM, Joudi M, Joudi M, Mahdikhani H, Ferasatkish R, et al. Preoperative anxiety in candidates for heart surgery. Iranian journal of psychiatry and behavioral sciences. 2014;8(2):90.

66. Albert PR. Why is depression more prevalent in women? Journal of psychiatry & neuroscience: JPN. 2015;40(4):219.

Figure Legend

Figure 1. PRISMA flow chart of the study identification process for systematic reviews and meta-analyses.

Figure 2: Forest plot showing the pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle income countries.

Figure 3: Funnel plot for testing publication bias (Random effect model, N=27).

Figure 4: Sensitivity analysis for studies included in the meta-analysis.

Supplementary file legend

Supplementary file 1. PRISMA (Preferred Reporting Items for Systematic review and Meta Analysis Protocols) 2020 checklist: Recommended items addressed in our systematic review and meta-analysis.

Supplementary file 2: Newcastle Ottawa (NOS) critical appraisal evaluation for Cross sectional studies.

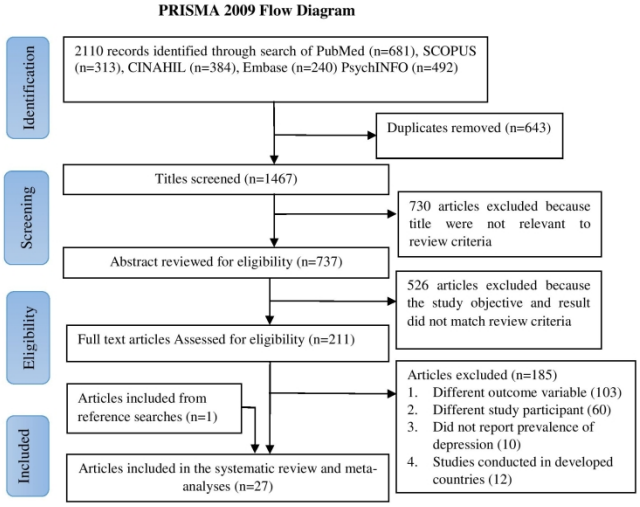

Figure 1. PRISMA flow chart of the study identification process for systematic reviews and meta-analyses

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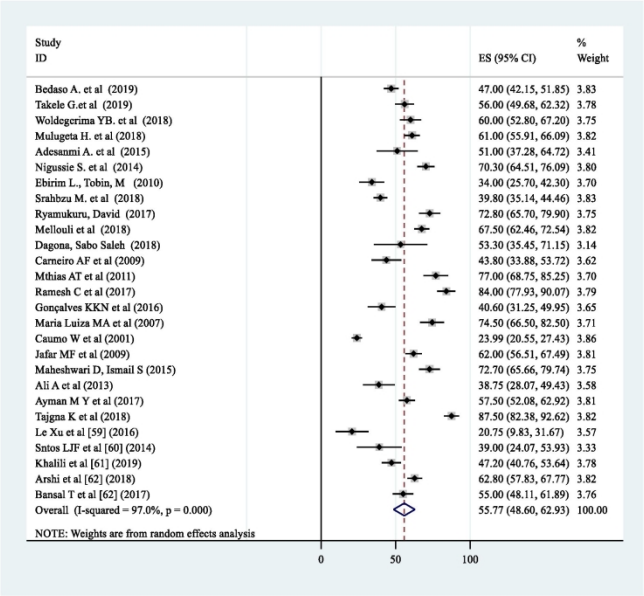

Figure 2: Forest plot showing the pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle income countries.

Figure 2: Forest plot showing the pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle-income countries.

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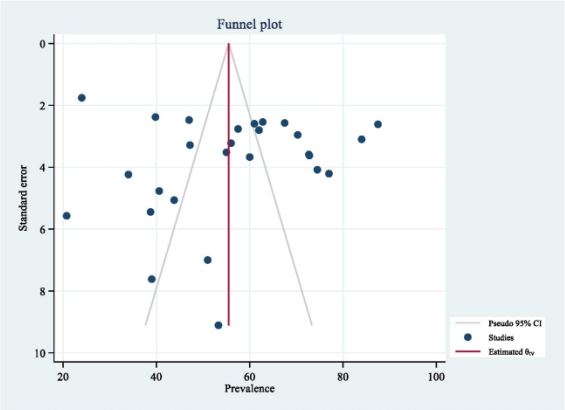

Figure 3: Funnel plot for testing publication bias (Random effect model, N=27)

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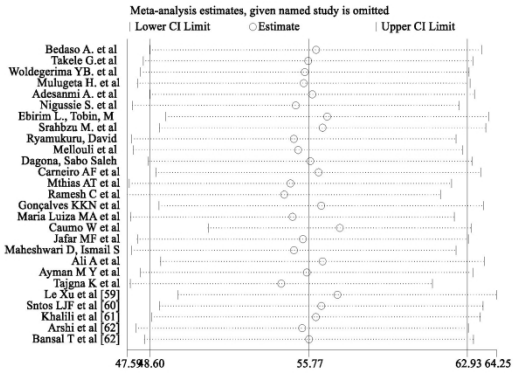

Figure 4: Sensitivity analysis for studies included in the meta-analysis

Figure 4: Sensitivity analysis for studies included in the meta-analysis

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Supplementary file 1. PRISMA (Preferred Reporting Items for Systematic review and Meta Analysis Protocols) 2020 checklist: Recommended items addressed in our systematic review and meta-analysis.

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3&4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	3&4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	Under review
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Page 4, Parag. 2
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4 Parag. 1
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Page 4 & 2
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Page 5
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	5 & 12
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	5
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	1 0, Para 1
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	10

Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	5 & 6
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	5 Parag 1
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	6
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	10, Par 5
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	10
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	10, Para 1
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	10
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	10 & 11
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	11 & 12
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	12
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	12 & 13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	13
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	5 & 6
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	5 Parag 1
RESULTS			
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Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	10

Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	10, Para 1
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	10
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	10 & 11
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Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	12 & 13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	13

Supplementary file 2: Newcastle Ottawa (NOS) critical appraisal evaluation for Cross-sectional studies

S.no	Author, Year of publication	Representativeness of the sample	Sample size	Non-respondent	Ascertainment of the exposure (risk factor)	Comparability (Confounding factors are controlled)	Assessment of outcome	Statistical Analysis	Total score
1	Bedaso A. et al [43]	1	1	0	2	1	2	1	8
2	Takele G.et al [44]	1	1	0	2	1	1	1	7
3	Woldegerima YB. et al [15]	1	1	1	2	1	1	1	7
4	Mulugeta H. et al [16]	1	1	1	2	1	2	1	9
5	Adesanmi A. et al [30]	0	1	0	2	0	2	1	6
6	Nigussie S. et al [5]	1	1	0	1	1	2	1	7
7	Ebirim L., Tobin, M [49]	1	0	0	2	1	1	1	6
8	Srahbzu M. et al [45]	1	1	0	2	1	1	1	7
9	Ryamukuru, David [46]	1	1	0	1	1	1	1	6
10	Mellouli et al [47]	1	1	0	1	1	1	1	6
11	Dagona, Sabo Saleh [48]	1	1	0	1	1	1	1	6
12	Mthias AT et al [50]	1	1	0	2	1	2	1	8
13	Carneiro AF et al [51]	1	1	0	2	1	2	1	8
14	Ramesh C et al [52]	1	1	1	2	1	2	1	9
15	Gonçalves et al [53]	1	1	0	2	1	1	1	7
16	Maria Luiza MA et al [54]	1	1	0	2	1	2	1	8
17	Caumo W et al [55]	1	1	0	2	1	2	1	8
18	Jafar MF et al [22]	1	1	0	2	1	1	1	7
19	Maheshwari D, Ismail S [7]	1	1	0	2	1	2	1	8
20	Ali A et al [56]	1	1	1	2	1	2	1	9
21	Ayman M Y et al [57]	1	1	0	2	1	2	1	8
22	Tajgna K et al [58]	1	1	1	2	1	2	1	9
23	Le Xu et al [59]	1	1	1	2	1	2	1	9
24	Sntos LJF et al [60]	1	1	0	2	1	2	1	8
25	Khalili et al [61]	1	1	0	2	1	1	1	7
26	Arshi et al [62]	1	1	0	1	1	1	1	6
27	Bansal T et al [62]	1	1	0	2	1	1	1	7

NB: NOS score ≥8 (High quality), 6-7 (moderate quality), and ≤ 5 (low quality)

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Prevalence and factors associated with preoperative anxiety among patients undergoing surgery in low and middle-income countries: A systematic review and meta-analysis

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Prevalence and factors associated with preoperative anxiety among patients undergoing surgery in low and middle-income countries: A systematic review and meta-analysis

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Abstract

Objectives: This review aimed to determine the pooled prevalence of preoperative anxiety and its associated factors among patients undergoing surgery in low and middle-income countries (LMICs).

Methods: We searched PubMed, SCOPUS, CINAHL, Embase, and PsychINFO to identify peer-reviewed studies on the prevalence and factors associated with preoperative anxiety among patients undergoing surgery using pre-defined eligibility criteria. Studies were pooled to estimate the prevalence of preoperative anxiety using a random-effect meta-analysis model. Heterogeneity was assessed using I^2 statistics. Funnel plot asymmetry and Egger's regression tests were used to check for publication bias.

Result: Our search identified 2110 studies, of which 27 studies from 12 countries with 5,575 participants were included in the final meta-analysis. Of the total 27 studies, eleven used the State-Trait Anxiety Inventory (STAI) to screen anxiety, followed by the Amsterdam Preoperative Anxiety and Information scale (APAI), used by four studies. The pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle-income countries was 55.7% (95% CI: 48.60-62.93). Our sub-group analysis found that a higher pooled prevalence of preoperative anxiety was found among female surgical patients (59.36%, 95%CI: 48.16-70.52, I^2= 95.43, P<0.001) and studies conducted in Asia (62.59%, 95% CI: 48.65, 76.53, I^2=97.48, P<0.001).

Conclusion: Our meta-analysis indicated that around one in two patients undergoing surgery in LMICs suffer from preoperative anxiety, which needs due attention. Routine screening of preoperative anxiety symptoms among patients scheduled for surgery is critically important.

Strengths and limitations

- Conducting abroad literature search, independent screening, quality appraisal, and data extraction by two investigators represent the main strength of the current review.
- The absence of significant publication bias increases the reliability of our findings.
- The significant heterogeneity among studies and the restriction applied to include studies published only in English language are the major limitations of the current review in generalizing these findings to all LMICs.

Keywords: Preoperative anxiety, surgical patients, associated factors, Prevalence, Systematic review, Meta-analysis, Low and middle-income countries

Introduction

Anxiety is defined as a subjective state of emotional uneasiness, distress, apprehension, or fearful concern associated with autonomic and somatic features and causes impaired functioning or activity (1). Anxiety can also be a normal emotional human reaction to circumstances of danger accompanied by physiological and psychological elements (1, 2). Surgery is one of the standard medical procedures that could increase anxiety irrespective of the type of surgery (2, 3). Surgery is a life-threatening procedure that causes the person to perceive himself under a direct physical restraint. Patients scheduled for surgery may experience fears and anxieties such as nervousness, fear of being unable to wake up from anesthesia, fear of postoperative pain, and fear of death (4). As a result, preoperative anxiety is becoming a significant mental health problem for many patients undergoing surgery (5, 6).

Different epidemiological studies revealed the varying magnitude of preoperative anxiety among patients undergoing surgery. For example, a global level systematic review and meta-analysis reported a 48% pooled prevalence of preoperative anxiety among patients undergoing surgery (7). A facility-based study conducted in Netherland found 27.9% and 20.3% of preoperative anxiety in patients undergoing hip and knee surgery, respectively (8). Epidemiological studies conducted in low and middle-income countries found that the prevalence of preoperative anxiety ranges from 47 to 70.3% in India (9, 10), 62 to 97% in Pakistan (11-13), and 39.8 to70% in Ethiopia (5, 14-18).

The magnitude of preoperative anxiety among patients undergoing surgery varies depending on the reasons and type of surgery, gender of the patient (12), patient interaction with medical staff, previous experience of surgical procedures, and sensitivity to stressful circumstances (19, 20). Also, factors such as fear of surgery, fear of anaesthesia, sociodemographic characteristics of the patient (age, educational status, and partner status), types of surgery, fear of postoperative pain, and fear of death were significant predictors of preoperative anxiety (16, 17, 21-25). However, the frequently mentioned major causes of preoperative anxiety were fear of the outcomes of surgery (29.3%), followed by fear of the progress after surgery (19.5%) and complications after surgery (11.4%) (26). Furthermore, evidence also indicated that in many low and middle-income countries, the potential effect of scarce resources at health facilities, weak health systems, and culture of a given community could play a paramount role in the increased rates of preoperative anxiety among surgical

patients. For example, studies demonstrated that waiting for a longer duration for surgery (27, 28), inadequate information about the procedure, disrespect by the clinician, lacking empathy (29), and receiving less inpatient care (28) could increase the risk of preoperative anxiety. Globally, the surgery rate ranges from 295 operations per 100,000 population in Ethiopia to 23,369 per 100,000 in Hungary, indicating a considerable difference in surgical service provision between low-income countries (LIC) and high-income countries (HIC) despite a growing unmet need (30). Despite the small number of surgical service in LMICs, it is compounded by the burden of managing postoperative complications such as delayed complications which mainly caused by inadequate inpatient care and low rates of follow-up service (31).

Increased preoperative anxiety levels may be a reason for patients to decline planned surgical procedures (32, 33). High levels of preoperative anxiety negatively affect the surgical operation and contribute to adverse surgical outcomes (34, 35). Literature showed that preoperative anxiety might cause slow, complicated, and painful postoperative recovery (35-37). Severe levels of anxiety before the surgical procedure have resulted in autonomic disturbances such as increased heart rate, raised blood pressure, and arrhythmias (38), and affecting the outcomes of surgical procedures (39). Before the surgical procedure, patients who developed anxiety were found to require higher doses of anesthetic medications, had a higher level of postoperative pain, increased consumption of analgesic drugs, increased morbidity, prolonged recovery, and hospital stay (40-42). Appropriate management of anxiety by clinicians may provide a better pre-operative assessment, less pharmacological premedication, smoother induction and maybe even better outcome (43).

Based on the above evidence there was a substantial difference in the reported prevalence of preoperative anxiety among patients undergoing surgery across studies. Also, there is no previously conducted systematic reviews and meta-analysis on the topic of interest, particularly in low and middle-income countries. Furthermore, identifying the significant correlates of preoperative anxiety is vital to reduce the burden or prevent the onset and subsequent consequences. Therefore, this review aimed to examine the prevalence and thematically quantify and present factors associated with preoperative anxiety among patients undergoing surgery in low and middle-income countries (LMICs) and formulate recommendations for future health care services in the area.

Methods

Search strategy

A systemic review and meta-analysis was conducted using studies that examined the prevalence and correlates of preoperative anxiety among patients undergoing surgery in low and middle-income countries. The strategy for literature search, selection of studies, data extraction, and reporting of results for the current review was designed following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (44) (**supplementary file 1**). The protocol for the current review was registered in PROSPERO (CRD42020161934).

Five electronic databases (PubMed, SCOPUS, CINAHIL, Embase, and PsychINFO) were systematically searched to identify studies that report the prevalence of preoperative anxiety among patients undergoing surgery in low and middle-income countries. Searching in PubMed was performed using the following terms: ((Prevalence OR Magnitude OR Epidemiology OR Incidence OR Estimates OR Burden OR Associated factors OR Determinants OR Correlates OR Predictors) AND ((Preoperative Anxiety OR Anxiety OR Anxiety symptoms OR Anxiety disorder OR General Anxiety disorder) AND (Surgical patients OR patients undergoing surgery OR surgery)). Database-specific subject headings associated with the above terms were used to screen studies indexed in SCOPUS, CINAHIL, Embase, and PsychINFO databases. Besides, we observed the reference lists of published studies to identify potential other relevant articles for this review. The whole search strategy of our review is presented in **Supplementary file 2**.

Eligibility Criteria

In the current review, we have included observational studies conducted on determining the prevalence and factors associated with preoperative anxiety among patients undergoing surgery in low and middle-income countries, and written in English language. Eligible studies included for this review had to fulfil the following criteria: first, the type of study has to be observational (cross-sectional, nested case-control, cohort studies, or follow-up studies). Second, the study participants were patients (age ≥18 years) who have a schedule to undergo surgical procedures under anesthesia, regardless of their sex. Third, measurement of anxiety was done using standard diagnostic criteria or a validated screening tools. Fourth, the studies should be from a low-income or middle income country. World Bank Atlas classified countries

as low-income and middle-income for those with the Gross National Income(GNI) per capita of ≤$1025 and between $1026 to 12,375, respectively (https://data.worldbank.org/indicator/NY.GNP.PCAP.CD).

Studies that reported pooled preoperative anxiety, had a poor quality score on the New Castle Ottawa Scale (NOS), duplicate studies, conference proceedings, commentaries, reports, short communications and letters to editors were excluded. Then full-text articles were independently checked for their eligibility by two investigators (AB and NM). Disagreements were resolved by discussing with a third author (BD) for the final selection of studies.

Data extraction and study quality assessment

Data were extracted using a specific form designed to extract data that authors developed. The data extraction form included the following information: name of the author, year of publication, country, study design, sample size, type of surgery, and the number of positive cases for preoperative anxiety, prevalence of preoperative anxiety and significant factors associated with preoperative anxiety. AB conducted the primary data extraction, and then NM assessed the extracted data independently. Any disagreements and discrepancies were resolved through discussion with the third author BD.

The methodological qualities of each included article were assessed by using a modified version of the Newcastle-Ottawa Scale (45). The methodological quality and eligibility of the identified articles were independently evaluated by two reviewers (AB and NM), and disagreements among reviewers were resolved through discussion with the third Author (BD). The Summary of the agreed level of bias and level of agreement between independent evaluators of studies is mentioned in **Supplementary file 3**. Finally, studies with a scale of ≥ 5 out of 10 were included in the current review.

Analysis

For the first objective, estimating the pooled prevalence of preoperative anxiety, the prevalence report extracted from all the included primary studies were meta-analyzed. For the second objective, identifying the significant factors associated with preoperative anxiety, reports of measures of associations (OR, r, β or RR) were analyzed narratively. While interpreting the association between significant factors and preoperative anxiety, adjusted

estimates were the first choice. However, for studies that missed reporting adjusted estimates, crude estimates were considered.

We have examined publication bias by visual inspection of a funnel and conducting Egger's regression tests (46, 47). A p-value <0.05 was used to declare the statistical significance of publication bias. Studies were pooled to estimate pooled prevalence and 95% CI using a random-effect model (48). We have assessed heterogeneity using Cochran's Q and the I^2 statistics (49). I^2 statistics is used to quantify the percentage of the total variation in the study estimate due to heterogeneity. I^2 values of 25, 50 and 75% were considered to represent low, medium and high heterogeneity, respectively (50). Due to significant heterogeneity across studies, we conducted a subgroup analysis using moderators such as methodological quality of studies, country, gender, anxiety assessment tool, economic level of a country, and region where a country located. Also, sensitivity analysis was conducted to evaluate the presence of outlier estimates of preoperative anxiety. All the extracted data were analyzed using STATA 16.

Patient and public involvement

No patient or public involved in the current review.

Results

Identification of studies

We have identified a total of 3110 studies from 5 databases in our initial electronic searching. After removing duplicates, reviewing titles and abstracts, 211 studies were considered eligible for full-text review. After excluding 185 articles in full-text review and adding 1 article that we get through reference searching, 27 studies were included in this systematic review and meta-analysis (**Figure 1**).

Characteristics of included studies

Of the total 27 studies (5,575 population), all (100%) studies employed cross-sectional study design, and 9 (81.2%) studies published in the past five years (14-18, 38, 51-53). Also, six studies were conducted in Ethiopia (5, 14-18), five studies were from Brazil (54-58), and three studies were from each of the following countries; Nigeria (38, 53, 59), Pakistan (11, 12, 60) and India (60-62). The sample size of the included studies ranges from 30 in Nigeria (53) to 591 in Brazil (57). The prevalence of preoperative anxiety ranges from 34% in Nigeria (59) to

87.5% in India (61). Of the 27 included studies, 16 (59.2%) were from middle-income countries, whereas 11 (40.8%) were from low-income countries. State-Trait Anxiety Inventory (STAI) is the most common tool used to screen anxiety (11 studies), followed by the Amsterdam Preoperative Anxiety and Information scale (APAI) (4 studies) (**Table 1**).

Table 1: Characteristics of studies included in the current systematic review

Author	Publication Year	Country	Sample size	Study design	Type of surgery	Cases	Prevalence (%)	Anxiety Measures (Cut-off point)
Bedaso A. et al (14)	2019	Ethiopia	407	Cross-sectional	All surgery	191	47	STAI (≥ 44/80)
Takele G.et al (15)	2019	Ethiopia	237	Cross-sectional	All surgery	132	56	PITI-20 Item (≥16/60)
Woldegerima YB. et al (16)	2018	Ethiopia	178	Cross-sectional	All surgery	106	60	STAI (> 44/80)
Mulugeta H. et al (17)	2018	Ethiopia	353	Cross-sectional	All surgery	215	61	STAI (> 44/80)
Adesanmi A. et al (38)	2015	Nigeria	51	Cross-sectional	All surgery	26	51	STAI (> 44/80)
Nigussie S. et al (5)	2014	Ethiopia	239	Cross-sectional	All surgery	168	70.3	STAI (≥ 44/80)
Ebirim L., Tobin, M (59)	2010	Nigeria	125	Cross-sectional	All surgery	43	34	VAS (≥45/100)
Srahbzu M. et al (18)	2018	Ethiopia	423	Cross-sectional	Orthopaedic surgery	168	39.8	HADS-A (≥ 18)
Ryamukuru, David (51)	2017	Rwanda	151	Cross-sectional	All surgery	110	72.8	PITI-20 Item (≥15/60)
Mellouli et al (52)	2018	Tunisia	332	Cross-sectional	All surgery	224	67.5	APAI score (>10)
Dagona, Sabo Saleh (53)	2018	Nigeria	30	Cross-sectional	All surgery	16	53.3	APAI-H (NA)
Mthias AT et al (63)	2011	Srilanka	100	Cross-sectional	Elective Surgery	77	77	APAI score (≥11)
Carneiro AF et al (54)	2009	Brazil	96	Cross-sectional	Cardiac Surgery	42	43.8	HADS-A (≥9)

Ramesh C et al (62)	2017	India	140	Cross-sectional	Cardiac Surgery	118	84	STAI (≥ 40/80)
Gonçalves et al (55)	2016	Brazil	106	Cross-sectional	Cardiac Surgery	43	40.6	BAI (NA)
Maria Luiza MA et al (56)	2007	Brazil	114	Cross-sectional	Cosmetic Surgery	85	74.5	STAI (> 36/80)
Caumo W et al (57)	2001	Brazil	591	Cross-sectional	Elective Surgery	141	23.99	STAI (≥ 39/80)
Jafar MF et al (11)	2009	Pakistan	300	Cross-sectional	Elective Surgery	186	62	STAI (NA)
Maheshwari D, Ismail S (12)	2015	Pakistan	154	Cross-sectional	Elective CS	112	72.7	VAS (≥50)
Ali A et al (64)	2013	Turkey	80	Cross-sectional	Gall bladder surgery	31	38.75	BAI (>17/63)
Ayman M Y et al (65)	2017	Palestine	320	Cross-sectional	All surgery	184	57.5	APAI score (>11)
Tajgna K et al (61)	2018	India	160	Cross-sectional	All surgery	140	87.5	DASS-21 (NA)
Le Xu et al (66)	2016	China	53	Cross-sectional	Gastric Cancer surgery	11	20.75	HADS-A (≥18)
Sntos LJF et al (58)	2014	Brazil	41	Cross-sectional	Rectal Surgery	16	39	BAI (≥10/63)
Khalili et al (67)	2019	Iran	231	Cross-sectional	All Surgery	109	47.2	STAI (≥40/80)
Arshi et al (60)	2018	Pakistan	363	Cross-sectional	All surgery	228	62.8	VAS(≥45/100)
Bansal T et al (60)	2017	India	200	Cross-sectional	Emergency CS	110	55	STA (≥40/80)

Abbreviations: VAS: Visual Analogue Scale; PITI: Preoperative Intrusive Thought Inventory; STAI: State-Trait Anxiety Inventory; APAI: Amsterdam preoperative Anxiety and Information scale; BAI: Beck Anxiety Inventory; DASS-21: Depression Anxiety and Stress Scale; BAI: Beck Anxiety Inventory; CS: Caesarean section.

