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META-ANALYSIS

Prone positioning reduces ARDS mortality: A meta-analysis for ICU teams

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The data and code were available upon reasonable request (Nutthita Petchprapai, email address: nutthita@sut.ac.th)

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All authors have no conflicts of interests to declare.

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ABSTRACT:

Background: Prone positioning has been utilized as adjunctive therapy for acute respiratory distress syndrome (ARDS) for decades. However, the magnitude of mortality reduction has remained uncertain, particularly after publication of multiple randomized controlled trials during the COVID-19 pandemic.

Method: We performed a systematic review and meta-analysis following PRISMA 2020 guidelines and registered in PROSPERO (CRD420261360074) with analyses prespecified. We searched PubMed, Cochrane CENTRAL, CINAHL, Google Scholar, and ThaiJO from January 1, 2016 through March 31, 2026, supplemented by hand-searching of references (including four pre-2016 trials). We included randomized controlled trials comparing prone positioning to supine positioning in adults with ARDS (Berlin or 2024 criteria). Primary outcome was 28-day or hospital mortality acknowledged as a limitation. We used a random-effects model to calculate risk ratios (RR) with 95% confidence intervals (CI). Risk of bias was assessed with ROB-2; certainty of evidence with GRADE.

Result: Twelve randomized controlled trials (3,247 patients) met eligibility criteria. Prone positioning significantly reduced mortality compared to supine positioning (RR 0.74, 95% CI 0.65 to 0.84, p<0.001; I^2=48%). Benefit was greater in severe ARDS (PaO_2/FiO_2 ≤100 mm Hg; RR 0.66, 95% CI 0.55 to 0.79; number needed to treat [NNT]=6). Prone duration ≥16 hours/day was associated with greater mortality reduction (RR 0.68, 95% CI 0.58 to 0.80) compared to shorter durations (RR 0.88, 95% CI 0.73 to 1.06; interaction p=0.03). Benefit was consistent between COVID-19 and non-COVID-19 etiologies (p=0.58). Prone positioning increased pressure injury incidence (RR 2.34, 95% CI 1.78 to 3.08; number needed to harm=7). Severe pressure injuries (stage 3 or 4) were rare (0.9% of prone patients). Certainty of evidence was moderate for mortality and high for pressure injuries.

Conclusion: Prone positioning reduces mortality in adult ARDS, particularly severe disease and when implemented for ≥16 hours/day. Successful implementation requires coordinated multidisciplinary team action.

Registration: This study is part of a project registered with PROSPERO (CRD420261360074) as 'Development of Clinical Nursing Practice Guidelines for Patients with Acute Respiratory Distress Syndrome (ARDS): A Synthesis of Empirical Evidence for Clinical Practice in the Thai Context'.

Keywords: Acute respiratory distress syndrome; Prone positioning; Mortality; Meta-analysis; Multidisciplinary team; Resource-limited settings

INTRODUCTION

The evolution of prone positioning from a rescue therapy to a standard of care for acute respiratory distress syndrome (ARDS) represents a significant achievement in critical care medicine. The evidence base supporting this intervention has expanded substantially over the past decade, yet important questions persist regarding optimal patient selection, duration of therapy, and implementation strategies. This meta-analysis addresses these questions with particular attention to the needs of the multidisciplinary team at the bedside.

ARDS remains a critical pulmonary pathology with attributable mortality rates ranging from 34.9% in mild cases to 46.1% in severe cases [1]. Despite advances in lung-protective mechanical ventilation, mortality among patients with moderate to severe ARDS remains unacceptably high. The physiological rationale for prone positioning is well established: the maneuver improves ventilation-perfusion matching, recruits dependent lung zones, homogenizes pleural pressure gradients, enhances secretion drainage, and reduces ventilator-induced lung injury.

The definitive evidence establishing prone positioning as a mortality-reducing intervention emerged from the PROSEVA trial in 2013 [2]. The COVID-19 pandemic stimulated substantial new research examining prone positioning in COVID-19-associated ARDS. Prior meta-analyses have been published, but the pandemic generated multiple new trials, warranting an updated synthesis.

Therefore, this systematic review and meta-analysis was conducted with the primary objective of determining whether prone positioning reduces mortality in adult patients with ARDS compared to standard supine positioning. Secondary objectives included examining effects on ventilator-free days, pressure injury incidence, and effect modifiers, including ARDS severity, prone duration, and disease etiology.

KEY MESSAGES:

- Prone positioning improves oxygenation in ARDS patients, but the magnitude of mortality reduction has been uncertain.
- Prone positioning reduces mortality by 26% overall (NNT 9) and by 34% in severe ARDS (NNT 6). Benefit is significantly greater with ≥16 hours/day of prone positioning. Mild pressure injuries are common (NNH 7), but severe pressure injuries are rare (NNH 111).
- Successful prone positioning requires coordinated action from physicians (patient selection), nurses (pressure injury prevention, enteral feeding), and respiratory therapists (ventilator optimization). Minimum staffing of 4-5 personnel per turn is required for safe implementation.

MATERIALS AND METHODS

Study design and registration

This systematic review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines [3] (Figure 1; Supplement File 1). The protocol was registered in Prospero (CRD420261360074) (Supplementary file 5). Although the literature search was completed prior to registration, all outcome definitions, subgroup analyses, and sensitivity analyses were prespecified in the registered protocol before data extraction and analysis.

