

Supplementary Table S1. Database search strategies

Database	Search strategy
PubMed/MEDLINE	('walant':ti,ab,kw OR 'wide awake local anesthesia no tourniquet':ti,ab,kw OR 'wide awake local anaesthesia no tourniquet':ti,ab,kw OR 'wide-awake local anesthesia no tourniquet':ti,ab,kw OR 'wide-awake local anaesthesia no tourniquet':ti,ab,kw OR 'local anesthesia no tourniquet':ti,ab,kw OR 'local anaesthesia no tourniquet':ti,ab,kw OR (('wide awake':ti,ab,kw OR 'wide-awake':ti,ab,kw) AND ('local anesthe*':ti,ab,kw OR 'local anaesthe*':ti,ab,kw) AND (tourniquet*:ti,ab,kw OR 'no tourniquet':ti,ab,kw))) AND (compar*:ti,ab,kw OR random*:ti,ab,kw OR trial:ti,ab,kw OR cohort:ti,ab,kw OR matched:ti,ab,kw) AND ('hand'/exp OR 'wrist'/exp OR 'forearm'/exp OR 'upper limb'/exp OR 'carpal tunnel syndrome'/exp OR 'trigger finger'/exp OR 'de quervain tenosynovitis'/exp OR 'radius fracture'/exp OR hand:ti,ab,kw OR wrist:ti,ab,kw OR forearm:ti,ab,kw OR 'upper extremity':ti,ab,kw OR 'upper limb':ti,ab,kw OR 'carpal tunnel':ti,ab,kw OR 'trigger finger':ti,ab,kw OR 'de quervain':ti,ab,kw OR fracture*:ti,ab,kw OR 'distal radius':ti,ab,kw OR metacarpal*:ti,ab,kw OR phalan*:ti,ab,kw) NOT ('review':it OR 'editorial':it OR 'letter':it OR 'comment':it) AND [2018-2025]/py
Embase	((('walant':ti,ab,kw OR 'wide awake local anesthesia no tourniquet':ti,ab,kw OR 'wide awake local anaesthesia no tourniquet':ti,ab,kw OR 'wide-awake local anesthesia no tourniquet':ti,ab,kw OR 'wide-awake local anaesthesia no tourniquet':ti,ab,kw OR 'local anesthesia no tourniquet':ti,ab,kw OR 'local anaesthesia no tourniquet':ti,ab,kw OR (('wide awake':ti,ab,kw OR 'wide-awake':ti,ab,kw) AND ('local anesthe*':ti,ab,kw OR 'local anaesthe*':ti,ab,kw) AND (tourniquet*:ti,ab,kw OR 'no tourniquet':ti,ab,kw))) AND (compar*:ti,ab,kw OR random*:ti,ab,kw OR trial:ti,ab,kw OR cohort:ti,ab,kw OR matched:ti,ab,kw) AND ('hand'/exp OR 'wrist'/exp OR 'forearm'/exp OR 'upper limb'/exp OR 'carpal tunnel syndrome'/exp OR 'trigger finger'/exp OR 'de quervain tenosynovitis'/exp OR 'radius fracture'/exp OR hand:ti,ab,kw OR wrist:ti,ab,kw OR forearm:ti,ab,kw OR 'upper extremity':ti,ab,kw OR 'upper limb':ti,ab,kw OR 'carpal tunnel':ti,ab,kw OR 'trigger finger':ti,ab,kw OR 'de quervain':ti,ab,kw OR fracture*:ti,ab,kw OR 'distal radius':ti,ab,kw OR metacarpal*:ti,ab,kw OR phalan*:ti,ab,kw) NOT ('review':it OR 'editorial':it OR 'letter':it OR 'comment':it) AND [2018-2025]/py

