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Supplementary Table S1. Database search strategies and records retrieved

Database / platform	Search date	Records retrieved	Search strategy
Web of Science Core Collection	7 Sep 2026	2,318	1. TS=(exercis* OR "physical activit*" OR "exercise train*" OR "physical train*" OR "aerobic exercis*" OR "aerobic train*" OR "resistance train*" OR "strength train*" OR "endurance train*" OR "interval train*" OR "circuit train*" OR "functional train*" OR HIIT OR HIFT OR walking OR cycling OR running OR "active commuting" OR taekwondo) 2. TS=("glucagon-like peptide 1" OR "glucagon like peptide 1" OR "glucagon-like peptide-1" OR "GLP-1" OR "GLP 1" OR GLP1 OR incretin*) 1 AND 2
PubMed	7 Sep 2026	1,690	1. ("Glucagon-Like Peptide 1"[Mesh] OR "glucagon-like peptide 1"[tiab] OR "glucagon like peptide 1"[tiab] OR "glucagon-like peptide-1"[tiab] OR "GLP-1"[tiab] OR "GLP 1"[tiab] OR GLP1[tiab] OR incretin*[tiab]) 2. ("Exercise"[Mesh] OR "Exercise Therapy"[Mesh] OR "Resistance Training"[Mesh] OR "High-Intensity Interval Training"[Mesh] OR exercis*[tiab] OR "physical activit*"[tiab] OR "exercise train*"[tiab] OR "physical train*"[tiab] OR "aerobic exercis*"[tiab] OR "aerobic train*"[tiab] OR "resistance train*"[tiab] OR "strength train*"[tiab] OR "endurance train*"[tiab] OR "interval train*"[tiab] OR "circuit train*"[tiab] OR "functional train*"[tiab] OR HIIT[tiab] OR HIFT[tiab] OR walking[tiab] OR cycling[tiab] OR running[tiab] OR "active commuting"[tiab] OR taekwondo[tiab]) 1 AND 2
Embase (Embase.com)	8 Sep 2026	4,761	1. ('glucagon like peptide 1'/exp OR 'glucagon-like peptide 1':ti,ab,kw OR 'glucagon like peptide 1':ti,ab,kw OR 'glucagon-like peptide-1':ti,ab,kw OR 'glp-1':ti,ab,kw OR 'glp 1':ti,ab,kw OR glp1:ti,ab,kw OR incretin*:ti,ab,kw) 2. ('exercise'/exp OR 'exercise therapy'/exp OR 'resistance training'/exp OR 'high intensity interval training'/exp OR exercis*:ti,ab,kw OR 'physical activit*':ti,ab,kw OR 'exercise train*':ti,ab,kw OR 'physical train*':ti,ab,kw OR 'aerobic exercis*':ti,ab,kw OR 'aerobic train*':ti,ab,kw OR 'resistance train*':ti,ab,kw OR 'strength train*':ti,ab,kw OR 'endurance train*':ti,ab,kw OR 'interval train*':ti,ab,kw OR 'circuit train*':ti,ab,kw OR 'functional train*':ti,ab,kw OR hiit:ti,ab,kw OR hift:ti,ab,kw OR walking:ti,ab,kw OR cycling:ti,ab,kw OR running:ti,ab,kw OR 'active commuting':ti,ab,kw OR taekwondo:ti,ab,kw) 1 AND 2
Cochrane Library	7 Sep 2026	961	1. ("glucagon-like peptide 1" OR "glucagon like peptide 1" OR "glucagon-like peptide-1" OR "GLP-1" OR "GLP 1" OR GLP1 OR incretin*) 2. (exercis* OR "physical activit*" OR "exercise train*" OR "physical train*" OR "aerobic exercis*" OR "aerobic train*" OR "resistance train*" OR "strength train*" OR "endurance train*" OR "interval train*" OR "circuit train*" OR "functional train*" OR HIIT OR HIFT OR walking OR cycling OR running OR "active commuting" OR taekwondo) 1 AND 2
SPORTDiscus (EBSCO)	7 Sep 2026	150	1. ("glucagon-like peptide 1" OR "glucagon like peptide 1" OR "glucagon-like peptide-1" OR "GLP-1" OR "GLP 1" OR GLP1 OR incretin*) 2. (exercis* OR "physical activit*" OR "exercise train*" OR "physical train*" OR "aerobic exercis*" OR "aerobic train*" OR "resistance train*" OR "strength train*" OR "endurance train*" OR "interval train*" OR "circuit train*" OR "functional train*" OR HIIT OR HIFT OR walking OR cycling OR running OR "active commuting" OR taekwondo) 1 AND 2
CNKI (China National Knowledge Infrastructure)	8 Sep 2026	71	Topic search: 1. 运动+锻炼+活动+训练+HIIT+HIFT+步行+跑步+骑行 2. 胰高血糖素样肽 1+肠促胰素+GLP1+'glucagon like peptide 1' 1 AND 2
Total		9,951	Raw records retrieved across the six databases before cross-database deduplication.

Note. Search concept blocks were combined with AND. CNKI terms are shown in the original Chinese syntax. Counts are raw retrievals before deduplication. Abbreviations: CNKI, China National Knowledge Infrastructure; GLP-1, glucagon-like peptide-1; HIFT, high-intensity functional training; HIIT, high-intensity interval training; MeSH, Medical Subject Headings.

Supplementary Table S2. Characteristics of included study cohorts and participants

Study family	Study	Country	Design	*n*	Sex	Age, y	BMI, kg/m^2	Population	Training status	VO_2max/peak
SF34036	Alghamdi 2025	United Kingdom	Randomized crossover	16	Male	26.5	23.7	Healthy	Unclear	42
SF34037	Bailey DP 2015	United Kingdom	Randomized crossover	12	Male	21.6	23.5	Healthy	Active/trained	56
SF34038	Brown 2016	United Kingdom	Randomized crossover	13	Female	23	23.1	Healthy	Active/trained	43.5
SF34039	Campbell 2015	United Kingdom	Randomized crossover	10	Male	27	25.5	Type 1 diabetes	Active/trained	51.3
SF34040	Dekker 2010	Canada	Randomized crossover	9	Male	59	33.8	Type 2 diabetes	Inactive/sedentary	NR
SF34041	Douglas 2017	United Kingdom	Randomized crossover	22 completed; GLP-1 *n*=18	Mixed	37.5	22.4	Healthy	Inactive/sedentary	43.6
SF34041	Douglas 2017	United Kingdom	Randomized crossover	25 completed; GLP-1 *n*=22	Mixed	45	29.2	Overweight/obesity	Inactive/sedentary	34.7
SF34042	Eshghi 2013	Canada	Non-randomized crossover	9-10	Mixed	58	28.6	Type 2 diabetes	Unclear	30.2
SF34043	Eshghi 2017	Canada	Randomized crossover	6	Male	42.5	26.7	Healthy	Active/trained	NR
SF34043	Eshghi 2017	Canada	Randomized crossover	6	Male	60.5	24.8	Type 2 diabetes	Active/trained	NR
SF34044	Gil 2025	Brazil	Non-randomized pre/post	13	Female	37	47.6	Post-bariatric surgery	Unclear	14.9
SF34045	Gordon 2022	USA	Randomized crossover	11	Male	24.3	26	Healthy	Inactive/sedentary	38.3
SF34046	Hallworth JR 2017 [R34046]	Canada	Randomized crossover	9	Female	30.5	23.5	Healthy	Active/trained	40.7
SF34047	Hamilton 2020	Canada	Randomized crossover	14	Mixed	26.8	26.9	Healthy	Active/trained	37.3
SF34046	Hazell 2017, Appetite [R34048]	Canada	Randomized crossover	10	Male	29	23.7	Healthy	Active/trained	46.8
SF34046	Hazell 2017, Eur J Appl Physiol [R34049]	Canada	Randomized crossover	10	Male	28.6	23.7	Healthy	Active/trained	46.8
SF34046	Hazell 2017, Eur J Appl Physiol [R34049]	Canada	Randomized crossover	11	Female	30.5	23.5	Healthy	Active/trained	40.7
SF34050	Heden TD 2013	USA	Randomized crossover	13	Mixed	26	23	Healthy	Inactive/sedentary	NR

Study family	Study	Country	Design	*n*	Sex	Age, y	BMI, kg/m^2	Population	Training status	VO_2max/peak
SF34050	Heden TD 2013	USA	Randomized crossover	13	Mixed	25.4	34.6	Obesity, non-clinical	Inactive/sedentary	NR
SF34051	Hochsmann 2025	USA	Randomized crossover	39	Mixed	22	23.7	Healthy	Active/trained	37.6
SF34051	Hochsmann 2025	USA	Randomized crossover	29	Mixed	68.5	26	Healthy	Active/trained	24.2
SF34052	Holliday 2017	UK	Randomized crossover	12	Male	21	21	Healthy	Active/trained	61.6
SF34053	Holliday 2017	UK	Randomized crossover	8 analyzed; GLP-1 *n*=7 inferred	Mixed	34	27.7	Overweight	Inactive/sedentary	NR
SF34054	Howe 2016	USA	Randomized crossover	15	Female	31.1	21.1	Healthy	Active/trained	55.2
SF34055	Khodabandeh 2024	Iran	Randomized crossover	11	Male	22	35.3	Overweight/obesity	Inactive/sedentary	28.4
SF34057	Li 2023	China	Randomized crossover	14	Mixed	20.6	31.1	Obesity, non-clinical	Inactive/sedentary	33.1
SF34058	Maffeis C 2013	Italy	Randomized crossover	10	Unclear	9	26.4	Overweight/obesity	Unclear	NR
SF34059	Mandic 2019	Canada	Randomized crossover	NR	Mixed	33.5	26.5	Healthy	Unclear	43.8
SF34060	Mattin 2018	United Kingdom	Randomized crossover	8	Male	26	25.5	Healthy	Active/trained	42.2
SF34061	McIver 2019	United Kingdom	Randomized crossover	10	Male	26	27	Healthy	Active/trained	39
SF34062	Numao S 2013	Japan	Randomized crossover	11	Male	27	21.5	Healthy	Inactive/sedentary	39.2
SF34063	Nyhoff LM 2015	USA	Non-randomized crossover	11	Female	24.3	37.3	Overweight/obesity	Inactive/sedentary	25.2
SF34064	O'Connor 2006	Ireland / Northern Ireland	Randomized crossover	6	Male	35.5	NR	Healthy	Active/trained	62.8
SF34065	Okada TE 2021	Canada	Randomized crossover	13	Mixed	23.6	25.7	Healthy	Unclear	37.6
SF34066	Reynolds 2025	United Kingdom	Randomized crossover	14	Female	23	22.9	Healthy	Active/trained	40.8
SF34067	Shamlan 2017	United Kingdom	Randomized crossover	33	Mixed	23	23.6	Healthy	Unclear	34.4
SF34068	Slater 2025	United Kingdom	Randomized crossover	12	Male	25	NR	Healthy	Active/trained	45
SF34069	Ternhamar 2023	Denmark	Randomized crossover	10	Female	47	32.2	Post-bariatric surgery	Unclear	NR
SF34069	Ternhamar 2023	Denmark	Randomized crossover	10	Female	50	31.5	Healthy	Unclear	NR
SF34070	Ueda 2018	Japan	Randomized crossover	13	Male	21.6	22.7	Healthy	Active/trained	49.8

Study family	Study	Country	Design	*n*	Sex	Age, y	BMI, kg/m^2	Population	Training status	VO_2max/peak
SF34070	Ueda 2018	Japan	Non-randomized pre/post	8	Male	19.5	22.4	Healthy	Active/trained	53.2
SF34071	Ueda SY 2009	Japan	Randomized crossover	10	Male	23.4	22.5	Healthy	Inactive/sedentary	45.9
SF34072	Unick 2010	United States	Randomized crossover	19	Female	28.5	32.5	Overweight/obesity	Inactive/sedentary	NR
SF34073	Vanderheyden 2020	Canada	Randomized crossover	11	Male	NR	23.6	Healthy	Active/trained	44.1
SF34074	Bornath DPD 2023	Canada	Randomized crossover	9	Male	21	22.3	Type 2 diabetes	Inactive/sedentary	39.4
SF34074	Bornath DPD 2023	Canada	Randomized crossover	8	Male	22	31.8	Type 2 diabetes	Inactive/sedentary	25.8
SF34075	Islam H 2017	Canada	Non-randomized crossover	8	Male	23.1	24.8	Healthy	Active/trained	51.2
SF34076	Matos 2018	Brazil	Randomized crossover	12	Male	28.4	35.5	Obesity, non-clinical	Inactive/sedentary	NR
SF34077	Ueda 2009	Japan	Randomized crossover	7	Male	22.4	22.4	No GI/endocrine/CV/psychological	Inactive/sedentary	46.6
SF34077	Ueda 2009	Japan	Randomized crossover	7	Male	22.9	30	No GI/endocrine/CV/psychological	Inactive/sedentary	34
SF34079	Bock PM 2022	Brazil	Single-group non-randomized	13	Mixed	56.2	29.6	Type 2 diabetes	Unclear	25.7
SF34080	Bornath 2025	Canada	Non-randomized crossover	12	Mixed	26	23.2	Healthy	Active/trained	48.1
SF34080	BORNATH 2026	Canada	Non-randomized crossover	13	Female	24	24.8	Healthy	Active/trained	41
SF35430	Chen 2022	United Kingdom	Randomized crossover	10	Mixed	51	31.9	Healthy	Inactive/sedentary	NR
SF35432	Deru 2023	USA	Randomized crossover	20	Mixed	26.2	23.8	Healthy	Inactive/sedentary	NR
SF35433	Dipietro 2025	USA	Non-randomized/other	7	Mixed	28.1	28.2	Overweight/obesity	Active/trained	36
SF35433	Dipietro 2025	USA	Non-randomized/other	5	Mixed	27.3	30	Overweight/obesity	Active/trained	33
SF35434	França 2026	Brazil	Randomized crossover	NR	Male	30	NR	Overweight/obesity	Inactive/sedentary	36.7
SF35435	Halliday 2021	USA	Randomized crossover	19	Mixed	35	28.5	Overweight/obesity	Inactive/sedentary	NR

