

Supplementary File (PDF)

The impact of exercise, physical activity, dietary or combined interventions on body weight in new kidney transplant recipients: a systematic review and meta-analysis

Table S1. PRISMA checklist. A completed PRISMA checklist for the systematic review

Table S2. Search strategy (Medline). An example search strategy using Medline database

Table S3. Screening form. A copy of the screening form used

Table S4. Detailed sample characteristics. Detailed information on participant samples in each key study

Table S5. Study characteristics of non-RCT's (n=6)

Table S6. Details of interventions non-RCT's (n=6)

Figure S1. Risk-of-bias plot for Non-RCT's (n=6)

Table S8. Sensitivity analysis. Additional forest plots for BW and BMI

Table S1. Completed PRISMA (2009) checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Title page
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	Abstract Page 1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	1 and 2
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	2 and 3
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	Page 2 Suppl material
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Page 2 and 3 Table 1
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be	Suppl.

		repeated.	material
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4 and 5
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Page 4, Suppl material
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	Page 4 Suppl material
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	4-6
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	4-6

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4-5, 15, 18
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	Page 18, Suppl material
RESULTS			

Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	5-6 Figure 1 (PRISMA)
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Table 2 page 7
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Page 15
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	17-18
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	17-18
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Page 4
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	Suppl material Page 18
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	19-20
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	21-22
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	22
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	22

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org.

Supplementary Material Table S2. Search Strategy Medline

Platform: OvidSP

Database coverage: 1946 to present

Limits: 1985, English

Date of search: 26th June 2020. The search was re-run on the 6th of April 2021 in all data-bases and the PRISMA diagram and manuscript updated.

Search Terms: see below, Mesh terms adapted to fit database

Search line number	Searches	Result
1	exp Kidney Transplantation/	92244
2	(kidney adj3 transplan*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	102708
3	(renal adj3 transplan*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	48156
4	exp Diet Therapy/	51883
5	diet* therap*.mp.	60692
6	diet* modification*.mp.	3285
7	diet* intervention*.mp.	7883
8	diet* treatment*.mp.	9923
9	nutrition treatment*.mp.	191
10	nutrition intervention*.mp.	2346
11	exp Exercise Therapy/	46650
12	exercise* therap*.mp.	39158
13	exercise* rehab*.mp.	698
14	exercis* interventio*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word,	5364

	keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	
15	exp Exercise/	180448
16	exercis*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	358637
17	activit* physical.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	915
18	physical activit*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	102929
19	training exercis*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	1606
20	exp Behavior Therapy/	70594
21	behavio?r therap*.mp.	32036
22	behavio?r modification*.mp.	2896
23	conditioning therap*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	502
24	(behavio?r adj2 change).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	16862
25	(behavio?r adj2 technique*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word,	1746

	protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	
26	behavio?r change technique*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	791
27	weight gain prevention.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	264
28	weight gain treatment*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	39
29	exp Obesity/	198824
30	obesity.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	299884
31	exp Weight Gain/	30126
32	(weight adj1 gain).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	72620
33	(weight gain or loss).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	967411
34	weight change*.mp.	10682
35	(body weight adj2 (gain or loss or change)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	21027

36	((bmi or body mass index) adj2 (gain or loss or change)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	4261
37	exp Body Weight/	441621
38	(body adj2 weight*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	344949
39	1 or 2 or 3	110856
40	4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28	637509
41	29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38	1508242
42	39 and 40 and 41	217
43	limit 42 to (english language and yr="1985 -Current")	188

Supplementary Material Table S3. Screening form

Review Question: Weight gain prevention interventions in Kidney transplant recipients, a systematic review

- Inclusion criteria:**
- **Population-** This will be defined as new Kidney Transplant recipients within the first year following surgery
 - **Intervention-** treatments to prevent weight gain (either singular or combined of physical activity or exercise advice, nutritional/dietician advice and or behavioural change techniques)
 - **Comparator-**usual care/ standard care
 - **Outcome-** weight gained post-transplant (baseline to six months or baseline to 12 months).
 - **Study type-** randomised controlled trials, systematic reviews, non-randomised controlled trials or quasi-randomised controlled trials.

