

Supplementary data

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Appendix A: PRISMA Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Page 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Page 1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Page 2-4
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 4
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 5
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.	Page 4-5
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Page 4-5
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.	Page 4-5
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.	Page 6
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 (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Page 5-6

Section and Topic	Item #	Checklist item	Location where item is reported
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Page 5-6
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.	Page 6
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Page 7
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Page 7-8
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Page 7-8
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Page 7-8
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Page 7-8
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Page 7-8
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Page 7-8
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Page 7-8
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Page 6
RESULTS			

Section and Topic	Item #	Checklist item	Location where item is reported
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.	Page 8 Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Page 8
Study characteristics	17	Cite each included study and present its characteristics.	Page 8 Table 1
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Page 8 Supplementary Appendix D and E
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Page 9-10 Figure 2-4
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Page 9-10
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Page 9-10
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Page 11
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Page 10-11
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Page 8-9
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Page 8-9 Table 2
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Page 12-15
	23b	Discuss any limitations of the evidence included in the	Page 16

Section and Topic	Item #	Checklist item	Location where item is reported
		review.	
	23c	Discuss any limitations of the review processes used.	Page 16
	23d	Discuss implications of the results for practice, policy, and future research.	Page 15-16
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.	Page 4
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Page 4
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	Page 4
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	The study was supported by ***
Competing interests	26	Declare any competing interests of review authors.	Page 21
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	All datasets for this study are included in the manuscript and the Supplementary data

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. This work is licensed under CC BY 4.0. To view a copy of this license, visit <https://creativecommons.org/licenses/by/4.0/>

Appendix B: Search strategies

PubMed

Concept	Query
#1	("Ankle Injuries"[Mesh]) OR (Ankle Injury[Title/Abstract]) OR (Injury, Ankle[Title/Abstract]) OR (Injuries, Ankle[Title/Abstract]) OR (Syndesmotoc Injuries[Title/Abstract]) OR (Injuries, Syndesmotoc[Title/Abstract]) OR (Injury, Syndesmotoc[Title/Abstract]) OR (Syndesmotoc Injury[Title/Abstract]) OR (Ankle Sprains[Title/Abstract]) OR (Ankle Sprain[Title/Abstract]) OR (Sprain, Ankle[Title/Abstract]) OR (Sprains, Ankle[Title/Abstract]) OR (Chronic ankle instability[Title/Abstract]) OR (CAI[Title/Abstract]) OR (ankle instability[Title/Abstract]) OR (Functional ankle instability[Title/Abstract]) OR (FAI[Title/Abstract]) OR (Ankle Sprain[Title/Abstract])
#2	(Blood flow restriction training[Title/Abstract]) OR (Blood flow restriction[Title/Abstract]) OR (Vascular occlusion resistance training[Title/Abstract]) OR (BFRT[Title/Abstract]) OR (BFR[Title/Abstract]) OR (Kaatsu[Title/Abstract])
#4	#1 AND #2

Cochrane Library

Concept	Query
#1	MeSH descriptor: [Ankle Injuries] explode all trees
#2	(Ankle Sprain):ti,ab,kw OR (Ankle Injury):ti,ab,kw OR (Injury, Ankle):ti,ab,kw OR (Injuries, Ankle):ti,ab,kw OR (Syndesmotoc Injuries):ti,ab,kw OR (Injuries, Syndesmotoc):ti,ab,kw OR (Injury, Syndesmotoc):ti,ab,kw OR (Syndesmotoc Injury):ti,ab,kw OR (Ankle Sprains):ti,ab,kw OR (Ankle Sprain):ti,ab,kw OR (Sprain, Ankle):ti,ab,kw OR (Sprains, Ankle):ti,ab,kw OR (Chronic ankle instability):ti,ab,kw OR (CAI):ti,ab,kw OR (ankle instability):ti,ab,kw OR (Functional ankle instability):ti,ab,kw OR (FAI):ti,ab,kw
#3	#1 OR #2
#4	(Blood flow restriction training):ti,ab,kw OR (Blood flow restriction):ti,ab,kw OR (Vascular occlusion resistance training):ti,ab,kw OR (BFRT):ti,ab,kw OR (BFR):ti,ab,kw OR (Kaatsu):ti,ab,kw
#5	#3 AND #4

