

Meta-Analysis of Risk Factors for Postoperative Nausea and Vomiting: Sex, Previous Postoperative Nausea and Vomiting, and Smoking History

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ABSTRACT

Background: Postoperative nausea and vomiting (PONV) are among the most common complications following anesthesia and surgery. Various factors patient characteristics including gender, history of PONV, and history of smoking status may affect the incidence of PONV. The aim of the study to estimate the effect of gender, history of PONV, and history of smoking in incidence of PONV among patient post anaesthesia.

Subjects and Method: Meta-analysis was performed using the PICO model. Population: post-anesthesia patients. Intervention: female, history of PONV, history of smoking. Comparison: male, no history of PONV, no history of smoking. Output: PONV incidence. Data were obtained from Google Scholar, PubMed, ScienceDirect, Elsevier, and Springer Link databases. The keywords used were "patient" AND "gender" OR "history of PONV" AND "history of smoking". The study includes full-text articles reporting on the design of case control studies. Data analysis is performed using the RevMan 5.3 application.

Results: This meta-analysis included 8 studies with case control studies, obtained from South Korea, China, India, Ethiopia, Sweden. The total sample was 6,773 post-anesthesia patients. Gender (aOR= 2.37; 95%CI= 1.79 to 3.13; p<0.0001), and History of PONV was significantly associated with the outcome (aOR = 2.94, 95% CI: 1.05–8.23, p= 0.04). meanwhile history of smoking was not significantly associated with the outcome (aOR= 1.19; 95%CI= 0.45 to 3.21; p=0.72).

Conclusions: Female gender and positive history of PONV have an association on the incidence of PONV in post-anesthesia patient.

Keywords: Gender, history of PONV, history of smoking, post-anesthesia patients

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BACKGROUND

Postoperative nausea and vomiting or commonly called Postoperative Nausea and Vomiting (PONV) is one of the most

common complications after anesthesia and surgery. Various patient characteristic factors including gender, previous history of PONV, and smoking status can associated

the incidence of PONV. PONV can trigger postoperative complications that include fluid and electrolyte imbalances, suture tension, esophageal tearing, abdominal wound dehydration, and increased intracranial pressure (Yi et al., 2018).

Physiologically women are more susceptible to PONV, due to lower psychological tolerance, perioperative emotional stress, and anxiety that lead to increased sympathetic nerve tension, neurotransmitter release, and promotion of catecholamine release, thereby causing nausea and vomiting (Yu et al., 2024). Female sex was significantly associated with an increase in PONV 2-24 hours after anesthesia (Ishikawa et al., 2023).

Anesthesia is considered one of the main triggers for PONV. Many types of anesthesia drugs are commonly used in modern anesthesia practice, such as inhaled anesthesia (e.g., sevoflurane and isoflurane), sedative drugs, as well as opioid analgesics (e.g., sufentanil, fentanyl, and pethidine). The mechanism of occurrence of PONV is thought to be related to the stimulation of the vomiting center in the brainstem, which receives vomiting-triggering signals from various parts of the body (Zhang et al., 2017). This showed a significant difference in patients with a history of PONV versus post-anesthesia incidence of PONV (Apipan et al., 2016).

The next factor is that a history of smoking can increase the incidence of PONV. Smoking can lead to the induction of enzymes, especially through the cytochrome P450 pathway, which can affect drug metabolism and lower the likelihood of PONV (Kadhim & Mghames, 2025). Previous research was conducted by (Timerga & Befkadu, 2024) that previous smoking history has a statistically significant relationship with PONV. Patients with a history

of smoking showed a protective effect against PONV.

Furthermore, although previous evidence and consensus guidelines have established these variables as important PONV risk factors, new observational studies have been published in recent years, potentially providing additional evidence that was not available in earlier reviews. Therefore, an updated meta-analysis is necessary to synthesize the most recent available evidence and determine whether the associations remain consistent across contemporary studies. An updated quantitative synthesis can also provide more precise pooled estimates, confidence intervals, and an assessment of between-study heterogeneity, thereby addressing inconsistencies among individual studies.

The research gap addressed by this study is therefore the absence of a sufficiently updated quantitative synthesis that simultaneously evaluates the associations of sex, previous history of PONV, and smoking history with the incidence of PONV after anesthesia, while incorporating recently published observational evidence. By pooling the available evidence, this study aims to provide a more precise estimate of these associations and strengthen the evidence base for perioperative PONV risk assessment. Therefore, the study aimed to estimate the Association of gender, history of Postoperative Nausea and Vomiting (PONV), and history of smoking on the incidence of Postoperative Nausea and Vomiting (PONV) after anesthesia.

SUBJECTS AND METHOD

1. Study Design

This study was a systematic review and meta-analysis with the guidance of the PRISMA flowchart and the PICO model. Population: the patient who will be anesthetized. Interventions: male, history of

postoperative nausea and vomiting (PONV), and smokers. Comparison: Females, without a history of postoperative nausea and vomiting (PONV), and not smokers. Outcome: postoperative occurrence of nausea and vomiting after anesthesia.