The methodological quality of studies

We used the modified Newcastle Ottawa Scale (NOS) (45) to evaluate the methodologic quality of the studies included in the current review. Among the 27 studies included in the present review, 16 studies were of high (NOS score ≥ 8), and 11 studies were of moderate methodologic quality (NOS score 6-7) (**Supplementary file 4**).

Meta-analysis

The pooled prevalence of preoperative anxiety among patients undergoing surgery within the LMICs included within this study was estimated to be 55.7% (95% CI: 48.60-62.93) with considerable heterogeneity between studies (I^2= 97%; P<0.001). Consequently, a random-effects meta-analysis model was employed to estimate the overall pooled prevalence (**Figure 2**).

Further, to explore the possible sources of heterogeneity we employed a random-effect univariate meta-regression model considering the sample size, publication year, and NOS quality score as moderators. However, none these continuous variables (i.e., sample size (Coefficient= -0.015, P= 0.533), publication year (Coefficient= 0.984, P= 0.202), and NOS quality score (Coefficient= -2.65, P= 0.412)) found to have significant association with heterogeneity.

Publication bias

Inspection of the funnel plot looks symmetric and shows no significant publication bias (**Figure 3**). Besides, eggers regression test suggested absence of publication bias (B= -2.79, SE= 2.013, P= 0.165).

Sub-group and sensitivity analysis

Due to the reported high heterogeneity index among studies, a subgroup analysis was conducted using characteristics like country, type of anxiety tool used, quality of studies and economic level of a country. Among studies that assessed the prevalence of preoperative anxiety among surgical patients, the subgroup analysis based on the region where the studies conducted revealed that a higher pooled prevalence of preoperative anxiety was reported in a study conducted in Asia (62.59%, 95% CI: 48.65, 76.53, I^2=97.48, P<0.001), followed by Africa (55.91%, 95% CI: 48.37, 63.44 I^2= 99.31, P<0.001) and Middle East (52.5%, 95% CI: 42.41,

62.59). Besides, a higher pooled prevalence of preoperative anxiety was reported in a study that used Depression Anxiety and Stress Scale (DASS) (87.5%, 95% CI: 82.37-92.62), followed by studies that used Amsterdam preoperative Anxiety and Information Scale (APAI) tool as an anxiety assessment tool (64.9%, 95% CI: 55.78-74.10, I^2= 83.4%, P<0.001).

To further explore the source of heterogeneity among studies included in the review, we have also conducted a subgroup analysis using the quality of studies as a moderator. The pooled prevalence of preoperative anxiety was higher in the studies with moderate methodological quality (57.2%) (95% CI: 48.49-65.97, I^2= 94.2%, P<0.001) compared to those studies with high methodological quality (54.8%) (95% CI: 44.28-65.28, I^2= 97.8, P<0.001). Furthermore, a pooled estimate of preoperative anxiety among female surgical patients (59.36%, 95%CI: 48.16-70.52, I^2= 95.43, P<0.001) was higher than their male counterparts (45.95%, 95%CI: 31.69-60.21, I^2= 96.67, P<0.001). However, a pooled estimate of preoperative anxiety in middle-income countries (55.7%) (95%CI: 48.60-62.93, I^2= 98, P<0.001) was comparable to studies conducted in low-income countries (54.9%, 95%CI: 47.69-62.17, I^2= 92.6, P<0.001) (**Table 2**).

Table 2: Subgroup analysis of the prevalence of preoperative anxiety among patients undergoing surgery by country, type of anxiety tool, quality of studies and economic level of a country.

Subgroup	Number of studies	Estimates		Heterogeneity across studies	
		Prevalence (%)	95% CI	I^2 (%)	P-value
Country					
Ethiopia	6	55.6	35.13-44.46	94.1	<0.001
Nigeria	3	44.6	31.86-58.16	69.6	0.037
Rwanda	1	72.8	65.7-79.89	-	-
Tunisia	1	67.5	62.46-72.53	-	-
Brazil	5	44.4	23.76-64.95	97.1	<0.001
Srilanka	1	77	68.75-85.25	96.6	<0.001
India	3	75.6	56.72-94.49	69	0.040
Pakistan	3	65.4	59.4-71.39	-	-
Turkey	1	38.8	28.07-49.4	-	-

Palestine	1	57.5	52.08-62.9	-	-
China	1	20.6	9.83-31.67	-	-
Iran	1	47.2	40.76-53.63	97	<0.001
Anxiety tool used					
STAI	11	57.8	45.80-69.78	97.9	<0.001
PITI	2	64.3	47.85-80.78	91.7	0.001
VAS	3	56.6	37.16-76.17	96.1	<0.001
HADS-A	3	35.3	23.77-46.90	82.6	0.003
APAI	4	64.9	55.78-74.10	83.4	<0.001
BAI	3	39.6	33.29-46.02	0%	0.964
DASS	1	87.5	82.37-92.62	-	-
Quality of studies					
High	16	54.8	44.28-65.28	97.8	<0.001
Moderate	11	57.2	48.49-65.97	94.2	<0.001
Economy level of a country					
Low Income	11	54.9	47.69-62.17	92.6	<0.001
Middle Income	16	55.7	48.60-62.93	98	<0.001
Gender					
Male	8	45.95	31.69-60.21	96.67	<0.001
Female	9	59.36	48.16-70.52	95.43	<0.001
Region					
Africa	11	55.91	48.37-63.44	99.31	<0.001
Asia	9	62.59	48.65-76.53	97.48	<0.001
South America	5	44.35	27.62-61.08	95.54	<0.001
Middle East	2	52.50	42.41-62.59	82.63	0.02

Moreover, we have conducted a leave-one-out sensitivity analysis to identify the influence of one study on the overall pooled estimate. The overall estimate of this study did not appear to be affected by the removal or addition of a single study at a time, suggesting the robustness of our pooled estimate. Thus, the pooled prevalence of preoperative anxiety ranges from 54.5% to 57.2% (**Figure 4**).

Factors associated with preoperative anxiety among patients undergoing surgery

The results extracted from studies conducted on factors associated with preoperative anxiety among patients undergoing surgery are presented in **Supplementary file 5**. Associated factors that have been adjusted in the studies included in this review were inconsistent across studies conducted in LMICs (5, 12, 14-18, 51, 52, 55, 57, 58, 62, 63, 67-70).

Of the total studies included in the review, ten studies (15, 17, 18, 55, 57, 62, 63, 67, 68, 70) reported the increased odds of preoperative anxiety symptoms among female patients when compared to male patients. Similarly, being young age (12, 16, 51, 67, 69) has significantly increased the odds of preoperative anxiety symptoms in patients waiting for scheduled surgery. Preoperative anxiety was significantly associated with fear of death, dependency, and disability (14, 16).

Further, patients who did not receive adequate preoperative information were more likely to have clinically significant preoperative anxiety levels compared to patients who did receive high-level information (5, 12, 15, 17, 52, 67). Not surprisingly, low income appeared to increase the odds of developing preoperative anxiety symptoms in patients waiting for surgery (5, 12). Likewise, having a family history of mental illness (45), history of cancer and smoking (49), lower educational attainment (68, 69) were found to be associated with preoperative anxiety symptoms in patients waiting for surgery.

Moreover, statistical adjustment for some other risk factors varied for respective studies included in this review. Factors such as getting low social support, fear of unexpected outcome of surgery (14), being non-partnered (5), urban residence, inadequate awareness of anaesthesia adverse effect (67), number of days of hospitalization (64), having a chronic medical illness (18), gastrointestinal problems (58) were found to have a significant positive correlation with preoperative anxiety after adjusting for other factors.

Discussion

This systematic review and meta-analysis synthesized the results of twenty-seven primary studies that were conducted in LMICs to determine the pooled prevalence and factors associated with preoperative anxiety among 5,575 surgical patients undergoing surgery.

The pooled prevalence of preoperative anxiety among patients undergoing surgery in LMICs was 55.7%. The pooled estimate in the current review was higher when compared to the pooled prevalence reported in a global level systematic review and meta-analysis that included 14,652 study participants (48%) (7). Likewise, the pooled estimate of our review was higher than the estimates from different epidemiological studies conducted in high-income countries such as the Netherlands reported that 27.9% and 20.3% of patients undergoing hip and knee surgery, respectively, experienced anxiety symptoms before the actual surgery (8). The variation in the demographic characteristics of participants and may partly explain the observed difference in the pooled estimates. Furthermore, risk factors such as genetic make-up of individuals, access to information regarding their surgical procedure, quality and availability of service in each health facility, sampling methods, and tools used to screen anxiety may contribute to the observed difference.

Surprisingly, the available epidemiological evidence was virtually unchanged when the origin of the primary studies included in this review considered as a moderator. For example, the pooled prevalence of preoperative anxiety was 77% in Sri Lanka, 75.6% in India and 72.8% in Rwanda. Although evidence suggests that an individual cultural background could potentially affect the experience of anxiety symptoms, the variability of the origin of primary studies appeared to play a negligible role in the pooled estimate of this study.

The subgroup analysis using the tools used to estimate the prevalence of preoperative anxiety showed a slight variation in the prevalence of preoperative anxiety among patients undergoing surgery. Most notably, the prevalence of preoperative anxiety among patients undergoing surgery was slightly higher in the studies that have used Depression Anxiety and Stress Scale (DASS) to ascertain preoperative anxiety in patients when compared to Amsterdam preoperative Anxiety and Information Scale (APAI). The discrepancy may be due to variability in the psychometric properties of those measures.

Our review found that the prevalence of preoperative anxiety was higher among female surgical patients compared to their male counterparts. Also, of the studies included in the current systematic review and meta-analysis, ten studies reported that being female increased the odds of developing preoperative anxiety among surgical patients (15, 17, 18, 55, 57, 62, 63, 67, 68, 70). This might be because of women's experience of some specific forms of mental health problems like premenstrual dysphoric disorder, postpartum

depression, and postmenopausal mental illness, which are linked with changes in ovarian hormones that may contribute to the observed difference in risk of developing preoperative anxiety among female patients (71).

Early screening and targeted intervention of preoperative anxiety among patients undergoing surgery are recommended for future action. Further studies should be conducted to examine the possible reasons for a substantially higher burden of preoperative anxiety among patients undergoing surgery. Moreover, interventional and randomized controlled trials (RCTs) are recommended for a specific group of surgical patients.

It is worth noting the following potential limitations of our review in generalizing the findings. First, there is significant heterogeneity among studies included in the current review. Second, the restriction to include studies published only in English language could introduce possible selection bias and limit the generalizability to all LMICs.

Conclusion

Our study indicated that around one in two patients undergoing surgery in low and middle-income countries suffer from preoperative anxiety, which needs due attention. Therefore, routine screening of preoperative anxiety among patients scheduled for surgery is vital. In addition, providing preoperative education on the effect of anesthesia, surgical procedure, and possible postoperative pain management options is highly warranted. Due to the significant heterogeneity across the studies, future studies should examine preoperative anxiety for a specific group of surgical patients by stratifying the possible associated factors. Moreover, since all the included studies employed a cross-sectional study design, the findings didn't show a temporal relationship between preoperative anxiety and its associated factors. Therefore, future longitudinal studies and randomized controlled trials are recommended.

Abbreviation

AOR: Adjusted Odds Ratio; APAI: Amsterdam preoperative Anxiety and Information Scale; CI: Confidence Interval; DASS: Depression Anxiety and Stress Scale ; GNI: Gross National Income; HADS: Hospital Anxiety and Depression Scale; HICs: High Income Countries; LICs: Low Income Countries; LMICs: Low and Middle Income Countries; NOS: Newcastle Ottawa Scale; NSW: New South Wales; OR: Odds Ratio; PITI: Preoperative Intrusive Thought Inventory; PRISMA:

Preferred Reporting Items for Systematic Reviews and Meta-Analyses; RCTs: Randomized Controlled Trials (RCTs); VAS: Visual Analogue Scale; WHO: World Health Organization.

Ethics approval and consent to participate

N/A

Consent for publication

N/A

Availability of data and material

All data generated or analysed during this review are included in this article.

Competing interests

The authors declare that there is no competing interest.

Funding

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Authors' contributions

The author AB performed the search, quality appraisal, data extraction, analyses, and writing the draft of the initial manuscript. NM participated in quality appraisal, and data extraction. BD contributed to the consensus, revising the draft manuscript, and approved the final manuscript.

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Reference

1. Association A. American Psychiatric Association's Diagnostic and statistical manual of mental disorders (DSM-IV). 1994.
2. Bellani ML. Psychological aspects in day-case surgery. International Journal of Surgery. 2008;6:S44-S6.
3. Bailey L. Strategies for decreasing patient anxiety in the perioperative setting. AORN journal. 2010;92(4):445-60.
4. Seda Banu Akıncı SF, Dal D AU. Preoperative anesthesic evaluation. Hacettepe Med Journal. 2003;36(91-7).
5. Nigussie S, Belachew T, Wolancho W. Predictors of preoperative anxiety among surgical patients in Jimma University specialized teaching hospital, South Western Ethiopia. BMC surgery. 2014;14(1):67.
6. McCleane G, Cooper R. The nature of pre-operative anxiety. Anaesthesia. 1990;45(2):153-5.
7. Abate SM, Chekol YA, Basu B. Global Prevalence and determinants of preoperative anxiety among surgical patients: A systematic review and Meta-analysis. International Journal of Surgery Open. 2020.
8. Duivenvoorden T, Vissers M, Verhaar J, Busschbach J, Gosens T, Bloem R, et al. Anxiety and depressive symptoms before and after total hip and knee arthroplasty: a prospective multicentre study. Osteoarthritis and Cartilage. 2013;21(12):1834-40.
9. Bansal T, Joon A. A comparative study to assess preoperative anxiety in obstetric patients undergoing elective or emergency cesarean section. Anaesthesia, Pain & Intensive Care. 2019:25-30.
10. Vadhanan P, Tripaty DK, Balakrishnan K. Pre-operative anxiety amongst patients in a tertiary care hospital in India-a prevalence study. Journal of Society of Anesthesiologists of Nepal. 2017;4(1):5-10.
11. Jafar MF, Khan FA. Frequency of preoperative anxiety in Pakistani surgical patients. Journal of the Pakistan Medical Association. 2009;59(6):359.
12. Maheshwari D, Ismail S. Preoperative anxiety in patients selecting either general or regional anesthesia for elective cesarean section. Journal of anaesthesiology, clinical pharmacology. 2015;31(2):196.

13. Zeb A, Hammad AM, Baig R, Rahman S. Pre-Operative Anxiety in Patients at Tertiary Care Hospital, Peshawar. Pakistan J Clin Trials Res. 2019;2(2):76-80.
14. Bedaso A, Ayalew M. Preoperative anxiety among adult patients undergoing elective surgery: a prospective survey at a general hospital in Ethiopia. Patient safety in surgery. 2019;13(1):18.
15. Takele G, Ayelegne D, Boru B. Preoperative Anxiety and its Associated Factors among Patients Waiting Elective Surgery in St. Luke's Catholic Hospital and Nursing College, Woliso, Oromia, Ethiopia, 2018. Emergency medicine ana critical care. 2019;4(2020):21-37.
16. Woldegerima Y, Fitwi G, Yimer H, Hailekiros A. Prevalence and factors associated with preoperative anxiety among elective surgical patients at University of Gondar Hospital. Gondar, Northwest Ethiopia, 2017. A cross-sectional study. International Journal of Surgery Open. 2018;10:21-9.
17. Mulugeta H, Ayana M, Sintayehu M, Dessie G, Zewdu T. Preoperative anxiety and associated factors among adult surgical patients in Debre Markos and Felege Hiwot referral hospitals, Northwest Ethiopia. BMC anesthesiology. 2018;18(1):155.
18. Srahbzu M, Yigizaw N, Fanta T, Assefa D, Tirfeneh E. Prevalence of depression and anxiety and associated factors among patients visiting orthopedic outpatient clinic at Tikur Anbessa specialized hospital, Addis Ababa, Ethiopia, 2017. J Psychiatry. 21: 450. J Psychiatry. 2018;21(450):2.
19. Robertson A, Khan R, Fick D, Robertson WB, Gunaratne DR, Yapa S, et al., editors. The effect of virtual reality in reducing preoperative anxiety in patients prior to arthroscopic knee surgery: a randomised controlled trial. 2017 IEEE 5th International Conference on Serious Games and Applications for Health (SeGAH); 2017: IEEE.
20. Duggan M, Dowd N, O'Mara D, Harmon D, Tormey W, Cunningham AJ. Benzodiazepine premedication may attenuate the stress response in daycase anesthesia: a pilot study. Canadian Journal of Anesthesia. 2002;49(9):932-5.
21. Sigdel S. Perioperative anxiety: A short review. Glob Anaesth Perioper Med. 2015;1(10.15761).
22. Bradt J, Dileo C, Potvin N. Music for stress and anxiety reduction in coronary heart disease patients. Cochrane Database of Systematic Reviews. 2013(12).

23. Ghimire R, Poudel P. Preoperative Anxiety and Its Determinants Among Patients Scheduled for Major Surgery: A Hospital Based Study. Journal of Anesthesiology. 2018;6(2):57-60.

24. Chow CH, Van Lieshout RJ, Schmidt LA, Dobson KG, Buckley N. Systematic review: audiovisual interventions for reducing preoperative anxiety in children undergoing elective surgery. Journal of pediatric psychology. 2016;41(2):182-203.

25. Hellstadius Y, Lagergren J, Zylstra J, Gossage J, Davies A, Hultman C, et al. Prevalence and predictors of anxiety and depression among esophageal cancer patients prior to surgery. Diseases of the Esophagus. 2016;29(8):1128-34.

26. Kuzminskaitė V, Kaklauskaitė J, Petkevičiūtė J. Incidence and features of preoperative anxiety in patients undergoing elective non-cardiac surgery. Acta medica Lituanica. 2019;26(1):93.

27. Masood Z, Haider J, Jawaid M, Alam SN. Preoperative anxiety in female patients: the issue needs to be addressed. Khyber Medical University Journal. 2009;1(2):38-41.

28. Gilmartin J, Wright K. Day surgery: patients' felt abandoned during the preoperative wait. Journal of clinical nursing. 2008;17(18):2418-25.

29. Jangland E, Gunningberg L, Carlsson M. Patients' and relatives' complaints about encounters and communication in health care: evidence for quality improvement. Patient education and counseling. 2009;75(2):199-204.

30. Weiser TG, Regenbogen SE, Thompson KD, Haynes AB, Lipsitz SR, Berry WR, et al. An estimation of the global volume of surgery: a modelling strategy based on available data. The Lancet. 2008;372(9633):139-44.

31. Limburg H, Foster A, Gilbert C, Johnson G, Kyndt M, Myatt M. Routine monitoring of visual outcome of cataract surgery. Part 2: Results from eight study centres. British Journal of Ophthalmology. 2005;89(1):50-2.

32. Guo P, East L, Arthur A. A preoperative education intervention to reduce anxiety and improve recovery among Chinese cardiac patients: a randomized controlled trial. International journal of nursing studies. 2012;49(2):129-37.

33. Sharma N, Ooi J, Figueira E, Rosenberg M, Masselos K, Papalkar D, et al. Patient perceptions of second eye clear corneal cataract surgery using assisted topical anaesthesia. Eye. 2008;22(4):547-50.

34. Fink C, Diener MK, Bruckner T, Müller G, Paulsen L, Keller M, et al. Impact of preoperative patient education on prevention of postoperative complications after major visceral surgery: study protocol for a randomized controlled trial (PEDUCAT trial). Trials. 2013;14(1):271.

35. Upton D, Hender C, Solowiej K. Mood disorders in patients with acute and chronic wounds: a health professional perspective. Journal of wound care. 2012;21(1):42-8.

36. Gouin J-P, Kiecolt-Glaser JK. The impact of psychological stress on wound healing: methods and mechanisms. Immunology and Allergy Clinics. 2011;31(1):81-93.

37. Kiecolt-Glaser JK, Page GG, Marucha PT, MacCallum RC, Glaser R. Psychological influences on surgical recovery: perspectives from psychoneuroimmunology. American Psychologist. 1998;53(11):1209.

38. Akinsulore A, Owojuyigbe AM, Faponle AF, Fatoye FO. Assessment of preoperative and postoperative anxiety among elective major surgery patients in a tertiary hospital in Nigeria. Middle East J Anaesthesiol. 2015;23(2):235-40.

39. Yilmaz M, Sezer H, Gürler H, Bekar M. Predictors of preoperative anxiety in surgical inpatients. Journal of clinical nursing. 2012;21(7-8):956-64.

40. Maranets I, Kain ZN. Preoperative anxiety and intraoperative anesthetic requirements. Anesthesia & Analgesia. 1999;87(6):1346.

41. Osborn TM, Sandler NA. The effects of preoperative anxiety on intravenous sedation. Anesthesia Progress. 2004;51(2):46.

42. Balasubramaniyan N, Rayapati DK, Puttiah RH, Tavane P, Singh SE, Rangan V, et al. Evaluation of anxiety induced cardiovascular response in known hypertensive patients undergoing exodontia-a prospective study. Journal of clinical and diagnostic research: JCDR. 2016;10(8):ZC123.