EMBASE

Concept	Query
#1	'ankle injuries'/exp OR 'ankle injuries' OR (('ankle'/exp OR ankle) AND ('injuries'/exp OR injuries)) OR 'ankle injury'/exp OR 'ankle injury' OR (('ankle'/exp OR ankle) AND ('injury'/exp OR injury)) OR 'injury, ankle'/exp OR 'injury, ankle' OR (('injury,'/exp OR injury,) AND ('ankle'/exp OR ankle)) OR 'injuries, ankle' OR (('injuries,'/exp OR injuries,) AND ('ankle'/exp OR ankle)) OR 'syndesmotoc injuries' OR (syndesmotoc AND ('injuries'/exp OR injuries)) OR 'injuries, syndesmotoc' OR (('injuries,'/exp OR injuries,) AND syndesmotoc) OR 'injury, syndesmotoc' OR (('injury,'/exp OR injury,) AND syndesmotoc) OR 'syndesmotoc injury'/exp OR

	'syndesmotoc injury' OR (syndesmotoc AND ('injury'/exp OR injury)) OR 'ankle sprains' OR (('ankle'/exp OR ankle) AND sprains) OR 'sprain, ankle'/exp OR 'sprain, ankle' OR (('sprain,'/exp OR sprain,) AND ('ankle'/exp OR ankle)) OR 'sprains, ankle' OR (sprains, AND ('ankle'/exp OR ankle)) OR 'chronic ankle instability'/exp OR 'chronic ankle instability' OR (chronic AND ('ankle'/exp OR ankle) AND ('instability'/exp OR instability)) OR 'cai'/exp OR cai OR 'ankle instability'/exp OR 'ankle instability' OR (('ankle'/exp OR ankle) AND ('instability'/exp OR instability)) OR 'functional ankle instability'/exp OR 'functional ankle instability' OR (functional AND ('ankle'/exp OR ankle) AND ('instability'/exp OR instability)) OR fai OR 'ankle sprain'/exp OR 'ankle sprain' OR (('ankle'/exp OR ankle) AND ('sprain'/exp OR sprain))
#2	'blood flow restriction training'/exp OR 'blood flow restriction training' OR (('blood'/exp OR blood) AND ('flow'/exp OR flow) AND ('restriction'/exp OR restriction) AND ('training'/exp OR training)) OR 'blood flow restriction'/exp OR 'blood flow restriction' OR (('blood'/exp OR blood) AND ('flow'/exp OR flow) AND ('restriction'/exp OR restriction)) OR 'vascular occlusion resistance training' OR (vascular AND ('occlusion'/exp OR occlusion) AND ('resistance'/exp OR resistance) AND ('training'/exp OR training)) OR bfrt OR bfr OR kaatsu
#3	#1 AND #2

Web of Science

Concept	Query
#1	TS=(Ankle Injuries OR Ankle Injury OR Injury, Ankle OR Injuries, Ankle OR Syndesmotoc Injuries OR Injuries, Syndesmotoc OR Injury, Syndesmotoc OR Syndesmotoc Injury OR Ankle Sprains OR Ankle Sprain OR Sprain, Ankle OR Sprains, Ankle OR Chronic ankle instability OR CAI OR ankle instability OR Functional ankle instability OR FAI OR Ankle Sprain)
#2	TS=(Blood flow restriction training OR Blood flow restriction OR Vascular occlusion resistance training OR BFRT OR BFR OR Kaatsu)
#3	#1 AND #2

