


EVIDENCE-BASED CASE REPORT

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Effectiveness of Exercise Therapy as a Non-Pharmacological Adjuvant on Physical Function in Older Adults with Cancer

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ABSTRACT

Introduction: Global population aging has led to a rising incidence of cancer among older adults, frequently accompanied by functional decline, cancer-related fatigue (CRF), and reduced quality of life (QoL). Conventional oncologic therapies often exacerbate these impairments, underscoring the need for safe, effective nonpharmacological adjunctive strategies. Exercise therapy has emerged as a promising intervention; however, evidence specifically targeting older cancer populations remains limited. **Methods:** An evidence-based case report (EBCR) was conducted through systematic searches of PubMed, Scopus, and Google Scholar (2015–2025). Of the 225 identified records, 150 remained after duplicate removal, and 6 studies met predefined PICO criteria (≥ 60 years, cancer diagnosis, exercise intervention, and outcomes including fatigue, physical function, and QoL). Included designs comprised randomized controlled trials (RCTs), controlled intervention studies, and systematic reviews with meta-analyses. Levels of evidence were appraised using the Oxford Center for Evidence-Based Medicine hierarchy. **Results:** Six studies demonstrated consistent benefits. Moderate-intensity treadmill training increased hemoglobin and erythrocyte levels (+5%–6%), mitigating anemia-related fatigue. Inpatient multicomponent programs significantly improved Short Physical Performance Battery scores (+1.92) and knee extension strength (+7.7 kg). Baduanjin exercise markedly reduced CRF (d = –1.8) and enhanced sleep quality, handgrip strength, and gait speed. Physical function (p = 0.002), muscle strength (p < 0.001), cognitive performance (MMSE: p = 0.005), and QoL (EuroQoL-5D: p = 0.038; EORTC QLQ-C30: p = 0.029) improved significantly. ERAS-based respiratory training post-lobectomy improved FEV1 and reduced pulmonary complications (5.2% vs 21.1%). Meta-analytic findings indicated small-to-moderate effects on physical function (SMD 0.29), strength (SMD 0.47), fatigue (SMD 0.44), and QoL (SMD 0.34). All studies reported favorable safety profiles. **Conclusion:** Exercise therapy is an effective adjunctive strategy for older adults with cancer, reducing CRF, preserving functional capacity, and enhancing QoL. Integration into individualized oncology care pathways is strongly recommended. Large-scale multicenter trials are warranted to standardize protocols and evaluate long-term outcomes.

Keywords: Cancer, elderly, exercise therapy, physical function.

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INTRODUCTION

The phenomenon of population aging, defined as an increasing proportion of older individuals within a population, is occurring globally, including in Indonesia, which is now entering an era of demographic aging. The World Health Organization projects that by 2030, the number of people aged 60 years and older worldwide will exceed 1.4 billion and will nearly double to approximately 2.1 billion by 2050.[1] Indonesia, as one of the world's most populous nations, is experiencing a similar demographic trend. The growing proportion of older adults in Indonesia is driven by a steady increase in life expectancy, which has risen from 68.2 years in 2022 to 74 years in 2024.[2] This trajectory reflects an ongoing demographic transition and poses significant challenges for the healthcare system.

Cancer represents one of the most prevalent health problems affecting older adults and constitutes a leading cause of both morbidity and mortality in this population. According to the Global Cancer Observatory, cancer is one of the leading causes of mortality worldwide, with its incidence increasing substantially with age. In Indonesia alone, 408,661 new cancer cases were recorded in 2022, resulting in 242,988 deaths.[3] Older adults with cancer face a considerably more complex dual burden compared to younger cancer patients. Physiological aging leads to a progressive decline in organ functional reserve, reduced muscle strength, and reduced immune function, collectively making older adults more susceptible to treatment- and disease-related complications.[4] The majority of older adults also present with comorbid conditions such as hypertension, diabetes mellitus, or cardiovascular disease, which

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may further compromise their clinical status and complicate cancer management.[5,6] The adverse effects of cancer therapies, including chemotherapy and radiotherapy, may induce additional symptoms such as fatigue, sleep disturbances, and diminished appetite, collectively contributing to a decline in overall quality of life.[7,8] The convergence of chronic disease burden, declining physiological function, and therapy-induced adverse effects represents a substantial clinical challenge in the management of cancer among older adults.