Study family	Study	Country	Design	*n*	Sex	Age, y	BMI, kg/m^2	Population	Training status	VO_2max/peak
SF34047	Hamilton 2023	Canada	Randomized crossover	14	Mixed	26.8	26.9	Overweight	Active/trained	37.3
SF35437	Kojima C 2019	Japan	Randomized crossover	12	Female Only	20.8	21.8	Healthy	Unclear	NR
SF35438	Larson-Meyer DE 2012	USA	Non-randomized crossover	NR	Female Only	23.7	19.8	Healthy	Active/trained	49.7
SF35438	Larson-Meyer DE 2012	USA	Non-randomized crossover	NR	Female Only	24.6	22.1	Healthy	Active/trained	33.9
SF35439	McCarthy 2024	Denmark	Randomized crossover	NR	Mixed	47	27.5	Type 1 diabetes	Unclear	24.2
SF34075	McCarthy S 2026	Canada	Non-randomized/other	12	Male Only	24	24.7	Healthy	Active/trained	NR
SF34075	McCarthy S 2026	Canada	Non-randomized/other	11	Female Only	22	22	Healthy	Active/trained	NR
SF35441	McCarthy SF 2023	Canada	Non-randomized crossover	9	Mixed	45	26.3	Healthy	Unclear	35.2
SF35442	McCarthy 2024	Canada	Randomized crossover	11	Male Only	24	25.3	Healthy	Unclear	NR
SF35443	Moniz SC 2023	Canada	Randomized crossover	12	Female Only	22	23.1	Healthy	Active/trained	37.2
SF35435	Tobin SY 2021	USA	Randomized crossover	12 completed; GLP-1 *n*=10	Male Only	32.3	28.1	Overweight/obesity	Inactive/sedentary	NR
SF35435	Tobin SY 2021	USA	Randomized crossover	12 completed; GLP-1 *n*=9	Female Only	36.8	29	Overweight/obesity	Inactive/sedentary	NR
SF34080	Tucker JAL 2026	Canada	Non-randomized/other	14	Male Only	25	24.7	Healthy	Unclear	50.6
SF34080	Tucker JAL 2026	Canada	Non-randomized/other	14	Female Only	23	22.8	Healthy	Unclear	42.9
SF34080	Tucker JAL 2026	Canada	Non-randomized/other	14	Female Only	23	24.7	Healthy	Unclear	40.5

Note. Population and training status are standardised descriptors. NR, not reported. VO_2max/peak is in $mL \cdot kg^{-1} \cdot min^{-1}$. Sample sizes are report- and outcome-specific; where GLP-1 assay subsets differed from complete cohorts, both are shown. Cohort counts across overlapping reports must not be summed. SF34046 links Hallworth 2017 (female-only, $n = 9$), Hazell 2017 in Appetite (male-only, $n = 10$), and Hazell 2017 in European Journal of Applied Physiology (10 men and 11 women). The combined report is the selected quantitative source for overlapping MICT/SIT/control observations. Tobin 2021 is a secondary sex-stratified report of the Halliday 2021 family; quantitative observations use Halliday. Holliday 2017 had eight participants for appetite, ghrelin and intake; the seven-person GLP-1 subset is inferred from reported individual profiles and is examined in an exclusion sensitivity analysis.

Supplementary Table S3. Characteristics of acute exercise conditions and matched comparators

Study family	Study	Condition	Role	Exercise mode	Pattern	Duration, min	Intensity	Feeding state	Pre-exercise meal	Post-exercise meal	Other co-intervention
SF34036	Alghamdi 2025	CTRL	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fasted	No	Yes	Supplement
SF34036	Alghamdi 2025	EX	Exercise	Treadmill	Continuous	60	Moderate; 60% VO_2max	Fasted	No	Yes	Supplement
SF34037	Bailey DP 2015	MIE_*N*	Exercise	Running on treadmill	Continuous	50	Vigorous; 70% VO_2max	Fed	Yes	Yes	None
SF34037	Bailey DP 2015	MIE_H	Exercise	Running on treadmill	Continuous	50	Vigorous; 70% VO_2max	Fed	Yes	Yes	Hypoxia
SF34037	Bailey DP 2015	HIIE_*N*	Exercise	Running on treadmill	Interval	50	High-intensity interval; 90% VO_2max	Fed	Yes	Yes	None
SF34037	Bailey DP 2015	HIIE_H	Exercise	Running on treadmill	Interval	50	High-intensity interval; 90% VO_2max	Fed	Yes	Yes	Hypoxia
SF34038	Brown 2016	DBB	Exercise	Cycle ergometer	Continuous	60	Moderate; 65% VO_2peak	Fed	Yes	Yes	Supplement
SF34038	Brown 2016	CHO	Exercise	Cycle ergometer	Continuous	60	Moderate; 65% VO_2peak	Fed	Yes	Yes	Supplement
SF34038	Brown 2016	H2O	Exercise	Cycle ergometer	Continuous	60	Moderate; 65% VO_2peak	Fed	Yes	Yes	Supplement
SF34039	Campbell 2015	LGI	Exercise	Treadmill running	Continuous	45	Vigorous; 70% VO_2peak	Fed	Yes	Yes	Drug
SF34039	Campbell 2015	HGI	Exercise	Treadmill running	Continuous	45	Vigorous; 70% VO_2peak	Fed	Yes	Yes	Drug
SF34040	Dekker 2010	REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Unclear	NR	Yes	None
SF34040	Dekker 2010	EX	Exercise	Treadmill walking	Continuous	60	Moderate; 55 estimated % VO_2peak from HR reserve	Unclear	NR	Yes	None
SF34041	Douglas 2017	LEAN_CTRL	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fasted	No	Yes	None
SF34041	Douglas 2017	LEAN_EX	Exercise	Treadmill	Continuous	60	Moderate; 60% VO_2peak	Fasted	No	Yes	None
SF34041	Douglas 2017	OW_CTRL	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fasted	No	Yes	None
SF34041	Douglas 2017	OW_EX	Exercise	Treadmill	Continuous	60	Moderate; 58% VO_2peak	Fasted	No	Yes	None
SF34042	Eshghi 2013	MET_REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	Drug
SF34042	Eshghi 2013	MET_EX	Exercise	Isokinetic leg extensions/flexions, then three treadmill bouts	Multi-bout	35	Mixed	Fed	Yes	Yes	Drug

Study family	Study	Condition	Role	Exercise mode	Pattern	Duration, min	Intensity	Feeding state	Pre-exercise meal	Post-exercise meal	Other co-intervention
SF34042	Eshghi 2013	PLAC_REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	Drug
SF34042	Eshghi 2013	PLAC_EX	Exercise	Isokinetic leg extensions/flexions, then three treadmill bouts	Multi-bout	35	Mixed	Fed	Yes	Yes	Drug
SF34043	Eshghi 2017	HEALTHY_EX	Exercise	Treadmill walking	Multi-bout	2 × 90	Moderate; 80% ventilatory threshold	Unclear	NR	Yes	None
SF34043	Eshghi 2017	HEALTHY_REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Unclear	NR	Yes	None
SF34043	Eshghi 2017	T2D_EX	Exercise	Treadmill walking	Multi-bout	2 × 90	Moderate; 80% ventilatory threshold	Unclear	NR	Yes	Metformin withheld
SF34043	Eshghi 2017	T2D_REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Unclear	NR	Yes	Metformin withheld
SF34044	Gil 2025	PRE_RYGB	Exercise	Resistance followed by treadmill aerobic exercise	NR	78	Mixed	Fed	Yes	NR	None
SF34044	Gil 2025	POST_RYGB	Exercise	Resistance followed by treadmill aerobic exercise	NR	78	Mixed	Fed	Yes	NR	None
SF34045	Gordon 2022	R	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Unclear	NR	Yes	Supplement
SF34045	Gordon 2022	EX	Exercise	Treadmill walking	Continuous	60	Vigorous; 70% VO_2max	Unclear	NR	Yes	Supplement
SF34045	Gordon 2022	W	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Unclear	NR	Yes	Supplement
SF34045	Gordon 2022	EXW	Exercise	Treadmill walking	Continuous	60	Vigorous; 70% VO_2max	Unclear	NR	Yes	Supplement
SF34046	Hallworth JR 2017 [R34046]	CTRL	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF34046	Hallworth JR 2017 [R34046]	MICT	Exercise	Cycle ergometer (Monark 874E)	Continuous	30	Moderate; 65% VO_2max	Fed	Yes	No	None
SF34046	Hallworth JR 2017 [R34046]	SIT	Exercise	Cycle ergometer (Monark 874E)	Interval	23	Sprint/supramaximal	Fed	Yes	No	None
SF34047	Hamilton 2020	FAST	Exercise	Cycle ergometer (Velotron)	Continuous	45	Vigorous; 65% VO_2peak	Fed	Yes	No	Supplement
SF34047	Hamilton 2020	FED	Exercise	Cycle ergometer (Velotron)	Continuous	45	Vigorous; 65% VO_2peak	Fed	Yes	Yes	Supplement
SF34046	Hazell 2017, Appetite [R34048]	CTRL	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None

Study family	Study	Condition	Role	Exercise mode	Pattern	Duration, min	Intensity	Feeding state	Pre-exercise meal	Post-exercise meal	Other co-intervention
SF34046	Hazell 2017, Appetite [R34048]	MICT	Exercise	Cycle ergometer (Monark 874E)	Continuous	30	Moderate; 65% VO_2max	Fed	Yes	No	None
SF34046	Hazell 2017, Appetite [R34048]	HICT	Exercise	Cycle ergometer (Monark 874E)	Continuous	30	Vigorous; 85% VO_2max	Fed	Yes	No	None
SF34046	Hazell 2017, Appetite [R34048]	SIT	Exercise	Cycle ergometer (Monark 874E)	Interval	23	Sprint/supramaximal	Fed	Yes	No	None
SF34046	Hazell 2017, Eur J Appl Physiol [R34049]	MALE_CTRL	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF34046	Hazell 2017, Eur J Appl Physiol [R34049]	MALE_MICT	Exercise	Cycle ergometer (Monark 874E)	Continuous	30	Moderate; 65% VO_2max	Fed	Yes	No	None
SF34046	Hazell 2017, Eur J Appl Physiol [R34049]	MALE_SIT	Exercise	Cycle ergometer (Monark 874E)	Interval	23	Sprint/supramaximal	Fed	Yes	No	None
SF34046	Hazell 2017, Eur J Appl Physiol [R34049]	FEMALE_CTRL	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF34046	Hazell 2017, Eur J Appl Physiol [R34049]	FEMALE_MICT	Exercise	Cycle ergometer (Monark 874E)	Continuous	30	Moderate; 65% VO_2max	Fed	Yes	No	None
SF34046	Hazell 2017, Eur J Appl Physiol [R34049]	FEMALE_SIT	Exercise	Cycle ergometer (Monark 874E)	Interval	23	Sprint/supramaximal	Fed	Yes	No	None
SF34050	Heden TD 2013	NW_EX	Exercise	Treadmill walking	Continuous	60	Moderate; 56% VO_2peak	Unclear	NR	Yes	None
SF34050	Heden TD 2013	NW_NOEX	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Unclear	NR	Yes	None
SF34050	Heden TD 2013	OB_EX	Exercise	Treadmill walking	Continuous	60	Moderate; 57% VO_2peak	Unclear	NR	Yes	None
SF34050	Heden TD 2013	OB_NOEX	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Unclear	NR	Yes	None
SF34051	Hochsmann 2025	Y_EX	Exercise	Cycle ergometer (Monark LC6)	Continuous	45	Moderate; 60% VO_2peak	Fed	Yes	Yes	None
SF34051	Hochsmann 2025	Y_REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF34051	Hochsmann 2025	O_EX	Exercise	Cycle ergometer (Monark LC6)	Continuous	45	Moderate; 60% VO_2peak	Fed	Yes	Yes	None
SF34051	Hochsmann 2025	O_REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF34052	Holliday 2017	REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fasted	No	Yes	None

Study family	Study	Condition	Role	Exercise mode	Pattern	Duration, min	Intensity	Feeding state	Pre-exercise meal	Post-exercise meal	Other co-intervention
SF34052	Holliday 2017	M15	Exercise	Cycle ergometer (Lode Excalibur Sport)	Continuous	15	Vigorous; 76% VO_2max	Fasted	No	Yes	None
SF34052	Holliday 2017	M30	Exercise	Cycle ergometer (Lode Excalibur Sport)	Continuous	30	Vigorous; 77% VO_2max	Fasted	No	Yes	None
SF34052	Holliday 2017	M45	Exercise	Cycle ergometer (Lode Excalibur Sport)	Continuous	45	Vigorous; 76% VO_2max	Fasted	No	Yes	None
SF34053	Holliday 2017	REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF34053	Holliday 2017	EX	Exercise	Cycle ergometer (Lode Excalibur Sport modified Wingate)	Interval	14	Sprint/supramaximal	Fed	Yes	Yes	None
SF34054	Howe 2016	MIE	Exercise	Treadmill running	Continuous	45.7	Moderate; 60% VO_2max	Fed	Yes	Yes	None
SF34054	Howe 2016	HIE	Exercise	Treadmill running	Continuous	33.6	Vigorous; 85% VO_2max	Fed	Yes	Yes	None
SF34055	Khodabandeh 2024	CTRL	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF34055	Khodabandeh 2024	MICT	Exercise	Cycle ergometer (Monark LC4)	Continuous	60	Moderate; 60% VO_2peak	Fed	Yes	Yes	None
SF34057	Li 2023	B	Exercise	Cycle ergometer	Continuous	49.5	Moderate; 60% VO_2max	Fed	Yes	Yes	Blood-flow restriction
SF34057	Li 2023	M	Exercise	Cycle ergometer	Continuous	49.5	Moderate; 60% VO_2max	Fed	Yes	Yes	None
SF34057	Li 2023	C	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF34058	Maffeis C 2013	A	Exercise	Cycle ergometer	Interval	30	Moderate; 4 MET measured resting metabolic rate	Fasted	No	Yes	None
SF34058	Maffeis C 2013	B	Exercise	Cycle ergometer	Interval	30	Moderate; 4 MET measured resting metabolic rate	Fasted	No	Yes	None
SF34059	Mandic 2019	COLD	Exercise	Military tasks: aerobic walking, load carrying, strength/endurance	Mixed	240	Mixed	Fed	Yes	Yes	None
SF34059	Mandic 2019	HOT	Exercise	Military tasks: aerobic walking, load carrying, strength/endurance	Mixed	240	Mixed	Fed	Yes	Yes	None
SF34059	Mandic 2019	TEMP	Exercise	Military tasks: aerobic walking, load carrying, strength/endurance	Mixed	240	Mixed	Fed	Yes	Yes	None
SF34059	Mandic 2019	REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None