EBSCO

Concept	Query
#1	AB Ankle Injuries OR AB Ankle Injury OR AB Injury, Ankle OR AB Injuries, Ankle OR AB Syndesmotoc Injuries OR AB Injuries, Syndesmotoc OR AB Injury, Syndesmotoc OR AB Syndesmotoc Injury OR AB Ankle Sprains OR AB Ankle Sprain OR AB Sprain, Ankle OR AB Sprains, Ankle OR AB Chronic ankle instability OR AB CAI OR ankle instability OR AB Functional ankle instability OR AB FAI OR AB Ankle Sprain
#2	AB Blood flow restriction training OR AB Blood flow restriction OR AB Vascular occlusion resistance training OR AB BFRT OR AB BFR OR AB Kaatsu
#3	#1 AND #2

Appendix C: Detailed International Ankle Consortium standard rating scales

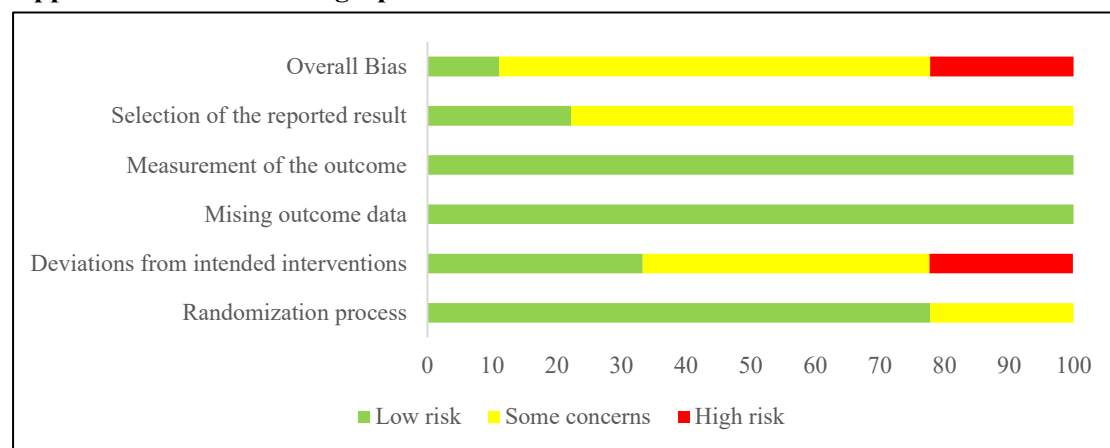
Inclusion criteria of studies included in the systematic review based on the recommendation of IAC.

First Author (Year)	Population defined by authors	All criteria required.				At least one of following symptoms.		
		A history of at least 1 significant ankle sprain	Injury resulting in pain, swelling, interruption of physical activity for at least 1 day	The initial ankle sprain occurred at least 12 months prior to the study	No history of ankle sprain in last 3 months	At least 2 episodes of “giving way” in the last 6 months.	Ankle sprain recurrence (at least 2 sprains on same ankle)	Self-reported ankle instability confirmed by questionnaires (i.e. at least 5 "yes" in AII, or lower than 24 in CAIT, or larger than 11 in IdFAI)
Jeong 2024 ¹	CAI	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Liang 2024 ²	FAI	Yes	Yes	Unclear	Unclear	Yes	Unclear	Yes
Liu 2024a ³	CAI	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Liu 2024b ⁴	CAI	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mahmoud 2023 ⁵	CAI	Yes	Yes	Unclear	Unclear	Yes	Unclear	Yes
Nagdi 2024 ⁶	CAI	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes
Wen 2023 ⁷	CAI	Yes	Yes	Yes	Unclear	Unclear	Unclear	Yes
Werasirirat 2022a ⁸	CAI	Yes	Yes	Yes	Unclear	Unclear	Unclear	Yes
Werasirirat 2022b ⁹	CAI	Yes	Yes	Yes	Unclear	Unclear	Unclear	Yes

Yes = Reported and achieved the standard, Unclear = Not Reported, No = Reported but the details did not achieve the standard.

IAC, International Ankle Consortium; CAI, chronic ankle instability; FAI, functional ankle instability; AII, Ankle Instability Instrument; CAIT, Cumberland Ankle Instability Tool; IdFAI, Identification of functional ankle instability.