Conventional pharmacological and medical treatment modalities for cancer in older adults, including surgery, chemotherapy, radiotherapy, and targeted therapy, are associated with a range of adverse effects that can significantly impact the quality of life of older patients with cancer.[7,8] There is a growing need for non-pharmacological interventions that can complement conventional cancer therapies and mitigate the adverse effects of cancer treatment; among these, exercise therapy represents one of the most evidence-supported approaches. Physical exercise has been shown to improve cardiorespiratory capacity and muscular strength, reduce cancer-related fatigue, and enhance metabolic function.[9–11] These benefits position exercise therapy as an essential complementary strategy in the management of cancer among older adults, who are particularly vulnerable to progressive physiological decline. In this population, exercise therapy functions as an adjuvant intervention that supports the effectiveness of primary cancer treatments, including chemotherapy, radiotherapy, and surgery, and may accelerate the recovery process.

Current evidence indicates that exercise therapy is safe for implementation in older adults with cancer, with no significant adverse effects reported. Furthermore, the available literature demonstrates that exercise therapy confers measurable benefits across multiple domains, including muscular strength, physical activity levels, physical function, and cognitive function.[12] The urgency of integrating exercise therapy as a component of comprehensive care for older adults with cancer extends beyond its role as an optional adjunct; it warrants consideration as a standard element of modern clinical practice. However, non-pharmacological approaches to cancer care remain underutilized, largely because exercise therapy continues to be regarded as an optional intervention rather than an integral standard of care. This disconnect reflects a broader gap between evidence-based knowledge and clinical practice.

To address this gap, the present study was conducted as an evidence-based case report (EBCR), a methodology that bridges scientific evidence and real-world patient cases. This approach moves beyond theoretical frameworks to examine how exercise therapy can be applied to older adults with cancer in everyday clinical settings. An evidence-based case report of this nature can make a meaningful contribution by presenting relevant, practical, and contextually grounded scientific data, strengthening the foundation for broader implementation of adjuvant exercise therapy across diverse healthcare settings.

CASE SCENARIO

A 72-year-old woman presented to the oncology outpatient clinic with a chief complaint of severe fatigue (cancer-related fatigue) experienced over the preceding three months in the context of ongoing chemotherapy for stage IIIB breast cancer. The patient reported significant difficulty performing activities of daily living, including walking long distances, performing household cleaning, and independent grocery shopping. She also reported decreased appetite, poor sleep quality, and low mood.

On physical examination, the patient appeared generally weak, with a body mass index of 21 kg/m², blood pressure of 128/78 mmHg, heart rate of 82 beats per minute, and an Eastern Cooperative Oncology Group (ECOG) performance status of 2. Routine laboratory investigations were within normal limits, except for a mildly reduced hemoglobin level of 10.8 g/dL. The patient had a history of hypertension, well-controlled with amlodipine, and had no significant cardiac or pulmonary comorbidities. The European Organization for Research and Treatment of Cancer Quality of Life Questionnaire (EORTC QLQ-C30) revealed low scores in both the physical and emotional functioning domains. The Brief Fatigue Inventory (BFI) indicated moderate-to-severe fatigue, with a mean score of 6 out of 10. The patient asked whether any non-pharmacological adjuvant therapy might help reduce her fatigue and improve her overall quality of life.

METHODS

This evidence-based case report (EBCR) employed a study design grounded in the Patient/Problem, Intervention, Comparison, and Outcome (PICO) framework, intending to address a clinically derived question through the synthesis of available scientific evidence, thereby generating findings that can serve as the basis for relevant and applicable clinical recommendations. Secondary data sources were obtained through systematic searches of three scientific databases: Google Scholar, Scopus, and PubMed. These databases were selected because they are primary repositories of peer-reviewed medical and health literature and are expected to yield high-quality, comprehensive scientific evidence.

Article searches were conducted systematically using keywords derived from each component of the PICO framework. Inclusion criteria were as follows: (1) studies employing a randomized controlled trial (RCT) design, controlled intervention trials, or systematic reviews and meta-analyses. (2) studies involving older adult patient populations aged 60 years and above, (3) Studies investigating exercise therapy or structured exercise as the primary intervention, (4) studies evaluating clinical outcomes including quality of life, fatigue, and physical function, and (5) articles published in English or Bahasa Indonesia between 2015 and 2025. Exclusion criteria comprised: (1) articles based on laboratory or animal studies and (2) studies that did not specifically involve an older adult population.