43. Kindler CH, Harms C, Amsler F, Ihde-Scholl T, Scheidegger D. The visual analog scale allows effective measurement of preoperative anxiety and detection of patients' anesthetic concerns. Anesthesia & Analgesia. 2000;90(3):706-12.

44. Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, et al. Preferred reporting items for systematic reviewand meta-analysis protocols (PRISMA-P) 2015statement. 2015;4(1).

45. Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of non randomized studies in meta-analyses. European journal of epidemiology. 2010;25(9):603–5.(9):603.

46. Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. BMJ (Clin Res Ed) 315 (7109): 629–634. 1997.

47. Ioannidis JP. Interpretation of tests of heterogeneity and bias in meta-analysis. Journal of evaluation in clinical practice. 2008;14(5):951-7.

48. Borenstein M, Hedges LV, Higgins JP, Rothstein HR. A basic introduction to fixed-effect and random-effects models for meta-analysis. Res Synth Methods. 2010;1(2):97-111.

49. Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. Statistics in medicine. 2002;21(11):1539-58.

50. JulianPTHiggins, Simon G Thompson, Jonathan J Deeks, Altman DG. Measuring inconsistency in meta-analyses. BMJ: British Medical Journal. 2003;327(7414):557.

51. Ryamukuru D. Assessment of preoperative anxiety for patients awaiting surgery at UTHK: University of Rwanda; 2017.

52. Zammit N, Menel M, Rania F. Preoperative Anxiety in the Tertiary Care Hospitals of Sousse, Tunisia: Prevalence and Predictors. SOJ Surgery. 2018;5(1):1-5.

53. Dagona SS. Prevalence of preoperative anxiety among Hausa patients undergoing elective surgery-a descriptive study. Advances in Social Sciences Research Journal. 2018;5(11).

54. Carneiro AF, Mathias LAST, Rassi Júnior A, Morais NSd, Gozzani JL, Miranda APd. Evaluation of preoperative anxiety and depression in patients undergoing invasive cardiac procedures. Revista brasileira de anestesiologia. 2009;59:431-8.

55. Gonçalves KKN, Silva JId, Gomes ET, Pinheiro LLdS, Figueiredo TR, Bezerra SMMdS. Anxiety in the preoperative period of heart surgery. Revista brasileira de enfermagem. 2016;69:397-403.

56. Alves MLM, Pimentel AJ, Guaratini ÁA, Marcolino JÁM, Gozzani JL, Mathias LAdST. Preoperative anxiety in surgeries of the breast: a comparative study between patients with suspected breast cancer and that undergoing cosmetic surgery. Revista brasileira de anestesiologia. 2007;57:147-56.

57. Caumo W, Schmidt AP, Schneider CN, Bergmann J, Iwamoto C, Bandeira D, et al. Risk factors for preoperative anxiety in adults. Acta Anaesthesiologica Scandinavica. 2001;45(3):298-307.

58. Santos LJF, GARCIA JBdS, Pacheco JS, VIEIRA ÉBdM, SANTOS AMd. Quality of life, pain, anxiety and depression in patients surgically treated with cancer of rectum. ABCD Arquivos Brasileiros de Cirurgia Digestiva (São Paulo). 2014;27:96-100.

59. Ebirim L, Tobin M. Factors responsible for pre-operative anxiety in elective surgical patients at a university teaching hospital: A pilot study. The internet journal of Anesthesiology. 2010;29(2):1-6.

60. Kanwal A, Asghar A, Ashraf A, Qadoos A. Prevalence of preoperative anxiety and its causes among surgical patients presenting in Rawalpindi medical university and allied hospitals, Rawalpindi. Journal of Rawalpindi Medical College. 2018;22(S-2):64-7.

61. Tajgna K, Krishna DPV, editors. Assessment of Preoperative Depression , Anxiety and Stress for Patients Awaiting Surgery in a Tertiary Care Hospital2018.

62. Ramesh C, Nayak BS, Pai VB, George A, George LS, Devi ES. Pre-operative anxiety in patients undergoing coronary artery bypass graft surgery–a cross-sectional study. International journal of Africa nursing sciences. 2017;7:31-6.

63. Matthias AT, Samarasekera DN. Preoperative anxiety in surgical patients-experience of a single unit. Acta Anaesthesiologica Taiwanica. 2012;50(1):3-6.

64. Ali A, Altun D, Oguz BH, Ilhan M, Demircan F, Koltka K. The effect of preoperative anxiety on postoperative analgesia and anesthesia recovery in patients undergoing laparascopic cholecystectomy. Journal of anesthesia. 2014;28(2):222-7.

65. Ayman Mohammed Ya'akba, vachkova E, NooraldinAlmasri. Prevalence of Preoperative Anxiety and its Contributing Risk Factors in Adult Patients Undergoing Elective Surgery: An-Najah National University; 2017.

66. Xu L, Pan Q, Lin R. Prevalence rate and influencing factors of preoperative anxiety and depression in gastric cancer patients in China: Preliminary study. Journal of International Medical Research. 2016;44(2):377-88.

67. Khalili N, Karvandian K, Ardebili HE, Eftekhar N, Nabavian O. Predictive factors of preoperative anxiety in the anesthesia clinic: a survey of 231 surgical candidates. Archives of Anesthesia and Critical Care. 2019.

68. Erkilic E, Kesimci E, Soykut C, Doger C, Gumus T, Kanbak O. Factors associated with preoperative anxiety levels of Turkish surgical patients: from a single center in Ankara. Patient preference and adherence. 2017;11:291.

69. Ocalan R, Akin C, Disli Z, Kilinc T, Ozlugedik S. Preoperative anxiety and postoperative pain in patients undergoing septoplasty. B-ent. 2015;11(1):19-23.

70. Fathi M, Alavi SM, Joudi M, Joudi M, Mahdikhani H, Ferasatkish R, et al. Preoperative anxiety in candidates for heart surgery. Iranian journal of psychiatry and behavioral sciences. 2014;8(2):90.

71. Albert PR. Why is depression more prevalent in women? Journal of psychiatry & neuroscience: JPN. 2015;40(4):219.

Figure Legend

Figure 1. PRISMA flow chart of the study identification process for systematic reviews and meta-analyses.

Figure 2: Forest plot showing the pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle income countries.

Figure 3: Funnel plot for testing publication bias (Random effect model, N=27).

Figure 4: Sensitivity analysis for studies included in the meta-analysis.

Supplementary file legend

Supplementary file 1. PRISMA (Preferred Reporting Items for Systematic review and Meta Analysis Protocols) 2020 checklist: Recommended items addressed in our systematic review and meta-analysis.

Supplementary file 2: Newcastle Ottawa (NOS) critical appraisal evaluation for Cross sectional studies.

Supplementary file 3: Summary of agreed level of bias and level of agreement on the methodological qualities of included studies in meta-analysis based on sampling, outcome, response rate and method of analysis.

Supplementary file 4: Newcastle Ottawa **(**NOS) critical appraisal evaluation for Cross-sectional studies.

Supplementary file 5: Factors associated with pre-operative among patients undergoing surgery.

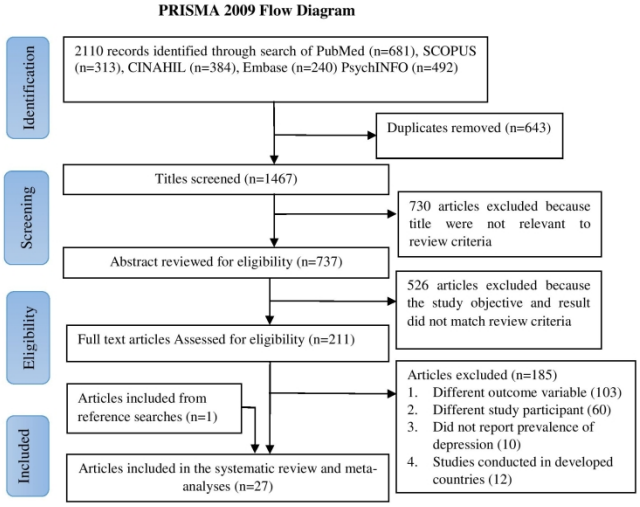

Figure 1. PRISMA flow chart of the study identification process for systematic reviews and meta-analyses

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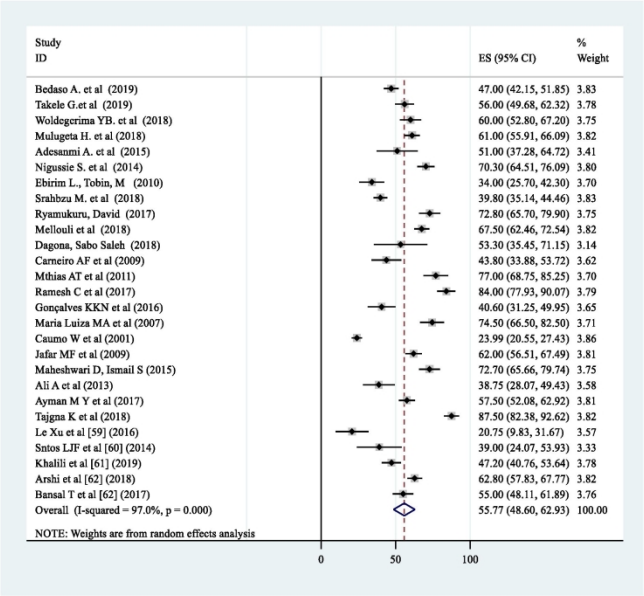

Figure 2: Forest plot showing the pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle income countries.

Figure 2: Forest plot showing the pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle-income countries.

210x297mm (300 x 300 DPI)

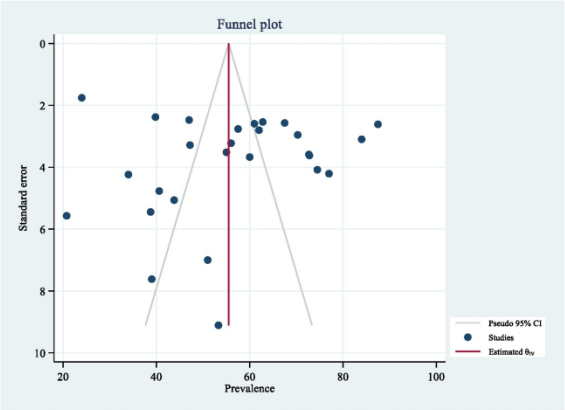

Figure 3: Funnel plot for testing publication bias (Random effect model, N=27)

Figure 3: Funnel plot for testing publication bias (Random effect model, N=27)

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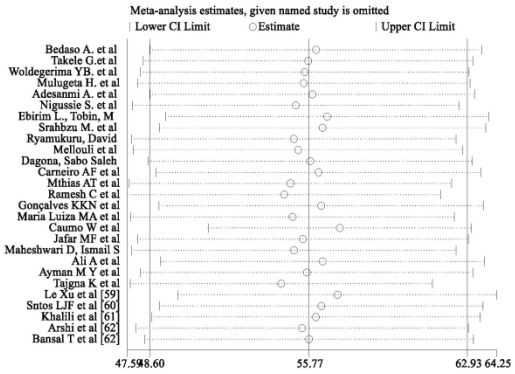

Figure 4: Sensitivity analysis for studies included in the meta-analysis

Figure 4: Sensitivity analysis for studies included in the meta-analysis

210x297mm (300 x 300 DPI)

Supplementary file 1. PRISMA (Preferred Reporting Items for Systematic review and Meta Analysis Protocols) 2020 checklist: Recommended items addressed in our systematic review and meta-analysis.

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3&4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	3&4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	CRD42020161934
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Page 4, Parag. 2
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4 Parag. 1
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Page 4 & 2
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Page 5
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	5 & 12
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	5
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	1 0, Para 1
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	10

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	5 & 6
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	5 Parag 1
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	6
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	10, Par 5
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	10
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	10, Para 1
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	10
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	10 & 11
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	11 & 12
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	12
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	12 & 13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	13
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	5 & 6
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	5 Parag 1
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	6
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	10, Par 5

Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	10
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	10, Para 1
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	10
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	10 & 11
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	11 & 12
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	12
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	12 & 13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	13

Supplementary file 2: The search strategies and search results in each database

1. PubMed search history

Search	Query	Items found
#6	#3 AND #2 AND #1: Humans; English; Adult 18+ years	681
#5	#3 AND #2 AND #1 Filters: Humans	2,915
#4	#3 AND #2 AND #1	2,385
#3	Surgical patients[Mesh] OR Patients Undergoing Surgery[Mesh] OR Surgery[Mesh] OR Surgical Patients[Title/Abstract] OR Patients Undergoing Surgery[Title/Abstract] OR Surgery[Title/Abstract]	4,000,195
#2	Preoperative Anxiety[Mesh] OR Anxiety[Mesh] OR Anxiety symptoms[Mesh] OR Anxiety disorder[Mesh] OR General Anxiety disorder[Mesh] OR Mental Health Problems[Mesh] OR Preoperative Anxiety[Title/Abstract] OR Anxiety[Title/Abstract] OR Anxiety symptoms[Title/Abstract] OR Anxiety disorder[Title/Abstract] OR General Anxiety disorder[Title/Abstract] OR Mental Health Problems[Title/Abstract]	312,808
#1	Prevalence[Mesh] OR Magnitude[Mesh] OR Epidemiology[Mesh] OR Incidence[Mesh] OR Burden[Mesh] OR Estimates [Mesh] OR Associated factors[Mesh] OR Determinants[Mesh] OR Correlates[Mesh] OR Predictors[Mesh] OR Prevalence[Title/Abstract] OR Magnitude[Title/Abstract] OR Epidemiology[Title/Abstract] OR Incidence[Title/Abstract] OR Burden[Title/Abstract] OR Estimates OR Associated factors[Title/Abstract] OR Determinants[Title/Abstract] OR Correlates[Title/Abstract] OR Predictors[Title/Abstract]	3,726,562

2. SCOPUS search history

Search	Query	Items found
#6	#5 AND (LIMIT-TO (LANGUAGE, “English"))	313
#5	#4 AND (LIMIT-TO (SUBJECT, “human"))	987
#4	#3 AND #2 AND #1	1,892
#3	"Surgical patients" OR "Patients Undergoing Surgery" OR "Surgery"	19,114
#2	"Preoperative Anxiety" OR "Anxiety" OR "Anxiety symptoms" OR "Anxiety disorder" OR "General Anxiety disorder" OR "Mental Health Problems"	21,138
#1	"Prevalence" OR "Magnitude" OR "Epidemiology" OR "Incidence" OR "Burden" OR "Estimates" OR "Associated factors" OR "Determinants" OR "Correlates" OR "Predictors"	8943

3. CINAHL search history

Search	Query	Items found
S5	Limiters: Human subject and English language	384
S4	S1 AND S2 AND S3	843
S3	(MH "Surgical patients") OR (MH "Patients Undergoing Surgery") OR "Surgery"	3,421
S2	(MH "Preoperative Anxiety") OR (MH "Anxiety") OR (MH "Anxiety symptoms") OR (MH "Anxiety disorder") OR (MH "General Anxiety disorder") OR (MH "Mental Health Problems")	9,124
S1	(MH "Prevalence") OR (MH "Magnitude") OR (MH "Epidemiology") OR (MH "Incidence") OR (MH "Burden") OR (MH "Estimates") OR (MH "Associated factors") OR (MH "Determinants") OR (MH "Correlates") OR (MH "Predictors")	7,841

4. PsychINFO search history

Search	Query	Items found
#5	Filters: Human subject and English language	492
#4	S1 AND S2 AND S3	1231
#3	(MH "Surgical patients") OR (MH "Patients Undergoing Surgery") OR "Surgery"	4,574
#2	(Preoperative Anxiety) OR (Anxiety.tw,id.) OR (Anxiety symptoms.tw,id.) OR (Anxiety disorder.tw,id.) OR (General Anxiety disorder.tw,id.) OR (Mental Health Problems.tw,id.)	9,457
#1	(Prevalence) OR (Magnitude) OR (Epidemiology) OR (Incidence) OR (Burden) OR (Estimates) OR (Associated factors) OR (Determinants) OR (Correlates) OR (Predictors)	12,531

5. Embase search history (Elsevier)

No	Query	Results
#6	#5 AND 'human'/de	240
#5	#4 AND [english]/lim	741
#4	#1 AND #2 AND #3	1109
#3	Surgical patients':ti,ab OR Patients Undergoing Surgery':ti,ab OR Surgery':ti,ab OR Surgical Patients':ti,ab OR Patients Undergoing Surgery':ti,ab OR Surgery':ti,ab	43,865
#2	'Preoperative Anxiety':ti,ab OR 'Anxiety':ti,ab OR 'Anxiety symptoms':ti,ab OR 'Anxiety disorder':ti,ab OR 'General Anxiety disorder':ti,ab OR 'Mental Health Problems':ti,ab.	21,143
#1	'Prevalence':ti,ab OR 'Magnitude': ti,ab OR 'Epidemiology':ti,ab OR 'Incidence':ti,ab OR 'Burden':ti,ab OR 'Estimates':ti,ab OR 'Associated	23,421

	factors':ti,ab OR 'Determinants':ti,ab OR 'Correlates':ti,ab OR 'Predictors':ti,ab OR 'Prevalence':ti,ab	

Supplementary file 3: Summary of the agreed level of bias and level of agreement on the methodological qualities of included studies in a meta-analysis based on sampling, outcome, response rate and method of analysis.

Study	Overall agreement and precision		
	Percentage of agreement	Kappa value	Level of agreement
Bedaso A. et al (14)	75	0.60	Moderate
Takele G.et al (15)	100	1	Almost perfect
Woldegerima YB. et al (16)	100	1	Almost perfect
Mulugeta H. et al (17)	75	0.60	Moderate
Adesanmi A. et al (36)	100	1	Almost perfect
Nigussie S. et al (5)	100	1	Almost perfect
Ebirim L., Tobin, M (57)	100	1	Almost perfect
Srahbzu M. et al (18)	100	1	Almost perfect
Ryamukuru, David (49)	75	0.50	Moderate
Mellouli et al (50)	75	0.60	Moderate
Dagona, Sabo Saleh (51)	100	1	Almost perfect
Mthias AT et al (61)	100	1	Almost perfect
Carneiro AF et al (52)	100	1	Almost perfect
Ramesh C et al (60)	75	0.60	Moderate
Gonçalves et al (53)	100	1	Almost perfect
Maria Luiza MA et al (54)	100	1	Almost perfect
Caumo W et al (55)	75	0.60	Moderate
Jafar MF et al (11)	75	0.60	Moderate
Maheshwari D, Ismail S (12)	100	1	Almost perfect
Ali A et al (62)	100	1	Almost perfect
Ayman M Y et al (63)	75	0.60	Moderate
Tajgna K et al (59)	100	1	Almost perfect
Le Xu et al (64)	100	1	Almost perfect
Sntos LJF et al (56)	100	1	Almost perfect
Khalili et al (65)	100	1	Almost perfect

Arshi et al (58)	100	1	Almost perfect
Bansal T et al (58)	75	0.60	Moderate

Supplementary file 4: Newcastle Ottawa (NOS) critical appraisal evaluation for Cross-sectional studies

S.no	Author, Year of publication	Representativeness of the sample	Sample size	Non-respondent	Ascertainment of the exposure (risk factor)	Comparability (Confounding factors are controlled)	Assessment of outcome	Statistical Analysis	Total score
1	Bedaso A. et al [43]	1	1	0	2	1	2	1	8
2	Takele G.et al [44]	1	1	0	2	1	1	1	7
3	Woldegerima YB. et al [15]	1	1	1	2	1	1	1	7
4	Mulugeta H. et al [16]	1	1	1	2	1	2	1	9
5	Adesanmi A. et al [30]	0	1	0	2	0	2	1	6
6	Nigussie S. et al [5]	1	1	0	1	1	2	1	7
7	Ebirim L., Tobin, M [49]	1	0	0	2	1	1	1	6
8	Srahbzu M. et al [45]	1	1	0	2	1	1	1	7
9	Ryamukuru, David [46]	1	1	0	1	1	1	1	6
10	Mellouli et al [47]	1	1	0	1	1	1	1	6
11	Dagona, Sabo Saleh [48]	1	1	0	1	1	1	1	6
12	Mthias AT et al [50]	1	1	0	2	1	2	1	8
13	Carneiro AF et al [51]	1	1	0	2	1	2	1	8
14	Ramesh C et al [52]	1	1	1	2	1	2	1	9
15	Gonçalves et al [53]	1	1	0	2	1	1	1	7
16	Maria Luiza MA et al [54]	1	1	0	2	1	2	1	8
17	Caumo W et al [55]	1	1	0	2	1	2	1	8
18	Jafar MF et al [22]	1	1	0	2	1	1	1	7
19	Maheshwari D, Ismail S [7]	1	1	0	2	1	2	1	8
20	Ali A et al [56]	1	1	1	2	1	2	1	9
21	Ayman M Y et al [57]	1	1	0	2	1	2	1	8
22	Tajgna K et al [58]	1	1	1	2	1	2	1	9
23	Le Xu et al [59]	1	1	1	2	1	2	1	9
24	Sntos LJF et al [60]	1	1	0	2	1	2	1	8
25	Khalili et al [61]	1	1	0	2	1	1	1	7
26	Arshi et al [62]	1	1	0	1	1	1	1	6
27	Bansal T et al [62]	1	1	0	2	1	1	1	7

NB: NOS score ≥8 (High quality), 6-7 (moderate quality), and ≤ 5 (low quality)

Supplementary file 4: Factors associated with pre-operative among patients undergoing surgery