Author name and year

Title and journal

Full text papers include or exclude paper		Include	Exclude	Notes
Population	New Kidney Transplant Recipient	<input type="checkbox"/> kidney transplant recipient (within first year)	<input type="checkbox"/> Kidney transplant recipient > 1 year <input type="checkbox"/> sample includes other CKD participants	
Outcome	Primary outcome: Weight gain	<input type="checkbox"/> baseline weight provided <input type="checkbox"/> follow up weight provided	<input type="checkbox"/> no reporting of body weight at baseline <input type="checkbox"/> no reporting of weight at follow up (either 3, 6 or 12 months)	
Outcome	Secondary outcomes	<input type="checkbox"/> body weight as secondary outcome <input type="checkbox"/> reports BMI <input type="checkbox"/> Bioimpedance <input type="checkbox"/> physical function <input type="checkbox"/> mood <input type="checkbox"/> self-efficacy <input type="checkbox"/> physical activity	<input type="checkbox"/> no recording of body weight <input type="checkbox"/> no recording of secondary outcomes listed	
Study design	Study type	<input type="checkbox"/> randomised controlled trials <input type="checkbox"/> non randomised controlled trials	<input type="checkbox"/> studies with no control group	
Intervention	Weight gain prevention intervention	<input type="checkbox"/> includes an intervention aimed to prevent weight gain (either singular or	<input type="checkbox"/> studies that include a drug in the intervention group	

		combined of physical activity or exercise advice, nutritional/dietician advice and or behavioural change techniques) <input type="checkbox"/> include interventions measuring body weight and BMI (combined, physical activity or nutritional)	
Other factors	Publication year and language	<input type="checkbox"/> English <input type="checkbox"/> studies > 1985	<input type="checkbox"/> exclude papers not in English <input type="checkbox"/> exclude papers published before 1985
Overall decision	<input type="checkbox"/> Included		<input type="checkbox"/> Excluded

Supplementary Material Table S4. Table depicting detailed description of characteristics of trials

RCT's are presented first (n=10) followed by the non-RCTs (n=6)

Study primary author, year and country or origin	Specifics of sample	Group (Usual care= RCTs, comparators= non-RCTs)	Sample at start of the study (n)	Dropouts (n and %)	% Males	Age M \pm SD	KTx vintage (mean in months)
RCT's (n=10)							
Lawrence 1995 (UK)[1]	<ul style="list-style-type: none"> Hyperlipidaemic KTRs Diabetics excluded 	Total sample	38	NI	NI	NI	NI Mean.
		Intervention	22	NI	59%	50 (range 20-70*)	Randomised after KTx
		Usual care	16	NI	22%	56 (range 31-71*)	
Painter [†] 2002[2], 2003[3] (USA)	<ul style="list-style-type: none"> Excluded if physical limits to exercise or psych issues 	Total sample	167	70 (42%) ‡	NI	NI	NI mean. Recruited one month after KTx
		Intervention	54	29	55.5%	39.7 \pm 12.6	
		Usual care	43	41	69.1%	43.7 \pm 10.7	
Tzvetanov 2014[4] (USA)	<ul style="list-style-type: none"> Obese KTRs with BMI > 30 Excluded if unable to participate in exercise 	Total sample	17	6 (35.3%) ‡	NI	NI	NI mean. Rehab started
		Intervention	9	0	50%	46.6 \pm 6.9	8.6 \pm 6.2 months after KTx
		Usual care	8	6	37.5%	45 \pm 19	
O'Connor [†] 2017[5], Greenwood 2015[6] (UK)	<ul style="list-style-type: none"> Long-term follow up ExeRT trial cohort [6] 	Total sample	46	4 (8.7%)	58.7%	51.8 \pm 12.5	6.58 \pm 4.51
		Intervention	13	1	77%	53.9 \pm 10.7	6.09 \pm 4.86
	<ul style="list-style-type: none"> 42/60 cohort followed up at 12 months (9 months after cessation Rx. 3 groups: AT, RT and UC Pragmatic inclusion criteria 	1 (AT)					
		Intervention	13	3	54%	54.6 \pm 10.6	7.39 \pm 5.13
		Usual care	20	0	50%	49.5 \pm 10.6	6.37 \pm 4.0