Clinical Question Formulation

The clinical question was formulated using the PICO framework (Population/Problem, Intervention, Comparison, and Outcome). The structured clinical question was derived directly from the presented case and is outlined in **Table 1.**

The initial database search yielded 225 articles in English and Bahasa Indonesia **(Table 2).** In Google Scholar, the search was





Table 1. Clinical question.

Population/Problem	Intervention	Comparison	Outcome
Older adults (≥ 60 years) with cancer experiencing cancer-related fatigue secondary to chemotherapy	Exercise therapy as an adjuvant intervention.	Chemotherapy alone without exercise therapy, or pharmacological treatment only	Reduction in fatigue; improvement in physical function, muscular strength, and quality of life
Clinical Aspect	Intervention		
Study Design	Interventional study, Randomized Controlled Trials (RCT), Systematic review/meta-analysis		
Clinical Question	In older adults with cancer-related fatigue secondary to chemotherapy, does exercise therapy as an adjuvant intervention, compared to standard care without exercise, improve physical function?		

Table 2. Article search results.

Database	Keywords	Total Articles
Google Scholar	""elderly" OR "older adult" OR aged AND "cancer" OR neoplasm OR malignancy OR oncology AND "exercise therapy" OR "exercise" OR "physical activity" OR "aerobic training" OR "resistance training"	86
Scopus	"elderly" OR "older adult" OR aged AND "cancer" OR neoplasm OR malignancy OR oncology AND "exercise therapy" OR "exercise" OR "physical activity" OR "aerobic training" OR "resistance training"	99
PubMed	"elderly" OR "older adult" OR aged AND "cancer" OR neoplasm OR malignancy OR oncology AND "exercise therapy" OR "exercise" OR "physical activity" OR "aerobic training" OR "resistance training"	40

filtered by publication year (2015–2025), article type (RCT, systematic review, and meta-analysis), and language (English or Bahasa Indonesia); however, no filter was applied for full-text availability or open access. In contrast, searches in Scopus and PubMed were more narrowly filtered, including publication year (2015–2025), article type, full-text availability, and language (English and Bahasa Indonesia).

The selection process followed sequential stages. In the first stage, we screened articles by title and abstract and removed duplicates. In the second stage, articles that met the initial screening criteria underwent an in-depth review to assess their relevance to the PICO-structured clinical question. Only articles fulfilling all pre-specified inclusion criteria were retained for final analysis. Two authors independently and in parallel critically appraised the six articles that passed the final selection stage **(Figure 1)** using the Oxford Center for Evidence-Based Medicine (CEBM) framework.

