Exercise training and resting blood pressure: a large-scale pairwise and network meta-analysis of randomised controlled trials

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ABSTRACT

Objective To perform a large-scale pairwise and network meta-analysis on the effects of all relevant exercise training modes on resting blood pressure to establish optimal antihypertensive exercise prescription practices.

Design Systematic review and network meta-analysis.

Data sources PubMed (Medline), the Cochrane library and Web of Science were systematically searched.

Eligibility criteria Randomised controlled trials published between 1990 and February 2023. All relevant work reporting reductions in systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) following an exercise intervention of ≥2 weeks, with an eligible non-intervention control group, were included.

Results 270 randomised controlled trials were ultimately included in the final analysis, with a pooled sample size of 15 827 participants. Pairwise analyses demonstrated significant reductions in resting SBP and DBP following aerobic exercise training (–4.49/–2.53 mm Hg, p<0.001), dynamic resistance training (–4.55/–3.04 mm Hg, p<0.001), combined training (–6.04/–2.54 mm Hg, p<0.001), high-intensity interval training (–4.08/–2.50 mm Hg, p<0.001) and isometric exercise training (–8.24/–4.00 mm Hg, p<0.001). As shown in the network meta-analysis, the rank order of effectiveness based on the surface under the cumulative ranking curve (SUCRA) values for SBP were isometric exercise training (SUCRA: 98.3%), combined training (75.7%), dynamic resistance training (46.1%), aerobic exercise training (40.5%) and high-intensity interval training (39.4%). Secondary network meta-analyses revealed isometric wall squat and running as the most effective submodes for reducing SBP (90.4%) and DBP (91.3%), respectively.

Conclusion Various exercise training modes improve resting blood pressure, particularly isometric exercise. The results of this analysis should inform future exercise guideline recommendations for the prevention and treatment of arterial hypertension.

WHAT IS ALREADY KNOWN?

⇒ The role of exercise training as an effective non-pharmacological antihypertensive intervention is generally well-established.
⇒ Traditional aerobic exercise training remains the primarily recommended exercise approach for the management of high blood pressure.
⇒ Current exercise guidelines for blood pressure control are largely based on older data, requiring an updated analysis with the inclusion of more novel exercise modes, including high-intensity interval training and isometric exercise training.

WHAT ARE THE NEW FINDINGS?

⇒ This large-scale systematic review and network meta-analysis of 270 randomised controlled trials demonstrates the optimal exercise prescription practices in the management of resting blood pressure.
⇒ Aerobic exercise training, dynamic resistance training, combined training, high-intensity interval training and isometric exercise training are all significantly effective in reducing resting systolic and diastolic blood pressure. Overall, isometric exercise training is the most effective mode in reducing both systolic and diastolic blood pressure.
⇒ These findings provide a comprehensive data-driven framework to support the development of new exercise guideline recommendations for the prevention and treatment of arterial hypertension.

INTRODUCTION

Hypertension is a leading modifiable risk factor for morbidity and mortality.[1–3] While differences in diagnostic cut-off points exist in guidelines,[4 5] blood pressure above optimal levels is lineally associated with an escalated risk of cardiovascular disease.[6] With the prevalence of hypertension increasing,[7] particularly in low- and middle-income countries,[8] research into effective antihypertensive interventions remains critical. Medical therapy is an effective means of reducing blood pressure[9]; however, poor adherence,[10–12] adverse side effects[13] and economic expenditure[14] are important limitations. As such, non-pharmacological approaches are favoured.[15 16] Exercise elicits conclusive cardiovascular health benefits and improves long-term survival, with a longitudinal association between physical activity and reduced mortality well documented.[17–20]

Previous large-scale analyses have reported significant systolic and diastolic blood pressure (SBP and DBP) reductions from varying exercise modes.[21–26] Based on previous work, traditional aerobic exercise training (AET) remains the primarily recommended exercise approach for the management of resting blood pressure.[4 5] However, the current exercise guideline recommendations are largely based on older data, with recent investigations demonstrating a growing interest in more novel exercise modes, such as high-intensity interval training (HIIT)[27] and isometric exercise training (IET),[24] as well as a plethora of new data on the role of independent dynamic resistance training (RT)[28] and combined RT and AET.[29 30] As a consequence, the optimal exercise intervention for the management of resting blood pressure is unknown, with existing guidelines probably outdated.

Therefore, this work aimed to provide an updated large-scale systematic review and network meta-analysis (NMA) of randomised controlled trials (RCTs) on the effects of exercise training on resting SBP and DBP. We aimed to perform independent pairwise meta-analyses for each exercise mode with subsequent comparative Bayesian NMAs. We also aimed to perform separate baseline blood pressure-stratified analyses to determine the effects of each exercise mode in those of differing blood pressure classifications.

METHODOLOGY

Search strategy

This review was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines,[31 32] with PROSPERO registration (CRD42022326565). A comprehensive electronic database search strategy was constructed to identify RCTs reporting the effects of an exercise training intervention on resting blood pressure. The systematic search was performed in PubMed (Medline), the Cochrane library and Web of Science using a combination of relevant medical subject heading (MeSH) terms and text words including exercise, physical activity, blood pressure and hypertension, with the Boolean search terms 'OR' and 'AND' (online supplemental appendix A). No search filters or limits were applied. Separately, the reference lists of previous systematic reviews and meta-analyses were hand searched for additional reports not identified in the initial search. Trials published between 1990 and February 2023 were considered eligible.

Screening and study eligibility

Following the systematic search, two authors (AD and OA) independently screened all papers for eligibility. Studies were initially screened by title and abstract, and subsequently by full text if they met the predetermined inclusion criteria. Any inconsistency and disagreements were discussed by the researchers and a consensus was reached with the opinion of a fourth researcher (JE), if necessary. Following study recruitment, the respective data of all included studies were extracted via Microsoft Excel. A third reviewer (MG) independently assessed and verified all data extraction. Baseline and postintervention mean (SD) SBP and DBP data were initially extracted owing to the common absence of change data being reported in exercise training and blood pressure RCTs. As required for NMAs, we acquired mean change from the baseline and postintervention values. Following the *Cochrane Handbook for Systematic Reviews of Interventions* (Chapter 6),[33] we aimed to calculate SD change from standard errors, 95% CIs, p values or t statistics where available. When studies did not report any such data, SD change was calculated using a correlation coefficient of 0.8 as previously tested and validated in a similar dataset.[22]

Following the participants, interventions, comparators, outcomes PICO) framework, the population included adult humans with no predetermined limitations on health or disease state in representation of the general population, which ensured we did not unnecessarily exclude any potentially valuable data. Considering the intervention, comparator and outcome of this work, trials were determined eligible if they were appropriately randomised, and reported pre- and postintervention SBP and/or DBP in both the exercise and non-intervention control group. To minimise confounding, any considerable dietary, counselling or exercise influence in the non-intervention control group resulted in exclusion. Similarly, studies containing concurrent co-interventions to exercise (such as supplementation or medication changes) were excluded. Only trials published in peer-reviewed journals were considered and thus dissertation theses were not eligible. Studies that might appear eligible but were excluded are available on request from the corresponding author (with the reason for exclusion).

For consistency, the exercise protocol/intensity of each included paper was screened against the Exercise Prescription in Everyday Practice and Rehabilitative Training (EXPERT) tool[34] to be defined and categorised. All protocols were then stratified into one of the following primary exercise mode categories: 'aerobic exercise training' (AET), 'dynamic resistance training' (RT), 'combined training' (CT), 'high-intensity interval training' (HIIT) and 'isometric exercise training' (IET). Each category was then further explored for appropriate subgroups, allowing for the analysis of walking, running and cycling as AET subgroups, sprint interval training (SIT) and aerobic interval training (AIT) as HIIT subgroups, and isometric handgrip (IHG), isometric leg extension (ILE) and isometric wall squat (IWS) as IET subgroups. IET programmes commonly employ protocols of 4×2 min contractions, separated by 1–4 min rest intervals, performed three times a week. IHG is often prescribed at 30% maximum voluntary contraction, while IWS and ILE protocols are typically performed at 95% of the peak heart rate achieved during a laboratory-based maximal incremental isometric exercise test. The IWS may also be prescribed using a self-selected wall squat, with a knee joint angle that would elicit a rate of perceived exertion (RPE) of 3.5–4.5/10 for bout 1; RPE 5–6/10 for bout 2; RPE of 6.5–7.5/10 for bout 3 and RPE of 8–9/10 for bout 4. This review defines HIIT as 'episodic short bouts of high-intensity exercise separated by short periods of recovery at a lower intensity'.[35] As subgroups of HIIT, SIT was defined as an 'all-out' maximal, low-volume protocol, whereas aerobic interval training AIT consisted of 4×4 min protocols of a lower intensity.

For baseline blood pressure stratified analyses, all included studies were categorised as normotension, prehypertension or hypertension based on the baseline SBP and DBP of both the intervention and control group. In accordance with the European Society of Hypertension/European Society of Cardiology (ESC/ESH) guidelines,[5] the SBP and DBP status subgroups were categorised as normotension, prehypertension or hypertension, with values equal to <130/85 mm Hg, 130–139/85–89 mm Hg or >140/90 mm Hg, respectively. Studies in which the intervention and control groups differed in baseline blood pressure categories were excluded from this analysis.

Study quality

Risk of bias and methodological rigour were evaluated using the TESTEX scale.[36] TESTEX is a 15-point (12 item) tool designed for the assessment of exercise training trials. As previously demonstrated in such large-scale reviews,[22] a random 10% sample of trials from each exercise mode was selected for risk of bias assessment. Two reviewers (AD and JE) independently scored all selected articles. Any disputes in quality analyses were resolved by consensus.

Statistical analysis

The pairwise meta-analyses were performed using Comprehensive Meta-Analysis, version 3 (Biostat, Englewood, New Jersey, USA). A pooled analysis was separately performed for each of the primary (AET, RT, CT, HIIT, IET) and secondary (walking, cycling, running, SIT, AIT, IHG, IWS and ILE) exercise mode groups to establish the weighted mean difference (WMD) in SBP and DBP between the exercise group and the non-intervention controls. Parallel pooled analyses were also performed in only those studies free from any cardiovascular or other disease. Each primary exercise mode group was then further dichotomised by categorisation of baseline blood pressure and separately analysed. Meta-regression analyses were performed to ascertain if any study-level moderator variables influenced blood pressure change and explain any of the observed interstudy variance in outcomes. The selected moderators to be run independently were intervention duration (in weeks), training frequency (sessions per week) and training compliance (mean percentage of prescribed sessions attended). Statistical heterogeneity was always tested alongside the pooled analysis and reported as the I^2 statistic. A significance threshold of 40% was applied to the I^2 statistic.[37] Once past this threshold, post hoc tests such as Egger's regression test (1997) was systematically planned to assess the presence of funnel plot asymmetry to account for potential publication bias.[38] The selection of fixed or random effects approaches were dependent on the presence of heterogeneity, with random effects analysis applied when interstudy variability was confirmed through significant heterogeneity. The results of the pooled analysis were considered significant with a p value of <0.05 and a Z-value of >2.

To facilitate the comparison of exercise modes that have not been directly compared in RCT's and enhance the precision of comparative effect estimates (via the inclusion of both direct and indirect data), we performed NMAs. Bayesian NMAs were performed via the MetaInsight tool (version V4.0.2).[39] MetaInsight is an interactive web-based tool powered by Rshiny which uses R packages 'gemtc' and 'BUGSnet' for Bayesian statistical calculations. This analysis runs Markov chain Monte Carlo simulations with four chains and a total of 25 000 iterations (burn-in period of 5000). Convergence of the model was tested via the Gelman-Rubin convergence assessment.[40] Based on pre-established interstudy heterogeneity, random-effects analyses of WMD were selected. Inconsistency between direct and indirect effect size comparisons were assessed via node-splitting models[41] with corresponding Bayesian P values. Residual deviance plots for the NMA with consistency models and unrelated mean effect inconsistency models were produced. For any studies with large residual deviance (>2), further exploration was planned and exclusion in a sensitivity analysis. To assess the moderator effect of baseline SBP and DBP, Bayesian NMA meta-regression analyses were separately performed using WinBUGS version 1.4.[42]

Separate NMAs were run by primary exercise mode categorisation (AET, RT, CT, HIIT and IET), and then via secondary exercise subgroup categorisation (walking, running, cycling, RT, CT, SIT, AIT, IHG, ILE, IWS). As there was no pre-established secondary exercise mode categorisation for RT and CT, these were included in both analyses. Network diagrams were produced to visualise the direct and indirect comparisons across different exercise modes. NMA data are reported as mean effect with 95% credible intervals. Ranking probability analyses were performed, with surface under the cumulative ranking curve (SUCRA) values generated for each exercise mode and submode, and displayed as litmus rank-o-gram SUCRA plots.[43]

Equity, diversity, and inclusion statement

Our study included all identified randomised controlled trials of exercise training for the management of blood pressure, inclusive of all genders, race/ethnicities and socioeconomic levels. Our author team consisted of two women and five men from different disciplines (medical research, sport and exercise science, population health), including three authors considered junior scholars. Our research methods were not altered based on regional, educational or socioeconomic differences.

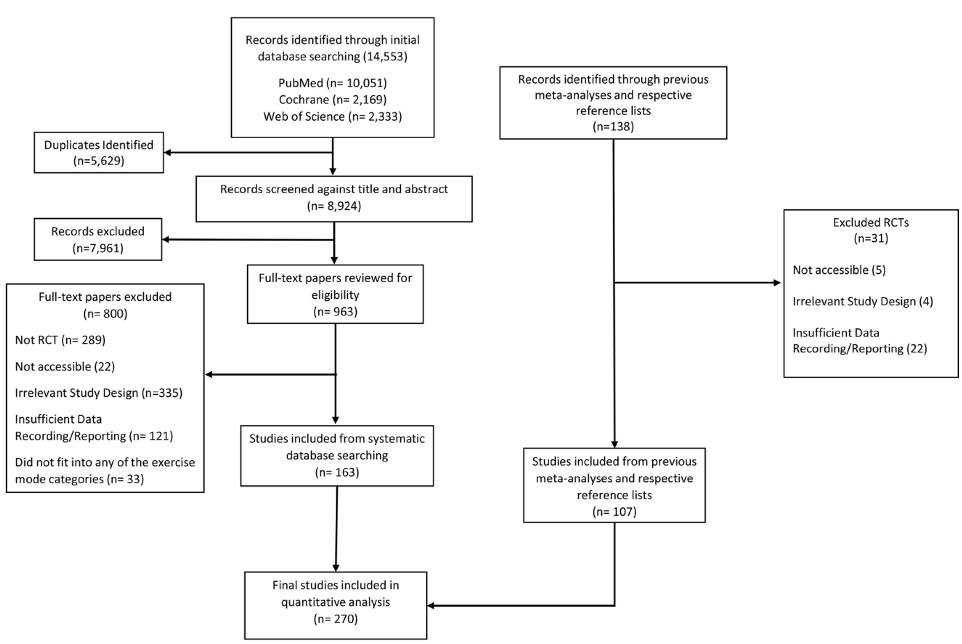

Figure 1 PRISMA systematic review and meta-analysis flow chart. RCT, randomised controlled trial.

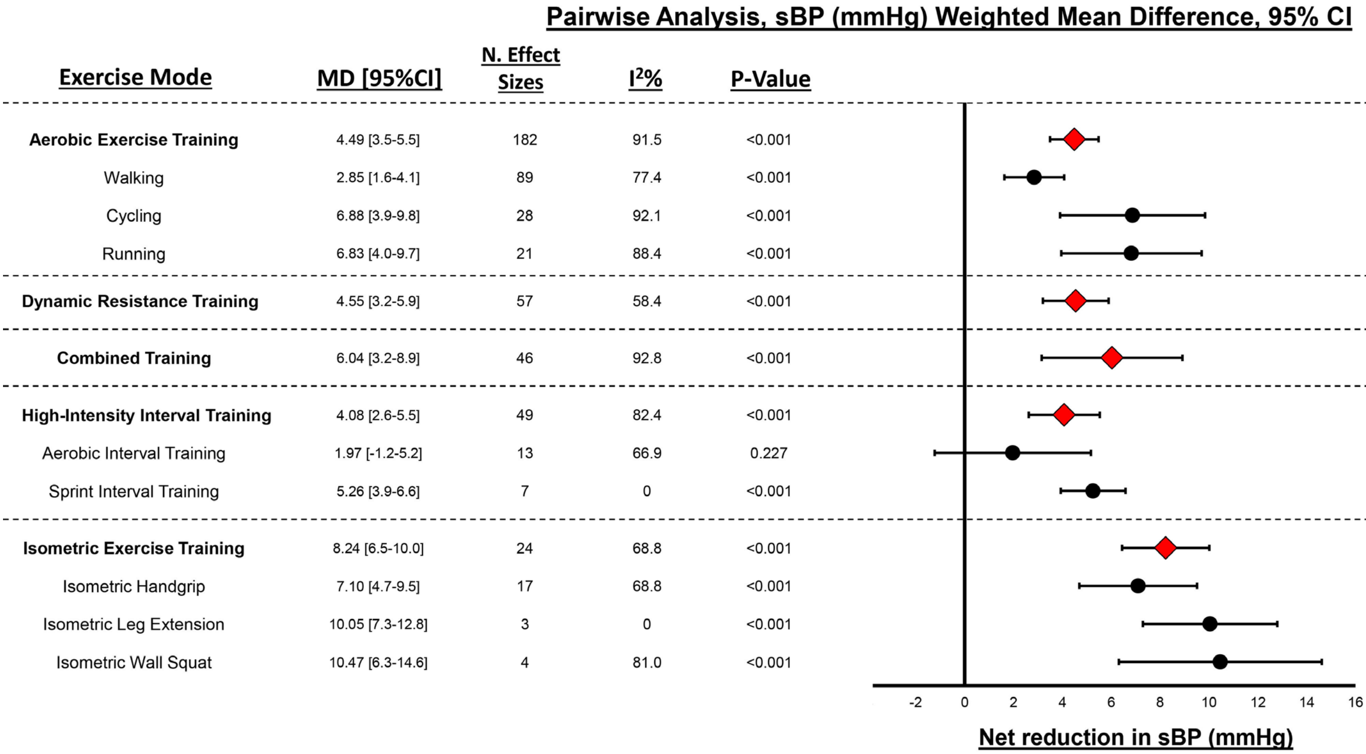

Figure 2 Forest plot depicting overall effects of each primary and secondary exercise mode on systolic blood pressure (SBP).