Author	Key results on factors associated with preoperative anxiety
Bedaso A. et al (14)	○ Having strong social support (AOR = 0.16, 95%CI = 0.07-0.34), ○ Fear of harm from doctor or nurse mistake (AOR = 5.03, 95%CI = 2.85-8.89), ○ unexpected result of the surgery (AOR = 3.03, 95%CI = 1.73-5.19), ○ Fear of unable to recover (AOR = 2.96, 95%CI = 1.18-4.87), and ○ Need of blood transfusion (AOR = 2.76, 95%CI = 1.65-4.62)
Takele G.et al (15)	○ Being female (AOR 3.30, 95% CI 1.30, 8.34), ○ Orthopaedics surgery (AOR 4.24, 95% CI 1.23, 14.05), ○ Not having information (AOR 2.48, 95% CI 1.11, 5.56), ○ Postponement of surgery (AOR 5.53, 95% CI: 1.28, 23.91) and ○ Not listening music (AOR 3.41, 95% CI: 1.45, 7.98)
Woldegerima et al (16)	○ Fear of death (AOR = 2.40, 95% CI = 1.08, 5.32), ○ Family concern (AOR = 2.15, 95% CI = 1.03, 4.50), ○ Fear of dependency (AOR = 2.75, 95% CI = 1.57, 7.20) and ○ Fear of disability (AOR = 2.75, 95% CI = 1.22, 6.21). ○ Being at the age of 18–30 years (AOR = 6.92, 95% CI = 1.39, 33.82), ○ Age 31–45 years (AOR = 5.72, 95% CI = 1.61, 20.28), ○ No income (AOR = 3.21, 95% CI = 1.01, 10.27), ○ Low income (AOR = 3.06, 95% CI = 1.18, 7.93). ○ Rural residency (AOR = 0.38, 95% CI = 0.16, 0.89)
Mulugeta H. et al (17)	○ Being female patients (AOR 2.19, 95%CI: 1.29, 3.71) and ○ Lack preoperative information (AOR 2.03, 95%CI: 1.22, 3.39).
Nigussie S. et al (5)	○ Being single (β=5.288, 95%CI: (2.149, 8.428), P<0.001), ○ Divorced marital status (β=5.629, 95%CI (0.053, 11.205), P<0.048), ○ Income (β=0.002, 95%CI: (0.001, 0.004), P=0.001), ○ Time of operation (afternoon) (β=-2.770, 95%CI: −4.906, −0.633), P=0.011) ○ No preoperative information (β= -2.337, 95%CI: −4.65, −0.018), P=0.04).
Srahbzu M. et al (18)	○ Being female (AOR=1.9995%CI: 1.11, 3.57), ○ Having a chronic medical illness (AOR=3.0795%CI:1.36, 6.92), ○ Having a family history of mental illness (AOR=2.24, 95%CI: 1.05, 5.4.9), ○ Lower extremity injury (AOR=2.93, 95%CI: 1.38, 6.21) and ○ Having severe pain (AOR=2.75, 95%CI: 1.32, 5.74)

Ryamukuru, David (49)	○ Orthopaedic surgery (OR: 10.22; 95% CI: 1.144, 91.304; P= 0.037). ○ Old patients (OR: 0.22, 95% CI: 0.075, 0.650; P=0.006).
Mellouli et al (50)	○ High grade of surgery (AOR: 9, 95% CI: 3.4, 23.8) and ○ High level of information requirement (AOR: 1.5, 95% CI: 1.30, 1.70)
Mthias AT et al (61)	○ Those who having a previous experience of surgery reported less anxiety (p<0.05). ○ Females patients who had a previous surgery were less anxious than those who had never experienced surgery (p=0.011)
Ramesh C et al (60)	○ Female reported a high level of state anxiety (X^2 =11.57, p < 0.001)
Gonçalves et al (53)	○ Women had a significantly higher scores of preoperative anxiety than men (p=0.003). ○ There is a significantly higher difference in anxiety in the group of patients who had undergone previous heart surgery (p=0.012) and among smokers (p=0.039).
Caumo W et al (55)	○ A history of cancer (AOR=2.26; 95%CI: 1.43–3.57), ○ Being female gender (AOR: 2, 95% CI: 1.24, 3.26) and ○ A history of smoking (AOR=7.47, 95% CI: 1.47, 37.81)
Fathi M et al (68)	○ Being females (r= 0.80, P< 0.001) and ○ Older patients (r= 0.226, P<0.001) had significant correlation with anxiety.
Maheshwari et al (12)	○ Age ≤ 25 years (AOR: 3.11, 95%CI: 1.03, 9.32, P= 0.04), ○ Nulli and primiparous (AOR: 2.87, 95%CI: 1.38, 5.98, P=0.05), ○ General anaesthesia in previous surgery (AOR: 4.29, 95% CI: 1.93, 9.53) ○ No previous surgery (AOR: 14.72, 95%CI: 3.13, 69.28) and ○ Source of information from non-anaesthetist (AOR: 0.18, 95%CI: 0.07, 0.45)
Ocalan R et al (67)	○ Age (r= −0.326, P=0.011), ○ Educational level (r=0.258, P=0.046), ○ Immediate (r=0.715, P<0.001) and late (r=0.605, P<0.001) postoperative pain had significant correlation with preoperative anxiety.
Ali A et al (62)	○ A significant positive correlation was found between the days of hospitalization and preoperative score (r= 0.370, P= 0.001).
Erkilic E et al (66)	○ Being women and less educated patients undergoing surgery had significant association with preoperative anxiety (P<0.05).

Sntos LJF et al [60]	○ Gastrointestinal problems (r=0.3975, P<0.05) and ○ Sexual problem (r=0.4017, P<0.05) had a moderate correlation with anxiety
Khalili et al (65)	○ Old age (OR= 0.95, 95%CI: 0.93, 0.97), ○ Female gender (OR: 2.33, 95%CI: 1.26, 4.29), ○ Urban residence (OR: 3.73, 95%CI: 1.65, 8.44) and ○ Inadequate patients' awareness about adverse effect of anaesthesia (OR: 3.43, 95%CI: 1.53, 7.67; p< 0.05).

Prevalence and factors associated with preoperative anxiety among patients undergoing surgery in low and middle-income countries: A systematic review and meta-analysis

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Abstract

Objectives: This review aimed to determine the pooled prevalence of preoperative anxiety and its associated factors among patients undergoing surgery in low and middle-income countries (LMICs).

Methods: We searched PubMed, SCOPUS, CINAHL, Embase, and PsychINFO to identify peer-reviewed studies on the prevalence and factors associated with preoperative anxiety among patients undergoing surgery using pre-defined eligibility criteria. Studies were pooled to estimate the prevalence of preoperative anxiety using a random-effect meta-analysis model. Heterogeneity was assessed using I^2 statistics. Funnel plot asymmetry and Egger's regression tests were used to check for publication bias.

Result: Our search identified 2110 studies, of which 27 studies from 12 countries with 5,575 participants were included in the final meta-analysis. Of the total 27 studies, eleven used the State-Trait Anxiety Inventory (STAI) to screen anxiety, followed by the Amsterdam Preoperative Anxiety and Information scale (APAI), used by four studies. The pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle-income countries was 55.7% (95% CI: 48.60-62.93). Our sub-group analysis found that a higher pooled prevalence of preoperative anxiety was found among female surgical patients (59.36%, 95%CI: 48.16-70.52, I^2= 95.43, P<0.001) and studies conducted in Asia (62.59%, 95% CI: 48.65, 76.53, I^2=97.48, P<0.001).

Conclusion: Our meta-analysis indicated that around one in two patients undergoing surgery in LMICs suffer from preoperative anxiety, which needs due attention. Routine screening of preoperative anxiety symptoms among patients scheduled for surgery is critically important.

Strengths and limitations

- Conducting abroad literature search, independent screening, quality appraisal, and data extraction by two investigators represent the main strength of the current review.
- The absence of significant publication bias increases the reliability of our findings.
- The significant heterogeneity among studies and the restriction applied to include studies published only in English language are the major limitations of the current review in generalizing these findings to all LMICs.

Keywords: Preoperative anxiety, surgical patients, associated factors, Prevalence, Systematic review, Meta-analysis, Low and middle-income countries

Introduction

Anxiety is defined as a subjective state of emotional uneasiness, distress, apprehension, or fearful concern associated with autonomic and somatic features and causes impaired functioning or activity (1). Anxiety can also be a normal emotional human reaction to circumstances of danger accompanied by physiological and psychological elements (1, 2). Surgery is one of the standard medical procedures that could increase anxiety irrespective of the type of surgery (2, 3). Surgery is a life-threatening procedure that causes the person to perceive himself under a direct physical restraint. Patients scheduled for surgery may experience fears and anxieties such as nervousness, fear of being unable to wake up from anesthesia, fear of postoperative pain, and fear of death (4). As a result, preoperative anxiety is becoming a significant mental health problem for many patients undergoing surgery (5, 6).

Different epidemiological studies revealed the varying magnitude of preoperative anxiety among patients undergoing surgery. For example, a global level systematic review and meta-analysis reported a 48% pooled prevalence of preoperative anxiety among patients undergoing surgery (7). A facility-based study conducted in Netherland found 27.9% and 20.3% of preoperative anxiety in patients undergoing hip and knee surgery, respectively (8). Epidemiological studies conducted in low and middle-income countries found that the prevalence of preoperative anxiety ranges from 47 to 70.3% in India (9, 10), 62 to 97% in Pakistan (11-13), and 39.8 to70% in Ethiopia (5, 14-18).

The magnitude of preoperative anxiety among patients undergoing surgery varies depending on the reasons and type of surgery, gender of the patient (12), patient interaction with medical staff, previous experience of surgical procedures, and sensitivity to stressful circumstances (19, 20). Also, factors such as fear of surgery, fear of anaesthesia, sociodemographic characteristics of the patient (age, educational status, and partner status), types of surgery, fear of postoperative pain, and fear of death were significant predictors of preoperative anxiety (16, 17, 21-25). However, the frequently mentioned major causes of preoperative anxiety were fear of the outcomes of surgery (29.3%), followed by fear of the progress after surgery (19.5%) and complications after surgery (11.4%) (26). Furthermore, evidence also indicated that in many low and middle-income countries, the potential effect of scarce resources at health facilities, weak health systems, and culture of a given community could play a paramount role in the increased rates of preoperative anxiety among surgical

patients. For example, studies demonstrated that waiting for a longer duration for surgery (27, 28), inadequate information about the procedure, disrespect by the clinician, lacking empathy (29), and receiving less inpatient care (28) could increase the risk of preoperative anxiety. Globally, the surgery rate ranges from 295 operations per 100,000 population in Ethiopia to 23,369 per 100,000 in Hungary, indicating a considerable difference in surgical service provision between low-income countries (LIC) and high-income countries (HIC) despite a growing unmet need (30). Despite the small number of surgical service in LMICs, it is compounded by the burden of managing postoperative complications such as delayed complications which mainly caused by inadequate inpatient care and low rates of follow-up service (31).

Increased preoperative anxiety levels may be a reason for patients to decline planned surgical procedures (32, 33). High levels of preoperative anxiety negatively affect the surgical operation and contribute to adverse surgical outcomes (34, 35). Literature showed that preoperative anxiety might cause slow, complicated, and painful postoperative recovery (35-37). Severe levels of anxiety before the surgical procedure have resulted in autonomic disturbances such as increased heart rate, raised blood pressure, and arrhythmias (38), and affecting the outcomes of surgical procedures (39). Before the surgical procedure, patients who developed anxiety were found to require higher doses of anesthetic medications, had a higher level of postoperative pain, increased consumption of analgesic drugs, increased morbidity, prolonged recovery, and hospital stay (40-42). Appropriate management of anxiety by clinicians may provide a better pre-operative assessment, less pharmacological premedication, smoother induction and maybe even better outcome (43).

Based on the above evidence there was a substantial difference in the reported prevalence of preoperative anxiety among patients undergoing surgery across studies. Also, there is no previously conducted systematic reviews and meta-analysis on the topic of interest, particularly in low and middle-income countries. Furthermore, identifying the significant correlates of preoperative anxiety is vital to reduce the burden or prevent the onset and subsequent consequences. Therefore, this review aimed to examine the prevalence and thematically quantify and present factors associated with preoperative anxiety among patients undergoing surgery in low and middle-income countries (LMICs) and formulate recommendations for future health care services in the area.

Methods

Search strategy

A systemic review and meta-analysis was conducted using studies that examined the prevalence and correlates of preoperative anxiety among patients undergoing surgery in low and middle-income countries. The strategy for literature search, selection of studies, data extraction, and reporting of results for the current review was designed following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (44) (**supplementary file 1**). The protocol for the current review was registered in PROSPERO (CRD42020161934).

Five electronic databases (PubMed, SCOPUS, CINAHIL, Embase, and PsychINFO) were systematically searched to identify studies that report the prevalence of preoperative anxiety among patients undergoing surgery in low and middle-income countries. Searching in PubMed was performed using the following terms: ((Prevalence OR Magnitude OR Epidemiology OR Incidence OR Estimates OR Burden OR Associated factors OR Determinants OR Correlates OR Predictors) AND ((Preoperative Anxiety OR Anxiety OR Anxiety symptoms OR Anxiety disorder OR General Anxiety disorder) AND (Surgical patients OR patients undergoing surgery OR surgery)). Database-specific subject headings associated with the above terms were used to screen studies indexed in SCOPUS, CINAHIL, Embase, and PsychINFO databases. Besides, we observed the reference lists of published studies to identify potential other relevant articles for this review. The whole search strategy of our review is presented in **Supplementary file 2**.

Eligibility Criteria

In the current review, we have included observational studies conducted on determining the prevalence and factors associated with preoperative anxiety among patients undergoing surgery in low and middle-income countries, and written in English language. Eligible studies included for this review had to fulfil the following criteria: first, the type of study has to be observational (cross-sectional, nested case-control, cohort studies, or follow-up studies). Second, the study participants were patients (age ≥18 years) who have a schedule to undergo surgical procedures under anesthesia, regardless of their sex. Third, measurement of anxiety was done using standard diagnostic criteria or a validated screening tools. Fourth, the studies should be from a low-income or middle income country. World Bank Atlas classified countries

as low-income and middle-income for those with the Gross National Income(GNI) per capita of ≤$1025 and between $1026 to 12,375, respectively (https://data.worldbank.org/indicator/NY.GNP.PCAP.CD).

Studies that reported pooled preoperative anxiety, had a poor quality score on the New Castle Ottawa Scale (NOS), duplicate studies, conference proceedings, commentaries, reports, short communications and letters to editors were excluded. Then full-text articles were independently checked for their eligibility by two investigators (AB and NM). Disagreements were resolved by discussing with a third author (BD) for the final selection of studies.

Data extraction and study quality assessment

Data were extracted using a specific form designed to extract data that authors developed. The data extraction form included the following information: name of the author, year of publication, country, study design, sample size, type of surgery, and the number of positive cases for preoperative anxiety, prevalence of preoperative anxiety and significant factors associated with preoperative anxiety. AB conducted the primary data extraction, and then NM assessed the extracted data independently. Any disagreements and discrepancies were resolved through discussion with the third author BD.

The methodological qualities of each included article were assessed by using a modified version of the Newcastle-Ottawa Scale (45). The methodological quality and eligibility of the identified articles were independently evaluated by two reviewers (AB and NM), and disagreements among reviewers were resolved through discussion with the third Author (BD). The Summary of the agreed level of bias and level of agreement between independent evaluators of studies is mentioned in **Supplementary file 3**. Finally, studies with a scale of ≥ 5 out of 10 were included in the current review.

Analysis

For the first objective, estimating the pooled prevalence of preoperative anxiety, the prevalence report extracted from all the included primary studies were meta-analyzed. For the second objective, identifying the significant factors associated with preoperative anxiety, reports of measures of associations (OR, r, β or RR) were analyzed narratively. While interpreting the association between significant factors and preoperative anxiety, adjusted

estimates were the first choice. However, for studies that missed reporting adjusted estimates, crude estimates were considered.

We have examined publication bias by visual inspection of a funnel and conducting Egger's regression tests (46, 47). A p-value <0.05 was used to declare the statistical significance of publication bias. Studies were pooled to estimate pooled prevalence and 95% CI using a random-effect model (48). We have assessed heterogeneity using Cochran's Q and the I^2 statistics (49). I^2 statistics is used to quantify the percentage of the total variation in the study estimate due to heterogeneity. I^2 values of 25, 50 and 75% were considered to represent low, medium and high heterogeneity, respectively (50). Due to significant heterogeneity across studies, we conducted a subgroup analysis using moderators such as methodological quality of studies, country, gender, anxiety assessment tool, economic level of a country, and region where a country located. Also, sensitivity analysis was conducted to evaluate the presence of outlier estimates of preoperative anxiety. All the extracted data were analyzed using STATA 16.

Patient and public involvement

No patient or public involved in the current review.

Results

Identification of studies

We have identified a total of 3110 studies from 5 databases in our initial electronic searching. After removing duplicates, reviewing titles and abstracts, 211 studies were considered eligible for full-text review. After excluding 185 articles in full-text review and adding 1 article that we get through reference searching, 27 studies were included in this systematic review and meta-analysis (**Figure 1**).

Characteristics of included studies

Of the total 27 studies (5,575 population), all (100%) studies employed cross-sectional study design, and 9 (81.2%) studies published in the past five years (14-18, 38, 51-53). Also, six studies were conducted in Ethiopia (5, 14-18), five studies were from Brazil (54-58), and three studies were from each of the following countries; Nigeria (38, 53, 59), Pakistan (11, 12, 60) and India (60-62). The sample size of the included studies ranges from 30 in Nigeria (53) to 591 in Brazil (57). The prevalence of preoperative anxiety ranges from 34% in Nigeria (59) to

87.5% in India (61). Of the 27 included studies, 16 (59.2%) were from middle-income countries, whereas 11 (40.8%) were from low-income countries. State-Trait Anxiety Inventory (STAI) is the most common tool used to screen anxiety (11 studies), followed by the Amsterdam Preoperative Anxiety and Information scale (APAI) (4 studies) (**Table 1**).

Table 1: Characteristics of studies included in the current systematic review

Author	Publication Year	Country	Sample size	Study design	Type of surgery	Cases	Prevalence (%)	Anxiety Measures (Cut-off point)
Bedaso A. et al (14)	2019	Ethiopia	407	Cross-sectional	All surgery	191	47	STAI (≥ 44/80)
Takele G.et al (15)	2019	Ethiopia	237	Cross-sectional	All surgery	132	56	PITI-20 Item (≥16/60)
Woldegerima YB. et al (16)	2018	Ethiopia	178	Cross-sectional	All surgery	106	60	STAI (> 44/80)
Mulugeta H. et al (17)	2018	Ethiopia	353	Cross-sectional	All surgery	215	61	STAI (> 44/80)
Adesanmi A. et al (38)	2015	Nigeria	51	Cross-sectional	All surgery	26	51	STAI (> 44/80)
Nigussie S. et al (5)	2014	Ethiopia	239	Cross-sectional	All surgery	168	70.3	STAI (≥ 44/80)
Ebirim L., Tobin, M (59)	2010	Nigeria	125	Cross-sectional	All surgery	43	34	VAS (≥45/100)
Srahbzu M. et al (18)	2018	Ethiopia	423	Cross-sectional	Orthopaedic surgery	168	39.8	HADS-A (≥ 18)
Ryamukuru, David (51)	2017	Rwanda	151	Cross-sectional	All surgery	110	72.8	PITI-20 Item (≥15/60)
Mellouli et al (52)	2018	Tunisia	332	Cross-sectional	All surgery	224	67.5	APAI score (>10)
Dagona, Sabo Saleh (53)	2018	Nigeria	30	Cross-sectional	All surgery	16	53.3	APAI-H (NA)
Mthias AT et al (63)	2011	Srilanka	100	Cross-sectional	Elective Surgery	77	77	APAI score (≥11)
Carneiro AF et al (54)	2009	Brazil	96	Cross-sectional	Cardiac Surgery	42	43.8	HADS-A (≥9)

Ramesh C et al (62)	2017	India	140	Cross-sectional	Cardiac Surgery	118	84	STAI (≥ 40/80)
Gonçalves et al (55)	2016	Brazil	106	Cross-sectional	Cardiac Surgery	43	40.6	BAI (NA)
Maria Luiza MA et al (56)	2007	Brazil	114	Cross-sectional	Cosmetic Surgery	85	74.5	STAI (> 36/80)
Caumo W et al (57)	2001	Brazil	591	Cross-sectional	Elective Surgery	141	23.99	STAI (≥ 39/80)
Jafar MF et al (11)	2009	Pakistan	300	Cross-sectional	Elective Surgery	186	62	STAI (NA)
Maheshwari D, Ismail S (12)	2015	Pakistan	154	Cross-sectional	Elective CS	112	72.7	VAS (≥50)
Ali A et al (64)	2013	Turkey	80	Cross-sectional	Gall bladder surgery	31	38.75	BAI (>17/63)
Ayman M Y et al (65)	2017	Palestine	320	Cross-sectional	All surgery	184	57.5	APAI score (>11)
Tajgna K et al (61)	2018	India	160	Cross-sectional	All surgery	140	87.5	DASS-21 (NA)
Le Xu et al (66)	2016	China	53	Cross-sectional	Gastric Cancer surgery	11	20.75	HADS-A (≥18)
Sntos LJF et al (58)	2014	Brazil	41	Cross-sectional	Rectal Surgery	16	39	BAI (≥10/63)
Khalili et al (67)	2019	Iran	231	Cross-sectional	All Surgery	109	47.2	STAI (≥40/80)
Arshi et al (60)	2018	Pakistan	363	Cross-sectional	All surgery	228	62.8	VAS(≥45/100)
Bansal T et al (60)	2017	India	200	Cross-sectional	Emergency CS	110	55	STA (≥40/80)

Abbreviations: VAS: Visual Analogue Scale; PITI: Preoperative Intrusive Thought Inventory; STAI: State-Trait Anxiety Inventory; APAI: Amsterdam preoperative Anxiety and Information scale; BAI: Beck Anxiety Inventory; DASS-21: Depression Anxiety and Stress Scale; BAI: Beck Anxiety Inventory; CS: Caesarean section.

The methodological quality of studies

We used the modified Newcastle Ottawa Scale (NOS) (45) to evaluate the methodologic quality of the studies included in the current review. Among the 27 studies included in the present review, 16 studies were of high (NOS score ≥ 8), and 11 studies were of moderate methodologic quality (NOS score 6-7) (**Supplementary file 4**).

Meta-analysis

The pooled prevalence of preoperative anxiety among patients undergoing surgery within the LMICs included within this study was estimated to be 55.7% (95% CI: 48.60-62.93) with considerable heterogeneity between studies (I^2= 97%; P<0.001). Consequently, a random-effects meta-analysis model was employed to estimate the overall pooled prevalence (**Figure 2**).

Further, to explore the possible sources of heterogeneity we employed a random-effect univariate meta-regression model considering the sample size, publication year, and NOS quality score as moderators. However, none these continuous variables (i.e., sample size (Coefficient= -0.015, P= 0.533), publication year (Coefficient= 0.984, P= 0.202), and NOS quality score (Coefficient= -2.65, P= 0.412)) found to have significant association with heterogeneity.

Publication bias

Inspection of the funnel plot looks symmetric and shows no significant publication bias (**Figure 3**). Besides, eggers regression test suggested absence of publication bias (B= -2.79, SE= 2.013, P= 0.165).

Sub-group and sensitivity analysis

Due to the reported high heterogeneity index among studies, a subgroup analysis was conducted using characteristics like country, type of anxiety tool used, quality of studies and economic level of a country. Among studies that assessed the prevalence of preoperative anxiety among surgical patients, the subgroup analysis based on the region where the studies conducted revealed that a higher pooled prevalence of preoperative anxiety was reported in a study conducted in Asia (62.59%, 95% CI: 48.65, 76.53, I^2=97.48, P<0.001), followed by Africa (55.91%, 95% CI: 48.37, 63.44 I^2= 99.31, P<0.001) and Middle East (52.5%, 95% CI: 42.41,

62.59). Besides, a higher pooled prevalence of preoperative anxiety was reported in a study that used Depression Anxiety and Stress Scale (DASS) (87.5%, 95% CI: 82.37-92.62), followed by studies that used Amsterdam preoperative Anxiety and Information Scale (APAI) tool as an anxiety assessment tool (64.9%, 95% CI: 55.78-74.10, I^2= 83.4%, P<0.001).

