Content

Table S1 Search Terms
Ovid MEDLINE(R) and In-Process, In-Data-Review & Other Non-Indexed Citations , 1946 Year

Steps	Terms	Hits
1	exp physical activity/ or exp exercise test/	291234
2	exp physical education/ or exp physical fitness/ or exp cardiorespiratory fitness/	47746
3	(exercise* or sport* or walking* or cycling or swimming or running or jogging or sedentary or inactiv*).ti,ab.	974933
4	(physical* adj3 (activ* or inactiv* or treat* or exercis* or exertion*)).ti,ab.	189257
5	or/1-4	1150170
6	(controlled clinical trial).ti,ab.	18436
7	exp clinical trial/	960936
8	(randomized controlled trial).ti.	58191
9	(randomized or trial).ti.	353729
10	exp cohort studies/	2439066
11	(retrospective or prospective or longitudinal).ti.	346157
12	or/6-11	3359654
13	5 and 12	172209
14	(exp animal/ or nonhuman/) not exp human/	5086829
15	13 not 14	170034
16	(interven* or change* or traject* or shift* or switch* or alternat* or differen* or variat* or revamp*).ti,kw.	1810596
17	15 and 16	19570
18	(uremi* or uraemi* or albuminuria* or proteinuria* or urin* or albumin* or protein* or glomerular filtration rate* or ?GFR).ti,ab.	4047257
19	exp kidney/ or exp proteinuria/	400331
20	(kidney or renal or disease or insufficien* or failure* or nephro*).ti,ab.	5132016
21	or/18-20	8407973
22	(kidney or renal).mp. and (transplan* or graft*).ti.	94451
23	21 not 22	8319260
24	17 and 23	4571
25	(conference abstract or conference paper or conference review).pt.	0
26	24 not 25	4571
27	editorial/ or letter/ or case reports/ or comment/ or note/	4217780
28	26 not 27	4540

Embase 1947-Present, updated daily

Steps	Terms	Hits
1	exp physical activity/ or exp exercise test/	623139
2	exp physical education/ or exp physical fitness/ or exp cardiorespiratory fitness/	65532
3	(exercise* or sport* or walking* or cycling or swimming or running or jogging or sedentary or inactiv*).ti,ab.	1279181
4	(physical* adj3 (activ* or inactiv* or treat* or exercis* or exertion*)).ti,ab.	260815
5	or/1-4	1707972
6	(controlled clinical trial).ti,ab.	24269
7	exp clinical trial/	1820578
8	(randomized controlled trial).ti.	71118
9	(randomized or trial).ti.	499542
10	exp cohort studies/	962599
11	(retrospective or prospective or longitudinal).ti.	484101
12	or/6-11	3118564
13	5 and 12	193380
14	(exp animal/ or nonhuman/) not exp human/	7826893
15	13 not 14	190775
16	(interven* or change* or traject* or shift* or switch* or alternat* or differen* or variat* or revamp*).ti,kw.	2269582
17	15 and 16	22019
18	(uremi* or uraemi* or albuminuria* or proteinuria* or urin* or albumin* or protein* or glomerular filtration rate* or ?GFR).ti,ab.	5179794
19	exp kidney/ or exp proteinuria/	643196
20	(kidney or renal or disease or insufficien* or failure* or nephro*).ti,ab.	7596748
21	or/18-20	11605916
22	(kidney or renal).mp. and (transplan* or graft*).ti.	156070
23	21 not 22	11459331
24	17 and 23	5916
25	(conference abstract or conference paper or conference review).pt.	5452713
26	24 not 25	4217
27	editorial/ or letter/ or case reports/ or comment/ or note/	2784877
28	26 not 27	4193

Pubmed

Steps	Terms	Hits
1	"exercise"[mesh] OR "exercise test"[mesh]	291459
2	"Physical Education and Training"[mesh] OR "physical fitness"[mesh] OR "cardiorespiratory fitness"[mesh]	47747
3	(exercise*[tiab] OR sport*[tiab] OR walking*[tiab] OR "cycling"[tiab] OR "swimming"[tiab] OR "running"[tiab] OR "jogging"[tiab] OR "sedentary"[tiab] OR inactiv*[tiab])	991749
4	(physical*[tiab] AND (activ*[tiab] OR inactiv*[tiab] OR treat*[tiab] OR exercis*[tiab] OR exertion*[tiab]))	459726
5	#1 OR #2 OR #3 OR #4	1384590
6	("controlled clinical trial"[tiab])	18695
7	"clinical trial"[pt]	961591
8	("randomized controlled trial"[ti])	58192
9	("randomized"[ti] OR "trial"[ti])	353735
10	"cohort studies"[mesh]	2441995
11	("retrospective"[ti] OR "prospective"[ti] OR "longitudinal"[ti])	346215
12	#6 OR #7 OR #8 OR #9 OR #10 OR #11	3362395
13	#5 AND #12	210509
14	"animals"[mesh]	26116055
15	#13 NOT #14	8628
16	interven*[ti] OR change*[ti] OR traject*[ti] OR shift*[ti] OR switch*[ti] OR alternat*[ti] OR differen*[ti] OR variat*[ti] OR revamp*[ti]	1765363
17	#15 AND #16	1223
18	(uremi*[tiab] OR uraemi*[tiab] OR albuminuria*[tiab] OR proteinuria*[tiab] OR urin*[tiab] OR albumin*[tiab] OR protein*[tiab] OR glomerular filtration rate*[tiab] OR "eGFR"[tiab] OR "mGFR"[tiab])	4147077
19	"kidney"[mesh] OR "proteinuria"[mesh]	400520
20	("kidney"[tiab] OR "renal"[tiab] OR "disease"[tiab] OR insufficien*[tiab] OR failure*[tiab] OR nephro*[tiab])	5250858
21	#18 OR #19 OR #20	8585949
22	(("kidney"[tiab] OR "kidney"[mh]) OR ("renal"[tiab])) AND (transplan*[ti] OR graft*[ti])	87814
23	#21 NOT #22	8498135
24	#17 AND #23	295
25	"editorial"[pt] OR "letter"[pt] OR "comment"[pt]	2129064
26	#24 NOT #25	294

Web of Science

Steps	**Terms**	**Hits**
1	TS=(physical activity OR exercise test OR physical fitness OR exercise OR sport OR sedentary OR inactive OR exertion)	2869900
2	TS=(controlled clinical trial OR clinical trail OR randomized controlled trial OR cohort study OR retrospective study OR prospective study OR longitudinal study)	4391262
3	#1 AND #2	230548
4	TS=(animal OR nonhuman OR non-human)	30545714
5	#3 NOT #4	118699
6	TS=(interven* or change* or traject* or shift* or switch* or alternat* or differen* or variat* or revamp*)	46832576
7	#5 AND #6	82111
8	TS=(uremi* or uraemi* or albumin* or proteinuria* or glomerular filtration rate* or eGFR or mGFR or kidney* or renal failure* or nephro*)	2677866
9	TS=(kidney or renal)	2378506
10	TS=(transplan* or graft*)	2270415
11	#9 AND #10	323241
12	#8 NOT #11	2405699
13	#7 AND #12	1320
14	TS=(editorial or letter or case report* or comment)	3433986
15	#13 NOT #14	1267

