INPLASY

# Association of Mechanical Power With Mortality Among Ventilated Critical Patients: A Systematic Review and Meta-Analysis

INPLASY202560092
doi: 10.37766/inplasy2025.6.0092
Received: 22 June 2025
Published: 22 June 2025

Sun, YH; Liu, KL; Li, X; Liu, Q.

**Corresponding author:**
Qi Liu

qi.liu@vip.163.com

**Author Affiliation:**
Not reported.

## ADMINISTRATIVE INFORMATION

**Support -** This study will be supported by the Natural Science Foundation of Henan Province (252300420096), Noncommunicable Chronic Diseases-National Science and Technology Major Project (2023ZD0505500), Leader Project of Henan Province Health Young and Middle-aged Professor (HNSWJW2020013).

**Review Stage at time of this submission -** Preliminary searches.

**Conflicts of interest -** None declared.

**INPLASY registration number:** INPLASY202560092

**Amendments -** This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 22 June 2025 and was last updated on 19 April 2025.

## INTRODUCTION

**Review question / Objective** What is the Association of Mechanical Power With Mortality Among Ventilated Critical Patients?

**Rationale** Mechanical ventilation is a crucial intervention for treating critically ill patients and providing respiratory support in the intensive care unit (ICU). However, mechanical ventilation is a double-edged sword: inappropriate use can easily lead to ventilator-induced lung injury (VILI), exacerbate patient conditions, and even increase mortality risk and fatality rate. VILI poses a significant threat to patients' lives and health, while also aggravating the economic burden on society and families.

Currently, four main mechanisms are thought to underline the pathogenesis of VILI: volutrauma, barotrauma, atelectotrauma, and biotrauma. However, these theories have not fully elucidated the mechanisms of VILI, and the mortality rate of patients receiving mechanical ventilation has not significantly decreased. Recently, mechanical power (MP) has emerged as a comprehensive indicator to estimate the risk of VILI. MP represents the total energy transferred by the ventilator to the respiratory system over time, encompassing all parameters that involved in VILI including airway pressure, tidal volume, respiratory rate, and airflow, resistance. Studies have suggested that high MP is associated with poorer patient outcomes. Therefore, MP serves as an important indicator for evaluating the appropriateness of mechanical ventilation protocols. However, the differences in MP between non-survivors and survivors, as well as the safe cut-off value of MP, remain unclear. This study performs a systematic review and meta-analysis of published clinical studies to assist clinicians in distinguishing mortality risks and making timely adjustments.

**Condition being studied** Globally, as many as 20 million patients in ICUs require mechanical ventilation each year. Moreover, with the increasing number of patients suffering from chronic and severe health issues, the proportion of patients dependent on mechanical ventilation is on the rise. In some developed countries, such as the United States, 38% of patients admitted to ICUs eventually undergo mechanical ventilation. A wide spectrum of severe underlying conditions necessitates mechanical ventilation, including respiratory, circulatory, and systemic diseases. Despite advancements in supportive care, the 30-day mortality remains very high. For example, the mortality rate of ARDS patients is still as high as about 45%, and inappropriate mechanical ventilation-induced VILI is one of the important reasons for its high mortality rate. Therefore, it is still necessary to study the mechanism of VILI to lay the foundation for optimizing protective mechanical ventilation.

## METHODS

**Search strategy** Two researchers will independently perform the electronic search using databases including PubMed, the Cochrane Library, Web of Science, Embase, and ScienceDirect, for relevant articles published between the period from the inception to 2026 March. The following combinations of terms or keywords will be used: (Mechanical Power) AND (Mortality OR Death OR Prognosis OR Clinical Outcome). Duplicate publications will be identified and counted once. The references of the relevant publications will be verified manually to identify potentially eligible studies.

**Participant or population** Adult (≥18 years) Ventilated Critical Patients.

**Intervention** Ventilation with Higher mechanical power.

**Comparator** Ventilation with Lower mechanical power.

**Study designs to be included** Observational cohort, case–control studies, randomized controlled trials or research letters with accurate data.