Cochrane Library Search Manager / Trials (CENTRAL)	(WALANT OR "wide awake local anesthesia no tourniquet" OR "wide awake local anaesthesia no tourniquet" OR "wide-awake local anesthesia no tourniquet" OR "wideawake local anaesthesia no tourniquet" OR "local anesthesia no tourniquet" OR "local anaesthesia no tourniquet" OR ("wide awake" OR "wide-awake") AND (local anesthe* OR local anaesthe*) AND tourniquet*) OR ((local anesthe* OR local anaesthe*) AND "no tourniquet")),ab,kw AND ([Hand] OR [Wrist] OR [Forearm] OR [Upper Extremity] OR [Carpal Tunnel Syndrome] OR [De Quervain Disease] OR [Ganglion Cysts] OR [Radius Fractures] OR hand OR hands OR wrist OR forearm OR "upper extremit*" OR "upper limb*" OR "carpal tunnel" OR "trigger finger*" OR "de quervain*" OR ganglion* OR fracture* OR "distal radius" OR metacarpal* OR phalan*),ab,kw AND (compar* OR random* OR trial OR cohort OR matched OR anesthesia OR anaesthesia OR IVRA OR block),ab,kw
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Supplementary Table S2. Eligibility criteria

Domain	Inclusion criteria	Exclusion criteria
Population	Adults ≥18 years	Pediatric populations
Procedure	Hand, wrist, forearm, or elbow surgery	Non-operative procedures
Intervention	WALANT	WALANT without surgical intervention
Comparator	GA, RA, IVRA, LAW, sedation, or conventional anesthesia	No comparator group
Study design	RCTs and comparative observational studies	Case reports, narrative reviews, editorials
Outcomes	Pain, complications, satisfaction, function, opioid use, conversion, cost, efficiency	No extractable outcome data

Supplementary Table S3. Data extraction form

Variable group	Extracted variables
Study identification	Author, year, country, journal
Design	RCT, prospective cohort, retrospective cohort
Population	Sample size, age, sex, inclusion criteria
Procedure	Carpal tunnel, trigger finger, tendon repair, fracture fixation, other
Urgency	Elective vs trauma/acute
Intervention	WALANT solution, epinephrine concentration, buffering, setting
Comparator	GA, RA, IVRA, LAWT, sedation
Outcomes	Pain, complications, function, satisfaction, opioid use, conversion, cost, OR time
Statistical data	Mean, SD, median, IQR, events, total n, effect estimates

Supplementary Table S4. Risk-of-bias tools

Study design	Tool	Domains
Randomized trials	Cochrane RoB 2	Randomization, deviations from intervention, missing data, outcome measurement, reporting bias
Non-randomized comparative studies, if needed	ROBINS-I	Confounding, selection bias, intervention classification, missing data, outcome measurement

Supplementary Table S5. RoB2 – Randomized Controlled Trials

Study	Randomization	Deviations from intervention	Missing data	Outcome measurement	Reporting bias	Overall
Abd Hamid 2021	Low	Low	Low	Low	Some concerns	Low risk
Okamura 2021	Low	Low	Low	Low	Some concerns	Low risk
Lee 2022	Low	Low	Low	Low	Low	Low risk

Supplementary Table S6. ROBINS-I – Comparative Cohort Studies

Study	Confounding	Selection bias	Classification	Missing data	Outcome measurement	Overall
Wellington 2021	Moderate	Moderate	Low	Low	Low	Moderate
Bayrak 2025	Moderate	Moderate	Low	Low	Low	Moderate
Yi 2020	Serious	Moderate	Low	Low	Low	Serious

Ruterana 2022	Moderate	Moderate	Low	Low	Low	Moderate
Chen 2023	Moderate	Moderate	Low	Low	Low	Moderate
Abitbol 2021	Moderate	Moderate	Low	Low	Low	Moderate
Verrewaere 2024	Moderate	Moderate	Low	Low	Low	Moderate
Far-Riera 2019	Moderate	Moderate	Low	Low	Low	Moderate
Meunier 2022	Moderate (reduced by propensity matching)	Low	Low	Low	Low	Moderate
Lin 2021	Serious	Moderate	Low	Low	Low	Serious

Supplementary Table S7. Data extraction matrix. Acute Fracture Fixation Cohorts and Comparative Studies