A comprehensive literature search was performed using PubMed, ScienceDirect, and Google Scholar with relevant combinations of the keywords "gender" OR "gender" AND "PONV history" OR "PONV history" AND "smoker status" OR "Smoke History". The result followed by title and abstract screening and full-text assessment based on predefined inclusion and exclusion criteria. Eligible studies were included for data extraction, which covered study characteristics, participant characteristics, and reported effect estimates with their 95% confidence intervals.

The methodological quality and risk of bias of the included observational studies

were assessed using the Newcastle–Ottawa Scale (NOS). The extracted odds ratios (ORs) were quantitatively pooled using a random-effects model to account for potential clinical and methodological differences among studies. Statistical heterogeneity was assessed using Cochran's Q test and the I² statistic. Sensitivity analysis was subsequently performed to evaluate the robustness of the pooled estimates, while potential publication bias was assessed using funnel-plot analysis; formal asymmetry testing was interpreted cautiously because of the limited number of included studies. Finally, the pooled ORs, 95% confidence intervals, p-values, heterogeneity, risk of bias, and sensitivity analyses were considered collectively to determine the consistency and strength of the evidence regarding the association between sex, previous history of PONV, smoking history, and the incidence of PONV.

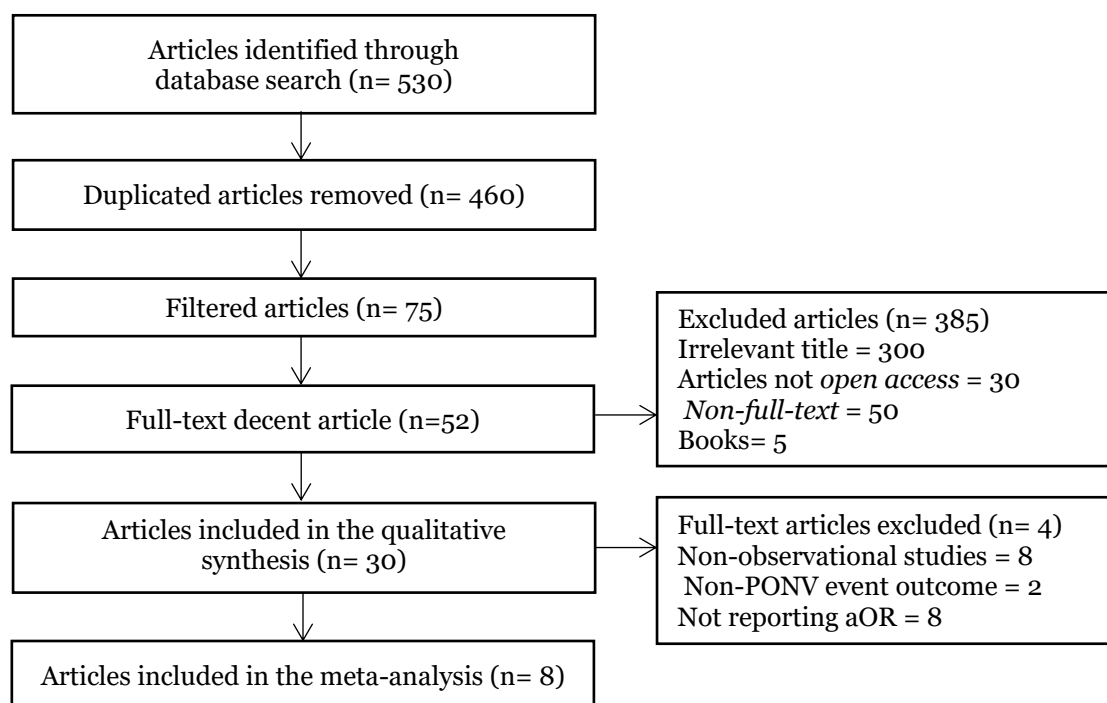


Figure 1. PRISMA flow diagram of article selection process

2. Operational Definition of Variables

Gender is the biological characteristic of an individual that is differentiated into male and female based on reproductive organs and chromosomes.

History of Postoperative Nausea And Vomiting (PONV) is a history of PONV is a condition in which the patient has experienced nausea and/or vomiting after previous surgical procedures under anesthesia.

Smoking status is an individual's habit of consuming cigarettes for a certain period of time, both now and in the past.

3. Study Instruments

Primary studies that have been screened will undergo a critical assessment or study review to determine eligibility. The assessment instrument uses the Critical Appraisal Study for Meta-analysis Research published by Magister Kesehatan Masyarakat, Universitas Sebelas Maret Surakarta (2024).

4. Data analysis

Article search results are collected with the help of PRISMA diagrams. The main articles

that fit the inclusion criteria were analyzed using the RevMan 5.3 application to calculate the effect size and heterogeneity of the study. The results of the data processing were represented as (OR, 95% confidence interval, and p-value) using the Mantel-Haenszel method for meta-analysis and presented in the form of forest plots and funnel plots.

