

Electronic Supplementary Material

Concurrent strength and endurance training: a systematic review and meta-analysis on the impact of sex and training status

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Table S1. Included studies where results from the same study groups were published before.

Included study	Study with same group	Reason for inclusion
Chtara et al. 2008 [1]	Chtara et al. 2005 [2]	Same participants but additional outcome: power (jump height)
Libardi et al. 2012 [3]	Libardi et al. 2011 [4]	Same participants but additional outcome: $\text{VO}_{2\text{max}}$
McCarthy et al. 2002 [5]	McCarthy et al. 1995 [6]	Same participants but additional outcome: hypertrophy (cross-sectional area)

Table S2. Excluded studies where results from the same study groups were published before.

Excluded study	Study with same group	Reason for exclusion
De Souza et al. 2014 [7]	De Souza et al. 2013 [8]	Same participants and similar outcomes
Kraemer et al. 2004 [9]	Kraemer et al. 1995 [10]	Same participants and similar outcomes
Rønnestad et al. 2011 [11]	Rønnestad et al. 2010a [12]	Same participants and similar outcomes
Rønnestad et al. 2016 [13]	Rønnestad et al. 2015 [14]	Same participants in control group
Vikmoen et al. 2016 [15]	Vikmoen et al. 2016 [16]	Same participants and similar outcomes

Table S3. Excluded studies that were eligible for data extraction, but did not present the necessary data for the meta-analysis.

Excluded study	Reason for exclusion
Beattie et al. 2017 [17]	Significant group differences at baseline
Gergley et al. 2009 [18]	Data was presented in percentage change
Gravelle et al. 2000 [19]	Significant group differences at baseline
Jones et al. 2016 [20]	Data was presented in percentage change
Kawano et al. 2009 [21]	Data was presented in percentage change
Lee et al. 2020 [22]	Data was presented in percentage change
Leveritt et al. 2003 [23]	Data was presented for mixed gender (males + females) and training status differed between CT group and controls
Psilander et al. 2015 [24]	Significant group differences at baseline
Støren et al. 2008 [25]	Data was presented for mixed gender (males + females) and training status differed between CT group and controls
Timmins et al. 2020 [26]	Data was presented in percentage change

Table S4. Characteristics of the participants, training and reported outcomes for the studies included in the meta-analysis.

Study	N	Age	Sex	Duration	Training status		Endurance training		Strength training			Outcomes	
					ST	ET	Frequency	Intensity	Mode	Frequency	Exercises		
Aagaard et al. 2011 [27]	7	19.1	M	16	ND	3	ND (15.5h/week)	ND (intensity was similar between concurrent and endurance training groups)	Cycling	2-3	Isolated knee extension, incline leg press, hamstring curls, calf raises	4 x 5-12 RM	VO2max
Balabinis et al. 2003 [28]	7	22.6	M	7	2	2	4	Continuous running at 70% HRmax and 30-500m intervals at >85% HRmax	Running	4	Bench-press, leg press, half squat, lateral pulldowns. In wk 4 and 5 also plyometrics: front cone hops, diagonal cone hops, lateral cone hops, tuck jump with knees up, incline push-up depth jump, and handstand depth jump	3-6 x 3-6 at 75-95% 1RM (30-40 reps at 40-70% 1RM in last 3 weeks). In weeks 4 and 5, also 2 x 15 plyometrics	Strength (lower) Strength (upper) Power VO2max
Beattie et al. 2017 [29]	6	38.0	M	20	1	2	ND (continued with their regular endurance program)	ND (because of the extensive longitudinal nature of the study, aerobic endurance training (intensity) was not controlled in either group)	Cycling	2	Squat jump, trap bar deadlift, Romanian deadlift, split squat, core circuit	2-3 x 3-12 heavy maximal strength and 2-3 x 3-8 light to medium effort. Both days focused on explosive movements.	VO2max
Bell et al. 1997 [30]	22	22.4	M/F	16	2	2	3	30-40 min continuous training at VT. 5x3 min interval training performed at 90% VO2max with 3 min recovery	Rowing	3	Bilateral incline (45 degree's) leg press, knee extension, knee flexion, bench press, seated row, lat pulldowns, and arm curls	3-6 x 2-10 at 65-85% 1RM	Strength (lower) Strength (upper)
Bell et al. 2000 [31]	13	22.3	M/F	12	ND	2	3	30-42 min continuous training at VT. 4-7x3 min interval training performed at 90% VO2max with 3 min recovery	Cycling	3	Double leg press, single leg knee flexion and extension, double leg calf raises, bench press, seated pulldowns, shoulder press, and bicep curls	2-6 x 4-12 at 72-84% 1RM	Strength (lower) VO2max
Bishop et al. 1999 [32]	14	18-42	F	12	ND	2	ND (continued with their regular endurance program)	ND (continued with their regular endurance program)	Cycling	2	Squat training on a plyopower resistance machine.	3-5 x 2-8 RM	VO2max

								110.2 ± 29.4 km/week)					
Chtara et al. 2005 [2] & Chtara et al. 2008* [1] CT1 (ST → ET)	10	21.4	M	12	ND	2	2	5 x 200m at 100% vVO2max active recovery at 60% vVO2max	Running	2	Circuit consisting of abdominal strengthening, hip extension, back extensors, half squats, forward alternated arm flexions, and forward lunges (in period 1 and 2) and drop jumps from a plinth (0.30–0.60 m), hops, hurdles jumps (0.50–0.70 m), single leg hops, single leg bounds, and multi-jump (in period 3 and 4)	4-5 x 5-30 RM	Power VO2max
	CT2 (ET → ST)	10	21.4	M	12	ND	2	5 x 200m at 100% vVO2max active recovery at 60% vVO2max	Running	2	Circuit consisting of abdominal strengthening, hip extension, back extensors, half squats, forward alternated arm flexions, and forward lunges (in period 1 and 2) and drop jumps from a plinth (0.30–0.60 m), hops, hurdles jumps (0.50–0.70 m), single leg hops, single leg bounds, and multi-jump (in period 3 and 4)	4-5 x 5-32 RM	Power VO2max
Damasceno et al. 2015 [33]	9	34.1	M	8	1	2	ND (continued with their regular endurance program 41.3 ± 9.1 km/week)	Continuous running at 50-70% VO2max	Running	2	Half-squat, leg-press, plantar flexion, and knee extension	2-3 x 3-10 RM	VO2max
De Souza et al. 2013 [8]	11	22.5	M	8	1	2	2	15-20 x 60s at 80-100% vVO2max with 45-90s recovery	Running	2	Leg-press 45 °, knee extension and knee flexion exercises	3-5 x 6-12 RM	Strength (lower) Hypertrophy VO2max
Dolezal & Potteiger 1998 [34]	10	20.1	M	10	2	2	3	25-40 min at 65-85% HRmax	Running	3	Bench press, lat pulldown, shoulder press, bicep curl, triceps pushdown, back squat, leg extension, leg curl, clean pulls, incline dumbbell press, leg press, seated row, and upright row	3 x 4-15 RM	Strength (lower) Strength (upper) VO2max
Dudley et al. 1985 [35]	6	22.2	M/F	7	ND	1	3	5 x 5 min intervals to VO2peak with 5 min recovery	Cycling	3	Knee extension on the Cybex 2 isokinetic loading dynamometer	2 x 26-28 contractions at MVC	VO2max

Ferrauti et al. 2010 [36]	11	40.0	M/F	8	1	2	ND (4h/week)	Basic endurance training plus one session of 15 km running at 90–95% of their expected marathon velocity	Running	2	Day 1: Leg press, knee extension, knee flexion, hip extension, ankle extension, Day 2: Reverse fly, bench press, lateral flexion, trunk extension, trunk flexion, trunk rotation	4 x 3-5 RM and 3 x 20-25 RM	VO2max
Filipas et al. 2022 [37] CT1 (Polarized)	15	34	M	7	ND	3	6	80% below VT1, 6% between VT1-VT2 14% above VT2	Running	1	Warmup with 20 submaximal vertical jumps, 10 submaximal longitudinal jumps and then 60 drop jumps	2 x 10 jumps at 20 cm 2 x 10 jumps at 40 cm 2 x 10 jumps at 60 cm, all at maximal intensity	VO2max
CT2 (Pyramidal)	15	34	M	7	ND	3	6	77% below VT1, 16% between VT1-VT2 7% above VT2	Running	1	Warmup with 20 submaximal vertical jumps, 10 submaximal longitudinal jumps and then 60 drop jumps	2 x 10 jumps at 20 cm 2 x 10 jumps at 40 cm 2 x 10 jumps at 60 cm, all at maximal intensity	VO2max
Fyfe et al. 2016 [38] CT1 (HIT)	8	29.6	M	8	1	2	3	5-11 x 2 min intervals at 120-150% LT1 with 1 min of recovery	Cycling	3	Leg press, bench press, seated row, leg extension and leg curl exercises. flat dumbbell press, lat pulldown, dumbbell lunges	3-5 x 4-12 at 65-90% 1RM	Strength (lower) Strength (upper) Power
CT2 (MICT)	7	29.6	M	8	1	1	3	15-33 min continuous cycling at 80-100% LT1	Cycling	3	Leg press, bench press, seated row, leg extension and leg curl exercises. flat dumbbell press, lat pulldown, dumbbell lunges	3-5 x 4-12 at 65-90% 1RM	Strength (lower) Strength (upper) Power
Glowacki et al. 2004 [39]	16	22	M	12	1	1	2-3	20-40 minutes at 65-80% HRR	Running	2-3	Leg press, leg curl, standing calf raise, barbell bench press, lateral pull-down, dumbbell military press, barbell curl and abdominal crunches	3 x 6-10 at 75-85% 1RM (excluding warm-up)	Strength (lower) Strength (upper) Power VO2max
Gómez-Molina et al. 2018 [40]	14	20.4	M	8	1	2	3	20-45 min at 70-80% HRmax	Running	2	Squat jump, split scissor jump, double leg bound, alternate leg bound, single leg forward hops, depth jump, double leg hurdle jump, single leg hurdle jump	2-6 x 5-10 at maximal explosive effort	VO2max
Gonçalves et al. 2022 [41]	10	38.8	M	12	ND	1	3	15-25 min at 50-60% HRR	Running or cycling	3	horizontal leg press, knee extension machine, bench press, seated knee flexion machine, Smith bench press, lat pull-down machine, seated rowing machine, dumbbell shoulder abduction, dumbbell arm curl, pull-down triceps, abdominal crunch, and trunk extension machine	1-3 x 4-12 RM	VO2max