Appendix D: Risk of bias graph



Appendix E: Risk of bias summary

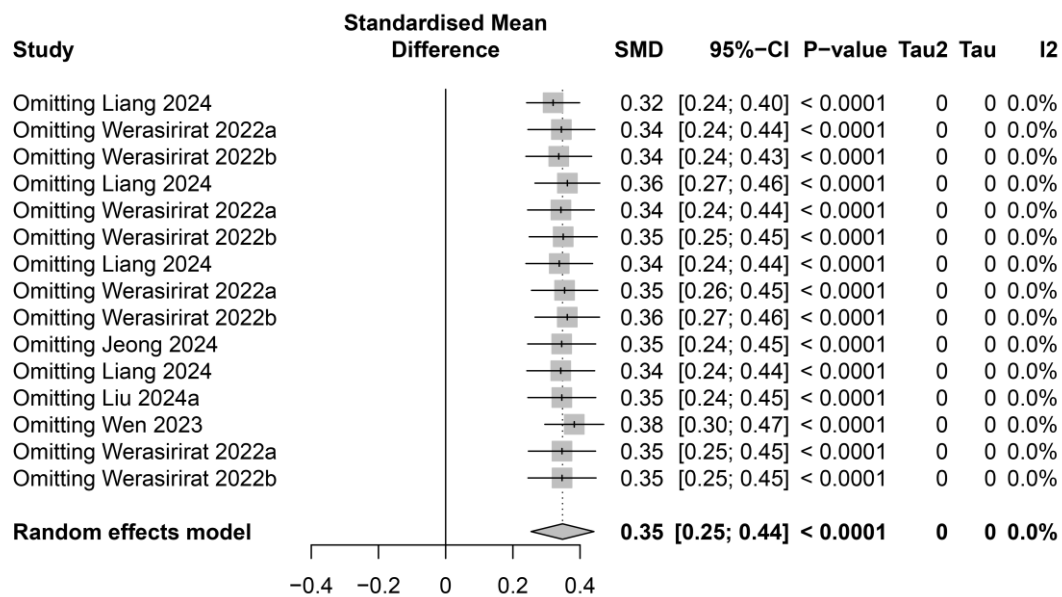
Study	Jeong 2024	Liang 2024	Liu 2024a	Liu 2024b	Mahmoud 2023	Nagdi 2024	Wen 2023	Werasirirat 2022a	Werasirirat 2022b	
Randomisation process	+	+	+	+	+	+	+	!	!	
Deviations from intended interventions	!	!	-	+	+	!	+	!	-	
Missing outcome data	+	+	+	+	+	+	+	+	+	
Measurement of the outcome	+	+	+	+	+	+	+	+	+	
Selection of the reported result	!	!	+	!	!	!	+	!	!	
Overall	!	!	-	!	!	!	+	!	-	