Henggeler 2018[7] (NZ)	Excluded if BMI > 40 or < 18.5.	Total sample	37	11 (29.7%) [‡]	69.4%	NI	NI mean. Recruited within the first month of KTx
		Treatment	19	6	67%	49.2±14.6	
		Usual care	18	5	72%	48.3±13.9	
Kuningas 2019[8] (UK)	Nondiabetic KTRs	Total sample	130	27 (20.8%)	54.6%	NI	NI mean total sample ≈ 8±6 months ≈ 8±5 months
		Treatment	66	10	43.7%	47.7±13.1	
		Usual care	64	17	56.5%	47.4±13.7	
Karelis 2016[9] (Canada)	<ul style="list-style-type: none"> Nondiabetic KTRs Non smokers Low ETOH Sedentary (< 2hrs exercise/week) 	Total sample	24	4 (16.66%)	50%	NI	NI mean. KTx 6-8 weeks earlier
		Treatment	12	2	50%	45.3±14	
		Usual care	12	2	50%	39.4±8	
Schmid-Mohler 2019[10] (Switzerland)	<ul style="list-style-type: none"> combined KTR and kidney-pancreas transplants (n=123) n=120 KTR 	Total	123 [§] (120 KTR)	3 (2.5%) [§]	61.8% [§]	50.2±13.1 [§] (50.5±13.1 KTR)	NI mean. Recruited < 6 weeks post Tx
		Usual care	62 [§] (60 KTR)	1 (1.6%) [§]	62.9% [§]	49.8±12.6 [§]	
		Treatment	61 [§] (60 KTR)	2 (3.3%) [§]	60.7% [§]	50.5±13.8 [§]	
Serper 2020[11] (USA)	<ul style="list-style-type: none"> combined sample of KTR and liver transplant recipients (n=127) n= 65 KTRs 	Total	127 [§] (65 KTR)	10 (7.8%) [§]	64% [§]	52±13 [§]	9.5 (3-17) ^{§¶}
		Usual care (Arm1)	42 [§] (20 KTR)	1 (2.4%) [§]	64% [§]	50±15 [§]	8.4 (3.7-16) ^{§¶}
		Device only (Arm 2)	44 [§] (22 KTR)	4 (9%) [§]	68% [§]	53±12 [§]	6.5 (3-13) ^{§¶}
		Treatment and device (Arm 3)	41 [§] (23 KTR)	5 (12.2%) [§]	58% [§]	54±13 [§]	13 (4-19) ^{§¶}
Gibson 2020[12] (USA)	<ul style="list-style-type: none"> KTRs recruited between 6-12 months post-transplant (n=10) included if BMI ≥ 22kg/m², able to participate in study 	Total	10	1	5 (50%)	44.6±10.0	NI on mean. However recruitment of participants within 6 to 12 months post kidney transplant
		Usual care	5	0	2 (40%)	44.0±11.0	
		Treatment	5	1	3 (60%)	45.2±10.2	

	visits over the trial length, English speakers, able to report data weekly (either by phone, email or fax) and access to the internet. <ul style="list-style-type: none"> Exclusion criteria includes unwillingness to be randomized, participation in weight management or physical activity programme.
--	--

Study primary author, year and country or origin	Specifics of sample	Group (Usual care= RCTs, comparators= non-RCTs)	Sample at start of the study (n)	Dropouts (n and %)	% Males	Age M \pm SD	KTx vintage (mean in months)
--	---------------------	---	--	-----------------------	---------	----------------	---------------------------------

Non RCT's (n=6)

Leasure 1995[13] (USA)	<ul style="list-style-type: none"> 18-64 years Willing to attend 3x week exercise for 12 weeks Quasi-experimental two group repeated measure design 	Total sample	8	3 (37.5%)†	Not reported	NI	NI mean. Started trial 8 weeks post KTx
		Treatment	2	Not reported	Not reported	NI	
		Comparator	3	Not reported	Not reported	NI	
Patel 1998[14] (UK)	<ul style="list-style-type: none"> Stable KTR Comparison group received no treatment 	Total sample	33	NI	69.7%	NI	NI mean. KTx 2months
		Treatment	11	NI	81.8%	39 \pm 17	
		Comparator	22	NI	63.6%	40 \pm 11	
		Total sample	452	NI	NI	NI	NI