Häkkinen et al. 2003 [42]	11	38	M	21	1	ND	2	30-150 min mainly under ~VT1 and 0-2 x 10 min between ~VT1-VT2 and 0-2 x 5 min above ~VT2	Running or cycling	2	Bilateral and/or unilateral knee extension, bench press, triceps pushdown lateral pull-down, sit up, exercise for the trunk extensors, bilateral/unilateral elbow or knee flexion exercise and leg adduction/abduction exercise	3-6 x 3-15 at 50-80% 1RM	Hypertrophy
Hausswirth et al. 2010 [43]	7	30.2	M	5	ND	3	ND (11.7h/week)	Mainly <75% VO2max (81% below VT2 and 19% above VT2)	Running, swimming, and cycling (triathletes)	3	Leg extension, leg press, hamstring curl, leg curl, sit-ups, dead lifts	3-5 x 3-5 at >90% 1RM	VO2max
Hendrickson et al. 2010 [44]	15	20	F	8	1	2	3	20-30 min at 75-85% HRmax and 400-800-1200-1600m interval runs close to maximal effort with 1:1 recovery.	Running	3	Squat, stiff-leg deadlift, bench press, lat pull-down, upright row, calf exercises, abdominal work, leg press, incline bench press, seated row, shoulder press.	3 x 3-12 RM	Strength (lower) Strength (upper) Power VO2max
Hickson 1980 [45]	7	26	M/F	10	1	1	6	6x5 min at ~VO2max (cycling) with 2 min recovery and 30-40 min running as fast as possible.	Running and cycling	5	Squat, knee flexion, knee extension, leg-press, calf raises, deadlifts, sit-ups	3-5 x 5 at >80% 1RM and 3 x 20 at >80% 1RM for calf raises	Strength (lower) Hypertrophy VO2max
Izquierdo et al. 2005 [46]	10	41.8	M	16	1	1	1	30-40 min continuous at 70-90% VO2max and using 30s intervals in week 5 (with 30s recovery)	Cycling	1	Bilateral leg press and bilateral knee extension exercises, bench press, chest press, lateral pull-down, shoulder press, abdominal crunch rotary torso, leg curl and adductor-abductor exercises	3-5 x 5-15 at 30-80% 1RM	Strength (lower) Strength (upper)
Johnston et al. 1997 [47]	6	30.3	F	10	2	3	4-5	20-30 miles/week running in steady state with a similar weekly frequency, intensity and distance during the intervention	Running	3	Parallel squat, knee flexion, straight-leg heel raises, seated press, rear lat pulldown, hammer curl, weighted sit ups, lunges, knee extensions, bent-leg heel raises, bench press, seated rows, front lat pull-down, and abdominal curl.	2-3 x 6-20 RM	VO2max
Kelly et al. 2008 [48]	7	21.0	F	10	1	2	3	Continuous long distance at 130-150bpm Intervals of 3-8min at 150-190 bpm Intervals of 30s-3 min at ~HRmax	Running	3	Squat, calf raises, hip extension, hip flexion, hamstring curl, seated row, bench press, and abdominal exercises	3 x 5 at 60-85+% RM	VO2max
Kraemer et al. 1995 [10] CT1 (upper & lower)	9	23.3	M	12	3	2	4	40 min at 80-85% VO2max and 200-800 m intervals at 95-100% VO2max	Running	4	Bench press, fly, lat pull down, arm curl, seated row, sit-up, military press, obliques, sit-ups, calf raises, single leg curl, split squat, leg press, deadlift, double knee extension	2-5 x 5-25 RM	Strength (lower) Strength (upper) Power VO2max

CT2 (upper body)	9	22.9	M	12	2	2	4	40 min at 80-85% VO2max and 200-800 m intervals at 95-100% VO2max	Running	4	Bench press, fly, lat pull down, arm curl, seated row, sit-up, military press, obliques, sit-ups	2-5 x 5-25 RM	Strength (lower) Strength (upper) Power VO2max
Laird et al. 2016 [49]	12	20.2	F	11	1	1	3	8 x 4 min bouts of 20s at 110-120% vVO2max with 10s recovery	Running	3	Back squat, bent over row, bench press, sit-ups, squat jump, deadlift, standing press, back extension	3-5 x 3-10 at 70-88% 1RM	Strength (lower) Power
Lemura et al. 2000 [50]	12	19.0	F	16	ND	1	2	30-45 min at 70-85% HRmax	Running, Rowing or Cycling	2	Leg extension, leg press, leg curl, triceps extension, bicep curl, chest press, decline press, deltoid lateral raises, behind-neck pullover, pectoral adduction and abduction crunches	2-3x8-10 at 60-70% 1RM	VO2max
Levin et al. 2009 [51]	7	25	M	6	2	2	ND (8.8h/week)	ND (continued with their regular endurance program)	Cycling	3	Session 1: Jump squats, single-leg jump squat, clean grip deadlift, single-leg calf raises, back extension Session 2: Lunges, squats, straight-leg deadlift, seated calf raises, inclined crunches Session 3: Single-leg leg press, knee extension, knee flexion, standing calf raises, abdominal crunches	3 x 6 RM 3 x 12 RM 4 x 5 RM	VO2max
Libardi et al. 2011 [4] & Libardi et al. 2012* [3]	11	48.5	M	16	1	1	3	30 min at 50-85% VO2max	Running	3	Leg press, leg curl, leg extension, calf raises, bench press, lat pull-down, arm curl.	3 x 8-10 RM	Strength (lower) Strength (upper) VO2max
Losnegard et al. 2011 [52]	9	21.2	M/F	12	ND	3	ND (15.2h/week)	ND (continued with their regular endurance program)	Cross country	1-2	Half squat, seated pull-down, standing double-poling and triceps press, and optional lower back and abdominal exercises	warm-up: 3 x 10-6-3 at 40-60-80% 1RM training: 3-4 x 4-10 RM	VO2max
McCarthy et al. 1995 [6] & McCarthy et al. 2002* [5]	10	27.3	M	10	1	1	3	30-50 min at 70% HRR	Cycling	3	Parallel squat, bench press, standing curl, knee extension, leg curl, wide grip lat pull-down, overhead press, heel raises	warm-up: 1 x 5-7 at 75%RM training: 3 x 5-7 RM	Strength (lower) Strength (upper) Power Hypertrophy VO2max
Mikkola et al. 2012 [53]	11	37	M	21	1	1	2	30-90 min below VT1 0-2 x 10 min between VT1-VT2 0-2 x 5 min > VT2	Cycling or Nordic walking	2	Leg press, knee extension, bench press or lat pull down, triceps pushdown or biceps curl, sit-up exercise or trunk extensors exercise, knee flexion or calf raises, and leg adduction or abduction exercises	2-4 x 3-15 at 50-80% 1RM (leg press and knee extension; with 20% at 50-60% 1RM) and 3-5 x 8-15 RM (other exercises)	Strength (lower) VO2max

Millet et al. 2002 [50]	7	24.3	M	14	ND	3	ND (continued with their regular endurance program of 20h/week)	Mainly <70% VO2max	Running, swimming, and cycling (triathletes)	2	Hamstring curl, leg press, seated press, parallel squat, leg extension, and heel raise	3-5 x 3-5 at >90% 1RM	VO2max
Mirghani et al. 2014 [55]	8	21.0	M	8	2	ND	2	16-30 min at 65-80% HRmax	Running	2	Bench press, toe raise, shoulder press, squat, lateral pull down and leg curl	2-3 x 6-10 at 55-85% 1RM	Strength (lower) Strength (upper)
Nelson et al. 1990 [56]	5	26.0	M	20	1	1	4	30-60 min at 75-85% HRmax	Cycling	4	Knee extension and knee flexion 30°/sec	3 x 6 RM	VO2max
Panissa et al. 2018 [57]	11	24.5	M	12	ND	ND	2	Intervals of 1 min at 100% MAV with 1 min recovery until reaching 5 km	Running	2	Bench press, half-squat, triceps extension, leg extension, seated row, leg curl, and arm curl	3 x 8-12 RM	Strength (lower)
Prieto-González et al. 2022 [58]	10	34.3	M	12	1	2	1-2	50-60 min running at 117-162bpm (first 6 weeks) 10-16 x 1-3 min intervals at 159-180 bpm with 2-8 min recovery	Running	1-2	Squat, leg curl, calf raises, hurdle hops, extended bounds, sprints 100-115% maximal aerobic speed	4-5 x 4-14 at 64-86% 1RM	Strength (lower) Power VO2max
Robineau et al. 2016 [59] CT1 (0h recovery)	15	24.3	M	7	1	2	2	3x6 min bouts with 15s intervals at 120% MAV (>90% HRmax) with 15s recovery	Running	2	Half squat, leg press, bench press, bench row, core, hamstrings exercise and plyometric jumps	3-4 x 3-10 at 70-90% 1RM	Strength (lower) Strength (upper) Power
CT2 (6h recovery)	11	28.0	M	7	1	2	2	3x6 min bouts with 15s intervals at 120% MAV (>90% HRmax) with 15s recovery	Running	2	Half squat, leg press, bench press, bench row, core, hamstrings exercise and plyometric jumps	3-4 x 3-10 at 70-90% 1RM	Strength (lower) Strength (upper) Power
CT3 (24h recovery)	12	24.8	M	7	1	2	2	3x6 min bouts with 15s intervals at 120% MAV (>90% HRmax) with 15s recovery	Running	2	Half squat, leg press, bench press, bench row, core, hamstrings exercise and plyometric jumps	3-4 x 3-10 at 70-90% 1RM	Strength (lower) Strength (upper) Power
Robineau et al. 2017 [60] CT1 (SIT)	10	26.4	M	8	3	2	2	4-8 x 30s all-out intervals with 4 min recovery	Running	2	Half squat, deadlift, leg extension, bench press, bench row, core, hamstrings exercise, plyometric jumps	3 x 3-10 at 70-90% 1RM	Strength (lower) Strength (upper) Power