Appendix F: PEDro scores of included studies

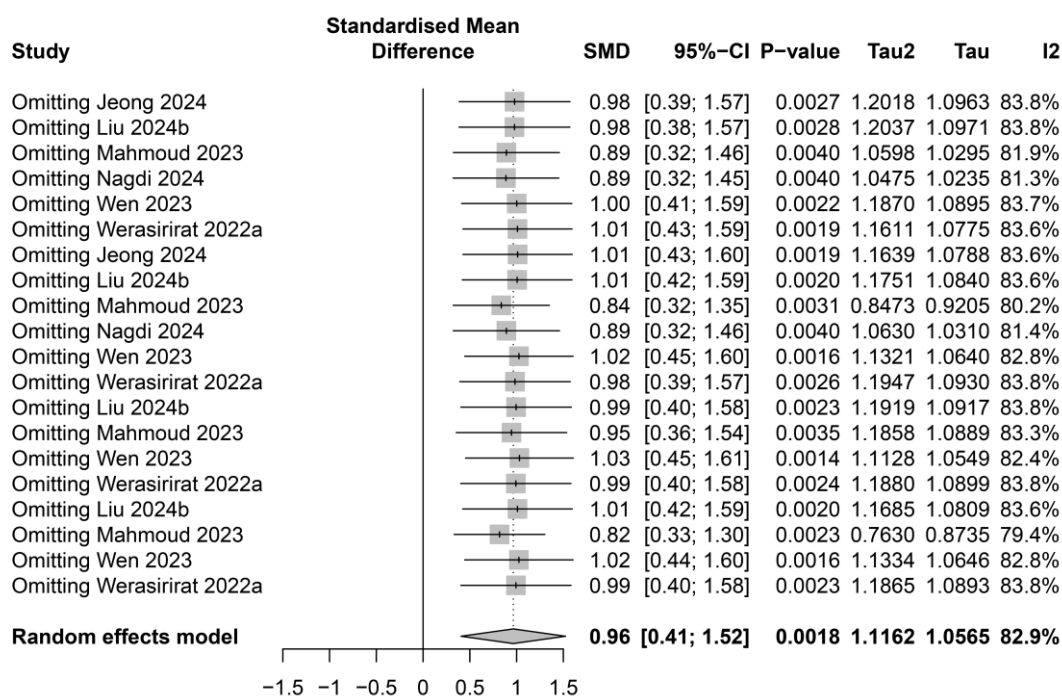
PEDro scores of included studies.											
Study	Random allocation	Concealed allocation	Groups similar at baseline	Participant blinding	Therapist blinding	Assessor blinding	< 15% dropouts	Intention-to-treat analysis	Between-group difference reported	Point estimate And variability	Total (0 to 10)
Jeong 2024 ¹	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	6
Liang 2024 ²	Yes	No	Yes	No	No	No	No	No	Yes	Yes	4
Liu 2024a ³	Yes	No	Yes	No	No	Yes	Yes	No	Yes	Yes	6
Liu 2024b ⁴	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	8
Mahmoud 2023 ⁵	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	7
Nagdi 2024 ⁶	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	8
Wen 2023 ⁷	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	9
Werasirirat 2022a ⁸	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	5
Werasirirat 2022b ⁹	Yes	No	Yes	Yes	No	No	Yes	No	Yes	Yes	6

Appendix G: Sensitivity analyses

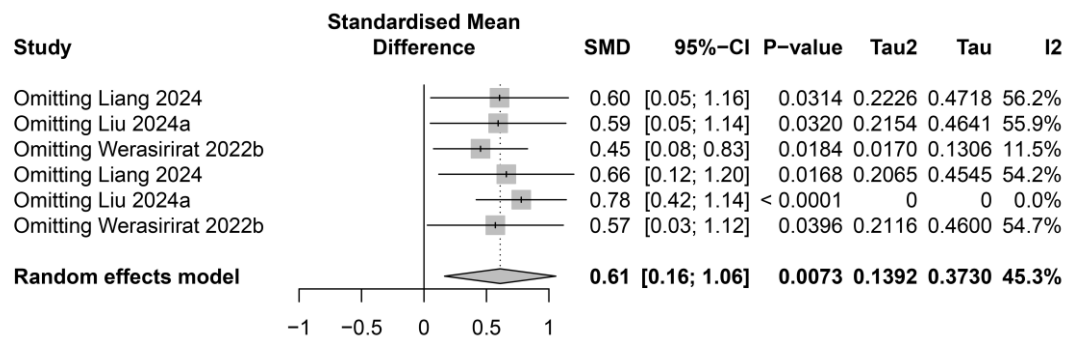
Sensitivity analysis for Y-balance test distance