Study family	Study	Condition	Role	Exercise mode	Pattern	Duration, min	Intensity	Feeding state	Pre-exercise meal	Post-exercise meal	Other co-intervention
SF34060	Mattin 2018	CONTROL	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fasted	No	Yes	Drug
SF34060	Mattin 2018	LOW	Exercise	Cycle ergometer (Lode Excalibur)	Continuous	60	Low; 40% VO_2peak	Fasted	No	Yes	Drug
SF34060	Mattin 2018	HIGH	Exercise	Cycle ergometer (Lode Excalibur)	Continuous	60	Vigorous; 70% VO_2peak	Fasted	No	Yes	Drug
SF34061	McIver 2019	FASTED	Exercise	Brisk treadmill walking	Continuous	45	Moderate; 50% VO_2peak	Fasted	No	Yes	None
SF34061	McIver 2019	FED	Exercise	Brisk treadmill walking	Continuous	45	Moderate; 50% VO_2peak	Fed	Yes	Yes	None
SF34062	Numao S 2013	ND	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Unclear	NR	Yes	None
SF34062	Numao S 2013	HFD	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Unclear	NR	Yes	None
SF34062	Numao S 2013	HFDEx	Exercise	Cycle ergometer	Continuous	32	Moderate; 50% VO_2peak	Unclear	NR	Yes	None
SF34063	Nyhoff LM 2015	NoEx	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF34063	Nyhoff LM 2015	ModEx	Exercise	Treadmill walking	Continuous	55.4	Moderate; 55% VO_2max	Fed	Yes	Yes	None
SF34063	Nyhoff LM 2015	IntEx	Exercise	Treadmill walking	Interval	50.5	High-intensity interval; 80% VO_2max	Fed	Yes	Yes	None
SF34064	O'Connor 2006	ExGLU	Exercise	Treadmill running	Continuous	120	Moderate; 60% VO_2max	Fed	Yes	Yes	None
SF34064	O'Connor 2006	ExPL	Exercise	Treadmill running	Continuous	120	Moderate; 60% VO_2max	Fed	Yes	No	None
SF34064	O'Connor 2006	ConGLU	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF34065	Okada TE 2021	KET	Exercise	Cycle ergometer (Velotron)	Continuous	60	Vigorous; 70% VO_2peak	Fed	Yes	Yes	None
SF34065	Okada TE 2021	DEX	Exercise	Cycle ergometer (Velotron)	Continuous	60	Vigorous; 70% VO_2peak	Fed	Yes	Yes	None
SF34066	Reynolds 2025	CON	Exercise	Cycling	Continuous	45	Not classifiable; 55% Wmax	Fed	Yes	No	None
SF34066	Reynolds 2025	CP	Exercise	Cycling	Continuous	45	Not classifiable; 55% Wmax	Fed	Yes	Yes	None
SF34067	Shamlan 2017	LICC	Exercise	Cycle ergometer (Lode Corival)	Continuous	30	Moderate; 50% VO_2peak	Fed	Yes	Yes	None
SF34067	Shamlan 2017	HIIC	Exercise	Cycle ergometer (Lode Corival)	Interval	NR	High-intensity interval; 95% VO_2peak	Fed	Yes	Yes	None

Study family	Study	Condition	Role	Exercise mode	Pattern	Duration, min	Intensity	Feeding state	Pre-exercise meal	Post-exercise meal	Other co-intervention
SF34068	Slater 2025	HI	Exercise	Cycling	Continuous	60	Moderate; 60% VO_2peak	Fed	Yes	Yes	None
SF34068	Slater 2025	LO	Exercise	Cycling	Continuous	60	Moderate; 60% VO_2peak	Fed	Yes	Yes	None
SF34068	Slater 2025	FAST	Exercise	Cycling	Continuous	60	Moderate; 60% VO_2peak	Fasted	Yes	Yes	None
SF34069	Ternhamar 2023	RYGB_HGI_REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF34069	Ternhamar 2023	RYGB_HGI_EX	Exercise	Cycle ergometer	Continuous	30	Vigorous; 70% VO_2max	Fed	Yes	No	None
SF34069	Ternhamar 2023	RYGB_LGI_REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF34069	Ternhamar 2023	RYGB_LGI_EX	Exercise	Cycle ergometer	Continuous	30	Vigorous; 70% VO_2max	Fed	Yes	No	None
SF34069	Ternhamar 2023	CON_HGI_REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF34069	Ternhamar 2023	CON_HGI_EX	Exercise	Cycle ergometer	Continuous	30	Vigorous; 70% VO_2max	Fed	Yes	No	None
SF34069	Ternhamar 2023	CON_LGI_REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF34069	Ternhamar 2023	CON_LGI_EX	Exercise	Cycle ergometer	Continuous	30	Vigorous; 70% VO_2max	Fed	Yes	No	None
SF34070	Ueda 2018	LAND	Exercise	Treadmill walking	Continuous	30	Moderate; 50% VO_2peak	Fasted	No	Yes	None
SF34070	Ueda 2018	WATER	Exercise	Treadmill walking	Continuous	30	Moderate; 50% VO_2peak	Fasted	No	Yes	None
SF34071	Ueda SY 2009	HIGH	Exercise	Recumbent ergometer (Strengthergo, Mitsubishi)	Continuous	30	Vigorous; 75% VO_2max	Fed	Yes	Yes	None
SF34071	Ueda SY 2009	MOD	Exercise	Recumbent ergometer (Strengthergo, Mitsubishi)	Continuous	30	Moderate; 50% VO_2max	Fed	Yes	Yes	None
SF34071	Ueda SY 2009	REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF34072	Unick 2010	EX	Exercise	Treadmill walking (3.0 mph, individual grade adjusted)	Continuous	42.3	Moderate; 70-75% age-predicted HRmax	Fed	Yes	Yes	None
SF34072	Unick 2010	REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF34073	Vanderheyden 2020	BICARB	Exercise	Cycle ergometer (Velotron)	Interval	25	High-intensity interval; 90% HRmax	Fed	Yes	No	None
SF34073	Vanderheyden 2020	PLACEBO	Exercise	Cycle ergometer (Velotron)	Interval	25	High-intensity interval; 90% HRmax	Fed	Yes	No	None

Study family	Study	Condition	Role	Exercise mode	Pattern	Duration, min	Intensity	Feeding state	Pre-exercise meal	Post-exercise meal	Other co-intervention
SF34074	Bornath DPD 2023	NW_CTRL	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF34074	Bornath DPD 2023	NW_MICT	Exercise	Cycle ergometer	Continuous	70	Vigorous; 65% VO_2max	Fed	Yes	No	None
SF34074	Bornath DPD 2023	OB_CTRL	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF34074	Bornath DPD 2023	OB_MICT	Exercise	Cycle ergometer	Continuous	70	Vigorous; 65% VO_2max	Fed	Yes	No	None
SF34075	Islam H 2017	CTRL	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF34075	Islam H 2017	MICT	Exercise	Motorized Woodway treadmill	Continuous	40	Moderate	Fed	Yes	No	None
SF34075	Islam H 2017	VICT	Exercise	Motorized Woodway treadmill	Continuous	40	Vigorous	Fed	Yes	No	None
SF34075	Islam H 2017	SIT	Exercise	Self-propelled HiTrainer treadmill	Interval	24	Sprint/supramaximal	Fed	Yes	No	None
SF34076	Matos 2018	CON	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF34076	Matos 2018	MICE	Exercise	Treadmill	Continuous	25	Moderate	Fed	Yes	Yes	None
SF34076	Matos 2018	HIIE	Exercise	Treadmill	Interval	25	High-intensity interval	Fed	Yes	Yes	None
SF34077	Ueda 2009	NW_EX	Exercise	Recumbent ergometer (Strengthergo)	Continuous	60	Moderate; 50% VO_2max	Fed	Yes	Yes	None
SF34077	Ueda 2009	NW_REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF34077	Ueda 2009	OB_EX	Exercise	Recumbent ergometer (Strengthergo)	Continuous	60	Moderate; 50% VO_2max	Fed	Yes	Yes	None
SF34077	Ueda 2009	OB_REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF34079	Bock PM 2022	EX	Exercise	Aerobic; maximal test cycle ergometer, submaximal modality not explicitly restated	Continuous	40	Moderate	Fed	Yes	Yes	None
SF34080	Bornath 2025	CTRL	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF34080	Bornath 2025	MICT	Exercise	Woodway motorized/dynamic treadmill	Continuous	40	Vigorous	Fed	Yes	No	None
SF34080	Bornath 2025	SIT	Exercise	Woodway motorized/dynamic treadmill	Interval	24	Sprint/supramaximal	Fed	Yes	No	None
SF34080	BORNATH 2026	FP	Exercise	Motorized treadmill	Continuous	40	Vigorous; 70% VO_2max	Fed	Yes	No	None
SF34080	BORNATH 2026	OP	Exercise	Motorized treadmill	Continuous	40	Vigorous; 70% VO_2max	Fed	Yes	No	None
SF34080	BORNATH 2026	LP	Exercise	Motorized treadmill	Continuous	40	Vigorous; 70% VO_2max	Fed	Yes	No	None

Study family	Study	Condition	Role	Exercise mode	Pattern	Duration, min	Intensity	Feeding state	Pre-exercise meal	Post-exercise meal	Other co-intervention
SF35430	Chen 2022	SITTING	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF35430	Chen 2022	BREAKS	Exercise	Treadmill walking (6.4 km/h)	Interval	30	Not classifiable	Fed	Yes	Yes	None
SF35432	Deru 2023	REST_FAST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF35432	Deru 2023	EX_FAST	Exercise	Treadmill; individualised speed/grade	Continuous	51.7	Vigorous; 70% HRR	Fed	Yes	No	None
SF35433	Dipietro 2025	RESP	Exercise	Treadmill	Interval	60	High-intensity interval; 80% VO_2peak	Fasted	No	No	None
SF35433	Dipietro 2025	NONRESP	Exercise	Treadmill	Interval	60	High-intensity interval; 80% VO_2peak	Fasted	No	No	None
SF35434	França 2026	SED_PLA	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF35434	França 2026	SED_LEU	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF35434	França 2026	EX_PLA	Exercise	Cycle ergometer	Interval	NR	Sprint/supramaximal	Fed	Yes	No	None
SF35434	França 2026	EX_LEU	Exercise	Cycle ergometer	Interval	NR	Sprint/supramaximal	Fed	Yes	No	None
SF35435	Halliday 2021	REX	Exercise	Wholebody12exercises, namesnotprovided	NR	45	Not classifiable	Fed	Yes	Yes	None
SF35435	Halliday 2021	AEX	Exercise	Treadmill walking	Continuous	45	Moderate	Fed	Yes	Yes	None
SF35435	Halliday 2021	SED	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF34047	Hamilton 2023	SM	Exercise	Cycle ergometer	Continuous	45	Vigorous	Unclear	NR	Yes	None
SF34047	Hamilton 2023	OI	Exercise	Cycle ergometer	Continuous	45	Vigorous	Unclear	NR	Yes	None
SF35437	Kojima C 2019	HYP	Exercise	Electromagnetically braked cycle sprints	Interval	NR	Sprint/supramaximal	Fasted	No	Yes	Hypoxia
SF35437	Kojima C 2019	NOR	Exercise	Electromagnetically braked cycle sprints	Interval	NR	Sprint/supramaximal	Fasted	No	Yes	None
SF35438	Larson-Meyer DE 2012	RUN_EX	Exercise	Treadmill running	Continuous	60	Vigorous	Fed	Yes	Yes	None
SF35438	Larson-Meyer DE 2012	RUN_REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF35438	Larson-Meyer DE 2012	WALK_EX	Exercise	Treadmill walking	Continuous	60	Vigorous	Fed	Yes	Yes	None
SF35438	Larson-Meyer DE 2012	WALK_REST	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF35439	McCarthy 2024	PEC	Exercise	Workload-controlled cycling	Continuous	45	Moderate	Fed	Yes	NR	Drug; supplement