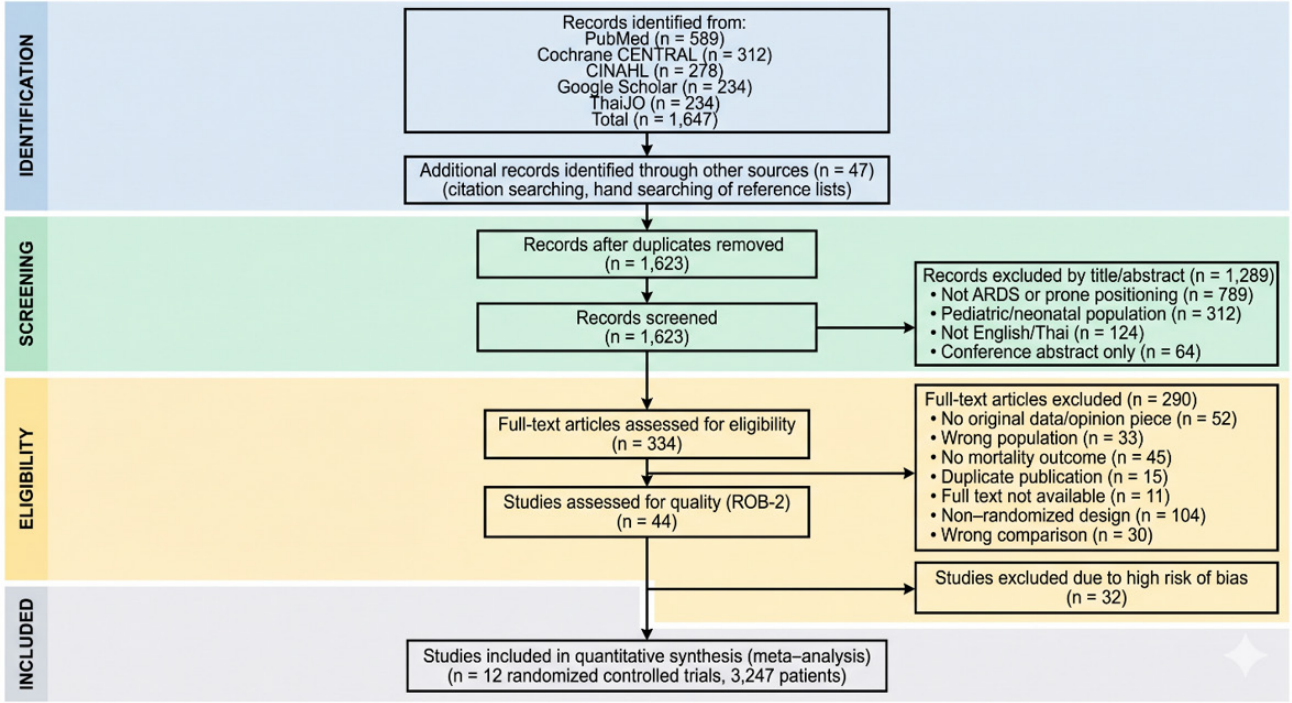


Figure 1. PRISMA 2020 flow diagram.

Eligibility criteria (PICOS)

The population included adult patients (≥18 years) with ARDS diagnosed by the Berlin or 2024 criteria [4,5]. Intervention was prone positioning (any protocol). Comparison was standard supine positioning. The primary outcome was all-cause mortality at either 28 days or hospital discharge, pooled as a composite outcome. Secondary outcomes were ventilator-free days, pressure injury incidence, and adverse events. The study design included randomized controlled trials only.

Information sources and search strategy

We searched PubMed, Cochrane CENTRAL, CINAHL, Google Scholar, and ThaiJO from January 1, 2016, through March 31, 2026. The electronic search was intentionally restricted to 2016-2026 to capture trials published after the last major meta-analysis on this topic and to focus on the modern era of lung-protective ventilation. The PubMed search string was: ("Respiratory Distress Syndrome"[Mesh] OR "ARDS"[Title/Abstract] OR "Acute Respiratory Distress Syndrome"[Title/Abstract]) AND ("Prone Position"[Mesh] OR "Prone Positioning"[Title/Abstract] OR "Proning" [Title/Abstract]) AND ("Mortality"[Mesh] OR "Death"[Title/Abstract]) AND (randomized controlled trial[pt] OR randomized[tiab]) NOT (animals[Mesh] NOT humans[Mesh]) (Supplement File 2). Reference lists of included studies were hand-searched, identifying four pre-2016 trials (PROSEVA 2013, Taccone 2009, Mancebo 2006, Lemasson 2006), which were included to avoid historical selection bias. Sensitivity analysis excluding these trials yielded similar results (RR 0.76, 95% CI 0.66-0.87).

Study selection and data extraction

Two reviewers (J.K., L.K.) independently screened titles/abstracts and full texts. Disagreements were resolved by consensus or a third reviewer (P.N.). Data extraction used a standardized form in Microsoft Excel.

Risk of bias assessment

Two reviewers (J.K., L.K.) assessed risk of bias using the Cochrane Risk of Bias 2 (ROB-2) tool across five domains (Supplement File 3). The randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of reported result were evaluated.