RESULTS

Figure 1 shows the PRISMA systematic review flow chart. The initial systematic search identified 14553 trials, with an additional 138 trials discovered through screening of previous meta-analyses and their respective reference lists. Following all exclusions, 270 exercise training RCTs were ultimately included, constituting an analysed sample of 15827 (7632 controls) participants. The analysis involved 358 effect sizes, including 182 AET (89 walking, 28 cycling, 21 running and 44 'Other' AET), 57 RT, 46 CT, 49 HIIT (of which 7 are SIT and 13 are AIT) and 24 IET (17 IHG, 4 IWS, 3 ILE).

The full TESTEX risk of bias assessment scoring can be found in online supplemental table S1. The TESTEX assessment demonstrated several consistent limitations throughout the exercise training literature. In particular, most trials failed to monitor control group activity or perform intention-to-treat analysis when appropriate. Study and training characteristics of all 270 trials are presented in online supplemental table S2. For sensitivity and comparative purposes, we also ran parallel primary analyses excluding all diseases (such as type 2 diabetes). Importantly, the inclusion/exclusion of such diseases does not meaningfully influence the overall results, instead often generating wider CIs following the omission of useful data (see online supplemental table S4). Heterogeneity results for each analysis can be found within the respective figures. Sensitivity analysis was performed for the primary outcomes using the in-built Comprehensive Meta-Analysis 'one-study removed' analysis method, which did not significantly influence any of the overall effect sizes.

Pairwise analyses

Figure 2 displays the overall SBP reductions following each exercise mode compared with the control group. There was a significant reduction in SBP following all modes of AET, with an overall reduction of 4.49 mm Hg (95% CI 3.5 to 5.5, Z=8.8, p_{random}<0.001), 2.85 mm Hg for walking, 6.88 mm Hg for cycling and 6.83 mm Hg for running. The post hoc Egger's test was significant for overall AET SBP publication bias (online supplemental figure S1). There were significant reductions in SBP following RT by 4.55 mm Hg (95% CI 3.2 to 5.9, Z=6.6, p_{random}<0.001), and CT by 6.04 mm Hg (95% CI 3.2 to 8.9, Z=4.1, $_{prandom}$<0.001). While there were significant SBP reductions following overall HIIT by 4.08 mm Hg (95% CI 2.6 to 5.5, Z=5.5, p_{random}<0.001) and SIT by 5.26 mm Hg, AIT did not significantly change. All IET modes produced significant reductions in SBP, with an overall reduction of 8.24 mm Hg (95% CI 6.5 to 10.0, Z=9.0, $_{prandom}$<0.001), 7.10 mm Hg for IHG, 10.05 mm Hg ILE and 10.47 mm Hg for IWS.

Figure 3 displays the overall DBP reductions following each exercise mode compared with the control group. There was a significant reduction in DBP following all modes of AET, with an overall reduction of 2.53 mm Hg (95% CI 1.8 to 3.2, Z=7.3, $_{prandom}$<0.001), 1.44 mm Hg for walking, 3.20 mm Hg for cycling and 5.67 mm Hg for running. The post hoc Egger's test was significant for overall AET DBP publication bias (online supplemental figure S2). There were significant reductions in DBP following RT by 3.04 mm Hg (95% CI 2.2 to 3.9, Z=6.9, p_{random}<0.001), and CT by 2.54 mm Hg (95% CI 1.1 to 4.0, Z=3.4, $_{prandom}$=0.001). While there were significant DBP reductions following overall HIIT by 2.50 mm Hg (95% CI 1.2 to 3.8, Z=3.8, p_{random}<0.001) and SIT by 3.29 mm Hg (95% CI 0.1 to 6.5, Z=2.0, p_{random}=0.043), AIT did not significantly change. All IET modes produced significant reductions in DBP, with an overall reduction of 4.0 (95% CI 2.7 to 5.3, Z=6.0, p_{random}<0.001), 3.46 mm Hg for IHG, 4.23 ILE and 5.33 for IWS. The post hoc Egger's test was significant for overall IET DBP publication bias (online supplemental figure S3).

Figure 4 shows the SBP reductions for each exercise mode stratified by baseline blood pressure status. All analyses were statistically significant except the prehypertension group analysis

dBP (mmHg) Weighted Mean Difference, 95% CI

Exercise Mode	MD [95%CI]	N. Effect Sizes	I²%	P-Value
Aerobic Exercise Training	2.53 [1.8-3.2]	176	91.54	<0.001
Walking	1.44 [0.7-2.2]	83	74.12	<0.001
Cycling	3.2 [1.8-4.6]	28	91.39	<0.001
Running	5.67 [3.9-7.5]	21	82.83	<0.001
Resistance Training	3.04 [2.2-3.9]	57	66.61	<0.001
Combined Training	2.54 [1.1-4.0]	45	85.45	0.001
High-Intensity Interval Training	2.50 [1.2-3.8]	47	91.11	<0.001
Aerobic Interval Training	2.60 [-0.5-5.7]	12	83.92	0.105
Sprint Interval Training	3.29 [0.1-6.5]	7	66.62	0.043
Isometric Exercise Training	4.0 [2.7-5.3]	24	63.67	<0.001
Isometric Handgrip	3.46 [1.7-5.2]	17	71.31	<0.001
Isometric Leg Extension	4.23 [1.4-7.0]	3	0.00	<0.001
Isometric Wall Squat	5.33 [3.6-7.0]	4	23.47	<0.001

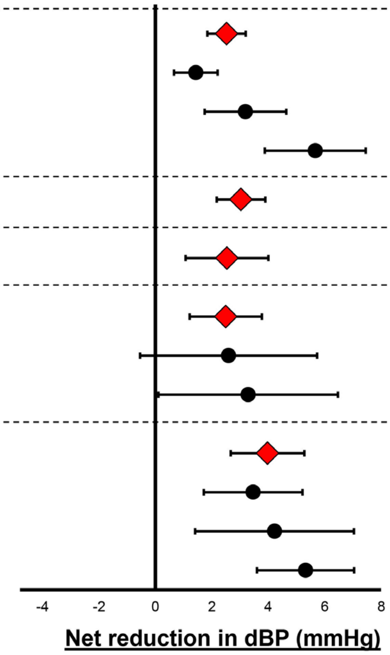

Figure 3 Forest plot depicting overall effects of each primary and secondary exercise mode on diastolic blood pressure (DBP).

for CT and HIIT. While all exercise modes demonstrated statistically significant reductions in SBP in normal blood pressure cohorts, all reductions were substantially larger in those with hypertension. Such baseline category stratified analysis was not feasible in DBP due to limited data.

As shown in online supplemental table S3, there was a significant SBP moderator interaction for AET, with a lower training frequency associated with a greater blood pressure reduction (B=−1.0596, p=0.019). There was no significant moderator

sBP (mmHg) Weighted Mean Difference, 95% CI, Exercise Category Pairwise Sub-Analysis

Exercise Mode Sub-group	MD [95%CI]	N. Effect Sizes	I²%	P-Value
Aerobic Exercise Training				
Normal Blood Pressure	3.60 [2.5-4.7]	69	69.80	<0.001
Pre-Hypertension	3.91 [2.3-5.6]	36	70.31	<0.001
Hypertension	7.74 [5.8-9.6]	31	92.91	<0.001
Resistance Training				
Normal Blood Pressure	2.86 [1.1-4.6]	32	48.04	<0.001
Pre-Hypertension	5.91 [2.4-9.4]	10	55.85	<0.001
Hypertension	6.32 [3.1-9.5]	9	69.55	<0.001
Combined Training				
Normal Blood Pressure	2.05 [0.6-3.5]	14	11.84	0.006
Pre-Hypertension	1.15 [-1.4-3.7]	10	47.55	0.37
Hypertension	11.14 [4.3-18.0]	14	96.30	0.001
High-Intensity Interval Training				
Normal Blood Pressure	3.92 [1.7-6.1]	25	86.78	<0.001
Pre-Hypertension	2.40 [-1.3-6.1]	8	81.07	0.209
Hypertension	6.59 [3.1-10.1]	7	48.82	<0.001
Isometric Exercise Training				
Normal Blood Pressure	6.65 [4.7-8.6]	7	0	<0.001
Pre-Hypertension	10.93 [9.3-12.6]	6	0	<0.001
Hypertension	9.22 [4.9-13.5]	4	48.36	<0.001

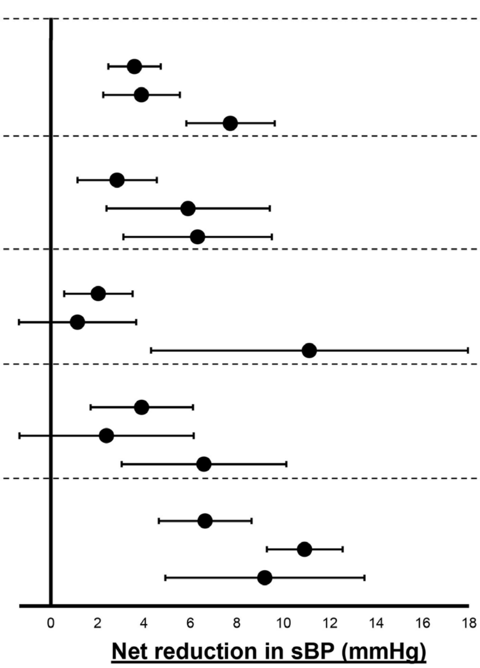

Figure 4 Forest plot depicting overall effects of each primary exercise mode on systolic blood pressure (SBP) stratified via baseline blood pressure category.

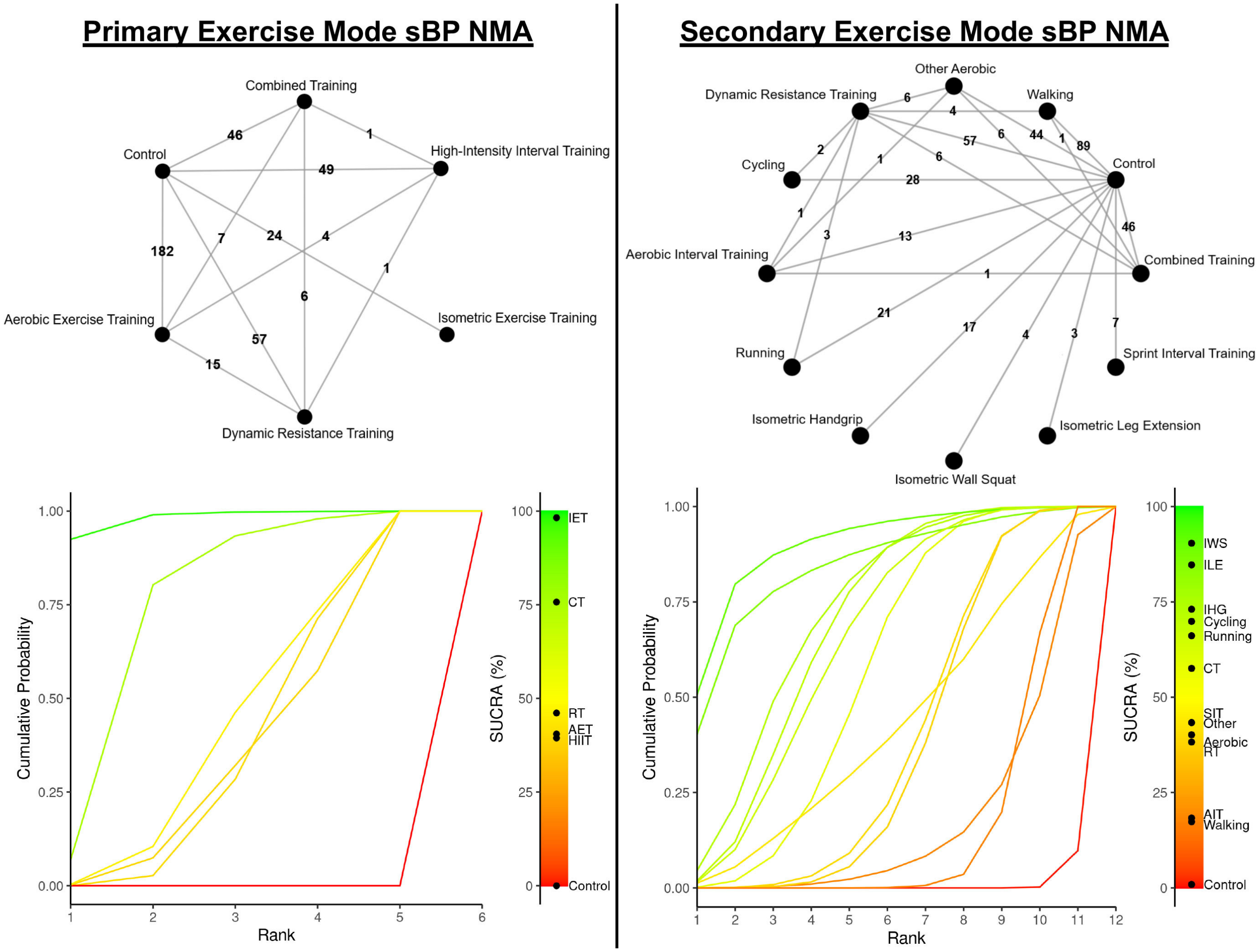

Figure 5 Network diagrams depicting the direct and indirect comparisons for the primary and secondary network meta-analyses and corresponding Bayesian ranking panel plots. AET, aerobic exercise training; AIT, aerobic interval training; CT, combined training; HIIT, high-intensity interval training; IET, isometric exercise training; IHG, isometric handgrip; ILE, isometric leg extension; IWS, isometric wall squat; NMA, network meta-analysis; RT, dynamic resistance training; SBP, systolic blood pressure; SIT, sprint interval training; SUCRA; surface under the cumulative ranking curve.

effect of intervention duration, training frequency or training compliance for any of the other exercise modes.

Network meta-analyses

Figure 5 depicts the network diagrams with corresponding Bayesian ranking panel plots, while tables 1 and 2, online supplemental tables S9 and S10 detail the comparative NMA findings for the primary and secondary exercise SBP and DBP mode analyses, respectively. Advanced analysis results, including the tables of rank probabilities with SUCRA (online supplemental tables S5, S6, S11 and S12), inconsistency tests with node-splitting models (online supplemental tables S7, S8, S13 and S14) and the deviance report plots (online supplemental figures S4, S5, S8 and S9) can be found in the supplementary file. There was no evidence of inconsistency in the primary or secondary NMA.

The primary exercise mode SBP NMA included 305 two-arm studies, 24 multiarm trials and 11 direct comparisons. As seen in table 1 and the Bayesian treatment ranking (figure 5 and Table S5), the order of effectiveness based on SUCRA values were IET (SUCRA: 98.3%), CT (75.7%), RT (46.1%), AET (40.53%)

Table 1 Comparative network meta-analysis for the systolic blood pressure primary exercise modes

	AET	Control	CT	HIIT	IET	RT
AET	**AET**	4.37 (3.45, 5.28)	−1.55 (−3.53, 0.43)	0.1 (−1.84, 2.03)	−3.86 (−6.54,−1.19)	−0.18 (−1.96, 1.6)
Control	−4.37 (−5.28,−3.45)	**Control**	−5.92 (−7.71,−4.11)	−4.27 (−6.02,−2.52)	−8.24 (−10.74,−5.72)	−4.54 (−6.16,−2.93)
CT	1.55 (−0.43, 3.53)	5.92 (4.11, 7.71)	**CT**	1.65 (−0.85, 4.12)	−2.31 (−5.42, 0.77)	1.37 (−1, 3.72)
HIIT	−0.1 (−2.03, 1.84)	4.27 (2.52, 6.02)	−1.65 (−4.12, 0.85)	**HIIT**	−3.95 (−7.03,−0.93)	−0.28 (−2.64, 2.09)
IET	3.86 (1.19, 6.54)	8.24 (5.72, 10.74)	2.31 (−0.77, 5.42)	3.95 (0.93, 7.03)	**IET**	3.68 (0.71, 6.66)
RT	0.18 (−1.6, 1.96)	4.54 (2.93, 6.16)	−1.37 (−3.72, 1)	0.28 (−2.09, 2.64)	−3.68 (−6.66,−0.71)	**RT**

AET, aerobic exercise training; CT, combined training; HIIT, high-intensity interval training; IET, isometric exercise training; RT, dynamic resistance training.