Study	Procedure	Design	Groups	Outcome	WALANT	Comparator	p-value	Use in metaanalysis
Yi 2020	Distal radius plating	Cohort	WALANT vs GA	n	20	20	—	Yes
Yi 2020	Distal radius plating	Cohort	Waiting time to surgery, days	6	20	<0.001	Narrative/MD if SD found	
Yi 2020	Distal radius plating	Cohort	Postoperative stay, days	1	2	0.009	Narrative/MD if SD found	
Yi 2020	Distal radius plating	Cohort	Blood pressure / blood loss / operative time	Similar	Similar	NS	Narrative until exact table extracted	
Yi 2020	Distal radius plating	Cohort	Conversion to GA	0/20	—	—	Yes, conversion/failure	
Yi 2020	Distal radius plating	Cohort	Adverse medication effects	0/20	not specified	—	Narrative	
Yi 2020	Distal radius plating	Cohort	Revision/reoperation	1/20	0/20	—	Yes, RR	
Ruterana 2022	Metacarpal/phalangeal fractures	Retrospective comparative	WALANT vs RA	n	17	19	—	Yes

Ruterana 2022	Metacarpal/phalangeal fractures	Retrospective comparative	QuickDASH 3 months, mean $\pm$ SD	8.4 $\pm$ 8.6	14.2 $\pm$ 13.7	0.21	Yes, SMD	
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Ruterana 2022	Metacarpal/phalangeal fractures	Retrospective comparative	Surgery duration, min	45.9	49.1	0.53	Narrative, SD missing	
Ruterana 2022	Metacarpal/phalangeal fractures	Retrospective comparative	Need for complementary anesthesia	1/17	1/19	1.00	Yes, RR	
Ruterana 2022	Metacarpal/phalangeal fractures	Retrospective comparative	Analgesic use, days mean $\pm$ SD	9.5 $\pm$ 16.5	6.8 $\pm$ 9.4	0.85	Yes, SMD/MD	
Ruterana 2022	Metacarpal/phalangeal fractures	Retrospective comparative	Revision surgery	1/17	1/19	1.00	Yes, RR	
Ruterana 2022	Metacarpal/phalangeal fractures	Retrospective comparative	Satisfaction excellent/good	16/17	16/18*	—	Narrative/RR possible	
Abitbol 2021	Distal radius plating	Prospective cohort	WALANT vs RA	n	21	20	—	Yes
Abitbol 2021	Distal radius plating	Prospective cohort	QuickDASH 6 weeks	20	28	<0.0001	Narrative, SD missing	
Abitbol 2021	Distal radius plating	Prospective cohort	QuickDASH 3 months	9	15	<0.0001	Narrative, SD missing	
Abitbol 2021	Distal radius plating	Prospective cohort	QuickDASH 6 months	6	7	0.066	Narrative, SD missing	
Abitbol 2021	Distal radius plating	Prospective cohort	Grip strength 6 weeks, % healthy side	28	19	<0.0001	Narrative, SD missing	
Abitbol 2021	Distal radius plating	Prospective cohort	Grip strength 3 months, % healthy side	60	50	<0.0001	Narrative, SD missing	
Abitbol 2021	Distal radius plating	Prospective cohort	Grip strength 6 months, % healthy side	84	82	0.058	Narrative, SD missing	
Abitbol 2021	Distal radius plating	Prospective cohort	Pain during anesthetic administration, VAS mean $\pm$ SD	2.8 $\pm$ 1.6	5.3 $\pm$ 3.2	<0.0001	Yes, SMD	
Abitbol 2021	Distal radius plating	Prospective cohort	Operative time, min	36	37	0.266	Narrative, SD missing	
Abitbol 2021	Distal radius plating	Prospective cohort	Recovery room time, min	45	80	<0.0001	Narrative, SD missing	

Abitbol 2021	Distal radius plating	Prospective cohort	Return to activity, days	33	48	<0.0001	Narrative, SD missing	
Abitbol 2021	Distal radius plating	Prospective cohort	Very satisfied	17/21	14/20	0.038	Yes, RR possible	
Abitbol 2021	Distal radius plating	Prospective cohort	Complications	0/21	0/20	—	Yes, complications	