Table S2 General characteristics of the included studies

Author, year	Study type	Country	Exercise Group Characteristics	Baseline Size of Exercise Group	Attrition	Study Population Age	Type of Exercise	Exercise Frequency	Exercise Length	Exercise Intensity	Kidney-relevant outcome	Findings
de Oliveira *et al.*[40], 2012	RCT	Brazil	Patients with type 2 diabetes mellitus of a diabetes ambulatory clinic.	Aerobic training: 12 people Strength training: 12 people Combination training: 12 people	Aerobic training: 9.1% Strength training: 16.7% Combination training: 16.7%	Mean (SD), years: Aerobic training: 52.09 (8.71) Strength training: 54.10 (8.94) Combined training: 57.90 (9.82)	Aerobic training, strength training, and combined training	One hour/session, three sessions/week	12 weeks	Not used VO2peak in aerobic and combined training due to unable to get accurate value, used lactate threshold. Strength training: 50% of 1 RM for the Week 1&2, 8-12 RM for Week 3&4.	Urea	Pre/Post Exercise, mean (SD), mg/dL Aerobic training: Urea 29.27 (5.93) / 28.18 (6.36) Strength training: Urea 31.00 (10.56) / 29.90 (8.82) Combined training: Urea 34.40 (9.91) / 35.20 (9.40)
Geyssant *et al.* [44], 1981	CT	France	Healthy male.	4 people	0%	Mean (SD), years: 36 (6.4)	Aerobic	One hour/session, four sessions/week	5 months	87% VO2max	PRA	Pre/Post Exercise, mean (SD), ng/l/mn PRA, 106.08 (48.48)/ 62.5 (49.9)
Hagberg *et al.* [30], 1989	RCT	United States of America	Patients with essential hypertension.	Low-intensity: 14 people Moderate-intensity: 10 people	Low-intensity: 21.4% Moderate-intensity: 0%	Mean (SD), years: all groups 64 (3)	Aerobic	Low-intensive: one hour/session, max three sessions/week Moderate-intensive: 45 to 60 minutes/session, 3 sessions/week for at least the last 4-5 months of training	9 months	Low-intensity: 50% VO2max Moderate-intensity: 70-85% VO2max	PRA	Pre/Post Exercise, mean (SD), ng/ml/hr Low-intensity: PRA 1.6 (1.1) / 0.7 (0.4) Moderate-intensity: PRA 2.0 (1.3) / 1.1 (0.9)
Kinoshita *et al.* [36], 1991	CT	Japan	Patients with essential hypertension.	12 people	0%	Mean (SD), years: 51.7 (2.3)	Aerobic	One hour/session, three sessions/week	10 weeks	50% VO2max	PRA, eGFR	Pre/Post Exercise, mean (SE), ng/ml/h PRA 1.3 (0.2) / 1.26 (0.4) Pre/Post Exercise, mean (SE), ml/min eGFR 99 (4.7) / 105 (5.2)

Kiyonaga *et al.* [31], 1985	CT	Japan	Patients with essential hypertension.	12 people	At 10 weeks: 0% At 20 weeks: 25%	Mean (Range), years: 46 (34 to 56)	Aerobic	One hour/session, three sessions/week	20 weeks	Used lactate threshold, but claimed to have a 50% VO2max although data were not published.	PRA Ang II	Pre/Post Exercise, mean (SE), ng/ml/hr PRA 11 (4) / 13 (3) Pre/Post Exercise, mean (SE), pg/ml Ang II 58 (8) / 91 (12)
Koga *et al.* [37], 1992	CT	Japan	Female atients with essential hypertension	10 people	0%	Mean (SEM), years: 49 (2)	Aerobic	One hour/session, three sessions/week	10 weeks	50% VO2max	PRA	Pre/Post Exercise, mean (SE), ng/ml/h PRA 0.77 (0.19) / 0.4 (0.1)
Martinelli *et al.* [34], 2010	CT	Brazil	Overweight patients with hypertension.	20 people	0%	Mean (SD), years: 57 (7.1)	Aerobic	40 min/session, three sessions/week	16 weeks	60-80% HRmax	PRA	Pre/Post Exercise, median (IQR), ng/ml/h PRA 0.8 (0.45 - 2.0) / 1.45 (0.8 - 2.15)
Matsusaki *et al.* [38], 1992	CT	Japan	Patients with hypertension.	Low-workload: 16 people High-workload: 14 people	Low-workload: 0% High-workload: 28.6%	Mean (SEM), years: all groups 47.2 (1.5)	Aerobic	Low-workload: one hour/session, three sessions/week High-workload: 30-40 min/session, three sessions per week	10 weeks	Low-workload: 50% VO2max High-workload: 75% VO2max	PRA	Pre/Post Exercise, mean (SE), ng/ml/h Low-workload: PRA 0.82 (0.22) / 0.62 (0.27) High-workload: PRA 1.26 (0.15) / 1.47 (0.16)
Nelson *et al.* [39], 1986	CT	Australia	Patients with essential hypertension of a risk-evaluation clinic.	17 people	23.5%	Mean (Range) , years: 44 (25 to 62)	Aerobic	Three levels of activity for one month each successively. First month: normal sedentary, no training Second month: 45 min/session, three sessions/week Third month: 45 min/session, seven sessions/week	2 months (exclude the first sedentary month)	60-70% VO2max	PRA	Pre/Post Exercise, mean (SEM), ng/ml/h PRA 1.45 (0.51) / 1.46 (0.30)
Passino *et al.* [45], 2006	RCT	Italy	Patients with heart failure.	47 people	6.4%	Mean (SD), years: 60 (2)	Aerobic	Minimum 30 min/day, three days/week	9 months	Heart rate at 65% VO2max	PRA	Pre/Post Exercise, mean (SD), ng/ml/h PRA 3.04 (0.66) /

												2.96 (0.62)
Sikiru and Okoye [33], 2014	RCT	Nigeria	Patients with essential hypertension of a hypertensive clinic.	162 people	30.9%	Mean (SD), years: 58.63 (7.22)	Aerobic	45 min/session, three sessions/week for Week 1 and 2 One hour/session, three sessions/week, for Week 3-8	8 weeks	60-79% of HR reserve	SCr	Pre/Post Exercise, mean (SD), mg/dL SCr 0.81 (0.17) / 0.85 (0.39)
Sullivan *et al*. [35], 1992	CT	United States of America	Male patients with uncomplicated essential hypertension.	15 people	0%	Mean (SD), years: 42.3 (1.0)	Strenuous Aerobic	18 min/session, three sessions/week	6 weeks	90% HRmax	PRA	Pre/Post Exercise, mean (SE), ng/ml/h PRA 1.9 (0.3) / 1.94 (0.4)
Szulinska *et al*. [42], 2016	RCT	Poland	Women with obesity.	Endurance training: 22 people Endurance+strength training: 22 people	Endurance training: 4.5% Endurance+strength training: 22.7%	Mean (SD), years: Endurance 51.3 (8.3) Endurance+strength 48.2 (11.2)	Endurance and Endurance+strength training	One hour/session, three sessions/week	3 months	Endurance group: 50-80% HRmax Endurance+strength group: 50-80% HRmax for endurance training, unclear intensity for strength exercise.	SCr eGFR UACR	Pre/Post Exercise, mean (SD) Endurance group SCr, mg/dL 0.76 (0.11) / 0.84 (0.11) eGFR-MDRD, 87.81 (18.43) / 77.90 (12.65) eGFR-CG, 129.47 (33.24) / 114.02 (24.98) UACR, mg/mmol cr 1.19 (2.32) / 1.28 (2.42) Endurance+strength group SCr, mg/dL 0.73 (0.10) / 0.81 (0.10) eGFR-MDRD, 93.58 (17.87) / 82.54 (12.01) eGFR-CG, 143.91 (36.69) / 124.65 (26.71) UACR, mg/mmol cr 0.76 (0.28) / 0.65 (0.28)

Trabelsi *et al*. [43], 2012	CT	Turnisa	Male recreational bodybuilders.	non-faster: 7 people	0%	Mean (SD), years: non-faster 26 (3)	Resistance	Four sessions/week	1 month	Four sets with a load of 10 RM for each exercise.	Urea SCr	Pre/Post Exercise, mean (SD), mmol/L Urea 4.51 (0.32) / 4.5 (0.26) Pre/Post Exercise, mean (SD), μmol/L SCr 91.14 (4.45) / 94.29 (4.31)
Urata *et al*. [32], 1987	RCT	Japan	Patients with essential hypertension.	10 people	0%	Mean (SE), years: 51.4 (2.8)	Aerobic	One hour/session, three sessions/week	10 weeks	40-60% VO2max	PRA	Pre/Post Exercise, mean (SE), ng/mL/min PRA 1.24 (0.24) / 1.50 (0.39)
Zaman *et al*.[41], 2021	RCT	Saudi Arabia	Obese and non-obese male people.	Obese resistance training: 25 Non-obese resistance training: 25	Obese resistance training: 20% Non-obese resistance training: 20%	Range, years: 35 to 60	Resistance	50 min/session, three days/week	12 weeks	50-70% of 1 RM	Urea	Pre/Post Exercise, mean (SD), mg/dl Obese people Urea 33.33 (3.57) / 32.27 (2.54),

Ang II,angiotensin II; CT, clinical trial; eGFR, estimated glomerular filtration rate; HR, heart rate; PRA, plasma renin activity; RCT, randomized clinical trial; RM, repetition maximum; SCr, serum creatinine; SD, standard deviation;SE, standard error; UARC, urine albumin-to-creatinine ratio; VO2, maximum rate of oxygen.