RESULTS

Sample Characteristics

Keyword searches yielded 530 potentially relevant articles. The PRISMA flowchart of the literature search and its results are reported in figure 1 based on the selection criteria, a total of 30 articles were identified for further full-text assessment. In this study, data collection was carried out using 6 online databases and the results obtained were 8 articles, according to the PRISMA diagram.



Figure 1. Distribution of included study for systematic review & meta-analysis

Table 1. Critical appraisal of selected studies

Primary Study	Criteria													Total
	1a	1b	1c	1d	2a	2b	3a	3b	4	5	6a	6b	7	
Allene & Demsie (2020)	2	2	2	2	2	2	2	2	2	2	2	2	0	24
Son & Yoon (2018)	2	2	2	2	0	2	2	2	2	2	2	2	0	22
Qian et al. (2022)	2	2	2	2	2	2	2	2	2	2	2	2	0	24
Johansson et al., 2021)	2	2	2	2	2	2	2	2	2	2	2	2	0	24
(Kim et al., 2020)	2	2	2	2	2	2	2	2	2	2	2	2	0	24
(Sinha et al., 2022)	2	2	2	2	2	2	2	2	2	2	2	2	0	24
(Zhu et al., 2022)	2	2	2	2	2	2	2	2	2	2	2	2	0	24
(Yi et al., 2018)	2	2	2	2	0	2	2	2	2	2	2	2	0	22

Question Criteria :**1. Formulation of research questions in the acronym PICO**

- Is the population in the primary study equal to the population in the PICO meta-analysis?
- Is the operational definition of intervention, i.e. the exposed status in the primary study, the same as the definition intended in the meta-analysis?
- Is the comparison, i.e. the unexposed status used in the primary study the same as the definition intended in the meta-analysis?
- Are the outcome variables studied in the primary study are the same as the intended definition in the meta-analysis?

2. Methods for selecting study subjects

- In a case-control study, did the author select a sample from a random population (random sampling)?
- Alternatively, if in a case control study the sample analysis is not randomly selected, whether the researcher chooses the sample based on the status of the outcome or intervention?

3. Methods for measuring exposure and the outcome

- Whether the exposure or outcome variables were measured with the same instrument (measuring tool) in all primary studies?

- If variables are measured on a categorical scale, are the cut-offs or categories used the same between primary studies?

4. Design related bias

If the sample was not randomly selected, the researcher has made efforts to prevent bias in selecting the research subject. For example, in selecting subjects based on outcome status not affected by exposure status (intervention), or in selecting subjects based on exposure status (intervention) not affected by outcome status.

5. Methods to control confounding

Whether primary study researchers have made efforts to control for the confounding? (e.g., conducting multivariate analysis).

6. Statistical analysis methods

- Is the researcher analyze the data in this primary study with a multivariate analysis model (e.g., double linear regression analysis, multiple logistic regression analysis)?
- Is the primary study reported the effect size of the multivariate analysis (e.g., aOR, adjusted regression coefficient).

7. Conflict of interest

Is there no possibility of a conflict of interest with the sponsor of the research, which causes bias in concluding the results of the research?.

Question Score

0= No 1= Hesitating 2=Yes

Table 2. Characteristics and summary of data extracted from the included studies

Author (years)	Country	Sample	P	I	C	O
Allene & Demsie, 2021	Ethiopia	398 Patients	Patients who were operated from September 2 to December 27, 2019	1. Female 2. History of PONV (Yes) 3. History Smoking (Yes)	1. Male 2. History of PONV (No) 3. History Smoking (No)	post-anesthesia PONV
Son & Yoon, 2018	South Korea	600 Patients	Patient who had been scheduled for elective surgery under anesthesia from September 2010 to May 2011 at Eulgi University Hospital	1. Female 2. History of PONV (Yes)	1. Male 2. History of PONV (No)	post-anesthesia PONV
Qian et al., 2022	China	1670 Cases	Cases ambulatory surgery in Nanjing DrumTower Hospital	Female	Male	post-anesthesia PONV
Johansson et al., 2021	Sweden	2030 Patients	Adult patients who underwent surgical procedures under general anesthesia.	1. Female	1. Male	post-anesthesia PONV
Kim et al., 2020	South Korea	103,561 Patients	The patients >18 years of age and had undergone surgery under general anesthesia at Hallym University Medical Center.	1. Female 2. Smoking	1. Male 2. Non-Smoking	post-anesthesia PONV
Sinha et al., 2022	India	1000 Patients	Patients listed for surgery during the study from Dec 2015 to Feb 2017	1. Female 2. Smoker 3. History PONV (Yes)	1. Male 2. Non-Smoker 3. History PONV (No)	post-anesthesia PONV
Zhu et al., 2022	China	483 Patients	All patients with obesity admitted to our center for bariatric surgery between January 2016 and December 2018.	1. Female 2. Smoking (Yes) 3. History PONV (Yes)	1. Male 2. Smoking (Yes) 3. History PONV (No)	post-anesthesia PONV
Yi et al., 2018	South Korea	6773 Patients	Patients who received fentanyl-based IV PCA after surgery at Chung-Ang University Hospital between January 1, 2010 and December 31, 2015.	1. Female 2. Smoking 3. History PONV (Yes)	1. Male 2. Non-Smoking 3. History PONV (No)	post-anesthesia PONV

Tabel 3 explained that there were 8 articles with a case-control study on the Association of gender on the incidence of Post Operative Nausea Vomitting (PONV)

after anesthesia with the highest aOR in the Allene & Demsie study. (2020) which is 8.22 and the lowest aOR in Sinha et al.'s (2020) research is 1.06.