Abitbol 2021	Distal radius plating	Prospective cohort	Postoperative radiographic outcomes	Similar	Similar	NS	Narrative	
Chen 2023	Distal radius plating	Cohort	WALANT vs balanced anesthesia	n	38	55	—	Yes
Chen 2023	Distal radius plating	Cohort	QuickDASH/time/complications		—	—		
Lin 2021	Metacarpal plate fixation	Retrospective comparative	WALANT vs GA vs wrist block	n	11	GA 24 / WB 28	—	Already extracted
Lin 2021	Metacarpal plate fixation	Retrospective comparative	PONV	0/11	20/24 GA	0.017	Yes, RR	
Lin 2021	Metacarpal plate fixation	Retrospective comparative	Complications	0/11	0/24 GA / 0/28 WB	—	Yes, complications	

Supplementary Table S8. Data extraction matrix. Elective Hand Surgery Studies

Study	Procedure	Design	Groups	Outcome	WALANT	Comparator	pvalue	Use in metaanalysis
Wellington 2021	Endoscopic CTR	Retrospective comparative	WALANT vs MAC + tourniquet	n	78	53	—	Yes
Wellington 2021	Endoscopic CTR	Retrospective comparative		n	78	25	—	Yes
Wellington 2021	Endoscopic CTR	Retrospective comparative		Procedure time, min	10 ± 2	11 ± 2	—	Yes, MD

Wellington 2021	Endoscopic CTR	Retrospective comparative		Procedure time, min	10 ± 2	11 ± 2	—	Yes, MD
Wellington 2021	Endoscopic CTR	Retrospective comparative		OR time, min	20 ± 3	32 ± 6	<0.001	Yes, MD
Wellington 2021	Endoscopic CTR	Retrospective comparative		OR time, min	20 ± 3	23 ± 3	<0.001	Yes, MD
Wellington 2021	Endoscopic CTR	Retrospective comparative	WALANT vs MAC + tourniquet	PACU time, min	12 ± 7	72 ± 26	<0.001	Yes, MD/SMD

Wellington 2021	Endoscopic CTR	Retrospective comparative	WALANT vs local + tourniquet	PACU time, min	12 ± 7	20 ± 22	<0.001	Yes, MD/SMD
Wellington 2021	Endoscopic CTR	Retrospective comparative	WALANT vs MAC + tourniquet	Door-to-door time, min	97 ± 21	171 ± 40	<0.001	Yes, MD/SMD
Wellington 2021	Endoscopic CTR	Retrospective comparative		Door-to-door time, min	97 ± 21	106 ± 33	<0.001	Yes, MD/SMD
Wellington 2021	Endoscopic CTR	Retrospective comparative	WALANT vs combined controls	Complications	Not numerically specified	Not numerically specified	NS	Narrative unless event table found
Okamura 2021	Open CTR	RCT	WALANT vs IVRA	n	likely 40	likely 38	—	Yes
Okamura 2021	Open CTR	RCT		Pain control	WALANT superior	IVRA inferior	—	
Okamura 2021	Open CTR	RCT		Operating room time	WALANT shorter	IVRA longer	—	
Okamura 2021	Open CTR	RCT		Analgesic use	WALANT lower	IVRA higher	—	
Okamura 2021	Open CTR	RCT		Failure rate	lower	higher, 13%	—	
Okamura 2021	Open CTR	RCT		BCTQ	No relevant difference	No relevant difference	—	

Bayrak 2025	CTR	Prospective observational quasirandomized	WALANT vs axillary block	n	21	24	—	Yes
Bayrak 2025	CTR	Prospective observational quasirandomized		OR time, min	20.8 ± 4.1	41.5 ± 9.4	0.001	Yes, MD
Bayrak 2025	CTR	Prospective observational quasirandomized		VAS preop	7.1 ± 2.6	7.4 ± 1.8	0.633	Baseline only
Bayrak 2025	CTR	Prospective observational quasirandomized		VAS 1 h postop	0.07 ± 0.2	0.6 ± 2.5	0.961	Yes, MD/SMD
Bayrak 2025	CTR	Prospective observational quasirandomized		VAS 8 h postop	3.8 ± 2.5	4.8 ± 2.5	0.4	Yes, MD/SMD
Bayrak 2025	CTR	Prospective observational quasirandomized		Boston SSS 3 mnd	20.6 ± 3.05 / 23.63 ± 4.95*	24.5 ± 6.4 / 20.83 ± 4.68*	0.33 / 0.21	Yes, but subgroup ambiguity
Bayrak 2025	CTR	Prospective observational quasirandomized		Boston FDS 3 mnd	17.3 ± 5.5 / 19.9 ± 5.4*	24 ± 6.1 / 20.1 ± 6.8*	0.11 / 0.94	Yes, but subgroup ambiguity