Note: Conversion factors for units: serum creatinine in mg/dL to μmol/L, ×88.4; urea nitrogen in mg/dL to mmol/L, ×0.357.

Table S3 Cochrane Risk of Bias Assessment Form

Author, Year	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias): Self-reported outcomes	Blinding of outcome assessment (detection bias): Objective measures	Incomplete outcome data (attrition bias): All outcomes	Selective reporting (reporting bias)	Other bias	Overall
de Oliveira *et al.*[40], 2012	Unclear	Low	High	Not applicable	Low	Low	Low	Low	Low
Geyssant *et al.*[44], 1981	Not applicable	Not applicable	High	Not applicable	Low	Low	Low	Low	Low
Hagberg *et al.*[30], 1989	Unclear	Low	High	Not applicable	Low	High	Low	Low	High
Kinoshita *et al.*[36], 1991	Not applicable	Not applicable	High	Not applicable	Low	Low	Low	Low	Low
Kiyonaga *et al.*[31], 1985	Not applicable	Not applicable	High	Not applicable	Low	High	Low	Low	High
Koga *et al.*[37], 1992	Not applicable	High	High	Not applicable	Low	Low	Low	Low	High
Martinelli *et al.*[34], 2010	Not applicable	Not applicable	High	Not applicable	Low	Low	Low	Low	Low
Matsusaki *et al.*[38], 1992	Unclear	Low	High	Not applicable	Low	High	Low	Low	High
Nelson *et al.*[39], 1986	Not applicable	Not applicable	High	Not applicable	Low	High	Low	Low	High
Passino *et al.*[45], 2006	Unclear	Low	High	Not applicable	Low	Low	Low	Low	Low
Sikiru and Okoye[33], 2014	High	High	High	Not applicable	Low	High	Low	Low	High

Sullivan *et al.*[35], 1992	Not applicable	Not applicable	High	Not applicable	Low	Low	Low	Low	Low
Szulinska *et al.*[42], 2016	Low	Low	High	Not applicable	Low	High	Low	Low	High
Trabelsi *et al.*[43], 2012	Unclear	High	High	Not applicable	Low	Low	Low	Low	High
Urata *et al.*[32], 1987	Unclear	Low	High	Not applicable	Low	Low	Low	Low	Low
Zaman *et al.*[41], 2021	Low	Unclear	High	Not applicable	Low	High	High	Low	High

Figure S1 PRISMA workflow

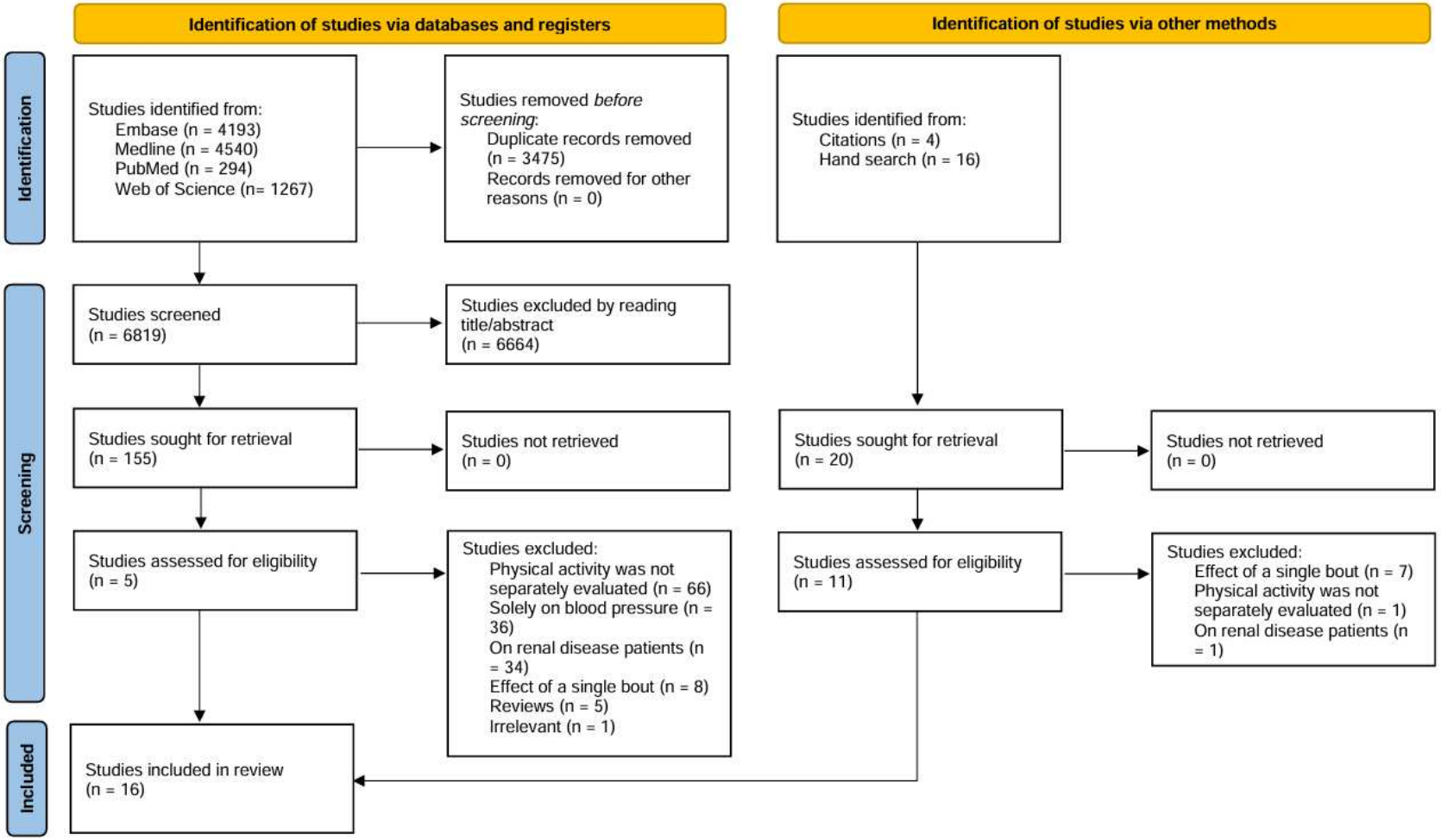
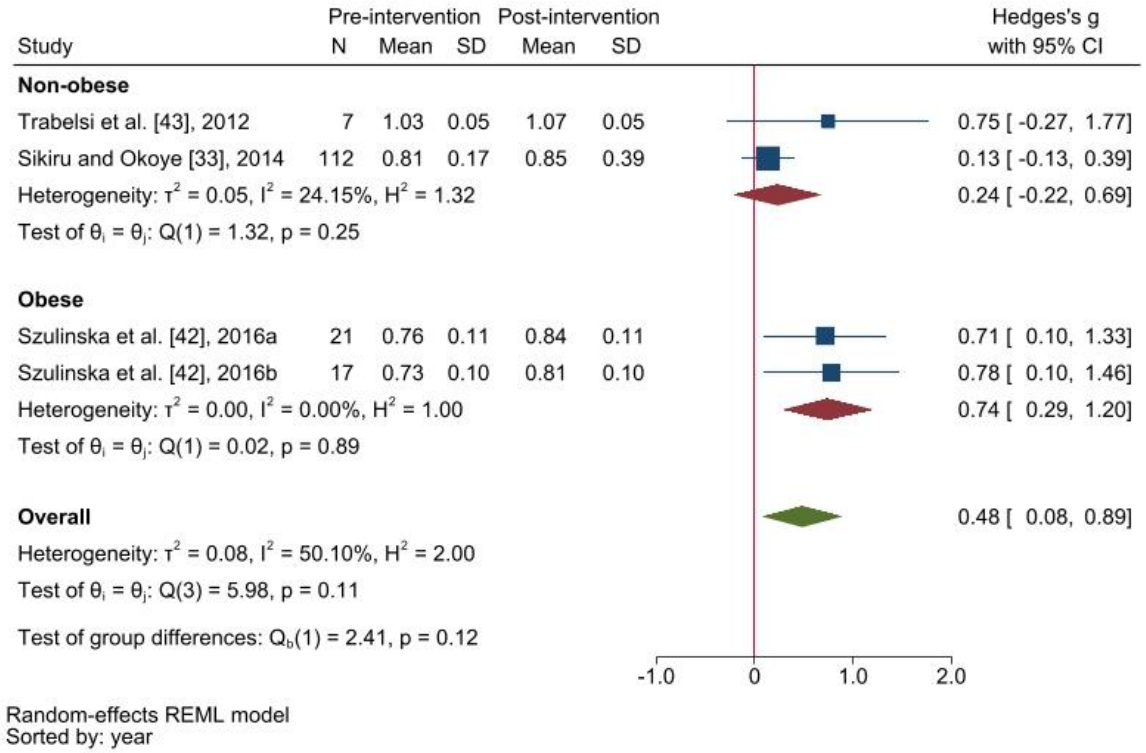