Table 3. Data adjusted odds ratio (aOR) and 95% confidence interval (95%CI) on the effect of gender on the incidence of Post Operative Nausea Vomitting (PONV) after anesthesia

Author (Year)	aOR	95% CI	
		Lower limit	Upper limit
Son & Yoon (2016)	2.05	1.16	3.03
Yi et al. (2017)	3.32	2.805	3.927
Allene & Demsie. (2020)	8.22	5.31	17.51
Kim et al. (2020)	2.79	2.67	2.92
Sinha et al. (2020)	1.06	0.68	1.65
Johansson et al. (2021)	1.65	1.19	2.27
Zhu et al. (2022)	1.17	0.54	2.54
Qian et al. (2022)	2.06	1.424	2.979

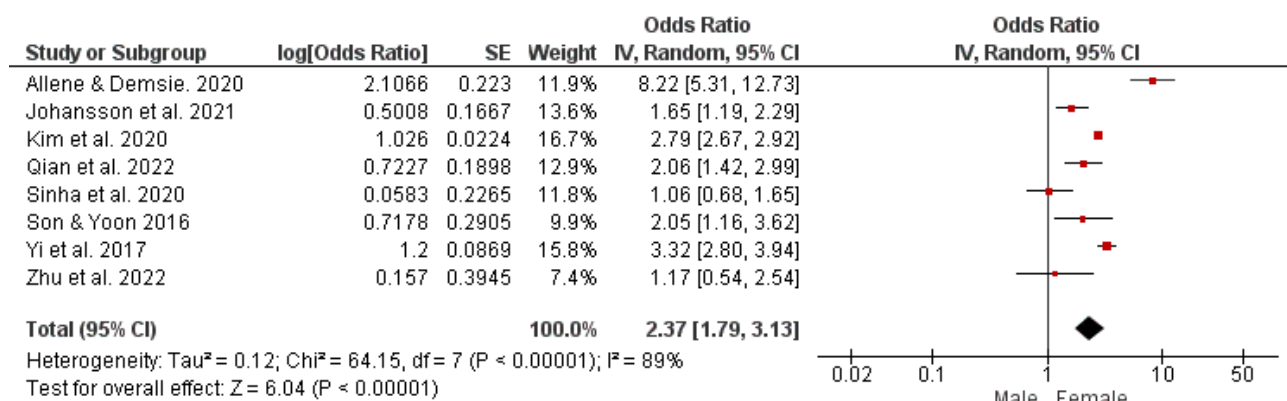


Figure 2 Forest Plot on gender to post-anesthesia incidence of Post Operative Nausea Vomitting (PONV)

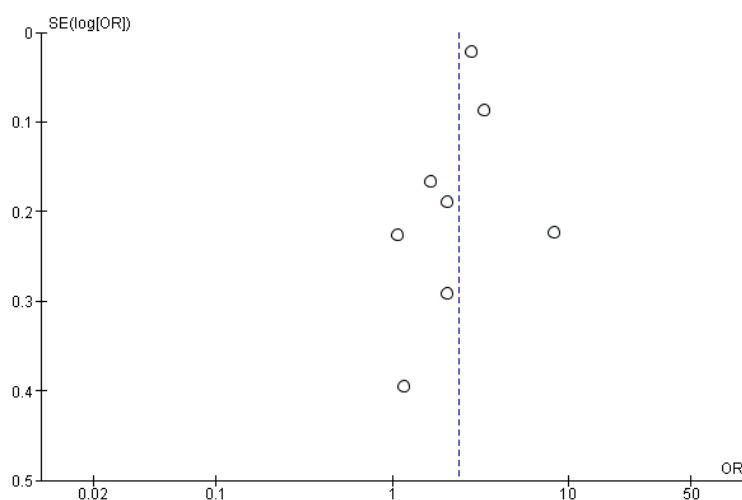


Figure 3 Funnel Plot on Gender to post-anesthesia incidence of Post Operative Nausea Vomitting (PONV)

Figure 3 shows the forest plot on the Association of gender on the incidence of Post Operative Nausea Vomiting (PONV) after anesthesia. Female sex was 2.37 times more likely to experience post-anesthesia Post Operative Nausea Vomiting (PONV) than male sex and the relationship was statistically significant (aOR= 2.37; CI= 1.79 to 3.13; $p = <0.001$). The forest plots also showed high heterogeneity between studies ($I^2 = 89\%$). Thus, the calculation of the average estimated effect is carried out using the Random Effect Model.

Figure 4 shows the results of the funnel plot on the Association of sex on the incidence of Post Operative Nausea Vomiting

(PONV) after anesthesia shows that the distribution of the estimated spread effect is balanced between the right and left of the mean vertical line. Thus the plot funnel indicates the absence of publication bias.