Supplementary Table S 9. Data extraction matrix. Comparative Fracture Surgery Studies

Study	Procedure	Design	Groups	Outcome	WALANT	Comparator	pvalue	Use in metaanalysis
Abd Hamid 2021	Distal radius plating	RCT	WALANT vs GA	n	32	33	—	Yes
Abd Hamid 2021	Distal radius plating	RCT	WALANT vs GA	Operative time, min	61.22	55.33	0.003	Narrative/MD if SD found

Abd Hamid 2021	Distal radius plating	RCT		Blood loss,	14.88	13.03	0.082	Narrative
Abd Hamid 2021	Distal radius plating	RCT		APAIS anxiety	7.78	7.36	0.233	Narrative
Abd Hamid 2021	Distal radius plating	RCT		Conversion to GA	0/32	—	—	Yes, failure/conversion
Abd Hamid 2021	Distal radius plating	RCT		Revision surgery	0/32	2/33	—	Yes, RR
Abd Hamid 2021	Distal radius plating	RCT		Surgical site infection	0/32	0/33	—	Yes, complications
Abd Hamid 2021	Distal radius plating	RCT		QuickDASH 6 months	4.09	4.45	—	Narrative, SD missing

Lin 2021	Single metacarpal plate fixation	Retrospective comparative	WALANT vs GA vs wrist block	n	11	GA 24 / WB 28	—	Yes, selected outcomes
Lin 2021	Single metacarpal plate fixation	Retrospective comparative	WALANT vs GA	Anesthesia time, min	21.36	32.83	0.003	Narrative/MD if SD found
Lin 2021	Single metacarpal plate fixation	Retrospective comparative	WALANT vs GA	Surgical time, min	50.72	44.67	0.315	Narrative
Lin 2021	Single metacarpal plate fixation	Retrospective comparative		PONV	0/11	20/24	0.017	Yes, RR
Lin 2021	Single metacarpal plate fixation	Retrospective comparative		Postop day 1 VAS	2.18	2.92	0.056	Narrative, SD missing

Lin 2021	Single metacarpal plate fixation	Retrospective comparative		Complications	0/11	0/24	—	Yes, complications
Lin 2021	Single metacarpal plate fixation	Retrospective comparative		Full ROM recovery	11/11	21/24	0.214	Yes, RR if needed
Lee 2022	Minor hand surgery	RCT	WALANT vs CTB vs conventional LA	n	56	CTB 58 / conventional 55	—	Yes, selected outcomes
Lee 2022	Minor hand surgery	RCT	WALANT vs conventional LA	Injection pain, VAS	3.90 ± 1.03	5.87 ± 1.45	<0.001	Yes, SMD
Lee 2022	Minor hand surgery	RCT	WALANT vs CTB	Injection pain, VAS	3.90 ± 1.03	3.85 ± 1.03	—	Yes, SMD
Lee 2022	Minor hand surgery	RCT	WALANT vs conventional LA	6-hour postop pain, VAS	1.38 ± 0.56	2.25 ± 0.92	<0.001	Yes, SMD/MD
Lee 2022	Minor hand surgery	RCT	WALANT vs CTB	6-hour postop pain, VAS	1.38 ± 0.56	2.45 ± 0.88	<0.001	Yes, SMD/MD
Lee 2022	Minor hand surgery	RCT	WALANT vs conventional LA	Anxiety, HAM-A	17.32 ± 5.96	21.15 ± 6.53	<0.001	Yes, SMD
Lee 2022	Minor hand surgery	RCT	WALANT vs CTB	Anxiety, HAM-A	17.32 ± 5.96	13.42 ± 5.35	<0.001	Yes, SMD
Lee 2022	Minor hand surgery	RCT	WALANT vs conventional LA	Satisfaction, Likert	4.12 ± 0.75	1.95 ± 1.03	<0.001	Yes, SMD
Lee 2022	Minor hand surgery	RCT	WALANT vs CTB	Satisfaction, Likert	4.12 ± 0.75	3.95 ± 0.69	0.265	Yes, SMD
Lee 2022	Minor hand surgery	RCT	WALANT vs conventional LA	Superficial infection	1/56	1/55	—	Yes, complications
Lee 2022	Minor hand surgery	RCT	WALANT vs CTB	Superficial infection	1/56	0/58	—	Yes, complication