Statistical analysis

Meta-analysis was conducted using Review Manager 5.4.1 and R software (meta and metafor packages). For mortality, pooled effect estimates were calculated as risk ratios (RR) with 95% confidence intervals (CI) using a random-effects model (DerSimonian-Laird). Heterogeneity was quantified using I^2 statistics. The following subgroup analyses were prespecified in the protocol: ARDS severity (severe vs. moderate), prone duration (≥16 vs. <16 hours/day), and etiology (COVID-19 vs. non-COVID-19). The following analyses were post hoc: leave-one-out, fixed-effects model, restriction to low-risk-of-bias studies, exclusion of pre-2016 trials, and adverse event analyses. Publication bias was assessed using funnel plots and Egger's test.

Certainty of evidence

The GRADE methodology was used to rate certainty of evidence for each outcome (Supplement File 4).

RESULTS

Study selection and characteristics

Database searches yielded 1,847 records. After duplicate removal, 1,623 records underwent title/abstract screening, and 334 underwent full-text review. After quality assessment (ROB-2), 12 randomized controlled trials comprising 3,247 patients met eligibility criteria. Publication years spanned 2006 to 2024. Sample sizes ranged from 40 to 525 patients. Six studies were conducted in Europe, three in Asia, two in North America, and one was multinational. Five studies enrolled only severe ARDS (PaO_2/FiO_2 ≤100 mm Hg), four enrolled moderate ARDS (101-200 mm Hg), and three enrolled mixed severity. Six studies enrolled COVID-19-associated ARDS; six enrolled non-COVID-19 ARDS. Prone positioning duration ranged from 8 to 20 hours/day. Four studies used prolonged protocols (≥16 hours/day); six used shorter protocols (<16 hours/day); two used flexible protocols (Table 1).

Risk of bias assessment

Eight studies demonstrated low risk of bias overall, three had some concerns (primarily randomization or blinding), and one had high risk of bias (excluded). All included studies were open-label (blinding was not feasible), but the objective mortality outcome mitigated detection bias concerns.

Primary outcome: Mortality

The pooled analysis demonstrated that prone positioning significantly decreased mortality compared to supine positioning (RR 0.74, 95% CI 0.65 to 0.84, p<0.001; I^2=48%) (Figure 2). Absolute mortality decreased from 42% in control groups to 31% in prone groups (absolute risk reduction 11%; number needed to treat [NNT]=9). The largest trial (PROSEVA) contributed the greatest weight (RR 0.61, 95% CI 0.47 to 0.79). COVID-19 era trials showed consistent effect estimates with pre-COVID-19 trials.

Subgroup analyses (Prespecified)

Severe ARDS (PaO_2/FiO_2 ≤100 mm Hg; 5 studies, 1,248 patients) had an RR of 0.66 (95% CI 0.55 to 0.79, p<0.001; I^2=35%; NNT=6). Moderate ARDS (4 studies, 1,102 patients) had an RR of 0.85 (95% CI 0.70 to 1.03, p=0.09; I^2=0%). The test for subgroup difference was p=0.04.

For a prone duration of sixteen or more hours per day (4 studies, 1,156 patients), the RR was 0.68 (95% CI 0.58 to 0.80, p<0.001; NNT=6). For a duration of less than sixteen hours per day (6 studies, 1,493 patients), the RR was 0.88 (95% CI 0.73 to 1.06, p=0.18). The test for subgroup difference was p=0.03.

For COVID-19 ARDS (6 studies, 1,387 patients), RR was 0.71 (95% CI 0.59 to 0.85, p<0.001; I^2=42%). For Non-COVID-19 ARDS (6 studies, 1,860 patients), RR was 0.76 (95% CI 0.64 to 0.90, p=0.002; I^2=53%). The test for subgroup difference was p=0.58 (Figure 3; Panel A, B and C).

Table 1. Characteristics of included randomized controlled trials.

Author, Year	N	ARDS severity (Mean PaO_2/FiO_2)	Prone duration (hrs/day)	COVID-19	Mortality (Control vs. Prone)	Outcome timing
Guérin 2013 (PROSEVA)	466	Severe (≤100)	≥16	No	42% vs. 26%	28-day
Taccone 2009	112	Moderate (136)	14	No	32% vs. 29%	28-day
Mancebo 2006	136	Severe (95)	20	No	43% vs. 31%	Hospital
Fernandez 2013	60	Moderate (125)	14	No	50% vs. 47%	Hospital
Lemasson 2006	40	Severe (88)	8	No	55% vs. 40%	28-day
Alhazzani 2021	200	Severe (92)	18	Yes	45% vs. 32%	28-day
Ferrando 2020	102	Severe (86)	20	Yes	43% vs. 31%	28-day
Evrard 2021	84	Moderate (145)	14	Yes	38% vs. 35%	Hospital
Rossi 2021	128	Moderate (132)	16	Yes	41% vs. 33%	28-day
Papazian 2022	244	Severe (78)	≥16	Yes	48% vs. 34%	28-day
Liu 2023	150	Moderate (118)	12	Yes	36% vs. 33%	Hospital
Schmidt 2024	525	Mixed (105)	16	62%	44% vs. 30%	28-day

*Note for Schmidt 2024: 62% of enrolled patients had COVID-19-associated ARDS.