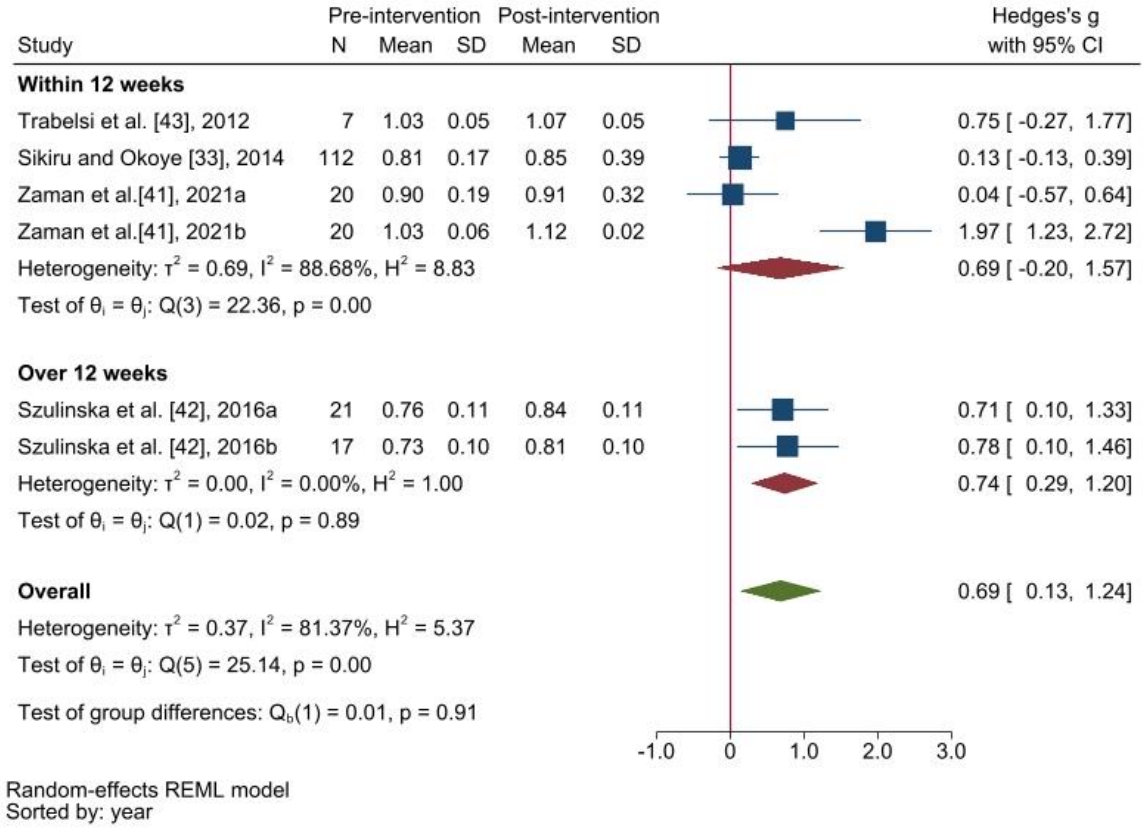
Figure S2a Obesity stratified meta-analysis on the association of changes in physical activity with serum creatinine.



Szulinska *et al.* [42], 2016a: Patients received endurance training.

Szulinska *et al.* [42], 2016b: Patients received both endurance and strength training.

Figure S2b Exercise duration stratified meta-analysis on the association of changes in physical activity with serum creatinine.



Szulinska *et al.* [42], 2016a: Patients received endurance training.

Szulinska *et al.* [42], 2016b: Patients received both endurance and strength training.

Zaman *et al.* [41], 2021a: Patients with obesity

Zaman *et al*.[41], 2021b: Patients without obesity

Figure S2c. Funnel plot of studies on the association of changes in physical activity with serum creatinine

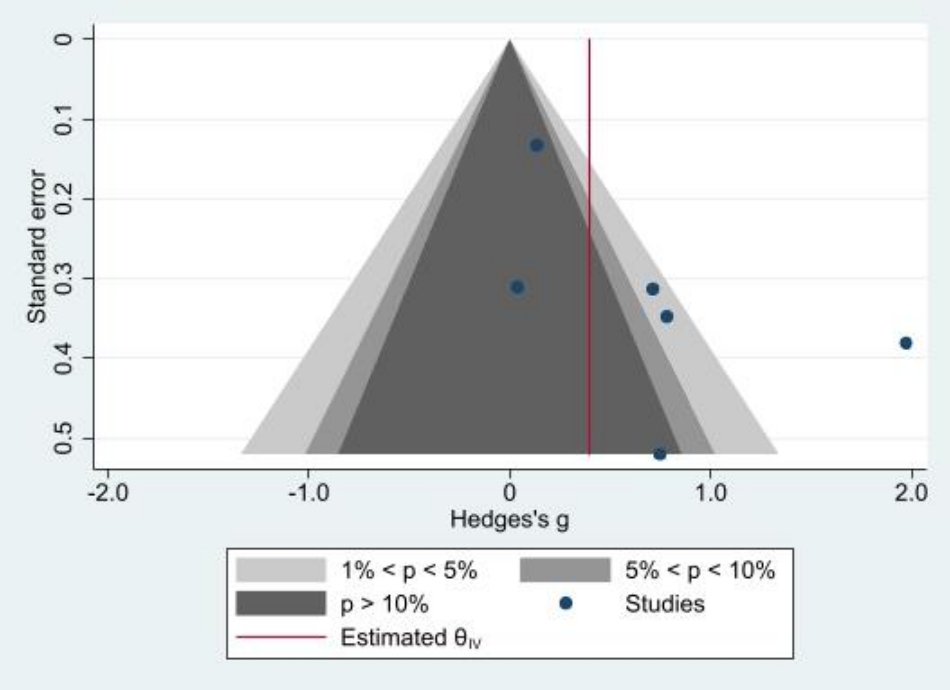
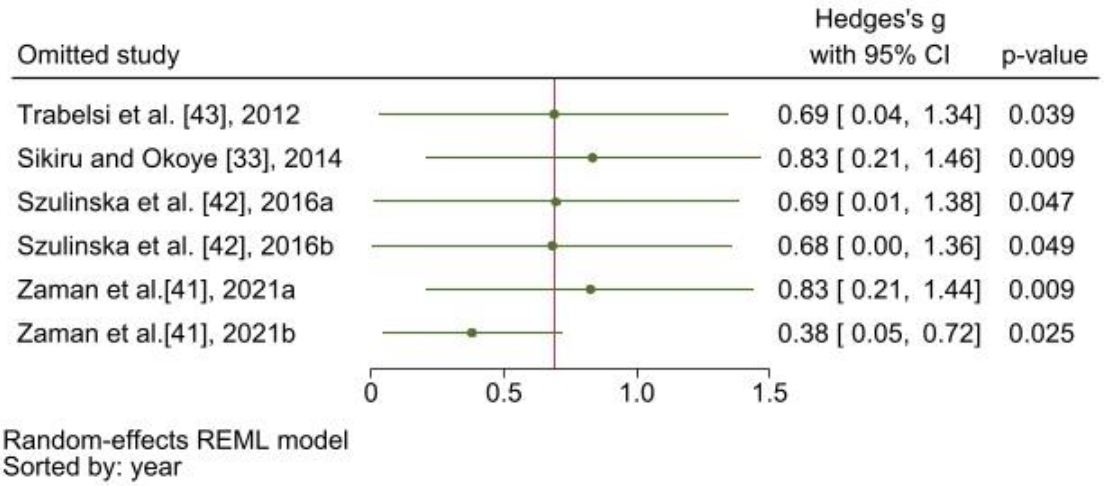


