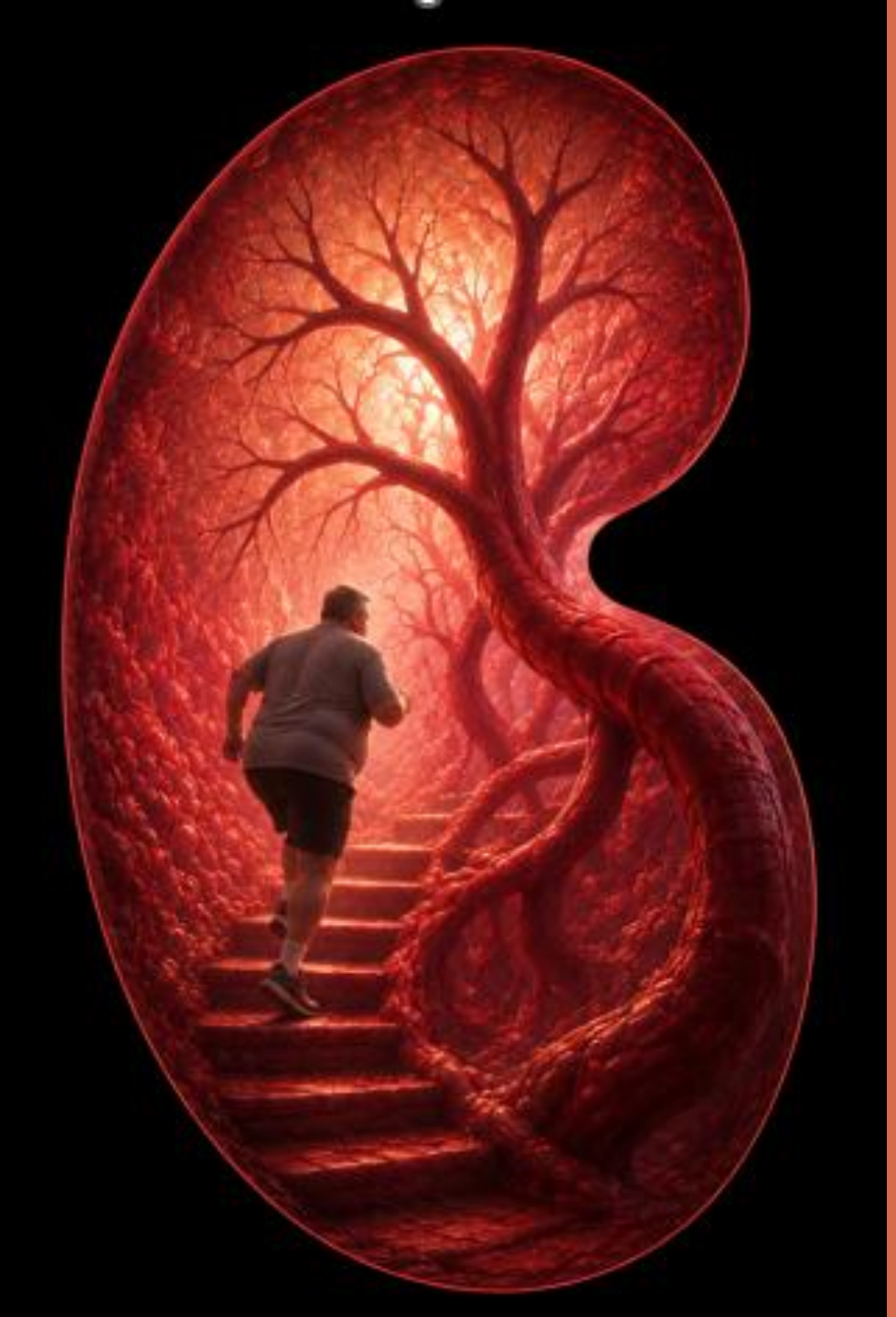


Beyond drugs and dialysis: The case for exercise in chronic kidney disease

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PHARMACIST


Emergency
Ambulance
NSW
PARAMEDIC


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University of
New England

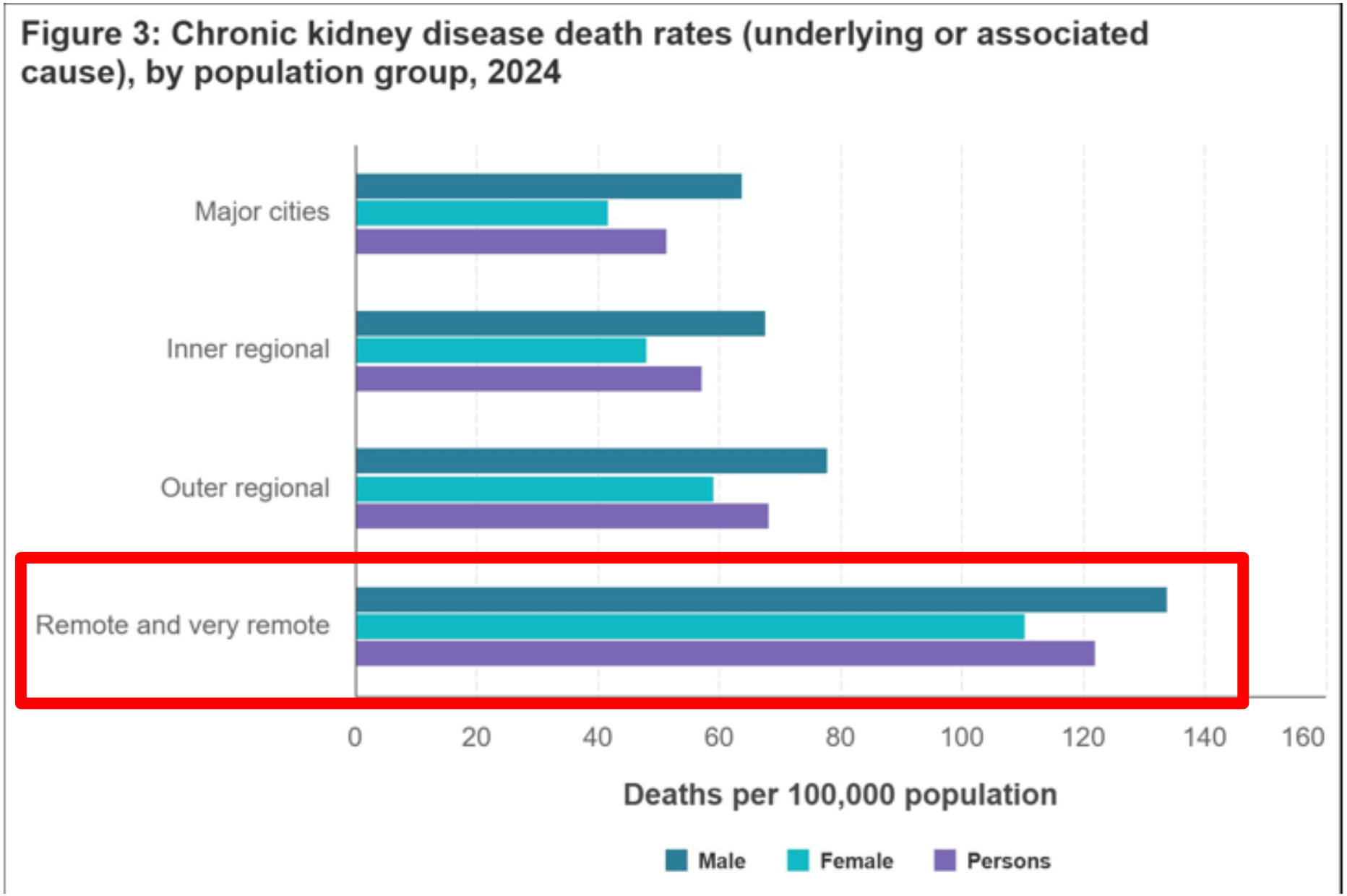




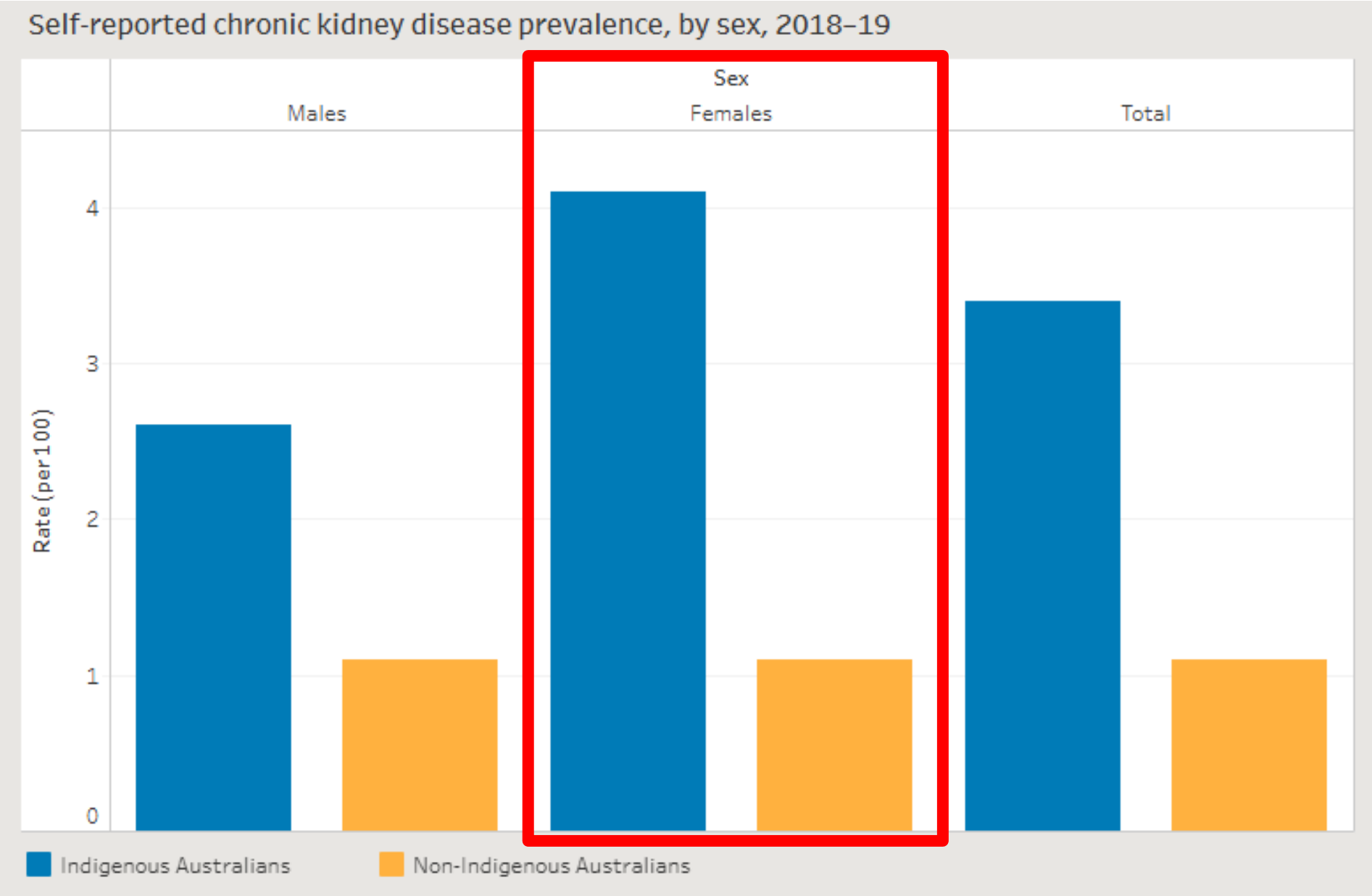






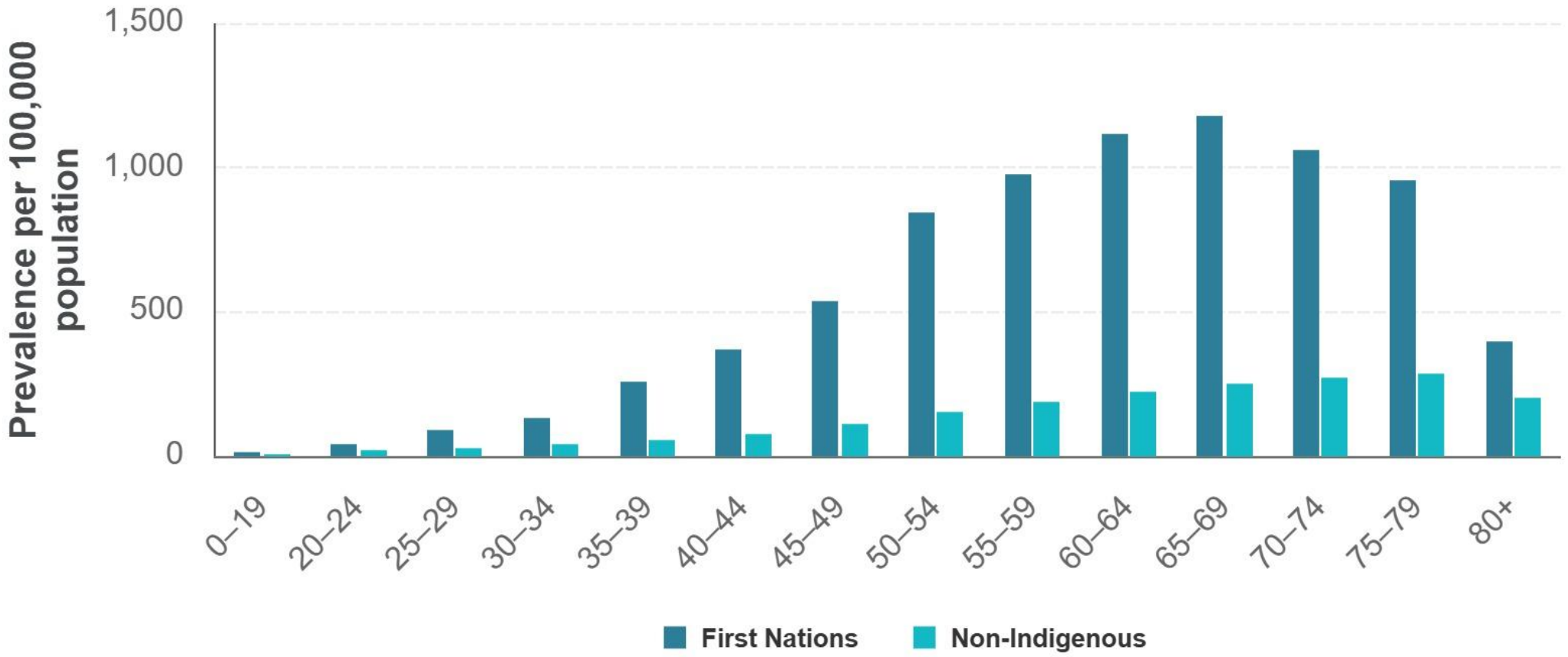


Australian Institute of Health and Welfare: Chronic Kidney disease: Australian facts (2024)



Australian Institute of Health and Welfare National Indigenous Australians Agency: Kidney disease (2018-2019)

Figure 4: Prevalence of kidney replacement therapy, by age and Indigenous status, 2024



Note: The prevalent population includes people with kidney failure who were receiving KRT as at 31 December 2024.