Table 2 Comparative network meta-analysis for the systolic blood pressure secondary exercise modes

	AIT	Control	CT	Cycling	IHG	ILE	IWS	Other aerobic	RT	Running	SIT	Walking
AIT	**AIT**	2.53 (−0.9, 5.99)	−3.39 (−7.22, 0.49)	−4.36 (−8.51,−0.18)	−4.75 (−9.34,−0.18)	−7.32 (−14.99, 0.29)	−8 (−14.74,−1.22)	−2.2 (−6.03, 1.65)	−2.08 (−5.85, 1.7)	−4.07 (−8.4, 0.26)	−2.28 (−8.1, 3.55)	−0.29 (−3.98, 3.39)
Control	−2.53 (−5.99, 0.9)	**Control**	−5.91 (−7.72,−4.1)	−6.88 (−9.22,−4.51)	−7.29 (−10.33,−4.21)	−9.84 (−16.72,−3.03)	−10.52 (−16.3,−4.7)	−4.73 (−6.55,−2.92)	−4.61 (−6.23,−2.98)	−6.61 (−9.21,−3.97)	−4.81 (−9.49,−0.15)	−2.82 (−4.13,−1.5)
CT	3.39 (−0.49, 7.22)	5.91 (4.1, 7.72)	**CT**	−0.97 (−3.9, 1.99)	−1.37 (−4.91, 2.2)	−3.92 (−11.03, 3.13)	−4.6 (−10.66, 1.5)	1.19 (−1.3, 3.65)	1.31 (−1.06, 3.65)	−0.69 (−3.86, 2.51)	1.11 (−3.93, 6.11)	3.1 (0.86, 5.29)
Cycling	4.36 (0.18, 8.51)	6.88 (4.51, 9.22)	0.97 (−1.99, 3.9)	**Cycling**	−0.39 (−4.24, 3.46)	−2.95 (−10.29, 4.28)	−3.65 (−9.92, 2.68)	2.15 (−0.85, 5.12)	2.28 (−0.57, 5.09)	0.28 (−3.26, 3.82)	2.08 (−3.19, 7.29)	4.06 (1.36, 6.74)
IHG	4.75 (0.18, 9.34)	7.29 (4.21, 10.33)	1.37 (−2.2, 4.91)	0.39 (−3.46, 4.24)	**IHG**	−2.57 (−10.09, 4.96)	−3.24 (−9.83, 3.38)	2.56 (−1.04, 6.11)	2.67 (−0.78, 6.15)	0.67 (−3.35, 4.72)	2.49 (−3.15, 8.02)	4.46 (1.13, 7.79)
ILE	7.32 (−0.29, 14.99)	9.84 (3.03, 16.72)	3.92 (−3.13, 11.03)	2.95 (−4.28, 10.29)	2.57 (−4.96, 10.09)	**ILE**	−0.68 (−9.69, 8.3)	5.11 (−1.96, 12.21)	5.21 (−1.77, 12.31)	3.23 (−4.09, 10.58)	5.04 (−3.19, 13.34)	7.01 (0.04, 14.05)
IWS	8 (1.22, 14.74)	10.52 (4.7, 16.3)	4.6 (−1.5, 10.66)	3.65 (−2.68, 9.92)	3.24 (−3.38, 9.83)	0.68 (−8.3, 9.69)	**IWS**	5.79 (−0.33, 11.87)	5.9 (−0.13, 11.96)	3.92 (−2.5, 10.31)	5.71 (−1.71, 13.18)	7.7 (1.69, 13.67)
Other aerobic	2.2 (−1.65, 6.03)	4.73 (2.92, 6.55)	−1.19 (−3.65, 1.3)	−2.15 (−5.12, 0.85)	−2.56 (−6.11, 1.04)	−5.11 (−12.21, 1.96)	−5.79 (−11.87, 0.33)	**Other aerobic**	0.12 (−2.23, 2.48)	−1.87 (−5.05, 1.32)	−0.08 (−5.08, 4.94)	1.91 (−0.32, 4.16)
RT	2.08 (−1.7, 5.85)	4.61 (2.98, 6.23)	−1.31 (−3.65, 1.06)	−2.28 (−5.09, 0.57)	−2.67 (−6.15, 0.78)	−5.21 (−12.31, 1.77)	−5.9 (−11.96, 0.13)	−0.12 (−2.48, 2.23)	**RT**	−2 (−5, 1.03)	−0.19 (−5.16, 4.73)	1.79 (−0.28, 3.84)
Running	4.07 (−0.26, 8.4)	6.61 (3.97, 9.21)	0.69 (−2.51, 3.86)	−0.28 (−3.82, 3.26)	−0.67 (−4.72, 3.35)	−3.23 (−10.58, 4.09)	−3.92 (−10.31, 2.5)	1.87 (−1.32, 5.05)	2 (−1.03, 5)	**Running**	1.79 (−3.6, 7.08)	3.79 (0.83, 6.72)
SIT	2.28 (−3.55, 8.1)	4.81 (0.15, 9.49)	−1.11 (−6.11, 3.93)	−2.08 (−7.29, 3.19)	−2.49 (−8.02, 3.15)	−5.04 (−13.34, 3.19)	−5.71 (−13.18, 1.71)	0.08 (−4.94, 5.08)	0.19 (−4.73, 5.16)	−1.79 (−7.08, 3.6)	**SIT**	1.98 (−2.84, 6.83)
Walking	0.29 (−3.39, 3.98)	2.82 (1.5, 4.13)	−3.1 (−5.29,−0.86)	−4.06 (−6.74,−1.36)	−4.46 (−7.79,−1.13)	−7.01 (−14.05,−0.04)	−7.7 (−13.67,−1.69)	−1.91 (−4.16, 0.32)	−1.79 (−3.84, 0.28)	−3.79 (−6.72,−0.83)	−1.98 (−6.83, 2.84)	**Walking**

AIT, aerobic interval training; CT, combined training; IHG, isometric handgrip; ILE, isometric leg extension; IWS, isometric wall squat; RT, dynamic resistance training; SIT, sSprint interval training.

and HIIT (39.44%). Comparatively, IET was significantly more effective at reducing SBP than AET (WMD: −3.86 mm Hg, 95% CI 1.19 to 6.54), HIIT (WMD: −3.95 mm Hg, 95% CI 0.93 to 7.03) and RT (WMD: −3.68 mm Hg, 95% CI 0.71 to 6.66). There were no other significant differences between primary exercise modes for SBP. In agreement with the pairwise meta-analysis, the NMA meta-regression demonstrated a significant moderator effect of baseline SBP across the exercise modes. Specifically, a single unit increase in mean baseline control group SBP increased the mean intervention change by 0.10 mm Hg (95% CI 0.05 to 0.15). A sensitivity analysis was run excluding a total of three trials with a residual deviance >2 (Figure S10). The effect size of CT was lower in the sensitivity analysis, thereby lowering its place in the Bayesian rankings compared with the primary analysis.

The secondary exercise mode SBP NMA included 282 two-arm studies, 21 multiarm trials and 21 direct comparisons. The order of effectiveness based on SUCRA values were IET IWS (90.4%), ILE (84.7%), IHG (73.1%), cycling (69.9%), running (66.1%), CT (57.6%), SIT (43.3%), other aerobic (40.1%), RT (38.2%), AIT (18.3%) and walking (17.4%). Comparatively, IWS, ILE, IHG, CT, cycling and running were all significantly more effective than walking. IWS, IHG and cycling were also significantly more effective than AIT. There were no other significant SBP differences between secondary exercise modes.

The primary exercise mode DBP NMA included 296 two-arm studies, 24 multiarm trials and 11 direct comparisons. The order of effectiveness based on SUCRA values (Figure S6) were IET (89.0%), RT (67.6%), HIIT (51.5%), CT (46.7%) and AET (45.1%). Comparatively, there were no statistically significant differences between the primary exercise modes for DBP. In agreement with the pairwise meta-analysis, the NMA meta-regression demonstrated a significant moderator effect of baseline DBP across the exercise modes. Specifically, a single unit increase in mean baseline control group DBP increased the mean intervention change by 0.06 mm Hg (95% CI 0.01 to 0.12). A sensitivity analysis was run excluding a total of five trials with a residual deviance>2 (Figure S11). The effect size of CT improved while HIIT decreased in the sensitivity analysis, thereby increasing the place of CT and lowering HIIT in the Bayesian rankings compared with the primary analysis.

The secondary exercise mode DBP NMA included 274 two-arm studies, 21 multiarm trials and 21 direct comparisons. The order of effectiveness based on SUCRA values (Figure S7) were running (91.3%), IWS (86.1%), IHG (57.1%), ILE (56.2%), cycling (54.3%), SIT (54.2%), RT (52.1%), AIT (48.1%), other aerobic (46.9%), CT (38.0%) and walking (14.7%). Comparatively, IWS, RT, running, cycling and other aerobic were all significantly more effective than walking. Running was also significantly more effective than CT, cycling, other aerobic and RT. There were no other significant DBP differences between secondary exercise modes.

DISCUSSION

In this systematic review and NMA, we analysed all relevant RCT data, involving 270 trials and 15 827 participants, to establish optimal exercise prescription practices in the management of resting arterial blood pressure (see figure 6). Pairwise analyses demonstrated a significant reduction in resting SBP and DBP following all exercise modes except AIT. All modes demonstrated substantially larger reductions in hypertensive cohorts than those with normal baseline blood pressure. As shown by the primary NMA, the rank order of effectiveness based on SUCRA values for SBP were IET ranked highest followed by CT, RT, AET and HIIT. IET was also highest ranked in the DBP NMA, followed by RT, HIIT, CT and AET. NMA of the secondary exercise submodes for SBP found IWS to be the most effective, followed by ILE, IHG, cycling, running, CT, SIT, other aerobic, RT, AIT and finally, walking. The DBP secondary NMA found running to be the most effective submode, followed by IWS, IHG, ILE, cycling, SIT, RT, AIT, other aerobic, CT and walking.

To our knowledge, only two previous large-scale meta-analyses of similar proportion have been performed.[21 22] However, the present study is the first to incorporate HIIT as a novel exercise mode, as well as provide advanced submode analyses of walking, cycling, running, SIT, AIT, IHG, ILE and IWS for the purpose of exercise prescription optimisation. Cornelissen *et al*[21] similarly reported IET to be the most effective exercise mode, but largely differed in magnitude for all other mode analyses, which is probably attributable to the substantial number of newer trials included in the present analysis. This is supported by the more recent Naci *et al*[22] NMA, which did not assess DBP, but showed more homogeneous AET, RT and CT SBP changes than in the present work. Given the emphasis placed on the Cornelissen and Smart[21] study in both the ESC/ESH[5] and American College of Cardiology/American Heart Association (ACC/AHA)[4] blood pressure management guidelines, the findings of the present study, combined with that of Naci *et al*,[22] suggest the need for an exercise recommendation guideline update.

A previous meta-review from Hanssen *et al*[44] sought to identify optimal personalised exercise prescription practices in the prevention and treatment of hypertension by indirectly comparing meta-analysis data from varying exercise modes. Differentially, our work applied a more direct approach in statistically comparing all individual RCTs. As such, our differences in findings, particularly for IET, may be in part attributed to the inevitable reliance of Hanssen *et al*[44] on older meta-analysis data to summarise the current effectiveness of IET,[45–47] as well as the inherent limitations of indirect meta-analytic comparisons. In particular, this previous umbrella review showed the inequitable over-representation of AET and RT meta-analysis research, concurrent with the under-representation of IET, CT and HIIT meta-analysis work, resulting in dependence on inadequately powered and dated systematic review and meta-analysis data to draw comparative conclusions.[44] As our analysis sourced the data directly from each RCT, this limiting gap between the dissemination of RCT data and its eventual transfer into published meta-analysis research was not present in our work.

Importantly, this updated analysis now provides large-scale data establishing CT as an effective exercise mode in reducing blood pressure, a mode which was previously considered inconclusive due to insufficient evidence.[21] Naci *et al*[22] previously reported similar SBP changes, but without any DBP data to support, while Hanssen *et al*[44] also provided support for CT but could only make limited comparative inferences on the basis of a single meta-analysis.[48] While the reductions observed from CT ostensibly appear somewhat comparable to those of IET, our novel analysis demonstrates that this magnitude of SBP reduction following CT is predominantly moderated by the greater prevalence of hypertensive populations included within the analysis. Indeed, the magnitude of change is underwhelming in those studies of normal blood pressure and prehypertensive cohorts, and the NMA SBP sensitivity analysis revealed the fragile nature of this body of data. Separately, and conversely to previous reports,[21] RT now appears comparable to AET in reducing resting blood pressure. However, it should be noted that the effectiveness of AET seems dependent on the submode

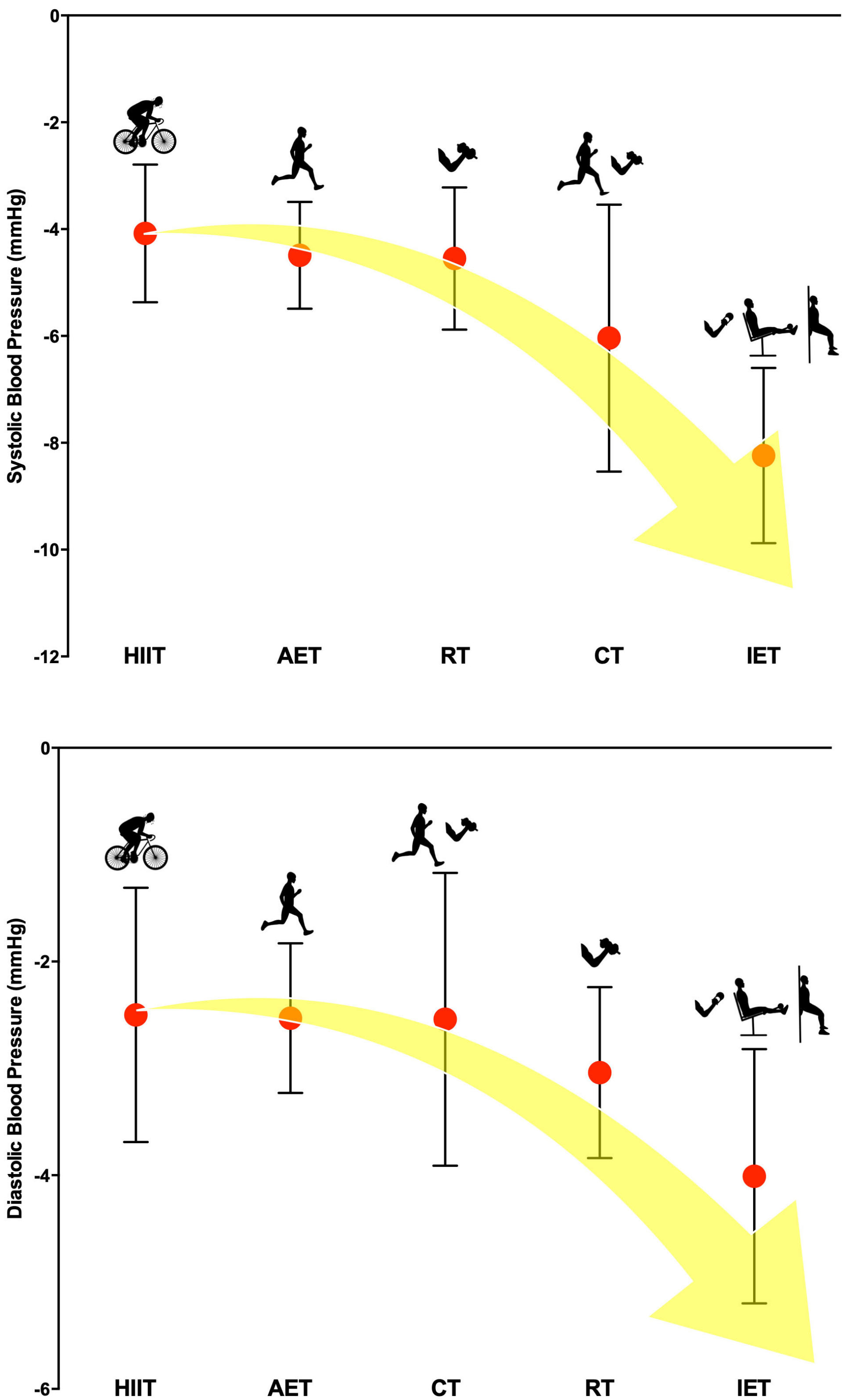

Figure 6 Central illustration. AET, aerobic exercise training; CT, combined training; HIIT, high-intensity interval training; IET, isometric exercise training; RT, dynamic resistance training.

performed, with cycling and running significantly more effective than walking AET. Our meta-regression analyses also reported the tendency for a greater SBP reduction with lower weekly training frequency in AET. Considering the interstudy differences in research protocols, the reason for this finding is unclear, but may provide loose support for the application of AET at a lower (eg, 3 times per week) frequency as opposed to extensive weekly volumes (≥5 times per week).

As a novel intervention, HIIT produced clinically relevant reductions in both SBP and DBP but ranked as the least effective among all primary modes for SBP. Secondary submode analyses (both pairwise and NMA) reveal the overarching SBP reductions to be primarily driven by SIT (low volume, maximal intensity intervals), while AIT (4×4 min intervals) failed to reach statistical significance for either SBP or DBP. This finding, combined with the comparative inferiority of walking against running and cycling AET, appears to highlight the need for higher intensity training to produce the greatest blood pressure reductions.

Similarly to IET, HIIT has recently generated substantial research interest due to its time-efficient and convenient nature, suggesting, although not without some disagreement,[49] the potential for increased adoption and adherence, with both modes having promising future clinical utility.[50–54] However, the outcomes of this analysis support our previous work,[24] which concluded that IET was the superior antihypertensive exercise mode. While IET may still require larger-scale longitudinal RCTs,[51 55] its clinical implementation as the primary recommended exercise mode in managing blood pressure in normotensive, prehypertensive and hypertensive individuals is supported by the present results. Importantly, the previous work of Cornelissen and Smart[21] included only four IET trials in 2013. Since then, a number of IET trials and subsequent meta-analyses over the previous decade have been published,[24 45 56–58] with the present study including 19 RCTs. Subsequently, the confidence interval of this finding has substantially narrowed,[59] providing more accurate SBP and DBP effect sizes of 8.2 and 4.0 mm Hg, respectively, which is comparable to standard-dose antihypertensive monotherapy.[60 61]

Of interest, the NMA findings highlight the IWS as more effective than the traditionally employed IHG. Despite the support of this analysis for IET, a degree of caution when interpreting these findings is advised given the current disparity in the quantity of trials analysed.[56] As seen in figure 5, the NMA included no direct comparative IET data. Previous trials that did not meet the inclusion criteria of this analysis have indeed shown conflicting results regarding the comparative effectiveness of IET against current exercise guidelines,[62 63] which requires consideration when interpreting these findings.

Limitations

Several limitations of this study should be acknowledged. Although only RCTs were included in this analysis, our TESTEX risk of bias assessment demonstrated several limitations consistent across the exercise training literature, including poor control group activity monitoring, missing intention-to-treat analyses and participant and investigator awareness on group allocation. Furthermore, with such a large analysis, we inevitably included trials of varying participant populations, statistical and methodological processes and exercise intervention specifics. As a likely consequence of this interstudy variability, we found significant heterogeneity for the majority of analyses. Additionally, we also found significant publication bias for overall AET SBP and DBP and IET DBP. Some of the more novel exercise modes, such as SIT, AIT, ILE and IWS involved an analysis of comparatively fewer RCTs than that of the more established modes such as AET and RT. As a result, these submodes could not be stratified and analysed by baseline blood pressure status. Finally, the majority of RCTs included in this analysis set a priori minimum attendance thresholds for inclusion in their analysis (eg, >80% of sessions completed). Therefore, our training compliance moderator analysis is, by default, not inclusive of low attendance rates, and these findings should be interpreted only in the context of assessing a compliance moderator effect among those individuals who are already adhering.

Conclusion

Aerobic exercise training, dynamic resistance training, combined training, high-intensity interval training and isometric exercise training are all significantly effective in reducing resting SBP and DBP. Comparatively, isometric exercise training remains the most effective mode. The findings of this analysis should inform future guideline recommendations.

Correction notice This article has been corrected since it published Online First. The article type has been changed to systematic review.

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Contributors JE and JO contributed to the conception and design of the study: contributed to the development of the search strategy; conducted the systematic review. JE, AD, MG and OA completed the acquisition of data. JE, NJC, and JO performed the data analysis. JE and JO were the principal writers of the manuscript. All authors contributed to the drafting and revision of the final article. All authors approved the final submitted version of the manuscript.