Jezior 2007[15] (Poland)	<ul style="list-style-type: none"> Treatment group= Obese and overweight KTR Recruited from weight reduction programme (mean BMI 33.35kg/m²) Comparator group monitored weight records for 56 months (mean BMI 25.9 kg/m²) 	Treatment	34	NI	NI	NI	NI
		Comparator	418	NI	NI	NI	NI
Sharif 2008[16] (UK)	<ul style="list-style-type: none"> KTR, grouped depending on their glucose tolerance. N=36 glucose intolerance did intensive Rx, n=79 control (leaflet) No diagnosis of Diabetes 	Total sample	115	4(3.5%)	76.3%	NI	NI Mean. Recruited 6months and later after KTx
		Treatment	36	4	79%	55 ±12** (SEM2)	
		Comparator	79	0	75%	50±17.78** (SEM2)	
Teplan 2014[17] (Czech Republic)	<ul style="list-style-type: none"> 1st KTx (cadaveric) Excluded if recent cardiac event, cannot have smoked within the past 3 years 	Total sample	238	16 (6.7%)	53.8%	NI	NI Mean. Recruited within first 6months KTx
		Treatment	116	8	49.2%	58±7	
		Comparator	122	8	53.8%	55±8	
Lorenz 2015[18] (USA)	<ul style="list-style-type: none"> Single KTR only (no combined Tx) Comparator group from 2 years earlier (post-hoc analysis) 	Total sample	307	NI	57%	51±13	NI mean. First visit within 3 weeks of KTx
		Treatment	145	NI	57.2%	51±14	
		Comparator	162	NI	56.8%	52±13	

Note. RCT indicates randomised controlled trial, M= mean, SD=standard deviation, KTR= kidney transplant recipient, numbers indicate references (see list below), KTx= kidney transplantation, NI- no information, BMI=body mass index, Rx= treatment, AT= aerobic training, RT= resistance training, UC= usual care

*= standard deviation not provided and unable to be calculated

†= study with two publications from the same research study

‡ = significant dropouts, data only given for those who completed follow up

§= data from transplant combined sample

¶= median and IQR provided by authors, only in publication

**= standard deviations manually calculated

Supplementary Material. Table S5 study characteristics non-RCT's (n=6)

Table summarising the characteristics of the included non-RCT studies (n=6)

First author, year (country of origin)	Study duration (months)	Sample	Groups	Outcomes (primary and secondary)	Results (for primary and secondary outcomes)	Comments
Leasure et al [13] (USA)	6	n=8 KTRs	IG: Exercise only for 12 weeks IG2: Initial 12 weeks no exercise, then exercise 12 weeks	Primary: Not stated Secondary: BC (hydrostatic weight and bioimpedance), strength (Cybex dynamometer), mean arm muscle area (skinfolds), endurance exercise tolerance test, nutritional assessment (4-day food diary), BW, BMI, and symptoms frequency distress scale for medication side effects	Primary/secondary: <ul style="list-style-type: none"> Increased fat weight (4%) initial post-transplant phase No between-group difference BW or BC Both groups gained fat weight and reduced lean weight. No consistent between-group difference in strength at 20 weeks No participants reached VO₂max No between-group difference in distress scale for medication All participants reported elevated appetite and difficulty following a low calorie/fat/salt diet 	<ul style="list-style-type: none"> Small sample size with dropouts (3 dropouts) Convenience sampling AEs not reported Limited reporting No longer-term follow-up Descriptive statistics due to limited sample size
Patel et al [14] (UK)	12	n=33	IG: Dietitian-led intensive dietary education for 4 months CG:	Primary: weight gain and BMI at 4 months and 1-year post KTx Secondary:	Primary: <ul style="list-style-type: none"> Significant between-group difference in BW and BMI at 4- and 12-months favouring IG 	<ul style="list-style-type: none"> AEs not reported Confounding variables not controlled for Limited reporting

			Post-hoc controls receiving no dietary advice. From 4 years earlier	BW, height, BMI, diet histories (subjective assessment by dietitian), PA	<ul style="list-style-type: none"> 5.5kg weight gain in IG vs 11.8kg in CG Secondary: <ul style="list-style-type: none"> Increased self-reported PA IG IG decreased high fat and sugar food and increased fruit and veg (diet histories) 	<ul style="list-style-type: none"> Control group was from KTRs 4 years earlier who had not received dietary intervention Limited trial reporting contributing to 'no-information' score for risk-of-bias
Jezior et al [15] (Poland)	6	n= 452, n=34 IG	IG: Ax with education on the harms of weight gain, and then dietary advice 2 nd visit CG: Retrospective controls 4.5 years after KTx . no specific information given.	Primary: Not stated Secondary: BW, waist/hip/thigh circumference, bioimpedance skinfold tests and 3-day dietary history	Primary/secondary: <ul style="list-style-type: none"> 27% IG increased BW during 6-months vs 80% CG during 4.5years IG demonstrated a mean weight loss of 2kg in 6-months with an associated reduction in BMI CG demonstrated a weight gain of approx. 0.62kg per six months 	<ul style="list-style-type: none"> AEs not reported Preliminary results of a weight reduction programme IG were included OW and OB KTR enrolled from a weight loss programme No further publications Limited reporting No between-group testing of BW Difficult to compare groups as significant difference in time