CT2 (HIT)	9	25.0	M	8	2	2	2	2 x 8-12 min bouts of 30s intervals at 100% MAV with 30s recovery at 50% MAV	Running	2	Half squat, deadlift, leg extension, bench press, bench row, core, hamstrings exercise, plyometric jumps	3 x 3-10 at 70-90% 1RM	Strength (lower) Strength (upper) Power
Rønnestad et al. 2010a [12]	11	27	M/F	12	ND	3	ND (10h/week)	Mainly 60-87% HRmax	Cycling	2	Half squat, one-legged leg press, one legged hip flexion, toe raises	3 x 4-10 RM	VO2max
Rønnestad et al. 2010b [61]	6	29	M/F	12	ND	3	ND (11.1h/week)	Mainly 60-87% HRmax	Cycling	2	Half squat, one-legged leg press, one legged hip flexion, toe raises	3 x 4-10 RM	VO2max
Rønnestad et al. 2015 [14]	9	19.1	M	25	ND	3	ND (11.3h/week in first 10 weeks; 15.2h/week in final 15 weeks)	Mainly 60-87% HRmax	Cycling	1-2	Half squat, one-legged leg press, one legged hip flexion, toe raises	3 x 4-10RM (first 12 weeks) 3 x 5 at 8-10RM (last 13 weeks)	VO2max
Rønnestad et al. 2017 [62]	12	19	M/F	10	ND	3	ND (12.3h/week)	Mainly 60-87% HRmax	Cycling	2	Half squat, one-legged leg press, one legged hip flexion, toe raises	3 x 4-10 RM	VO2max
Sánchez-Moreno et al. 2021 [63] CT1 (velocity loss 15%)	11	25	M	8	2	2	2	4-14 x 30s at 80-120% vVO2max with 1-2 min recovery	Running	2	Full squat	3 x 3.2-5.8 at 58-80% 1RM	VO2max
CT2 (velocity loss 45%)	11	25	M	8	2	2	2	4-14 x 30s at 80-120% vVO2max with 1-2 min recovery	Running	2	Full squat	3 x 6-15.5 at 58-80% 1RM	VO2max
Shamim et al. 2018 [64]	12	26	M	12	2	1	3	MICT at 50% MAP Intervals at 70% MAP with 60s recovery and intervals at 100% MAP with 20-60 sec recovery at 40% MAP	Cycling	3	Leg press, knee extension, bench press, incline bench, Romanian deadlift, sit-ups, triceps extension, dumbbell row, dumbbell shrugs, seated overhead, biceps curl, hip thrusts, lunges	2-5 x 2-15 at 60-98% 1RM	Strength (lower) Strength (upper) Power Hypertrophy VO2max
Shaw et al. 2009 [65]	13	26	M	16	ND	1	3	22 min at 60% HRmax	Running, rowing and cycling	3	Shoulder press, latissimus dorsi pull-downs, seated rows, unilateral leg presses, unilateral knee extensions, unilateral hamstring curls, crunches	2 x 15 at 60% 1RM	VO2max
Silva et al. 2012 [66] CT1 (MICT running)	10	22.3	F	11	1	1	2	20-30 min at 95% HR at VT2	Running	2	Inclined leg press, knee extension, leg curl, bench press, inverted fly, upright row, and sit-ups	2-3 x 8-18 RM	Strength (lower) Strength (upper)
CT2 (HIT running)	11	24.3	F	11	1	1	2	1 min at 100% vVO2max with 1 min recovery at 50% vVO2max for 20-30 min	Running	2	Inclined leg press, knee extension, leg curl, bench press, inverted fly, upright row, and sit-ups	2-3 x 8-18 RM	Strength (lower) Strength (upper)

CT3 (MICT cycling)	11	21.8	F	11	1	1	2	20-30 min at 95% HR at VT2	Cycling	2	Inclined leg press, knee extension, leg curl, bench press, inverted fly, upright row, and sit-ups	2-3 x 8-18 RM	Strength (lower) Strength (upper)
Skovgaard et al. 2014 [67]	12	31.1	M	8	2	2	4	2 sessions: 4-12 x 30s all-out with 3 min recovery 1 session: 4 x 4min with 2 min recovery at >85% HRmax 1 session: 40-70 min continuous running at 75-85% HRmax	Running	2	Squat, deadlift, and leg press as exercises.	3-4 x 4-8 at 15-4RM	VO2max
Spiliopoulou et al. 2021 [68]	9	21.8	F	6	1	1	3	10 x 1min at 100% MAP with 1 min recovery	Cycling	3	Counter movement jumps, drop jumps, eccentric squat, half squat	4-6 x 2 at 40-65% 1RM (half squats) 6-8 x 3 CMJ and drop jumps at maximal effort	Strength (lower) Power
Štohanzl et al. 2018 [69] CT1 (30min ST)	11	32	F	10	1	1	ND (2.5h/week)	2.5h < VT2	Running	1	Calf jumps, low skater jumps, push-ups on the bench, half squat jumps, lunges, step-ups on bench, plank	3-4 x 12-30 3-4 x 30-40s (plank)	VO2max
CT2 (60min ST)	9	32	F	10	1	2	ND (2h/week)	2h < VT2	Running	2	Calf jumps, low skater jumps, push-ups on the bench, half squat jumps, lunges, step-ups on bench, plank	3-4 x 12-30 3-4 x 30-40s (plank)	VO2max
Sunde et al. 2010 [70]	8	29.9	M/F	8	ND	2	ND (continued their regular endurance program of ~9h/week)	ND (training intensity zones were monitored for each subject based on 60–85%, 85–90%, and 90–95% of HRmax, but these were not reported)	Cycling	3	Half squats	4 x 4 RM	VO2max
Terzis et al. 2016 [71]	10	21.6	F	6	ND	2	3	30 min at 60-70% HRmax	Running	3	Half squats, counter movement jumps, drop jumps	6 x 2 at 40-65% 1RM (half squats) 6-8 x 3 CMJ and drop jump at maximal effort	Strength (lower) Power
Trowell et al. 2022 [72]	14	33.1	M/F	10	1	2	ND (continued their regular endurance program of 4.5 times/week and 288 min/week)	ND (total training time was matched for both CT and ET groups)	Running	2	Ankle bounce, back squat, hurdle jumps, frontal plank, high knee drill or A-skip drill, single leg deadlift, split squat jump, side-stepping, counter movement jump or drop jump, glute bridge	3-5 x 6-20 at 70% 1RM 3-5 x 60s (plank) 3-5 x 15 (hurdles) 3-5 x 20m (drills)	VO2max

Tsitkanou et al. 2017 [73]	10	21.8	M	8	ND	1	2	10 x 60s at 100% MAP with 1 min recovery	Cycling	2	Leg press, half squat Abdominal crunches, lateral crunches, dorsal raises	4 x 6 at 80-100% 6RM and 2 x 10 for crunches and dorsal raises.	Strength (lower) Hypertrophy
Vikmoen et al. 2016 [16]	11	31.5	F	11	1	3	4.1	63% below ~VT1 21% ~VT1-VT2 16% above ~VT2	Cycling	2	Half squat, one-legged leg press, on legged hip flexion, toe raises	3 x 4-10 RM	VO2max
Vorup et al. 2016 [74]	9	39.2	M	8	1	2	3.7	2 sessions: 2 x 100m at 75% Vmax + 4-10 x 30s at 90-95% Vmax with 3 min recovery 1 session: continuous running at 80% HRmax (2-17km) 1 session: 8 x 2 min at >90% HRmax with 1 min recovery	Running	2	Squat, leg press, and deadlift	1-4 x 4-10 RM	VO2max

M= male, F= female, for training status: ST= strength training status, ET = endurance training status, 1= untrained, 2= trained, 3=highly-trained, ND= not determined, no available data, h=hours. *=studies same CT group, bpm= beats per minute; HIT = high intensity interval training; HRmax= maximal heart rate; HRR = heart rate reserve; LT1 = first lactate threshold; MAP= maximal aerobic power; MAV= maximal aerobic velocity; MICT = moderate intensity continuous training; RM = repetition maximum; SIT = sprint interval training; VO2max= maximal oxygen uptake; VT1= first ventilatory threshold; VT2= second ventilatory threshold; vVO2max=velocity at maximal aerobic capacity;

Table S5. Differences in training status and training regimen between males and females for comparisons related to lower-body strength.

Strength (lower-body)	Males		Females	
N	210		59	
Training status	<u>Strength</u>	<u>Endurance</u>	<u>Strength</u>	<u>Endurance</u>
Untrained	59%	39%	75%	75%
Trained	28%	52%	0%	25%
Highly trained	5%	0%	0%	0%
Not determined	9%	9%	25%	0%
Training duration				
<8 weeks	21%		17%	
8-12 weeks	63%		83%	
>12 weeks	15%		0%	
Training frequency				
≤4 times / week	61%		54%	
5-6 times / week	31%		46%	
>6 times / week	8%		0%	
Training mode (ET)				
Cycling	36%		27%	
Running	64%		73%	
Other	0%		0%	

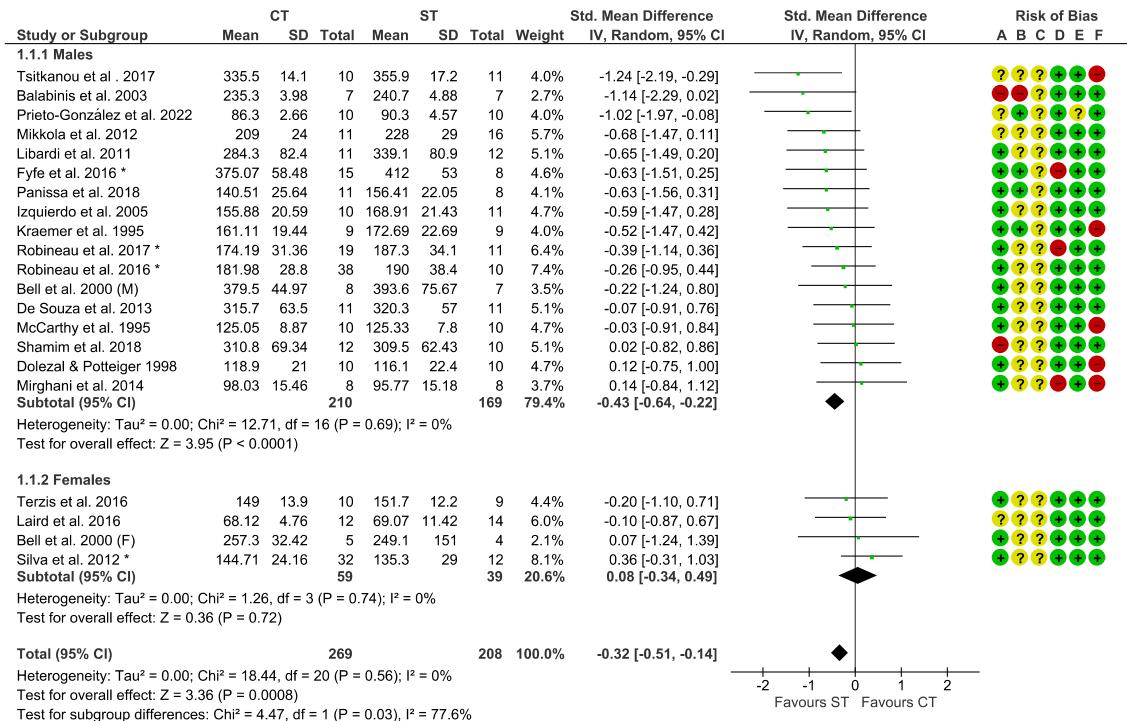


Figure S1. Forest plot of studies comparing differences in adaptations in lower-body strength with concurrent training between males and females.