Figure S2d Leave-one-out figure of studies on the association of changes in physical activity with serum creatinine



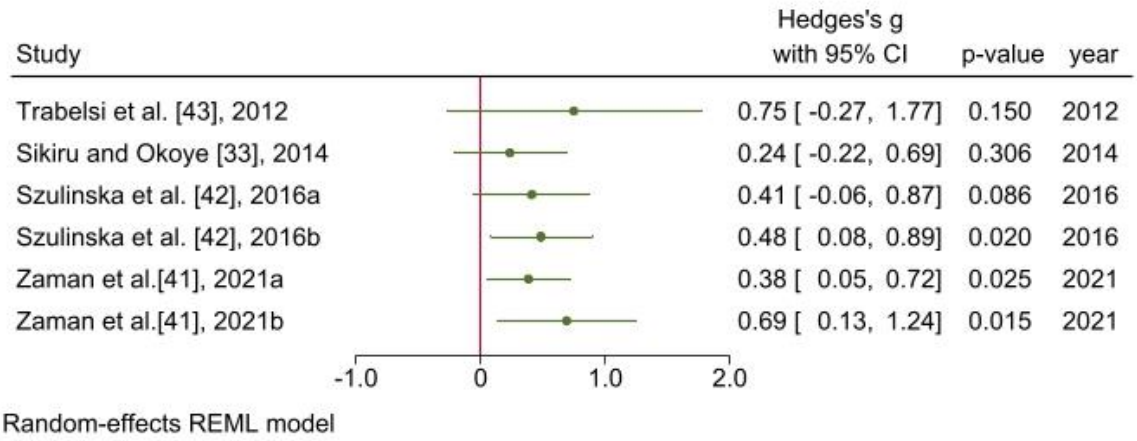
Szulinska *et al.* [42], 2016a: Patients received endurance training.

Szulinska *et al.* [42], 2016b: Patients received both endurance and strength training.

Zaman *et al.* [41], 2021a: Patients with obesity

Zaman *et al.*[41], 2021b: Patients without obesity

Figure S2e Cumulative meta-analysis of the association of changes in physical activity with serum creatinine



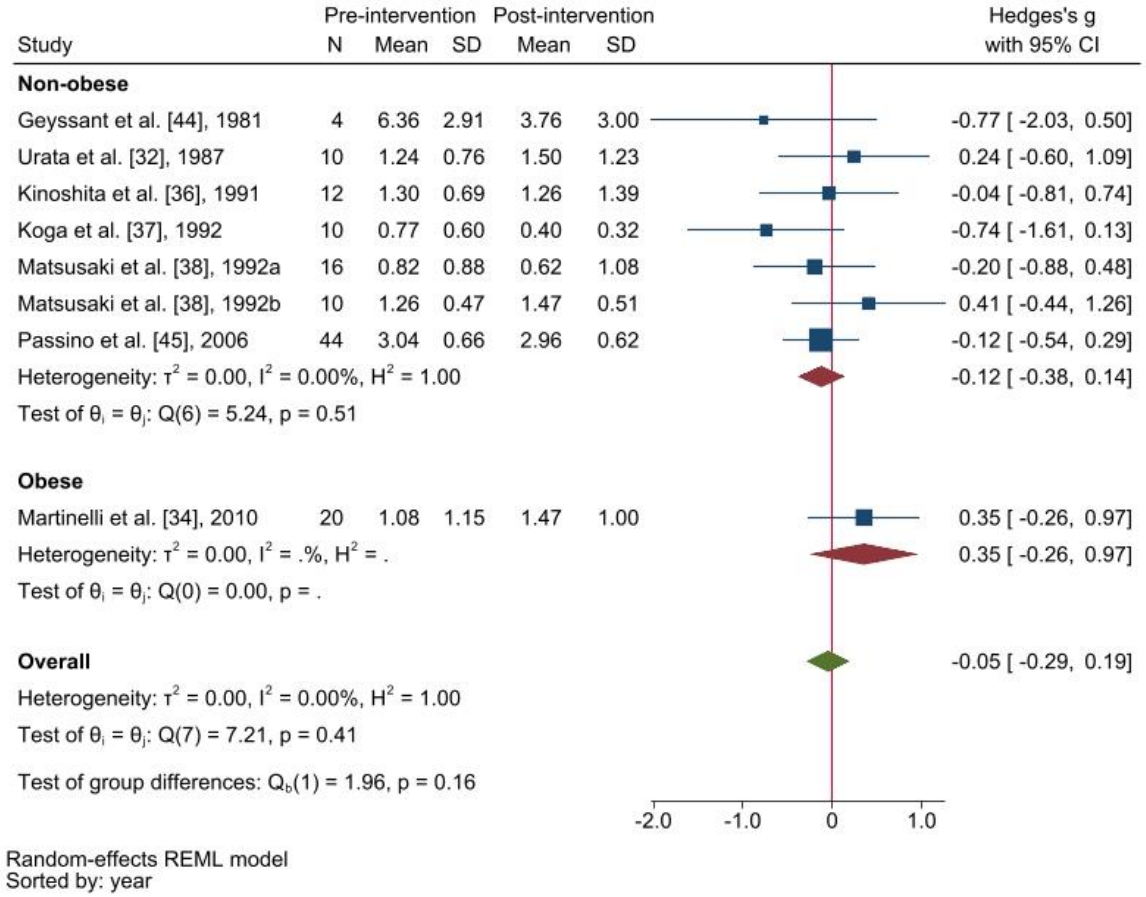
Szulinska *et al.* [42], 2016a: Patients received endurance training.

Szulinska *et al.* [42], 2016b: Patients received both endurance and strength training.