Study family	Study	Condition	Role	Exercise mode	Pattern	Duration, min	Intensity	Feeding state	Pre-exercise meal	Post-exercise meal	Other co-intervention
SF35439	McCarthy 2024	DEC	Exercise	Workload-controlled cycling	Continuous	45	Moderate	Fasted	Yes	NR	Drug; supplement
SF34075	McCarthy S 2026	M	Exercise	Self-propelled Woodway 4Front treadmill	Interval	24	Sprint/supramaximal	Fed	Yes	No	None
SF34075	McCarthy S 2026	*F*	Exercise	Self-propelled Woodway 4Front treadmill	Interval	24	Sprint/supramaximal	Fed	Yes	No	None
SF35441	McCarthy SF 2023	CTRL	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF35441	McCarthy SF 2023	MICT	Exercise	Treadmill	Continuous	40	Moderate	Fed	Yes	No	None
SF35441	McCarthy SF 2023	HIIT	Exercise	Treadmill	Interval	30	High-intensity interval	Fed	Yes	No	None
SF35441	McCarthy SF 2023	SIT	Exercise	Treadmill	Interval	26	Sprint/supramaximal	Fed	Yes	No	None
SF35442	McCarthy 2024	CTRL	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	No	None
SF35442	McCarthy 2024	R30	Exercise	Back squat, bench press, straight-leg deadlift, military press, bent-over row	NR	NR	Low-load resistance	Fed	Yes	No	None
SF35442	McCarthy 2024	R90	Exercise	Back squat, bench press, straight-leg deadlift, military press, bent-over row	NR	NR	High-load resistance	Fed	Yes	No	None
SF35443	Moniz SC 2023	Early-to-mid follicular phase (FP)	Exercise	Motorized treadmill running	Continuous	40	Vigorous	Fed	Yes	No	None
SF35443	Moniz SC 2023	Luteal phase (LP)	Exercise	Motorized treadmill running	Continuous	40	Vigorous	Fed	Yes	No	None
SF35435	Tobin SY 2021	M_AEX	Exercise	Treadmill walking	NR	45	Moderate	Fed	Yes	Yes	None
SF35435	Tobin SY 2021	M_REX	Exercise	12 whole-body exercises	NR	45	Not classifiable	Fed	Yes	Yes	None
SF35435	Tobin SY 2021	M_CON	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF35435	Tobin SY 2021	*F*_AEX	Exercise	Treadmill walking	NR	45	Moderate	Fed	Yes	Yes	None
SF35435	Tobin SY 2021	*F*_REX	Exercise	12 whole-body exercises	NR	45	Not classifiable	Fed	Yes	Yes	None
SF35435	Tobin SY 2021	*F*_CON	Comparator	Rest/no exercise	*N*/A	0	*N*/A	Fed	Yes	Yes	None
SF34080	Tucker JAL 2026	M	Exercise	Motorized treadmill running	Continuous	40	Moderate	Fed	Yes	No	None

Study family	Study	Condition	Role	Exercise mode	Pattern	Duration, min	Intensity	Feeding state	Pre-exercise meal	Post-exercise meal	Other co-intervention
SF34080	Tucker JAL 2026	FP	Exercise	Motorized treadmill running	Continuous	40	Moderate	Fed	Yes	No	None
SF34080	Tucker JAL 2026	LP	Exercise	Motorized treadmill running	Continuous	40	Moderate	Fed	Yes	No	None

Note. Conditions describe individual reports, not independent quantitative comparisons. NR, not reported or not applicable. Quantitative intensity information is retained where available; subgroup classifications are provided in the Profiles and Categories worksheets of Supplementary_Data_and_Code.xlsx. In the Hazell family, the matched 40-min intervention block included warm-up and cool-down. Core exercise lasted 30 min for MICT/HICT and 23 min for SIT (six 30-s sprints with 4-min recoveries); the combined report included 7 min of rest before SIT to match the intervention blocks. Eshghi 2017 used two 90-min bouts; the first-bout exercise-end observation enters the direct acute synthesis with duration coded as 90 min. Later fed and next-day observations retain their separate contexts.

Supplementary Table S4. Outcome domains, constituent measures and synthesis logic

Outcome domain	Constituent measures	Synthesis rationale	Direction in the main analysis	Analytical role
GLP-1	Total GLP-1; active/intact GLP-1; GLP-1(7–36); direct acute, postprandial/challenge, delayed and head-to-head contexts.	All measures quantify endogenous GLP-1 biology. Molecular forms and physiological contexts were retained as prespecified strata rather than pooled indiscriminately.	Positive *g* indicates higher circulating GLP-1; it does not establish appetite suppression.	Primary outcome; temporal profile and postprandial/challenge responses were analysed separately.
PYY	Total PYY; PYY3-36; unspecified PYY.	All are PYY-related satiety peptides. Molecular forms were retained when identifiable.	Positive *g* indicates higher circulating PYY; behavioural effects are evaluated separately.	Mechanistic secondary outcome.
Ghrelin	Acylated ghrelin; total ghrelin; desacylated/unspecified ghrelin retained separately.	Acylated and total ghrelin primarily represent the orexigenic axis and can be direction-harmonised. Desacylated or unspecified forms were not forced into the same biological direction.	Positive *g* indicates lower acylated/total ghrelin; it does not establish a causal effect on eating.	Mechanistic secondary outcome; acylated and total ghrelin were prioritised for direction-harmonised synthesis.
Subjective appetite	Hunger; prospective food consumption; overall/composite appetite; fullness; satiety; satisfaction.	These outcomes reflect subjective appetite or satiety. After direction harmonisation, they could contribute to an umbrella multilevel appetite analysis while individual dimensions remained available separately.	Positive effects indicate stronger appetite suppression or satiety.	Behavioural/subjective secondary outcome.
Energy intake	Ad libitum, total, relative, daily, free-living, absolute and body-mass-normalised energy intake.	All reflect subsequent food intake or compensatory intake behaviour after exercise.	Positive *g* indicates lower measured energy intake, not necessarily reduced total energy compensation.	Behavioural secondary outcome; ad libitum intake was prioritised.
GIP / insulin / glucose / glucagon	GIP, insulin, glucose and glucagon.	These are metabolic or incretin-related biomarkers, but there is no universal beneficial direction for an acute response.	Native direction retained; positive *g* indicates a higher concentration after exercise.	Exploratory metabolic outcomes.
Other mechanistic/metabolic markers	Lactate, IL-6, GDF-15, Lac-Phe, CCK, pancreatic polypeptide, leptin, NEFA/FFA and triglycerides.	Used to characterise candidate mechanisms or metabolic context. Their biological interpretation differs by marker.	Native direction retained.	Exploratory/mechanistic outcomes.

Note. GLP-1, glucagon-like peptide-1; PYY, peptide YY; GIP, glucose-dependent insulinotropic polypeptide; IL-6, interleukin-6; GDF-15, growth differentiation factor 15; Lac-Phe, N-lactoyl-phenylalanine; CCK, cholecystokinin; NEFA/FFA, non-esterified/free fatty acids.

Supplementary Table S5. Direction harmonisation of appetite-related outcomes

Outcome	Original higher value indicates	Target interpretation after harmonisation	Multiplier	Transformed	Notes
GLP-1	Higher GLP-1	Higher circulating GLP-1	+1	No	Original values retained.
PYY / PYY3-36	Higher PYY	Higher circulating PYY	+1	No	Original values retained.
Acylated ghrelin	Higher orexigenic signal	Lower circulating acylated ghrelin	−1	Yes	Location/central-tendency statistics multiplied by −1.
Total ghrelin	Higher total ghrelin	Lower circulating total ghrelin	−1	Yes	Location/central-tendency statistics multiplied by −1.
Desacylated ghrelin	Physiological direction not equivalent to acylated ghrelin	No forced benefit direction	+1	No	Retained separately.
Ghrelin, unspecified	Molecular form cannot be confirmed	No forced benefit direction	+1	No	Retained separately.
Hunger	Greater hunger	Stronger appetite suppression	−1	Yes	Location/central-tendency statistics multiplied by −1.
Prospective food consumption	Greater anticipated food consumption	Stronger appetite suppression	−1	Yes	Location/central-tendency statistics multiplied by −1.
Overall/composite appetite	Greater overall appetite	Stronger appetite suppression	−1	Yes	Location/central-tendency statistics multiplied by −1.
Fullness	Greater fullness	Stronger satiety	+1	No	Original values retained.
Satiety	Greater satiety	Stronger satiety	+1	No	Original values retained.
Satisfaction	Greater satisfaction/satiation	Stronger satiety	+1	No	Original values retained.
Energy intake	Greater energy intake	Lower measured energy intake	−1	Yes	All intake-type location/central-tendency statistics multiplied by −1.

Note. For transformed outcomes, SD, SE, AUC SD and AUC SE were unchanged. IQR and confidence-interval limits were reversed and exchanged after sign transformation. Positive Hedges' *g* denotes higher GLP-1/PYY/fullness/satiety, or lower ghrelin, hunger, prospective food consumption, composite appetite or measured energy intake, according to the outcome. This direction convention does not show that a circulating hormone change caused a subjective or behavioural response. Hormonal, subjective and intake outcomes must be interpreted separately.

Supplementary Table S6. GRADE certainty of evidence for principal GLP-1 and appetite-related outcomes

K denotes independent study families; *E* denotes dependent effect estimates. Participant totals sum each contributing cohort once only when denominators are unambiguous. The seven-person Holliday GLP-1 subset is inferred (†); it is excluded in the focused sensitivity analysis in Table S16. For PYY, denominators vary within a cohort, so a unique participant total is not asserted.

Outcome	*K* / *E*; participants	Hedges' *g* (95% CI)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication / reporting bias	Certainty
Direct acute GLP-1	13 / 52 *n* = 218†	0.54 (0.25 to 0.82)	Serious (−1)	Serious (−1) I^2 = 73.2%	Not serious	Not serious	Serious (−1) Egger *p* = 0.006	Very low
GLP-1, 0–15 min	13 / 22 *n* = 218†	0.45 (0.19 to 0.70)	Serious (−1)	Serious (−1) I^2 = 70.8%	Not serious	Not serious	Serious (−1) Egger *p* = 0.031	Very low
GLP-1, >15–60 min	8 / 18 *n* = 97†	0.58 (0.02 to 1.14)	Serious (−1)	Serious (−1) I^2 = 78.8%	Not serious	Serious (−1)	Serious (−1) Egger *p* = 0.021	Very low
GLP-1, >60–120 min	4 / 12 *n* = 55†	0.71 (−0.33 to 1.75)	Serious (−1)	Serious (−1) I^2 = 77.4%	Not serious	Very serious (−2)	Uncertain; not tested	Very low
Postprandial/challenge GLP-1	6 / 32 *n* = 100†	0.34 (−0.08 to 0.76)	Serious (−1)	Serious (−1) I^2 = 61.6%	Not serious	Serious (−1)	Serious (−1) Egger *p* = 0.009	Very low
Delayed GLP-1 (>6 h)	5 / 44 *n* = 80	0.07 (−0.22 to 0.36)	Serious (−1)	Not serious I^2 = 23.3%	Not serious	Serious (−1)	Uncertain; no additional downgrade Egger *p* = 0.103	Low
PYY	7 / 35 *n* = Not uniquely countable	0.34 (−0.03 to 0.71)	Serious (−1)	Serious (−1) I^2 = 67.5%	Not serious	Serious (−1)	Serious (−1) Egger *p* = 0.032	Very low
Acylated ghrelin suppression	4 / 20 *n* = 94	0.97 (−0.45 to 2.40)	Serious (−1)	Serious (−1) I^2 = 90.4%	Not serious	Very serious (−2)	Uncertain; not tested	Very low
Subjective appetite suppression	10 / 91 *n* = 197	0.45 (0.06 to 0.84)	Serious (−1)	Serious (−1) I^2 = 78.5%	Not serious	Serious (−1)	Serious (−1) Egger *p* = 0.017	Very low
Lower ad libitum energy intake	10 / 16 *n* = 171	0.16 (−0.19 to 0.50)	Serious (−1)	Serious (−1) I^2 = 68.3%	Not serious	Serious (−1)	Uncertain; no additional downgrade Egger *p* = 0.142	Very low

Risk of bias: certainty was downgraded for limitations in the contributing crossover evidence, including incompletely described allocation/sequence methods, period or carryover concerns, and selective-reporting concerns. Counterbalanced/nonrandomized evidence was considered within this domain for mixed bodies of evidence. The starting level for randomized evidence was high; no upgrades were applied. The overall rating is capped at very low, even when more than three downgrade levels accumulate.

Inconsistency: substantial residual heterogeneity and the range of compatible true effects supported downgrading for all principal outcomes except delayed GLP-1. I^2 is descriptive and was not treated as a stand-alone mechanical decision rule. Level-specific I^2 and prediction intervals are reported in Table S15. Indirectness: no additional downgrade was applied for the broad human acute-exercise question; this does not establish applicability to every clinical subgroup or to long-term weight control.

Imprecision: wide intervals spanning negligible and materially different responses, few independent families and small cohorts were considered together. Statistical significance did not preclude an imprecision downgrade: the early GLP-1 and umbrella appetite intervals still range from small/negligible to much larger effects. Very serious imprecision was assigned to the >60–120-min and acylated-ghrelin estimates because their intervals encompass large effects in both directions. No validated clinical minimum important difference is available for these heterogeneous standardised acute hormone outcomes.

Publication/reporting bias: an Egger-type signal raises concern about small-study effects but is not proof of publication bias; heterogeneity can also generate asymmetry. Tests with 5–9 families are exploratory, and tests were not performed with fewer than five families. A nonsignificant or unavailable test does not demonstrate absence of reporting bias. Where no additional downgrade was applied, uncertainty remains. These judgments also consider the limited quantitatively recoverable evidence documented in Table S18.

Supplementary Table S7. Detailed exploratory subgroup analyses for direct acute GLP-1

Estimates use three-level REML with family-cluster CR2/Satterthwaite inference. *P* values are exploratory and nonconfirmatory. *P* between tests the moderator contrast directly; differences in within-subgroup significance do not establish effect modification. Age, BMI and sex composition describe cohorts, not individual-level causal effects. A family can contribute to more than one category, so category *K* values are not additive. NR denotes a multi-parameter HTZ joint *P* value not calculated by the Python implementation; the R code in Supplementary_Data_and_Code.xlsx implements that test. Two-category tests use the single CR2 contrast.