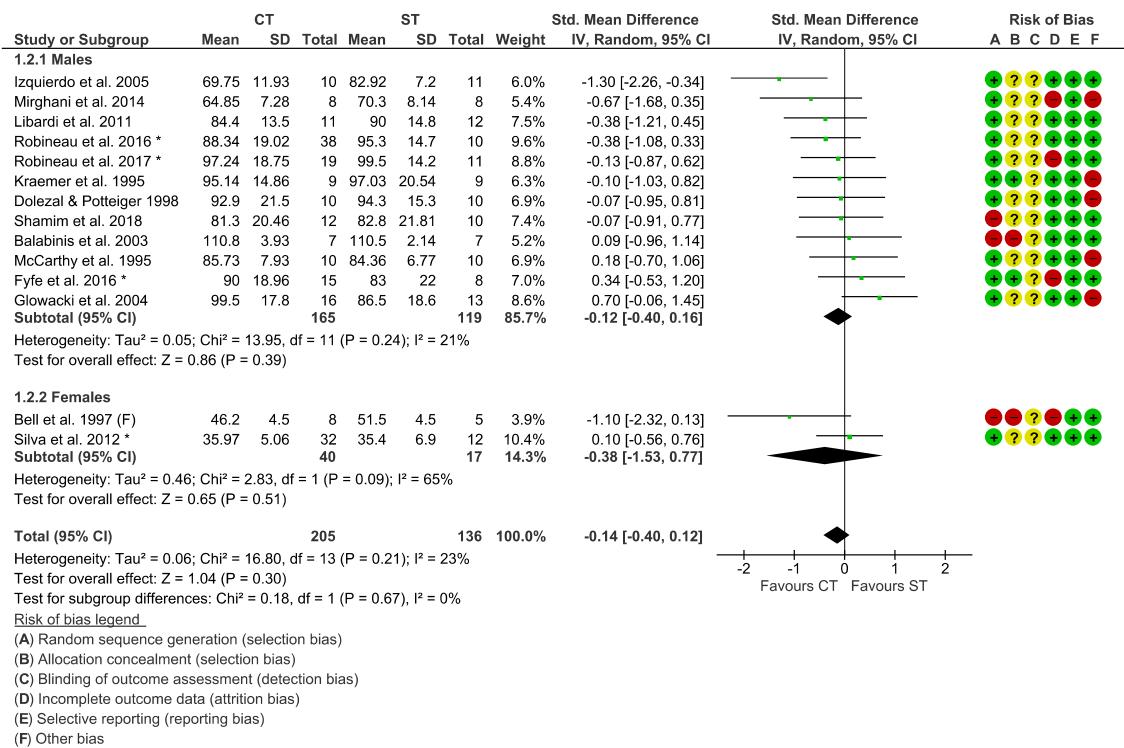


Figure S2. Forest plot of studies comparing differences in adaptations in upper-body strength with concurrent training between males and females.

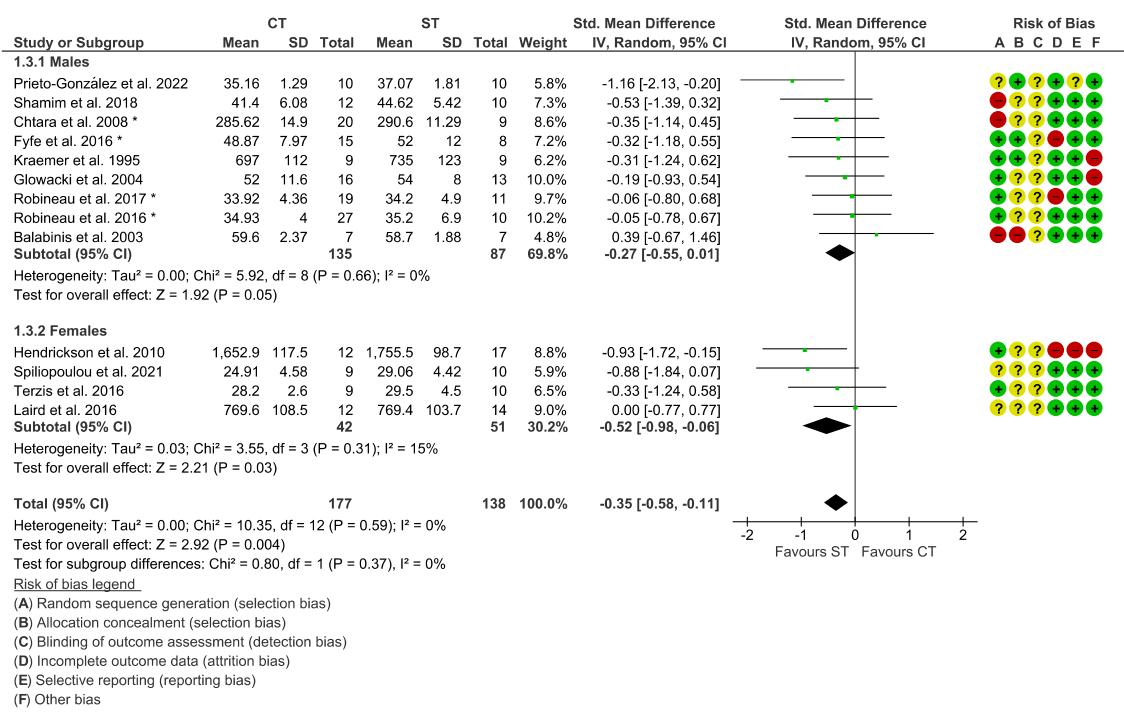


Figure S3. Forest plot of studies comparing differences in adaptations in power with concurrent training between males and females.

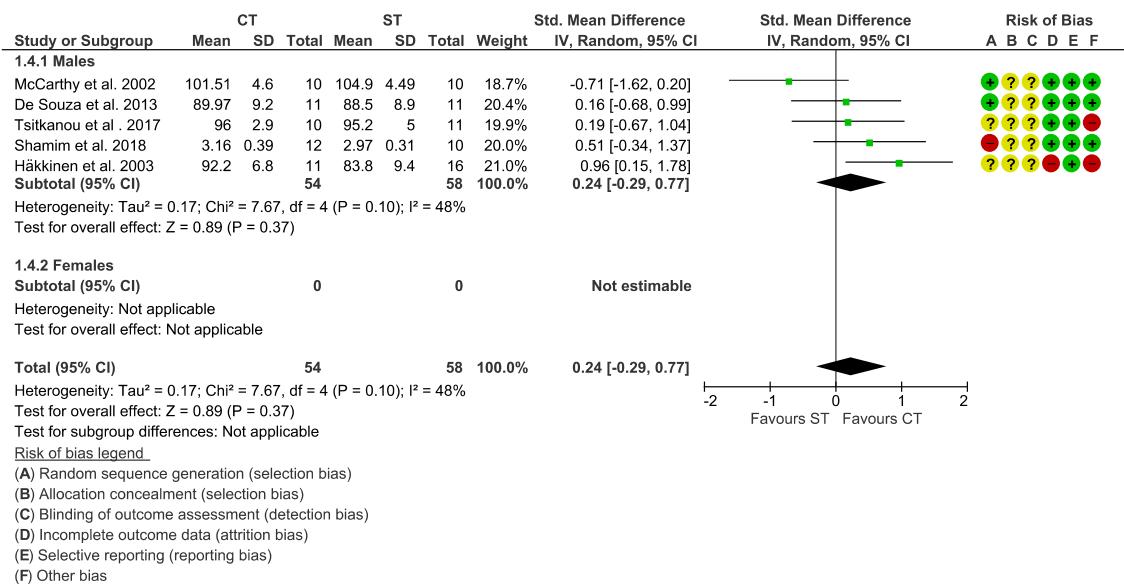
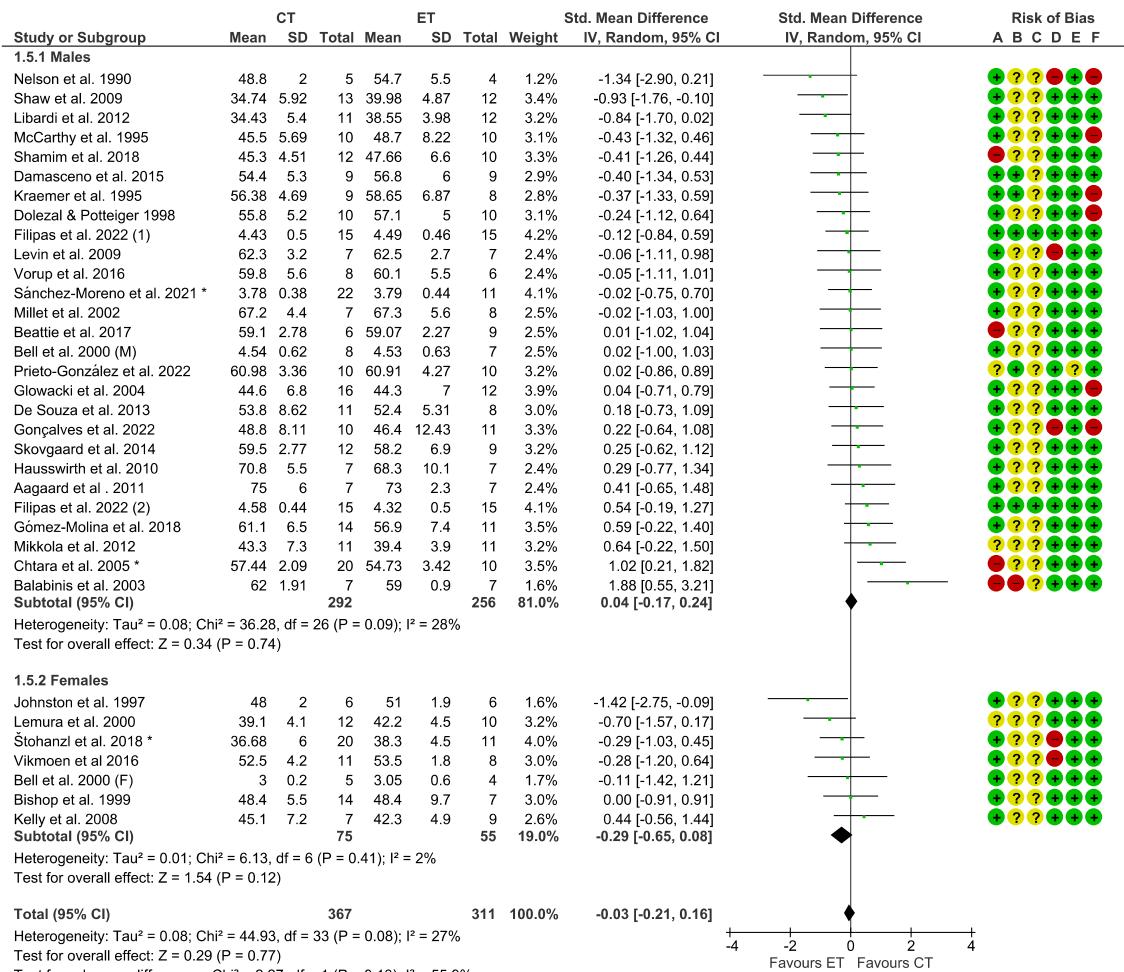