						since transplant (6 months IG vs 4.5 years CG)
Sharif et al [16] (UK)	Mean follow-up 8.2	n=115 KTR, grouped depending on GT	IG: IGT patients. Given Diet and exercise for 6 months CG: Normal GT. Given education about the risks of IGT and received leaflets on healthy lifestyle and exercise	Primary: change in GT Secondary: BW, height, self-reported PA	Primary: <ul style="list-style-type: none"> Significant within group difference in the IG with a significant reduction in 2-hr postprandial glucose levels ($P=0.012$) Significant within group increase in glucose levels ($P=0.001$) in CG Secondary: <ul style="list-style-type: none"> Good adherence IG throughout the study with 100% adherence to the dietitian visits, 94% completed food diary, and 88% maintained exercise diary No significant changes in BW in either group Significant within-group difference in self-reported PA in both groups, IG appeared to have a higher gain in PA 	<ul style="list-style-type: none"> Only KTRs with no diagnosis of PTDM were eligible Participants allocated to groups based on GT AEs not reported Unclear number of Rx visits Preliminary work for the CAVIAR trial by Kuningas 2019 [8]
Teplan et al [17] (Czech Republic)	6	n=238	IG: 6-months ET (AT) CG: Matched controls, no ET	Primary: ADMA (blood marker for risk of cardiovascular disease) Secondary:	Primary: <ul style="list-style-type: none"> Significant between-group difference favouring IG vs UC for reduced ADMA levels Secondary:	<ul style="list-style-type: none"> AE not reported BW not reported Reasons for dropouts (n=12) at

				blood lipids, HbA1C. Insulin, BP, Height, BW	<ul style="list-style-type: none"> No significant difference in HbA1c, insulin, BP or blood lipids between groups Significant between-group difference in BMI and waist circumference with an increase in the CG compared with IG ($P<0.02$) 	6-months not reported
Lorenz et al [18] (USA)	12	n=307	IG: 90 days pedometer and PA CG: Post-hoc controls, no PA Rx	Primary: Adherence to Rx Secondary: Metabolic parameters (HTN, hyperlipidaemia, PTDM), renal bloods	Primary: <ul style="list-style-type: none"> IG adherence to PA prescription was 36.5% 44.8% of IG returned PA diaries Secondary: <ul style="list-style-type: none"> No significant between-group difference between groups for 4-month weight gain, PTDM, lipids, or kidney function Lower BP at four-months post KTx IG vs CG Less impaired fasting glucose IG vs CG (between-group analysis, $P=0.04$) Adherent IG participants were less likely to gain weight ($P=0.01$) 	<ul style="list-style-type: none"> AEs not reported Low adherence to Rx prescription 36.5% Additional data (SD) provided by authors on request BMI not reported

Note. KTRs= kidney transplant recipient, IG= intervention Group, CG= control group, BW= body weight (kg), BMI= body mass index (kg/m²), AE=adverse event, Ax= assessment, GT= glucose tolerance, IGT= impaired glucose tolerance, PA= physical activity, AT= aerobic training, ADMA=asymmetric dimethylarginine, HbA1c=haemoglobin A1c, BP= blood pressure, HTN= hypertension, PTDM= post-transplant diabetes mellitus and SD= standard deviation, vs=versus

Supplementary Material Table S6. Table depicting detailed description of characteristics of trials