Supplementary Table S10. Table of excluded studies.

Because a large number of screened records were excluded for recurring methodological or eligibility reasons, excluded studies are summarized thematically rather than listed individually. Categories were based on the main reason for exclusion after title/abstract and full-text assessment, including lack of comparator group, conference abstract only, non-primary research, cost-only analysis, non-target population, duplicate/overlapping reports, and studies outside the prespecified contemporary review window.

Exclusion category	Reason for exclusion	Studies	Disposition
Review, narrative overview, Current concepts, or educational article	Not primary comparative clinical research; no original WALANT versus comparator outcome data suitable for synthesis.	Sawhney et al., 2024; Shahid et al., 2022; Hoelscher & Pientka, 2024, Stocker-Downing et al., 2025	Excluded from review; relevant background articles may be cited in Introduction/Discussion.
Conference abstract only or insufficient full-text information	Abstract-only publication, conference proceeding, or insufficient detail for risk-of-bias assessment and outcome extraction.	Ackfeld et al., 2021; Zbinden et al., 2021; Doirado et al., 2021; Laforet et al., 2022; Elzagh et al., 2023; Kamaly et al., 2024	Excluded from quantitative and qualitative synthesis.
No direct WALANT versus conventional anesthesia comparator	Single-arm WALANT study, feasibility series, patient experience survey, or implementation audit without a concurrent conventional anesthesia group.	Lech et al., 2021; Avoricani et al., 2022; Reynolds et al., 2022; Rellán et al., 2023; Kotb et al., 2023; Elsaftawy et al., 2024; Makishi et al., 2025, Morris et al., 2022; Lech et al., 2021.	Excluded from meta-analysis. Selected uncontrolled studies directly relevant to fracture/emergency feasibility were retained in narrative synthesis.
Cost, throughput, or service-redesign study without clinical comparative outcomes	Focused primarily on cost, operating-room logistics, or institutional implementation rather than predefined clinical, functional, safety, or patient-reported outcomes.	Alter et al., 2018; Kazmers et al., 2018; Maliha et al., 2019; Bowen et al., 2023; Thomas et al., 2025; Delgado et al., 2025, Billig et al., 2020; Kazmers et al., 2018.	Excluded from main synthesis; used only as contextual support when relevant.
Different target population	Population outside the adult eligibility criterion or not representative of the adult elective hand surgery/fracture fixation population.	Long et al., 2024 (adolescent WALANT hand surgery)	Excluded.
Procedure outside predefined clinical scope or not aligned with elective hand procedures/acute fracture fixation	Procedure did not match the prespecified target categories or represented a highly specific technique not comparable with the included surgical pathways.	Enechukwu et al., 2021; Xu et al., 2021; Sharma et al., 2023; Hoelscher & Pientka, 2024; Altaş et al., 2024	Excluded from main synthesis; may be referenced only for background discussion.