Zaman *et al.* [41], 2021a: Patients with obesity

Zaman *et al*.[41], 2021b: Patients without obesity

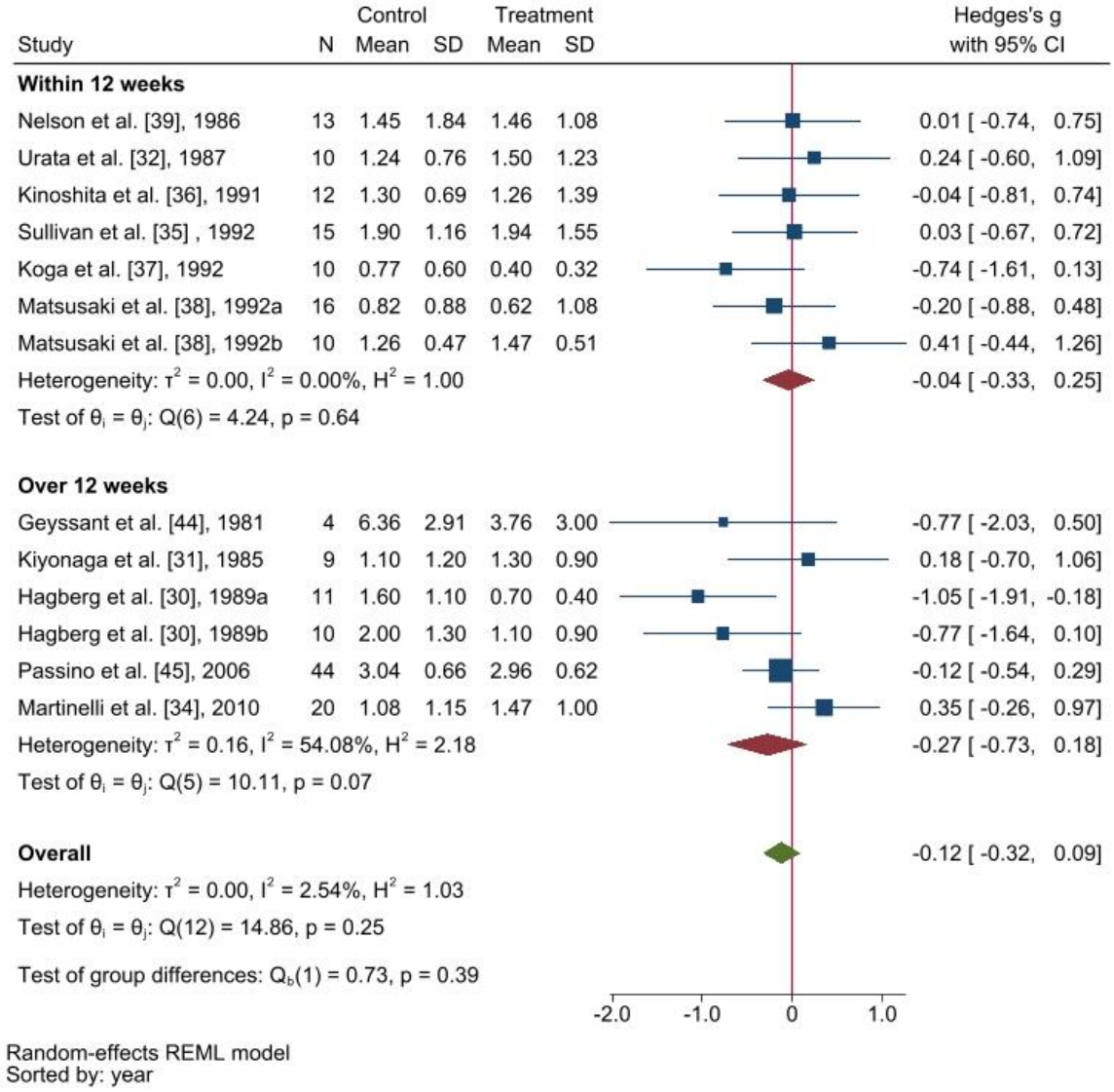
Figure S3a Obesity stratified meta-analysis on the association of changes in physical activity with plasma renin activity



Matsusaki *et al.*[38], 1992a: Patients performed low-workload physical activity.

Matsusaki *et al.*[38], 1992b: Patients performed high-workload physical activity.

Figure S3b Exercise duration stratified meta-analysis on the association of changes in physical activity with plasma renin activity



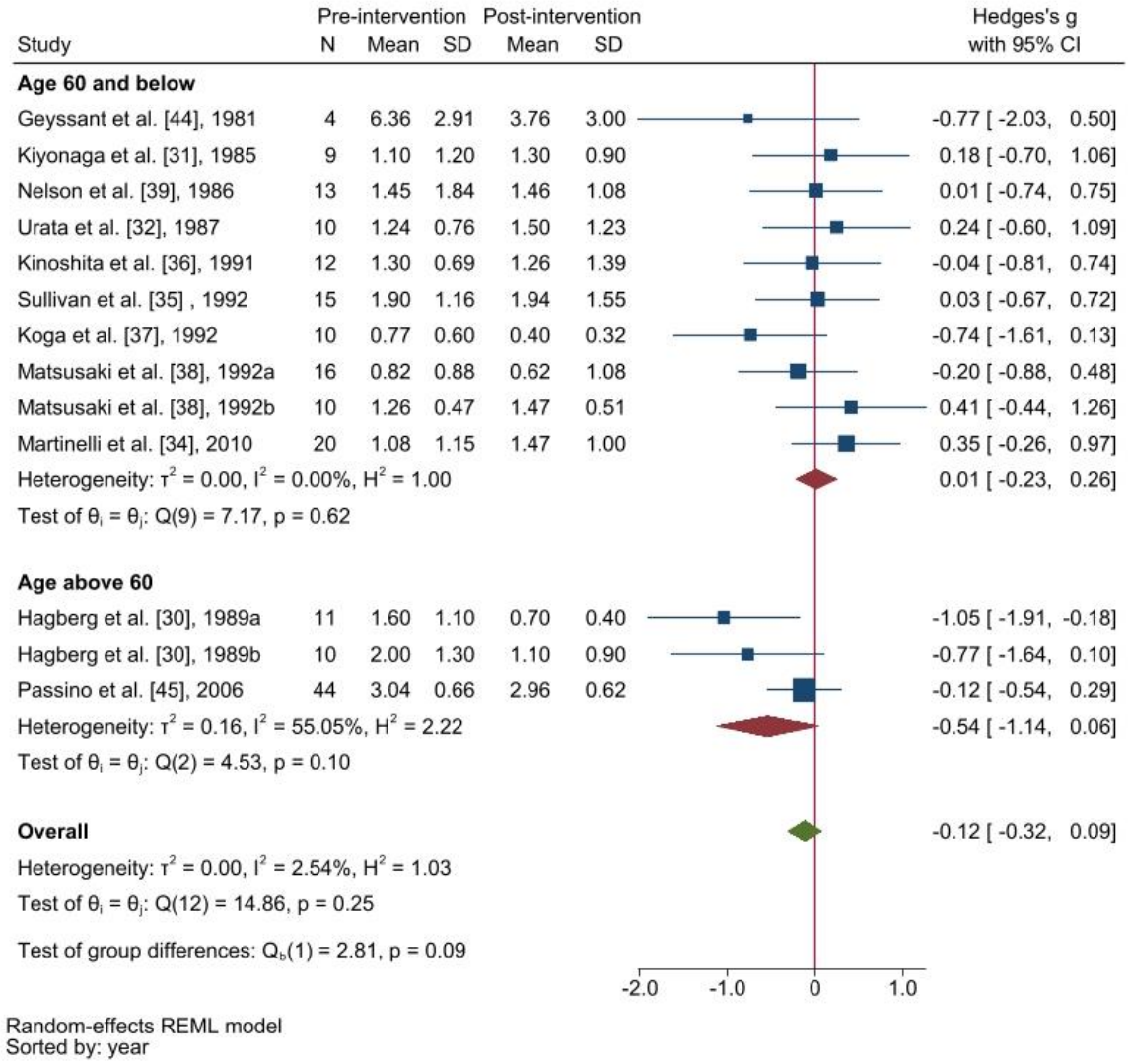
Hagberg *et al.* [30], 1989a: Patients performed low-intensity physical activity.

Hagberg *et al.* [30], 1989b: Patients performed moderate-intensity physical activity.

Matsusaki *et al.*[38], 1992a: Patients performed low-workload physical activity.

Matsusaki *et al.*[38], 1992b: Patients performed high-workload physical activity.

Figure S3c Age stratified meta-analysis on the association of changes in physical activity with plasma renin activity



Hagberg *et al.* [30], 1989a: Patients performed low-intensity physical activity.

Hagberg *et al.* [30], 1989b: Patients performed moderate-intensity physical activity.

Matsusaki *et al.*[38], 1992a: Patients performed low-workload physical activity.

Matsusaki *et al.*[38], 1992b: Patients performed high-workload physical activity.

Figure S3d. Funnel plot of studies on the association of changes in physical activity plasma renin activity