Australian Institute of Health and Welfare: Chronic Kidney disease: Australian facts (2024)


MORE THAN DRUGS & DIALYSIS


PhD
Doctoral Degree
Thesis
Data Analysis
Research Skills
Dream
Plan
Believe
Achieve
PhD Track

The effect of exercise training in people with pre-dialysis chronic kidney disease. A systematic review with meta-analysis

5 Databases

Randomised controlled trials

Exercise versus usual care in adults

More than 2 weeks

Aerobic, resistance, combined or mind-body exercise

Numerous outcomes

37 Trials 1,248 Participants

Key Findings

Peak VO_2 (+2.66 mL/kg/min)

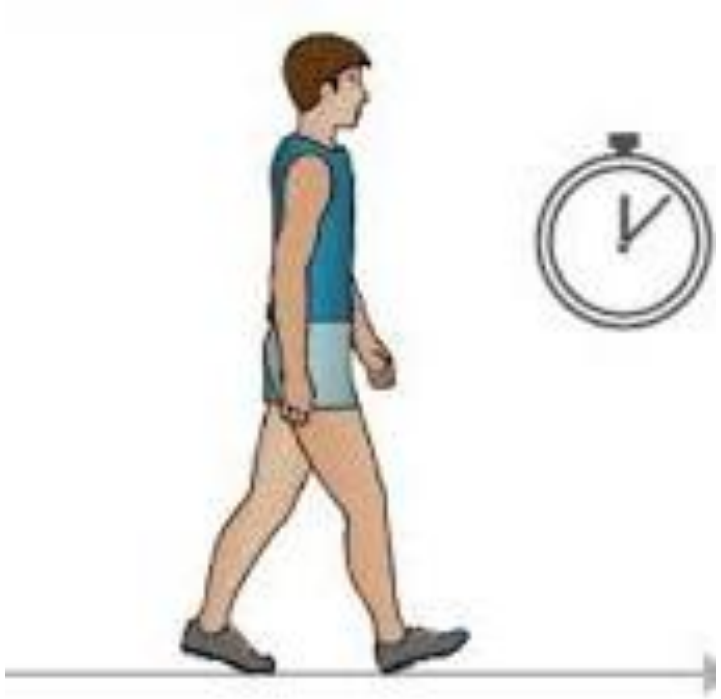
6-minute walk distance (+58.8 m)

Timed Up and Go (SMD –0.35)

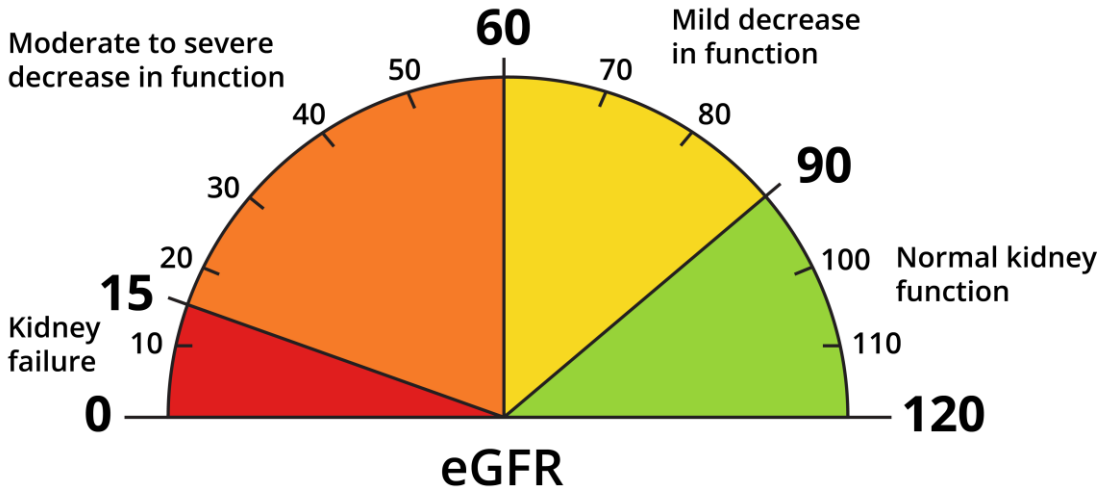
Sit-to-Stand (+4.55 reps)

Quality of life

- Mental component summary (+1.86/100)
- General Health (+4.26/100)



https://thoracicandsleep.com.au/blog/a-novel-prediction-tool-could-be-used-as-an-alternative-to-a-6-minute-walk-test-for-immobile-individuals/



Key Findings

- eGFR (+2.19 mL/min/1.73 m^2)
- Serum cystatin-C (–0.06 mg/L)
- Resting heart rate (–1.97 bpm)
- Waist circumference (–3.12 cm)
- Triglycerides (–12.97 mg/dL)
- HbA1c (–0.25%)
- IL-6 (–2.24 pg/mL

https://www.niddk.nih.gov/news/media-library/24166





https://www.dailyexpress.com.my/news/143244/patients-undergoing-dialysis-can-now-exercise/; https://kidneydiabetesresearch.org.au/news-stories/latest-news/strengthening-the-core-for-dialysis-patients/



https://ew.com/music/2017/04/13/olivia-newton-john-physical-interview/

The effect of exercise training on quality of life in people with pre-dialysis chronic kidney disease requiring dialysis. A systematic review with meta-analysis

5 Databases

Randomised controlled trials

Exercise versus usual care

More than 4 weeks

Aerobic, resistance, combined or mind-body exercise

Physical and mental component score (PCS & MCS)

25 Trials – 30 Intervention groups

1,246 Participants

Key Findings

Physical component summary (+3.75/100)

Mental component summary (+3.33/100)



Different Questionnaires, *Different* Signals

RAND SF-36
Generic Health Questionnaire

PCS ↑ MCS ↑

Detected improvements in both *physical and mental health.*




Additional disease-burden items may dilute mental health signal.

KDQoL
CKD-Specific Questionnaire

PCS ↑ MCS →

Detected improvement in physical health only.





The case for exercise in CKD

Improves:

Physical function

Risk factors

Quality of life

Slow disease progression

Safe

Adaptable

Low cost

Tailored



References

Australian Institute of Health and Welfare. (2026) *Chronic Kidney Disease: Australian facts* https://www.aihw.gov.au/reports/chronic-kidney-disease/chronic-kidney-disease/contents/how-many-people-are-living-with-ckd

Australian Institute of Health and Welfare *National Indigenous Australians Agency: Kidney disease* *https://www.indigenoushpf.gov.au/measures/1-10-kidney-disease/data#DataVisualisation*