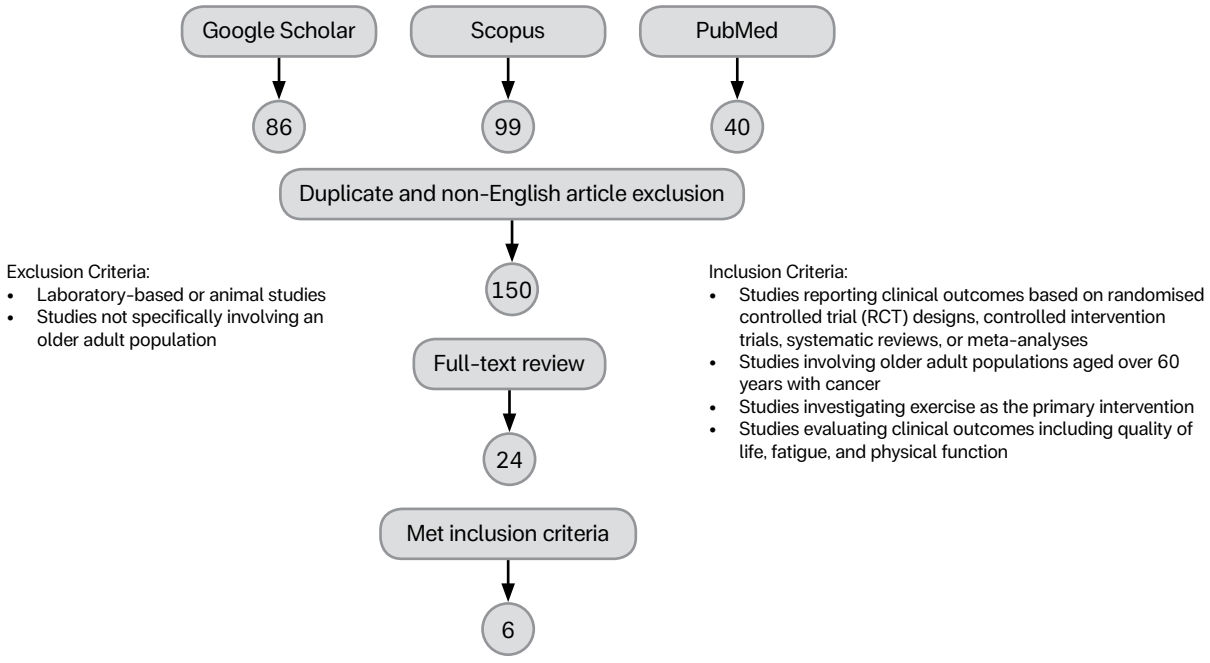


Figure 1. Flow diagram of the article search and selection process.





RESULTS

Table 3. Summary of included articles.

Study	Year	Design	Sample	Intervention	Results	Level of Evidence
Mohamady[13]	2017	RCT	30F, 60–70 y, breast Ca, chemo, BMI 30–35	Treadmill 25–40', 50%–70% HRmax, 3 x/weeks, 12 weeks	Hb ↑ +5%, RBC ↑ +6%, anemia ↓ (p <0.001)	II
Ferara[14]	2025	RCT (in-hospital, 4 d)	58 ≥ 65 y, solid Ca (±metastatic), acute	Individualized multicomponent (resist, balance, gait) 2 x/day	SPPB ↑ +1.9; knee ext ↑ +7.7 kg; fatigue ↓ (EORTC, p < 0.001); safe	II
Jarden[15]	2024	SR/MA (49 RCTs, n = 3,494)	≥ 18 y, hematologic Ca (5 studies ≥ 60 y)	Aerobic, resist, combination, yoga/ Qigong, 1–36 weeks	Physical function SMD 0.29; QoL 0.34; aerobic cap 0.53; strength 0.47; fatigue 0.44; dep 0.37	Ia
Rosero[16]	2020	Non-RCT (10 weeks)	26 ≥ 70 y, NSCLC I–IV, chemo	Supervised multicomponent 2 x/ weeks + home Vivifrail	SPPB, gait, chair stand, strength ↑ (p < 0.01); cognition (MMSE) ↑; QoL ↑ (EORTC & EuroQoL); pain & dyspnea ↓	IIb–III
Wu[17]	2025	RCT (3-arm, 12 weeks)	96 ≥ 60 y, lung Ca, chemo	Baduanjin 3 x/weeks ± nutrition	Ex+Nutri: CRF ↓ (d –1.8); sleep (PSQI) ↓; grip & gait ↑ (p < 0.001). Ex only: effect emerged at week 12	Ib
Du[18]	2023	RCT (ERAS resp exercise)	109 ≥ 60 y, lung Ca, lobectomy	Pre-/post-op breathing + aerobic light	FEV1, FVC, ADL ↑; QoL (SGRQ) ↑; pulmonary complications ↓ (5% vs 21%)	Ib

Abbreviations: ADL: Activities of daily living; BMI: Body mass index; Ca: Cancer; Chemo: Chemotherapy; CRF: Cancer-related fatigue; d: Days (design column) or Cohen's d effect size (results column); EORTC: European Organisation for Research and Treatment of Cancer; ERAS: Enhanced recovery after surgery; EuroQoL: European Quality of Life questionnaire; Ex: Exercise; F: Female; FEV1: Forced expiratory volume in one second; FVC: Forced vital capacity; Hb: Hemoglobin; HRmax: Maximum heart rate; Knee ext: Knee extension; MA: Meta-analysis; MMSE: Mini-Mental State Examination; NSCLC: Non-small-cell lung cancer; Nutri: Nutrition; PSQI: Pittsburgh Sleep Quality Index; QoL: Quality of life; RBC: Red blood cell count; RCT: Randomized controlled trial; resist: Resistance exercise; Resp: Respiratory; SGRQ: St. George's Respiratory Questionnaire; SMD: Standardized mean difference; SPPB: Short physical performance battery; SR: Systematic review; y: years.