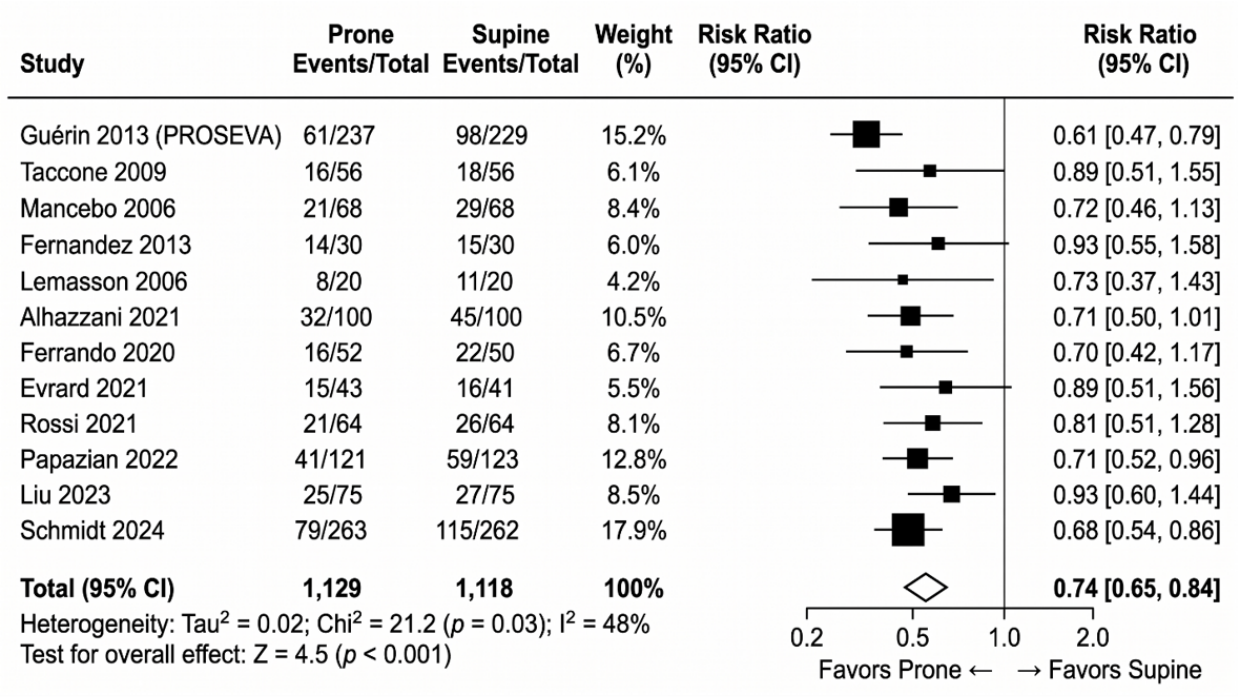
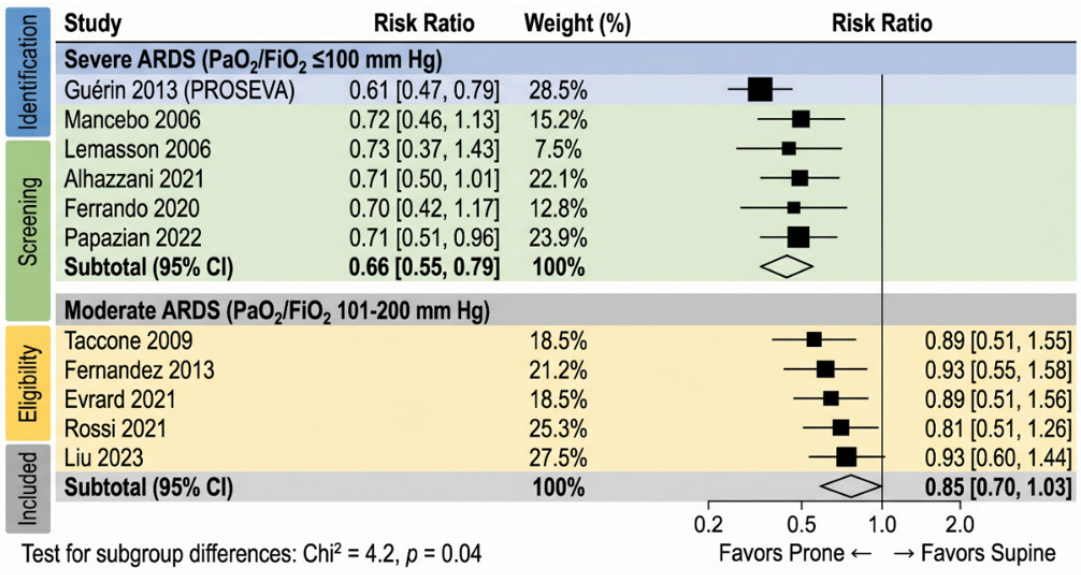
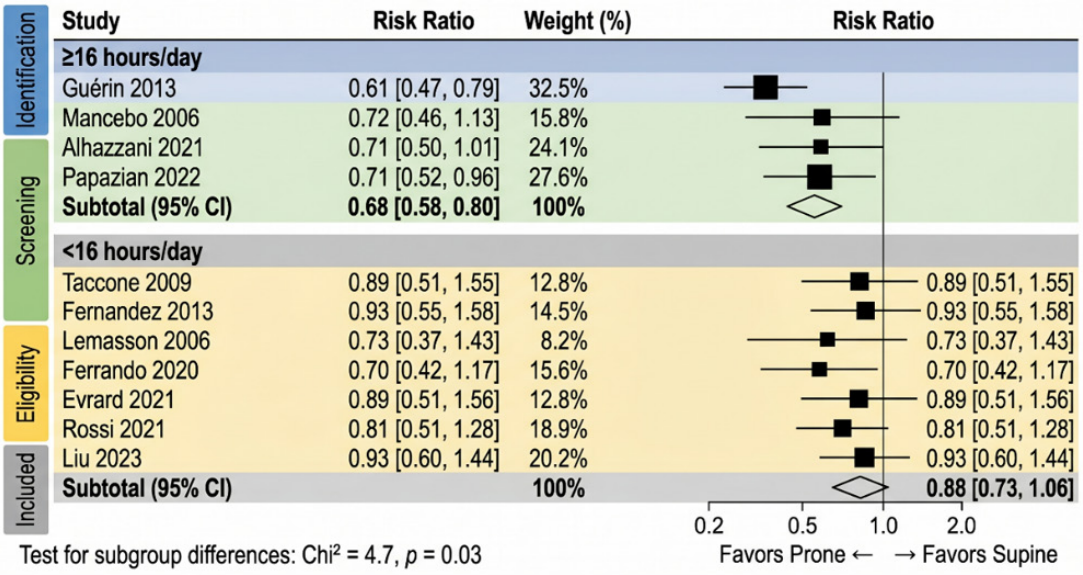