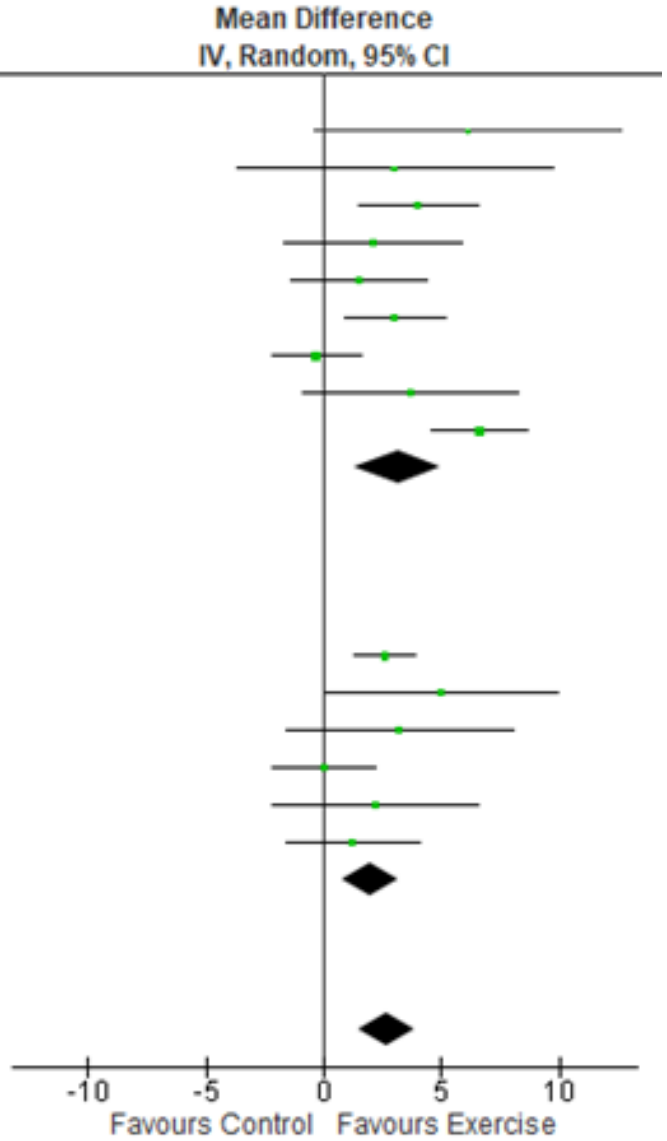
Traise, A., Dieberg, G., Pearson, M. J., & Smart, N. A. (2024). The effect of exercise training in people with pre-dialysis chronic kidney disease: A systematic review with meta-analysis. *Journal of Nephrology, 37*(8), 2063–2098. https://doi.org/10.1007/s40620-024-02081-9

Traise, A., Dieberg, G., Degotardi, E., Hart, B., Kaippilly, F., McInnes, D., Pearson, M. J., Ryan, D., & Smart, N. A. (2025). The effect of exercise training on quality of life in people with chronic kidney disease requiring dialysis: A systematic review with meta-analysis. *Journal of Nephrology, 38*(3), 893–911. https://doi.org/10.1007/s40620-025-02245-1

Peak respiratory Exchange Ratio	Total Cholesterol (TC) [mg/dL]	Estimated Glomerular Filtration Rate serum cystatin-C (eGFR sCys-C) [mL/min/1.73m^2]
Handgrip Strength [kg]	Low Density Lipoprotein (LDL-C) [mg/dL]	Serum Creatinine (sCr) [mg/dL]
Systolic Blood Pressure (SBP) [mmHg]	High Density Lipoprotein (HDL-C) [mg/dL]	Serum Albumin (ALB) [g/dL]
Diastolic Blood Pressure (DBP) [mmHg]	Blood Glucose (BG) [mg/dL]	Urine Albumin-to-Creatinine Ratio (UACR) [g/gCr]
Ambulatory 24-hour Systolic Blood Pressure [mmHg]	Haemoglobin (Hb) [g/dL]	Urine Protein-to-Creatinine Ratio (UPCR) [g/gCr]
Ambulatory 24-hour Diastolic Blood Pressure [mmHg]	Body Weight [kg]	24-hour Urine Protein [g/24hr]
Pulse Wave Velocity (PWV) aortic [m/s]	Body Mass Index (BMI) [kg/m^2]	Blood Urea Nitrogen (BUN) [mg/dL]
Augmentation Index (AIx) central arterial [%]	Body Fat [%]	C-Reactive-Protein (CRP) [mg/L]
Asymmetric dimethylarginine (AMDA) [umol/L]	Lean Body Mass (LBM) [kg]	

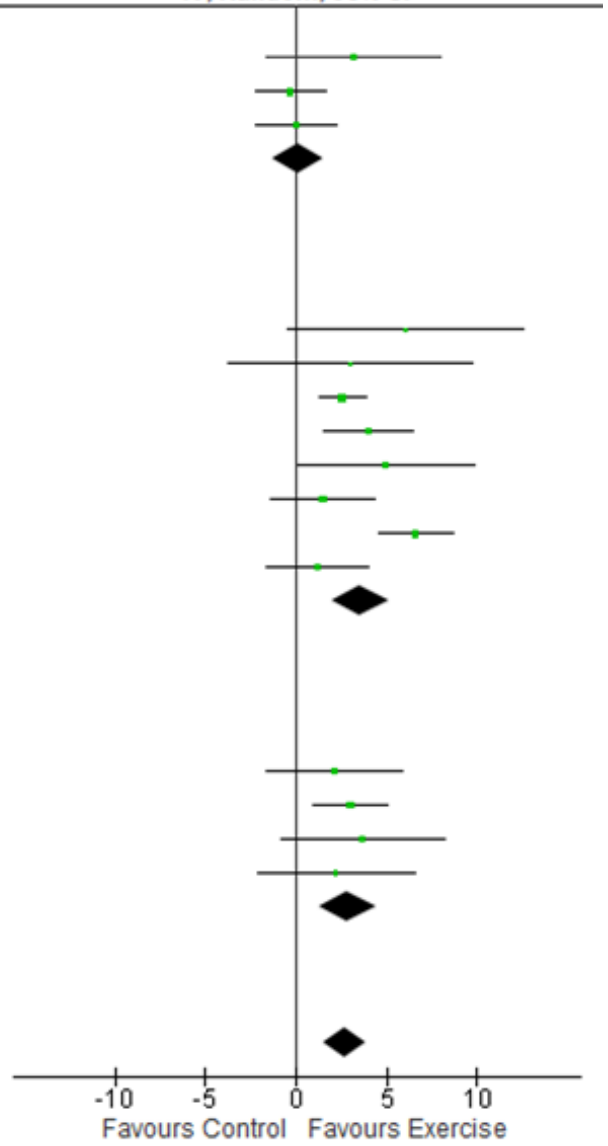
Peak VO_2 [mL/kg/min] – by modality

Study or Subgroup	Exercise Mean	Exercise SD	Exercise Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Random, 95% CI
1.2.1 Aerobic Training								
Aoike 2018 Centre	5.4	6.85	13	-0.7	7.71	8	2.6%	6.10 [-0.41, 12.61]
Aoike 2018 Home	2.3	6.24	12	-0.7	7.71	7	2.5%	3.00 [-3.71, 9.71]
Eidemak 1997	2	3.1313	12	-2	2.9927	11	8.3%	4.00 [1.50, 6.50]
Headley 2014	1.6	7.25	25	-0.5	5.86	21	5.6%	2.10 [-1.69, 5.89]
Ikizler 2018	1.43337	4.53	22	-0.0667	4.7	18	7.4%	1.50 [-1.38, 4.38]
Kirkman 2019	2.09	3.5757	15	-0.93	2.122	16	9.3%	3.02 [0.93, 5.11]
Leehey 2009	0.7	2.08	7	1	1.18	4	9.8%	-0.30 [-2.23, 1.63]
Mustata 2011	3.3	4.84	10	-0.4	5.51	10	4.4%	3.70 [-0.85, 8.25]
Van Craenenbroeck 2015	5.82	3.3196	19	-0.79	3.2074	21	9.5%	6.61 [4.58, 8.64]
Subtotal (95% CI)			**135**			**116**	**59.3%**	**3.13 [1.30, 4.95]**
Heterogeneity: Tau² = 4.81; Chi² = 26.28, df = 8 (P = 0.0009); I² = 70%								
Test for overall effect: Z = 3.35 (P = 0.0008)								
1.2.2 Combined Training								
Beetham 2018	1.7	3.7	74	-0.9	4.2	68	11.4%	2.60 [1.29, 3.91]
Greenwood 2015	2.9	5.57	8	-2.1	4.81	10	4.0%	5.00 [0.12, 9.88]
Headley 2012	1.4	6.79	10	-1.8	3.99	11	4.1%	3.20 [-1.62, 8.02]
Leehey 2016	-1	2.98	14	-1	3.42	18	9.0%	0.00 [-2.22, 2.22]
Thompson 2022	2.4	5.31	10	0.2	4.81	11	4.7%	2.20 [-2.15, 6.55]
Weiner 2022	1.6	5.25	25	0.4	6.04	37	7.5%	1.20 [-1.63, 4.03]
Subtotal (95% CI)			**141**			**155**	**40.7%**	**1.96 [0.78, 3.14]**
Heterogeneity: Tau² = 0.36; Chi² = 5.93, df = 5 (P = 0.31); I² = 16%								
Test for overall effect: Z = 3.25 (P = 0.001)								
Total (95% CI)			**276**			**271**	**100.0%**	**2.66 [1.48, 3.83]**
Heterogeneity: Tau² = 2.70; Chi² = 34.27, df = 14 (P = 0.002); I² = 59%								
Test for overall effect: Z = 4.44 (P < 0.00001)								
Test for subgroup differences: Chi² = 1.11, df = 1 (P = 0.29), I² = 9.6%								