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Exercise training and resting blood pressure: a large-scale pairwise and network meta-analysis of RCTs

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Supplementary File

Appendix S1. Search Strategy

All searches were originally performed on 02/10/21 and subsequently updated on 03/02/2023.

PubMed:

10,051 results

Set 1: ("exercise"[MeSH Terms] OR "exercise training"[Text Word])

Set 2: ("blood pressure"[MeSH Terms] OR "arterial pressure"[Text Word])

Search Performed: #1 AND #2

Cochrane:

2,169 results

ID	Search	Hits
#1	MeSH descriptor: [Exercise] explode all trees	
#2	MeSH descriptor: [High-Intensity Interval Training] explode all trees	
#3	MeSH descriptor: [Walking] explode all trees	
#4	MeSH descriptor: [Jogging] explode all trees	
#5	MeSH descriptor: [Resistance Training] explode all trees	
#6	#1 OR #2 OR #3 OR #4 OR #5	
#7	MeSH descriptor: [Blood Pressure] explode all trees	
#8	MeSH descriptor: [Arterial Pressure] explode all trees	
#9	MeSH descriptor: [Hypertension] explode all trees	
#10	#7 OR #8 OR #9	
#11	**#6 AND #10**	**2169**

Web of Science:

2333 results (Web of Science Core Collection)

Set 1: TS=("exercise training")

Set 2: TS=("blood pressure") OR TS=("arterial pressure")

Search Performed: #1 AND #2

Table S1. Risk of bias TESTEX scoring.

Study name	Eligibility criteria specified	Randomisation specified	Allocation concealment	Groups similar at baseline	Assessors blinded	Outcome measures assessed >85% of participants	Intention to treat analysis	Between group statistical comparisons reported	Point estimates reported	Activity monitoring in control group	Relative exercise intensity review	Exercise volume & energy expended	Overall TESTEX
Albright et al., 1991	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	YES	9
Aoike et al., 2015	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	YES	9
Brandon & Elliot-Lloyd., 2006	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	YES	9
Brenner et al., 2019	YES	NO	NO	YES	NO	YES (3)	NO	YES (2)	YES	NO	YES	YES	10
Sohn et al., 2007	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	NO	NO	7
Wallis et al., 2016	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	YES	9
Goldberg et al., 2012	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	YES	9
Magalhães et al., 2019	YES	YES	NO	YES	YES	YES (2)	NO	YES (2)	YES	NO	YES	YES	11
Mora-Rodriguez et al., 2017	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	YES	9
Foulds et al., 2014	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	NO	NO	7

Tsai et al., 2004	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	NO	YES	8
Blumenthal et al., 1991	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	YES	9
Fenkci et al., 2006	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	YES	9
Guimaraes et al., 2010	YES	YES	NO	YES	YES	YES (2)	NO	YES (2)	YES	NO	YES	YES	11
Yavari et al., 2012	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	YES	9
Beltran Valls et al., 2013	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	YES	9
Conceicao et al., 2013	YES	NO	NO	YES	NO	YES (1)	NO	YES (2)	YES	NO	YES	YES	8
DeVallance et al., 2016	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	YES	9
Olson et al., 2006	YES	YES	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	YES	10
Venojarvi et al., 2013	YES	NO	NO	YES	NO	YES (1)	NO	YES (2)	YES	NO	YES	YES	8
Figueroa et al., 2011	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	YES	9
Seo et al., 2010	YES	NO	NO	YES	NO	YES	NO	YES (2)	YES	NO	YES	YES	8
Park et al., 2020	YES	YES	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	YES	10
Shiotsu et al., 2018	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	YES	9

Taylor (2018)	YES	NO	NO	YES	NO	YES (1)	NO	YES (2)	YES	NO	YES	NO	7
Yamagata et al (2020)	YES	YES	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	YES	NO	9
O'Driscoll (2018)	YES	NO	NO	YES	YES	YES (1)	NO	YES (2)	YES	NO	NO	YES	8
Edwards et al (2020)	YES	NO	NO	YES	NO	YES (2)	NO	YES (2)	YES	NO	NO	YES	8
Sandstad et al (2015)	YES	YES	NO	YES	NO	NO	NO	YES (2)	YES	NO	YES	YES	8
May (2018)	YES	NO	YES	YES	NO	YES (1)	NO	YES (2)	YES	NO	NO	YES	8

Note: Black= Walking trials, Gold= Cycling, Dark Blue= Running, Orange= 'Other' Aerobic, Purple= Resistance Training, Green= Combined Training, Red= Isometric Exercise Training, Light Blue= High intensity Interval Training

Table S2. Study and Training Characteristics.

Study	Country	Population	Mode	Intensity	Duration weeks	Freq p/w
Walking						
Albright et al., 1991	USA	Healthy	Walking	65-77% Peak Hr from Baseline Test	24	5
Aoike et al., 2015	BRAZIL	Chronic Kidney Disease	Walking	40-60% Minimum Vo2	12	3
Araiza et al., 2006	USA	T2D	Walking	Nr	6	5
Arca et al., 2014	BRAZIL	Hypertensive Postmenopausal	Walking	50-60%Hrr	12	3
Arija et al., 2017	SPAIN	Primary Care	Walking	396Mets/Min/Week	36	2
Arora et al., 2009	INDIA	Type 2 Diabetes	Walking	Nr	8	3
Asikainen et al., 2003	FINLAND	Postmenopausal Women	Walking	Up To 65% Max Aerobic Power	10	5
Baker et al., 2008	UK	Healthy	Walking	12 To 14 On Borg Scale	12	5
Baross et al., 2017	UK	Healthy	Walking	6.5Km/H	6	4
Bell et al., 2010	CANADA	Healthy	Walking	5600-10000 Steps Per Day	24	7
Braith et al., 1994	USA	Normotensives	Walking	50-70% Hrr or 50-85% Hrr	26	3
Brandon & Elliot-Lloyd., 2006	USA	Sedentary Women	Walking	Nr	18	3
Brenner et al., 2019	CANADA	Peripheral Artery Disease	Walking	<40% Hrr	12	5
Brixius et al., 2008	GERMANY	Overweight Men 50-60 Y/O	Walking	2-4 Mmol/L Lactate	24	3
Brown et al., 2014	UK	Healthy	Walking	Nr	8	2
Chiang et al., 2019	TAIWAN	Obese	Walking	12000 Steps/Day, 103Steps/Min^-1	8	5
Coghill et al., 2008	UK	Hypercholesterolemia Men	Walking	12000 Steps Per Day	12	5
Cooper et al., 2000	UK	Hypertension	Walking	150-200Kcal Daily	6	5
Dalleck et al., 2009	USA	Post-Menopausal Women	Walking	50% Vo2R	12	5
Duncan et al., 1991	USA	Sed Premenopausal	Walking	8Kmh	24	5
Foulds et al., 2014	GERMANY	Active Participants	Walking	Nr	13	1-3
Fritz et al., 2013	SWEDEN	T2D	Walking	Pace That Caused Slight Shortness of Breath	16	Nr
Goldie et al., 2012	CANADA	Hypertensives	Walking	Less Than 40%Hrr	12	7

Gradidge & Golele., 2018	SOUTH AFRICA	Healthy Women	Walking	Nr	12	3
Hamdorf et al., 1999	AUSTRALIA	Elderly Women	Walking	40-60%Hrr	24	2
He et al., 2018	CHINA	Elderly Essential Hypertension	Walking	40-50 Vo2Max	12	3
Headley et al., 2017	USA	Chronic Kidney Disease	Walking	50-60% Vo2 Peak	16	3
Herzig et al., 2014	FINLAND	Pre-Diabetes	Walking	3-4Kmh	12	3
Higashi et al., 1999	JAPAN	Hypertension	Walking	Around 50% Vo2Max	12	5-7
Hur et al., 2014	KOREA	Type D Personality	Walking	60-70% Hr Max	40	3
Khalid et al., 2013	LYBIA	Postmenopausal	Walking	60-75%Hrmax	8	3
Koh et al., 2010	AUSTRALIA	Hemodialysis Patients	Walking	12-13 Borg Scale	24	3
Kucio et al., 2017	POLAND	Hypertensive	Walking	40-70 Maximum Hr	4	5
Kurban et al., 2011	TURKEY	T2D	Walking	Nr	12	3
Latosik et al., 2014	POLAND	Hypertensive Postmenopausal	Walking	40-70%	8	nr
Lee et al., 2007	TAIWAN	Hypertensives	Walking	Nr	24	nr
Lim et al., 2015	SOUTH KOREA	Night Shift Workers	Walking	60-79% Maximal Hr	10	3
Murphy et al., 1998	IRELAND	Sed	Walking	70-80%Hrmax	10	5
Murphy et al., 2006	UK	Sedentary Civil Servants	Walking	Nr	8	2
Murtagh et al., 2005	UK	Healthy	Walking	Self-Reported Rpe	12	3
Myslivecek et al., 2002	CANADA	Premenopausal Women	Walking	13 Borg Scale Rpe	12	5
Nemoto et al., 2007	JAPAN	Older Adults	Walking	50%Vo2Peak	20	>4
Neumann et al., 2006	USA	Silent Myocardial Ischemia	Walking	70%Hrr	24	3
Palmer et al., 1995	USA	Healthy	Walking	60-70%Hrmax	8	Nr
Pospieszna et al., 2017	POLAND	Postmenopausal	Walking	90% Ventilators Threshold	12	3
Punia et al., 2022	INDIA	Pre-Hypertensives and Hypertensives	Walking	60-70% Target Hr	8	3
Ready et al., 1996	CANADA	Postmenopausal	Walking	70-80%Hrmax or 60%Vo2Peak	24	3-5
Ruangthai & Phoemsapthawee., 2019	THAILAND	Hypertensives	Walking	60-70%Hrmax	12	3
Saptharishi et al., 2009	INDIA	Prehypertensive And Hypertensives	Walking	Nr	8	4
Serwe et al., 2011	USA	Healthy	Walking	60-70%Hrr	8	5-7

Shenoy et al., 2010	INDIA	T2D	Walking	60-70%Hrr or 50-70%Hrmax	8	5
Simons et al., 2006	USA	Elderly Adults	Walking	Nr	16	2
Sohn et al., 2007	USA	Hypertensive	Walking	Nr	26	5-7
Stutzman et al., 2010	CANADA	Pregnant	Walking	11-13 Rpe	16	5
Tudor-Locke et al., 2004	CANADA	T2D	Walking	Nr	12	4
Tully et al., 2005	IRELAND	Healthy Sed	Walking	Slightly Breathless	12	5
Tully et al., 2007	UK	Healthy Sed	Walking	Self-Paced	12	3-5
Tully et al., 2011	UK	University Students	Walking	15% Vo2 Max	6	7
Venojarvi et al., 2013	FINLAND	Men with Impaired Glucose Regulation	Walking	55-75% Hr Reserve	12	3
Venturelli et al., 2011	ITALY	Alzheimers	Walking	As Fast As Possible	24	4
Wallis et al., 2016	AUSTRALIA	Osteoarthritis, Increased Cardiovascular Risk	Walking	3 Rate of Perceived Exertion Scale	12	2
Wing et al., 1998	USA	Overweight	Walking	60%Vo2Peak or Up To 1500Kcal Per Week	24	5
Cycling						
Abrahin et al., 2022	BRAZIL	Hypertension	Cycling	60-75% Hrmax	12	3
Bouaziz et al., 2019	FRANCE	Old Sed	Cycling	40% Of Pre-Intervention Vt1 Workload	9.5	2
Brixius et al., 2008	GERMANY	Overweight Men 50-60 Y/O	Cycling	2-4 Mmol/L Lactate	24	3
Connolly et al., 2017	UK	Premenopausal Women	Cycling	Nr	12	3
Davoodi et al., 2022	IRAN	Type 2 Diabetes	Cycling	70% Hrmax	12	3
Eguchi et al., 2012	JAPAN	20-65Y/O Healthy Adults	Cycling	50% Vo2Max	12	3
Fairey et al., 2005	CANADA	Post-Menopausal Women Cancer Survivors	Cycling	70-75%	15	3
Finucane et al., 2010	UK	Healthy Older People	Cycling	50-70 W Max	12	3
Fujie et al., 2014	JAPAN	Increasing Plasma Apelin Level	Cycling	40 % Peak O2 Uptake	8	3
Georgiades et al., 2000	USA	Stage 1 Or 2 Hypertension	Cycling	70-85% Heart Rate Reserve	24	3
Goldberg et al., 2012	AUSTRALIA	Family History of Hypertension	Cycling	65% Of Subjects Pre-Determined Load	4	3
Jabbour et al., 2017	CANADA	Obese Adults	Cycling	40-50%	6	3

Lamina et al., 2013	NIGERIA	Mild Hypertension	Cycling	60-79% Hr Max	8	nr
Lamina., 2011	NIGERIA	Hypertensive	Cycling	60-79% Hr Max Reserve	8	3
Li et al., 2022	China	Type 2 Diabetes	Cycling	50-70% Hrmax	12	5
Maeda et al., 2004	JAPAN	Elderly Women	Cycling	85% Age Predicated Hr	12	5
Magalhães et al., 2019	PORTUGAL	Type 2 Diabetes	Cycling	40-60% Hrr	52	3
Mora-Rodriguez et al., 2017	SPAIN	Metabolic Syndrome	Cycling	70% Mhr- 90%Mhr	24	3
Oue et al., 2019	JAPAN	Young Healthy	Cycling	60%Hrr	8	3
Pereira Jorge et al., 2011	BRAZIL	Type 2 Diabetes	Cycling	Nr	12	3
Pitsavos et al., 2011	GREECE	Mild Hypertension	Cycling	60-80%Hrmax	16	3
Poptempa et al., 1995		Hemiparetic Stroke	Cycling	30-50% Max Effort	10	3
Sakai et al., 1998	JAPAN	Mild Hypertensive	Cycling	40-60% Maximum Oxygen Consumption	4	3
Sandberg et al., 2021	SWEDEN	Stroke	Cycling	60% Hrmax	3	5
Sikiru., 2013	NIGERIA	Mild To Moderate Hypertension	Cycling	60-79%	8	3
Van Craenenbroeck et al., 2015	BELGIUM	CKD Stage 3-4	Cycling	>90% Max Hr For 10 Mins in a Session	12	4
Yoshizama et al., 2008	JAPAN	Women	Cycling	60-70% Vo2Max	12	2
Running						
Abdelaal & Mohamad, 2015	EGYPT	Diabetic Hypertensives	Running	12-14 Borg Scale	12	3
Amin-Shokravi et al., 2011	USA	45-55Y/O Iranian Women With CVD/ Risk Factors	Running	70-80% Hrmax	12	3
Anderssen et al., 1995	NORWAY	Mild Hypertension	Running	60-80%Hrpeak	52	3
Anshel., 1996	AUSTRALIA	Healthy	Running	170Bpm	10	3
Boeno et al., 2020	BRAZIL	Hypertensives	Running	60-80%Hrr	12	3
Chung et al., 2017	KOREA	Middle Aged Obese Women	Running	85 Mhr	12	3
Ezema et al., 2014	NIGERIA	HIV	Running	60-79% Hrr	8	3
Foulds et al., 2014	GERMANY	Active Participants	Running	Nr	13	3
Krustrup et al., 2009	DENMARK	Healthy Men	Running	82% Mhr	12	2
Krustrup et al., 2010	DENMARK	Premenopausal	Running	80-84%	16	2
Nybo et al., 2010	DENMARK	Untrained Men	Running	65% Vo Max	12	2.5

Pascoalino et al., 2015	BRAZIL	Heart Transplant	Running	69%Vo2Max	12	3
Patterson et al., 2017	UK	Untrained Premenopausal Women	Running	75% Max Hr	8	3
Ramos et al., 2018	BRAZIL	Hypertensive Overweight	Running	60%Hrmax	12	3
Ribeiro et al., 2012	PORTUGAL	Acute Myocardial Infarction	Running	60-75%Hrmax	8	3
Richter et al., 2009	BRAZIL	Hyper-Reactive Individuals	Running	Nr	8	3
Roberson et al., 2018	CANADA	Older Adults	Running	55%Hrr	12	3
Suter et al., 1990	SWITZERLAND	Sed Men	Running	85%Hrmax	16	2-6
Tsai et al., 2002	TAIWAN	Mild Hypertension	Running	6-7 Mets	12	3
Tsai et al., 2002	TAIWAN	White Coat Hypertension	Running	6-7 Mets	12	3
Tsai et al., 2004	TAIWAN	Hypertension	Running	6-7 Mets	10	3
'Other Aerobic'						
Amaro-Gahete et al., 2019	SPAIN	Sedentary Adults	Other Aerobic	60-65% Hr Reserve	12	3
Amozadeh et al., 2018	IRAN	Overweight And Obese Females	Other Aerobic	40-50% Target Hr	8	3
Ballesta-García et al., 2020	SPAIN	Middle Aged - Older Women with Controlled Hypertension	Other Aerobic	Nr	18	2
Beck et al., 2013	USA	Young Pre-Hypertensive	Other Aerobic	60-85% Perceived Max Hr	8	3
Blumenthal et al., 1991	USA	Mild Hypertension	Other Aerobic	70%Hrpeak	16	3
Calders et al., 2011	BELGIUM	Intellectual Disability	Other Aerobic	90% Voluntary Anabolic Threshold	20	2
Dureja et al., 2014	INDIA	Healthy	Other Aerobic	5-10Kmh, 1-6% Incline	4	6
Eriksson et al., 1998	USA	Impaired Glucose Tolerance	Other Aerobic	60%Hrmax	24	3
Faulkner et al., 2014	UK	Transient Ischemic Attack	Other Aerobic	Nr	8	2
Fenkci et al., 2006	TURKEY	Obese Women with Severe Eating Disorders	Other Aerobic	50-80% Max Hr	12	3