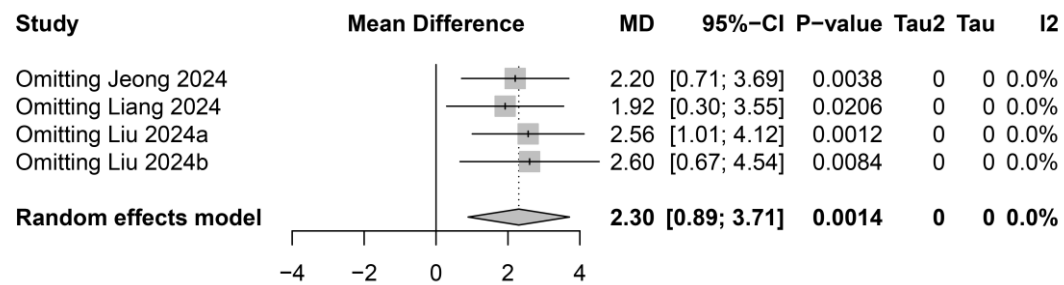
Sensitivity analysis for ankle-muscle strength



Sensitivity analysis for ankle-muscle activation

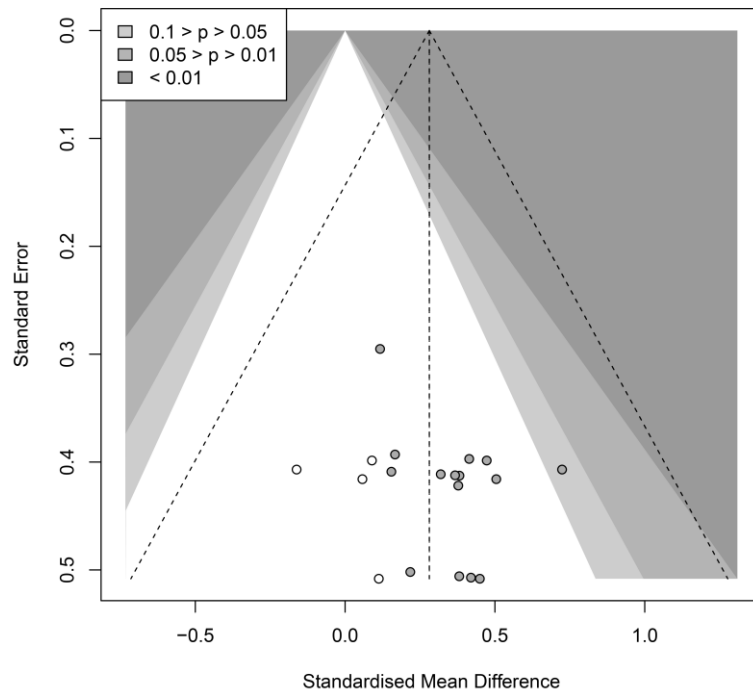


Sensitivity analysis for Cumberland ankle instability tool score

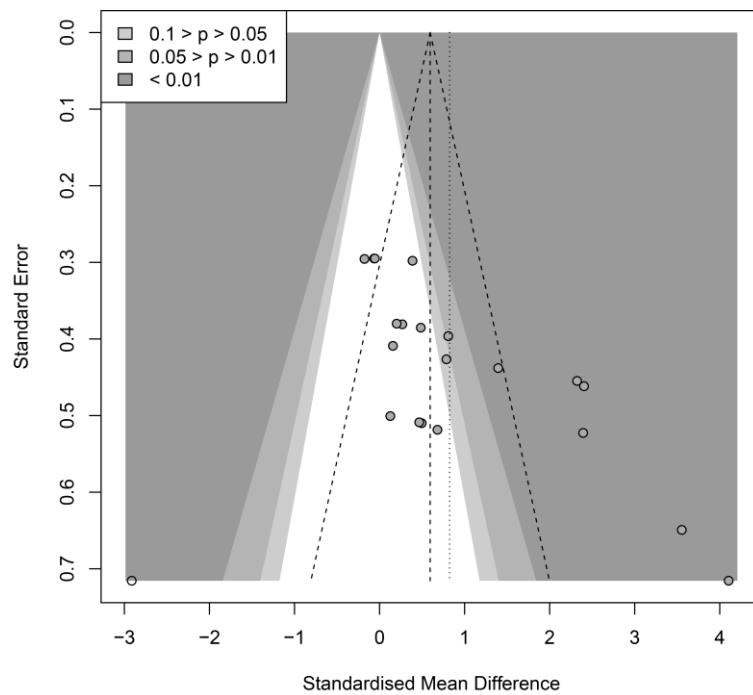


Appendix H: Publication bias

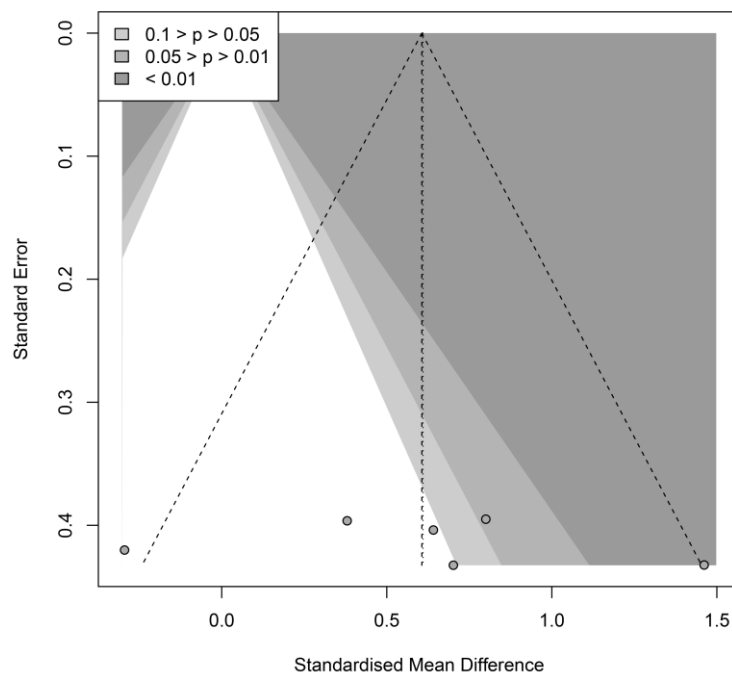