To further explore the source of heterogeneity among studies included in the review, we have also conducted a subgroup analysis using the quality of studies as a moderator. The pooled prevalence of preoperative anxiety was higher in the studies with moderate methodological quality (57.2%) (95% CI: 48.49-65.97, I^2= 94.2%, P<0.001) compared to those studies with high methodological quality (54.8%) (95% CI: 44.28-65.28, I^2= 97.8, P<0.001). Furthermore, a pooled estimate of preoperative anxiety among female surgical patients (59.36%, 95%CI: 48.16-70.52, I^2= 95.43, P<0.001) was higher than their male counterparts (45.95%, 95%CI: 31.69-60.21, I^2= 96.67, P<0.001). However, a pooled estimate of preoperative anxiety in middle-income countries (55.7%) (95%CI: 48.60-62.93, I^2= 98, P<0.001) was comparable to studies conducted in low-income countries (54.9%, 95%CI: 47.69-62.17, I^2= 92.6, P<0.001) (**Table 2**).

Table 2: Subgroup analysis of the prevalence of preoperative anxiety among patients undergoing surgery by country, type of anxiety tool, quality of studies and economic level of a country.

Subgroup	Number of studies	Estimates		Heterogeneity across studies	
		Prevalence (%)	95% CI	I^2 (%)	P-value
Country					
Ethiopia	6	55.6	35.13-44.46	94.1	<0.001
Nigeria	3	44.6	31.86-58.16	69.6	0.037
Rwanda	1	72.8	65.7-79.89	-	-
Tunisia	1	67.5	62.46-72.53	-	-
Brazil	5	44.4	23.76-64.95	97.1	<0.001
Srilanka	1	77	68.75-85.25	96.6	<0.001
India	3	75.6	56.72-94.49	69	0.040
Pakistan	3	65.4	59.4-71.39	-	-
Turkey	1	38.8	28.07-49.4	-	-

Palestine	1	57.5	52.08-62.9	-	-
China	1	20.6	9.83-31.67	-	-
Iran	1	47.2	40.76-53.63	97	<0.001
Anxiety tool used					
STAI	11	57.8	45.80-69.78	97.9	<0.001
PITI	2	64.3	47.85-80.78	91.7	0.001
VAS	3	56.6	37.16-76.17	96.1	<0.001
HADS-A	3	35.3	23.77-46.90	82.6	0.003
APAI	4	64.9	55.78-74.10	83.4	<0.001
BAI	3	39.6	33.29-46.02	0%	0.964
DASS	1	87.5	82.37-92.62	-	-
Quality of studies					
High	16	54.8	44.28-65.28	97.8	<0.001
Moderate	11	57.2	48.49-65.97	94.2	<0.001
Economy level of a country					
Low Income	11	54.9	47.69-62.17	92.6	<0.001
Middle Income	16	55.7	48.60-62.93	98	<0.001
Gender					
Male	8	45.95	31.69-60.21	96.67	<0.001
Female	9	59.36	48.16-70.52	95.43	<0.001
Region					
Africa	11	55.91	48.37-63.44	99.31	<0.001
Asia	9	62.59	48.65-76.53	97.48	<0.001
South America	5	44.35	27.62-61.08	95.54	<0.001
Middle East	2	52.50	42.41-62.59	82.63	0.02

Moreover, we have conducted a leave-one-out sensitivity analysis to identify the influence of one study on the overall pooled estimate. The overall estimate of this study did not appear to be affected by the removal or addition of a single study at a time, suggesting the robustness of our pooled estimate. Thus, the pooled prevalence of preoperative anxiety ranges from 54.5% to 57.2% (**Figure 4**).

Factors associated with preoperative anxiety among patients undergoing surgery

The results extracted from studies conducted on factors associated with preoperative anxiety among patients undergoing surgery are presented in **Supplementary file 5**. Associated factors that have been adjusted in the studies included in this review were inconsistent across studies conducted in LMICs (5, 12, 14-18, 51, 52, 55, 57, 58, 62, 63, 67-70).

Of the total studies included in the review, ten studies (15, 17, 18, 55, 57, 62, 63, 67, 68, 70) reported the increased odds of preoperative anxiety symptoms among female patients when compared to male patients. Similarly, being young age (12, 16, 51, 67, 69) has significantly increased the odds of preoperative anxiety symptoms in patients waiting for scheduled surgery. Preoperative anxiety was significantly associated with fear of death, dependency, and disability (14, 16).

Further, patients who did not receive adequate preoperative information were more likely to have clinically significant preoperative anxiety levels compared to patients who did receive high-level information (5, 12, 15, 17, 52, 67). Not surprisingly, low income appeared to increase the odds of developing preoperative anxiety symptoms in patients waiting for surgery (5, 12). Likewise, having a family history of mental illness (45), history of cancer and smoking (49), lower educational attainment (68, 69) were found to be associated with preoperative anxiety symptoms in patients waiting for surgery.

Moreover, statistical adjustment for some other risk factors varied for respective studies included in this review. Factors such as getting low social support, fear of unexpected outcome of surgery (14), being non-partnered (5), urban residence, inadequate awareness of anaesthesia adverse effect (67), number of days of hospitalization (64), having a chronic medical illness (18), gastrointestinal problems (58) were found to have a significant positive correlation with preoperative anxiety after adjusting for other factors.

Discussion

This systematic review and meta-analysis synthesized the results of twenty-seven primary studies that were conducted in LMICs to determine the pooled prevalence and factors associated with preoperative anxiety among 5,575 surgical patients undergoing surgery.

The pooled prevalence of preoperative anxiety among patients undergoing surgery in LMICs was 55.7%. The pooled estimate in the current review was higher when compared to the pooled prevalence reported in a global level systematic review and meta-analysis that included 14,652 study participants (48%) (7). Likewise, the pooled estimate of our review was higher than the estimates from different epidemiological studies conducted in high-income countries such as the Netherlands reported that 27.9% and 20.3% of patients undergoing hip and knee surgery, respectively, experienced anxiety symptoms before the actual surgery (8). The variation in the demographic characteristics of participants and may partly explain the observed difference in the pooled estimates. Furthermore, risk factors such as genetic make-up of individuals, access to information regarding their surgical procedure, quality and availability of service in each health facility, sampling methods, and tools used to screen anxiety may contribute to the observed difference.

Surprisingly, the available epidemiological evidence was virtually unchanged when the origin of the primary studies included in this review considered as a moderator. For example, the pooled prevalence of preoperative anxiety was 77% in Sri Lanka, 75.6% in India and 72.8% in Rwanda. Although evidence suggests that an individual cultural background could potentially affect the experience of anxiety symptoms, the variability of the origin of primary studies appeared to play a negligible role in the pooled estimate of this study.

The subgroup analysis using the tools used to estimate the prevalence of preoperative anxiety showed a slight variation in the prevalence of preoperative anxiety among patients undergoing surgery. Most notably, the prevalence of preoperative anxiety among patients undergoing surgery was slightly higher in the studies that have used Depression Anxiety and Stress Scale (DASS) to ascertain preoperative anxiety in patients when compared to Amsterdam preoperative Anxiety and Information Scale (APAI). The discrepancy may be due to variability in the psychometric properties of those measures.

Our review found that the prevalence of preoperative anxiety was higher among female surgical patients compared to their male counterparts. Also, of the studies included in the current systematic review and meta-analysis, ten studies reported that being female increased the odds of developing preoperative anxiety among surgical patients (15, 17, 18, 55, 57, 62, 63, 67, 68, 70). This might be because of women's experience of some specific forms of mental health problems like premenstrual dysphoric disorder, postpartum

depression, and postmenopausal mental illness, which are linked with changes in ovarian hormones that may contribute to the observed difference in risk of developing preoperative anxiety among female patients (71).

Early screening and targeted intervention of preoperative anxiety among patients undergoing surgery are recommended for future action. Further studies should be conducted to examine the possible reasons for a substantially higher burden of preoperative anxiety among patients undergoing surgery. Moreover, interventional and randomized controlled trials (RCTs) are recommended for a specific group of surgical patients.

It is worth noting the following potential limitations of our review in generalizing the findings. First, there is significant heterogeneity among studies included in the current review. Second, the restriction to include studies published only in English language could introduce possible selection bias and limit the generalizability to all LMICs.

Conclusion

Our study indicated that around one in two patients undergoing surgery in low and middle-income countries suffer from preoperative anxiety, which needs due attention. Therefore, routine screening of preoperative anxiety among patients scheduled for surgery is vital. In addition, providing preoperative education on the effect of anesthesia, surgical procedure, and possible postoperative pain management options is highly warranted. Due to the significant heterogeneity across the studies, future studies should examine preoperative anxiety for a specific group of surgical patients by stratifying the possible associated factors. Moreover, since all the included studies employed a cross-sectional study design, the findings didn't show a temporal relationship between preoperative anxiety and its associated factors. Therefore, future longitudinal studies and randomized controlled trials are recommended.

Abbreviation

AOR: Adjusted Odds Ratio; APAI: Amsterdam preoperative Anxiety and Information Scale; CI: Confidence Interval; DASS: Depression Anxiety and Stress Scale ; GNI: Gross National Income; HADS: Hospital Anxiety and Depression Scale; HICs: High Income Countries; LICs: Low Income Countries; LMICs: Low and Middle Income Countries; NOS: Newcastle Ottawa Scale; NSW: New South Wales; OR: Odds Ratio; PITI: Preoperative Intrusive Thought Inventory; PRISMA:

Preferred Reporting Items for Systematic Reviews and Meta-Analyses; RCTs: Randomized Controlled Trials (RCTs); VAS: Visual Analogue Scale; WHO: World Health Organization.

Ethics approval and consent to participate

N/A

Consent for publication

N/A

Availability of data and material

All data generated or analysed during this review are included in this article.

Competing interests

The authors declare that there is no competing interest.

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Authors' contributions

The author AB performed the search, quality appraisal, data extraction, analyses, and writing the draft of the initial manuscript. NM participated in quality appraisal, and data extraction. BD contributed to the consensus, revising the draft manuscript, and approved the final manuscript.

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Reference

1. Association A. American Psychiatric Association's Diagnostic and statistical manual of mental disorders (DSM-IV). 1994.
2. Bellani ML. Psychological aspects in day-case surgery. International Journal of Surgery. 2008;6:S44-S6.
3. Bailey L. Strategies for decreasing patient anxiety in the perioperative setting. AORN journal. 2010;92(4):445-60.
4. Seda Banu Akıncı SF, Dal D AU. Preoperative anesthesic evaluation. Hacettepe Med Journal. 2003;36(91-7).
5. Nigussie S, Belachew T, Wolancho W. Predictors of preoperative anxiety among surgical patients in Jimma University specialized teaching hospital, South Western Ethiopia. BMC surgery. 2014;14(1):67.
6. McCleane G, Cooper R. The nature of pre-operative anxiety. Anaesthesia. 1990;45(2):153-5.
7. Abate SM, Chekol YA, Basu B. Global Prevalence and determinants of preoperative anxiety among surgical patients: A systematic review and Meta-analysis. International Journal of Surgery Open. 2020.
8. Duivenvoorden T, Vissers M, Verhaar J, Busschbach J, Gosens T, Bloem R, et al. Anxiety and depressive symptoms before and after total hip and knee arthroplasty: a prospective multicentre study. Osteoarthritis and Cartilage. 2013;21(12):1834-40.
9. Bansal T, Joon A. A comparative study to assess preoperative anxiety in obstetric patients undergoing elective or emergency cesarean section. Anaesthesia, Pain & Intensive Care. 2019:25-30.
10. Vadhanan P, Tripaty DK, Balakrishnan K. Pre-operative anxiety amongst patients in a tertiary care hospital in India-a prevalence study. Journal of Society of Anesthesiologists of Nepal. 2017;4(1):5-10.
11. Jafar MF, Khan FA. Frequency of preoperative anxiety in Pakistani surgical patients. Journal of the Pakistan Medical Association. 2009;59(6):359.
12. Maheshwari D, Ismail S. Preoperative anxiety in patients selecting either general or regional anesthesia for elective cesarean section. Journal of anaesthesiology, clinical pharmacology. 2015;31(2):196.

13. Zeb A, Hammad AM, Baig R, Rahman S. Pre-Operative Anxiety in Patients at Tertiary Care Hospital, Peshawar. Pakistan J Clin Trials Res. 2019;2(2):76-80.
14. Bedaso A, Ayalew M. Preoperative anxiety among adult patients undergoing elective surgery: a prospective survey at a general hospital in Ethiopia. Patient safety in surgery. 2019;13(1):18.
15. Takele G, Ayelegne D, Boru B. Preoperative Anxiety and its Associated Factors among Patients Waiting Elective Surgery in St. Luke's Catholic Hospital and Nursing College, Woliso, Oromia, Ethiopia, 2018. Emergency medicine ana critical care. 2019;4(2020):21-37.
16. Woldegerima Y, Fitwi G, Yimer H, Hailekiros A. Prevalence and factors associated with preoperative anxiety among elective surgical patients at University of Gondar Hospital. Gondar, Northwest Ethiopia, 2017. A cross-sectional study. International Journal of Surgery Open. 2018;10:21-9.
17. Mulugeta H, Ayana M, Sintayehu M, Dessie G, Zewdu T. Preoperative anxiety and associated factors among adult surgical patients in Debre Markos and Felege Hiwot referral hospitals, Northwest Ethiopia. BMC anesthesiology. 2018;18(1):155.
18. Srahbzu M, Yigizaw N, Fanta T, Assefa D, Tirfeneh E. Prevalence of depression and anxiety and associated factors among patients visiting orthopedic outpatient clinic at Tikur Anbessa specialized hospital, Addis Ababa, Ethiopia, 2017. J Psychiatry. 21: 450. J Psychiatry. 2018;21(450):2.
19. Robertson A, Khan R, Fick D, Robertson WB, Gunaratne DR, Yapa S, et al., editors. The effect of virtual reality in reducing preoperative anxiety in patients prior to arthroscopic knee surgery: a randomised controlled trial. 2017 IEEE 5th International Conference on Serious Games and Applications for Health (SeGAH); 2017: IEEE.
20. Duggan M, Dowd N, O'Mara D, Harmon D, Tormey W, Cunningham AJ. Benzodiazepine premedication may attenuate the stress response in daycase anesthesia: a pilot study. Canadian Journal of Anesthesia. 2002;49(9):932-5.
21. Sigdel S. Perioperative anxiety: A short review. Glob Anaesth Perioper Med. 2015;1(10.15761).
22. Bradt J, Dileo C, Potvin N. Music for stress and anxiety reduction in coronary heart disease patients. Cochrane Database of Systematic Reviews. 2013(12).

23. Ghimire R, Poudel P. Preoperative Anxiety and Its Determinants Among Patients Scheduled for Major Surgery: A Hospital Based Study. Journal of Anesthesiology. 2018;6(2):57-60.

24. Chow CH, Van Lieshout RJ, Schmidt LA, Dobson KG, Buckley N. Systematic review: audiovisual interventions for reducing preoperative anxiety in children undergoing elective surgery. Journal of pediatric psychology. 2016;41(2):182-203.

25. Hellstadius Y, Lagergren J, Zylstra J, Gossage J, Davies A, Hultman C, et al. Prevalence and predictors of anxiety and depression among esophageal cancer patients prior to surgery. Diseases of the Esophagus. 2016;29(8):1128-34.

26. Kuzminskaitė V, Kaklauskaitė J, Petkevičiūtė J. Incidence and features of preoperative anxiety in patients undergoing elective non-cardiac surgery. Acta medica Lituanica. 2019;26(1):93.

27. Masood Z, Haider J, Jawaid M, Alam SN. Preoperative anxiety in female patients: the issue needs to be addressed. Khyber Medical University Journal. 2009;1(2):38-41.

28. Gilmartin J, Wright K. Day surgery: patients' felt abandoned during the preoperative wait. Journal of clinical nursing. 2008;17(18):2418-25.

29. Jangland E, Gunningberg L, Carlsson M. Patients' and relatives' complaints about encounters and communication in health care: evidence for quality improvement. Patient education and counseling. 2009;75(2):199-204.

30. Weiser TG, Regenbogen SE, Thompson KD, Haynes AB, Lipsitz SR, Berry WR, et al. An estimation of the global volume of surgery: a modelling strategy based on available data. The Lancet. 2008;372(9633):139-44.

31. Limburg H, Foster A, Gilbert C, Johnson G, Kyndt M, Myatt M. Routine monitoring of visual outcome of cataract surgery. Part 2: Results from eight study centres. British Journal of Ophthalmology. 2005;89(1):50-2.

32. Guo P, East L, Arthur A. A preoperative education intervention to reduce anxiety and improve recovery among Chinese cardiac patients: a randomized controlled trial. International journal of nursing studies. 2012;49(2):129-37.

33. Sharma N, Ooi J, Figueira E, Rosenberg M, Masselos K, Papalkar D, et al. Patient perceptions of second eye clear corneal cataract surgery using assisted topical anaesthesia. Eye. 2008;22(4):547-50.

34. Fink C, Diener MK, Bruckner T, Müller G, Paulsen L, Keller M, et al. Impact of preoperative patient education on prevention of postoperative complications after major visceral surgery: study protocol for a randomized controlled trial (PEDUCAT trial). Trials. 2013;14(1):271.

35. Upton D, Hender C, Solowiej K. Mood disorders in patients with acute and chronic wounds: a health professional perspective. Journal of wound care. 2012;21(1):42-8.

36. Gouin J-P, Kiecolt-Glaser JK. The impact of psychological stress on wound healing: methods and mechanisms. Immunology and Allergy Clinics. 2011;31(1):81-93.

37. Kiecolt-Glaser JK, Page GG, Marucha PT, MacCallum RC, Glaser R. Psychological influences on surgical recovery: perspectives from psychoneuroimmunology. American Psychologist. 1998;53(11):1209.

38. Akinsulore A, Owojuyigbe AM, Faponle AF, Fatoye FO. Assessment of preoperative and postoperative anxiety among elective major surgery patients in a tertiary hospital in Nigeria. Middle East J Anaesthesiol. 2015;23(2):235-40.

39. Yilmaz M, Sezer H, Gürler H, Bekar M. Predictors of preoperative anxiety in surgical inpatients. Journal of clinical nursing. 2012;21(7-8):956-64.

40. Maranets I, Kain ZN. Preoperative anxiety and intraoperative anesthetic requirements. Anesthesia & Analgesia. 1999;87(6):1346.

41. Osborn TM, Sandler NA. The effects of preoperative anxiety on intravenous sedation. Anesthesia Progress. 2004;51(2):46.

42. Balasubramaniyan N, Rayapati DK, Puttiah RH, Tavane P, Singh SE, Rangan V, et al. Evaluation of anxiety induced cardiovascular response in known hypertensive patients undergoing exodontia-a prospective study. Journal of clinical and diagnostic research: JCDR. 2016;10(8):ZC123.

43. Kindler CH, Harms C, Amsler F, Ihde-Scholl T, Scheidegger D. The visual analog scale allows effective measurement of preoperative anxiety and detection of patients' anesthetic concerns. Anesthesia & Analgesia. 2000;90(3):706-12.

44. Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, et al. Preferred reporting items for systematic reviewand meta-analysis protocols (PRISMA-P) 2015statement. 2015;4(1).

45. Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of non randomized studies in meta-analyses. European journal of epidemiology. 2010;25(9):603–5.(9):603.

46. Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. BMJ (Clin Res Ed) 315 (7109): 629–634. 1997.

47. Ioannidis JP. Interpretation of tests of heterogeneity and bias in meta-analysis. Journal of evaluation in clinical practice. 2008;14(5):951-7.

48. Borenstein M, Hedges LV, Higgins JP, Rothstein HR. A basic introduction to fixed-effect and random-effects models for meta-analysis. Res Synth Methods. 2010;1(2):97-111.

49. Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. Statistics in medicine. 2002;21(11):1539-58.

50. JulianPTHiggins, Simon G Thompson, Jonathan J Deeks, Altman DG. Measuring inconsistency in meta-analyses. BMJ: British Medical Journal. 2003;327(7414):557.

51. Ryamukuru D. Assessment of preoperative anxiety for patients awaiting surgery at UTHK: University of Rwanda; 2017.

52. Zammit N, Menel M, Rania F. Preoperative Anxiety in the Tertiary Care Hospitals of Sousse, Tunisia: Prevalence and Predictors. SOJ Surgery. 2018;5(1):1-5.

53. Dagona SS. Prevalence of preoperative anxiety among Hausa patients undergoing elective surgery-a descriptive study. Advances in Social Sciences Research Journal. 2018;5(11).

54. Carneiro AF, Mathias LAST, Rassi Júnior A, Morais NSd, Gozzani JL, Miranda APd. Evaluation of preoperative anxiety and depression in patients undergoing invasive cardiac procedures. Revista brasileira de anestesiologia. 2009;59:431-8.

55. Gonçalves KKN, Silva JId, Gomes ET, Pinheiro LLdS, Figueiredo TR, Bezerra SMMdS. Anxiety in the preoperative period of heart surgery. Revista brasileira de enfermagem. 2016;69:397-403.

56. Alves MLM, Pimentel AJ, Guaratini ÁA, Marcolino JÁM, Gozzani JL, Mathias LAdST. Preoperative anxiety in surgeries of the breast: a comparative study between patients with suspected breast cancer and that undergoing cosmetic surgery. Revista brasileira de anestesiologia. 2007;57:147-56.

57. Caumo W, Schmidt AP, Schneider CN, Bergmann J, Iwamoto C, Bandeira D, et al. Risk factors for preoperative anxiety in adults. Acta Anaesthesiologica Scandinavica. 2001;45(3):298-307.

58. Santos LJF, GARCIA JBdS, Pacheco JS, VIEIRA ÉBdM, SANTOS AMd. Quality of life, pain, anxiety and depression in patients surgically treated with cancer of rectum. ABCD Arquivos Brasileiros de Cirurgia Digestiva (São Paulo). 2014;27:96-100.

59. Ebirim L, Tobin M. Factors responsible for pre-operative anxiety in elective surgical patients at a university teaching hospital: A pilot study. The internet journal of Anesthesiology. 2010;29(2):1-6.

60. Kanwal A, Asghar A, Ashraf A, Qadoos A. Prevalence of preoperative anxiety and its causes among surgical patients presenting in Rawalpindi medical university and allied hospitals, Rawalpindi. Journal of Rawalpindi Medical College. 2018;22(S-2):64-7.

61. Tajgna K, Krishna DPV, editors. Assessment of Preoperative Depression , Anxiety and Stress for Patients Awaiting Surgery in a Tertiary Care Hospital2018.