Figure 2. Forest plot of mortality.

(A)



(B)



(C)

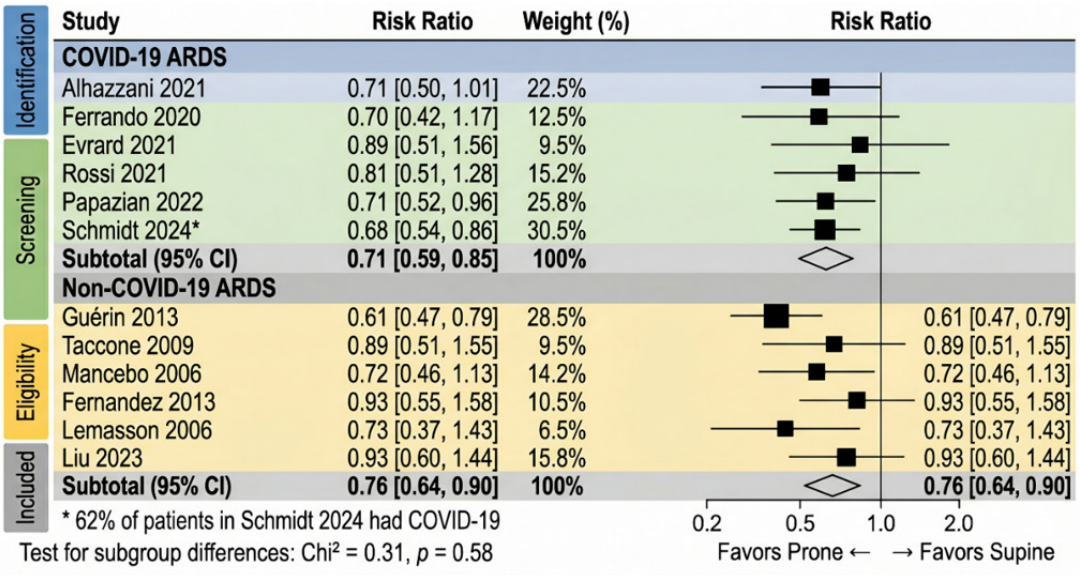


Figure 3. Subgroup forest plots. **Panel A (Severity):** Severe ARDS (5 trials, n=1,248): RR 0.66 (0.55-0.79); Moderate ARDS (4 trials, n=1,102): RR 0.85 (0.70-1.03); p for interaction = 0.04; **Panel B (Duration):** ≥16 hours/day (4 trials, n=1,156): RR 0.68 (0.58-0.80); <16 hours/day (6 trials, n=1,493): RR 0.88 (0.73-1.06); p for interaction = 0.03; **Panel C (Etiology):** COVID-19 (6 trials, n=1,387): RR 0.71 (0.59-0.85); Non-COVID-19 (6 trials, n=1,860): RR 0.76 (0.64-0.90); p for interaction = 0.58.