Study	Rx type	Rx Description	Rx Behaviour components	Provider	Duration	Frequency	Intensity	Type of ET	Time (in mins)
Leasure 1995 [13]	Exercise	<ul style="list-style-type: none"> ET started 8 weeks after KTx Progressed from 30 to 60 minutes Mode: F2F 	<ul style="list-style-type: none"> NI 	PT	12 weeks	36 sessions/ 12 weeks, 3x week, 1x week supervised	AT based on HR; RT based on Ax	AT + RT	30-60
Patel 1998 [14]	Diet	<ul style="list-style-type: none"> Verbal and written edu on exercise and healthy lifestyle edu on snacks, shopping, convenience foods, stress, weight management, alcohol and smoking Mode: NI, assume F2F 	<ul style="list-style-type: none"> Goal setting (BCT) for diet or weight loss 	RD	4 months	NI	NA	NI	NI
Jezior 2007 [15]	Other (measures and edu)	2 x F2F visits: <ul style="list-style-type: none"> Visit 1=measures taken (weight, height, waist, bioimpedance, skinfolds, dietary questionnaires) and edu on negative effects of obesity Visit 2= dietary guidance (limited information reported) 	<ul style="list-style-type: none"> Information about health consequences of obesity on mortality after transplant 	Phys	NI	2x visits over 6 months	NA	NA	NA
Sharif 2008 [16]	Combined	<ul style="list-style-type: none"> Lifestyle edu Multiple components 	<ul style="list-style-type: none"> Self-monitoring (diaries) 	RD	6 months	RD= NI sessions	NI	AT=walking, jogging, swimming	AT 120 minutes /

		<ul style="list-style-type: none"> • Healthy eating edu based on Diabetes UK guidelines • Graded ET • Food and exercise diaries • Mode: NI, assume F2F 				ET=2hrs per week		week	
Teplan 2014 [17]	Exercise	<ul style="list-style-type: none"> • Cycling on stationary bikes • Mode: F2F 	<ul style="list-style-type: none"> • NI 	Phys	6 months	2-3x week (1x week unsupervised)	60-70% difference in HR	AT	60
Lorenz 2015 [18]	PA	<ul style="list-style-type: none"> • Prior to discharge participants in Rx group given a pedometer and recording sheet for 90 days • Mode: F2F to give pedometer, steps taken unsupervised 	<ul style="list-style-type: none"> • Self-monitoring behaviour (PA) 	Self-directed	90 days (≈2.96 months)	Daily	Advised to walk as many steps as possible in 20 mins	AT= walking	20

Note. Rx indicates treatment, ET= exercise training, edu=education, F2F=face-to-face, NI= no information, RD= renal dietitian, NA= not applicable, KTx= Kidney transplant, PT= Physiotherapist, Ax=assessment, AT= aerobic training, HR= hear rate, RT= resistance training, BCT= behaviour-change techniques, HRM= heart rate max, Phys.= Physician, 1:1= one on one (individual treatment), CBT= cognitive behavioural therapy, P.Tr= Personal trainer, PA= physical activity, 1RM= one repetition maximum, UC= usual care, HRR- heart rate reserve, reps= repetitions, SMART goals= specific measurable achievable realistic and timed goals, Ex. Phys= Exercise Physiologist, PTDM= post-transplant diabetes mellitus, and APN= advanced practice nurse

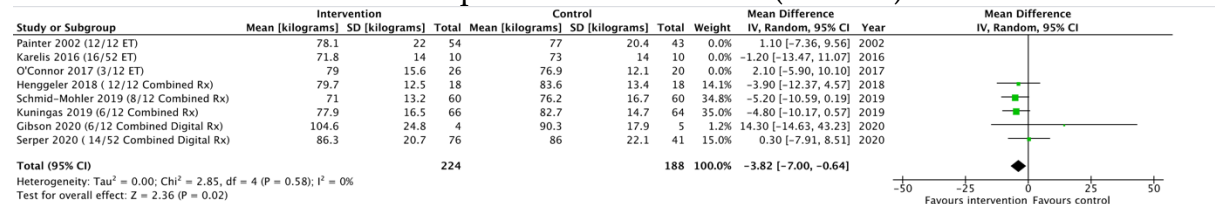
Supplementary Material Figure S1. Risk-of-bias plot non-RCT's (n=6)



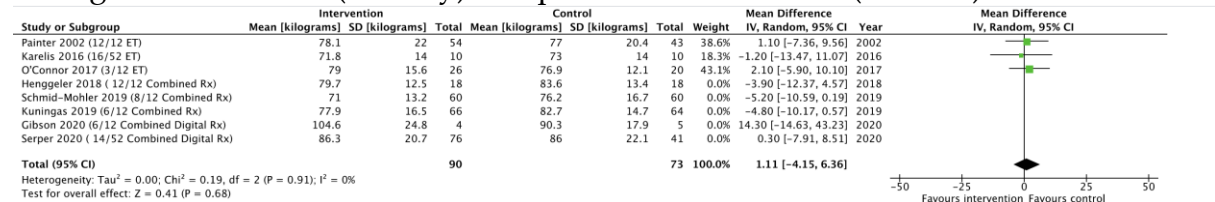
Supplementary Material Table S7. Sensitivity Analysis

To explore the relationship between the type of intervention (exercise, diet or combined) and BW and BMI, the following sensitivity analyses were performed.