Wrong or non-standard intervention/comparator for review question	Intervention was not standard WALANT as defined in this review, or comparator did not match conventional anesthesia categories.	Rivas et al., 2024 (LANT rather than WALANT in distal radius fixation); studies evaluating modified WALANT variants only	Excluded.
Duplicate, overlapping, or secondary report	Study appeared to report overlapping cohorts, secondary analyses, or implementation data already represented by a more complete included article.	Far-Riera et al., 2022; Tahir et al., 2020 JPMA report; conference abstracts later published as full articles	Most complete peer-reviewed full-text article retained; overlapping reports excluded.
Retracted publication	Retracted publication not eligible for inclusion in evidence synthesis.	Tahir et al., 2020, Bone & Joint Research	Excluded.
Published before prespecified contemporary time window	Published before January 2018 and therefore outside the review window selected to capture contemporary WALANT implementation.	Codding et al., 2017; Rhee et al., 2017; Chapman et al., 2017; Miller et al., 2017; Gunasagaran et al., 2017	Excluded from study pool; potentially used as historical background.
Insufficient or nonextractable outcome data	Reported outcomes could not be extracted in a form suitable for the predefined synthesis, or lacked relevant outcome data after full-text review.	Several patient-experience, audit, and cost-only studies identified in screening library	Excluded from quantitative synthesis; considered narratively only when directly relevant.

Supplementary Table S11. Completed PRISMA 2020 Checklist
PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Title

ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Structured Abstract
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Introduction
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Final paragraph of Introduction
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Eligibility Criteria; Table 1
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Information Sources and Search Strategy
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Supplementary Table S1
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Study Selection
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Data Extraction
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought and, if not, the methods used to decide which results to collect.	Eligibility Criteria; Data Extraction
Data items	10b	List and define all other variables for which data were sought. Describe any assumptions made about any missing or unclear information.	Data Extraction; Supplementary Table S3
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Risk of Bias Assessment
Section and Topic	Item #	Checklist item	Location where item is reported
Effect measures	12	Specify for each outcome the effect measure(s) used in the synthesis or presentation of results.	Quantitative Synthesis
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis.	Quantitative Synthesis

Synthesis methods	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics or data conversions.	Data Extraction; Quantitative Synthesis
Synthesis methods	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Quantitative Synthesis
Synthesis methods	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s).	Quantitative Synthesis
Synthesis methods	13e	Describe any methods used to explore possible causes of heterogeneity among study results.	Quantitative Synthesis; Sensitivity Analysis
Synthesis methods	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Sensitivity Analysis by Study Design
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis.	Not performed because fewer than 10 studies contributed to pooled outcomes
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Certainty of Evidence

Section and Topic	Item #	Checklist item	Location where item is reported
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Figure 1; Study Selection
Study selection	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Supplementary Table S10
Study characteristics	17	Cite each included study and present its characteristics.	Table 2
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Table 3; Supplementary Tables S5-S6
Results of individual studies	19	For all outcomes, present, for each study: summary statistics for each group and an effect estimate and its precision, ideally using structured tables or plots.	Tables 2-4; Supplementary Tables S7-S9
Section and Topic	Item #	Checklist item	Location where item is reported

Results of syntheses	20a	For each synthesis, briefly summarize the characteristics and risk of bias among contributing studies.	Results
Results of syntheses	20b	Present results of all statistical syntheses conducted.	Quantitative Synthesis
Results of syntheses	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Quantitative Synthesis
Results of syntheses	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Sensitivity Analysis by Study Design
Reporting biases	21	Present assessments of risk of bias due to missing results for each synthesis assessed.	Not performed
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Table 7
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Discussion
Discussion	23b	Discuss any limitations of the evidence included in the review.	Strengths and Limitations
Discussion	23c	Discuss any limitations of the review processes used.	Strengths and Limitations
Discussion	23d	Discuss implications of the results for practice, policy, and future research.	Discussion; Conclusion
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	PROSPERO: CRD420251073722
Registration and protocol	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	PROSPERO registry
Registration and protocol	24c	Describe and explain any amendments to information provided at registration or in the protocol.	No major protocol amendments after registration
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Funding Statement
Competing interests	26	Declare any competing interests of review authors.	Competing Interests Statement
Availability of data, code and other materials	27	Report which materials are publicly available and where they can be found, including data collection forms, extracted data, analysis data, analytic code, and other materials used in the review.	Data Availability Statement