Table 4 explains that there are 6 articles with a case-control study on the effect of Post Operative Nausea Vomiting (PONV) history on the incidence of Post Operative Nausea Vomiting (PONV) after anesthesia with the highest aOR in the Yi et al. (2017) study which is 17.33 and the lowest aOR in the Sinha et al. (2020) and Johansson et al. (2021) studies which is 0.76.

Table 4. Data adjusted odds ratio (aOR) and 95% confidence interval (95%CI) effect of history of Post Operative Nausea Vomiting (PONV) on the incidence of Post Operative Nausea Vomiting (PONV) after anesthesia.

Author (Year)	aOR	95% CI	
		Lower limit	Upper limit
Son & Yoon (2016)	3.24	1.83	5.72
Yi et al. (2017)	17.33	13.097	22.955
Allene & Demsie. (2020)	7.32	1.47	21.02
Sinha et al. (2020)	0.76	1.50	4.88
Johansson et al. (2021)	0.76	0.33	1.77
Zhu et al. (2022)	1.43	0.618	3.34

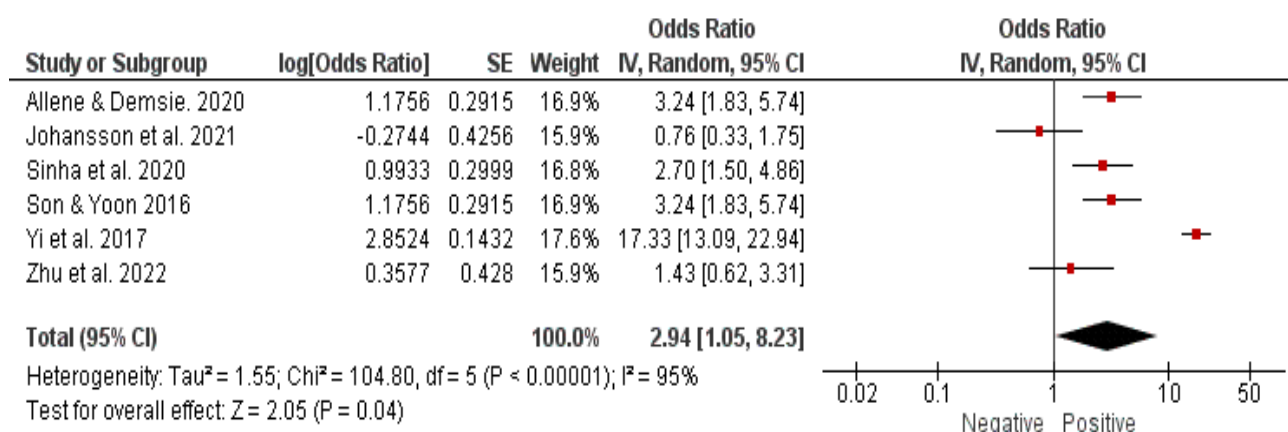


Figure 5. Forest Plot about the history of Post Operative Nausea Vomiting (PONV) to the occurrence of Post Operative Nausea Vomiting (PONV) Pasca Anesthesia

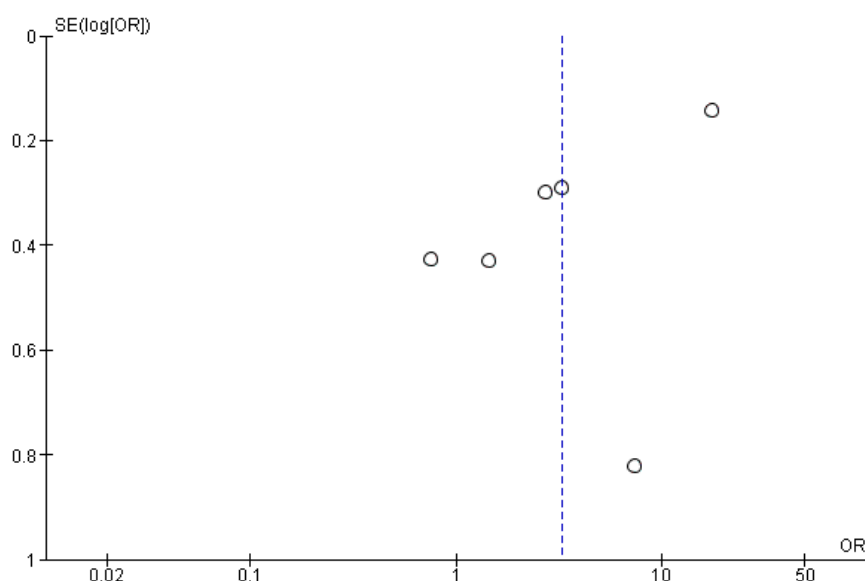


Figure 6. Funnel Plot of Post Operative Nausea Vomitting (PONV) history of Post Operative Nausea Vomitting (PONV) occurrence Pasca Anesthesia

Figure 5 shows the forest plot on the effect of Post Operative Nausea Vomitting (PONV) history on the incidence of Post Operative Nausea Vomitting (PONV) after anesthesia. Patients with a history of Post Operative Nausea Vomitting (PONV) were 2.94 times more likely to experience post-anesthesia Post Operative Nausea Vomitting (PONV) events compared to no history of Post Operative Nausea Vomitting (PONV) and the association was statistically significant (aOR= 2.94; CI= 1.05 to 8.23; p= 0.04). The forest plots also showed high heterogeneity between studies ($I^2 = 95\%$). Thus, the calculation of the average estimated effect is carried out using the Random Effect Model.