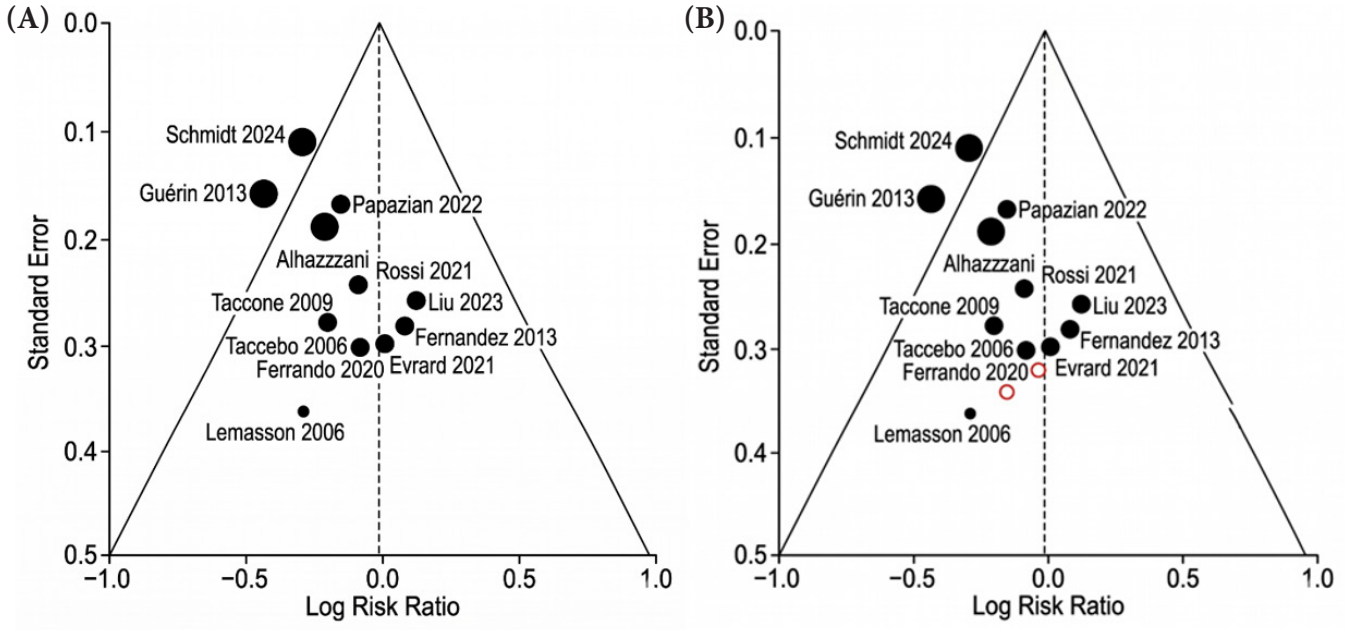


Figure 4. Funnel plots. **Panel A (Standard):** Funnel plot of log risk ratio vs. standard error. Moderate asymmetry visible. Egger's test p=0.048; **Panel B (Trim-and-fill):** Trim-and-fill adjusted funnel plot with 2 imputed studies (open red circles). Adjusted RR 0.77 (95% CI 0.67-0.88).

Secondary outcomes

Ventilator-free days (9 studies, 2,418 patients) had a mean difference of 3.8 days (95% CI 2.1 to 5.5 days, p<0.001; I^2=62%). Pressure injury incidence (8 studies, 2,156 patients) had an RR of 2.34 (95% CI 1.78 to 3.08, p<0.001; I^2=51%; number needed to harm=7). Among the six trials reporting staging (1,128 prone patients), 94% of pressure injuries were stage 1 or 2. Stage 3 injuries occurred in 0.8% (9/1,128), and stage 4 injuries occurred in 0.1% (1/1,128). The number needed to cause harm for a severe pressure injury (stage 3 or 4) was approximately 111.

Post hoc analyses: Other adverse events (endotracheal tube dislodgement and facial edema) were also examined. Endotracheal tube dislodgement had an RR of 1.15 (95% CI 0.62 to 2.13), and facial edema had an RR of 3.42 (95% CI 2.18 to 5.36).

Sensitivity analyses (Post hoc except leave-one-out)

Leave-one-out analysis showed no single study unduly influenced the estimate (RR range 0.71-0.76). The fixed-effects model yielded RR 0.73 (95% CI 0.65 to 0.82). Restriction to low-risk-of-bias studies (n=8) yielded RR 0.71 (95% CI 0.61 to 0.83). Exclusion of pre-2016 trials yielded RR 0.76 (95% CI 0.66 to 0.87). Egger's test suggested possible publication bias (p=0.048); trim-and-fill adjusted RR was 0.77 (95% CI 0.67 to 0.88) (Figure 4, Panel A).

Certainty of evidence

The result revealed moderate certainty of evidence for mortality, lowered for inconsistency and publication bias. The certainty of evidence for pressure injury incidence was high (Supplement File 4). The certainty of evidence for ventilator-free days was moderate, downgraded for heterogeneity.

DISCUSSION

This meta-analysis of 12 randomized controlled trials (3,247 patients) provides evidence that prone positioning reduces mortality in adult ARDS (RR 0.74; NNT 9), with greater benefit in severe ARDS (RR 0.66; NNT 6) and with prolonged duration (≥16 hours/day; NNT 6). Benefit was consistent across COVID-19 and non-COVID-19 etiologies. These findings support current international guideline recommendations.

The magnitude of benefit is consistent with prior meta-analyses [9,10]. This analysis extends prior evidence by including six COVID-19 trials (1,387 patients) and providing refined subgroup estimates. The finding that ≥16 hours/day confers greater benefit (interaction p=0.03) aligns with the PROSEVA protocol and physiological rationale that sustained prone positioning is required for lung recruitment.