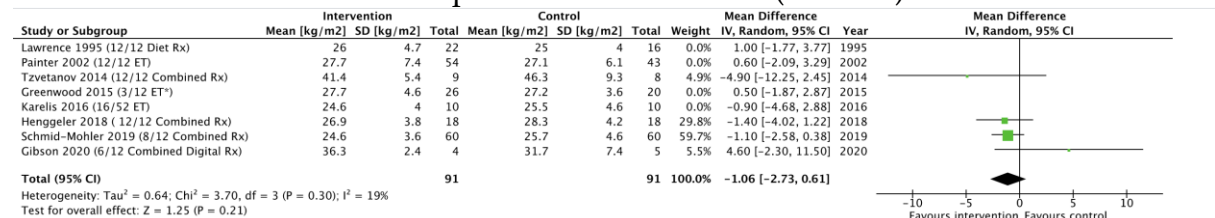
1. Combined interventions and post-intervention BW (5 RCT's)



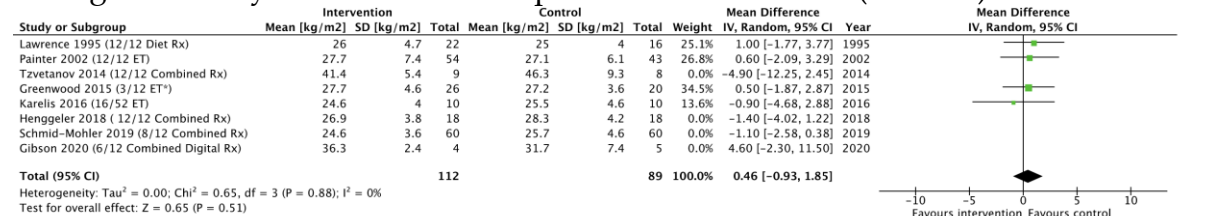
2. Single interventions (ET only) and post-intervention BW (3 RCT's)



3. Combined interventions and post-intervention BMI (4 RCT's)



4. Single modality interventions and post-intervention BMI (4 RCT's)



Supplementary Material References

1. Lawrence, I.R.; Thomson, A.; Hartley, G.H.; Wilkinson, R.; Day, J.; Goodship, T.H.J. The effect of dietary intervention on the management of hyperlipidemia in British renal transplant patients. *J Ren Nutr* **1995**, *5*, 73-77.
2. Painter, P.L.; Hector, L.; Ray, K.; Lynes, L.; Dibble, S.; Paul, S.M.; Tomlanovich, S.L.; Ascher, N.L. A randomized trial of exercise training after renal transplantation. *Transplantation* **2002**, *74*, 42-48, doi:10.1097/00007890-200207150-00008.
3. Painter, P.L.; Hector, L.; Ray, K.; Lynes, L.; Paul, S.M.; Dodd, M.; Tomlanovich, S.L.; Ascher, N.L. Effects of exercise training on coronary heart disease risk factors in renal transplant recipients. *Am J Kidney Dis* **2003**, *42*, 362-369, doi:10.1016/s0272-6386(03)00673-5.
4. Tzvetanov, I.; West-Thielke, P.; D'Amico, G.; Johnsen, M.; Ladik, A.; Hachaj, G.; Grazman, M.; Heller, R.U.; Fernhall, B.; Daviglus, M.L.; et al. A novel and personalized rehabilitation program for obese kidney transplant recipients. *Transplant Proc* **2014**, *46*, 3431-3437, doi:10.1016/j.transproceed.2014.05.085.
5. O'Connor, E.M.; Koufaki, P.; Mercer, T.H.; Lindup, H.; Nugent, E.; Goldsmith, D.; Macdougall, I.C.; Greenwood, S.A. Long-term pulse wave velocity outcomes with aerobic and resistance training in kidney transplant recipients - A pilot randomised controlled trial. *PLoS One* **2017**, *12*, doi:10.1371/journal.pone.0171063.
6. Greenwood, S.A.; Koufaki, P.; Mercer, T.H.; Rush, R.; O'Connor, E.; Tuffnell, R.; Lindup, H.; Haggis, L.; Dew, T.; Abdunnassir, L.; et al. Aerobic or Resistance Training and Pulse Wave Velocity in Kidney Transplant Recipients: A 12-Week Pilot Randomized Controlled Trial (the Exercise in Renal Transplant [ExeRT] Trial). *Am J Kidney Dis* **2015**, doi: 10.1053/j.ajkd.2015.1006.1016, doi:10.1053/j.ajkd.2015.06.016.
7. Henggeler, C.K.; Plank, L.D.; Ryan, K.J.; Gilchrist, E.L.; Casas, J.M.; Lloyd, L.E.; Mash, L.E.; McLellan, S.L.; Robb, J.M.; Collins, M.G. A Randomized Controlled Trial of an Intensive Nutrition Intervention Versus Standard Nutrition Care to Avoid Excess Weight Gain After Kidney Transplantation: The INTENT Trial. *J Ren Nutr* **2018**, 340-351., doi:10.1053/j.jrn.2018.03.001.
8. Kuningas, K.; Driscoll, J.; Mair, R.; Smith, H.; Dutton, M.; Day, E.; Sharif, A. Comparing glycaemic benefits of active versus passive lifestyle intervention in kidney allograft recipients (CAVIAR): a randomised controlled trial. *Transplantation* **2019**, doi:10.1097/tp.0000000000002969.
9. Karelis, A.D.; Hébert, M.-J.; Rabasa-Lhoret, R.; Räkel, A. Impact of Resistance Training on Factors Involved in the Development of New-Onset Diabetes After Transplantation in Renal Transplant Recipients: An Open Randomized Pilot Study. *Can J Diabetes* **2016**, *40*, 382-388, doi:10.1016/j.jcjd.2015.08.014.
10. Schmid-Mohler, G.; Zala, P.; Graf, N.; Witschi, P.; Mueller, T.F.; Peter Wuthrich, R.; Huber, L.; Fehr, T.; Spirig, R. Comparison of a Behavioral