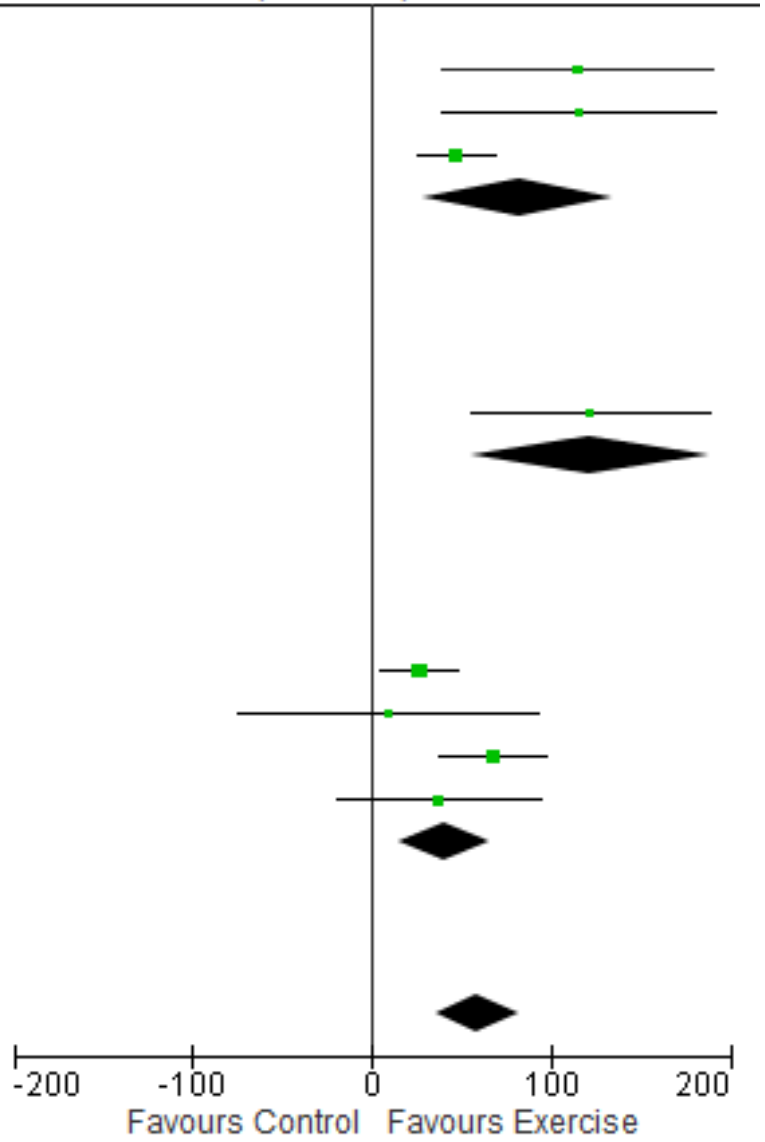
Peak VO_2 [mL/kg/min] – by CKD stage

Study or Subgroup	Exercise Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
1.6.3 CKD stages 2 to 4 only								
Headley 2012	1.4	6.79	10	-1.8	3.99	11	4.1%	3.20 [-1.62, 8.02]
Leehey 2009	0.7	2.08	7	1	1.18	4	9.8%	-0.30 [-2.23, 1.63]
Leehey 2016	-1	2.98	14	-1	3.42	18	9.0%	0.00 [-2.22, 2.22]
Subtotal (95% CI)			**31**			**33**	**22.8%**	**0.11 [-1.28, 1.50]**
Heterogeneity: Tau² = 0.00; Chi² = 1.76, df = 2 (P = 0.41); I² = 0%								
Test for overall effect: Z = 0.15 (P = 0.88)								
1.6.4 CKD stages 3 to 4 only								
Aoike 2018 Centre	5.4	6.85	13	-0.7	7.71	8	2.6%	6.10 [-0.41, 12.61]
Aoike 2018 Home	2.3	6.24	12	-0.7	7.71	7	2.5%	3.00 [-3.71, 9.71]
Beetham 2018	1.7	3.7	74	-0.9	4.2	68	11.4%	2.60 [1.29, 3.91]
Eidemak 1997	2	3.1313	12	-2	2.9927	11	8.3%	4.00 [1.50, 6.50]
Greenwood 2015	2.9	5.57	8	-2.1	4.81	10	4.0%	5.00 [0.12, 9.88]
Ikizler 2018	1.43337	4.53	22	-0.0667	4.7	18	7.4%	1.50 [-1.38, 4.38]
Van Craenenbroeck 2015	5.82	3.3196	19	-0.79	3.2074	21	9.5%	6.61 [4.58, 8.64]
Weiner 2022	1.6	5.25	25	0.4	6.04	37	7.5%	1.20 [-1.63, 4.03]
Subtotal (95% CI)			**185**			**180**	**53.1%**	**3.56 [1.98, 5.13]**
Heterogeneity: Tau² = 2.51; Chi² = 16.37, df = 7 (P = 0.02); I² = 57%								
Test for overall effect: Z = 4.43 (P < 0.00001)								
1.6.5 CKD stages 3, 4, and 3 to 5								
Headley 2014	1.6	7.25	25	-0.5	5.86	21	5.6%	2.10 [-1.69, 5.89]
Kirkman 2019	2.09	3.5757	15	-0.93	2.122	16	9.3%	3.02 [0.93, 5.11]
Mustata 2011	3.3	4.84	10	-0.4	5.51	10	4.4%	3.70 [-0.85, 8.25]
Thompson, 2022	2.4	5.31	10	0.2	4.81	11	4.7%	2.20 [-2.15, 6.55]
Subtotal (95% CI)			**60**			**58**	**24.0%**	**2.83 [1.25, 4.41]**
Heterogeneity: Tau² = 0.00; Chi² = 0.40, df = 3 (P = 0.94); I² = 0%								
Test for overall effect: Z = 3.52 (P = 0.0004)								
Total (95% CI)			**276**			**271**	**100.0%**	**2.66 [1.48, 3.83]**
Heterogeneity: Tau² = 2.70; Chi² = 34.27, df = 14 (P = 0.002); I² = 59%								
Test for overall effect: Z = 4.44 (P < 0.00001)								
Test for subgroup differences: Chi² = 11.89, df = 2 (P = 0.003), I² = 83.2%								