Moderator	Category	*K*	*E*	Hedges' *g* (95% CI)	Nominal *p*	CR2 *df*	I^2 L2, %	I^2 L3, %	*P* between
Cohort mean age	<30 y	9	32	0.56 (0.25 to 0.87)	0.003	7.42	38.1	27.7	0.673
Cohort mean age	≥30 y	6	20	0.49 (−0.16 to 1.14)	0.108	4.77	24.3	56.2	0.673
Cohort sex composition	Female <50%	9	33	0.52 (0.24 to 0.80)	0.003	7.23	31.5	23.4	0.391
Cohort sex composition	Female ≥50%	5	19	0.67 (−0.21 to 1.55)	0.101	3.93	18.1	69.2	0.391
Exercise duration	<45 min	6	35	0.74 (0.36 to 1.11)	0.004	4.95	36.8	24.6	0.059
Exercise duration	≥45 min	7	17	0.26 (−0.17 to 0.68)	0.176	4.82	54.8	22.2	0.059
Cohort mean BMI	BMI <25	7	30	0.60 (0.24 to 0.96)	0.007	5.37	33.2	27.8	0.629
Cohort mean BMI	BMI ≥25	7	21	0.47 (−0.09 to 1.02)	0.083	5.44	39.4	42.6	0.629
Feeding state	Fasted	3	8	0.43 (−0.25 to 1.10)	0.101	1.63	0.0	7.0	0.468
Feeding state	Fed	10	44	0.58 (0.20 to 0.96)	0.007	8.39	37.7	40.4	0.468
Exercise intensity	Low/moderate	9	20	0.37 (0.09 to 0.65)	0.017	6.15	71.7	0.0	0.055
Exercise intensity	Vigorous/high	6	29	0.77 (0.41 to 1.12)	0.003	4.88	31.2	22.0	0.055
Cohort training status	Active/trained	7	31	0.57 (0.20 to 0.93)	0.010	5.59	26.3	36.1	0.853
Cohort training status	Inactive/sedentary	5	19	0.54 (−0.24 to 1.32)	0.126	3.81	34.6	49.5	0.853
Exercise mode	Cycling	6	22	0.68 (0.22 to 1.14)	0.013	4.76	23.2	43.0	0.387
Exercise mode	Weight-bearing locomotor	7	27	0.48 (0.04 to 0.91)	0.036	5.44	42.1	29.8	0.387
Exercise pattern	Continuous/multi-bout	12	33	0.51 (0.24 to 0.77)	0.002	10.09	41.0	27.4	0.178
Exercise pattern	Interval/sprint	5	16	0.84 (0.42 to 1.25)	0.006	3.64	61.5	0.0	0.178
GLP-1 molecular form	Active/intact GLP-1	3	16	0.75 (−0.45 to 1.95)	0.111	1.88	29.0	32.3	0.449
GLP-1 molecular form	Total GLP-1	7	27	0.50 (0.16 to 0.84)	0.011	5.86	31.7	31.8	0.449

Supplementary Table S8. Detailed exploratory subgroup analyses for GLP-1, 0–15 min

Estimates use three-level REML with family-cluster CR2/Satterthwaite inference. *P* values are exploratory and nonconfirmatory. *P* between tests the moderator contrast directly; differences in within-subgroup significance do not establish effect modification. Age, BMI and sex composition describe cohorts, not individual-level causal effects. A family can contribute to more than one category, so category *K* values are not additive. NR denotes a multi-parameter HTZ joint *P* value not calculated by the Python implementation; the R code in Supplementary_Data_and_Code.xlsx implements that test. Two-category tests use the single CR2 contrast.

Moderator	Category	*K*	*E*	Hedges' *g* (95% CI)	Nominal *p*	CR2 *df*	I^2 L2, %	I^2 L3, %	*P* between
Cohort mean age	<30 y	9	13	0.43 (0.05 to 0.80)	0.031	7.85	2.0	64.4	0.678
Cohort mean age	≥30 y	6	9	0.53 (0.01 to 1.05)	0.047	4.33	74.0	0.0	0.678
Cohort sex composition	Female <50%	9	14	0.35 (0.05 to 0.65)	0.028	7.61	0.0	38.9	0.420
Cohort sex composition	Female ≥50%	5	8	0.67 (−0.13 to 1.46)	0.080	3.62	65.0	21.5	0.420
Exercise duration	<45 min	6	12	0.48 (−0.02 to 0.98)	0.055	3.93	57.3	8.4	0.754
Exercise duration	≥45 min	7	10	0.41 (0.02 to 0.81)	0.043	4.94	77.0	0.0	0.754
Cohort mean BMI	BMI <25	7	12	0.48 (0.24 to 0.73)	0.005	4.34	53.1	0.0	0.626
Cohort mean BMI	BMI ≥25	7	9	0.40 (−0.18 to 0.99)	0.137	5.04	82.5	0.0	0.626
Feeding state	Fasted	3	4	0.40 (−0.06 to 0.86)	0.065	1.94	0.0	0.0	0.773
Feeding state	Fed	10	18	0.47 (0.14 to 0.79)	0.012	6.76	76.5	0.0	0.773
Exercise intensity	Low/moderate	9	12	0.48 (0.07 to 0.90)	0.028	7.48	43.6	31.7	0.820
Exercise intensity	Vigorous/high	6	9	0.53 (0.22 to 0.84)	0.009	4.12	49.9	0.0	0.820
Cohort training status	Active/trained	7	13	0.44 (0.10 to 0.78)	0.023	4.31	56.8	0.0	0.924
Cohort training status	Inactive/sedentary	5	7	0.47 (−0.43 to 1.37)	0.209	3.44	78.9	6.1	0.924
Exercise mode	Cycling	6	10	0.60 (0.06 to 1.15)	0.037	3.83	59.1	14.9	0.474
Exercise mode	Weight-bearing locomotor	7	11	0.43 (−0.02 to 0.87)	0.056	5.81	9.0	48.3	0.474
Exercise pattern	Continuous/multi-bout	12	16	0.54 (0.22 to 0.86)	0.004	10.07	51.9	17.9	0.291
Exercise pattern	Interval/sprint	4	5	0.36 (−0.20 to 0.93)	0.126	2.59	57.0	0.0	0.291
GLP-1 molecular form	Active/intact GLP-1	3	6	0.56 (0.14 to 0.97)	0.030	1.85	0.0	0.0	0.311
GLP-1 molecular form	Total GLP-1	7	12	0.34 (−0.08 to 0.76)	0.089	5.18	40.3	28.1	0.311

Supplementary Table S9. Detailed exploratory subgroup analyses for GLP-1, >15–60 min

Estimates use three-level REML with family-cluster CR2/Satterthwaite inference. *P* values are exploratory and nonconfirmatory. *P* between tests the moderator contrast directly; differences in within-subgroup significance do not establish effect modification. Age, BMI and sex composition describe cohorts, not individual-level causal effects. A family can contribute to more than one category, so category *K* values are not additive. NR denotes a multi-parameter HTZ joint *P* value not calculated by the Python implementation; the R code in Supplementary_Data_and_Code.xlsx implements that test. Two-category tests use the single CR2 contrast.

Moderator	Category	*K*	*E*	Hedges' *g* (95% CI)	Nominal *p*	CR2 *df*	I^2 L2, %	I^2 L3, %	*P* between
Exercise duration	<45 min	5	14	0.91 (0.29 to 1.54)	0.016	3.92	0.0	60.9	0.039
Exercise duration	≥45 min	3	4	−0.07 (−1.15 to 1.02)	0.815	1.93	12.4	51.4	0.039
Cohort mean BMI	BMI <25	4	11	0.74 (−0.21 to 1.68)	0.090	2.97	7.0	66.9	0.559
Cohort mean BMI	BMI ≥25	4	7	0.43 (−0.82 to 1.69)	0.351	2.99	0.0	85.0	0.559
Feeding state	Fasted	2	4	0.46 (−1.36 to 2.27)	0.193	1.00	0.0	0.0	0.587
Feeding state	Fed	6	14	0.66 (−0.18 to 1.51)	0.099	4.97	8.1	76.3	0.587
Exercise intensity	Low/moderate	4	4	0.21 (−0.46 to 0.88)	0.387	2.96	0.0	57.3	0.214
Exercise intensity	Vigorous/high	5	13	0.92 (0.25 to 1.59)	0.020	3.90	5.0	59.2	0.214
Cohort training status	Active/trained	4	11	0.74 (−0.21 to 1.68)	0.090	2.97	7.0	66.9	0.559
Cohort training status	Inactive/sedentary	4	7	0.43 (−0.82 to 1.69)	0.351	2.99	0.0	85.0	0.559
Exercise mode	Cycling	3	6	0.68 (−0.81 to 2.16)	0.186	1.98	0.0	70.8	0.815
Exercise mode	Weight-bearing locomotor	5	11	0.61 (−0.26 to 1.49)	0.124	3.97	14.4	67.4	0.815
Exercise pattern	Continuous/multi-bout	7	11	0.47 (0.01 to 0.93)	0.047	5.90	0.0	64.8	0.314
Exercise pattern	Interval/sprint	4	6	1.05 (0.04 to 2.06)	0.045	2.72	45.0	23.2	0.314
GLP-1 molecular form	Active/intact GLP-1	2	7	1.16 (−7.38 to 9.71)	0.334	1.00	21.2	66.4	0.564
GLP-1 molecular form	Total GLP-1	5	9	0.59 (0.08 to 1.10)	0.033	3.87	0.0	51.4	0.564

Supplementary Table S10. Detailed exploratory subgroup analyses for postprandial/challenge GLP-1

Estimates use three-level REML with family-cluster CR2/Satterthwaite inference. *P* values are exploratory and nonconfirmatory. *P* between tests the moderator contrast directly; differences in within-subgroup significance do not establish effect modification. Age, BMI and sex composition describe cohorts, not individual-level causal effects. A family can contribute to more than one category, so category *K* values are not additive. NR denotes a multi-parameter HTZ joint *P* value not calculated by the Python implementation; the R code in Supplementary_Data_and_Code.xlsx implements that test. Two-category tests use the single CR2 contrast.

Moderator	Category	*K*	*E*	Hedges' *g* (95% CI)	Nominal *p*	CR2 *df*	I^2 L2, %	I^2 L3, %	*P* between
Cohort mean age	<30 y	2	8	−0.06 (−2.17 to 2.06)	0.795	1.00	0.0	34.2	0.089
Cohort mean age	≥30 y	4	24	0.49 (−0.09 to 1.06)	0.062	1.23	30.8	0.0	0.089
Cohort sex composition	Female <50%	4	21	0.41 (−0.12 to 0.94)	0.088	2.75	6.2	42.9	0.129
Cohort sex composition	Female ≥50%	3	11	0.32 (−1.29 to 1.94)	0.470	1.93	0.0	84.6	0.129
Exercise duration	<45 min	2	2	0.37 (−8.77 to 9.51)	0.695	1.00	0.0	87.7	0.851
Exercise duration	≥45 min	4	30	0.36 (−0.11 to 0.84)	0.087	2.61	8.3	36.9	0.851
Cohort training status	Active/trained	3	15	0.34 (−0.61 to 1.28)	0.250	1.86	0.0	43.8	0.971
Cohort training status	Inactive/sedentary	3	17	0.37 (−1.23 to 1.97)	0.410	1.90	8.1	77.5	0.971

Supplementary Table S11. Detailed exploratory subgroup analyses for delayed GLP-1 (>6 h)

Estimates use three-level REML with family-cluster CR2/Satterthwaite inference. *P* values are exploratory and nonconfirmatory. *P* between tests the moderator contrast directly; differences in within-subgroup significance do not establish effect modification. Age, BMI and sex composition describe cohorts, not individual-level causal effects. A family can contribute to more than one category, so category *K* values are not additive. NR denotes a multi-parameter HTZ joint *P* value not calculated by the Python implementation; the R code in Supplementary_Data_and_Code.xlsx implements that test. Two-category tests use the single CR2 contrast.

Moderator	Category	*K*	*E*	Hedges' *g* (95% CI)	Nominal *p*	CR2 *df*	I^2 L2, %	I^2 L3, %	*P* between
Cohort mean BMI	BMI <25	4	22	0.04 (−0.41 to 0.49)	0.776	2.92	0.0	33.3	0.246
Cohort mean BMI	BMI ≥25	3	22	0.08 (−0.39 to 0.55)	0.509	1.87	0.0	10.0	0.246
Exercise intensity	Low/moderate	3	38	0.00 (−0.56 to 0.57)	0.982	1.70	0.0	14.2	0.497
Exercise intensity	Vigorous/high	2	6	0.19 (−2.70 to 3.07)	0.560	1.00	0.0	53.9	0.497

Supplementary Table S12. Detailed exploratory subgroup analyses for PYY

Estimates use three-level REML with family-cluster CR2/Satterthwaite inference. *P* values are exploratory and nonconfirmatory. *P* between tests the moderator contrast directly; differences in within-subgroup significance do not establish effect modification. Age, BMI and sex composition describe cohorts, not individual-level causal effects. A family can contribute to more than one category, so category *K* values are not additive. NR denotes a multi-parameter HTZ joint *P* value not calculated by the Python implementation; the R code in Supplementary_Data_and_Code.xlsx implements that test. Two-category tests use the single CR2 contrast.