Publication bias for Y-balance test distance



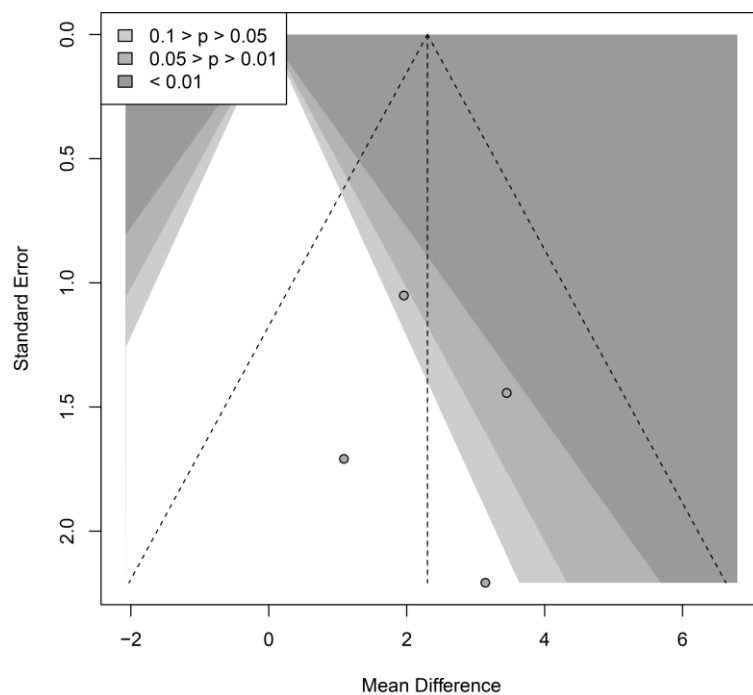
Publication bias for ankle-muscle strength



Publication bias for ankle-muscle activation



Publication bias for Cumberland ankle instability tool score



Appendix I: Meta-regression

Changes in heterogeneity

Below we present the results from the changes in heterogeneity in each meta-regression model.