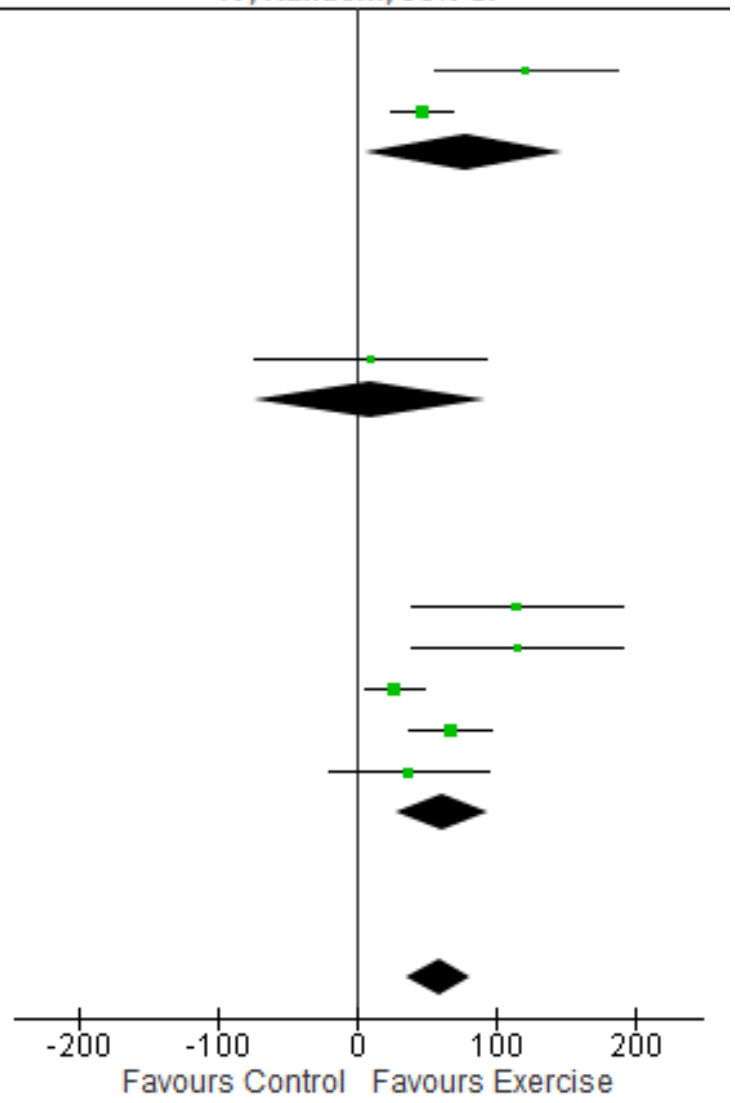
Six-Minute Walk Test [meters] – by modality

Study or Subgroup	Exercise Mean	Exercise SD	Exercise Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Random, 95% CI
1.8.1 Aerobic Training								
Aoike 2018 Centre	105.2	98.15	13	-9.7	78.07	8	7.0%	114.90 [38.92, 190.88]
Aoike 2018 Home	105.8	89.48	12	-9.7	78.07	7	6.9%	115.50 [38.64, 192.36]
Tang 2017	41.93	56.47	42	-5.05	46.29	42	21.3%	46.98 [24.90, 69.06]
Subtotal (95% CI)			**67**			**57**	**35.3%**	**81.76 [28.45, 135.06]**
Heterogeneity: Tau² = 1382.06; Chi² = 5.25, df = 2 (P = 0.07); I² = 62%								
Test for overall effect: Z = 3.01 (P = 0.003)								
1.8.2 Resistance Training								
de Araujo 2023	125.94	83.4	16	4.4	103.67	15	8.5%	121.54 [55.04, 188.04]
Subtotal (95% CI)			**16**			**15**	**8.5%**	**121.54 [55.04, 188.04]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 3.58 (P = 0.0003)								
1.8.3 Combined Training								
Beetham 2018	29.5	63.9	74	3	67.9	68	21.4%	26.50 [4.76, 48.24]
Leehey 2016	10	130.54	14	1	104.46	18	6.1%	9.00 [-74.69, 92.69]
Rossi 2014	64	81.1	48	-3.1	67.1	46	18.4%	67.10 [37.06, 97.14]
Weiner 2022	47.24	105.97	29	10.05	131.65	37	10.3%	37.19 [-20.14, 94.52]
Subtotal (95% CI)			**165**			**169**	**56.2%**	**40.35 [14.92, 65.77]**
Heterogeneity: Tau² = 265.66; Chi² = 5.13, df = 3 (P = 0.16); I² = 42%								
Test for overall effect: Z = 3.11 (P = 0.002)								
Total (95% CI)			**248**			**241**	**100.0%**	**58.83 [35.26, 82.41]**
Heterogeneity: Tau² = 551.65; Chi² = 16.92, df = 7 (P = 0.02); I² = 59%								
Test for overall effect: Z = 4.89 (P < 0.00001)								
Test for subgroup differences: Chi² = 6.08, df = 2 (P = 0.05), I² = 67.1%								



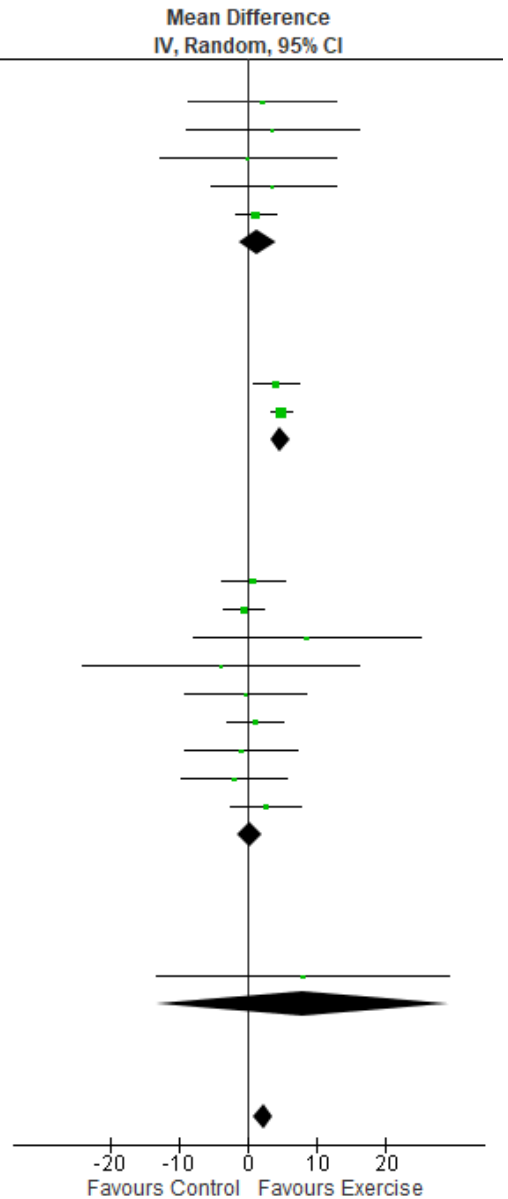
Six-Minute Walk Test [meters] – by CKD stage

Study or Subgroup	Exercise Mean	Exercise SD	Exercise Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Random, 95% CI
1.11.2 CKD stages 2, and 1 to 3								
de Araujo 2023	125.94	83.4	16	4.4	103.67	15	8.5%	121.54 [55.04, 188.04]
Tang 2017	41.93	56.47	42	-5.05	46.29	42	21.3%	46.98 [24.90, 69.06]
Subtotal (95% CI)			**58**			**57**	**29.8%**	**77.39 [5.57, 149.21]**
Heterogeneity: Tau² = 2140.51; Chi² = 4.35, df = 1 (P = 0.04); I² = 77%								
Test for overall effect: Z = 2.11 (P = 0.03)								
1.11.3 CKD stages 2 to 4 only								
Leehey 2016	10	130.54	14	1	104.46	18	6.1%	9.00 [-74.69, 92.69]
Subtotal (95% CI)			**14**			**18**	**6.1%**	**9.00 [-74.69, 92.69]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.21 (P = 0.83)								
1.11.4 CKD stages 3 to 4 only								
Aoike 2018 Centre	105.2	98.15	13	-9.7	78.07	8	7.0%	114.90 [38.92, 190.88]
Aoike 2018 Home	105.8	89.48	12	-9.7	78.07	7	6.9%	115.50 [38.64, 192.36]
Beetham 2018	29.5	63.9	74	3	67.9	68	21.4%	26.50 [4.76, 48.24]
Rossi 2014	64	81.1	48	-3.1	67.1	46	18.4%	67.10 [37.06, 97.14]
Weiner 2022	47.24	105.97	29	10.05	131.65	37	10.3%	37.19 [-20.14, 94.52]
Subtotal (95% CI)			**176**			**166**	**64.1%**	**61.33 [28.10, 94.57]**
Heterogeneity: Tau² = 813.35; Chi² = 11.37, df = 4 (P = 0.02); I² = 65%								
Test for overall effect: Z = 3.62 (P = 0.0003)								
Total (95% CI)			**248**			**241**	**100.0%**	**58.83 [35.26, 82.41]**
Heterogeneity: Tau² = 551.65; Chi² = 16.92, df = 7 (P = 0.02); I² = 59%								
Test for overall effect: Z = 4.89 (P < 0.00001)								
Test for subgroup differences: Chi² = 1.64, df = 2 (P = 0.44), I² = 0%								