62. Ramesh C, Nayak BS, Pai VB, George A, George LS, Devi ES. Pre-operative anxiety in patients undergoing coronary artery bypass graft surgery–a cross-sectional study. International journal of Africa nursing sciences. 2017;7:31-6.

63. Matthias AT, Samarasekera DN. Preoperative anxiety in surgical patients-experience of a single unit. Acta Anaesthesiologica Taiwanica. 2012;50(1):3-6.

64. Ali A, Altun D, Oguz BH, Ilhan M, Demircan F, Koltka K. The effect of preoperative anxiety on postoperative analgesia and anesthesia recovery in patients undergoing laparascopic cholecystectomy. Journal of anesthesia. 2014;28(2):222-7.

65. Ayman Mohammed Ya'akba, vachkova E, NooraldinAlmasri. Prevalence of Preoperative Anxiety and its Contributing Risk Factors in Adult Patients Undergoing Elective Surgery: An-Najah National University; 2017.

66. Xu L, Pan Q, Lin R. Prevalence rate and influencing factors of preoperative anxiety and depression in gastric cancer patients in China: Preliminary study. Journal of International Medical Research. 2016;44(2):377-88.

67. Khalili N, Karvandian K, Ardebili HE, Eftekhar N, Nabavian O. Predictive factors of preoperative anxiety in the anesthesia clinic: a survey of 231 surgical candidates. Archives of Anesthesia and Critical Care. 2019.

68. Erkilic E, Kesimci E, Soykut C, Doger C, Gumus T, Kanbak O. Factors associated with preoperative anxiety levels of Turkish surgical patients: from a single center in Ankara. Patient preference and adherence. 2017;11:291.

69. Ocalan R, Akin C, Disli Z, Kilinc T, Ozlugedik S. Preoperative anxiety and postoperative pain in patients undergoing septoplasty. B-ent. 2015;11(1):19-23.

70. Fathi M, Alavi SM, Joudi M, Joudi M, Mahdikhani H, Ferasatkish R, et al. Preoperative anxiety in candidates for heart surgery. Iranian journal of psychiatry and behavioral sciences. 2014;8(2):90.

71. Albert PR. Why is depression more prevalent in women? Journal of psychiatry & neuroscience: JPN. 2015;40(4):219.

Figure Legend

Figure 1. PRISMA flow chart of the study identification process for systematic reviews and meta-analyses.

Figure 2: Forest plot showing the pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle income countries.

Figure 3: Funnel plot for testing publication bias (Random effect model, N=27).

Figure 4: Sensitivity analysis for studies included in the meta-analysis.

Supplementary file legend

Supplementary file 1. PRISMA (Preferred Reporting Items for Systematic review and Meta Analysis Protocols) 2020 checklist: Recommended items addressed in our systematic review and meta-analysis.

Supplementary file 2: Newcastle Ottawa (NOS) critical appraisal evaluation for Cross sectional studies.

Supplementary file 3: Summary of agreed level of bias and level of agreement on the methodological qualities of included studies in meta-analysis based on sampling, outcome, response rate and method of analysis.

Supplementary file 4: Newcastle Ottawa **(**NOS) critical appraisal evaluation for Cross-sectional studies.

Supplementary file 5: Factors associated with pre-operative among patients undergoing surgery.

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Prevalence and factors associated with preoperative anxiety among patients undergoing surgery in low and middle-income countries: A systematic review and meta-analysis

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Abstract

Objectives: This review aimed to determine the pooled prevalence of preoperative anxiety and its associated factors among patients undergoing surgery in low and middle-income countries (LMICs).

Methods: We searched PubMed, SCOPUS, CINAHL, Embase, and PsychINFO to identify peer-reviewed studies on the prevalence and factors associated with preoperative anxiety among patients undergoing surgery using pre-defined eligibility criteria. Studies were pooled to estimate the prevalence of preoperative anxiety using a random-effect meta-analysis model. Heterogeneity was assessed using I^2 statistics. Funnel plot asymmetry and Egger's regression tests were used to check for publication bias.

Result: Our search identified 2110 studies, of which 27 studies from 12 countries with 5,575 participants were included in the final meta-analysis. Of the total 27 studies, eleven used the State-Trait Anxiety Inventory (STAI) to screen anxiety, followed by the Amsterdam Preoperative Anxiety and Information scale (APAI), used by four studies. The pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle-income countries was 55.7% (95% CI: 48.60-62.93). Our sub-group analysis found that a higher pooled prevalence of preoperative anxiety was found among female surgical patients (59.36%, 95%CI: 48.16-70.52, I^2= 95.43, P<0.001) and studies conducted in Asia (62.59%, 95% CI: 48.65, 76.53, I^2=97.48, P<0.001).

Conclusion: Our meta-analysis indicated that around one in two patients undergoing surgery in LMICs suffer from preoperative anxiety, which needs due attention. Routine screening of preoperative anxiety symptoms among patients scheduled for surgery is vital.

Strengths and limitations

- Conducting abroad literature search, independent screening, quality appraisal, and data extraction by two investigators represent the main strength of the current review.
- The absence of significant publication bias increases the reliability of our findings.
- The significant heterogeneity among studies and the restriction applied to include studies published only in English language are the major limitations of the current review in generalizing these findings to all LMICs.

Keywords: Preoperative anxiety, surgical patients, associated factors, Prevalence, Systematic review, Meta-analysis, Low and middle-income countries

Introduction

Anxiety is defined as a subjective state of emotional uneasiness, distress, apprehension, or fearful concern associated with autonomic and somatic features and causes impaired functioning or activity (1). Anxiety can also be a normal emotional human reaction to circumstances of danger accompanied by physiological and psychological elements (1, 2). Surgery is one of the standard medical procedures that could increase anxiety irrespective of the type of surgery (2, 3). Surgery is a life-threatening procedure that causes the person to perceive himself under a direct physical restraint. Patients scheduled for surgery may experience fears and anxieties such as nervousness, fear of being unable to wake up from anesthesia, fear of postoperative pain, and fear of death (4). As a result, preoperative anxiety is becoming a significant mental health problem for many patients undergoing surgery (5, 6).

Different epidemiological studies revealed the varying magnitude of preoperative anxiety among patients undergoing surgery. For example, a global level systematic review and meta-analysis reported a 48% pooled prevalence of preoperative anxiety among patients undergoing surgery (7). A facility-based study conducted in Netherland found 27.9% and 20.3% of preoperative anxiety in patients undergoing hip and knee surgery, respectively (8). Epidemiological studies conducted in low and middle-income countries found that the prevalence of preoperative anxiety ranges from 47 to 70.3% in India (9, 10), 62 to 97% in Pakistan (11-13), and 39.8 to70% in Ethiopia (5, 14-18).

The magnitude of preoperative anxiety among patients undergoing surgery varies depending on the reasons and type of surgery, gender of the patient (12), patient interaction with medical staff, previous experience of surgical procedures, and sensitivity to stressful circumstances (19, 20). Also, factors such as fear of surgery, fear of anaesthesia, sociodemographic characteristics of the patient (age, educational status, and partner status), types of surgery, fear of postoperative pain, and fear of death were significant predictors of preoperative anxiety (16, 17, 21-25). However, the frequently mentioned major causes of preoperative anxiety were fear of the outcomes of surgery (29.3%), followed by fear of the progress after surgery (19.5%) and complications after surgery (11.4%) (26). Furthermore, evidence also indicated that in many low and middle-income countries, the potential effect of scarce resources at health facilities, weak health systems, and culture of a given community could play a paramount role in the increased rates of preoperative anxiety among surgical

patients. For example, studies demonstrated that waiting for a longer duration for surgery (27, 28), inadequate information about the procedure, disrespect by the clinician, lacking empathy (29), and receiving less inpatient care (28) could increase the risk of preoperative anxiety. Globally, the surgery rate ranges from 295 operations per 100,000 population in Ethiopia to 23,369 per 100,000 in Hungary, indicating a considerable difference in surgical service provision between low-income countries (LIC) and high-income countries (HIC) despite a growing unmet need (30). Despite the small number of surgical service in LMICs, it is compounded by the burden of managing postoperative complications such as delayed complications which mainly caused by inadequate inpatient care and low rates of follow-up service (31).

Increased preoperative anxiety levels may be a reason for patients to decline planned surgical procedures (32, 33). High levels of preoperative anxiety negatively affect the surgical operation and contribute to adverse surgical outcomes (34, 35). Literature showed that preoperative anxiety might cause slow, complicated, and painful postoperative recovery (35-37). Severe levels of anxiety before the surgical procedure have resulted in autonomic disturbances such as increased heart rate, raised blood pressure, and arrhythmias (38), and affecting the outcomes of surgical procedures (39). Before the surgical procedure, patients who developed anxiety were found to require higher doses of anesthetic medications, had a higher level of postoperative pain, increased consumption of analgesic drugs, increased morbidity, prolonged recovery, and hospital stay (40-42). Appropriate management of anxiety by clinicians may provide a better pre-operative assessment, less pharmacological premedication, smoother induction and maybe even better outcome (43).

Based on the above evidence there was a substantial difference in the reported prevalence of preoperative anxiety among patients undergoing surgery across studies. Also, there is no previously conducted systematic reviews and meta-analysis on the topic of interest, particularly in low and middle-income countries. Furthermore, identifying the significant correlates of preoperative anxiety is vital to reduce the burden or prevent the onset and subsequent consequences. Therefore, this review aimed to examine the prevalence and thematically quantify and present factors associated with preoperative anxiety among patients undergoing surgery in low and middle-income countries (LMICs) and formulate recommendations for future health care services in the area.

Methods

Search strategy

A systemic review and meta-analysis was conducted using studies that examined the prevalence and factors associated with preoperative anxiety among patients undergoing surgery in LMICs. The strategy for literature search, selection of studies, data extraction, and reporting of results for the current review was designed following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (44) (**supplementary file 1**). The protocol for the current review was registered in PROSPERO (CRD42020161934).

Five electronic databases (PubMed, SCOPUS, CINAHIL, Embase, and PsychINFO) were systematically searched to identify studies that report the prevalence of preoperative anxiety among patients undergoing surgery in LMICs. Searching in PubMed was performed using the following terms: ((Prevalence OR Magnitude OR Epidemiology OR Incidence OR Estimates OR Burden OR Associated factors OR Determinants OR Correlates OR Predictors) AND ((Preoperative Anxiety OR Anxiety OR Anxiety symptoms OR Anxiety disorder OR General Anxiety disorder) AND (Surgical patients OR patients undergoing surgery OR surgery)). Database-specific subject headings associated with the above terms were used to screen studies indexed in SCOPUS, CINAHIL, Embase, and PsychINFO databases. Besides, we observed the reference lists of published studies to identify potential other relevant articles for this review. The whole search strategy of our review is presented in **Supplementary file 2**.

Eligibility Criteria

In the current review, we have included observational studies conducted on determining the prevalence and factors associated with preoperative anxiety among patients undergoing surgery in low and middle-income countries, and written in English language. Eligible studies included for this review had to fulfil the following criteria: first, the type of study has to be observational (cross-sectional, nested case-control, cohort studies, or follow-up studies). Second, the study participants were patients (age ≥18 years) who have a schedule to undergo surgical procedures under anesthesia, regardless of their sex. Third, measurement of anxiety was done using standard diagnostic criteria or a validated screening tools. Fourth, the studies should be from a low-income or middle income country. World Bank Atlas classified countries as low-income and middle-income for those with the Gross National Income(GNI) per capita of

≤$1025 and between $1026 to 12,375, respectively (https://data.worldbank.org/indicator/NY.GNP.PCAP.CD).

Studies that reported pooled preoperative anxiety, had a poor quality score on the New Castle Ottawa Scale (NOS), duplicate studies, conference proceedings, commentaries, reports, short communications and letters to editors were excluded. Then full-text articles were independently checked for their eligibility by two investigators (AB and NM). Disagreements were resolved by discussing with a third author (BD) for the final selection of studies.

Data extraction and study quality assessment

Data were extracted using a specific form designed to extract data that authors developed. The data extraction form included the following information: name of the author, year of publication, country, study design, sample size, type of surgery, and the number of positive cases for preoperative anxiety, prevalence of preoperative anxiety and significant factors associated with preoperative anxiety. AB conducted the primary data extraction, and then NM assessed the extracted data independently. Any disagreements and discrepancies were resolved through discussion with the third author BD.

The methodological qualities of each included article were assessed by using a modified version of the Newcastle-Ottawa Scale (45). The methodological quality and eligibility of the identified articles were independently evaluated by two reviewers (AB and NM), and disagreements among reviewers were resolved through discussion with the third Author (BD). The summary of the agreed level of bias and level of agreement between independent evaluators of studies is mentioned in **Supplementary file 3**. Finally, studies with a scale of ≥ 5 out of 10 were included in the current review.

Data analysis

For the first objective, estimating the pooled prevalence of preoperative anxiety, the prevalence report extracted from all the included primary studies were meta-analyzed. For the second objective, identifying the significant factors associated with preoperative anxiety, reports of measures of associations (OR, r, β or RR) were presented using narrative synthesis. The narrative synthesis was conducted per the approaches indicated on the Conduct of Narrative Synthesis in Systematic Reviews (46). While interpreting the association between significant factors and preoperative anxiety, adjusted estimates were the first choice.

However, for studies that missed reporting adjusted estimates, crude estimates were considered.

We have examined publication bias by visual inspection of a funnel and conducting Egger's regression tests (47, 48). A p-value <0.05 was used to declare the statistical significance of publication bias. Studies were pooled to estimate pooled prevalence and 95% CI using a random-effect model (49). We have assessed heterogeneity using Cochran's Q and the I^2 statistics (50). I^2 statistics is used to quantify the percentage of the total variation in the study estimate due to heterogeneity. I^2 values of 25, 50 and 75% were considered to represent low, medium and high heterogeneity, respectively (51). Due to significant heterogeneity across studies, we conducted a subgroup analysis using moderators such as methodological quality of studies, country, gender, anxiety assessment tool, economic level of a country, and region where a country located. Also, sensitivity analysis was conducted to evaluate the presence of outlier estimates of preoperative anxiety. All the extracted data were analyzed using STATA 16.

Patient and public involvement

No patient or public involved in the current review.

Results

Identification of studies

We have identified a total of 3110 studies from 5 databases in our initial electronic searching. After removing duplicates, reviewing titles and abstracts, 211 studies were considered eligible for full-text review. After excluding 185 articles in full-text review and adding 1 article that we get through reference searching, 27 studies were included in this systematic review and meta-analysis (**Figure 1**).

Characteristics of included studies

Of the total 27 studies (5,575 population), all (100%) studies employed cross-sectional study design, and 9 (81.2%) studies published in the past five years (14-18, 38, 52-54). Also, six studies were conducted in Ethiopia (5, 14-18), five studies were from Brazil (55-59), and three studies were from each of the following countries; Nigeria (38, 54, 60), Pakistan (11, 12, 61) and India (61-63). The sample size of the included studies ranges from 30 in Nigeria (54) to 591 in Brazil (58). The prevalence of preoperative anxiety ranges from 34% in Nigeria (60) to

87.5% in India (62). Of the 27 included studies, 16 (59.2%) were from middle-income countries, whereas 11 (40.8%) were from low-income countries. State-Trait Anxiety Inventory (STAI) is the most common tool used to screen anxiety (11 studies), followed by the Amsterdam Preoperative Anxiety and Information scale (APAI) (4 studies) (**Table 1**).

Table 1: Characteristics of studies included in the current systematic review

Author	Publication Year	Country	Sample size	Study design	Type of surgery	Cases	Prevalence (%)	Anxiety Measures (Cut-off point)
Bedaso A. et al (14)	2019	Ethiopia	407	Cross-sectional	All surgery	191	47	STAI (≥ 44/80)
Takele G.et al (15)	2019	Ethiopia	237	Cross-sectional	All surgery	132	56	PITI-20 Item (≥16/60)
Woldegerima YB. et al (16)	2018	Ethiopia	178	Cross-sectional	All surgery	106	60	STAI (> 44/80)
Mulugeta H. et al (17)	2018	Ethiopia	353	Cross-sectional	All surgery	215	61	STAI (> 44/80)
Adesanmi A. et al (38)	2015	Nigeria	51	Cross-sectional	All surgery	26	51	STAI (> 44/80)
Nigussie S. et al (5)	2014	Ethiopia	239	Cross-sectional	All surgery	168	70.3	STAI (≥ 44/80)
Ebirim L., Tobin, M (60)	2010	Nigeria	125	Cross-sectional	All surgery	43	34	VAS (≥45/100)
Srahbzu M. et al (18)	2018	Ethiopia	423	Cross-sectional	Orthopaedic surgery	168	39.8	HADS-A (≥ 18)
Ryamukuru, David (52)	2017	Rwanda	151	Cross-sectional	All surgery	110	72.8	PITI-20 Item (≥15/60)
Mellouli et al (53)	2018	Tunisia	332	Cross-sectional	All surgery	224	67.5	APAI score (>10)
Dagona, Sabo Saleh (54)	2018	Nigeria	30	Cross-sectional	All surgery	16	53.3	APAI-H (NA)
Mthias AT et al (64)	2011	Srilanka	100	Cross-sectional	Elective Surgery	77	77	APAI score (≥11)
Carneiro AF et al (55)	2009	Brazil	96	Cross-sectional	Cardiac Surgery	42	43.8	HADS-A (≥9)

Ramesh C et al (63)	2017	India	140	Cross-sectional	Cardiac Surgery	118	84	STAI (≥ 40/80)
Gonçalves et al (56)	2016	Brazil	106	Cross-sectional	Cardiac Surgery	43	40.6	BAI (NA)
Maria Luiza MA et al (57)	2007	Brazil	114	Cross-sectional	Cosmetic Surgery	85	74.5	STAI (> 36/80)
Caumo W et al (58)	2001	Brazil	591	Cross-sectional	Elective Surgery	141	23.99	STAI (≥ 39/80)
Jafar MF et al (11)	2009	Pakistan	300	Cross-sectional	Elective Surgery	186	62	STAI (NA)
Maheshwari D, Ismail S (12)	2015	Pakistan	154	Cross-sectional	Elective CS	112	72.7	VAS (≥50)
Ali A et al (65)	2013	Turkey	80	Cross-sectional	Gall bladder surgery	31	38.75	BAI (>17/63)
Ayman M Y et al (66)	2017	Palestine	320	Cross-sectional	All surgery	184	57.5	APAI score (>11)
Tajgna K et al (62)	2018	India	160	Cross-sectional	All surgery	140	87.5	DASS-21 (NA)
Le Xu et al (67)	2016	China	53	Cross-sectional	Gastric Cancer surgery	11	20.75	HADS-A (≥18)
Sntos LJF et al (59)	2014	Brazil	41	Cross-sectional	Rectal Surgery	16	39	BAI (≥10/63)
Khalili et al (68)	2019	Iran	231	Cross-sectional	All Surgery	109	47.2	STAI (≥40/80)
Arshi et al (61)	2018	Pakistan	363	Cross-sectional	All surgery	228	62.8	VAS(≥45/100)
Bansal T et al (61)	2017	India	200	Cross-sectional	Emergency CS	110	55	STA (≥40/80)

Abbreviations: VAS: Visual Analogue Scale; PITI: Preoperative Intrusive Thought Inventory; STAI: State-Trait Anxiety Inventory; APAI: Amsterdam preoperative Anxiety and Information scale; BAI: Beck Anxiety Inventory; DASS-21: Depression Anxiety and Stress Scale; BAI: Beck Anxiety Inventory; CS: Caesarean section.

The methodological quality of studies

We used the modified Newcastle Ottawa Scale (NOS) (45) to evaluate the methodologic quality of the studies included in the current review. Among the 27 studies included in the present review, 16 studies were of high (NOS score ≥ 8), and 11 studies were of moderate methodologic quality (NOS score 6-7) (**Supplementary file 4**).

Meta-analysis

The pooled prevalence of preoperative anxiety among patients undergoing surgery within the LMICs included within this study was estimated to be 55.7% (95% CI: 48.60-62.93) with considerable heterogeneity between studies (I^2= 97%; P<0.001). Consequently, a random-effects meta-analysis model was employed to estimate the overall pooled prevalence (**Figure 2**).

Further, to explore the possible sources of heterogeneity we employed a random-effect univariate meta-regression model considering the sample size, publication year, and NOS quality score as moderators. However, none these continuous variables (i.e., sample size (Coefficient= -0.015, P= 0.533), publication year (Coefficient= 0.984, P= 0.202), and NOS quality score (Coefficient= -2.65, P= 0.412)) found to have significant association with heterogeneity.

Publication bias

Inspection of the funnel plot looks symmetric and shows no significant publication bias (**Figure 3**). Besides, eggers regression test suggested absence of publication bias (B= -2.79, SE= 2.013, P= 0.165).

Sub-group and sensitivity analysis

Due to the reported high heterogeneity index among studies, a subgroup analysis was conducted using characteristics like country, type of anxiety tool used, quality of studies and economic level of a country. Among studies that assessed the prevalence of preoperative anxiety among surgical patients, the subgroup analysis based on the region where the studies conducted revealed that a higher pooled prevalence of preoperative anxiety was reported in a study conducted in Asia (62.59%, 95% CI: 48.65, 76.53, I^2=97.48, P<0.001), followed by Africa (55.91%, 95% CI: 48.37, 63.44 I^2= 99.31, P<0.001) and Middle East (52.5%, 95% CI: 42.41,

62.59). Besides, a higher pooled prevalence of preoperative anxiety was reported in a study that used Depression Anxiety and Stress Scale (DASS) (87.5%, 95% CI: 82.37-92.62), followed by studies that used Amsterdam preoperative Anxiety and Information Scale (APAI) tool as an anxiety assessment tool (64.9%, 95% CI: 55.78-74.10, I^2= 83.4%, P<0.001).

To further explore the source of heterogeneity among studies included in the review, we have also conducted a subgroup analysis using the quality of studies as a moderator. The pooled prevalence of preoperative anxiety was higher in the studies with moderate methodological quality (57.2%) (95% CI: 48.49-65.97, I^2= 94.2%, P<0.001) compared to those studies with high methodological quality (54.8%) (95% CI: 44.28-65.28, I^2= 97.8, P<0.001). Furthermore, a pooled estimate of preoperative anxiety among female surgical patients (59.36%, 95%CI: 48.16-70.52, I^2= 95.43, P<0.001) was higher than their male counterparts (45.95%, 95%CI: 31.69-60.21, I^2= 96.67, P<0.001). However, a pooled estimate of preoperative anxiety in middle-income countries (55.7%) (95%CI: 48.60-62.93, I^2= 98, P<0.001) was comparable to studies conducted in low-income countries (54.9%, 95%CI: 47.69-62.17, I^2= 92.6, P<0.001) (**Table 2**).