Figure S4. Forest plot of studies comparing differences in adaptations in muscle hypertrophy with concurrent training between males and females.



Risk of bias legend

- (A) Random sequence generation (selection bias)
- (B) Allocation concealment (selection bias)
- (C) Blinding of outcome assessment (detection bias)
- (D) Incomplete outcome data (attrition bias)
- (E) Selective reporting (reporting bias)
- (F) Other bias

Figure S5. Forest plot of studies comparing differences in adaptations in $\dot{V}O_{2\max}$ with concurrent training between males and females.

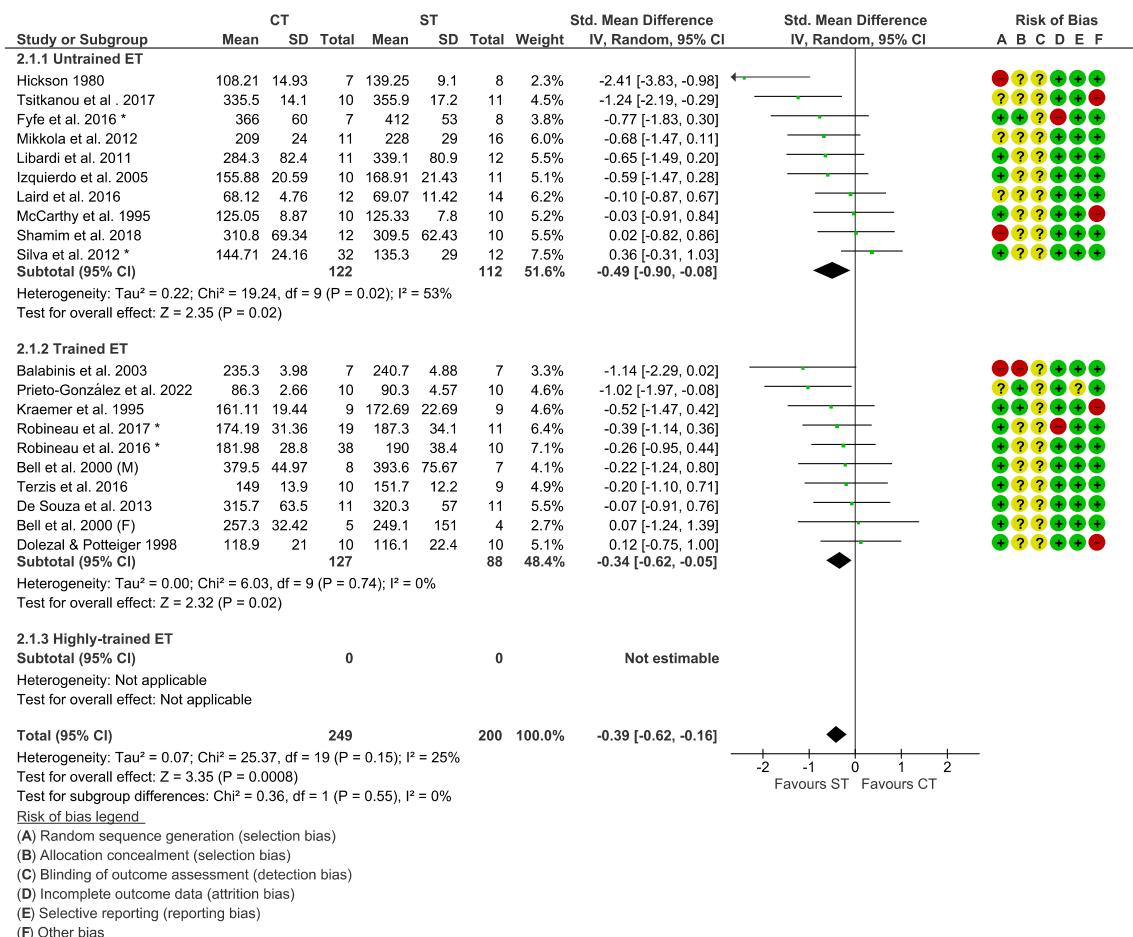


Figure S6. Forest plot of studies comparing differences in adaptations in lower-body strength with concurrent training between untrained and endurance-trained participants.

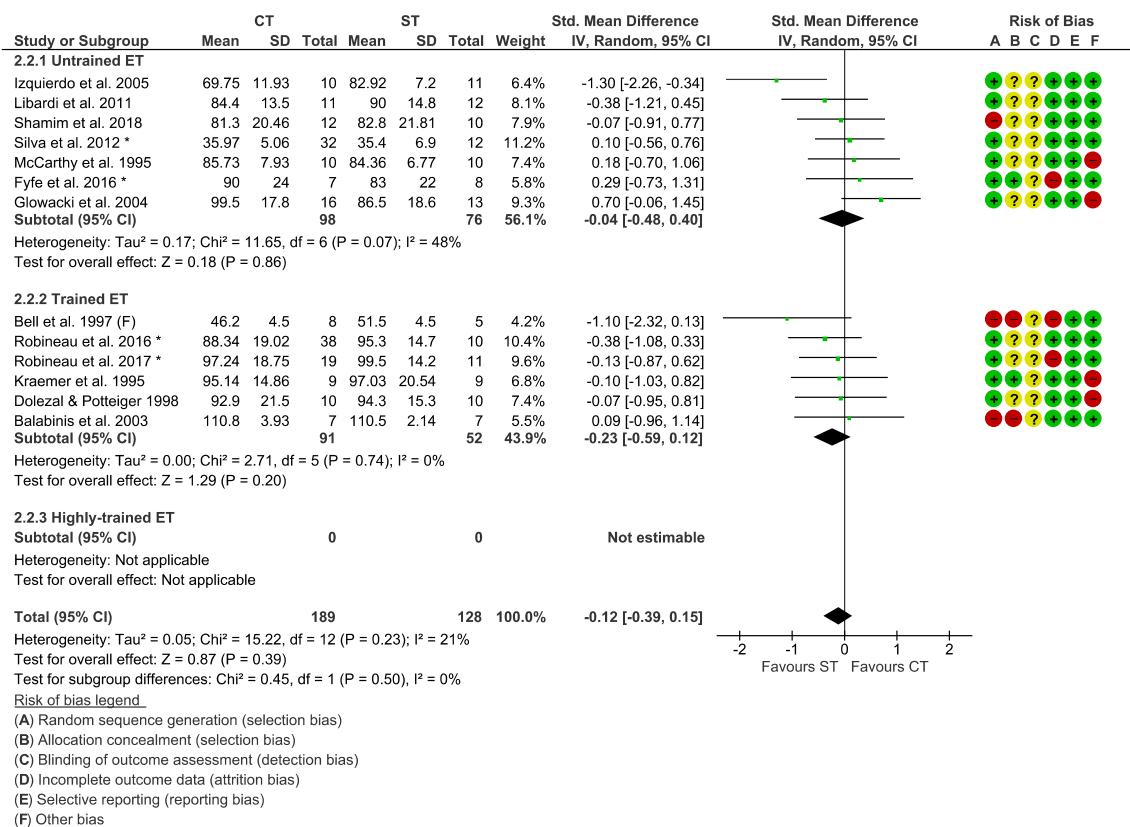


Figure S7. Forest plot of studies comparing differences in adaptations in upper-body strength with concurrent training between untrained and endurance-trained participants.