Covariate	β (95% Confidence Interval)	Standard Error	P-value
Y-balance test distance			
Total number of interventions	0.02 (-0.01, 0.06)	0.02	0.191
Average age	0.00 (-0.01, 0.01)	0.00	0.926
Proportion of males	-0.00 (-0.00, 0.01)	0.00	0.760
Pressure value	-0.01 (-0.01, 0.00)	0.00	0.145
Cuff width	-0.02 (-0.07, 0.02)	0.02	0.238
Ankle-muscle strength			
Total number of interventions	-	-	-
Average age	-0.00 (-0.07, 0.06)	0.03	0.913
Proportion of males	0.02 (0.01, 0.04)	0.01	0.004
Pressure value	0.01 (-0.04, 0.06)	0.02	0.604
Cuff width	-0.05 (-0.33, 0.24)	0.13	0.742
Ankle-muscle activation			
Total number of interventions	-0.02 (-0.30, 0.26)	0.10	0.867
Average age	-2.66 (-6.86, 1.53)	1.51	0.153
Proportion of males	-0.02 (-0.01, 0.06)	0.01	0.169
Pressure value	-0.03 (-0.06, 0.11)	0.03	0.393
Cuff width	0.11 (-0.15, 0.37)	0.10	0.312
Cumberland ankle instability tool score			
Total number of interventions	0.25 (-0.37, 0.88)	0.14	0.220
Average age	0.03 (-0.23, 0.29)	0.06	0.647
Proportion of males	0.01 (-0.13, 0.16)	0.03	0.741
Pressure value	0.01 (-0.30, 0.31)	0.07	0.952
Cuff width	0.32 (-0.40, 1.04)	0.17	0.194

*Significant influence factors, 95% CI does not contain zero

References

1. Jeong LH. Effects of blood flow restriction exercise on ankle muscle strength, balance ability and gait in chronic ankle instability with obese middle-aged woman. *J Korean Phys Ther Sci* 2024; 31: 57-69.
2. Liang X, Han Y, Wang S, et al. Effect of blood flow restriction combined with low-intensity plyometric jump training on functional ankle instability. *Chin J Rehabil Theory Pract* 2024: 352-361.
3. Liu S, Tang J, Hu G, et al. Blood flow restriction training improves the efficacy of routine intervention in patients with chronic ankle instability. *Sports Med Health Sci* 2024; 6: 159-166. 2024/05/06. DOI: 10.1016/j.smhs.2023.11.001.
4. Liu Y and Wang Y. Effect of 6-week bfrt combined with iastam therapy on international standard dancers with chronic ankle instability. *Front Physiol* 2024; 15: 1417544. 2024/10/11. DOI: 10.3389/fphys.2024.1417544.
5. Mahmoud WS, Radwan NL, Ibrahim MM, et al. Effect of blood flow restriction as a stand-alone treatment on muscle strength, dynamic balance, and physical function in female patients with chronic ankle instability. *Medicine* 2023; 102: e35765. 2023/11/07. DOI: 10.1097/md.00000000000035765.
6. Nagdi MG, Elsayed WH, Abouzied M, et al. Effect of blood flow restriction and proprioception training in recurrent ankle sprain patients. *Afr J Biol Sci* 2024, 6(Si3):310-322. DOI: 10.33472/AFJBS.6.Si3.2024.310-322.
7. Wen Z, Zhu J, Wu X, et al. Effect of low-load blood flow restriction training on patients with functional ankle instability: A randomized controlled trial. *J Sport Rehabil* 2023; 32: 863-872. 2023/08/10. DOI: 10.1123/jsr.2022-0462.
8. Werasirirat P and Yimlamai T. Effect of supervised rehabilitation combined with blood flow restriction training in athletes with chronic ankle instability: A randomized placebo-controlled trial. *J Exerc Rehabil* 2022; 18: 123-132. 2022/05/19. DOI: 10.12965/jer.2244018.009.
9. Werasirirat P and Yimlamai T. Effect of supervised rehabilitation program combined with blood flow restriction training on muscle activation and postural control in athletes with chronic ankle instability: A randomized controlled trial. *J Phys Educ Sport* 2022; 22: 1145-1154.