Table 2: Subgroup analysis of the prevalence of preoperative anxiety among patients undergoing surgery by country, type of anxiety tool, quality of studies and economic level of a country.

Subgroup	Number of studies	Estimates		Heterogeneity across studies	
		Prevalence (%)	95% CI	I^2 (%)	P-value
Country					
Ethiopia	6	55.6	35.13-44.46	94.1	<0.001
Nigeria	3	44.6	31.86-58.16	69.6	0.037
Rwanda	1	72.8	65.7-79.89	-	-
Tunisia	1	67.5	62.46-72.53	-	-
Brazil	5	44.4	23.76-64.95	97.1	<0.001
Srilanka	1	77	68.75-85.25	96.6	<0.001
India	3	75.6	56.72-94.49	69	0.040
Pakistan	3	65.4	59.4-71.39	-	-
Turkey	1	38.8	28.07-49.4	-	-

Palestine	1	57.5	52.08-62.9	-	-
China	1	20.6	9.83-31.67	-	-
Iran	1	47.2	40.76-53.63	97	<0.001
Anxiety tool used					
STAI	11	57.8	45.80-69.78	97.9	<0.001
PITI	2	64.3	47.85-80.78	91.7	0.001
VAS	3	56.6	37.16-76.17	96.1	<0.001
HADS-A	3	35.3	23.77-46.90	82.6	0.003
APAI	4	64.9	55.78-74.10	83.4	<0.001
BAI	3	39.6	33.29-46.02	0%	0.964
DASS	1	87.5	82.37-92.62	-	-
Quality of studies					
High	16	54.8	44.28-65.28	97.8	<0.001
Moderate	11	57.2	48.49-65.97	94.2	<0.001
Economy level of a country					
Low Income	11	54.9	47.69-62.17	92.6	<0.001
Middle Income	16	55.7	48.60-62.93	98	<0.001
Gender					
Male	8	45.95	31.69-60.21	96.67	<0.001
Female	9	59.36	48.16-70.52	95.43	<0.001
Region					
Africa	11	55.91	48.37-63.44	99.31	<0.001
Asia	9	62.59	48.65-76.53	97.48	<0.001
South America	5	44.35	27.62-61.08	95.54	<0.001
Middle East	2	52.50	42.41-62.59	82.63	0.02

Moreover, we have conducted a leave-one-out sensitivity analysis to identify the influence of one study on the overall pooled estimate. The overall estimate of this study did not appear to be affected by the removal or addition of a single study at a time, suggesting the robustness of our pooled estimate. Thus, the pooled prevalence of preoperative anxiety ranges from 54.5% to 57.2% (**Figure 4**).

Factors associated with preoperative anxiety among patients undergoing surgery

The results extracted from studies conducted on factors associated with preoperative anxiety among patients undergoing surgery are presented in **Supplementary file 5**. Associated factors that have been adjusted in the studies included in this review were inconsistent across studies conducted in LMICs (5, 12, 14-18, 52, 53, 56, 58, 59, 63, 64, 68-71).

Of the total studies included in the review, ten studies (15, 17, 18, 56, 58, 63, 64, 68, 69, 71) reported the increased odds of preoperative anxiety symptoms among female patients when compared to male patients. Similarly, being young age (12, 16, 52, 68, 70) has significantly increased the odds of preoperative anxiety symptoms in patients waiting for scheduled surgery. Preoperative anxiety was significantly associated with fear of death, dependency, and disability (14, 16).

Further, patients who did not receive adequate preoperative information were more likely to have clinically significant preoperative anxiety levels compared to patients who did receive high-level information (5, 12, 15, 17, 53, 68). Not surprisingly, low income appeared to increase the odds of developing preoperative anxiety symptoms in patients waiting for surgery (5, 12). Likewise, having a family history of mental illness (45), history of cancer and smoking (49), lower educational attainment (69, 70) were found to be associated with preoperative anxiety symptoms in patients waiting for surgery.

Moreover, statistical adjustment for some other risk factors varied for respective studies included in this review. Factors such as getting low social support, fear of unexpected outcome of surgery (14), being non-partnered (5), urban residence, inadequate awareness of anaesthesia adverse effect (68), number of days of hospitalization (65), having a chronic medical illness (18), gastrointestinal problems (59) were found to have a significant positive correlation with preoperative anxiety after adjusting for other factors.

Discussion

This systematic review and meta-analysis synthesized the results of twenty-seven primary studies that were conducted in LMICs to determine the pooled prevalence and factors associated with preoperative anxiety among 5,575 surgical patients undergoing surgery.

The pooled prevalence of preoperative anxiety among patients undergoing surgery in LMICs was 55.7%. The pooled estimate in the current review was higher when compared to the pooled prevalence reported in a global level systematic review and meta-analysis that included 14,652 study participants (48%) (7). Likewise, the pooled estimate of our review was higher than the estimates from different epidemiological studies conducted in high-income countries such as the Netherlands reported that 27.9% and 20.3% of patients undergoing hip and knee surgery, respectively, experienced anxiety symptoms before the actual surgery (8). The variation in the demographic characteristics of participants and may partly explain the observed difference in the pooled estimates. Furthermore, risk factors such as genetic make-up of individuals, access to information regarding their surgical procedure, quality and availability of service in each health facility, sampling methods, and tools used to screen anxiety may contribute to the observed difference.

Surprisingly, the available epidemiological evidence was virtually unchanged when the origin of the primary studies included in this review considered as a moderator. For example, the pooled prevalence of preoperative anxiety was 77% in Sri Lanka, 75.6% in India and 72.8% in Rwanda. Although evidence suggests that an individual cultural background could potentially affect the experience of anxiety symptoms, the variability of the origin of primary studies appeared to play a negligible role in the pooled estimate of this study.

The subgroup analysis using the tools used to estimate the prevalence of preoperative anxiety showed a slight variation in the prevalence of preoperative anxiety among patients undergoing surgery. Most notably, the prevalence of preoperative anxiety among patients undergoing surgery was slightly higher in the studies that have used Depression Anxiety and Stress Scale (DASS) to ascertain preoperative anxiety in patients when compared to Amsterdam preoperative Anxiety and Information Scale (APAI). The discrepancy may be due to variability in the psychometric properties of those measures.

Our review found that the prevalence of preoperative anxiety was higher among female surgical patients compared to their male counterparts. Also, of the studies included in the current systematic review and meta-analysis, ten studies reported that being female increased the odds of developing preoperative anxiety among surgical patients (15, 17, 18, 56, 58, 63, 64, 68, 69, 71). This might be because of women's experience of some specific forms of mental health problems like premenstrual dysphoric disorder, postpartum

depression, and postmenopausal mental illness, which are linked with changes in ovarian hormones that may contribute to the observed difference in risk of developing preoperative anxiety among female patients (72).

Early screening and targeted intervention of preoperative anxiety among patients undergoing surgery are recommended for future action. Further studies should be conducted to examine the possible reasons for a substantially higher burden of preoperative anxiety among patients undergoing surgery. Moreover, interventional and randomized controlled trials (RCTs) are recommended for a specific group of surgical patients.

It is worth noting the following potential limitations of our review in generalizing the findings. First, there is significant heterogeneity among studies included in the current review. Second, the restriction to include studies published only in English language could introduce possible selection bias and limit the generalizability to all LMICs.

Conclusion

Our study indicated that around one in two patients undergoing surgery in low and middle-income countries suffer from preoperative anxiety, which needs due attention. Therefore, routine screening of preoperative anxiety among patients scheduled for surgery is vital. In addition, providing preoperative education on the effect of anesthesia, surgical procedure, and possible postoperative pain management options is highly warranted. Due to the significant heterogeneity across the studies, future studies should examine preoperative anxiety for a specific group of surgical patients by stratifying the possible associated factors. Moreover, since all the included studies employed a cross-sectional study design, the findings didn't show a temporal relationship between preoperative anxiety and its associated factors. Therefore, future longitudinal studies and randomized controlled trials are recommended.

Abbreviation

AOR: Adjusted Odds Ratio; APAI: Amsterdam preoperative Anxiety and Information Scale; CI: Confidence Interval; DASS: Depression Anxiety and Stress Scale ; GNI: Gross National Income; HADS: Hospital Anxiety and Depression Scale; HICs: High Income Countries; LICs: Low Income Countries; LMICs: Low and Middle Income Countries; NOS: Newcastle Ottawa Scale; NSW: New South Wales; OR: Odds Ratio; PITI: Preoperative Intrusive Thought Inventory; PRISMA:

Preferred Reporting Items for Systematic Reviews and Meta-Analyses; RCTs: Randomized Controlled Trials (RCTs); VAS: Visual Analogue Scale; WHO: World Health Organization.

Ethics approval and consent to participate

N/A

Consent for publication

N/A

Availability of data and material

All data generated or analysed during this review are included in this article.

Competing interests

The authors declare that there is no competing interest.

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Authors' contributions

The author AB performed the search, quality appraisal, data extraction, analyses, and writing the draft manuscript. NM participated in the quality appraisal and data extraction. BD contributed to the consensus, analysis, revising the draft manuscript, and approved the final manuscript.

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Reference

1. Association A. American Psychiatric Association's Diagnostic and statistical manual of mental disorders (DSM-IV). 1994.
2. Bellani ML. Psychological aspects in day-case surgery. International Journal of Surgery. 2008;6:S44-S6.
3. Bailey L. Strategies for decreasing patient anxiety in the perioperative setting. AORN journal. 2010;92(4):445-60.
4. Seda Banu Akıncı SF, Dal D AU. Preoperative anesthesic evaluation. Hacettepe Med Journal. 2003;36(91-7).
5. Nigussie S, Belachew T, Wolancho W. Predictors of preoperative anxiety among surgical patients in Jimma University specialized teaching hospital, South Western Ethiopia. BMC surgery. 2014;14(1):67.
6. McCleane G, Cooper R. The nature of pre-operative anxiety. Anaesthesia. 1990;45(2):153-5.
7. Abate SM, Chekol YA, Basu B. Global Prevalence and determinants of preoperative anxiety among surgical patients: A systematic review and Meta-analysis. International Journal of Surgery Open. 2020.
8. Duivenvoorden T, Vissers M, Verhaar J, Busschbach J, Gosens T, Bloem R, et al. Anxiety and depressive symptoms before and after total hip and knee arthroplasty: a prospective multicentre study. Osteoarthritis and Cartilage. 2013;21(12):1834-40.
9. Bansal T, Joon A. A comparative study to assess preoperative anxiety in obstetric patients undergoing elective or emergency cesarean section. Anaesthesia, Pain & Intensive Care. 2019:25-30.
10. Vadhanan P, Tripaty DK, Balakrishnan K. Pre-operative anxiety amongst patients in a tertiary care hospital in India-a prevalence study. Journal of Society of Anesthesiologists of Nepal. 2017;4(1):5-10.
11. Jafar MF, Khan FA. Frequency of preoperative anxiety in Pakistani surgical patients. Journal of the Pakistan Medical Association. 2009;59(6):359.
12. Maheshwari D, Ismail S. Preoperative anxiety in patients selecting either general or regional anesthesia for elective cesarean section. Journal of anaesthesiology, clinical pharmacology. 2015;31(2):196.

13. Zeb A, Hammad AM, Baig R, Rahman S. Pre-Operative Anxiety in Patients at Tertiary Care Hospital, Peshawar. Pakistan J Clin Trials Res. 2019;2(2):76-80.
14. Bedaso A, Ayalew M. Preoperative anxiety among adult patients undergoing elective surgery: a prospective survey at a general hospital in Ethiopia. Patient safety in surgery. 2019;13(1):18.
15. Takele G, Ayelegne D, Boru B. Preoperative Anxiety and its Associated Factors among Patients Waiting Elective Surgery in St. Luke's Catholic Hospital and Nursing College, Woliso, Oromia, Ethiopia, 2018. Emergency medicine ana critical care. 2019;4(2020):21-37.
16. Woldegerima Y, Fitwi G, Yimer H, Hailekiros A. Prevalence and factors associated with preoperative anxiety among elective surgical patients at University of Gondar Hospital. Gondar, Northwest Ethiopia, 2017. A cross-sectional study. International Journal of Surgery Open. 2018;10:21-9.
17. Mulugeta H, Ayana M, Sintayehu M, Dessie G, Zewdu T. Preoperative anxiety and associated factors among adult surgical patients in Debre Markos and Felege Hiwot referral hospitals, Northwest Ethiopia. BMC anesthesiology. 2018;18(1):155.
18. Srahbzu M, Yigizaw N, Fanta T, Assefa D, Tirfeneh E. Prevalence of depression and anxiety and associated factors among patients visiting orthopedic outpatient clinic at Tikur Anbessa specialized hospital, Addis Ababa, Ethiopia, 2017. J Psychiatry. 21: 450. J Psychiatry. 2018;21(450):2.
19. Robertson A, Khan R, Fick D, Robertson WB, Gunaratne DR, Yapa S, et al., editors. The effect of virtual reality in reducing preoperative anxiety in patients prior to arthroscopic knee surgery: a randomised controlled trial. 2017 IEEE 5th International Conference on Serious Games and Applications for Health (SeGAH); 2017: IEEE.
20. Duggan M, Dowd N, O'Mara D, Harmon D, Tormey W, Cunningham AJ. Benzodiazepine premedication may attenuate the stress response in daycase anesthesia: a pilot study. Canadian Journal of Anesthesia. 2002;49(9):932-5.
21. Sigdel S. Perioperative anxiety: A short review. Glob Anaesth Perioper Med. 2015;1(10.15761).
22. Bradt J, Dileo C, Potvin N. Music for stress and anxiety reduction in coronary heart disease patients. Cochrane Database of Systematic Reviews. 2013(12).

23. Ghimire R, Poudel P. Preoperative Anxiety and Its Determinants Among Patients Scheduled for Major Surgery: A Hospital Based Study. Journal of Anesthesiology. 2018;6(2):57-60.

24. Chow CH, Van Lieshout RJ, Schmidt LA, Dobson KG, Buckley N. Systematic review: audiovisual interventions for reducing preoperative anxiety in children undergoing elective surgery. Journal of pediatric psychology. 2016;41(2):182-203.

25. Hellstadius Y, Lagergren J, Zylstra J, Gossage J, Davies A, Hultman C, et al. Prevalence and predictors of anxiety and depression among esophageal cancer patients prior to surgery. Diseases of the Esophagus. 2016;29(8):1128-34.

26. Kuzminskaitė V, Kaklauskaitė J, Petkevičiūtė J. Incidence and features of preoperative anxiety in patients undergoing elective non-cardiac surgery. Acta medica Lituanica. 2019;26(1):93.

27. Masood Z, Haider J, Jawaid M, Alam SN. Preoperative anxiety in female patients: the issue needs to be addressed. Khyber Medical University Journal. 2009;1(2):38-41.

28. Gilmartin J, Wright K. Day surgery: patients' felt abandoned during the preoperative wait. Journal of clinical nursing. 2008;17(18):2418-25.

29. Jangland E, Gunningberg L, Carlsson M. Patients' and relatives' complaints about encounters and communication in health care: evidence for quality improvement. Patient education and counseling. 2009;75(2):199-204.

30. Weiser TG, Regenbogen SE, Thompson KD, Haynes AB, Lipsitz SR, Berry WR, et al. An estimation of the global volume of surgery: a modelling strategy based on available data. The Lancet. 2008;372(9633):139-44.

31. Limburg H, Foster A, Gilbert C, Johnson G, Kyndt M, Myatt M. Routine monitoring of visual outcome of cataract surgery. Part 2: Results from eight study centres. British Journal of Ophthalmology. 2005;89(1):50-2.

32. Guo P, East L, Arthur A. A preoperative education intervention to reduce anxiety and improve recovery among Chinese cardiac patients: a randomized controlled trial. International journal of nursing studies. 2012;49(2):129-37.

33. Sharma N, Ooi J, Figueira E, Rosenberg M, Masselos K, Papalkar D, et al. Patient perceptions of second eye clear corneal cataract surgery using assisted topical anaesthesia. Eye. 2008;22(4):547-50.

34. Fink C, Diener MK, Bruckner T, Müller G, Paulsen L, Keller M, et al. Impact of preoperative patient education on prevention of postoperative complications after major visceral surgery: study protocol for a randomized controlled trial (PEDUCAT trial). Trials. 2013;14(1):271.

35. Upton D, Hender C, Solowiej K. Mood disorders in patients with acute and chronic wounds: a health professional perspective. Journal of wound care. 2012;21(1):42-8.

36. Gouin J-P, Kiecolt-Glaser JK. The impact of psychological stress on wound healing: methods and mechanisms. Immunology and Allergy Clinics. 2011;31(1):81-93.

37. Kiecolt-Glaser JK, Page GG, Marucha PT, MacCallum RC, Glaser R. Psychological influences on surgical recovery: perspectives from psychoneuroimmunology. American Psychologist. 1998;53(11):1209.

38. Akinsulore A, Owojuyigbe AM, Faponle AF, Fatoye FO. Assessment of preoperative and postoperative anxiety among elective major surgery patients in a tertiary hospital in Nigeria. Middle East J Anaesthesiol. 2015;23(2):235-40.

39. Yilmaz M, Sezer H, Gürler H, Bekar M. Predictors of preoperative anxiety in surgical inpatients. Journal of clinical nursing. 2012;21(7-8):956-64.

40. Maranets I, Kain ZN. Preoperative anxiety and intraoperative anesthetic requirements. Anesthesia & Analgesia. 1999;87(6):1346.

41. Osborn TM, Sandler NA. The effects of preoperative anxiety on intravenous sedation. Anesthesia Progress. 2004;51(2):46.

42. Balasubramaniyan N, Rayapati DK, Puttiah RH, Tavane P, Singh SE, Rangan V, et al. Evaluation of anxiety induced cardiovascular response in known hypertensive patients undergoing exodontia-a prospective study. Journal of clinical and diagnostic research: JCDR. 2016;10(8):ZC123.

43. Kindler CH, Harms C, Amsler F, Ihde-Scholl T, Scheidegger D. The visual analog scale allows effective measurement of preoperative anxiety and detection of patients' anesthetic concerns. Anesthesia & Analgesia. 2000;90(3):706-12.

44. Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, et al. Preferred reporting items for systematic reviewand meta-analysis protocols (PRISMA-P) 2015statement. 2015;4(1).

45. Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of non randomized studies in meta-analyses. European journal of epidemiology. 2010;25(9):603–5.(9):603.

46. Popay J, Roberts H, Sowden A, Petticrew M, Arai L, Rodgers M, et al. Guidance on the conduct of narrative synthesis in systematic reviews. A product from the ESRC methods programme Version. 2006;1(1):b92.

47. Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. BMJ (Clin Res Ed) 315 (7109): 629–634. 1997.

48. Ioannidis JP. Interpretation of tests of heterogeneity and bias in meta-analysis. Journal of evaluation in clinical practice. 2008;14(5):951-7.

49. Borenstein M, Hedges LV, Higgins JP, Rothstein HR. A basic introduction to fixed-effect and random-effects models for meta-analysis. Res Synth Methods. 2010;1(2):97-111.

50. Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. Statistics in medicine. 2002;21(11):1539-58.

51. JulianPTHiggins, Simon G Thompson, Jonathan J Deeks, Altman DG. Measuring inconsistency in meta-analyses. BMJ: British Medical Journal. 2003;327(7414):557.

52. Ryamukuru D. Assessment of preoperative anxiety for patients awaiting surgery at UTHK: University of Rwanda; 2017.

53. Zammit N, Menel M, Rania F. Preoperative Anxiety in the Tertiary Care Hospitals of Sousse, Tunisia: Prevalence and Predictors. SOJ Surgery. 2018;5(1):1-5.

54. Dagona SS. Prevalence of preoperative anxiety among Hausa patients undergoing elective surgery-a descriptive study. Advances in Social Sciences Research Journal. 2018;5(11).

55. Carneiro AF, Mathias LAST, Rassi Júnior A, Morais NSd, Gozzani JL, Miranda APd. Evaluation of preoperative anxiety and depression in patients undergoing invasive cardiac procedures. Revista brasileira de anestesiologia. 2009;59:431-8.

56. Gonçalves KKN, Silva JId, Gomes ET, Pinheiro LLdS, Figueiredo TR, Bezerra SMMdS. Anxiety in the preoperative period of heart surgery. Revista brasileira de enfermagem. 2016;69:397-403.

57. Alves MLM, Pimentel AJ, Guaratini ÁA, Marcolino JÁM, Gozzani JL, Mathias LAdST. Preoperative anxiety in surgeries of the breast: a comparative study between patients

with suspected breast cancer and that undergoing cosmetic surgery. Revista brasileira de anestesiologia. 2007;57:147-56.

58. Caumo W, Schmidt AP, Schneider CN, Bergmann J, Iwamoto C, Bandeira D, et al. Risk factors for preoperative anxiety in adults. Acta Anaesthesiologica Scandinavica. 2001;45(3):298-307.

59. Santos LJF, GARCIA JBdS, Pacheco JS, VIEIRA ÉBdM, SANTOS AMd. Quality of life, pain, anxiety and depression in patients surgically treated with cancer of rectum. ABCD Arquivos Brasileiros de Cirurgia Digestiva (São Paulo). 2014;27:96-100.

60. Ebirim L, Tobin M. Factors responsible for pre-operative anxiety in elective surgical patients at a university teaching hospital: A pilot study. The internet journal of Anesthesiology. 2010;29(2):1-6.

61. Kanwal A, Asghar A, Ashraf A, Qadoos A. Prevalence of preoperative anxiety and its causes among surgical patients presenting in Rawalpindi medical university and allied hospitals, Rawalpindi. Journal of Rawalpindi Medical College. 2018;22(S-2):64-7.

62. Tajgna K, Krishna DPV, editors. Assessment of Preoperative Depression , Anxiety and Stress for Patients Awaiting Surgery in a Tertiary Care Hospital2018.

63. Ramesh C, Nayak BS, Pai VB, George A, George LS, Devi ES. Pre-operative anxiety in patients undergoing coronary artery bypass graft surgery–a cross-sectional study. International journal of Africa nursing sciences. 2017;7:31-6.

64. Matthias AT, Samarasekera DN. Preoperative anxiety in surgical patients-experience of a single unit. Acta Anaesthesiologica Taiwanica. 2012;50(1):3-6.

65. Ali A, Altun D, Oguz BH, Ilhan M, Demircan F, Koltka K. The effect of preoperative anxiety on postoperative analgesia and anesthesia recovery in patients undergoing laparascopic cholecystectomy. Journal of anesthesia. 2014;28(2):222-7.

66. Ayman Mohammed Ya'akba, vachkova E, NooraldinAlmasri. Prevalence of Preoperative Anxiety and its Contributing Risk Factors in Adult Patients Undergoing Elective Surgery: An-Najah National University; 2017.

67. Xu L, Pan Q, Lin R. Prevalence rate and influencing factors of preoperative anxiety and depression in gastric cancer patients in China: Preliminary study. Journal of International Medical Research. 2016;44(2):377-88.