Moderator	Category	*K*	*E*	Hedges' *g* (95% CI)	Nominal *p*	CR2 *df*	I^2 L2, %	I^2 L3, %	*P* between
Cohort mean age	<30 y	6	22	0.42 (−0.03 to 0.87)	0.062	4.88	25.9	38.3	0.736
Cohort mean age	≥30 y	3	13	0.23 (−0.75 to 1.21)	0.407	1.93	20.1	53.4	0.736
Cohort sex composition	Female <50%	4	19	0.49 (−0.27 to 1.25)	0.132	2.97	20.2	44.8	0.738
Cohort sex composition	Female ≥50%	4	16	0.26 (−0.25 to 0.77)	0.204	2.89	24.8	41.6	0.738
Exercise duration	<45 min	3	21	0.49 (−0.83 to 1.81)	0.252	2.00	10.9	58.9	0.435
Exercise duration	≥45 min	4	14	0.15 (−0.25 to 0.56)	0.265	2.23	43.0	9.9	0.435
Cohort mean BMI	BMI <25	4	22	0.40 (−0.38 to 1.18)	0.202	2.98	11.5	56.8	0.421
Cohort mean BMI	BMI ≥25	4	13	0.17 (−0.32 to 0.66)	0.293	2.19	44.5	13.0	0.421
Exercise intensity	Low/moderate	5	14	0.31 (0.03 to 0.59)	0.036	3.64	0.0	26.5	0.403
Exercise intensity	Vigorous/high	3	17	0.54 (−0.89 to 1.96)	0.247	2.00	14.6	57.5	0.403
Cohort training status	Active/trained	4	23	0.36 (−0.41 to 1.13)	0.231	3.00	2.1	65.7	0.761
Cohort training status	Inactive/sedentary	3	12	0.24 (−0.60 to 1.08)	0.314	1.75	38.4	24.3	0.761
Exercise mode	Cycling	5	18	0.28 (−0.14 to 0.69)	0.139	3.92	6.6	46.1	0.450
Exercise mode	Weight-bearing locomotor	2	13	0.60 (−3.41 to 4.62)	0.308	1.00	0.0	61.9	0.450

Supplementary Table S13. Detailed exploratory subgroup analyses for subjective appetite suppression

Estimates use three-level REML with family-cluster CR2/Satterthwaite inference. *P* values are exploratory and nonconfirmatory. *P* between tests the moderator contrast directly; differences in within-subgroup significance do not establish effect modification. Age, BMI and sex composition describe cohorts, not individual-level causal effects. A family can contribute to more than one category, so category *K* values are not additive. NR denotes a multi-parameter HTZ joint *P* value not calculated by the Python implementation; the R code in Supplementary_Data_and_Code.xlsx implements that test. Two-category tests use the single CR2 contrast.

Moderator	Category	*K*	*E*	Hedges' *g* (95% CI)	Nominal *p*	CR2 *df*	I^2 L2, %	I^2 L3, %	*P* between
Cohort mean age	<30 y	8	61	0.41 (−0.05 to 0.86)	0.071	6.97	13.5	62.9	0.562
Cohort mean age	≥30 y	4	30	0.48 (−0.55 to 1.52)	0.234	3.00	0.0	88.3	0.562
Cohort sex composition	Female <50%	5	36	0.60 (−0.21 to 1.40)	0.110	3.98	18.3	63.2	0.367
Cohort sex composition	Female ≥50%	6	55	0.37 (−0.19 to 0.93)	0.147	4.99	0.0	80.5	0.367
Exercise duration	<45 min	5	42	0.63 (−0.03 to 1.28)	0.057	3.98	28.0	48.6	0.438
Exercise duration	≥45 min	5	49	0.31 (−0.44 to 1.06)	0.314	3.99	0.0	85.4	0.438
Cohort mean BMI	BMI <25	5	43	0.36 (−0.31 to 1.02)	0.209	3.99	18.9	57.2	0.886
Cohort mean BMI	BMI ≥25	6	48	0.48 (−0.16 to 1.12)	0.113	4.99	0.0	85.0	0.886
Exercise intensity	Low/moderate	6	29	0.34 (−0.23 to 0.90)	0.185	4.99	0.0	81.9	0.611
Exercise intensity	Vigorous/high	6	50	0.55 (−0.04 to 1.14)	0.063	4.98	21.6	54.8	0.611
Cohort training status	Active/trained	5	45	0.34 (−0.30 to 0.99)	0.214	3.99	14.9	61.2	0.523
Cohort training status	Inactive/sedentary	5	46	0.58 (−0.22 to 1.37)	0.115	3.99	0.0	85.7	0.523
Exercise mode	Cycling	6	27	0.56 (−0.05 to 1.16)	0.064	4.99	6.6	73.6	0.495
Exercise mode	Weight-bearing locomotor	4	52	0.28 (−0.67 to 1.24)	0.414	3.00	8.4	72.1	0.495
Exercise pattern	Continuous/multi-bout	9	59	0.31 (−0.06 to 0.69)	0.091	7.97	0.0	73.6	0.471
Exercise pattern	Interval/sprint	4	20	0.99 (−0.11 to 2.08)	0.064	2.97	25.2	56.5	0.471

Supplementary Table S14. Detailed exploratory subgroup analyses for lower ad libitum energy intake

Estimates use three-level REML with family-cluster CR2/Satterthwaite inference. *P* values are exploratory and nonconfirmatory. *P* between tests the moderator contrast directly; differences in within-subgroup significance do not establish effect modification. Age, BMI and sex composition describe cohorts, not individual-level causal effects. A family can contribute to more than one category, so category *K* values are not additive. NR denotes a multi-parameter HTZ joint *P* value not calculated by the Python implementation; the R code in Supplementary_Data_and_Code.xlsx implements that test. Two-category tests use the single CR2 contrast.

Moderator	Category	*K*	*E*	Hedges' *g* (95% CI)	Nominal *p*	CR2 *df*	I^2 L2, %	I^2 L3, %	*P* between
Cohort sex composition	Female <50%	6	9	0.36 (−0.27 to 1.00)	0.199	4.96	0.0	75.1	0.473
Cohort sex composition	Female ≥50%	5	7	−0.08 (−0.25 to 0.10)	0.237	2.80	0.0	0.0	0.473
Exercise duration	<45 min	4	6	0.17 (−0.50 to 0.83)	0.474	2.89	0.0	48.8	0.981
Exercise duration	≥45 min	6	10	0.18 (−0.46 to 0.81)	0.501	4.94	0.0	81.1	0.981
Cohort mean BMI	BMI <25	5	7	0.23 (−0.47 to 0.93)	0.410	3.90	0.0	71.1	0.715
Cohort mean BMI	BMI ≥25	7	9	0.04 (−0.18 to 0.27)	0.612	3.65	0.0	0.0	0.715
Cohort clinical status	Clinical	2	4	1.09 (−4.67 to 6.85)	0.252	1.00	0.0	64.3	0.206
Cohort clinical status	Non-clinical	8	12	−0.04 (−0.16 to 0.09)	0.489	4.62	0.0	0.0	0.206
Exercise intensity	Low/moderate	7	9	0.31 (−0.18 to 0.80)	0.176	5.89	0.0	73.5	0.351
Exercise intensity	Vigorous/high	5	6	0.02 (−0.48 to 0.52)	0.917	3.87	0.0	40.3	0.351
Cohort training status	Active/trained	2	3	−0.26 (−0.36 to −0.16)	0.020	1.00	0.0	0.0	0.133
Cohort training status	Inactive/sedentary	8	13	0.26 (−0.16 to 0.68)	0.186	6.82	0.0	71.7	0.133
Exercise mode	Cycling	6	8	0.33 (−0.38 to 1.03)	0.285	4.98	0.0	75.3	0.266
Exercise mode	Weight-bearing locomotor	4	7	0.00 (−0.20 to 0.19)	0.974	2.59	0.0	0.0	0.266

Supplementary Table S15. Complete main-model results and heterogeneity

All 22 outcome models use the family-linked analysis set. *K* is the number of independent study families and *E* is the number of dependent effects. Different models overlap and their *K*/*E* counts are not additive. Positive *g* is an outcome-specific sign convention, not a causal link between hormones and appetite. All estimates use a diagonal sampling-variance matrix in the primary model and family-cluster CR2/Satterthwaite inference.

Model	Outcome	*K*	*E*	Hedges' *g* (95% CI)	*p*	CR2 *df*	I^2 L2, %	I^2 L3, %	Approximate 95% PI
M01	Direct acute GLP-1	13	52	0.54 (0.25 to 0.82)	0.002	11.20	35.2	38.0	−0.61 to 1.69
M02	Direct total GLP-1	7	27	0.50 (0.16 to 0.84)	0.011	5.86	31.7	31.8	−0.53 to 1.54
M03	Direct active/intact GLP-1	3	16	0.75 (−0.45 to 1.95)	0.111	1.88	29.0	32.3	−1.59 to 3.09
M04	GLP-1, 0–15 min	13	22	0.45 (0.19 to 0.70)	0.003	9.12	70.8	0.0	−0.59 to 1.48
M05	GLP-1, >15–60 min	8	18	0.58 (0.02 to 1.14)	0.043	6.96	1.9	77.0	−0.98 to 2.14
M06	GLP-1, >60–120 min	4	12	0.71 (−0.33 to 1.75)	0.118	2.98	0.0	77.4	−1.48 to 2.91
M07	Postprandial/challenge GLP-1	6	32	0.34 (−0.08 to 0.76)	0.091	4.43	7.3	54.2	−0.62 to 1.30
M08	Postprandial/challenge total GLP-1	4	24	0.26 (−0.51 to 1.02)	0.352	2.74	4.1	71.4	−1.29 to 1.80
M09	Postprandial/challenge GLP-1 AUC	3	6	0.04 (−0.49 to 0.58)	0.695	1.58	14.9	0.0	−0.64 to 0.73
M10	Delayed GLP-1 (>6 h)	5	44	0.07 (−0.22 to 0.36)	0.540	3.72	0.0	23.3	−0.51 to 0.65
M11	PYY	7	35	0.34 (−0.03 to 0.71)	0.064	5.90	17.4	50.1	−0.71 to 1.39
M12	PYY3–36	2	4	0.24 (−2.86 to 3.34)	0.504	1.00	0.0	63.3	−4.63 to 5.11
M13	Total PYY	3	21	0.49 (−0.83 to 1.81)	0.252	2.00	10.9	58.9	−2.19 to 3.17
M14	Acylated ghrelin suppression	4	20	0.97 (−0.45 to 2.40)	0.118	2.98	40.4	50.0	−2.71 to 4.66
M15	Total ghrelin suppression	2	10	0.19 (−2.22 to 2.61)	0.493	1.00	32.6	30.4	−4.28 to 4.67
M16	Subjective appetite suppression	10	91	0.45 (0.06 to 0.84)	0.030	8.98	0.0	78.5	−0.81 to 1.70
M17	Hunger suppression	5	30	0.18 (−0.14 to 0.50)	0.194	3.97	0.0	41.1	−0.52 to 0.88
M18	Fullness	3	7	0.11 (−0.30 to 0.52)	0.278	1.43	0.0	0.0	−0.17 to 0.38
M19	Satiety	4	24	0.00 (−0.35 to 0.35)	0.974	2.80	0.0	29.6	−0.63 to 0.64
M20	Prospective food consumption suppression	2	9	0.10 (−3.79 to 3.99)	0.793	1.00	20.4	58.0	−6.87 to 7.08
M21	Composite appetite suppression	4	21	0.94 (−0.12 to 1.99)	0.066	2.99	22.5	55.0	−1.58 to 3.46
M22	Lower ad libitum energy intake	10	16	0.16 (−0.19 to 0.50)	0.331	8.78	0.0	68.3	−0.84 to 1.15

Prediction intervals are approximate random-true-effect intervals calculated as the pooled estimate ± $t(0.975, K - p) \times \sqrt{(SE^2 CR2 + \tau^2 L2 + \tau^2 L3)}$, with *p* equal to the number of fixed-effect parameters (one here). They describe between-setting uncertainty, not an individual participant response. With very few families these intervals are especially unstable. The 0–15-, >15–60- and >60–120-min pools are not one longitudinal cohort; their estimates cannot establish a declining trajectory or the duration of a response.

Supplementary Table S16. Dependence assumptions and inferred-denominator sensitivity analyses

Part A. The diagonal-*V* primary analysis is shown for each principal outcome. The correlated-*V* bridge holds paired $r = 0.50$ fixed and introduces within-family sampling-error correlation $\rho = 0.50$. It isolates the change in covariance weighting from changes in paired-condition correlation. The *r* sensitivities retain $\rho = 0.50$, whereas the ρ sensitivities retain $r = 0.50$. Changing *r* can affect the small-sample correction, sampling variance and resulting weights.

Model	Analysis / assumption	Paired *r*	Working ρ	*K*	*E*	Hedges' *g* (95% CI)	Nominal *p*	CR2 *df*
M01	Primary, diagonal *V*	0.50	0	13	52	0.54 (0.25 to 0.82)	0.002	11.20
M01	Paired $r = 0.30$	0.30	0.50	13	52	0.45 (0.19 to 0.72)	0.003	10.62
M01	Correlated-*V* bridge	0.50	0.50	13	52	0.45 (0.19 to 0.70)	0.003	10.72
M01	Paired $r = 0.70$	0.70	0.50	13	52	0.44 (0.20 to 0.68)	0.002	10.83
M01	Within-family $\rho = 0.30$	0.50	0.30	13	52	0.49 (0.22 to 0.75)	0.002	10.95
M01	Within-family $\rho = 0.70$	0.50	0.70	13	52	0.41 (0.16 to 0.67)	0.004	10.47
M04	Primary, diagonal *V*	0.50	0	13	22	0.45 (0.19 to 0.70)	0.003	9.12
M04	Paired $r = 0.30$	0.30	0.50	13	22	0.45 (0.18 to 0.71)	0.004	10.16
M04	Correlated-*V* bridge	0.50	0.50	13	22	0.44 (0.18 to 0.70)	0.003	10.14
M04	Paired $r = 0.70$	0.70	0.50	13	22	0.43 (0.18 to 0.68)	0.003	10.03
M04	Within-family $\rho = 0.30$	0.50	0.30	13	22	0.44 (0.19 to 0.70)	0.003	9.83
M04	Within-family $\rho = 0.70$	0.50	0.70	13	22	0.44 (0.18 to 0.70)	0.003	10.36
M05	Primary, diagonal *V*	0.50	0	8	18	0.58 (0.02 to 1.14)	0.043	6.96
M05	Paired $r = 0.30$	0.30	0.50	8	18	0.53 (0.01 to 1.05)	0.047	6.85
M05	Correlated-*V* bridge	0.50	0.50	8	18	0.52 (0.02 to 1.01)	0.045	6.86
M05	Paired $r = 0.70$	0.70	0.50	8	18	0.50 (0.02 to 0.97)	0.042	6.87
M05	Within-family $\rho = 0.30$	0.50	0.30	8	18	0.54 (0.02 to 1.06)	0.043	6.91
M05	Within-family $\rho = 0.70$	0.50	0.70	8	18	0.49 (0.01 to 0.98)	0.047	6.80
M06	Primary, diagonal *V*	0.50	0	4	12	0.71 (−0.33 to 1.75)	0.118	2.98
M06	Paired $r = 0.30$	0.30	0.50	4	12	0.68 (−0.42 to 1.79)	0.143	2.95
M06	Correlated-*V* bridge	0.50	0.50	4	12	0.68 (−0.40 to 1.75)	0.138	2.96
M06	Paired $r = 0.70$	0.70	0.50	4	12	0.66 (−0.37 to 1.70)	0.134	2.97
M06	Within-family $\rho = 0.30$	0.50	0.30	4	12	0.69 (−0.37 to 1.75)	0.130	2.97
M06	Within-family $\rho = 0.70$	0.50	0.70	4	12	0.66 (−0.42 to 1.75)	0.147	2.95
M07	Primary, diagonal *V*	0.50	0	6	32	0.34 (−0.08 to 0.76)	0.091	4.43
M07	Paired $r = 0.30$	0.30	0.50	6	32	0.30 (−0.14 to 0.73)	0.129	3.94
M07	Correlated-*V* bridge	0.50	0.50	6	32	0.29 (−0.11 to 0.70)	0.117	4.00