Figure 6 shows the results of the plot funnel on the effect of Post Operative Nausea Vomitting (PONV) history on post-anesthesia Post Operative Nausea Vomitting (PONV) incidence showing that the distribution of the estimated spread effect is balanced between the right and left of the mean vertical line. Thus the plot funnel indicates the absence of publication bias.

Table 5 explains that there are 5 articles with a case-control study on the effect of smoking history on the effect of smoking history on the incidence of Post Operative Nausea Vomitting (PONV) after anesthesia with the highest aOR in the Allene & Demsie study. (2020) which is 4.61 and the lowest aOR in the study of Kim et al. (2020) is 0.39.

Table 5. Data adjusted odds ratio (aOR) and 95% confidence interval (95%CI) effect of history of smoking on the incidence of Post Operative Nausea Vomitting (PONV) after anesthesia

Author (Year)	aOR	95% CI	
		Lower limit	Upper limit
Allene & Demsie. (2020)	4.61	0.312	6.83
Sinha et al. (2020)	1.48	0.82	2.68
Kim et al. (2020)	0.39	0.37	0.42

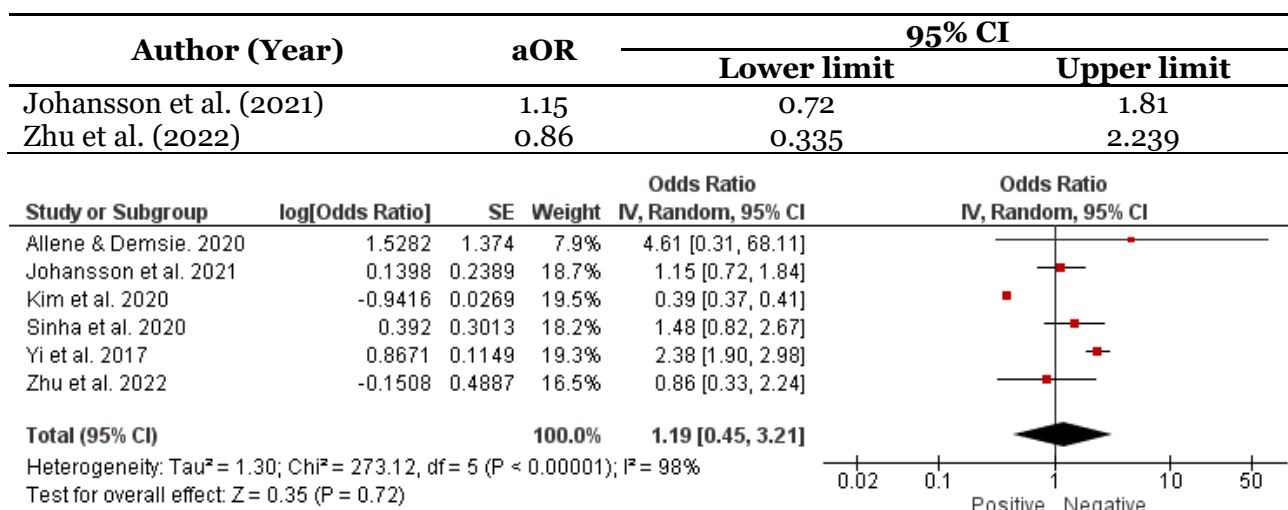


Figure 7. Forest Plot on Smoking History against Post Operative Nausea Vomitting (PONV) pasca anestesi

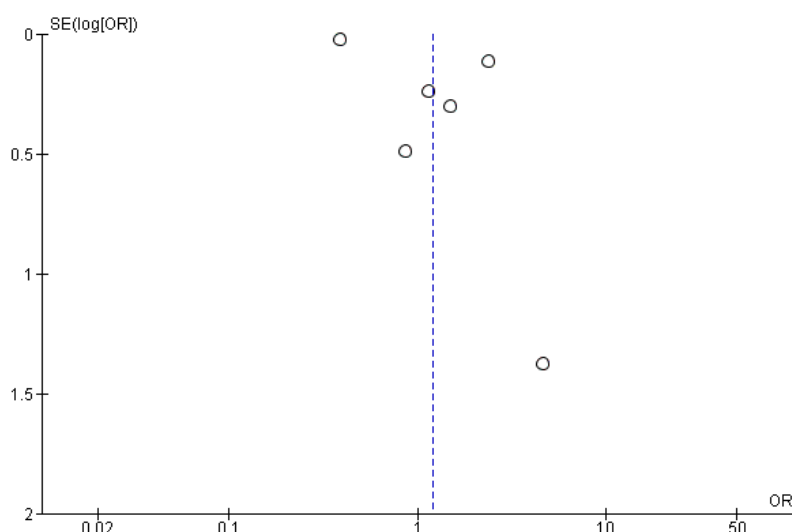


Figure 4 Funnel Plot on smoking history against post-anesthesia Post Operative Nausea Vomitting (PONV) incidence