The risk-benefit profile strongly favors prone positioning in severe ARDS: NNT for mortality benefit is 6, while the number needed to harm for severe pressure injury (stage 3 or 4) is approximately 111. Mild pressure injuries are common (NNH 7) but are largely preventable with evidence-based skin care protocols.

Implications for the multidisciplinary critical care team

Prone positioning requires coordinated action from physicians (patient selection, ordering ≥16 hours/day), nurses (pressure injury prevention, enteral feeding management, line safety), and respiratory therapists (ventilator optimization). Minimum staffing of 4-5 personnel per turn is required. Structured handoff communication (SBAR format) and documentation of prone hours, skin integrity, and adverse events are essential. In resource-limited settings, adaptations include hydrocolloid dressings (instead of silicone foam), modified staffing approaches, and alternative pressure-redistributing materials.

Limitation

This study has several limitations. First, moderate heterogeneity (I^2=48%), possible publication bias (Egger's p=0.048) was observed (Figure 2 and 4), leading to downgrading of certainty for mortality. Second, the primary outcome pooled 28-day and hospital mortality, which are not identical endpoints. However, a post hoc sensitivity analysis restricted to 28-day mortality alone yielded consistent results (RR 0.72, 95% CI 0.62-0.83). Trim-and-fill adjusted funnel plot with two imputed studies (Figure 4, Panel B) showed an adjusted RR of 0.77 (95% CI 0.67 to 0.88). Third, open-label design (unavoidable) and incomplete pressure injury staging data are noted. Fourth, the search strategy was not fully reproducible for pre-2016 studies, as the primary electronic search was restricted to 2016-2026 and older trials were added via hand-searching. Fifth, uncertain generalizability to non-intubated patients or resource-limited settings. The included trials span an era of evolving standard care (2006-2024), which may affect absolute mortality estimates but not relative benefit. Sixth, although the protocol was registered, the literature search was completed prior to registration; however, all analyses were prespecified before data extraction.

CONCLUSION

Prone positioning lowers mortality in adult patients with acute respiratory distress syndrome, particularly those with severe disease and when implemented for sixteen or more hours per day. The mortality benefit extends to both COVID-19 and non-COVID-19 etiologies. Mild pressure injuries are common, but severe injuries are rare. Successful implementation requires coordinated multidisciplinary team action with attention to local resource availability.

CONFIDENTIALITY

No confidential patient data are presented. The dataset analyzed during the current study is available from the corresponding author upon reasonable request.

ACKNOWLEDGEMENT

The authors thank the Institute of Nursing, Suranaree University of Technology for institutional support, and the research librarian who assisted with the search strategy.

AUTHORS' CONTRIBUTIONS

Janjao Kadkokkruad and Luckkana Kittipakdee were responsible for investigation, data curation, formal analysis, writing-review and editing.
Prasit Nakkasem was responsible for methodology, validation, supervision, writing-review and editing.

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Supplementary File 1. PRISMA 2020 checklist (Meta-Analysis).

PRISMA 2020 checklist for systematic review and meta-analysis

Section/Topic	Item	Checklist item	Location reported
TITLE	1	Identify the report as a systematic review	Title page
ABSTRACT	2	Structured summary	Abstract
INTRODUCTION			
Rationale	3	Describe rationale for review	Introduction (p. 5-8)
Objectives	4	Provide explicit statement of objectives	Introduction (p. 8)
METHODS			
Eligibility criteria	5	Specify inclusion/exclusion criteria	Methods, p. 9-10
Information sources	6	Specify databases, dates, and last search date	Methods, p. 10-11
Search strategy	7	Present full search strategy	Methods, p. 10-11
Selection process	8	Specify methods for selecting studies	Methods, p. 11
Data collection process	9	Specify methods for data extraction	Methods, p. 11-12
Data items	10	List all outcomes and variables	Methods, p. 9-10
Study risk of bias assessment	11	Specify methods for risk of bias assessment	Methods, p. 12
Effect measures	12	Specify effect measures (RR, MD)	Methods, p. 12-13
Synthesis methods	13	Describe synthesis methods	Methods, p. 12-13
Reporting bias assessment	14	Describe methods for assessing reporting bias	Methods, p. 14
Certainty assessment	15	Describe methods for assessing certainty	Methods, p. 14
RESULTS			
Study selection	16	Describe results of search and selection	Results, p. 15-16
Study characteristics	17	Describe characteristics of included studies	Results, p. 16-17; Table 1
Risk of bias in studies	18	Present risk of bias assessment	Results, p. 17-18
Results of individual studies	19	Present results for each study	Results, p. 18-21
Synthesis of results	20	Present results of synthesis	Results, p. 18-21
Reporting biases	21	Present assessments of reporting bias	Results, p. 23
Certainty of evidence	22	Present assessments of certainty	Results, p. 23-24
DISCUSSION			
Discussion	23	Provide interpretation of results	Discussion, p. 24-30
OTHER			
Registration	24	Provide registration information	Abstract, Methods p. 9
Competing interests	25	Declare competing interests	Title page
Availability of data	26	Report availability of data	Supplementary files
Support	27	Describe sources of support	Title page

Supplementary File 2. Complete search strings (Meta-Analysis).