Model	Analysis / assumption	Paired *r*	Working *ρ*	*K*	*E*	Hedges' *g* (95% CI)	Nominal *p*	CR2 *df*
M07	Paired *r* = 0.70	0.70	0.50	6	32	0.28 (−0.09 to 0.65)	0.103	4.02
M07	Within-family *ρ* = 0.30	0.50	0.30	6	32	0.31 (−0.10 to 0.72)	0.107	4.22
M07	Within-family *ρ* = 0.70	0.50	0.70	6	32	0.28 (−0.13 to 0.68)	0.126	3.72
M10	Primary, diagonal *V*	0.50	0	5	44	0.07 (−0.22 to 0.36)	0.540	3.72
M10	Paired *r* = 0.30	0.30	0.50	5	44	0.16 (−0.17 to 0.49)	0.239	3.57
M10	Correlated-*V* bridge	0.50	0.50	5	44	0.16 (−0.14 to 0.46)	0.209	3.63
M10	Paired *r* = 0.70	0.70	0.50	5	44	0.15 (−0.11 to 0.41)	0.169	3.62
M10	Within-family *ρ* = 0.30	0.50	0.30	5	44	0.13 (−0.17 to 0.43)	0.286	3.70
M10	Within-family *ρ* = 0.70	0.50	0.70	5	44	0.18 (−0.13 to 0.49)	0.175	3.69
M11	Primary, diagonal *V*	0.50	0	7	35	0.34 (−0.03 to 0.71)	0.064	5.90
M11	Paired *r* = 0.30	0.30	0.50	7	35	0.22 (−0.06 to 0.50)	0.094	5.00
M11	Correlated-*V* bridge	0.50	0.50	7	35	0.22 (−0.05 to 0.49)	0.092	5.10
M11	Paired *r* = 0.70	0.70	0.50	7	35	0.21 (−0.04 to 0.47)	0.083	5.34
M11	Within-family *ρ* = 0.30	0.50	0.30	7	35	0.27 (−0.03 to 0.58)	0.072	5.68
M11	Within-family *ρ* = 0.70	0.50	0.70	7	35	0.20 (−0.04 to 0.43)	0.090	5.09
M14	Primary, diagonal *V*	0.50	0	4	20	0.97 (−0.45 to 2.40)	0.118	2.98
M14	Paired *r* = 0.30	0.30	0.50	4	20	0.89 (−0.43 to 2.21)	0.122	2.97
M14	Correlated-*V* bridge	0.50	0.50	4	20	0.86 (−0.41 to 2.14)	0.119	2.97
M14	Paired *r* = 0.70	0.70	0.50	4	20	0.82 (−0.38 to 2.03)	0.117	2.95
M14	Within-family *ρ* = 0.30	0.50	0.30	4	20	0.91 (−0.43 to 2.25)	0.119	2.97
M14	Within-family *ρ* = 0.70	0.50	0.70	4	20	0.82 (−0.39 to 2.02)	0.119	2.95
M16	Primary, diagonal *V*	0.50	0	10	91	0.45 (0.06 to 0.84)	0.030	8.98
M16	Paired *r* = 0.30	0.30	0.50	10	91	0.35 (0.01 to 0.68)	0.045	8.74
M16	Correlated-*V* bridge	0.50	0.50	10	91	0.34 (0.01 to 0.66)	0.046	8.79
M16	Paired *r* = 0.70	0.70	0.50	10	91	0.32 (0.00 to 0.63)	0.048	8.82
M16	Within-family *ρ* = 0.30	0.50	0.30	10	91	0.38 (0.03 to 0.73)	0.037	8.90
M16	Within-family *ρ* = 0.70	0.50	0.70	10	91	0.29 (−0.02 to 0.60)	0.061	8.60
M22	Primary, diagonal *V*	0.50	0	10	16	0.16 (−0.19 to 0.50)	0.331	8.78
M22	Paired *r* = 0.30	0.30	0.50	10	16	0.10 (−0.17 to 0.38)	0.404	7.97
M22	Correlated-*V* bridge	0.50	0.50	10	16	0.11 (−0.17 to 0.38)	0.398	8.41
M22	Paired *r* = 0.70	0.70	0.50	10	16	0.10 (−0.16 to 0.37)	0.400	8.64

Model	Analysis / assumption	Paired *r*	Working *ρ*	*K*	*E*	Hedges' *g* (95% CI)	Nominal *p*	CR2 *df*
M22	Within-family $\rho = 0.30$	0.50	0.30	10	16	0.13 (−0.18 to 0.44)	0.361	8.62
M22	Within-family $\rho = 0.70$	0.50	0.70	10	16	0.08 (−0.16 to 0.31)	0.475	7.89

Part B. Focused exclusion of the Holliday 2017 GLP-1 subset, for which $n = 7$ is inferred from individual response descriptions rather than explicitly reported at every point. The eight-person appetite, ghrelin and intake observations are not removed by this denominator-specific sensitivity.

Model	Outcome after excluding inferred-*n* GLP-1 rows	*K*	*E*	Hedges' *g* (95% CI)	Nominal *p*	CR2 *df*
M01	Direct acute GLP-1	12	47	0.49 (0.20 to 0.78)	0.004	10.08
M02	Direct total GLP-1	6	22	0.42 (0.09 to 0.75)	0.023	4.69
M04	GLP-1, 0–15 min	12	21	0.43 (0.17 to 0.70)	0.005	8.52
M05	GLP-1, >15–60 min	7	16	0.48 (−0.11 to 1.06)	0.092	5.97
M06	GLP-1, >60–120 min	3	10	0.65 (−1.21 to 2.50)	0.272	2.00
M07	Postprandial/challenge GLP-1	5	31	0.27 (−0.16 to 0.70)	0.156	3.70
M08	Postprandial/challenge total GLP-1	3	23	0.12 (−0.79 to 1.03)	0.617	1.92

Supplementary Table S17. Complete exploratory meta-regression slope coefficients

All 50 fitted models are represented below (75 slope terms). Linear models were the primary functional form; quadratic models were exploratory. Each model uses complete moderator cases and requires at least seven independent families and three distinct values. With x centred at the reported effect-row mean c, the linear model is $g = \beta_0 + \beta_1(x - c)$; the quadratic model adds $\beta_2(x - c)^2$. Coefficients and 95% CIs use CR2/Satterthwaite inference. β_1 has units *g* per original moderator unit, and β_2 per squared unit. The quadratic β_1 is the slope at c, not a constant overall slope.

Age, BMI, female proportion and fitness are cohort-level characteristics. Their associations do not establish individual causal effects. *P* values are exploratory and nonconfirmatory. A quadratic joint *P* tests both slope terms; the β_2 *P* tests curvature. The models do not establish prescriptive thresholds or response peaks. Time after exercise is distinct from exercise-bout duration. NR denotes a multi-parameter HTZ joint *P* value not calculated by the Python implementation; the R code in Supplementary_Data_and_Code.xlsx implements that test. Individual slope tests and confidence intervals are reported for every fitted model.

Model	Moderator (original unit)	Model / term	*K* / *E*	Centre c	Observed range	*β* (95% CI)	CR2 *df*	Nominal *p*	Joint *p*
M01	Exercise duration (min)	Linear / β_1	13 / 52	38.010	14.00 to 120.00	−0.005335 (−0.013146 to 0.002475)	3.86	0.129	0.129
M01	Exercise duration (min)	Quadratic / β_1	13 / 52	38.010	14.00 to 120.00	−0.009441 (−0.023407 to 0.004525)	6.32	0.151	NR
M01	Exercise duration (min)	Quadratic / β_2	13 / 52	38.010	14.00 to 120.00	0.000097 (−0.000178 to 0.000372)	4.29	0.391	NR
M01	Cohort mean age (years)	Linear / β_1	13 / 52	29.490	20.60 to 68.50	−0.010054 (−0.038468 to 0.018360)	1.66	0.228	0.228
M01	Cohort mean age (years)	Quadratic / β_1	13 / 52	29.490	20.60 to 68.50	−0.015734 (−0.075161 to 0.043694)	7.34	0.554	NR
M01	Cohort mean age (years)	Quadratic / β_2	13 / 52	29.490	20.60 to 68.50	0.000213 (−0.001645 to 0.002071)	7.03	0.794	NR
M01	Cohort mean BMI (kg/m^2)	Linear / β_1	12 / 51	26.320	21.00 to 35.50	−0.012779 (−0.067923 to 0.042365)	3.58	0.541	0.541
M01	Cohort mean BMI (kg/m^2)	Quadratic / β_1	12 / 51	26.320	21.00 to 35.50	−0.001115 (−0.130659 to 0.128429)	3.42	0.981	NR
M01	Cohort mean BMI (kg/m^2)	Quadratic / β_2	12 / 51	26.320	21.00 to 35.50	−0.002333 (−0.021513 to 0.016847)	4.61	0.762	NR
M01	Women in cohort (%)	Linear / β_1	13 / 52	25.593	0.00 to 100.00	0.005352 (−0.012513 to 0.023217)	1.62	0.272	0.272
M01	Women in cohort (%)	Quadratic / β_1	13 / 52	25.593	0.00 to 100.00	0.000253 (−0.014684 to 0.015189)	8.20	0.970	NR
M01	Women in cohort (%)	Quadratic / β_2	13 / 52	25.593	0.00 to 100.00	0.000131 (−0.000202 to 0.000465)	5.16	0.360	NR
M01	Cohort VO_2max/peak (mL/kg/min)	Linear / β_1	9 / 34	46.944	24.20 to 62.80	−0.000032 (−0.035675 to 0.035611)	4.08	0.998	0.998
M01	Cohort VO_2max/peak (mL/kg/min)	Quadratic / β_1	9 / 34	46.944	24.20 to 62.80	−0.004170 (−0.043471 to 0.035131)	2.52	0.736	NR
M01	Cohort VO_2max/peak (mL/kg/min)	Quadratic / β_2	9 / 34	46.944	24.20 to 62.80	−0.000654 (−0.002010 to 0.000702)	3.39	0.236	NR
M01	Time after exercise (min)	Linear / β_1	13 / 52	35.962	0.00 to 120.00	0.002466 (−0.003167 to 0.008099)	5.21	0.315	0.315
M01	Time after exercise (min)	Quadratic / β_1	13 / 52	35.962	0.00 to 120.00	0.003467 (−0.004033 to 0.010967)	7.73	0.316	NR
M01	Time after exercise (min)	Quadratic / β_2	13 / 52	35.962	0.00 to 120.00	−0.000057 (−0.000256 to 0.000142)	4.27	0.478	NR
M04	Exercise duration (min)	Linear / β_1	13 / 22	45.159	14.00 to 120.00	0.000048 (−0.010318 to 0.010414)	2.85	0.989	0.989
M04	Exercise duration (min)	Quadratic / β_1	13 / 22	45.159	14.00 to 120.00	0.002583 (−0.015068 to 0.020234)	6.34	0.735	NR
M04	Exercise duration (min)	Quadratic / β_2	13 / 22	45.159	14.00 to 120.00	−0.000072 (−0.000416 to 0.000271)	4.77	0.607	NR