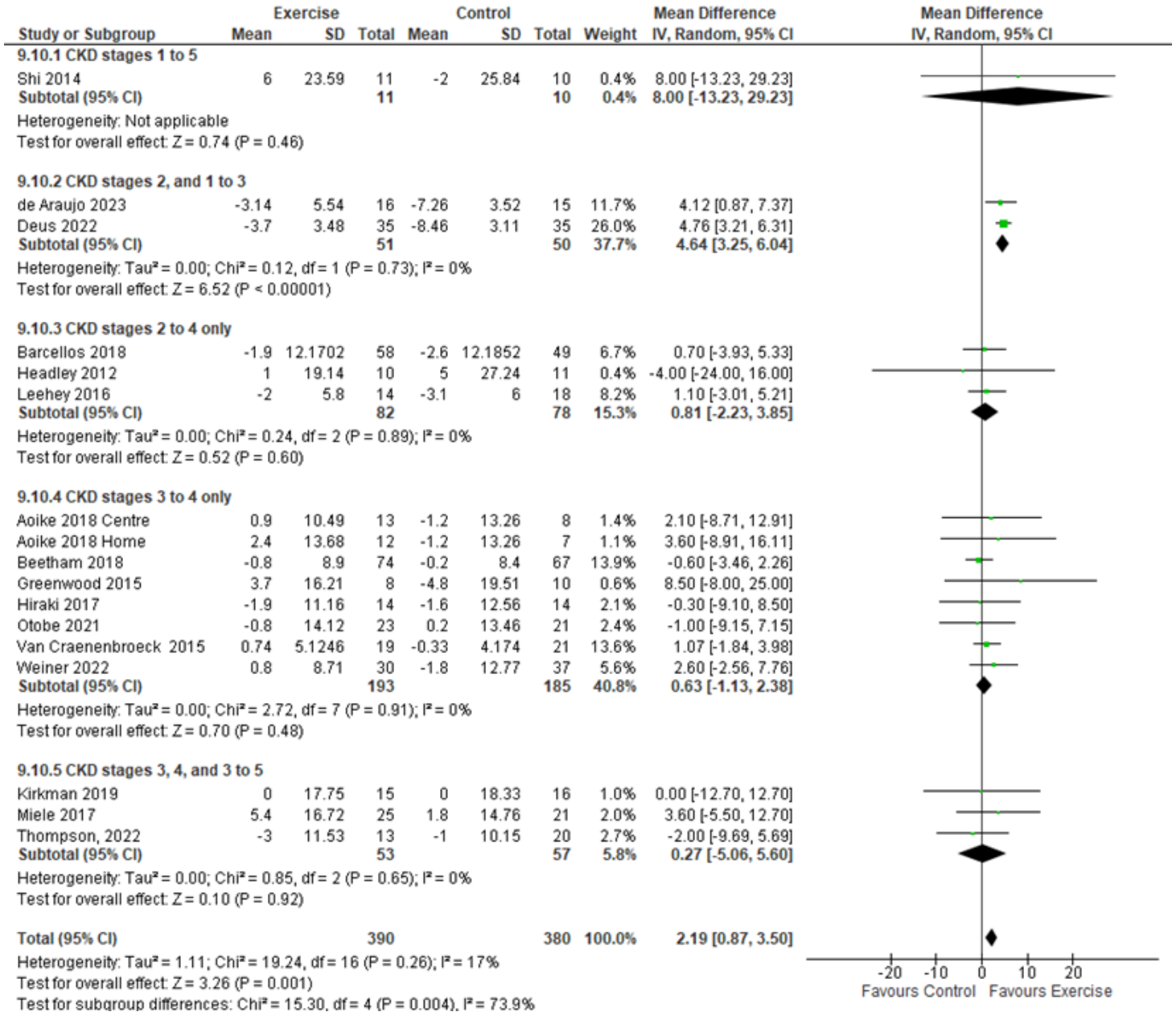


eGFR [ml/min/1.73m^2] – by modality

Study or Subgroup	Exercise Mean	Exercise SD	Exercise Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Random, 95% CI
9.7.1 Aerobic Training								
Aoike 2018 Centre	0.9	10.49	13	-1.2	13.26	8	1.4%	2.10 [-8.71, 12.91]
Aoike 2018 Home	2.4	13.68	12	-1.2	13.26	7	1.1%	3.60 [-8.91, 16.11]
Kirkman 2019	0	17.75	15	0	18.33	16	1.0%	0.00 [-12.70, 12.70]
Miele 2017	5.4	16.72	25	1.8	14.76	21	2.0%	3.60 [-5.50, 12.70]
Van Craenenbroeck 2015	0.74	5.1246	19	-0.33	4.174	21	13.6%	1.07 [-1.84, 3.98]
Subtotal (95% CI)			**84**			**73**	**19.1%**	**1.39 [-1.18, 3.97]**
Heterogeneity: Tau² = 0.00; Chi² = 0.46, df = 4 (P = 0.98); I² = 0%								
Test for overall effect: Z = 1.06 (P = 0.29)								
9.7.2 Resistance Training								
de Araujo 2023	-3.14	5.54	16	-7.26	3.52	15	11.7%	4.12 [0.87, 7.37]
Deus 2022	-3.7	3.48	35	-8.46	3.11	35	26.0%	4.76 [3.21, 6.31]
Subtotal (95% CI)			**51**			**50**	**37.7%**	**4.64 [3.25, 6.04]**
Heterogeneity: Tau² = 0.00; Chi² = 0.12, df = 1 (P = 0.73); I² = 0%								
Test for overall effect: Z = 6.52 (P < 0.00001)								
9.7.3 Combined Training								
Barcellos 2018	-1.9	12.1702	58	-2.6	12.1852	49	6.7%	0.70 [-3.93, 5.33]
Beetham 2018	-0.8	8.9	74	-0.2	8.4	67	13.9%	-0.60 [-3.46, 2.26]
Greenwood 2015	3.7	16.21	8	-4.8	19.51	10	0.6%	8.50 [-8.00, 25.00]
Headley 2012	1	19.14	10	5	27.24	11	0.4%	-4.00 [-24.00, 16.00]
Hiraki 2017	-1.9	11.16	14	-1.6	12.56	14	2.1%	-0.30 [-9.10, 8.50]
Leehey 2016	-2	5.8	14	-3.1	6	18	8.2%	1.10 [-3.01, 5.21]
Otobe 2021	-0.8	14.12	23	0.2	13.46	21	2.4%	-1.00 [-9.15, 7.15]
Thompson 2022	-3	11.53	13	-1	10.15	20	2.7%	-2.00 [-9.69, 5.69]
Weiner 2022	0.8	8.71	30	-1.8	12.77	37	5.6%	2.60 [-2.56, 7.76]
Subtotal (95% CI)			**244**			**247**	**42.8%**	**0.28 [-1.49, 2.06]**
Heterogeneity: Tau² = 0.00; Chi² = 2.90, df = 8 (P = 0.94); I² = 0%								
Test for overall effect: Z = 0.31 (P = 0.75)								
9.7.4 Mind-Body Exercise Training (Tai Chi, Yoga)								
Shi 2014	6	23.59	11	-2	25.84	10	0.4%	8.00 [-13.23, 29.23]
Subtotal (95% CI)			**11**			**10**	**0.4%**	**8.00 [-13.23, 29.23]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.74 (P = 0.46)								
Total (95% CI)			**390**			**380**	**100.0%**	**2.19 [0.87, 3.50]**
Heterogeneity: Tau² = 1.11; Chi² = 19.24, df = 16 (P = 0.26); I² = 17%								
Test for overall effect: Z = 3.26 (P = 0.001)								
Test for subgroup differences: Chi² = 15.76, df = 3 (P = 0.001), I² = 81.0%								