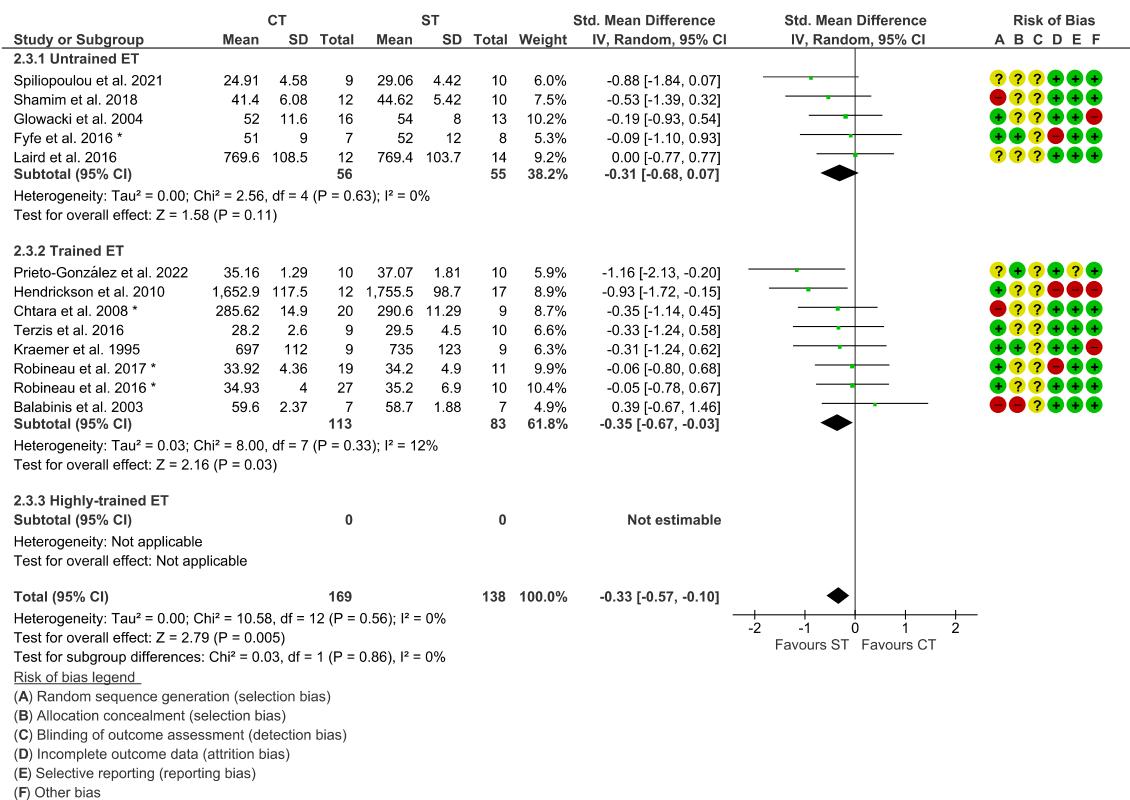


Figure S8. Forest plot of studies comparing differences in adaptations in power with concurrent training between untrained and endurance-trained participants.

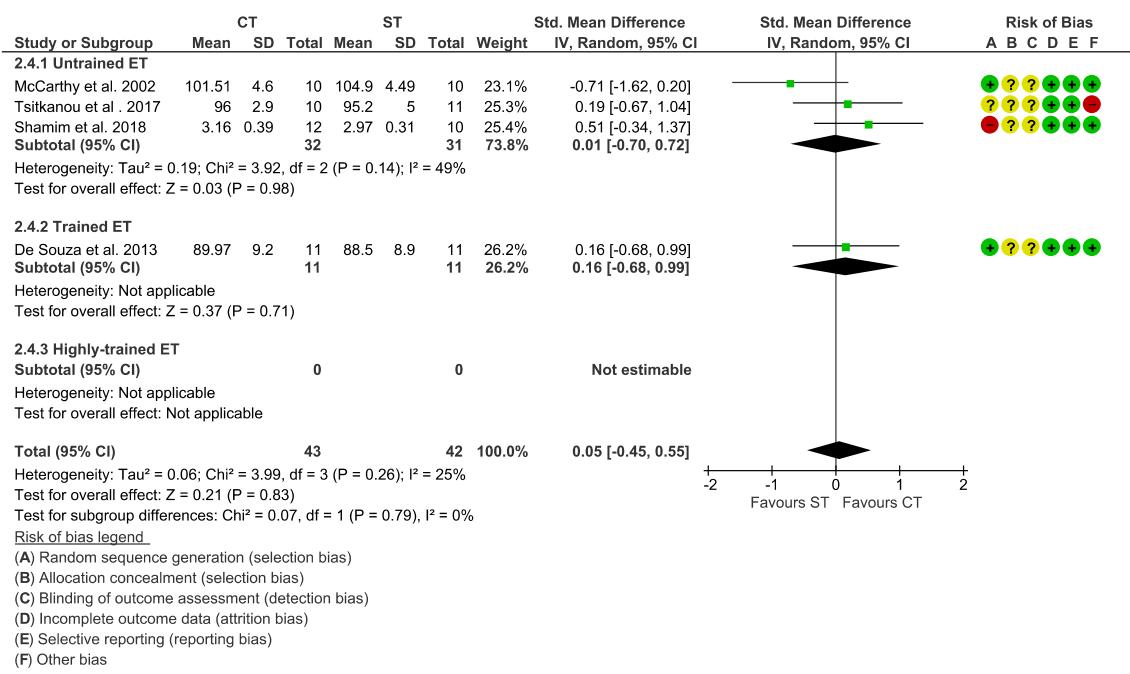


Figure S9. Forest plot of studies comparing differences in adaptations in muscle hypertrophy with concurrent training between untrained and endurance-trained participants.

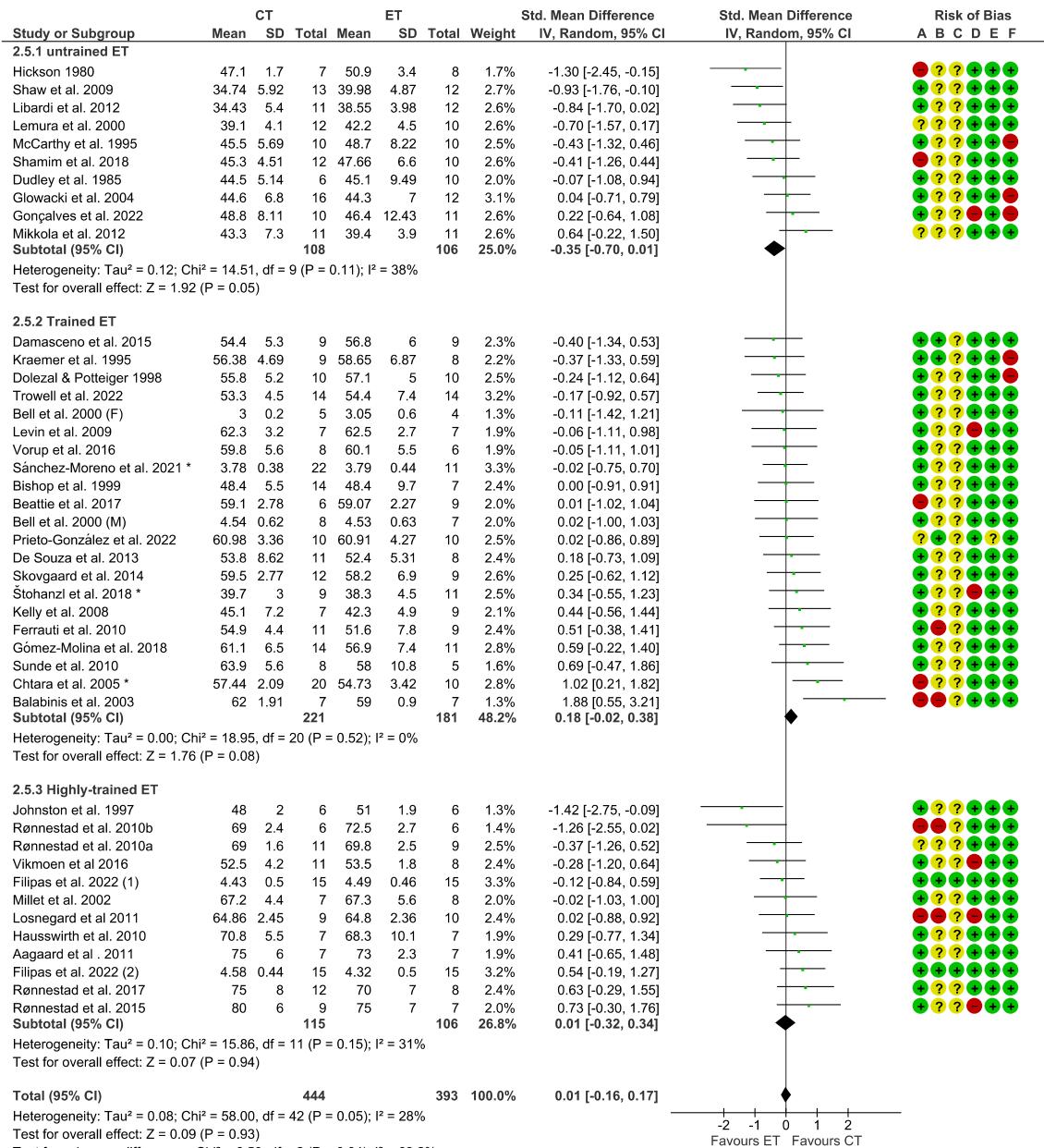


Figure S10. Forest plot of studies comparing differences in adaptations in $\dot{V}O_{2\max}$ with concurrent training between untrained, trained and highly-trained endurance athletes.