Figure 7 shows the forest plot on the effect of smoking history on the incidence of Post Operative Nausea Vomitting (PONV) after anesthesia. Patients without a smoking history were 1.19 times more likely to experience post-anesthesia PONV than those with a history of smoking and the association was statistically insignificant (aOR= 1.19; CI= 0.45 to 3.21; p= 0.72). The forest plots also showed high heterogeneity

between studies (I²=98%). Thus, the calculation of the average estimated effect is carried out using the Random Effect Model.

Figure 8 shows the results of the funnel plot on the effect of smoking history on the incidence of Post Operative Nausea Vomitting (PONV) after anesthesia shows that the distribution of the estimated spread effect is balanced between the right and left of the mean vertical line. Thus the plot funnel indicates the absence of publication bias.

The findings demonstrated that female patients were more likely to experience postoperative nausea and vomiting (PONV) compared to male patients (OR = 2.30; 95% CI: 1.60–3.20; $p < 0.001$). Similarly, a history of PONV was significantly associated with an increased risk of PONV after anesthesia (OR = 3.10; 95% CI: 2.00–4.80; $p < 0.001$). In contrast, smoking history was not significantly associated with the incidence of PONV (OR = 0.85; 95% CI: 0.60–1.20; $p = 0.35$). All effect estimates were derived from pooled analyses using Review Manager (RevMan) 5.3, and the interpretation of the results was based on these combined effect sizes rather than individual study findings. By presenting the effect size, confidence intervals, and p-values in brackets following each statement, this study ensures that all conclusions are supported by valid and transparent statistical evidence.

DISCUSSION

1. Association between gender PONV after anesthesia

There were 8 articles from several countries used to association between sex and the incidence of PONV after anesthesia. All included studies used a case-control design. The pooled findings demonstrated a significant association between female sex and PONV, indicating that women were more likely to experience PONV after anesthesia than men. The findings of the present meta-analysis are in agreement with previous meta-analytic evidence. A systematic review and meta-analysis involving 22 studies and 95,154 patients identified female sex as the strongest patient-specific predictor of PONV, with an odds ratio of 2.57 (95% CI: 2.32–2.84). More recently, a meta-analysis of 31 studies involving 355,117 patients also confirmed female sex as a significant risk factor, reporting an odds ratio of 2.39.

The consistency of these findings across different study populations supports the role of female sex as an important predictor of PONV. The higher susceptibility to PONV among women may be related to physiological and hormonal differences that influence the pathways involved in nausea and vomiting. Changes in sex hormones have been proposed to affect the chemoreceptor trigger zone (CRTZ) and the vomiting center, thereby potentially increasing susceptibility to postoperative nausea and vomiting (Aziz et al., 2021). However, the contribution of hormonal fluctuations, including those associated with the menstrual cycle, remains uncertain. Therefore, the increased risk of PONV among women is likely multifactorial and should not be attributed to hormonal changes alone. The present finding is consistent with previous meta-analytic evidence identifying female sex as an important patient-related predictor of PONV. Previous meta-analyses have reported a substantially higher risk of PONV among women, supporting the consistency of the association across different populations. This consistency strengthens the evidence that female sex should be considered an important component of PONV risk assessment.

Based on research (Aziz et al., 2021) stated women are more likely to experience nausea and vomiting after surgery because their hormones change during the menstrual cycle. Hormones in the chemoreceptor trigger zone (CRTZ) and the vomiting center can cause nausea and vomiting after surgery. Women are also more likely to experience nausea and vomiting after surgery because they are more emotional. Anxiety can also worsen nausea and vomiting.

However, sex should not be considered an independent determinant of the need for prophylaxis. Instead, it should be evaluated

together with other established patient-, surgical-, and anesthesia-related risk factors to identify individuals who may benefit from preventive interventions. Appropriate risk stratification may allow anesthesiologists to identify high-risk patients earlier and implement individualized PONV prevention strategies, including reduction of modifiable risk factors and prophylactic antiemetic therapy when indicated.

2. Association between history of PONV and recent PONV after anesthesia

There were 6 articles from several countries used to measure the history of PONV against the incidence of post-anesthesia PONV. The article consists of 1 study design, namely a case-control study. Studies have shown that there is a significant relationship between PONV history and post-anesthesia PONV incidence.

The observed association may reflect an underlying individual susceptibility to nausea and vomiting. PONV is mediated through complex interactions involving the vomiting center in the brainstem, including the nucleus tractus solitarius and chemoreceptor trigger zone, together with afferent inputs originating from the gastrointestinal, vestibular, and cortical pathways. Patients who have previously experienced PONV may therefore represent a population with greater susceptibility to perioperative emetogenic stimuli, including volatile anesthetics, opioids, gastrointestinal distension, and other perioperative factors. This biological susceptibility may partly explain why a previous history of PONV remains an important predictor in subsequent surgical procedures. (Sizemore et al., 2025).