Guimaraes et al., 2010	BRAZIL	Treated Hypertension	Other Aerobic	60% Hr Reserve	16	3
Hanssen et al., 2017	GERMANY	Migraine	Other Aerobic	70%Hrmax	12	2
Headley et al., 2014	USA	CKD Stage 3	Other Aerobic	50-60% Vo2 Peak	16	3
Hellénius et al., 1993	SWEDEN	CV Risk Factors	Other Aerobic	60-80% Hrmax	24	3
Hinderliter et al., 2002	USA	Overweight	Other Aerobic	75%-85% Max Heart Rate Reserve	24	3-4
Hofgaard et al., 2019	FAROE ISLANDS	Older Adults	Other Aerobic	Nr	6	2
Irving et al., 2008	USA	Women With Metabolic Syndrome	Other Aerobic	Nr	16	5
Kadoglou et al., 2007	GREECE	Type 2 Diabetes	Other Aerobic	50-75% Vo2 Max	24	4
Kim et al., 2012	KOREA	Obese Postmenopausal Women	Other Aerobic	55%-80% Hr Max	16	3
King et al., 1991	USA	Healthy	Other Aerobic	73-88% Hrpeak	52	3
Lopes et al., 2021	PORTUGAL	Resistant Hypertension	Other Aerobic	50-70%Vo2Max	12	3
Mouodi et al., 2019	IRAN	Healthy	Other Aerobic	Nr	16	nr
Saremi et al., 2010	IRAN	Overweight/Obese Males	Other Aerobic	60-65% Max Hr	12	5
Schroeder et al., 2019	USA	Elevated Blood Pressure/ Hypertension	Other Aerobic	40-70% Max Hr	8	3
Seo et al., 2010	KOREA	Middle Aged Women	Other Aerobic	60-80% Max Hr	12	3
Sigla et al., 2007	CANADA	Type 2 Diabetes	Other Aerobic	60-75% Max HR	4	3
Skow et al., 2021	CANADA	Gestational Hypertension	Other Aerobic	50-70% Heart Rate Reserve	36	3

Sousa et al., 2013	PORTUGAL	Older Men	Other Aerobic	Less Than 80% Hrmax	32	3
Staffileno et al., 2001	USA	Hypertensive Postmenopausal Women	Other Aerobic	50-60% Vo2 Max	8	5
Stefanick et al., 1998	USA	Postmenopausal Men	Other Aerobic	Nr	52	3
Swift et al., 2012	USA	Obese Postmenopausal Women	Other Aerobic	At Least 50% Baseline Vo2	24	3-4
Tanaka et al., 1997	USA	Stage 1 And 2 Hypertensive	Other Aerobic	60% Maximal Hr Reserve	10	3
Wanderley et al., 2013	PORTUGAL	Older Adults	Other Aerobic	50-80% Hr Reserve	32	3
Watkins et al., 2003	USA	Cardiac Risk Factors	Other Aerobic	70-85% Heart Rate Reserve	26	4
Westhoff et al., 2008	GERMANY	Hypertensive	Other Aerobic	Cycling Rate Of 80-90 Cycles P/ Min	12	3
Williamson et al., 2022	UK	Young Adults	Other Aerobic	60-80% peakHR	16	3
Wong et al., 2018	USA	Menopausal Hypertension	Other Aerobic	11-13 Rpe	12	4
Wong et al., 2019	SOUTH KOREA	Stage 2 Hypertensives	Other Aerobic	60%Hrmax	20	3-4
Yavari et al., 2010	IRAN	Type 2 Diabetes	Other Aerobic	50-70% Max Hr	16	3
Yavari et al., 2012	IRAN	Type 2 Diabetes	Other Aerobic	60-75% Max Hr	52	3
Resistance Training						
Abrahin et al., 2022	BRAZIL	Hypertension	Resistance Training	ACSM Guidelines increasing 2-10% upon 10 repetition completion	12	3
Abdelaal & Mohamad, 2015	EGYPT	Diabetic Hypertensives	Resistance Training	75%1Rm	12	3
Arora et al., 2009	INDIA	Type 2 Diabetes	Resistance Training	60% - 100% 1Rm	8	2

Beck et al., 2013	USA	Young Pre-Hypertensive	Resistance Training	60-85% Perceived Max Hr	8	3
Beltran Valls et al., 2013	ITALY	Older People	Resistance Training	> 85% Max Hr	12	nr
Boeno et al., 2020	BRAZIL	Hypertensives	Resistance Training	Nr	12	3
Castaneda et al., 2002	USA	Type 2 Diabetes	Resistance Training	70.2%1Rm	16	3
Choi et al., 2020	SOUTH KOREA	Healthy	Resistance Training	12-14 Rpe	12	3
Conceicao et al., 2013	BRAZIL	Postmenopausal Women	Resistance Training	10 Rep Max	16	3
Dantas et al., 2016	BRAZIL	Hypertensives	Resistance Training	5-7 On the Omni Scale	10	2
Dantas et al., 2023	BRAZIL	>60 Years of Age	Resistance Training	50-70% 1Rm or 70-85% 1Rm	12	2
DeVallance et al., 2016	USA	Metabolic Syndrome and A Normal Group	Resistance Training	60-85% 1 Rm	8	3
Elliot et al., 2002	UK	Postmenopausal Women	Resistance Training	80% 10 Rep Max	8	nr
Fenkci et al., 2006	TURKEY	Obese Women with Severe Eating Disorders	Resistance Training	40-80%1Rm	12	3
Franklin et al., 2015	USA	Obese Premenopausal Women	Resistance Training	80-90%10Rm	8	2
Gelecek et al., 2012	TURKEY	Postmenopausal Women	Resistance Training	60% Of 1 Rm	12	3
Gerage et al., 2013	BRAZIL	Elderly Postmenopausal Women	Resistance Training	Nr	12	3
Heffernan et al., 2012	USA	Prehypertension/Hypertension	Resistance Training	40-60% 1Rm	12	3
Hsieh et al., 2018	TAIWAN	T2DM	Resistance Training	50-70%1Rm	12	3
Hu et al., 2009	FINLAND	Healthy Men	Resistance Training	75% 1Rm	10	2-3

Jaime et al., 2019	USA	Postmenopausal Women	Resistance Training	40%1Rm	12	nr
Kanegusuku et al., 2011	BRAZIL	Elderly	Resistance Training	70-90%1Rm	16	2
Kawano et al., 2006	USA	Healthy Men	Resistance Training	50-80% 1Rm	16	3
Lin et al., 2022	TAIWAN	Middle-Age to Older Hypertensives	Resistance Training	50% 1Rm or 80% 1Rm	24	2
Lovell et al., 2009	AUSTRALIA	Healthy	Resistance Training	70-90% 1Rm	16	3
Miyachi et al., 2004	JAPAN	Healthy	Resistance Training	80% 1Rm	16	2
Nybo et al., 2010	DENMARK	Untrained Men	Resistance Training	12-15 Rep Max	12	2
Okamoto et al., 2006	JAPAN	Healthy Women	Resistance Training	80-100% 1Rm	8	3
Okamoto et al., 2008	JAPAN	Sedentary Healthy Males	Resistance Training	80-100% 1Rm	8	3
Olson et al., 2006	USA	Overweight Women	Resistance Training	Nr	52	2
Park et al., 2011	SOUTH KOREA	Hypertensives	Resistance Training	'Red Resistance Band'	12	2
Plotnikoff et al., 2010	AUSTRALIA	Obese Adults with Type 2 Diabetes	Resistance Training	50-80% 1Rm	16	3
Polito et al, 2020	BRAZIL	Hypertensives	Resistance Training	5-7 On the Omni Scale	12	3
Queiroz et al., 2011	BRAZIL	Normotensive Older Adults	Resistance Training	30-50% 1Rm or 70-90% 1Rm	16	2
Ruangthai & Phoemsapthawee., 2019	THAILAND	Hypertensives	Resistance Training	50-80%1Rm	12	3
Schroeder et al., 2019	USA	Elevated Blood Pressure/ Hypertension	Resistance Training	Nr	8	3
Sigla et al., 2007	CANADA	T2D	Resistance Training	60-75%Hrmax	4	3

Simons et al., 2006	USA	Elderly Adults	Resistance Training	75% 1 Rm	16	2
Stensvold et al., 2010	NORWAY	Metabolic Syndrome	Resistance Training	70-95% Peak Hr And > 80% 1 Rm	12	3
Tomeleri et al, 2017	BRAZIL	Older Women	Resistance Training	Nr	12	3
Van Hoof et al., 1996	BELGIUM	Sedentary Men	Resistance Training	70-90%1Rm	16	3
Venojarvi et al., 2013	FINLAND	Men with Impaired Glucose Regulation	Resistance Training	50-85% Rm	12	3
Vincent et al., 2003	USA	Older Adults	Resistance Training	50%1Rm or 80%1Rm	24	3
Wanderley et al., 2013	PORTUGAL	Older Adults	Resistance Training	50-60% Up To 80% 1Rm	32	3
Werner et al., 2021	USA	Healthy Inactive Males	Resistance Training	50-70%1RM or 80-90% 1RM	12	3-5
Yavari et al., 2012	IRAN	Type 2 Diabetes	Resistance Training	60-80% 1Rm	52	3
Yoshizama et al., 2008	JAPAN	Women	Resistance Training	60%1Rm	12	2
Zanetti et al, 2017	BRAZIL	HIV	Resistance Training	Nr	12	3
Combined Training						
Badicci et al., 2012	ITALY	Overweight w/ T2Dm	Combined Training	Nr	48	2
Calders et al., 2011	BELGIUM	Intellectual Disability	Combined Training	90% Voluntary Anabolic Threshold	20	2
Do Amaral et al., 2022	BRAZIL	Patients Previously Hospitalized due to COVID-19	Combined Training	14-17 RPE for Resistance Training and 11-13 for Aerobic Training	12	5-7
Dos Santos et al., 2014	BRAZIL	Hypertensive	Combined Training	100-120% 10Rep Max And 65-75% Target Hr Or 70% Of 10 Rep Max And 65-75% Target Hr	16	3
Ehlken et al., 2015	GERMANY	PAH, Chronic Thromboembolic, Hypertension	Combined Training	Nr	12	5-7

Figueroa et al., 2011	SOUTH KOREA	Postmenopausal Women	Combined Training	60% 1Rm & 60% Hrmax	12	3
Frih et al., 2017	TUNISA	Chronic Kidney Disease	Combined Training	50% Initial 1Rm	16	4
Garnaes et al., 2016	NORWAY	Obese Pregnant	Combined Training	80% Max Capacity, 12-15 Borg Scale	~24	3
Greenwood et al., 2015	UK	CKD	Combined Training	80% 1Rm	52	3
Jeon et al., 2020	KOREA	Postmenopausal Diabetic	Combined Training	11-15 Rpe Scale And 70% 1Rm	12	3
Jones et al., 2020	NEW ZEALAND	Breast Cancer Survivors	Combined Training	60% 1Rm	12	2
Jung et al., 2022	SOUTH KOREA	Elderly Obese Women with Sarcopenia	Combined Training	60-80%Hrr	12	3
Kagioglou et al., 2021	GREECE	Pulmonary Hypertension	Combined Training	60-80% Hr	24	3
Karelis et al., 2016	CANADA	Post Kidney Transplant	Combined Training	80% 1Rm	16	3
Kawano et al., 2006	USA	Healthy Men	Combined Training	60% Max Hr	16	3
Martins et al., 2011	PORTUGAL	Sedentary	Combined Training	40-85% Hr Reserve	16	3
Masroor et al., 2018	INDIA	Sedentary Hypertensive Women	Combined Training	50-80% Hrmax, 50-80% 1Rm	4	3
McGavock et al., 2004	CANADA	Type 2 Diabetes	Combined Training	65-75% Hr Reserve And 50-65% 1 Rm	10	3
McGuigan et al., 2001	AUSTRALIA	Peripheral Arterial Disease	Combined Training	100% 10 Rep Max	24	3
Miura et al., 2015	JAPAN	Hypertensives	Combined Training	Nr	12	nr
Ohkubo et al,. 2001	JAPAN	Older Adults	Combined Training	Started At 50-60Rpm At Less Than 25% Hrr, Made Way Up To 60% Hrr by The End	25	3

Okamoto et al., 2007	JAPAN	Healthy	Combined Training	80% Rep Max And 60 % Target Hr	8	2
Park & Park, 2017	SOUTH KOREA	Sarcopenic Obesity	Combined Training	13-17Rpe	24	5
Park & Park., 2017	SOUTH KOREA	Overweight Obese Women	Combined Training	5 To 6 Out Of 10Rpe	24	5
Park et al., 2020	S KOREA	Obese Older Men	Combined Training	6–7 On the Omni-Resistance Exercise Scale of Perceived Exertion, 60-70% 1Rm & 60-70% Hrmax	12	3
Ruangthai & Phoemsapthawee., 2019	THAILAND	Hypertensives	Combined Training	50-80%1Rm, 60-70% Hrmax	12	3
Saghebjoo et al., 2021	IRAN	Hypertensive Men	Combined Training	60-80%1Rm, 40-60%Hrr	10	4
Sardeli et al., 2022	BRAZIL	Hypertensive Older Adults	Combined Training	63% VO2max	16	3
Schroeder et al., 2019	USA	Elevated Blood Pressure/ Hypertension	Combined Training	40-70% Hrmax, Resistance Intensity Nr	8	3
Seo et al., 2010	KOREA	Middle Aged Women	Combined Training	60-80% Max Hr And 50-70% 1 Rm	12	3
Seo et al., 2011	USA	Obese Middle Age Women	Combined Training	60-70% Hr Reserve And 10 Rep Max	12	3
Shiotsu et al., 2018	JAPAN	Older Men	Combined Training	60% Hrr, 70-80%1Rm	10	2
Sigla et al., 2007	CANADA	T2D	Combined Training	60-75%Hrmax	4	3
Siu et al., 2021	HONG KONG	Obese	Combined Training	Nr	12	3
Son et al., 2017	KOREA	Postmenopausal With Hypertension	Combined Training	40-70% Hr Reserve	12	3
Songcharern et al., 2022	THAILAND	Prehypertensive Males	Combined Training	50-80%1Rm, 60-70%Hrr	8	3
Sousa et al., 2013	PORTUGAL	Older Men	Combined Training	Less Than 80% Hrmax, Between 65-75% 1Rm	32	3

Stensvold et al., 2010	NORWAY	Metabolic Syndrome	Combined Training	6--80% 1 Rm	12	3
Stewart et al., 2005	USA	Untreated Hypertension	Combined Training	50% 1 Rm And 60--90% Max Hr Reserve	26	3
Tan et al., 2012	AUSTRALIA	Elderly T2D	Combined Training	55-75% Max Hr And 50-70% 1Rm	24	3
Yavari et al., 2012	IRAN	Type 2 Diabetes	Combined Training	60-75% Max Hr And 60-80% 1Rm	52	3
Yen et al., 2019	TAIWAN	Neck Cancer	Combined Training	60-70% Hrpeak, RPE Scale Of Between Somewhat Heavy To Heavy	8	3
High Intensity Interval Training						
Allen et al., 2017	AUSTRALIA	Sedentary Adults	HIIT	Maximal Sprint	9	3
Alvarez et al., 2016	CHILE	Type 2 Diabetes	HIIT	90-100% Age Predicted Heart Rate Reserve	16	3
Atan & Karavelioglu., 2020	TURKEY	Adult Women with Fibromyalgia	HIIT	80-95% Peak Hr	6	5
Atashak et al., 2021	IRAN	Obese Men	HIIT	85-95% Hrmax	12	3
Bahmanbeglou et al., 2019	IRAN	Stage 1 Hypertensive Adults	HIIT	75-90% Vo2Max Or 80-100% Vo2Max	8	3
Blackwell et al., 2020	UK	Patients Before Surgery with Urological Cancer	HIIT	100-115% Max Watts	4	3-4
Boutcher et al., 2019	AUSTRALIA	Postmenopausal	HIIT	80-85%Hrmax	8	3
Cassidy et al., 2015	UK	T2D	HIIT	Rpe 16-17	12	3
Cassidy et al., 2019	UK	Adults With Type 2 Diabetes	HIIT	16-17 Rpe	12	3
Chidnok et al., 2020	THAILAND	Sed	HIIT	80%Hrmax	6	3
Chin. et al., 2020	HONG KONG	Obese / Overweight Men	HIIT	90% Hrr	8	1-3
Connolly et al., 2017	UK	Premenopausal Women	HIIT	90 Maximum Effort	12	3
Connolly et al., 2020	UK	Inactive Premenopausal	HIIT	Low/Moderate/High	12	3
Davoodi et al., 2022	IRAN	Type 2 Diabetes	HIIT	85-90% Hrmax	12	3
Edwards et al., 2021	UK	Healthy	HIIT	7.5% Bw Maximal Effort	2	3
Engel et al., 2019	GERMANY	Healthy	HIIT	Nr	8	4
Garcia-Suarez et al., 2020	MEXICO	College Students	HIIT	100% Vo2 Peak	4	3

Ghardashi Afousi et al., 2018	IRAN	Coronary Bypass Graft Recipients	HIIT	70%Hrmax	6	3
Gjellesvik et al., 2020	NORWAY	Previous Stroke	HIIT	85-95%Hrpeak	8	3
Hallsworth et al., 2015	UK	Fatty Liver Disease	HIIT	Rpe 16-17	12	3
Hanssen et al., 2017	GERMANY	Episodic Migraine	HIIT	90-95%Hrmax	12	2
Heydari et al., 2013	AUSTRALIA	Healthy Adult Males	HIIT	80-90% Age Predicted Max Hr	12	3
Ho et al., 2019	AUSTRALIA	Post-Menopausal Women	HIIT	Maximal Effort	8	3
Karstoft et al., 2013	DENMARK	T2D	HIIT	70%Peak Expenditure	16	5
Kiel et al., 2018	NORWAY	Healthy	HIIT	85-95%Hrmax	10	3
Lee et al., 2020	AUSTRALIA	Overweight Or Obese Adults with Type 1 Diabetes	HIIT	85-95% Hrpeak	12	3
Li et al., 2022	China	Type 2 Diabetes	HIIT	80-95% Hrmax	12	5
Madssen et al., 2014	NORWAY	Individuals After Cardiac Rehab	HIIT	85-95% Hrmax	52	3
May et al., 2018	USA	Healthy	HIIT	90%Hrmax	4	3
Mohr et al., 2014	EXETER/FAROE ISLANDS	Mildly Hypertensive Women	HIIT	Maximal	15	3
Nytroen et al., 2012	NORWAY	Heart Transplant	HIIT	85-95% Hrmax	24	3
O'Driscoll et al., 2018	UK	Sedentary Males	HIIT	7.5% Bw Maximal Effort	2	3
Rentería et al., 2019	MEXICO	Healthy Adult Women	HIIT	80% Map	4	3
Romain et al., 2019	CANADA	Overweight Adults With Psychotic Disorders	HIIT	80-90% Max Hr	26	2
Rustad et al., 2012	NORWAY	Heart Transplant	HIIT	85-95%Hrpeak	8	3
Sandstad et al., 2015	NORWAY	Rheumatic Disease	HIIT	85-95%Hrmax	10	2
Soltani et al., 2019	IRAN	Hypertensives	HIIT	75-90%Vo2Peak Or 80-90%Vo2Peak	8	3
Stensvold et al., 2010	NORWAY	Metabolic Syndrome	HIIT	90-95%Hrpeak	12	3
Streese et al., 2019	SWITZERLAND	Adults At Risk Of Cardiovascular Disease	HIIT	75-90% Hrmax	12	3
Tambrus et al., 2018	BRASIL	Coronary Artery Disease Patients	HIIT	100-110 Of Power Output Reached at VAT	16	3
Tew et al., 2019	UK	Adults With Crohns Disease	HIIT	90% Wpeak	12	3

