International Platform of Registered Systematic Review and Meta-analysis Protocols

INPLASY

INPLASY2026110024

doi: 10.37766/inplasy2026.11.0024

Received: 7 November 2026

Published: 7 November 2026

Corresponding author:
Sijun Wu

2512111008@sus.edu.cn

Author Affiliation:
Shanghai University of Sport.

Effects of exercise modalities on changes in circulating inflammatory markers in adults with type 2 diabetes: a protocol for a systematic review and dose–response network meta-analysis

Wu, SJ; Zhang, CX; Tang, TY; Cai, YJ.

ADMINISTRATIVE INFORMATION

Support - None.

Review stage at the time of initial registration - Data analysis.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY2026110024

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 7 November 2026 and was last updated on 7 November 2026.

INTRODUCTION

Review question / Objective To synthesize exercise intervention trials comparing the effects of different training modalities on inflammatory markers in adults with type 2 diabetes, characterize the relationships between weekly training volume and treatment effects, and compare modalities at equivalent doses within ranges supported by the available data.

Rationale Previous reviews have compared the average effects of exercise modalities, but differences in prescribed training volume remain relevant to interpretation. This review evaluates exercise modality and weekly training volume within a common framework to inform the design of further exercise intervention trials.

Condition being studied Type 2 diabetes and the associated chronic low-grade inflammatory state.

METHODS

Search strategy Searches combine controlled vocabulary and synonymous free-text terms for two concepts: diabetes and exercise training. Search fields are adapted to each database. Core terms include type 2 diabetes, exercise, aerobic training, resistance training, HIIT, and corresponding Chinese terms. Full search strings are based on the records of the searches actually performed.

Participant or population Adults aged 18 years or older with type 2 diabetes diagnosed in the original studies. For studies enrolling mixed populations, only separately available data for adults with type 2 diabetes are eligible.

Intervention Structured, repeatable exercise programmes classified into six categories according to their training content: continuous aerobic exercise, resistance training, high-intensity

Wu et al. INPLASY protocol 2026110024. doi:10.37766/inplasy2026.11.0024 Downloaded from https://inplasy.com/inplasy-2026-11-0024/

interval training, combined aerobic and resistance training, combined high-intensity interval and resistance training, and mind–body exercise.

Comparator Usual care, waiting-list controls, low-stimulus active controls, or direct comparisons between eligible exercise programmes. Medication, dietary measures, and other non-exercise interventions should be identical across groups so that between-group differences reflect the effects of training.

Study designs to be included Randomized controlled trials.

Eligibility criteria Studies must provide serum or plasma measurements of at least one target marker. No minimum intervention duration is imposed. Single-session exercise experiments, multicomponent interventions in which the contribution of exercise cannot be isolated, and measurements clearly affected by the acute response to the most recent exercise session are excluded.

Information sources PubMed, Embase, Web of Science, Scopus, Cochrane CENTRAL, China National Knowledge Infrastructure (CNKI), Wanfang, and VIP were searched.

Main outcome(s) The co-primary outcomes are C-reactive protein (CRP), including high-sensitivity measurements, interleukin-6 (IL-6), and tumour necrosis factor-alpha (TNF-α). The review focuses on changes in resting concentrations from baseline to the end of training. Each marker is synthesized separately; studies are not required to report all three markers.

Additional outcome(s) No additional clinical secondary outcomes are specified. Modality rankings, dose–response curves, and the locations of their minima are derived analyses of the primary markers.

Data management Records are assessed sequentially at the title/abstract and full-text stages, with reasons for exclusion recorded. Multiple reports are linked at the trial level to avoid duplicate inclusion of the same outcome data. Extracted information covers participant characteristics, exercise prescriptions, blood sampling conditions, co-interventions, and sample sizes and outcome data for each group, with source locations retained.

Quality assessment / Risk of bias analysis Two reviewers independently assess risk of bias using RoB 2, with disagreements resolved by a third reviewer. Certainty of evidence for comparisons between exercise modalities is assessed using CINeMA.

Strategy of data synthesis Effects are Hedges-corrected standardized change differences standardized to pooled baseline SD within studies; negative values denote reduced inflammatory markers. SD of change is preferred, otherwise derived or estimated assuming a baseline–follow-up correlation of 0.5. We perform random-effects pairwise meta-analyses and Bayesian random-effects network meta-analyses (non-training control as reference), reporting 95% credible intervals and assessing convergence, heterogeneity, transitivity and consistency. Intervention ranking uses SUCRA. Exercise dose is MET-min/week (MET × session minutes × weekly sessions); multi-phase programmes are weighted by phase duration, combined programmes summed, and controls coded 0. Doses are binned to the nearest 250 MET-min/week (minimum category = 250). Natural cubic splines model overall and modality-specific dose–response associations with knots at 10%, 50%, and 90% of maximum dose. Modality-specific models estimate the first coefficient per modality while sharing remaining coefficients; model fit is compared against linear and Emax models. Curve minima are estimated within the observed dose range with separate uncertainty for dose location and effect, and boundary estimates flagged. Modalities are compared at 500, 750, and 1000 MET-min/week where data permit. Analyses are conducted in R using multinma and MBNMAdose.Effects are expressed as Hedges-corrected standardized differences in change, using the pooled baseline standard deviation within each study as the standardization denominator. Negative values indicate a relative reduction in inflammatory markers. Reported standard deviations of change are preferred; when unavailable, they are derived from other statistics or, where necessary, estimated using a baseline–follow-up correlation of 0.5.

Subgroup analysis Dose–response curves are estimated separately for the six exercise categories. Intervention duration in weeks is included as a continuous covariate in network meta-regression.

Sensitivity analysis Primary analyses are repeated after excluding low-stimulus active controls. Results before and after excluding studies at high risk of bias are compared using the same frequentist model. Comparison-adjusted funnel

Wu et al. INPLASY protocol 2026110024. doi:10.37766/inplasy2026.11.0024 Downloaded from https://inplasy.com/inplasy-2026-11-0024/

plots and Egger regression are used to explore small-study effects.

Language restriction No language-based exclusion criteria are imposed.

Country(ies) involved China.

Keywords Type 2 diabetes; exercise training; circulating inflammation; network meta-analysis; dose–response.

Contributions of each author

Author 1 - Sijun Wu.
Email: 2512111008@sus.edu.cn
Author 2 - Chuanxiang Zhang.
Email: 2521151035@sus.edu.cn
Author 3 - Tianyu Tang.
Email: 2521852060@sus.edu.cn
Author 4 - Yujun Cai.
Email: caiyujun@sus.edu.cn

Wu et al. INPLASY protocol 2026110024. doi:10.37766/inplasy2026.11.0024 Downloaded from https://inplasy.com/inplasy-2026-11-0024/