A summary of the included articles is presented in **Table 3**. Randomized controlled trials and controlled intervention studies demonstrate consistent benefits of exercise therapy for fatigue, quality of life, and physical function in older adults with cancer. Mohamady, *et al.*,[13] *further* demonstrated that aerobic treadmill exercise performed three times per week produced significant improvements in hemoglobin levels (+5.03%) and red blood cell count (+5.89%), in contrast to the control group, which experienced notable declines in both parameters (Hb: –11.79%; RBC: –13.02%; p < 0.001).[13] These findings underscore that exercise therapy not only improves quality of life but also attenuates the biological hematological consequences of chemotherapy, particularly chemotherapy-induced anemia.

Hospital-based interventions demonstrated a broader range of beneficial effects. Ferrara, *et al.*,[14] reported that in acutely hospitalised older adults with solid cancers, exercise intervention produced a significant improvement in Short Physical Performance Battery (SPPB) score of +1.92 points (95% CI: 0.80–3.07; p = 0.002) and knee-extension strength of +7.72 kg (95% CI: 1.83–13.8; p = 0.018), accompanied by a significant reduction in fatigue (Δ –26.5 points; p < 0.001). Similarly, Rosero, *et al.*,[16] reported improvements in physical function (SPPB total score; p = 0.002), muscular strength (leg press, chest press, and hip abduction; p < 0.001), and cognitive function (Mini-Mental State Examination [MMSE]: p = 0.005), alongside improvements in quality of life (EuroQoL-5D; p = 0.038; EORTC QLQ-C30; p = 0.029) and reductions in pain and dyspnoea symptoms (p < 0.05). These findings are further reinforced by the meta-analysis of Jarden, *et al.*, which synthesized data from 49 RCTs (n = 3,494) and reported significant pooled effects on physical function (SMD 0.29), quality of life (SMD 0.34), aerobic capacity (SMD 0.53), muscular strength (SMD 0.47), fatigue reduction (SMD 0.44), and depressive symptoms (SMD 0.37).[15]

Integrative approaches demonstrated the most promising outcomes. Wu, *et al.*,[17] demonstrated that a combined programme of traditional Baduanjin exercise and nutritional support produced a significant reduction in cancer-related fatigue (CRF) from as early as week six (d = –1.80; p < 0.001), alongside improvements in sleep quality (Pittsburgh Sleep Quality Index [PSQI]: –2.13 points; p < 0.001), grip strength (p < 0.001), and gait speed (p < 0.001). Notably, 78% of patients in the intervention group returned to a normal fast-walking category, compared to 20% in the control group (p = 0.023).[17] Du, *et al.*, similarly reported that an enhanced recovery after surgery (ERAS)-based respiratory exercise programme in patients with lung cancer following lobectomy resulted in significant improvements in forced expiratory volume in one second (FEV_1), forced vital capacity (FVC), Barthel Index scores, and quality of life as measured by the St. George's Respiratory Questionnaire (SGRQ: p < 0.05), accompanied by a significant reduction in





pulmonary complications (5.26% vs. 21.15%; $p = 0.013$).[18] Taken together, exercise therapy in its various forms, including aerobic exercise, resistance training, multicomponent programs, and traditional modalities such as Baduanjin, has been demonstrated to be safe, feasible, and clinically beneficial for older adults with cancer, and therefore warrants consideration as a standard adjuvant therapeutic strategy.

DISCUSSION

A meta-analysis of 49 RCTs showed significant effects on physical function (SMD 0.29), aerobic capacity (SMD 0.53), muscular strength (SMD 0.47), and fatigue (SMD 0.44).[15] These effect sizes are clinically meaningful, given that cancer-related fatigue represents one of the most debilitating symptoms experienced by older adults with cancer, with direct implications for functional independence and long-term prognosis.