Tjonna et al., 2008	NORWAY	Metabolic Syndrome	HIIT	90% Hf Max	16	3
Winding et al., 2018	DENMARK	Type 2 Diabetes	HIIT	95% Wpeak	11	3
Isometric Exercise Training						
Baddeley-White et al., 2019	UK	Healthy	IET	4 X 2 Min, 1 Min Rest Interval, 30%MVC.	4	3
Badrov et al., 2013a	CANADA	Normotensive Women	IET	4 X 2 Min, 4 Min Rest Intervals, 30% MVC.	8	3-5
Badrov et al., 2013b	CANADA	Hypertensives	IET	4 X 2 Min Bilateral, 1 Min Rest Interval, 30% MVC.	10	3
Baross et al., 2012	UK	Middle Aged Men	IET	4 X 2 Min, 2 Min Rest Intervals, 14%Mvc, 85%Hrpeak, 75%Hrpeak.	8	3
Baross et al., 2013	UK	Sedentary Older Men	IET	4 X 2 Min, 2 Min Rest Intervals, 85%Hrpeak.	8	3
Cahu Rodrigues et al., 2019	BRAZIL	Hypertensives	IET	4 X 2 Min, 1 Min Rest Interval, 30%MVC.	12	3
Correia et al., 2020	BRAZIL	Peripheral Artery Disease	IET	4 X 2 Min, 4 Min Rest Intervals, 30%MVC.	8	3
Decaux et al., 2021	UK	Healthy	IET	4 X 2 Min, 2 Min Rest Intervals, 95% Hrpeak.	4	3
Farah et al., 2018	BRAZIL	Hypertensives	IET	4 X 2 Min, 1 Min Rest Interval, 30%MVC.	12	3
Gordan et al., 2018	USA	Hypertensives	IET	4 X 2 Min, 1 Min Rest Interval, 30%MVC.	12	2
Nemoto et al., 2021	JAPAN	Hypertensives	IET	4 X 2 Min, 1 Min Rest Intervals, 30% MVC	8	3
O’Driscoll et al., 2022	UK	Healthy Prehypertensive	IET	4 X 2 Min, 2 Min Rest Intervals, 95% Hrpeak.	52	3
Okamoto et al., 2020	JAPAN	Middle Aged and Older Adults	IET	4 X 2 Min, 1 Min Rest Interval, 30% MVC.	8	3
Punia et al., 2019	INDIA	Hypertensives	IET	4 X 2 Min, 4 Min Rest Intervals, 30%MVC.	8	3

Taylor et al., 2003	CANADA	Hypertensives	IET	4 X 2 Min, 1 Min Rest Intervals, 30%MVC.	10	3
Taylor et al., 2018	UK	Hypertensives	IET	4 X 2 Min, 2 Min Rest Intervals, 95% Hrpeak.	4	3
Wiles et al., 2009	UK	Healthy	IET	4 X 2 Min, 2 Min Rest Intervals, Hi-95%Hrpeak.	8	3
Wiles et al., 2016	UK	Healthy Young Males	IET	4 X 2 Min, 1 Min Rest Interval, 95%Hrpeak).	4	3
Yamagata et al., 2020	JAPAN	Young Women	IET	4 X 2 Min, 3 Min Rest Intervals, 25% MVC Handgrip.	8	3

Note: *Multi-intervention trials are duplicated in different categories based on exercise mode.*

Figure S1. Aerobic Exercise Training sBP Significant Publication Bias Funnel Plot.

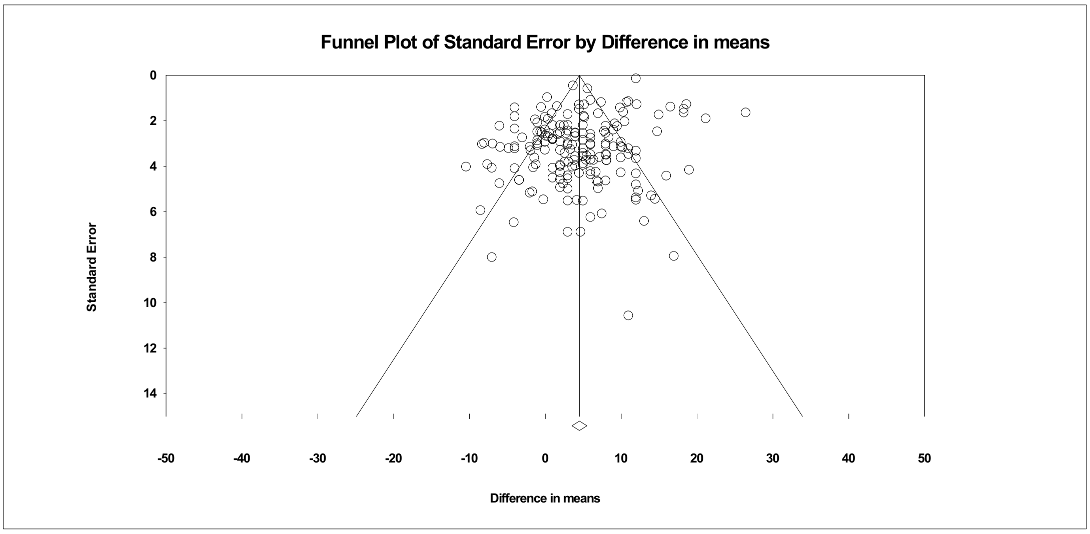


Figure S2. Aerobic Exercise Training dBP Significant Publication Bias Funnel Plot.

Figure S3. Isometric Exercise Training dBP Significant Publication Bias Funnel Plot.

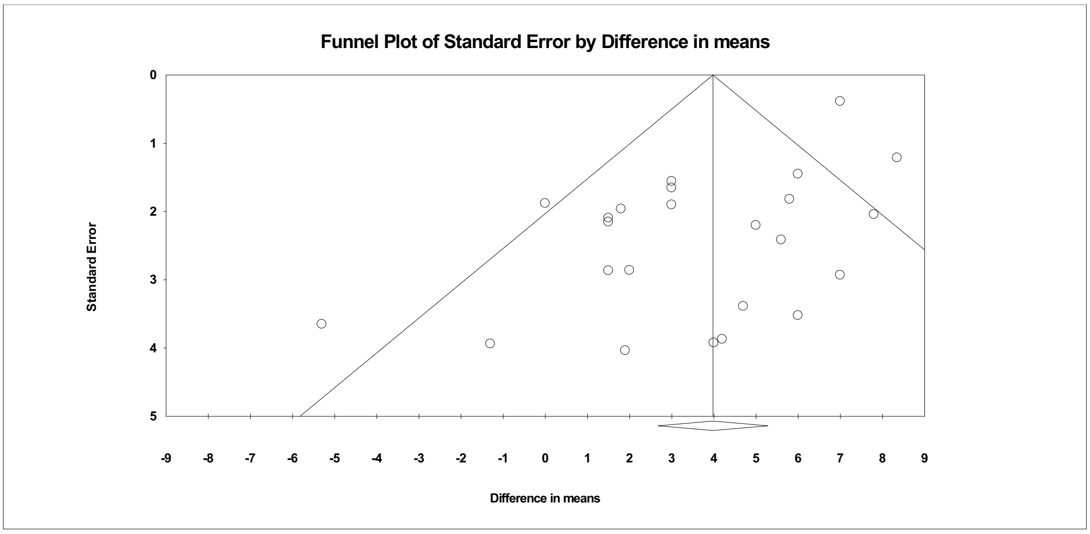


Table S3. Moderator Analysis Results

Mode	Intervention Duration	Training Frequency	Training Compliance %
Aerobic Exercise Training	B= -0.0898, R^2= 0, p=0.0774	B= -1.0596, R^2= 0.05, p=0.0193	B= 0.0764, R^2= 0.02, p=0.3257
Dynamic Resistance Training	B= 0.0886, R^2= 0, p=0.3026	B= -0.7858, R^2= 0, p=0.5743	B= 0.0750, R^2= 0, p=0.5503
Combined Training	B= 0.0288, R^2= 0, p=0.8412	B= -0.5001, R^2= 0, p=0.8490	B= 0.3482, R^2= 0, p=0.3160
High Intensity Interval Training	B= -0.1617, R^2= 0, p=0.1071	B= -0.5124, R^2= 0, p=0.6537	B= 0.0715, R^2= 0.09, p=0.4251
Isometric Exercise Training	B= -0.0176, R^2= 0, p=0.8447	B= 0.1787, R^2= 0, p=0.9296	B= 0.1068, R^2= 0, p=0.2337

Note: Minus indicates a higher sBP reduction with a decreasing duration/frequency (i.e. There was a significant moderator interaction on sBP for Aerobic Training, with a lower training frequency associated with a greater BP reduction).

Table S4. Full Statistical Outcome Data (Including Disease-Free Analyses)

Analysis	Full Statistical Outcome (Including Disease-Free Analysis)
Overall Aerobic Exercise Training Primary Analysis	**sBP:** 182 effect sizes/measured groups, WMD= 4.492, CI Lower= 3.496, CI Upper=5.488, I2=91.453, Z= 8.843, p<0.001. WMD Eggers p-value: <0.001 **Disease Free Analysis:** ES:137, WMD= 4.603, CI Lower= 3.481, CI Upper=5.725, I2=91.759, Z= 8.042, p<0.001. **dBP:** 176 effect sizes/measured groups, WMD= 2.525, CI Lower= 1.846, CI Upper=3.204, I2=91.538, Z= 7.288, p<0.001. WMD Eggers p-value: <0.001 **Disease Free Analysis:** ES:129, WMD= 2.617, CI Lower= 1.810, CI Upper= 3.423, I2=92.558, Z= 6.360, p<0.001.
Walking Primary Analysis	**sBP:** 89 effect sizes/measured groups, WMD= 2.851, CI Lower= 1.629, CI Upper=4.073, I2=77.387, Z= 4.573, p<0.001. WMD Eggers p-value: 0.20242 **Disease Free Analysis:** ES:70, WMD= 3.174, CI Lower= 1.849, CI Upper=4.498, I2=76.931, Z= 4.697, p<0.001. **dBP:** 83 effect sizes/measured groups, WMD= 1.436, CI Lower= 0.663, CI Upper=2.209, I2=74.118, Z= 3.640, p<0.001. WMD Eggers p-value: 0.53502 **Disease Free Analysis:** ES:64, WMD= 1.690, CI Lower= 0.837, CI Upper=2.543, I2=73.139, Z= 3.883, p<0.001.
Cycling Primary Analysis	**sBP:** 28 effect sizes/measured groups, WMD= 6.876, CI Lower= 3.908, CI Upper=9.845, I2=92.092, Z= 4.540, p<0.001. WMD Eggers p-value: 0.61227 **Disease Free Analysis:** ES:19, WMD= 8.622, CI Lower= 4.896, CI Upper=12.349, I2=94.343, Z= 4.535, p<0.001. **dBP:**

	28 effect sizes/measured groups, WMD= 3.196, CI Lower= 1.750, CI Upper=4.641, I2=91.392, Z= 4.333, p<0.001. WMD Eggers p-value: 0.92794 **Disease Free Analysis:** ES:19, WMD= 3.747, CI Lower= 1.961, CI Upper=5.532, I2=93.961, Z= 4.113, p<0.001.
Running Primary Analysis	**sBP:** 21 effect sizes/measured groups, WMD= 6.830, CI Lower= 3.958, CI Upper= 9.701, I2= 88.366, Z= 4.662, p<0.001. WMD Eggers p-value: 0.93655 **Disease Free Analysis:** ES:15, WMD= 6.083, CI Lower= 4.582, CI Upper=7.585, I2=34.776, Z= 7.940, p<0.001. **dBP:** 21 effect sizes/measured groups, WMD= 5.670, CI Lower= 3.880, CI Upper= 7.459, I2= 82.829, Z= 6.209, p<0.001. WMD Eggers p-value: 0.65089 **Disease Free Analysis:** ES:15, WMD= 5.038, CI Lower= 2.339, CI Upper=7.736, I2=82.678, Z= 3.659, p<0.001
Resistance Training Primary Analysis	**sBP:** 57 effect sizes/measured groups, WMD= 4.551, CI Lower= 3.202, CI Upper= 5.899, I2= 58.378, Z= 6.613, p<0.001. WMD Eggers p-value: 0.35677 **Disease Free Analysis:** ES:45, WMD= 4.485, CI Lower= 2.807, CI Upper=6.162, I2=62.597, Z= 5.240, p<0.001. **dBP:** 57 effect sizes/measured groups, WMD= 3.036, CI Lower= 2.174, CI Upper= 3.897, I2= 66.609, Z= 6.905, p<0.001. WMD Eggers p-value: 0.14719 **Disease Free Analysis:** ES:45, WMD= 3.318, CI Lower= 2.216, CI Upper=4.421, I2=67.243, Z= 5.899, p<0.001.
Combined Training Primary Analysis	**sBP:** 46 effect sizes/measured groups, WMD= 6.035, CI Lower= 3.157, CI Upper= 8.914, I2= 92.834, Z= 4.110, p<0.001. WMD Eggers p-value: 0.89051 **Disease Free Analysis**: ES:27, WMD= 6.552, CI Lower= 2.527, CI Upper=10.576, I2=95.096, Z= 3.191, p=0.001. **dBP:** 45 effect sizes/measured groups, WMD= 2.540, CI Lower= 1.071, CI Upper= 4.008, I2= 85.452, Z= 3.390, p=0.001.

	WMD Eggers p-value: 0.24258 **Disease Free Analysis:** ES:27, WMD= 3.424, CI Lower= 1.378, CI Upper=5.469, I2=89.465, Z= 3.280, p=0.001.
Overall HIIT Primary Analysis	**sBP:** 49 effect sizes/measured groups, WMD= 4.079, CI Lower= 2.625, CI Upper= 5.534, I2= 82.420, Z= 5.497, p<0.001. WMD Eggers p-value: 0.16285 **Disease Free Analysis:** ES:26, WMD= 5.818, CI Lower= 3.602, CI Upper=8.033, I2=88.331, Z= 5.147, p<0.001. **dBP:** 47 effect sizes/measured groups, WMD= 2.496, CI Lower= 1.218, CI Upper= 3.775, I2= 91.113, Z= 3.827, p<0.001. WMD Eggers p-value: 0.37732 **Disease Free Analysis:** ES:24, WMD= 3.745, CI Lower= 1.927, CI Upper=5.563, I2=92.397, Z= 4.038, p<0.001.
SIT Primary Analysis	**sBP:** 7 effect sizes/measured groups, WMD= 5.261, CI Lower=3.937, CI Upper= 6.584, I2=0, Z= 7.791, p<0.001. WMD Eggers p-value: 0.66940 **Disease Free Analysis:** ES:6, WMD= 5.127, CI Lower= 3.772, CI Upper=6.482, I2=3.005, Z= 7.415, p<0.001. **dBP:** 7 effect sizes/measured groups, WMD= 3.291, CI Lower= 0.108, CI Upper= 6.474, I2= 66.616, Z= 2.026, p=0.043. WMD Eggers p-value: 0.90345 **Disease Free Analysis:** ES:6, WMD= 1.818, CI Lower= -0.298, CI Upper=3.934, I2=13.342, Z= 1.684, p=0.092.
AIT Primary Analysis	**sBP:** 13 effect sizes/measured groups, WMD= 1.972, CI Lower= -1.226, CI Upper= 5.170, I2= 66.901, Z= 1.208, p=0.227. WMD Eggers p-value: 0.59221 **Disease Free Analysis:** ES:4, WMD= 6.415, CI Lower= 0.433, CI Upper=12.397, I2=65.302, Z= 2.102, p<0.001. **dBP:** 12 effect sizes/measured groups, WMD= 2.597, CI Lower= -0.542, CI Upper= 5.737, I2= 83.923, Z= 1.621, p=0.105. WMD Eggers p-value: 0.55983 **Disease Free Analysis:** ES:3, WMD= 6.371, CI Lower= -5.165, CI Upper=17.906, I2=93.368, Z= 1.082, p=0.279.

IET Primary Analysis	**sBP:** 24 effect sizes/measured groups, WMD= 8.235, CI Lower= 6.450, CI Upper= 10.019, I2= 68.795, Z= 9.045, p<0.001. WMD Eggers p-value: 0.14434 **Disease Free Analysis:** ES:23, WMD= 8.431, CI Lower= 6.628, CI Upper=10.234, I2=68.741, Z= 9.166, p<0.001. **dBP:** 24 effect sizes/measured groups, WMD= 3.977, CI Lower= 2.673, CI Upper= 5.280, I2= 63.674, Z= 5.980, p<0.001. WMD Eggers p-value: <0.001 **Disease Free Analysis:** ES:23, WMD= 4.030, CI Lower= 2.683, CI Upper= 5.377, I2=63.565, Z= 5.864, p<0.001.
IHG IET Primary Analysis	**sBP:** 17 effect sizes/measured groups, WMD= 7.104, CI Lower= 4.694, CI Upper= 9.515, I2= 68.795, Z= 5.777, p<0.001. WMD Eggers p-value: 0.18292 **Disease Free Analysis:** ES:16, WMD= 7.357, CI Lower= 4.874, CI Upper= 9.839, I2=69.206, Z= 5.809, p<0.001. **dBP:** 17 effect sizes/measured groups, WMD= 3.464, CI Lower= 1.715, CI Upper= 5.214, I2= 71.305, Z= 3.881, p<0.001. WMD Eggers p-value: <0.001 **Disease Free Analysis:** ES:16, WMD= 3.489, CI Lower= 1.641, CI Upper= 5.337, I2=71.433, Z= 3.700, p<0.001.
IWS IET Primary Analysis	**sBP:** 4 effect sizes/measured groups, WMD= 10.469, CI Lower= 6.315, CI Upper= 14.623, I2= 81.030, Z= 4.940, p<0.001. WMD Eggers p-value:0.77376 **Disease Free Analysis:** Identical results (no disease groups were analysed) **dBP:** 4 effect sizes/measured groups, WMD= 5.326, CI Lower= 3.605, CI Upper= 7.048, I2= 23.470, Z= 6.065, p<0.001. WMD Eggers p-value:0.62065 **Disease Free Analysis:** Identical results (no disease groups were analysed)
ILE IET Primary Analysis	**sBP:**

	3 effect sizes/measured groups, WMD= 10.047, CI Lower= 7.297, CI Upper= 12.798, I2= 0, Z= 7.159, p<0.001. WMD Eggers p-value: 0.51599 **Disease Free Analysis:** Identical results (no disease groups were analysed) **dBP:** 3 effect sizes/measured groups, WMD= 4.226, CI Lower= 1.409, CI Upper= 7.042, I2= 0, Z= 2.941, p=0.003. WMD Eggers p-value: 0.32533 **Disease Free Analysis:** Identical results (no disease groups were analysed)

<u>Systolic Blood Pressure Network Meta-Analysis – Supplementary Information</u>

Table S5. Systolic Blood Pressure Primary Exercise Mode Bayesian Table of Rank Probabilities and Surface Under the Cumulative Ranking Curve.