eGFR [ml/min/1.73m^2] – by CKD stage



Study or Subgroup	Exercise Mean	Exercise SD	Exercise Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Random, 95% CI
9.10.1 CKD stages 1 to 5								
Shi 2014	6	23.59	11	-2	25.84	10	0.4%	8.00 [-13.23, 29.23]
Subtotal (95% CI)			**11**			**10**	**0.4%**	**8.00 [-13.23, 29.23]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.74 (P = 0.46)								
9.10.2 CKD stages 2, and 1 to 3								
de Araujo 2023	-3.14	5.54	16	-7.26	3.52	15	11.7%	4.12 [0.87, 7.37]
Deus 2022	-3.7	3.48	35	-8.46	3.11	35	26.0%	4.76 [3.21, 6.31]
Subtotal (95% CI)			**51**			**50**	**37.7%**	**4.64 [3.25, 6.04]**
Heterogeneity: Tau² = 0.00; Chi² = 0.12, df = 1 (P = 0.73); I² = 0%								
Test for overall effect: Z = 6.52 (P < 0.00001)								
9.10.3 CKD stages 2 to 4 only								
Barcellos 2018	-1.9	12.1702	58	-2.6	12.1852	49	6.7%	0.70 [-3.93, 5.33]
Headley 2012	1	19.14	10	5	27.24	11	0.4%	-4.00 [-24.00, 16.00]
Leehey 2016	-2	5.8	14	-3.1	6	18	8.2%	1.10 [-3.01, 5.21]
Subtotal (95% CI)			**82**			**78**	**15.3%**	**0.81 [-2.23, 3.85]**
Heterogeneity: Tau² = 0.00; Chi² = 0.24, df = 2 (P = 0.89); I² = 0%								
Test for overall effect: Z = 0.52 (P = 0.60)								
9.10.4 CKD stages 3 to 4 only								
Aoike 2018 Centre	0.9	10.49	13	-1.2	13.26	8	1.4%	2.10 [-8.71, 12.91]
Aoike 2018 Home	2.4	13.68	12	-1.2	13.26	7	1.1%	3.60 [-8.91, 16.11]
Beetham 2018	-0.8	8.9	74	-0.2	8.4	67	13.9%	-0.60 [-3.46, 2.26]
Greenwood 2015	3.7	16.21	8	-4.8	19.51	10	0.6%	8.50 [-8.00, 25.00]
Hiraki 2017	-1.9	11.16	14	-1.6	12.56	14	2.1%	-0.30 [-9.10, 8.50]
Otobe 2021	-0.8	14.12	23	0.2	13.46	21	2.4%	-1.00 [-9.15, 7.15]
Van Craenenbroeck 2015	0.74	5.1246	19	-0.33	4.174	21	13.6%	1.07 [-1.84, 3.98]
Weiner 2022	0.8	8.71	30	-1.8	12.77	37	5.6%	2.60 [-2.56, 7.76]
Subtotal (95% CI)			**193**			**185**	**40.8%**	**0.63 [-1.13, 2.38]**
Heterogeneity: Tau² = 0.00; Chi² = 2.72, df = 7 (P = 0.91); I² = 0%								
Test for overall effect: Z = 0.70 (P = 0.48)								
9.10.5 CKD stages 3, 4, and 3 to 5								
Kirkman 2019	0	17.75	15	0	18.33	16	1.0%	0.00 [-12.70, 12.70]
Miele 2017	5.4	16.72	25	1.8	14.76	21	2.0%	3.60 [-5.50, 12.70]
Thompson, 2022	-3	11.53	13	-1	10.15	20	2.7%	-2.00 [-9.69, 5.69]
Subtotal (95% CI)			**53**			**57**	**5.8%**	**0.27 [-5.06, 5.60]**
Heterogeneity: Tau² = 0.00; Chi² = 0.85, df = 2 (P = 0.65); I² = 0%								
Test for overall effect: Z = 0.10 (P = 0.92)								
Total (95% CI)			**390**			**380**	**100.0%**	**2.19 [0.87, 3.50]**
Heterogeneity: Tau² = 1.11; Chi² = 19.24, df = 16 (P = 0.26); I² = 17%								
Test for overall effect: Z = 3.26 (P = 0.001)								
Test for subgroup differences: Chi² = 15.30, df = 4 (P = 0.004), I² = 73.9%								

SF-36 and KDQoL questionnaire domains

SF-36	KDQoL = SF-36 plus disease specific questions
Physical functioning	Symptoms and problems
Role limitations due to physical health	Effects of kidney disease
Bodily pain	Burden of kidney disease
General health	Cognitive function
Vitality	Quality of social interaction
Social functioning	Sexual function
Role limitations due to emotional problems	Sleep
Mental health	Social support
	Work status
Physical Component Summary (PCS): Assesses physical functioning, bodily pain, and general health.	Dialysis staff encouragement
Mental Component Summary (MCS): Assesses mental health, emotional state, and vitality.	Patient satisfaction

Heterogeneity, publication bias, study quality

Random-effects model
I squared
TESTEX and ROB2
Sub-analyses
Leave-one-out sensitivity tests

Funnel plots were mostly symmetrical
Some small-study effects in certain outcomes
But overall robust

Key limitations

The effect of exercise training in people with pre-dialysis chronic kidney disease: A systematic review with meta-analysis.

- Heterogeneity of interventions: Exercise programs varied widely in type, duration, and intensity, limiting direct comparability and pooled effect precision.
- Small sample sizes: Many included trials were underpowered, reducing confidence in subgroup analyses.
- Short intervention periods: Most studies lasted fewer than 6 months, restricting insight into long-term renal or functional outcomes.
- Incomplete reporting: Several trials lacked detailed adherence data or supervision protocols, making it difficult to assess fidelity.
- Limited representation: Few studies included older adults, women, or culturally diverse populations, constraining generalisability.
- Potential publication bias: Funnel plot asymmetry suggested small-study effects for some outcomes.

Key limitations

The effect of exercise training on quality of life in people with chronic kidney disease requiring dialysis: A systematic review with meta-analysis.

- Variability in QoL instruments: Use of different questionnaires (SF-36, KDQoL, SF-12) introduced measurement inconsistency and limited direct comparison.
- Heterogeneous exercise protocols: Wide variation in modality, frequency, and supervision contributed to statistical heterogeneity.
- Limited mental health data: Few trials reported MCS outcomes, reducing power to detect psychological benefits.
- Short follow-up durations: Most interventions were ≤ 12 weeks, preventing assessment of sustained QoL improvements.
- Potential reporting bias: Some studies selectively reported significant outcomes, and blinding was rarely feasible.
- Underrepresentation of home-based programs: Most trials were intra-dialytic, limiting insight into broader implementation.

Future research

More resistance-training trials

Longer-term follow-up

Telehealth delivery

Culturally responsive programs