**Eligibility criteria** Additional Eligibility criteria (1) the main purpose was to report on the association of mechanical power with mortality; (2) at least one outcome of interest could be extracted; (3)the same formula was utilized to calculate mechanical power within the same patient cohort.
The exclusion criteria were: (1) data could not be extracted accurately; (2) trials focused on the postoperative patient during anesthesia; (3) only a meeting paper or abstract was published without the full text; (4) studies without a control group; (5) editorials, case reports, letters, reviews, news, comments, guidelines, and meta-analyses.

**Information sources** Two researchers will independently perform the electronic search using databases including PubMed, the Cochrane Library, Web of Science, Embase, and ScienceDirect, for relevant articles published between the period from the inception to 2025 June. There is no language limitation but the search will be restricted to human studies. The references of the relevant publications will be verified manually to identify potentially eligible studies. Duplicate publications will be identified and counted once.

**Main outcome(s)** The primary outcome is the comparison of mechanical power between survivors and non-survivors.

**Additional outcome(s)** Secondary outcomes include the effects of mechanical power above the cutoff value on ICU mortality, hospital mortality, and 28- to 30-day mortality.

**Data management** Two authors will extract data independently, including the first author's family name, publication year, characteristics of the patients and studies, the value of mechanical power, risk factors, and mortality. For dichotomous data (mortality), number of events and patients in each group will be picked up as the established protocol. For continuous data (mechanical power, mechanical power per predicted body weight, etc), we will extract the means, standard deviations (or calculate them from median and 95% confidence interval), and the group sizes. If discrepancies occur, they will be resolved by rechecking the original data and discussions with Qi Liu, who will make the final decision. The extracted information is stored in a pre-designed Excel spreadsheet.

**Quality assessment / Risk of bias analysis** The observed studies will be assessed with the Newcastle–Ottawa scale (NOS) for the possible risk of bias, which consists of three categories, selection, comparability, and outcome, with eight items evaluated on a nine-point scale. One point will be awarded for each qualified specific item. For RCTs, the Cochrane Collaboration tool will be used. This tool covers six domains as follows:

sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, and selective outcome reporting. Each domain will be rated as “high risk”, “low risk” or “unclear” of bias according to the relative information. Evaluations will be performed by Two authors. Disagreements will be discussed and Qi Liu will be consulted for the final decision.The heterogeneity across studies will be tested by the I2 statistic, a quantitative measure of inconsistency. I2 values of 25–50 % indicates low, 50–70 % moderate, and >75 % high heterogeneity.

**Strategy of data synthesis** For dichotomous outcomes, pooled odds ratio (OR) with 95 % confidence interval (CI) will be estimated by the Mantel-Haenszel method. For continuous outcomes,pooled effect sizes will be calculated by the inverse variance method and expressed as mean difference (MD) with 95 % CI. If the homogeneity across studies is sufficient, the analysis will be performed using a fixed effect model, whereas if not, a random effects model will be used.

**Subgroup analysis** Subgroup analysis will be implemented according to the potential impact factors of the outcomes.

**Sensitivity analysis** Sensitivity analysis will be performed by removing one or more RCTs to observe the change in heterogeneity and try to find the origin of the high heterogeneity.

**Language restriction** Without language limitation.

**Country(ies) involved** China.

**Other relevant information** None.

**Keywords** Mechanical power, mechanical ventilation, prognosis, mortality, cut off value.

**Dissemination plans** The result will be published in a proper journal.

**Contributions of each author**

Author 1 - Yu-han Sun - literature search, collecting data, statistical analysis, and help to draft the manuscript.
Email: yhan_sun@163.com
Author 2 - Kai-le Liu - literature search, collecting data, statistical analysis, and help to draft the manuscript.
Email: 15839614023@163.com
Author 3 - Xin Li - participate in the literature search, collecting data, statistical analysis, and help to draft the manuscript.
Email: lixinzzuedu@163.com
Author 4 - qi Liu - Design the study, interpret the results, draft and revise the manuscript.
Email: qi.liu@vip.163.com