Treatment	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	SUCRA
AET	0.0002750	0.0270500	0.2583500	0.4277750	0.2865500	0.0000000	40.5345000
Control	0.0000000	0.0000000	0.0000000	0.0000000	0.0000125	0.9999875	0.0002500
CT	0.0683125	0.7335125	0.1325750	0.0456250	0.0199750	0.0000000	75.6912500
HIIT	0.0020125	0.0726500	0.2481375	0.2497625	0.4274250	0.0000125	39.4405000
IET	0.9261500	0.0646625	0.0067750	0.0017750	0.0006375	0.0000000	98.2782500
RT	0.0032500	0.1021250	0.3541625	0.2750625	0.2654000	0.0000000	46.0552500

Table S6. Systolic Blood Pressure Secondary Exercise Mode Bayesian Table of Rank Probabilities and Surface Under the Cumulative Ranking Curve.

Treatment	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	SUCRA
AIT	0.00005	0.00090	0.00283	0.00623	0.01253	0.02270	0.03776	0.06344	0.12476	0.23379	0.42119	0.07384	18.31148
Control	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00194	0.09565	0.90241	0.90477
CT	0.00168	0.01666	0.06571	0.14463	0.22651	0.25514	0.16794	0.08314	0.03260	0.00545	0.00055	0.00000	57.55784
Cycling	0.01816	0.10236	0.22913	0.24143	0.18555	0.11698	0.06179	0.02933	0.01224	0.00274	0.00031	0.00000	69.87614
IHG	0.04454	0.17390	0.27053	0.18538	0.13128	0.08730	0.05249	0.03073	0.01720	0.00553	0.00115	0.00000	73.07727
ILE	0.40224	0.28600	0.08865	0.05535	0.04129	0.03136	0.02468	0.02255	0.02031	0.01480	0.01024	0.00254	84.69818
IWS	0.50605	0.29054	0.07588	0.04205	0.02780	0.01889	0.01341	0.01018	0.00773	0.00441	0.00278	0.00030	90.37875
Other Aerobic	0.00004	0.00121	0.00709	0.02304	0.05953	0.12681	0.22314	0.27306	0.20971	0.06449	0.01189	0.00000	40.14648
RT	0.00001	0.00039	0.00244	0.01259	0.04005	0.10434	0.22003	0.30034	0.24156	0.06833	0.00994	0.00000	38.23432
Running	0.01498	0.08549	0.18305	0.21066	0.19005	0.14255	0.08763	0.05048	0.02625	0.00740	0.00148	0.00000	66.11864
SIT	0.01226	0.04255	0.07471	0.07865	0.08538	0.09321	0.10573	0.10738	0.14478	0.12169	0.11278	0.02090	43.34091
Walking	0.00000	0.00000	0.00000	0.00001	0.00005	0.00073	0.00543	0.02940	0.16286	0.46945	0.33206	0.00001	17.35523

Table S7. Systolic Blood Pressure Primary Exercise Mode Inconsistency Test with Node-splitting Model.

Comparison	**P-value**	**CrI**
d.AET.CT	0.458775	NA
-> direct	NA	-3.0 (-7.9, 2.0)
-> indirect	NA	-0.92 (-3.1, 1.3)
-> network	NA	-1.5 (-3.5, 0.44)
d.AET.HIIT	0.733925	NA
-> direct	NA	-0.96 (-7.1, 5.1)
-> indirect	NA	0.16 (-1.9, 2.2)
-> network	NA	0.096 (-1.9, 2.0)
d.AET.RT	0.6983	NA
-> direct	NA	-0.60 (-3.9, 2.7)
-> indirect	NA	0.19 (-2.0, 2.4)
-> network	NA	-0.18 (-2.0, 1.6)
d.CT.HIIT	0.560575	NA
-> direct	NA	-2.3 (-16., 11.)
-> indirect	NA	1.8 (-0.74, 4.3)
-> network	NA	1.6 (-0.87, 4.1)
d.CT.RT	0.4762	NA
-> direct	NA	-0.33 (-5.5, 4.9)
-> indirect	NA	1.8 (-0.86, 4.4)
-> network	NA	1.4 (-0.97, 3.7)
d.HIIT.RT	0.629575	NA
-> direct	NA	3.1 (-11., 17.)
-> indirect	NA	-0.40 (-2.8, 2.0)
-> network	NA	-0.28 (-2.7, 2.1)

Table S8. Systolic Blood Pressure Secondary Exercise Mode Inconsistency Test with Notesplitting Model.

Comparison	**p-value**	**CrI**
d.AIT.CT	0.3839	NA
-> direct	NA	2.4 (-11., 16.)
-> indirect	NA	-4.0 (-8.0, 0.056)
-> network	NA	-3.4 (-7.2, 0.45)
d.AIT.Other_Aerobic	0.377575	NA
-> direct	NA	3.3 (-9.2, 16.)
-> indirect	NA	-2.6 (-6.7, 1.5)
-> network	NA	-2.2 (-6.0, 1.6)
d.AIT.RT	0.439425	NA
-> direct	NA	3.0 (-11., 17.)
-> indirect	NA	-2.6 (-6.6, 1.4)
-> network	NA	-2.1 (-5.9, 1.7)
d.CT.Other_Aerobic	0.4613	NA
-> direct	NA	2.9 (-2.4, 8.3)
-> indirect	NA	0.67 (-2.1, 3.5)
-> network	NA	1.2 (-1.3, 3.7)
d.CT.RT	0.5001	NA
-> direct	NA	-0.30 (-5.6, 4.9)
-> indirect	NA	1.7 (-0.92, 4.4)
-> network	NA	1.3 (-1.1, 3.7)
d.CT.Walking	0.999675	NA
-> direct	NA	3.0 (-10., 16.)
-> indirect	NA	3.0 (0.77, 5.3)
-> network	NA	3.1 (0.88, 5.3)
d.Cycling.RT	0.59955	NA
-> direct	NA	-0.22 (-10., 9.7)
-> indirect	NA	2.5 (-0.44, 5.5)
-> network	NA	2.3 (-0.54, 5.1)
d.Other_Aerobic.RT	0.457825	NA
-> direct	NA	-1.6 (-6.7, 3.5)
-> indirect	NA	0.59 (-2.1, 3.3)
-> network	NA	0.12 (-2.2, 2.5)
d.RT.Running	0.663025	NA
-> direct	NA	-0.47 (-7.7, 6.7)
-> indirect	NA	-2.3 (-5.6, 1.2)
-> network	NA	-2.0 (-5.0, 1.0)
d.RT.Walking	0.576075	NA
-> direct	NA	0.075 (-6.3, 6.4)
-> indirect	NA	2.0 (-0.22, 4.2)
-> network	NA	1.8 (-0.26, 3.8)

Figure S4. Systolic Blood Pressure Deviance Report: Residual Deviance from NMA model and UME Inconsistency Model for Primary Exercise Mode Analysis.

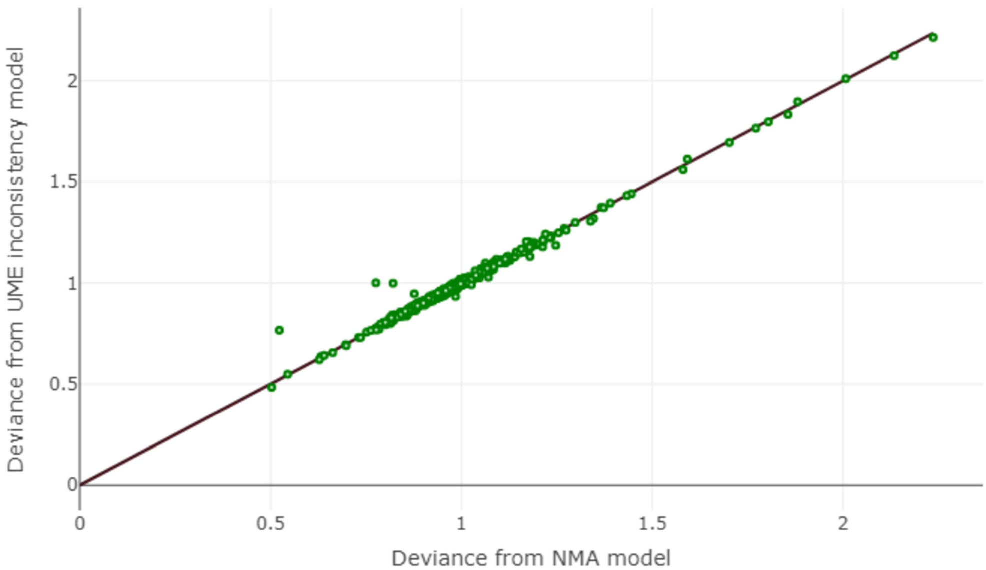
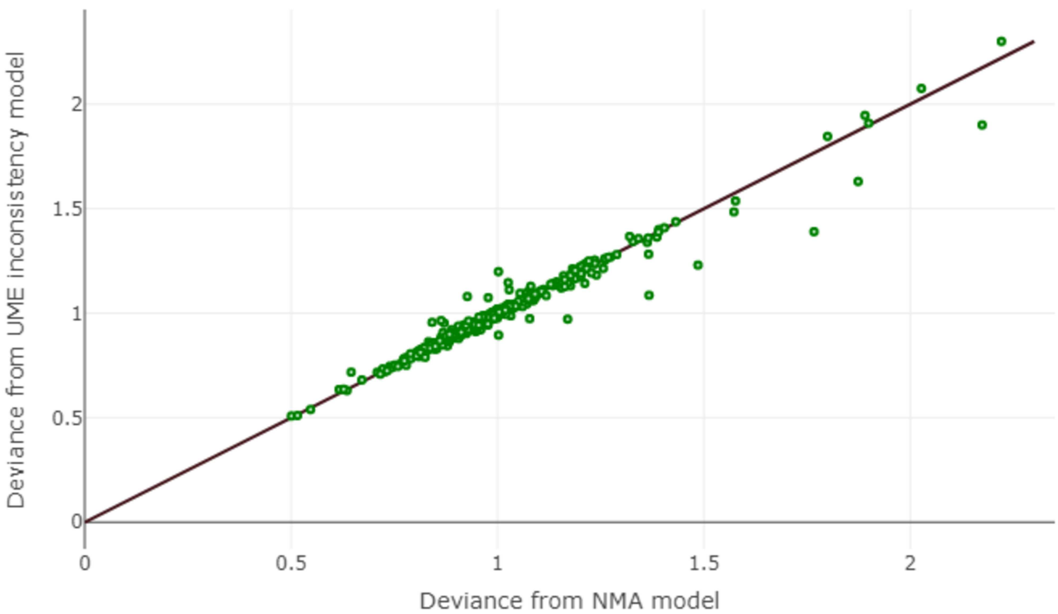


Figure S5. Systolic Blood Pressure Deviance Report: Residual Deviance from NMA model and UME Inconsistency Model for Secondary Exercise Mode Analysis.



Diastolic Blood Pressure Network Meta-Analysis – Supplementary Information

Table S9. Diastolic Blood Pressure Comparative Network Meta-Analysis for the Primary Exercise Modes.

	AET	Control	CT	HIIT	IET	RT
AET	AET	2.47 (1.88, 3.06)	0.01 (-1.27, 1.3)	-0.1 (-1.37, 1.18)	-1.23 (-3, 0.52)	-0.44 (-1.59, 0.7)
Control	-2.47 (-3.06, -1.88)	Control	-2.46 (-3.63, -1.29)	-2.57 (-3.71, -1.42)	-3.7 (-5.36, -2.04)	-2.91 (-3.95, -1.89)
CT	-0.01 (-1.3, 1.27)	2.46 (1.29, 3.63)	CT	-0.11 (-1.72, 1.52)	-1.24 (-3.27, 0.78)	-0.45 (-1.97, 1.05)
HIIT	0.1 (-1.18, 1.37)	2.57 (1.42, 3.71)	0.11 (-1.52, 1.72)	HIIT	-1.13 (-3.14, 0.88)	-0.35 (-1.88, 1.19)
IET	1.23 (-0.52, 3)	3.7 (2.04, 5.36)	1.24 (-0.78, 3.27)	1.13 (-0.88, 3.14)	IET	0.79 (-1.16, 2.75)
RT	0.44 (-0.7, 1.59)	2.91 (1.89, 3.95)	0.45 (-1.05, 1.97)	0.35 (-1.19, 1.88)	-0.79 (-2.75, 1.16)	RT

Table S10. Diastolic Blood Pressure Comparative Network Meta-Analysis for the Secondary Exercise Modes.

	AIT	Control	CT	Cycling	IHG	ILE	IWS	Other_Aerobic	RT	Running	SIT	Walking
AIT	AIT	2.85 (0.67, 5.06)	0.37 (-2.08, 2.83)	-0.24 (-2.84, 2.39)	-0.4 (-3.32, 2.52)	-0.58 (-5.87, 4.76)	-2.69 (-7.02, 1.62)	0.04 (-2.37, 2.47)	-0.14 (-2.53, 2.26)	-2.58 (-5.33, 0.19)	-0.32 (-4.08, 3.44)	1.48 (-0.86, 3.84)
Control	-2.85 (-5.06, -0.67)	Control	-2.48 (-3.63, -1.33)	-3.09 (-4.53, -1.66)	-3.25 (-5.18, -1.33)	-3.43 (-8.3, 1.45)	-5.54 (-9.3, -1.84)	-2.81 (-3.94, -1.68)	-2.99 (-4.01, -1.98)	-5.43 (-7.1, -3.75)	-3.19 (-6.28, -0.1)	-1.37 (-2.21, -0.54)
CT	-0.37 (-2.83, 2.08)	2.48 (1.33, 3.63)	CT	-0.61 (-2.46, 1.23)	-0.77 (-3.01, 1.48)	-0.95 (-5.97, 4.08)	-3.05 (-6.97, 0.84)	-0.33 (-1.89, 1.23)	-0.51 (-1.99, 0.97)	-2.95 (-4.97, -0.92)	-0.7 (-4, 2.61)	1.11 (-0.3, 2.53)
Cycling	0.24 (-2.39, 2.84)	3.09 (1.66, 4.53)	0.61 (-1.23, 2.46)	Cycling	-0.16 (-2.55, 2.23)	-0.33 (-5.4, 4.75)	-2.45 (-6.47, 1.54)	0.29 (-1.54, 2.1)	0.1 (-1.63, 1.84)	-2.34 (-4.55, -0.14)	-0.08 (-3.51, 3.31)	1.72 (0.06, 3.39)
IHG	0.4 (-2.52, 3.32)	3.25 (1.33, 5.18)	0.77 (-1.48, 3.01)	0.16 (-2.23, 2.55)	IHG	-0.17 (-5.42, 5.04)	-2.29 (-6.53, 1.89)	0.44 (-1.79, 2.68)	0.26 (-1.9, 2.45)	-2.18 (-4.73, 0.38)	0.07 (-3.57, 3.67)	1.88 (-0.22, 3.98)
ILE	0.58 (-4.76, 5.87)	3.43 (-1.45, 8.3)	0.95 (-4.08, 5.97)	0.33 (-4.75, 5.4)	0.17 (-5.04, 5.42)	ILE	-2.12 (-8.23, 4.05)	0.62 (-4.36, 5.61)	0.44 (-4.56, 5.4)	-2.01 (-7.18, 3.17)	0.24 (-5.49, 5.97)	2.06 (-2.89, 7)
IWS	2.69 (-1.62, 7.02)	5.54 (1.84, 9.3)	3.05 (-0.84, 6.97)	2.45 (-1.54, 6.47)	2.29 (-1.89, 6.53)	2.12 (-4.05, 8.23)	IWS	2.72 (-1.13, 6.64)	2.54 (-1.3, 6.44)	0.1 (-3.96, 4.24)	2.35 (-2.48, 7.21)	4.16 (0.37, 8.02)
Other_Aerobic	-0.04 (-2.47, 2.37)	2.81 (1.68, 3.94)	0.33 (-1.23, 1.89)	-0.29 (-2.1, 1.54)	-0.44 (-2.68, 1.79)	-0.62 (-5.61, 4.36)	-2.72 (-6.64, 1.13)	Other_Aerobic	-0.18 (-1.65, 1.28)	-2.62 (-4.64, -0.6)	-0.38 (-3.65, 2.91)	1.44 (0.03, 2.84)
RT	0.14 (-2.26, 2.53)	2.99 (1.98, 4.01)	0.51 (-0.97, 1.99)	-0.1 (-1.84, 1.63)	-0.26 (-2.45, 1.9)	-0.44 (-5.4, 4.56)	-2.54 (-6.44, 1.3)	0.18 (-1.28, 1.65)	RT	-2.44 (-4.33, -0.53)	-0.19 (-3.44, 3.05)	1.62 (0.33, 2.91)

Running	2.58 (-0.19, 5.33)	5.43 (3.75, 7.1)	2.95 (0.92, 4.97)	2.34 (0.14, 4.55)	2.18 (-0.38, 4.73)	2.01 (-3.17, 7.18)	-0.1 (-4.24, 3.96)	2.62 (0.6, 4.64)	2.44 (0.53, 4.33)	Running	2.24 (-1.24, 5.77)	4.06 (2.19, 5.93)
SIT	0.32 (-3.44, 4.08)	3.19 (0.1, 6.28)	0.7 (-2.61, 4)	0.08 (-3.31, 3.51)	-0.07 (-3.67, 3.57)	-0.24 (-5.97, 5.49)	-2.35 (-7.21, 2.48)	0.38 (-2.91, 3.65)	0.19 (-3.05, 3.44)	-2.24 (-5.77, 1.24)	SIT	1.81 (-1.39, 4.99)
Walking	-1.48 (-3.84, 0.86)	1.37 (0.54, 2.21)	-1.11 (-2.53, 0.3)	-1.72 (-3.39, -0.06)	-1.88 (-3.98, 0.22)	-2.06 (-7, 2.89)	-4.16 (-8.02, -0.37)	-1.44 (-2.84, -0.03)	-1.62 (-2.91, -0.33)	-4.06 (-5.93, -2.19)	-1.81 (-4.99, 1.39)	Walking

Figure S6. Diastolic Blood Pressure Primary Exercise Mode Analysis Bayesian Ranking Panel: Litmus Rank-O-Gram Surface Under the Cumulative Ranking Curve Plot.