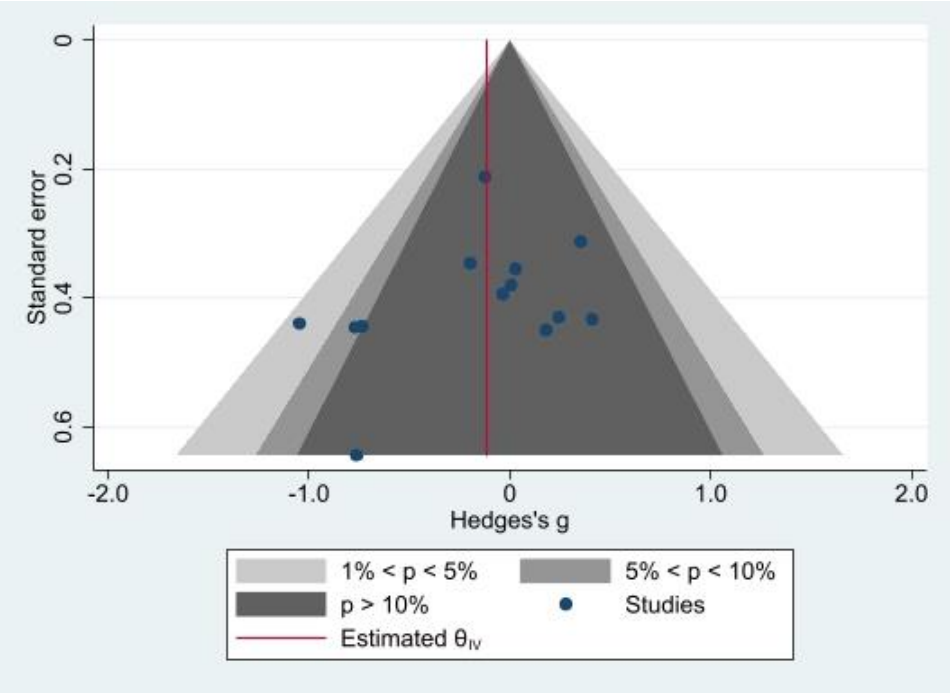
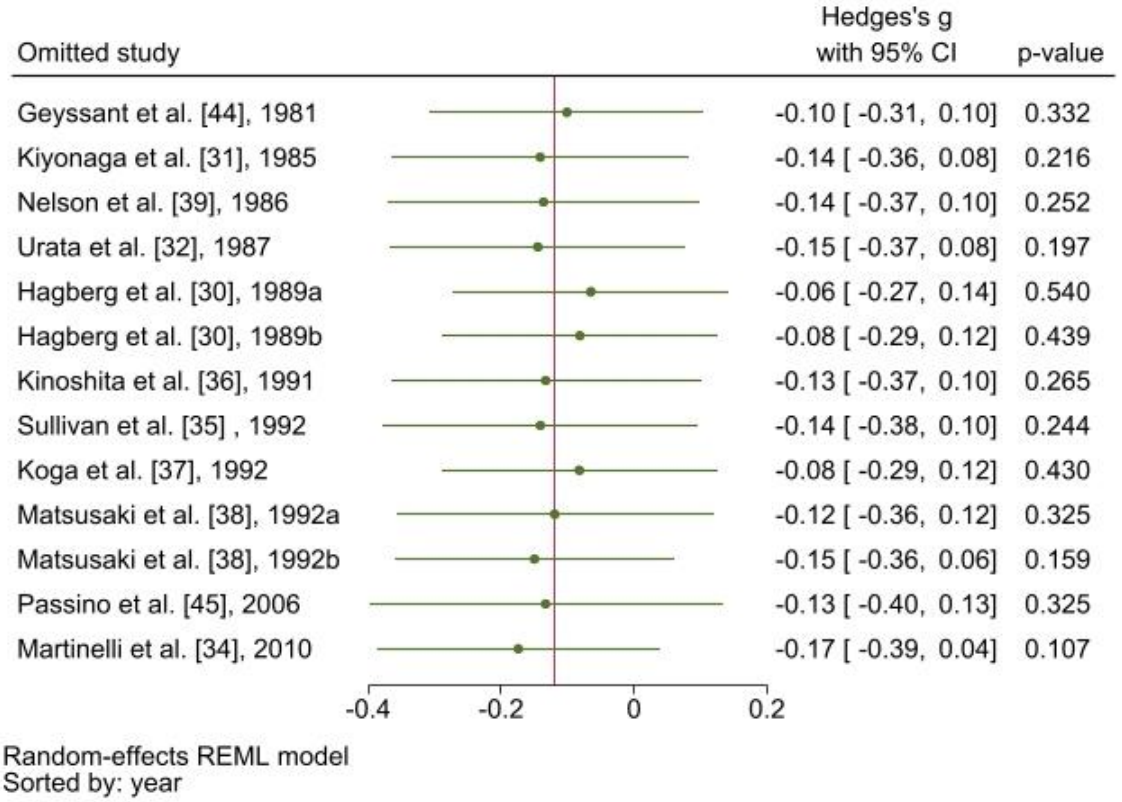


Figure S3e. Leave-one-out figure of studies on the association of changes in physical activity with plasma renin activity



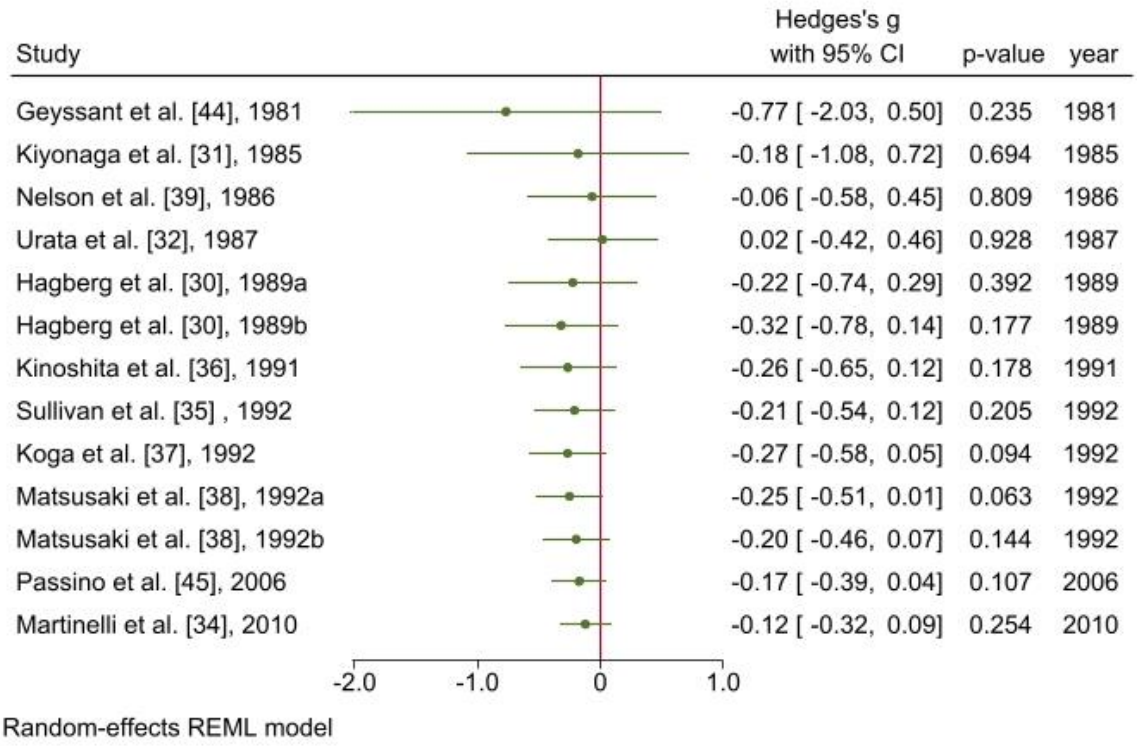
Hagberg *et al.* [30], 1989a: Patients performed low-intensity physical activity.

Hagberg *et al.* [30], 1989b: Patients performed moderate-intensity physical activity.

Matsusaki *et al.*[38], 1992a: Patients performed low-workload physical activity.

Matsusaki *et al.*[38], 1992b: Patients performed high-workload physical activity.