Versus an Educational Weight Management Intervention After Renal Transplantation: A Randomized Controlled Trial. *Transplant Direct* **2019**, 5, e507, doi:10.1097/TXD.0000000000000936.

11. Serper, M.; Barankay, I.; Chadha, S.; Shults, J.; Jones, L.S.; Olthoff, K.M.; Reese, P.P. A randomized, controlled, behavioral intervention to promote walking after abdominal organ transplantation: results from the LIFT study. *Transpl Int* **2020**, 33, 632-643, doi:10.1111/tri.13570.
12. Gibson, C.A.; Gupta, A.; Greene, J.L.; Lee, J.; Mount, R.R.; Sullivan, D.K. Feasibility and acceptability of a televideo physical activity and nutrition program for recent kidney transplant recipients. *Pilot Feasibility Stud* **2020**, 6, 126, doi:10.1186/s40814-020-00672-4.
13. Leasure, R.; Belknap, D.; Burks, C.; Schlegel, J. The effects of structured exercise on muscle mass, strength, and endurance of immunosuppressed adult renal transplant patients: a pilot study. *Rehabil Nurs* **1995**, 4, 47-57.
14. Patel, M.G. The effect of dietary intervention on weight gains after renal transplantation. *J Ren Nutr* **1998**, 8, 137-141.
15. Jezior, D.; Krajewska, M.; Madziarska, K.; Regulska-Ilow, B.; Ilow, R.; Janczak, D.; Patrzalek, D.; Klinger, M. Weight Reduction in Renal Transplant Recipients Program: The First Successes. *Transplant Proc* **2007**, 39, 2769-2771, doi:10.1016/j.transproceed.2007.08.055.
16. Sharif, A.; Moore, R.; Baboolal, K. Influence of lifestyle modification in renal transplant recipients with postprandial hyperglycemia. *Transplantation* **2008**, 85, 353-358, doi:10.1097/TP.0b013e3181605ebf.
17. Teplan, V.; Mahrova, A.; Pitha, J.; Racek, J.; Gurlich, R.; Teplan, V., Jr.; Valkovsky, I.; Stollova, M. Early exercise training after renal transplantation and asymmetric dimethylarginine: the effect of obesity. *Kidney Blood Press Res* **2014**, 39, 289-298, doi:10.1159/000355806.
18. Lorenz, E.C.; Amer, H.; Dean, P.G.; Stegall, M.D.; Cosio, F.G.; Cheville, A.L. Adherence to a pedometer-based physical activity intervention following kidney transplant and impact on metabolic parameters. *Clin Transplant* **2015**, 29, 560-568, doi:10.1111/ctr.12553.