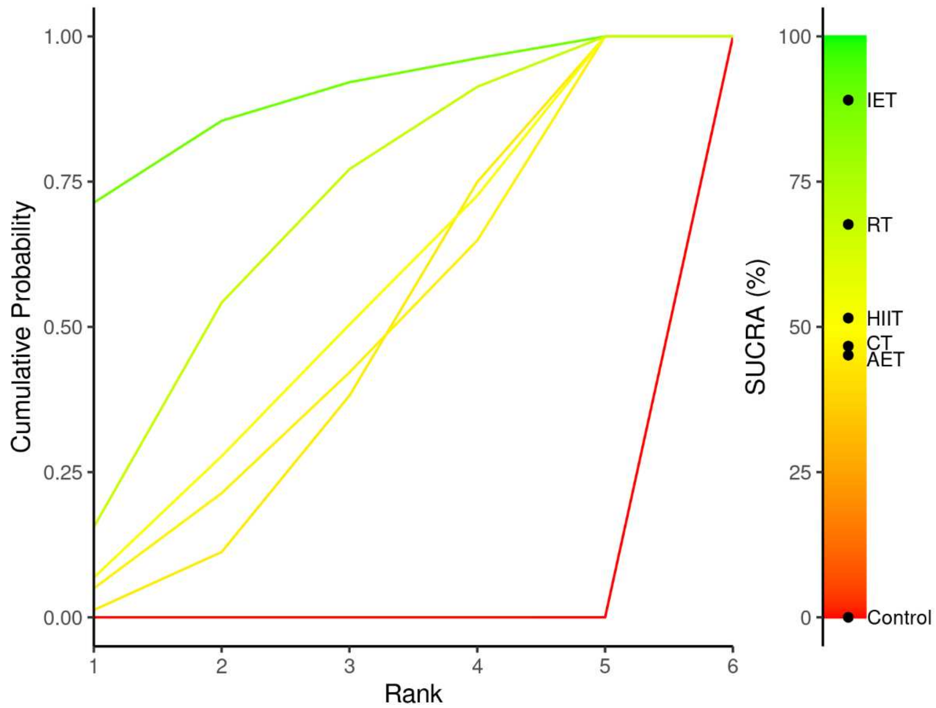


Figure S7. Diastolic Blood Pressure Secondary Exercise Mode Analysis Bayesian Ranking Panel: Litmus Rank-O-Gram Surface Under the Cumulative Ranking Curve Plot.

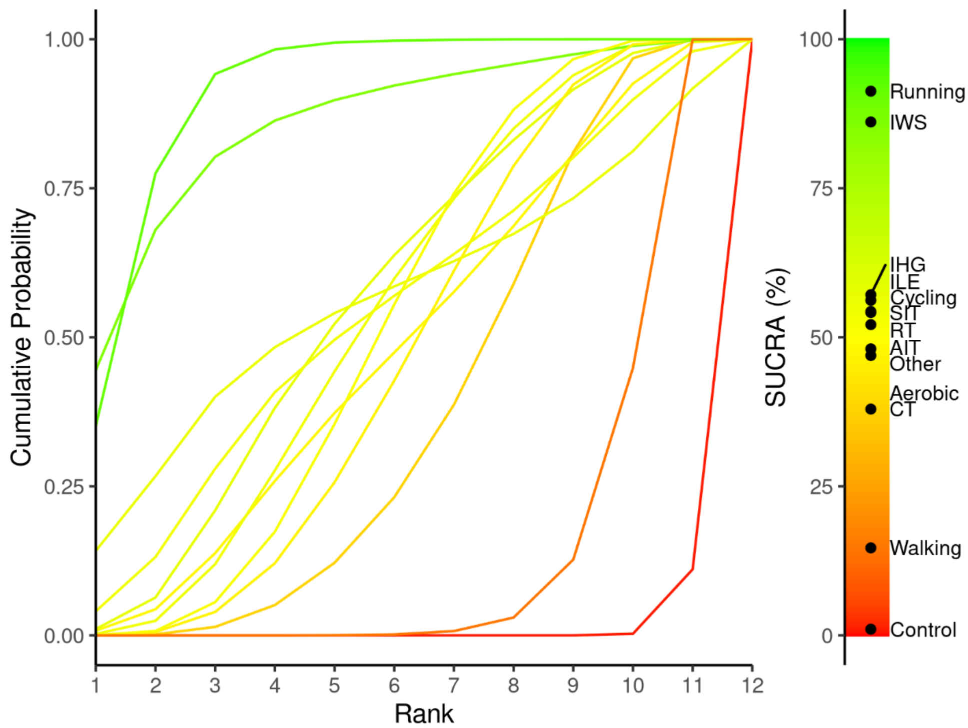


Table S11. Diastolic Blood Pressure Primary Exercise Mode Bayesian Table of Rank Probabilities and Surface Under the Cumulative Ranking Curve.

Treatment	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	SUCRA
AET	0.0125375	0.0999000	0.2692625	0.3677375	0.2505625	0.0000000	45.1222500
Control	0.0000000	0.0000000	0.0000000	0.0000000	0.0000125	0.9999875	0.0002500
CT	0.0498375	0.1638875	0.2079500	0.2271375	0.3511750	0.0000125	46.6807500
HIIT	0.0683875	0.2088625	0.2267125	0.2219875	0.2740500	0.0000000	51.5110000
IET	0.7137875	0.1409875	0.0663625	0.0412875	0.0375750	0.0000000	89.0425000
RT	0.1554500	0.3863625	0.2297125	0.1418500	0.0866250	0.0000000	67.6432500

Table S12. Diastolic Blood Pressure Secondary Exercise Mode Bayesian Table of Rank Probabilities and Surface Under the Cumulative Ranking Curve.

Treatment	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Rank 10	Rank 11	Rank 12	SUCRA
AIT	0.0078375	0.0359125	0.0940625	0.1211250	0.1140625	0.1014250	0.1017500	0.1104000	0.1211250	0.1178500	0.0695375	0.0049125	48.0622727
Control	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0026000	0.1081625	0.8892375	1.0305682
CT	0.0000250	0.0016375	0.0124875	0.0366250	0.0709375	0.1098500	0.1552875	0.2026250	0.2209500	0.1575750	0.0319875	0.0000125	37.9511364
Cycling	0.0023375	0.0221000	0.0949375	0.1571625	0.1661500	0.1555250	0.1342750	0.1175375	0.0894500	0.0505875	0.0099375	0.0000000	54.3239773
IHG	0.0105625	0.0529125	0.1461375	0.1719000	0.1411000	0.1149875	0.0994000	0.0938250	0.0848750	0.0610000	0.0228375	0.0004625	57.1376136
ILE	0.1418000	0.1252375	0.1331500	0.0831625	0.0571750	0.0447625	0.0424250	0.0457500	0.0596750	0.0791375	0.1050625	0.0826625	56.2010227
IWS	0.4451250	0.2351375	0.1224875	0.0607250	0.0344125	0.0243750	0.0190750	0.0166625	0.0165375	0.0143875	0.0093250	0.0017500	86.1164773
Other Aerobic	0.0002500	0.0054125	0.0336500	0.0815625	0.1359000	0.1702875	0.1843750	0.1760750	0.1363875	0.0671125	0.0089875	0.0000000	46.9436364
RT	0.0003500	0.0069750	0.0483750	0.1181000	0.1805750	0.2005625	0.1864250	0.1404250	0.0848250	0.0310625	0.0023250	0.0000000	52.1265909
Running	0.3512875	0.4236750	0.1666250	0.0412250	0.0115250	0.0032375	0.0014250	0.0007500	0.0001625	0.0000875	0.0000000	0.0000000	91.2838636
SIT	0.0404250	0.0910000	0.1480875	0.1283750	0.0879250	0.0737750	0.0699125	0.0732250	0.0888250	0.0970500	0.0811000	0.0203000	54.1520455
Walking	0.0000000	0.0000000	0.0000000	0.0000375	0.0002375	0.0012125	0.0056500	0.0227250	0.0971875	0.3215500	0.5507375	0.0006625	14.6707955

Table S13. Diastolic Blood Pressure Primary Exercise Mode Inconsistency Test with Notesplitting Model.

Comparison	P-value	CrI
d.AET.CT	0.365925	NA
-> direct	NA	-1.4 (-4.7, 2.0)
-> indirect	NA	0.33 (-1.1, 1.8)
-> network	NA	0.0077 (-1.3, 1.3)
d.AET.HIIT	0.663325	NA
-> direct	NA	0.71 (-3.2, 4.6)
-> indirect	NA	-0.20 (-1.6, 1.1)
-> network	NA	-0.10 (-1.4, 1.2)
d.AET.RT	0.889375	NA
-> direct	NA	-0.29 (-2.4, 1.8)
-> indirect	NA	-0.47 (-1.9, 0.95)
-> network	NA	-0.44 (-1.6, 0.70)
d.CT.HIIT	0.246975	NA
-> direct	NA	-4.8 (-13., 3.3)
-> indirect	NA	0.10 (-1.6, 1.8)
-> network	NA	-0.11 (-1.7, 1.5)
d.CT.RT	0.779825	NA
-> direct	NA	-0.84 (-4.1, 2.4)
-> indirect	NA	-0.31 (-2.0, 1.4)
-> network	NA	-0.45 (-2.0, 1.1)
d.HIIT.RT	0.5527	NA
-> direct	NA	2.2 (-6.5, 11.)
-> indirect	NA	-0.44 (-2.0, 1.1)
-> network	NA	-0.34 (-1.9, 1.2)

Table S14. Diastolic Blood Pressure Secondary Exercise Mode Inconsistency Test with Notesplitting Model.

Comparison	P-value	CrI
d.AIT.CT	0.2482	NA
-> direct	NA	4.8 (-3.1, 13.)
-> indirect	NA	-0.089 (-2.7, 2.5)
-> network	NA	0.36 (-2.1, 2.8)
d.AIT.Other_Aerobic	0.648475	NA
-> direct	NA	-1.6 (-9.2, 6.0)
-> indirect	NA	0.26 (-2.3, 2.9)
-> network	NA	0.036 (-2.4, 2.5)
d.AIT.RT	0.552525	NA
-> direct	NA	2.2 (-6.2, 11.)
-> indirect	NA	-0.48 (-3.0, 2.0)
-> network	NA	-0.14 (-2.5, 2.3)
d.CT.Other_Aerobic	0.490925	NA
-> direct	NA	0.81 (-2.8, 4.4)
-> indirect	NA	-0.59 (-2.4, 1.2)
-> network	NA	-0.33 (-1.9, 1.2)
d.CT.RT	0.8048	NA
-> direct	NA	-0.85 (-4.1, 2.4)
-> indirect	NA	-0.40 (-2.1, 1.3)
-> network	NA	-0.51 (-2.0, 0.97)
d.CT.Walking	0.4723	NA
-> direct	NA	4.0 (-4.1, 12.)
-> indirect	NA	1.0 (-0.46, 2.4)
-> network	NA	1.1 (-0.30, 2.5)
d.Cycling.RT	0.96225	NA
-> direct	NA	-0.015 (-6.5, 6.5)
-> indirect	NA	0.15 (-1.7, 2.0)
-> network	NA	0.10 (-1.6, 1.8)
d.Other_Aerobic.RT	0.592525	NA
-> direct	NA	0.55 (-2.6, 3.7)
-> indirect	NA	-0.42 (-2.1, 1.3)
-> network	NA	-0.17 (-1.6, 1.3)
d.RT.Running	0.321075	NA
-> direct	NA	-0.36 (-4.9, 4.2)
-> indirect	NA	-2.9 (-5.0, -0.70)
-> network	NA	-2.4 (-4.3, -0.53)
d.RT.Walking	0.995175	NA
-> direct	NA	1.6 (-2.2, 5.4)
-> indirect	NA	1.6 (0.25, 3.0)
-> network	NA	1.6 (0.32, 2.9)
d.AIT.CT	0.2482	NA
-> direct	NA	4.8 (-3.1, 13.)
-> indirect	NA	-0.089 (-2.7, 2.5)
-> network	NA	0.36 (-2.1, 2.8)

Figure S8. Diastolic Blood Pressure Deviance Report: Residual Deviance from NMA model and UME Inconsistency Model for Primary Exercise Mode Analysis.

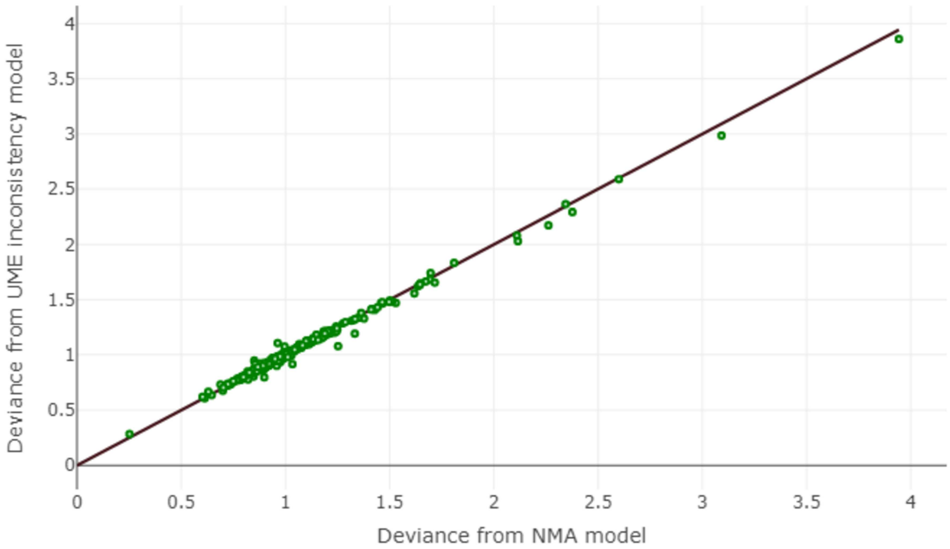
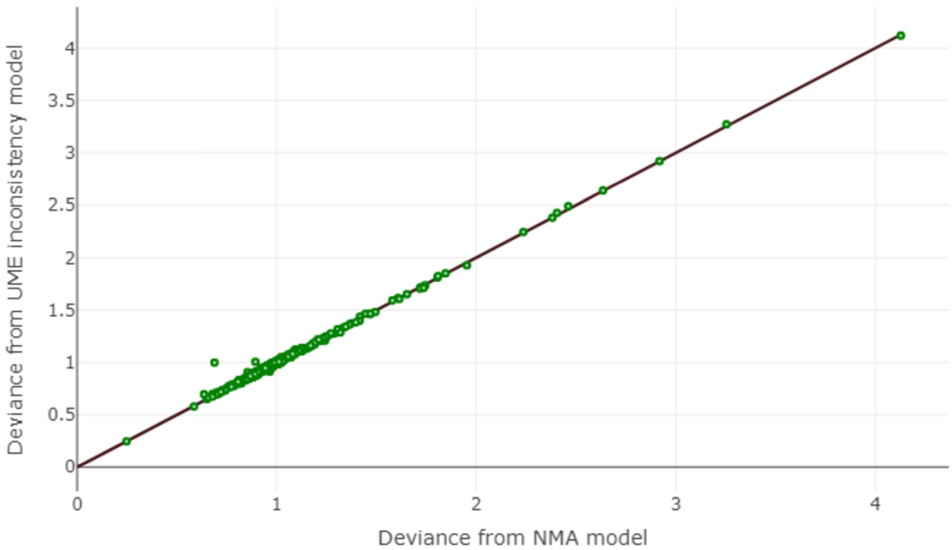


Figure S9. Diastolic Blood Pressure Deviance Report: Residual Deviance from NMA model and UME Inconsistency Model for Secondary Exercise Mode Analysis.



Network Meta-Analysis Sensitivity Analysis – Supplementary Information

Figure S10. Systolic Blood Pressure Primary Exercise Mode Sensitivity Analysis Bayesian Ranking Panel: Litmus Rank-O-Gram Surface Under the Cumulative Ranking Curve Plot.

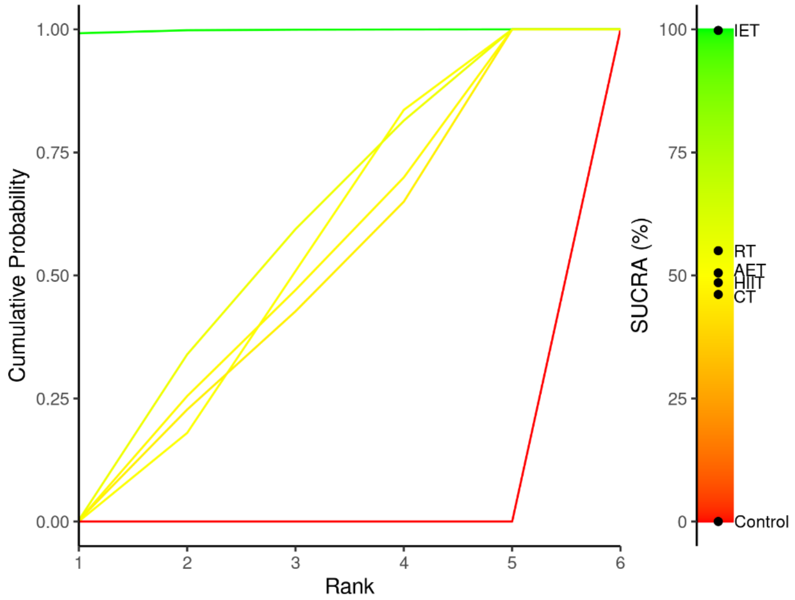


Figure S11. Diastolic Blood Pressure Primary Exercise Mode Sensitivity Analysis Bayesian Ranking Panel: Litmus Rank-O-Gram Surface Under the Cumulative Ranking Curve Plot.