Figure S3f. Cumulative meta-analysis on the association of changes in physical activity with plasma renin activity



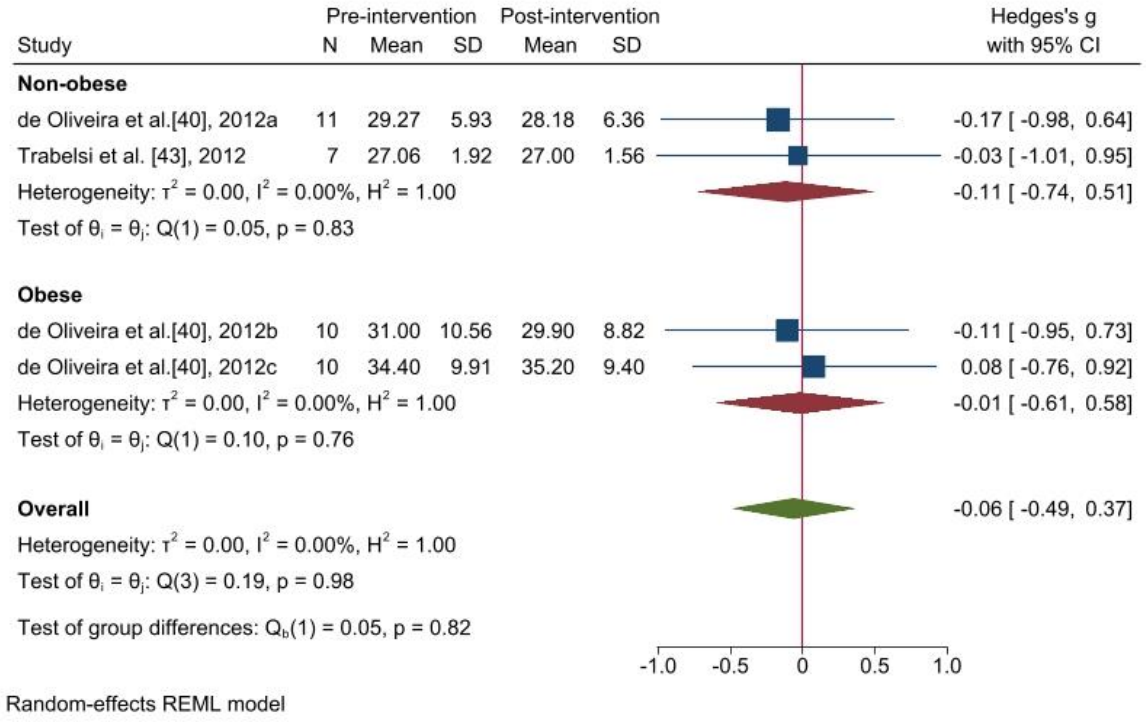
Hagberg *et al.* [30], 1989a: Patients performed low-intensity physical activity.

Hagberg *et al.* [30], 1989b: Patients performed moderate-intensity physical activity.

Matsusaki *et al.*[38], 1992a: Patients performed low-workload physical activity.

Matsusaki *et al*.[38], 1992b: Patients performed high-workload physical activity.

Figure S4a Obesity stratified meta-analysis on the association of changes in physical activity with urea



de Oliveira *et al.* [40], 2012a: Patients performed aerobic training.

de Oliveira *et al.* [40], 2012b: Patients performed strength training.

de Oliveira *et al.* [40], 2012c: Patients performed aerobic and strength training.

Figure S4b Funnel plot of studies on the association of changes in physical activity with urea

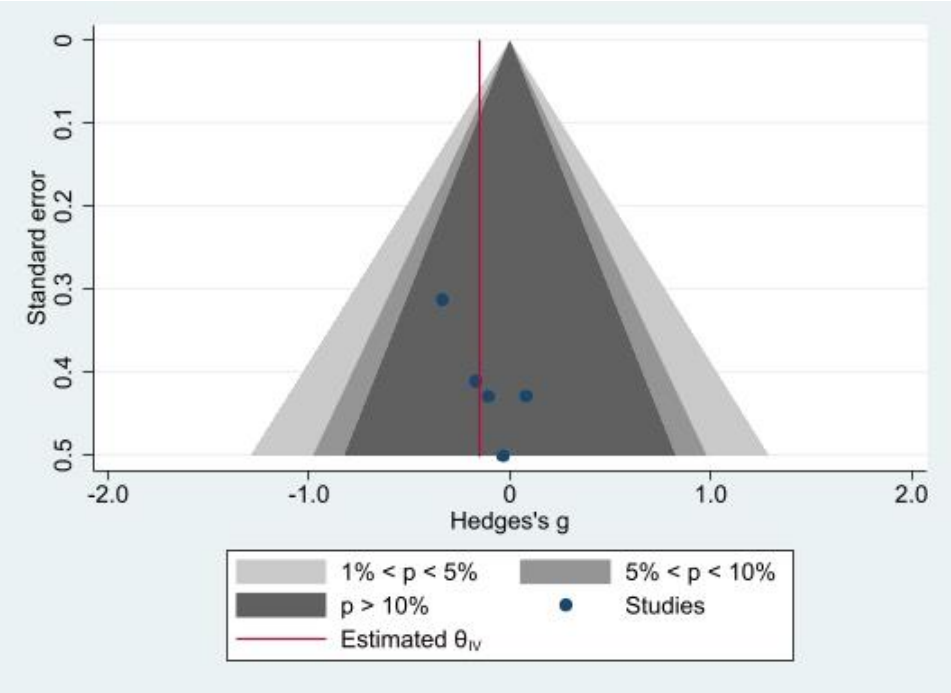
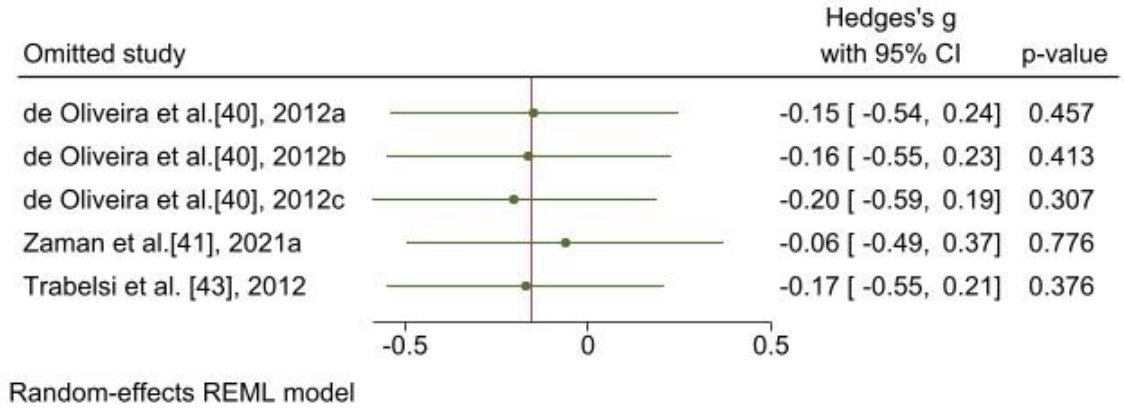


Figure S4c Leave-one-out figure of studies on the association of changes in physical activity with urea



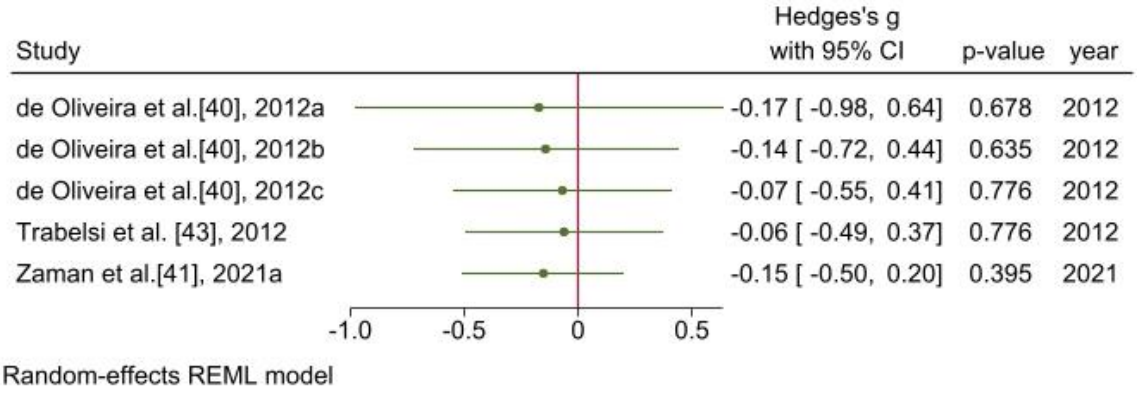
de Oliveira *et al.* [40], 2012a: Patients performed aerobic training.

de Oliveira *et al.* [40], 2012b: Patients performed strength training.

de Oliveira *et al.* [40], 2012c: Patients performed aerobic and strength training.

Zaman *et al.* [41], 2021a: Patients with obesity

Figure S4d Cumulative meta-analysis on the association of changes in physical activity with urea



de Oliveira *et al.* [40], 2012a: Patients performed aerobic training.

de Oliveira *et al.* [40], 2012b: Patients performed strength training.

de Oliveira *et al.* [40], 2012c: Patients performed aerobic and strength training.

Zaman *et al.* [41], 2021a: Patients with obesity