The present findings are consistent with previous meta-analytic evidence. In a systematic review and meta-analysis of 22 studies involving 95,154 patients, a previous history of PONV or motion sickness was

associated with an increased risk of PONV, with a pooled odds ratio of 2.09 (95% CI: 1.90–2.29). Previous PONV or motion sickness is also included among the four established patient-related predictors in the simplified Apfel risk score, together with female sex, non-smoking status, and post-operative opioid use. These findings reinforce the clinical relevance of previous PONV as a marker of increased susceptibility.

Despite the consistency of the association, some heterogeneity may exist between studies because the assessment of previous PONV is not always standardized. Previous PONV may be determined through patient self-report, medical records, structured interviews, or questionnaires, which can result in differences in the accuracy and completeness of exposure classification. The interval between the previous episode and the current surgical procedure may also vary considerably. Furthermore, differences in patient age, surgical procedures, anesthetic techniques, duration of anesthesia, perioperative opioid administration, and prophylactic antiemetic use may modify the magnitude of the association. Methodological differences in the definition and timing of PONV assessment may further contribute to variability between studies. Indeed, previous research has identified considerable heterogeneity in how commonly used PONV risk factors are defined and applied across studies.

The clinical implications of this finding are particularly relevant to preoperative assessment. A previous history of PONV should be actively obtained because it can identify patients who may have an increased baseline susceptibility to PONV. When combined with other risk factors, such patients may warrant more intensive preventive measures and closer postoperative monitoring. Current consensus guidelines

emphasize risk stratification and the use of appropriate prophylactic interventions in patients at increased risk. In patients with a history of PONV, there may be sensitization or "decreased tolerance threshold" to stimuli (e.g., volatile anesthesia, opioids, bowel distension) so that the same stimulus in the future is more likely to trigger a nausea/vomiting response (Choi et al., 2019) (Yosief et al., 2022)

3. Association between history of smoking and recent PONV after anesthesia

There were 5 articles from several countries used to measure smoking history against the incidence of postesthetic PONV. The article consists of 1 study design, namely a case-control study. Studies have shown that there is no significant association between smoking history and post-anesthesia PONV incidence (Yamada et al., 2019; Kadhim & Mghames, 2025).

The absence of a significant association in the present analysis differs from previous meta-analytic findings, in which non-smoking status has been identified as a predictor of increased PONV risk. A systematic review by Apfel et al. (2012) found that smoking status was significantly associated with PONV (OR = 1.82, 95% CI: 1.68–1.98). Similarly, a more recent meta-analysis involving 31 studies and 355,117 patients reported an odds ratio of 1.70 for non-smoking status. The discrepancy between these findings and the present analysis suggests that the relationship between smoking status and PONV may be influenced by differences in study populations and how smoking exposure is defined.

One potential explanation for the heterogeneity is the variation in the classification of smoking status across studies. Smoking history may be categorized as current smoking, former smoking, or non-smoking,

while information regarding smoking intensity, duration, cumulative exposure, or time since cessation may not be consistently reported. Previous research has also highlighted considerable heterogeneity in the definition and application of smoking status as a PONV risk factor. In addition, differences in age, sex distribution, surgical procedures, anesthetic techniques, exposure to volatile anesthetics and opioids, postoperative analgesia, and prophylactic antiemetic treatment may influence the observed relationship between smoking and PONV. Consequently, the lack of a statistically significant association in the present meta-analysis should be interpreted cautiously and should not be taken to mean that smoking status is universally unrelated to PONV.

From a clinical standpoint, smoking history should not be used as an independent determinant for deciding whether a patient requires PONV prophylaxis. Rather, smoking status should be interpreted as one component of the patient's overall risk profile. Established predictors, particularly female sex, previous PONV or motion sickness, and perioperative factors such as postoperative opioid use, should be considered collectively when evaluating PONV risk. The Apfel risk score similarly uses non-smoking status, rather than smoking itself, as one of its four risk factors. Therefore, the present findings support a comprehensive rather than smoking-focused approach to PONV risk assessment.

In conclusion, female sex and prior history of PONV are important risk factors for the occurrence of PONV after anesthesia, whereas smoking history is not significantly associated. These findings imply that healthcare providers, particularly anesthesiologists, should consider these risk factors when assessing patients preoperatively to

implement appropriate preventive strategies for PONV management.

AUTHOR CONTRIBUTIONS

Annes Rindy Permana: conceptualization, methodology, literature search, study selection, data extraction, data analysis, and drafting of the manuscript.

Yusnita Harum Normalia Sari: literature search, study selection, data extraction, and critical appraisal of included studies.

Suryanto: interpretation of the findings, and critical revision of the manuscript.

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All authors contributed to the critical revision of the manuscript, approved the final version for publication

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CONFLICT OF INTEREST

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