68. Khalili N, Karvandian K, Ardebili HE, Eftekhar N, Nabavian O. Predictive factors of preoperative anxiety in the anesthesia clinic: a survey of 231 surgical candidates. Archives of Anesthesia and Critical Care. 2019.

69. Erkilic E, Kesimci E, Soykut C, Doger C, Gumus T, Kanbak O. Factors associated with preoperative anxiety levels of Turkish surgical patients: from a single center in Ankara. Patient preference and adherence. 2017;11:291.

70. Ocalan R, Akin C, Disli Z, Kilinc T, Ozlugedik S. Preoperative anxiety and postoperative pain in patients undergoing septoplasty. B-ent. 2015;11(1):19-23.

71. Fathi M, Alavi SM, Joudi M, Joudi M, Mahdikhani H, Ferasatkish R, et al. Preoperative anxiety in candidates for heart surgery. Iranian journal of psychiatry and behavioral sciences. 2014;8(2):90.

72. Albert PR. Why is depression more prevalent in women? Journal of psychiatry & neuroscience: JPN. 2015;40(4):219.

Figure Legend

Figure 1. PRISMA flow chart of the study identification process for systematic reviews and meta-analyses.

Figure 2: Forest plot showing the pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle income countries.

Figure 3: Funnel plot for testing publication bias (Random effect model, N=27).

Figure 4: Sensitivity analysis for studies included in the meta-analysis.

Supplementary file legend

Supplementary file 1. PRISMA (Preferred Reporting Items for Systematic review and Meta Analysis Protocols) 2020 checklist: Recommended items addressed in our systematic review and meta-analysis.

Supplementary file 2: Newcastle Ottawa (NOS) critical appraisal evaluation for Cross sectional studies.

Supplementary file 3: Summary of agreed level of bias and level of agreement on the methodological qualities of included studies in meta-analysis based on sampling, outcome, response rate and method of analysis.

Supplementary file 4: Newcastle Ottawa **(**NOS) critical appraisal evaluation for Cross-sectional studies.

Supplementary file 5: Factors associated with pre-operative anxiety among patients undergoing surgery in LMICs.

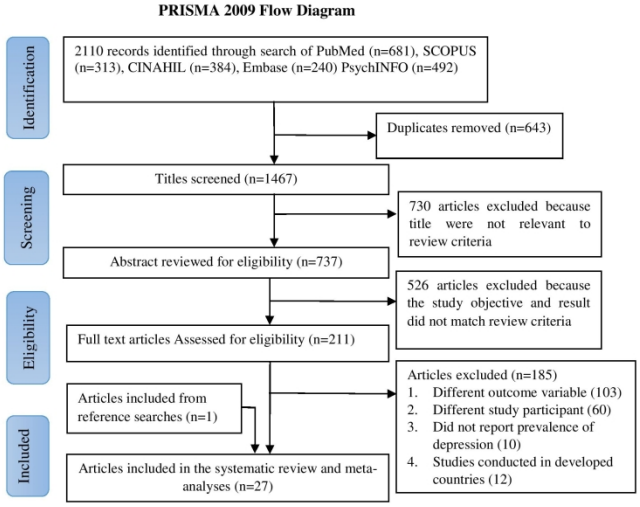

Figure 1. PRISMA flow chart of the study identification process for systematic reviews and meta-analyses

Figure 1. PRISMA flow chart of the study identification process for systematic reviews and meta-analyses

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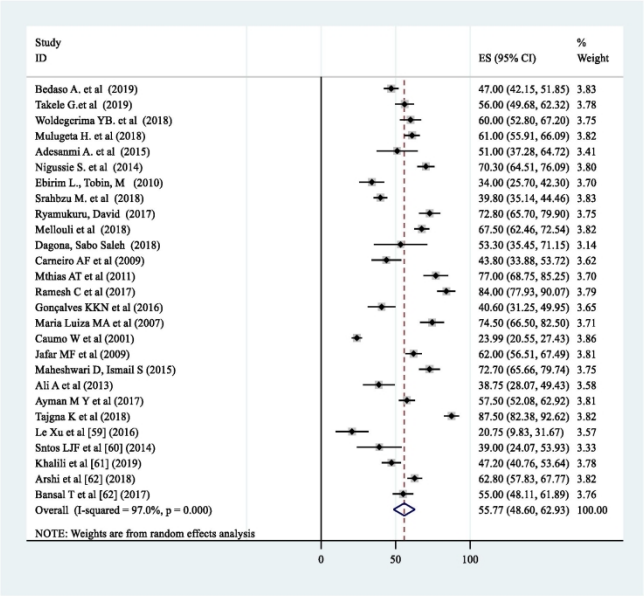

Figure 2: Forest plot showing the pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle income countries.

Figure 2: Forest plot showing the pooled prevalence of preoperative anxiety among patients undergoing surgery in low and middle-income countries.

210x297mm (300 x 300 DPI)

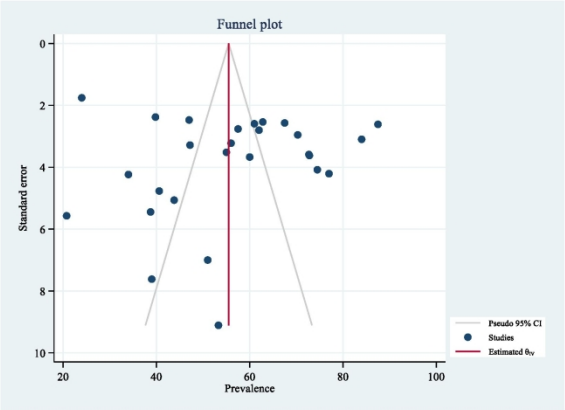

Figure 3: Funnel plot for testing publication bias (Random effect model, N=27)

Figure 3: Funnel plot for testing publication bias (Random effect model, N=27)

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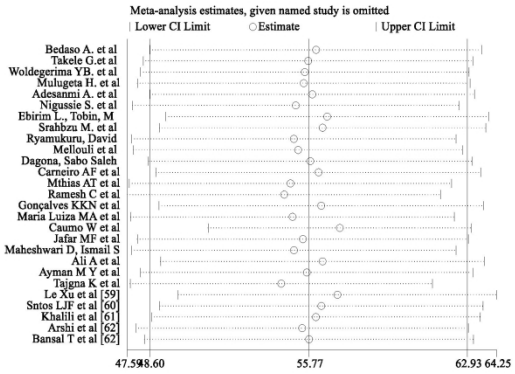

Figure 4: Sensitivity analysis for studies included in the meta-analysis

Figure 4: Sensitivity analysis for studies included in the meta-analysis

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Supplementary file 1. PRISMA (Preferred Reporting Items for Systematic review and Meta Analysis Protocols) 2020 checklist: Recommended items addressed in our systematic review and meta-analysis.

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3&4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	3&4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	CRD42020161934
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Page 4, Parag. 2
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4 Parag. 1
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Page 4 & 2
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Page 5
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	5 & 12
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	5
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	1 0, Para 1
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	10

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	5 & 6
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	5 Parag 1
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	6
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	10, Par 5
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	10
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	10, Para 1
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	10
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	10 & 11
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	11 & 12
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	12
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	12 & 13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	13
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	5 & 6
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	5 Parag 1
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	6
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	10, Par 5

Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	10
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	10, Para 1
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	10
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	10 & 11
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	11 & 12
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	12
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	12 & 13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	13

Supplementary file 2: The search strategies and search results in each database

1. PubMed search history

Search	Query	Items found
#6	#3 AND #2 AND #1: Humans; English; Adult 18+ years	681
#5	#3 AND #2 AND #1 Filters: Humans	2,915
#4	#3 AND #2 AND #1	2,385
#3	Surgical patients[Mesh] OR Patients Undergoing Surgery[Mesh] OR Surgery[Mesh] OR Surgical Patients[Title/Abstract] OR Patients Undergoing Surgery[Title/Abstract] OR Surgery[Title/Abstract]	4,000,195
#2	Preoperative Anxiety[Mesh] OR Anxiety[Mesh] OR Anxiety symptoms[Mesh] OR Anxiety disorder[Mesh] OR General Anxiety disorder[Mesh] OR Mental Health Problems[Mesh] OR Preoperative Anxiety[Title/Abstract] OR Anxiety[Title/Abstract] OR Anxiety symptoms[Title/Abstract] OR Anxiety disorder[Title/Abstract] OR General Anxiety disorder[Title/Abstract] OR Mental Health Problems[Title/Abstract]	312,808
#1	Prevalence[Mesh] OR Magnitude[Mesh] OR Epidemiology[Mesh] OR Incidence[Mesh] OR Burden[Mesh] OR Estimates [Mesh] OR Associated factors[Mesh] OR Determinants[Mesh] OR Correlates[Mesh] OR Predictors[Mesh] OR Prevalence[Title/Abstract] OR Magnitude[Title/Abstract] OR Epidemiology[Title/Abstract] OR Incidence[Title/Abstract] OR Burden[Title/Abstract] OR Estimates OR Associated factors[Title/Abstract] OR Determinants[Title/Abstract] OR Correlates[Title/Abstract] OR Predictors[Title/Abstract]	3,726,562

2. SCOPUS search history

Search	Query	Items found
#6	#5 AND (LIMIT-TO (LANGUAGE, “English"))	313
#5	#4 AND (LIMIT-TO (SUBJECT, “human"))	987
#4	#3 AND #2 AND #1	1,892
#3	"Surgical patients" OR "Patients Undergoing Surgery" OR "Surgery"	19,114
#2	"Preoperative Anxiety" OR "Anxiety" OR "Anxiety symptoms" OR "Anxiety disorder" OR "General Anxiety disorder" OR "Mental Health Problems"	21,138
#1	"Prevalence" OR "Magnitude" OR "Epidemiology" OR "Incidence" OR "Burden" OR "Estimates" OR "Associated factors" OR "Determinants" OR "Correlates" OR "Predictors"	8943

3. CINAHL search history

Search	Query	Items found
S5	Limiters: Human subject and English language	384
S4	S1 AND S2 AND S3	843
S3	(MH "Surgical patients") OR (MH "Patients Undergoing Surgery") OR "Surgery"	3,421
S2	(MH "Preoperative Anxiety") OR (MH "Anxiety") OR (MH "Anxiety symptoms") OR (MH "Anxiety disorder") OR (MH "General Anxiety disorder") OR (MH "Mental Health Problems")	9,124
S1	(MH "Prevalence") OR (MH "Magnitude") OR (MH "Epidemiology") OR (MH "Incidence") OR (MH "Burden") OR (MH "Estimates") OR (MH "Associated factors") OR (MH "Determinants") OR (MH "Correlates") OR (MH "Predictors")	7,841

4. PsychINFO search history

Search	Query	Items found
#5	Filters: Human subject and English language	492
#4	S1 AND S2 AND S3	1231
#3	(MH "Surgical patients") OR (MH "Patients Undergoing Surgery") OR "Surgery"	4,574
#2	(Preoperative Anxiety) OR (Anxiety.tw,id.) OR (Anxiety symptoms.tw,id.) OR (Anxiety disorder.tw,id.) OR (General Anxiety disorder.tw,id.) OR (Mental Health Problems.tw,id.)	9,457
#1	(Prevalence) OR (Magnitude) OR (Epidemiology) OR (Incidence) OR (Burden) OR (Estimates) OR (Associated factors) OR (Determinants) OR (Correlates) OR (Predictors)	12,531

5. Embase search history (Elsevier)

No	Query	Results
#6	#5 AND 'human'/de	240
#5	#4 AND [english]/lim	741
#4	#1 AND #2 AND #3	1109
#3	Surgical patients':ti,ab OR Patients Undergoing Surgery':ti,ab OR Surgery':ti,ab OR Surgical Patients':ti,ab OR Patients Undergoing Surgery':ti,ab OR Surgery':ti,ab	43,865
#2	'Preoperative Anxiety':ti,ab OR 'Anxiety':ti,ab OR 'Anxiety symptoms':ti,ab OR 'Anxiety disorder':ti,ab OR 'General Anxiety disorder':ti,ab OR 'Mental Health Problems':ti,ab.	21,143
#1	'Prevalence':ti,ab OR 'Magnitude': ti,ab OR 'Epidemiology':ti,ab OR 'Incidence':ti,ab OR 'Burden':ti,ab OR 'Estimates':ti,ab OR 'Associated	23,421

	factors':ti,ab OR 'Determinants':ti,ab OR 'Correlates':ti,ab OR 'Predictors':ti,ab OR 'Prevalence':ti,ab	

Supplementary file 3: Summary of the agreed level of bias and level of agreement on the methodological qualities of included studies in a meta-analysis based on sampling, outcome, response rate and method of analysis.

Study	Overall agreement and precision		
	Percentage of agreement	Kappa value	Level of agreement
Bedaso A. et al (14)	75	0.60	Moderate
Takele G.et al (15)	100	1	Almost perfect
Woldegerima YB. et al (16)	100	1	Almost perfect
Mulugeta H. et al (17)	75	0.60	Moderate
Adesanmi A. et al (36)	100	1	Almost perfect
Nigussie S. et al (5)	100	1	Almost perfect
Ebirim L., Tobin, M (57)	100	1	Almost perfect
Srahbzu M. et al (18)	100	1	Almost perfect
Ryamukuru, David (49)	75	0.50	Moderate
Mellouli et al (50)	75	0.60	Moderate
Dagona, Sabo Saleh (51)	100	1	Almost perfect
Mthias AT et al (61)	100	1	Almost perfect
Carneiro AF et al (52)	100	1	Almost perfect
Ramesh C et al (60)	75	0.60	Moderate
Gonçalves et al (53)	100	1	Almost perfect
Maria Luiza MA et al (54)	100	1	Almost perfect
Caumo W et al (55)	75	0.60	Moderate
Jafar MF et al (11)	75	0.60	Moderate
Maheshwari D, Ismail S (12)	100	1	Almost perfect
Ali A et al (62)	100	1	Almost perfect
Ayman M Y et al (63)	75	0.60	Moderate
Tajgna K et al (59)	100	1	Almost perfect
Le Xu et al (64)	100	1	Almost perfect
Sntos LJF et al (56)	100	1	Almost perfect
Khalili et al (65)	100	1	Almost perfect

Arshi et al (58)	100	1	Almost perfect
Bansal T et al (58)	75	0.60	Moderate

Supplementary file 4: Newcastle Ottawa (NOS) critical appraisal evaluation for Cross-sectional studies

S.no	Author, Year of publication	Representativeness of the sample	Sample size	Non-respondent	Ascertainment of the exposure (risk factor)	Comparability (Confounding factors are controlled)	Assessment of outcome	Statistical Analysis	Total score
1	Bedaso A. et al [43]	1	1	0	2	1	2	1	8
2	Takele G.et al [44]	1	1	0	2	1	1	1	7
3	Woldegerima YB. et al [15]	1	1	1	2	1	1	1	7
4	Mulugeta H. et al [16]	1	1	1	2	1	2	1	9
5	Adesanmi A. et al [30]	0	1	0	2	0	2	1	6
6	Nigussie S. et al [5]	1	1	0	1	1	2	1	7
7	Ebirim L., Tobin, M [49]	1	0	0	2	1	1	1	6
8	Srahbzu M. et al [45]	1	1	0	2	1	1	1	7
9	Ryamukuru, David [46]	1	1	0	1	1	1	1	6
10	Mellouli et al [47]	1	1	0	1	1	1	1	6
11	Dagona, Sabo Saleh [48]	1	1	0	1	1	1	1	6
12	Mthias AT et al [50]	1	1	0	2	1	2	1	8
13	Carneiro AF et al [51]	1	1	0	2	1	2	1	8
14	Ramesh C et al [52]	1	1	1	2	1	2	1	9
15	Gonçalves et al [53]	1	1	0	2	1	1	1	7
16	Maria Luiza MA et al [54]	1	1	0	2	1	2	1	8
17	Caumo W et al [55]	1	1	0	2	1	2	1	8
18	Jafar MF et al [22]	1	1	0	2	1	1	1	7
19	Maheshwari D, Ismail S [7]	1	1	0	2	1	2	1	8
20	Ali A et al [56]	1	1	1	2	1	2	1	9
21	Ayman M Y et al [57]	1	1	0	2	1	2	1	8
22	Tajgna K et al [58]	1	1	1	2	1	2	1	9
23	Le Xu et al [59]	1	1	1	2	1	2	1	9
24	Sntos LJF et al [60]	1	1	0	2	1	2	1	8
25	Khalili et al [61]	1	1	0	2	1	1	1	7
26	Arshi et al [62]	1	1	0	1	1	1	1	6
27	Bansal T et al [62]	1	1	0	2	1	1	1	7

NB: NOS score ≥8 (High quality), 6-7 (moderate quality), and ≤ 5 (low quality)

Supplementary file 5: Factors associated with pre-operative anxiety among patients undergoing surgery in LMICs.

Author	Key results on factors associated with preoperative anxiety
Bedaso A. et al (14)	○ Having strong social support (AOR = 0.16, 95%CI = 0.07-0.34), ○ Fear of harm from doctor or nurse mistake (AOR = 5.03, 95%CI = 2.85-8.89), ○ unexpected result of the surgery (AOR = 3.03, 95%CI = 1.73-5.19), ○ Fear of unable to recover (AOR = 2.96, 95%CI = 1.18-4.87), and ○ Need of blood transfusion (AOR = 2.76, 95%CI = 1.65-4.62)
Takele G.et al (15)	○ Being female (AOR 3.30, 95% CI 1.30, 8.34), ○ Orthopaedics surgery (AOR 4.24, 95% CI 1.23, 14.05), ○ Not having information (AOR 2.48, 95% CI 1.11, 5.56), ○ Postponement of surgery (AOR 5.53, 95% CI: 1.28, 23.91) and ○ Not listening music (AOR 3.41, 95% CI: 1.45, 7.98)
Woldegerima et al (16)	○ Fear of death (AOR = 2.40, 95% CI = 1.08, 5.32), ○ Family concern (AOR = 2.15, 95% CI = 1.03, 4.50), ○ Fear of dependency (AOR = 2.75, 95% CI = 1.57, 7.20) and ○ Fear of disability (AOR = 2.75, 95% CI = 1.22, 6.21). ○ Being at the age of 18–30 years (AOR = 6.92, 95% CI = 1.39, 33.82), ○ Age 31–45 years (AOR = 5.72, 95% CI = 1.61, 20.28), ○ No income (AOR = 3.21, 95% CI = 1.01, 10.27), ○ Low income (AOR = 3.06, 95% CI = 1.18, 7.93). ○ Rural residency (AOR = 0.38, 95% CI = 0.16, 0.89)
Mulugeta H. et al (17)	○ Being female patients (AOR 2.19, 95%CI: 1.29, 3.71) and ○ Lack preoperative information (AOR 2.03, 95%CI: 1.22, 3.39).
Nigussie S. et al (5)	○ Being single (β=5.288, 95%CI: (2.149, 8.428), P<0.001), ○ Divorced marital status (β=5.629, 95%CI (0.053, 11.205), P<0.048), ○ Income (β=0.002, 95%CI: (0.001, 0.004), P=0.001), ○ Time of operation (afternoon) (β=-2.770, 95%CI: −4.906, −0.633), P=0.011) ○ No preoperative information (β= -2.337, 95%CI: −4.65, −0.018), P=0.04).
Srahbzu M. et al (18)	○ Being female (AOR=1.9995%CI: 1.11, 3.57), ○ Having a chronic medical illness (AOR=3.0795%CI:1.36, 6.92), ○ Having a family history of mental illness (AOR=2.24, 95%CI: 1.05, 5.4.9), ○ Lower extremity injury (AOR=2.93, 95%CI: 1.38, 6.21) and ○ Having severe pain (AOR=2.75, 95%CI: 1.32, 5.74)

Ryamukuru, David (49)	○ Orthopaedic surgery (OR: 10.22; 95% CI: 1.144, 91.304; P= 0.037). ○ Old patients (OR: 0.22, 95% CI: 0.075, 0.650; P=0.006).
Mellouli et al (50)	○ High grade of surgery (AOR: 9, 95% CI: 3.4, 23.8) and ○ High level of information requirement (AOR: 1.5, 95% CI: 1.30, 1.70)
Mthias AT et al (61)	○ Those who having a previous experience of surgery reported less anxiety (p<0.05). ○ Females patients who had a previous surgery were less anxious than those who had never experienced surgery (p=0.011)
Ramesh C et al (60)	○ Female reported a high level of state anxiety (X^2 =11.57, p < 0.001)
Gonçalves et al (53)	○ Women had a significantly higher scores of preoperative anxiety than men (p=0.003). ○ There is a significantly higher difference in anxiety in the group of patients who had undergone previous heart surgery (p=0.012) and among smokers (p=0.039).
Caumo W et al (55)	○ A history of cancer (AOR=2.26; 95%CI: 1.43–3.57), ○ Being female gender (AOR: 2, 95% CI: 1.24, 3.26) and ○ A history of smoking (AOR=7.47, 95% CI: 1.47, 37.81)
Fathi M et al (68)	○ Being females (r= 0.80, P< 0.001) and ○ Older patients (r= 0.226, P<0.001) had significant correlation with anxiety.
Maheshwari et al (12)	○ Age ≤ 25 years (AOR: 3.11, 95%CI: 1.03, 9.32, P= 0.04), ○ Nulli and primiparous (AOR: 2.87, 95%CI: 1.38, 5.98, P=0.05), ○ General anaesthesia in previous surgery (AOR: 4.29, 95% CI: 1.93, 9.53) ○ No previous surgery (AOR: 14.72, 95%CI: 3.13, 69.28) and ○ Source of information from non-anaesthetist (AOR: 0.18, 95%CI: 0.07, 0.45)
Ocalan R et al (67)	○ Age (r= −0.326, P=0.011), ○ Educational level (r=0.258, P=0.046), ○ Immediate (r=0.715, P<0.001) and late (r=0.605, P<0.001) postoperative pain had significant correlation with preoperative anxiety.
Ali A et al (62)	○ A significant positive correlation was found between the days of hospitalization and preoperative score (r= 0.370, P= 0.001).
Erkilic E et al (66)	○ Being women and less educated patients undergoing surgery had significant association with preoperative anxiety (P<0.05).

Sntos LJF et al [60]	○ Gastrointestinal problems (r=0.3975, P<0.05) and ○ Sexual problem (r=0.4017, P<0.05) had a moderate correlation with anxiety
Khalili et al (65)	○ Old age (OR= 0.95, 95%CI: 0.93, 0.97), ○ Female gender (OR: 2.33, 95%CI: 1.26, 4.29), ○ Urban residence (OR: 3.73, 95%CI: 1.65, 8.44) and ○ Inadequate patients' awareness about adverse effect of anaesthesia (OR: 3.43, 95%CI: 1.53, 7.67; p< 0.05).