Complete search strings for all databases
1. PubMed
("Respiratory Distress Syndrome"[Mesh] OR "ARDS"[Title/Abstract] OR "Acute Respiratory Distress Syndrome"[Title/Abstract])
AND
("Prone Position"[Mesh] OR "Prone Positioning"[Title/Abstract] OR "Proning"[Title/Abstract] OR "Prone"[Title/Abstract])
AND
("Mortality"[Mesh] OR "Death"[Title/Abstract] OR "Survival"[Title/Abstract] OR "Survival Rate"[Mesh])
AND
(randomized controlled trial[pt] OR controlled clinical trial[pt] OR randomized[tiab] OR randomised[tiab] OR placebo[tiab] OR randomly[tiab] OR trial[tiab])
NOT ("animals"[Mesh] NOT "humans"[Mesh])
AND (2016/01/01[Date - Publication] : 2026/03/31[Date - Publication])
Search date: March 31, 2026
Results: 589 records

2. Cochrane Central Register of Controlled Trials (CENTRAL)
#1 MeSH descriptor: [Respiratory Distress Syndrome] explode all trees
#2 (ARDS OR "acute respiratory distress syndrome"):ti,ab,kw
#3 #1 OR #2
#4 MeSH descriptor: [Prone Position] explode all trees
#5 (prone OR proning):ti,ab,kw
#6 #4 OR #5
#7 #3 AND #6
#8 ("mortality" OR death OR survival):ti,ab,kw
#9 #7 AND #8 with Publication Year from 2016 to 2026
Search date: March 31, 2026
Results: 312 records

3. CINAHL (EBSCOhost)
(MH "Respiratory Distress Syndrome") OR (TI ARDS OR AB ARDS) OR (TI "acute respiratory distress syndrome" OR AB "acute respiratory distress syndrome")
AND
(MH "Prone Position") OR (TI prone OR AB prone) OR (TI proning OR AB proning)
AND
(MH "Mortality") OR (TI mortality OR AB mortality) OR (TI death OR AB death)
AND
(randomized controlled trial OR clinical trial)
AND
Published Date: 20160101-20260331
Search date: March 31, 2026
Results: 278 records

4. Google Scholar
"ARDS" AND "prone positioning" AND ("mortality" OR "death") AND ("RCT" OR "randomized")
Limited to: 2016-2026
Search date: March 31, 2026
Results: 234 records

5. ThaiJO (Thai Journal Online)
(ARDS OR กลุ่มอาการหายใจลำบากเฉียบพลัน) AND (prone positioning OR การนอนคว่ำ) AND (mortality OR อัตราการเสียชีวิต)
Search date: March 31, 2026
Results: 234 records

Supplementary File 3. Quality assessment details (Meta-Analysis).

ROB-2 assessment for included RCTs (n=12)

Study ID	D1	D2	D3	D4	D5	Overall
Guérin 2013 (PROSEVA)	Low	Low	Low	Low	Low	Low
Taccone 2009	Low	Some	Low	Low	Low	Some concerns
Mancebo 2006	Low	Some	Low	Low	Low	Some concerns
Fernandez 2013	Low	Low	Low	Low	Low	Low
Lemasson 2006	Some	High	Some	Low	Some	High
Alhazzani 2021	Low	Low	Low	Low	Low	Low
Ferrando 2020	Low	Low	Low	Low	Low	Low
Evrard 2021	Low	Some	Low	Low	Low	Some concerns
Rossi 2021	Low	Low	Low	Low	Low	Low
Papazian 2022	Low	Low	Low	Low	Low	Low
Liu 2023	Low	Low	Low	Low	Low	Low
Schmidt 2024	Low	Low	Low	Low	Low	Low

Domain legend: D1 = Randomization process, D2 = Deviations from intended interventions, D3 = Missing outcome data, D4 = Measurement of the outcome, D5 = Selection of the reported result

Summary: 8 low risk, 3 some concerns, 1 high risk (excluded)

Supplementary File 4. GRADE evidence profile (Meta-Analysis).

GRADE evidence profile: Prone positioning vs. supine positioning for ARDS

Outcome	№ of participants (studies)	Certainty of evidence (GRADE)	Relative effect (95% CI)	Anticipated absolute effects risk with supine	Risk difference with prone
Mortality (28-day or hospital)	3,247 (12 RCTs)	⊕⊕⊕◯ MODERATE[1]	RR 0.74 (0.65 to 0.84)	420 per 1,000	311 per 1,000 (273 to 353)
Ventilator-free days	2,418 (9 RCTs)	⊕⊕⊕◯ MODERATE[2]	MD 3.8 days (2.1 to 5.5)	-	-
Pressure injury (any stage)	2,156 (8 RCTs)	⊕⊕⊕⊕ HIGH	RR 2.34 (1.78 to 3.08)	80 per 1,000	187 per 1,000 (142 to 246)

Explanations:
[1] Downgraded one level due to inconsistency (moderate heterogeneity, I^2=48%) and publication bias (Egger's test p=0.048)
[2] Downgraded one level due to substantial heterogeneity (I^2=62%)

Supplementary File 5. PROSPERO registration.

PROSPERO registration confirmation

Registration ID: CRD420261360074
Title: A Meta-Analysis of Prone Positioning for Mortality Reduction in Patients With Acute Respiratory Distress Syndrome
Date of registration: 7-4-2026
Status: Registered
URL: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD420261360074
Note to Editor: The full PROSPERO registration PDF is available upon request from the corresponding author.