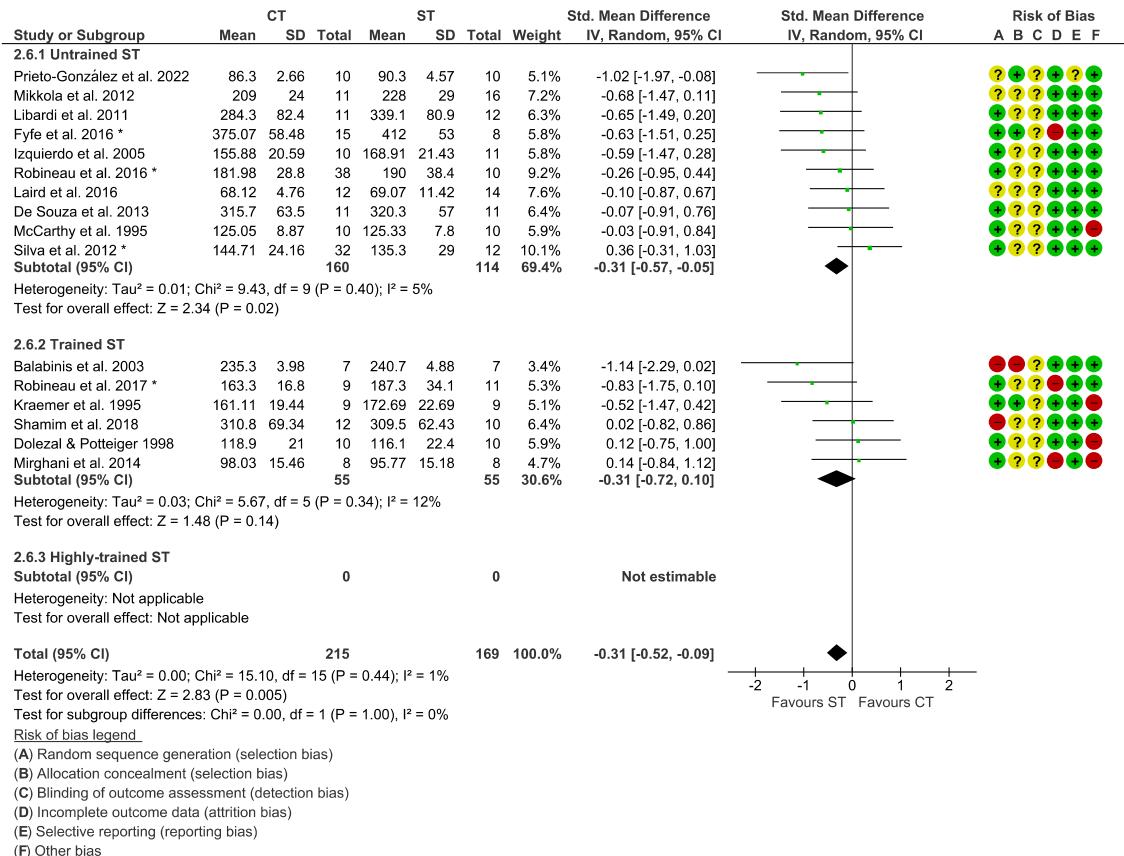


Figure S11. Forest plot of studies comparing differences in adaptations in lower-body strength with concurrent training between untrained and strength-trained participants.

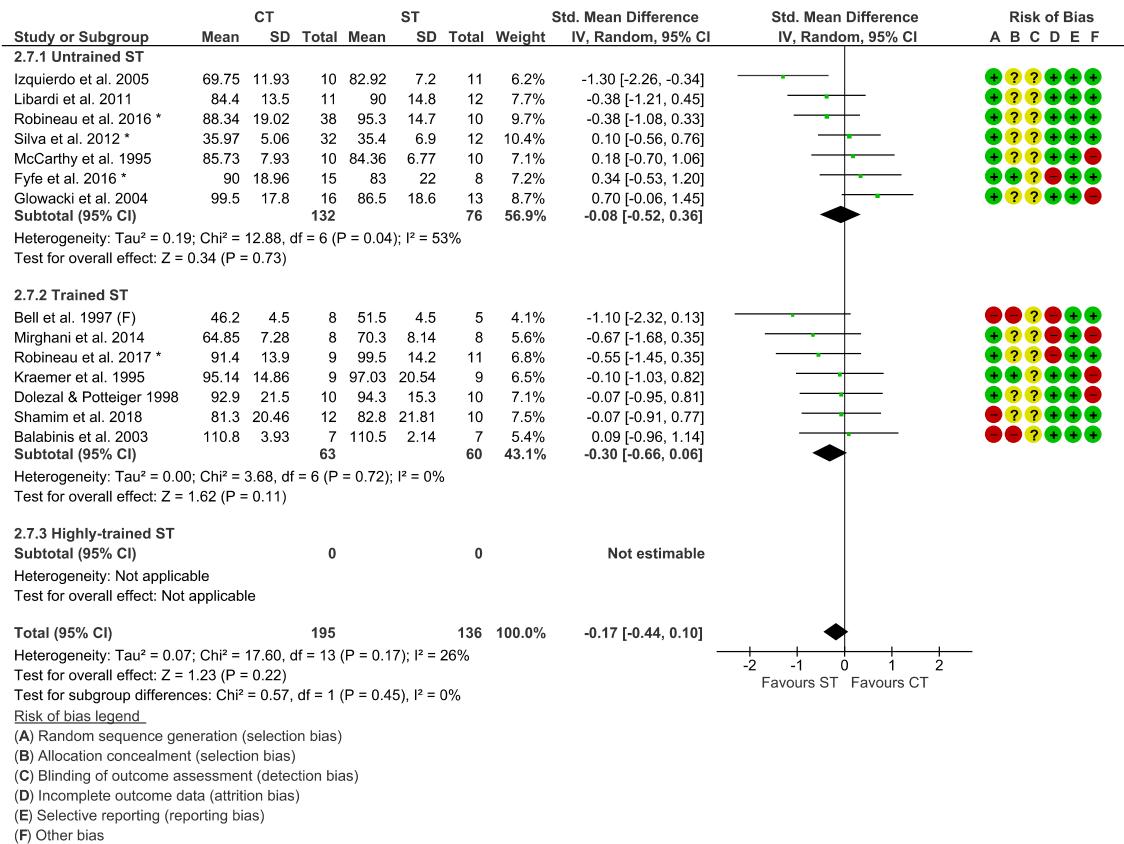


Figure S12. Forest plot of studies comparing differences in adaptations in upper-body strength with concurrent training between untrained and strength-trained participants.

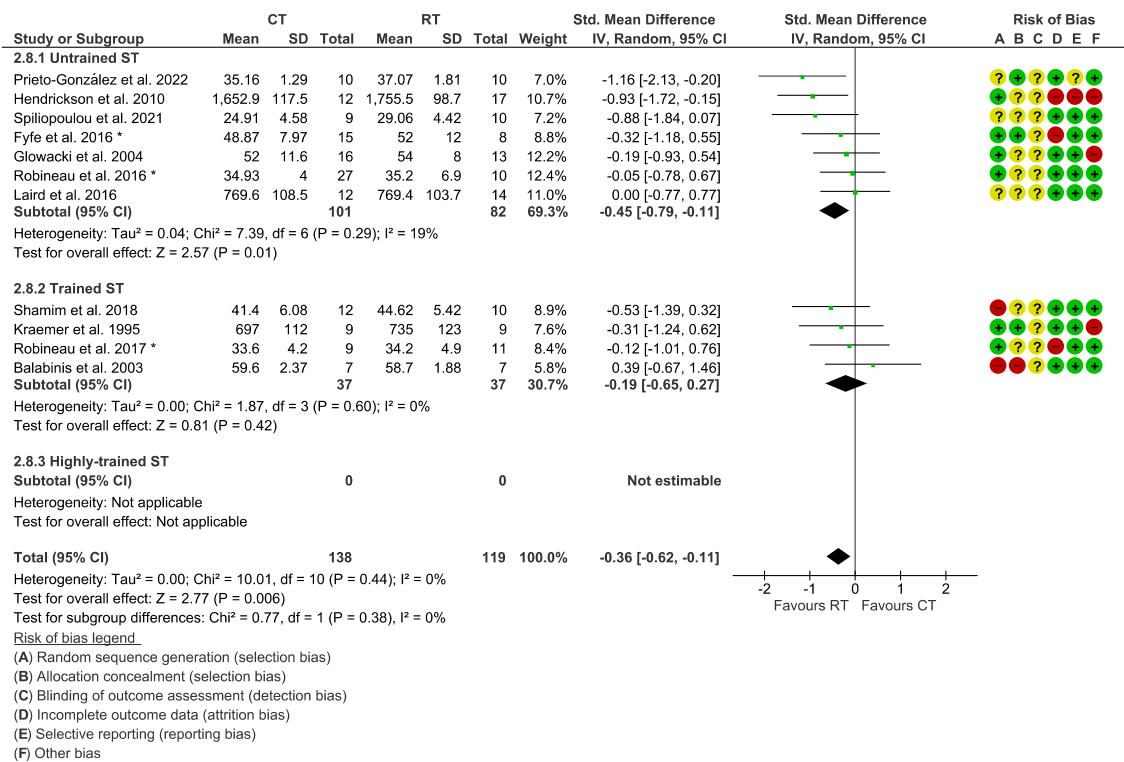


Figure S13. Forest plot of studies comparing differences in adaptations in power with concurrent training between untrained and strength-trained participants.

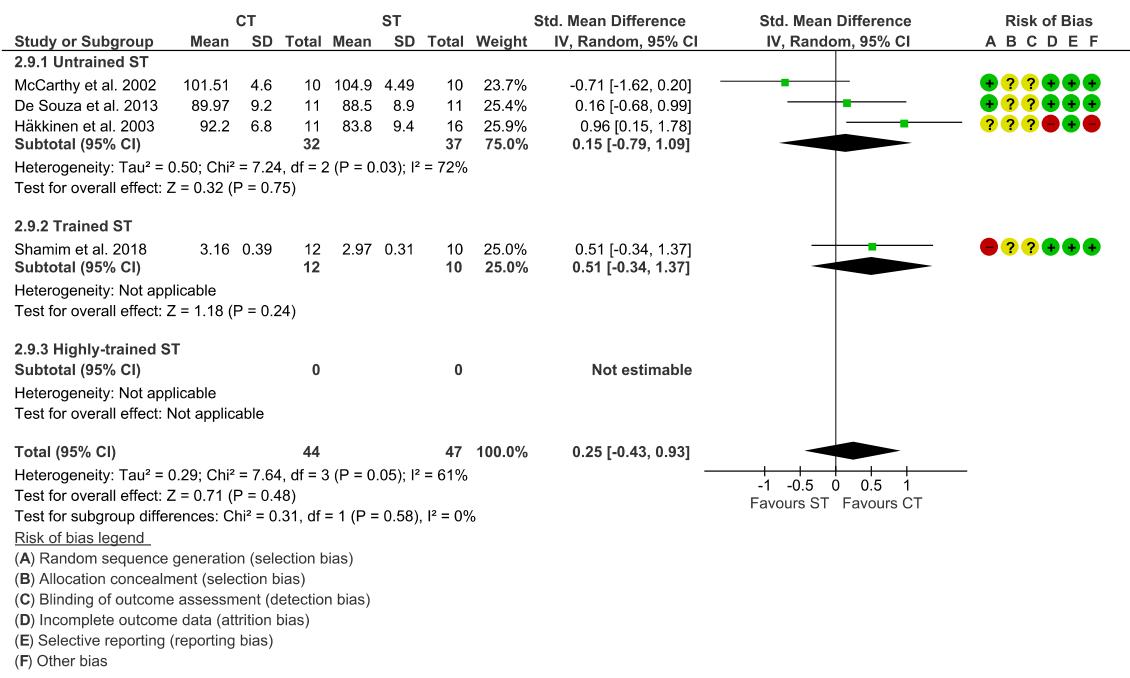


Figure S14. Forest plot of studies comparing differences in adaptations in muscle hypertrophy with concurrent training between untrained and strength-trained participants.