Beyond subjective improvements, exercise therapy also confers measurable benefits on biological parameters. Mohamady, *et al.*,[13] reported significant increases in hemoglobin and red blood cell count following 12 weeks of moderate-intensity aerobic exercise, directly attenuating chemotherapy-induced anemia. This reinforces the hypothesis that exercise therapy not only modulates symptoms but also influences hematopoiesis and tissue perfusion mechanisms, which are particularly important for preserving functional capacity in older adults with limited physiological reserve. These findings are further supported by Ferrara, *et al.*,[14] who demonstrated that a multicomponent exercise program delivered during hospitalization significantly improved Short Physical Performance Battery (SPPB) scores (+1.92 points; $p = 0.002$) and knee-extension strength (+7.72 kg; $p = 0.018$), while simultaneously producing a significant reduction in fatigue (Δ −26.5 points; $p < 0.001$).

Integrative approaches highlight the synergistic potential of combining exercise therapy with other interventions. The combination of Baduanjin exercise and nutritional support produced a faster reduction in cancer-related fatigue than exercise alone, with significant effects observed as early as week six in the combined intervention group, versus week twelve in the exercise-only group.[17] This supports a multimodal geriatric oncology care model in which exercise, nutritional support, and psychosocial interventions work in concert to target the underlying biological mechanisms of aging, including chronic inflammation, sarcopenia, and mitochondrial dysfunction. Du, *et al.*,[18] similarly showed that an ERAS-based respiratory exercise program significantly improved pulmonary function (FEV_1 and FVC), activities of daily living (ADL), and quality of life, while reducing postoperative pulmonary complications (5.3% vs. 21.1%). These findings underscore that exercise therapy is effective not only during the rehabilitation phase but also in the perioperative period, facilitating accelerated recovery in older adults with lung cancer.

From a biological standpoint, the effectiveness of exercise therapy in older adults with cancer can be explained through several interrelated geroprotective mechanisms. Exercise attenuates inflammaging by reducing pro-inflammatory cytokines, including interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α), thereby mitigating fatigue and improving physical function. However, the response to exercise depends heavily on functional status, comorbidity burden, and degree of frailty. Consequently, a Comprehensive Geriatric Assessment (CGA) is recommended before determining the appropriate exercise intensity and modality. The American Society of Clinical Oncology (ASCO) further affirms that structured exercise is safe and effective during chemotherapy, provided it is individualized according to the older patient's clinical condition.[19]

Taken together, the available evidence spanning levels of evidence Ia through IIb supports integrating exercise therapy into the comprehensive management of cancer in older adults. Variability in outcomes across studies largely reflects heterogeneity in intervention design, cancer type, disease stage, and baseline functional status. Nevertheless, the consistency of benefits observed across fatigue, physical function, and quality of life domains strongly suggests that exercise therapy should be regarded not merely as an adjunctive option, but as a core component of evidence-based geriatric oncology care.

CONCLUSION

The available scientific evidence consistently demonstrates that exercise therapy, as an adjuvant intervention for older adults with cancer, is associated with reductions in cancer-related fatigue, improvements in functional capacity, and enhancements in overall quality of life. Across the reviewed studies, exercise interventions were safe, feasible, and implementable across a range of settings, including home-based, hospital-based, and perioperative contexts. Although the evidence is drawn from studies with levels of evidence ranging from Ia to IIb, limitations, including heterogeneity in study designs and the absence of pooled statistical analyses, should be considered when interpreting these findings. Nevertheless, from a clinical standpoint, exercise therapy warrants inclusion as an integral component of the comprehensive management of cancer in older adult populations. Structured implementation, individualizing exercise programs to each patient's clinical condition, and multidisciplinary support can maximize clinical benefit and help translate this evidence into routine geriatric oncology practice.

DECLARATIONS

Consent for Publication

Not applicable. The case scenario presented in this report is used solely to frame the clinical question and contains no personal data or identifiable images of any individual; therefore, consent for publication was not required.

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Author Contributions

BW contributed to the study's conception and design, supervised the critical appraisal, and critically revised the manuscript. EE contributed to the study design and interpretation of the evidence. SNA and AK conducted the literature search, article selection, data extraction, and critical appraisal, and wrote the first draft. NH contributed to data interpretation and revised the manuscript. All authors reviewed and approved the final manuscript.

Conflict of Interest

The authors declare no financial or non-financial conflicts of interest.





Declaration on the Use of Artificial Intelligence (AI)

The authors declare that AI-assisted tools were used solely for language editing during the preparation of this manuscript. No AI tools were used for data analysis or interpretation of findings. The authors have reviewed, verified, and approved the entire manuscript and take full responsibility for its content.

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