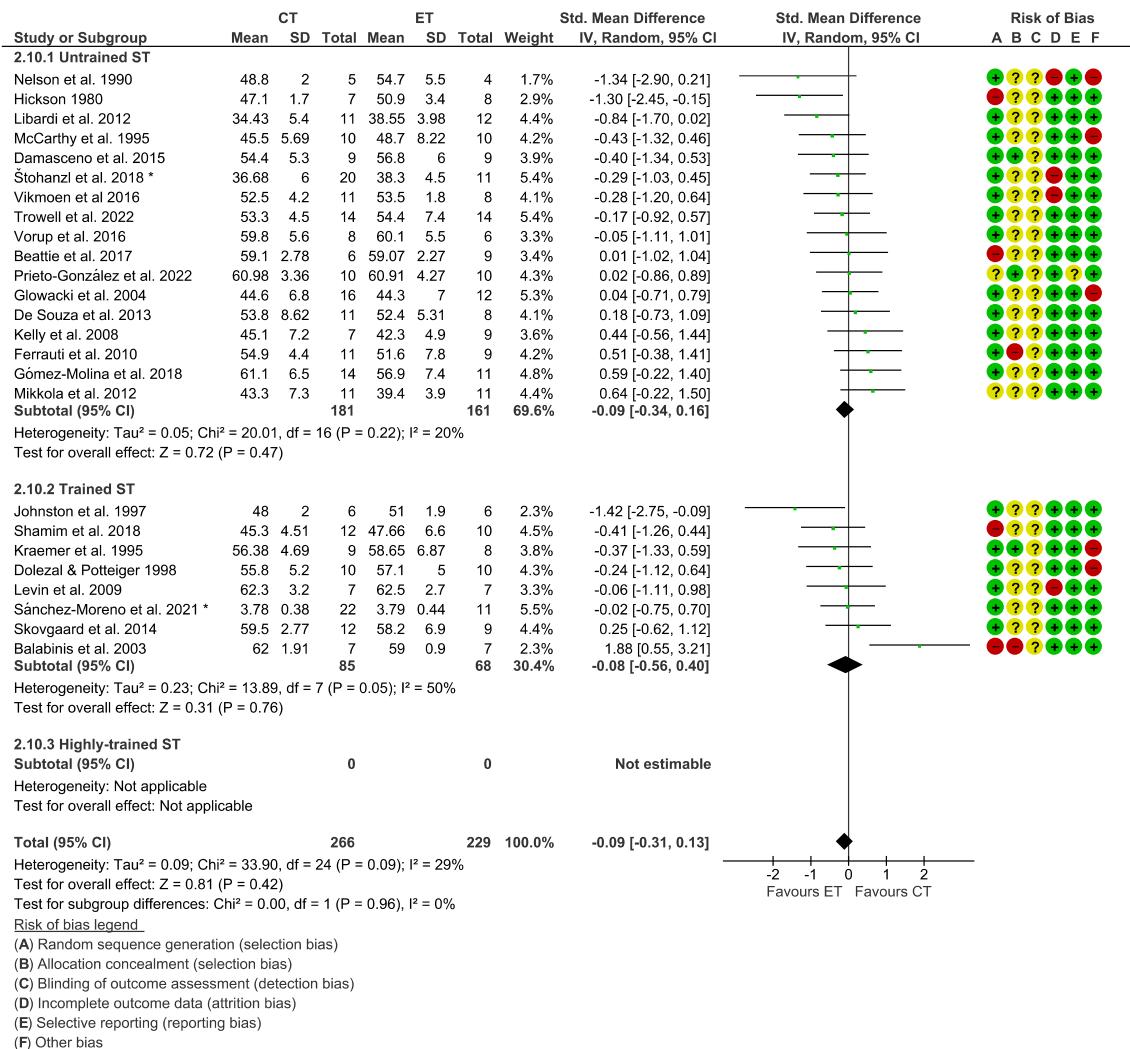


Figure S15. Forest plot of studies comparing differences in adaptations in $\dot{V}O_{2\max}$ with concurrent training between untrained and strength-trained participants.

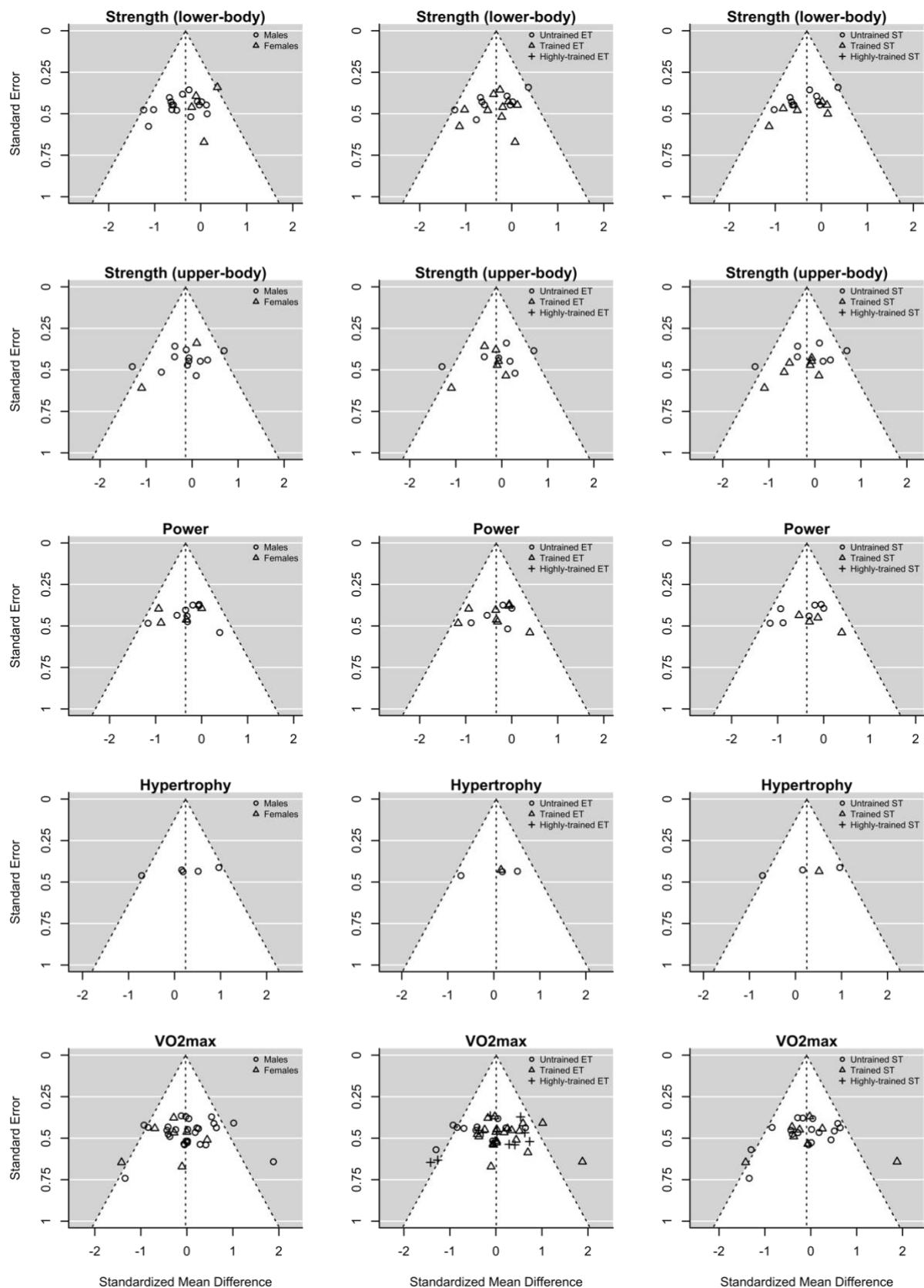


Figure S16. Funnel plots for outcome measures maximal lower-body and upper-body strength, power, muscle hypertrophy and $\dot{V}\text{O}_{2\text{max}}$ with comparisons related to sex (left panels), endurance training status (middle panels) and strength training status (right panels). Egger's regression tests showed no funnel plot asymmetries indicative for a publication bias ($P>0.05$), except for lower-body strength with levels of strength training status ($P=0.033$).

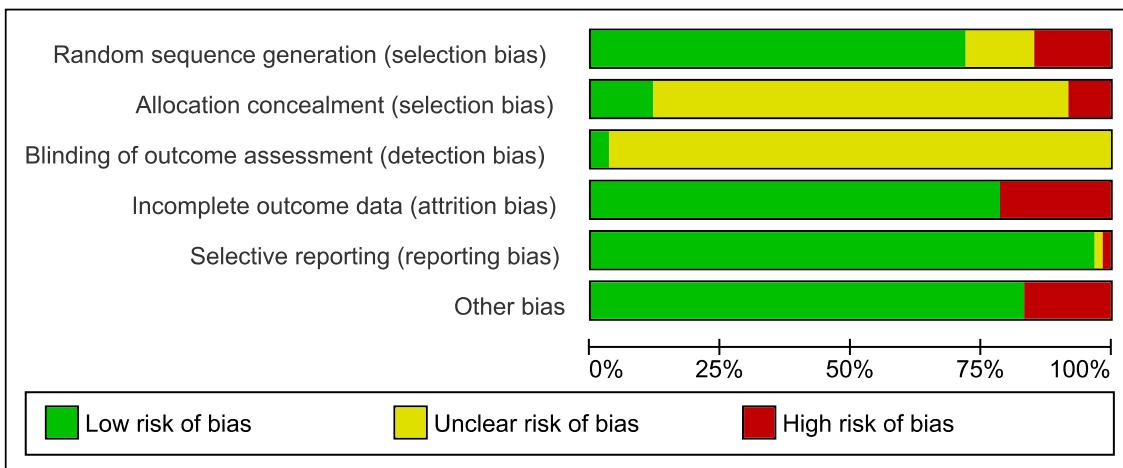


Figure S17. Risk of bias assessment of all included studies according to the Cochrane guidelines.

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