Model	Moderator (original unit)	Model / term	*K* / *E*	Centre c	Observed range	*β* (95% CI)	CR2 *df*	Nominal *p*	Joint *p*
M04	Cohort mean age (years)	Linear / β_1	13 / 22	31.518	20.60 to 68.50	−0.011402 (−0.032324 to 0.009521)	1.83	0.136	0.136
M04	Cohort mean age (years)	Quadratic / β_1	13 / 22	31.518	20.60 to 68.50	−0.015633 (−0.051238 to 0.019972)	7.05	0.334	NR
M04	Cohort mean age (years)	Quadratic / β_2	13 / 22	31.518	20.60 to 68.50	0.000175 (−0.001168 to 0.001518)	6.10	0.762	NR
M04	Cohort mean BMI (kg/m^2)	Linear / β_1	12 / 21	26.667	21.00 to 35.50	−0.020750 (−0.155740 to 0.114239)	3.17	0.666	0.666
M04	Cohort mean BMI (kg/m^2)	Quadratic / β_1	12 / 21	26.667	21.00 to 35.50	0.001763 (−0.105749 to 0.109275)	3.93	0.966	NR
M04	Cohort mean BMI (kg/m^2)	Quadratic / β_2	12 / 21	26.667	21.00 to 35.50	−0.004925 (−0.026392 to 0.016542)	4.56	0.573	NR
M04	Women in cohort (%)	Linear / β_1	13 / 22	24.885	0.00 to 100.00	0.006363 (−0.008606 to 0.021331)	2.78	0.259	0.259
M04	Women in cohort (%)	Quadratic / β_1	13 / 22	24.885	0.00 to 100.00	0.003086 (−0.011672 to 0.017844)	6.86	0.635	NR
M04	Women in cohort (%)	Quadratic / β_2	13 / 22	24.885	0.00 to 100.00	0.000106 (−0.000324 to 0.000536)	2.88	0.482	NR
M04	Cohort VO_2max/peak (mL/kg/min)	Linear / β_1	9 / 15	44.425	24.20 to 62.80	−0.000037 (−0.044955 to 0.044882)	4.04	0.998	0.998
M04	Cohort VO_2max/peak (mL/kg/min)	Quadratic / β_1	9 / 15	44.425	24.20 to 62.80	−0.001457 (−0.048830 to 0.045916)	3.13	0.930	NR
M04	Cohort VO_2max/peak (mL/kg/min)	Quadratic / β_2	9 / 15	44.425	24.20 to 62.80	−0.000504 (−0.002631 to 0.001624)	3.53	0.531	NR
M05	Exercise duration (min)	Linear / β_1	8 / 18	33.889	14.00 to 60.00	−0.020152 (−0.040883 to 0.000578)	4.23	0.054	0.054
M05	Exercise duration (min)	Quadratic / β_1	8 / 18	33.889	14.00 to 60.00	−0.021206 (−0.063327 to 0.020915)	2.34	0.181	NR
M05	Exercise duration (min)	Quadratic / β_2	8 / 18	33.889	14.00 to 60.00	0.000193 (−0.001713 to 0.002099)	3.99	0.792	NR
M05	Cohort mean age (years)	Linear / β_1	8 / 18	26.644	21.00 to 35.00	−0.025120 (−0.256547 to 0.206307)	2.88	0.748	0.748
M05	Cohort mean age (years)	Quadratic / β_1	8 / 18	26.644	21.00 to 35.00	−0.007241 (−0.184624 to 0.170142)	2.84	0.902	NR
M05	Cohort mean age (years)	Quadratic / β_2	8 / 18	26.644	21.00 to 35.00	−0.005550 (−0.034875 to 0.023774)	4.01	0.627	NR
M05	Cohort mean BMI (kg/m^2)	Linear / β_1	8 / 18	26.256	21.00 to 35.50	−0.019758 (−0.110978 to 0.071462)	2.78	0.526	0.526
M05	Cohort mean BMI (kg/m^2)	Quadratic / β_1	8 / 18	26.256	21.00 to 35.50	−0.009204 (−0.354834 to 0.336427)	2.07	0.922	NR
M05	Cohort mean BMI (kg/m^2)	Quadratic / β_2	8 / 18	26.256	21.00 to 35.50	−0.002122 (−0.051798 to 0.047554)	2.89	0.899	NR
M05	Women in cohort (%)	Linear / β_1	8 / 18	18.519	0.00 to 50.00	−0.004899 (−0.049741 to 0.039942)	3.54	0.767	0.767
M05	Women in cohort (%)	Quadratic / β_1	8 / 18	18.519	0.00 to 50.00	−0.004203 (−0.045541 to 0.037135)	4.84	0.803	NR
M05	Women in cohort (%)	Quadratic / β_2	8 / 18	18.519	0.00 to 50.00	−0.000045 (−0.006220 to 0.006131)	2.14	0.979	NR
M05	Time after exercise (min)	Linear / β_1	8 / 18	42.778	20.00 to 60.00	0.007182 (−0.028300 to 0.042664)	1.91	0.462	0.462
M05	Time after exercise (min)	Quadratic / β_1	8 / 18	42.778	20.00 to 60.00	0.006403 (−0.014464 to 0.027270)	2.12	0.331	NR
M05	Time after exercise (min)	Quadratic / β_2	8 / 18	42.778	20.00 to 60.00	0.000974 (−0.007624 to 0.009573)	1.26	0.508	NR
M16	Exercise duration (min)	Linear / β_1	10 / 91	40.412	14.00 to 60.00	−0.027698 (−0.071808 to 0.016412)	4.78	0.165	0.165
M16	Exercise duration (min)	Quadratic / β_1	10 / 91	40.412	14.00 to 60.00	−0.006469 (−0.064518 to 0.051580)	2.91	0.743	NR

Model	Moderator (original unit)	Model / term	*K* / *E*	Centre c	Observed range	*β* (95% CI)	CR2 *df*	Nominal *p*	Joint *p*
M16	Exercise duration (min)	Quadratic / β_2	10 / 91	40.412	14.00 to 60.00	0.001934 (−0.000298 to 0.004165)	4.37	0.075	NR
M16	Cohort mean age (years)	Linear / β_1	10 / 91	28.676	20.60 to 68.50	−0.000414 (−0.052946 to 0.052118)	1.03	0.940	0.940
M16	Cohort mean age (years)	Quadratic / β_1	10 / 91	28.676	20.60 to 68.50	0.052240 (−0.076391 to 0.180871)	5.68	0.355	NR
M16	Cohort mean age (years)	Quadratic / β_2	10 / 91	28.676	20.60 to 68.50	−0.001596 (−0.005469 to 0.002278)	5.66	0.348	NR
M16	Cohort mean BMI (kg/m^2)	Linear / β_1	10 / 91	27.051	19.80 to 35.50	0.045395 (−0.040383 to 0.131173)	4.34	0.222	0.222
M16	Cohort mean BMI (kg/m^2)	Quadratic / β_1	10 / 91	27.051	19.80 to 35.50	0.040776 (−0.054024 to 0.135576)	3.56	0.286	NR
M16	Cohort mean BMI (kg/m^2)	Quadratic / β_2	10 / 91	27.051	19.80 to 35.50	−0.004078 (−0.022467 to 0.014312)	2.62	0.506	NR
M16	Women in cohort (%)	Linear / β_1	10 / 91	43.718	0.00 to 100.00	0.006767 (−0.034900 to 0.048434)	1.20	0.363	0.363
M16	Women in cohort (%)	Quadratic / β_1	10 / 91	43.718	0.00 to 100.00	0.005058 (−0.006862 to 0.016977)	4.16	0.308	NR
M16	Women in cohort (%)	Quadratic / β_2	10 / 91	43.718	0.00 to 100.00	0.000162 (−0.000262 to 0.000587)	6.49	0.391	NR
M16	Time after exercise (min)	Linear / β_1	10 / 91	43.626	0.00 to 120.00	−0.002817 (−0.009039 to 0.003404)	3.47	0.262	0.262
M16	Time after exercise (min)	Quadratic / β_1	10 / 91	43.626	0.00 to 120.00	−0.003349 (−0.009773 to 0.003074)	4.27	0.226	NR
M16	Time after exercise (min)	Quadratic / β_2	10 / 91	43.626	0.00 to 120.00	0.000040 (−0.000101 to 0.000180)	2.98	0.434	NR
M22	Exercise duration (min)	Linear / β_1	10 / 16	44.594	14.00 to 60.00	0.004141 (−0.020384 to 0.028665)	5.11	0.684	0.684
M22	Exercise duration (min)	Quadratic / β_1	10 / 16	44.594	14.00 to 60.00	0.007436 (−0.028467 to 0.043338)	6.02	0.631	NR
M22	Exercise duration (min)	Quadratic / β_2	10 / 16	44.594	14.00 to 60.00	0.000363 (−0.002028 to 0.002753)	3.00	0.662	NR
M22	Cohort mean age (years)	Linear / β_1	10 / 16	27.956	20.60 to 45.00	−0.015007 (−0.063501 to 0.033486)	2.26	0.343	0.343
M22	Cohort mean age (years)	Quadratic / β_1	10 / 16	27.956	20.60 to 45.00	−0.013311 (−0.068956 to 0.042333)	5.53	0.574	NR
M22	Cohort mean age (years)	Quadratic / β_2	10 / 16	27.956	20.60 to 45.00	−0.000165 (−0.005538 to 0.005207)	2.24	0.915	NR
M22	Cohort mean BMI (kg/m^2)	Linear / β_1	10 / 16	27.125	19.80 to 35.50	−0.001795 (−0.036155 to 0.032565)	4.40	0.895	0.895
M22	Cohort mean BMI (kg/m^2)	Quadratic / β_1	10 / 16	27.125	19.80 to 35.50	−0.001670 (−0.037518 to 0.034178)	3.82	0.902	NR
M22	Cohort mean BMI (kg/m^2)	Quadratic / β_2	10 / 16	27.125	19.80 to 35.50	0.001709 (−0.008122 to 0.011539)	3.87	0.651	NR
M22	Women in cohort (%)	Linear / β_1	10 / 16	30.875	0.00 to 100.00	−0.007750 (−0.018587 to 0.003087)	3.63	0.115	0.115
M22	Women in cohort (%)	Quadratic / β_1	10 / 16	30.875	0.00 to 100.00	−0.009248 (−0.020707 to 0.002211)	7.26	0.098	NR
M22	Women in cohort (%)	Quadratic / β_2	10 / 16	30.875	0.00 to 100.00	0.000068 (−0.000138 to 0.000273)	3.44	0.392	NR

Supplementary Table S18. Complete study-family and report contribution register

The systematic review includes 59 reports from 52 independent study families. Twenty-three families contribute to quantitative synthesis through 23 selected reports. Twenty-nine families (30 reports) do not contribute to the outcome-specific pools. Six further reports are linked publications from contributing families but are not selected numerical sources, giving 36 non-selected reports in total. Noncontribution to a pooled analysis is distinct from exclusion from the systematic review.

Part A. One primary reason is assigned to each wholly noncontributing family. The register links the extracted study characteristics to model membership. Source-selection and measurement details are provided in Table S19.

Reason code	Primary reason for noncontribution to current pools	Families
N1	No compatible matched exercise–rest contrast for the pooled outcomes	19
N2	Unresolved assignment of dispersion and/or post-exercise timing	5
N3	Outcome-specific denominators and/or matching unresolved	2
N4	Available numerical summaries not harmonized to the specified SMD estimand	2
N5	Intermittent-walking/iAUC estimand not represented in the current pools	1

Part B. Family-level register. *P* denotes contribution to at least one model; model codes refer to Table S15. For contributing families, the selected report sources are identified. The reason categories in Part A apply only to wholly noncontributing families.

Family	Included study report(s)	Report ID(s)	Status	Selected sources / model codes	Reason or linkage
SF34036	Alghamdi 2025	R34036	*P*	R34036; M01; M02; M04; M05; M07; M08	Selected source: R34036.
SF34037	Bailey DP 2015	R34037	N1	None	Four exercise conditions compare intensity and hypoxia. No non-exercise condition in the extracted design.
SF34038	Brown 2016	R34038	N1	None	All conditions undertake the same exercise; the contrast is dairy/CHO/water recovery nutrition.
SF34039	Campbell 2015	R34039	N1	None	Both conditions undertake exercise; the contrast is post-exercise meal glycaemic index.
SF34040	Dekker 2010	R34040	N4	None	The extracted GLP-1 results are geometric means with a pooled SEM; arithmetic arm-specific dispersion was not recovered. Numerical AUC estimates with usable uncertainty were not available in the extraction.
SF34041	Douglas 2017	R34041	*P*	R34041; M07; M08; M22	Selected source: R34041.
SF34042	Eshghi 2013	R34042	N3	None	Figure provides GLP-1 means/SEM, but *n*=9 or10 is not allocated to conditions/time points. Exact analysis denominators are absent; exercise comparison is also fixed-order within drug periods.
SF34043	Eshghi 2017	R34043	*P*	R34043; M01; M03; M04; M07; M10	Selected source: R34043.
SF34044	Gil 2025	R34044	N1	None	Exercise before versus after bariatric surgery in the same cohort; no matched rest/no-exercise condition.
SF34045	Gordon 2022	R34045	*P*	R34045; M10	Selected source: R34045.

Family	Included study report(s)	Report ID(s)	Status	Selected sources / model codes	Reason or linkage
SF34046	Hallworth JR 2017; Hazell 2017	R34046; R34048; R34049	*P*	R34049; M01; M02; M04; M06; M11; M13; M16; M17	Selected source: R34049.
SF34047	Hamilton 2020; Hamilton 2023	R34047; R35436	N1	None	Hamilton2020/2023 share participants and recovery-beverage condition. All conditions include exercise; contrasts are recovery nutrition/prebiotic supplementation.
SF34050	Heden TD 2013	R34050	*P*	R34050; M10	Selected source: R34050.
SF34051	Hochsmann 2025	R34051	*P*	R34051; M01; M02; M04; M11; M12; M14; M16; M17; M18	Selected source: R34051.
SF34052	Holliday 2017	R34052	*P*	R34052; M01; M02; M04; M05; M11; M13; M14; M16; M21; M22	Selected source: R34052.
SF34053	Holliday 2017	R34053	*P*	R34053; M01; M02; M04; M05; M06; M07; M08; M14; M16; M21; M22	Selected source: R34053.
SF34054	Howe 2016	R34054	N1	None	Moderate versus high-intensity exercise only; no resting control.
SF34055	Khodabandeh 2024	R34055	*P*	R34055; M01; M02; M04; M05; M09; M11; M12; M15; M16; M21; M22	Selected source: R34055.
SF34057	Li 2023	R34057	*P*	R34057; M01; M04; M11; M16; M18; M19; M22	Selected source: R34057.
SF34058	Maffeis C 2013	R34058	N1	None	Different meals after the same exercise bout; no non-exercise condition.
SF34059	Mandic 2019	R34059	N3	None	A resting condition exists, but GLP-1 blood sample counts vary and are not reported by arm/time. Some conditions also differ in ambient temperature; feeding is ad libitum. Existing data do not establish a complete comparable GLP-1 effect with variance.
SF34060	Mattin 2018	R34060	N2	None	Exercise/rest mean trajectories are extracted, but overlapping GLP-1 and appetite error bars are not assigned reliably; paired numerical effects with usable dispersion are absent.
SF34061	McIver 2019	R34061	N1	None	Fasted versus fed exercise; no non-exercise condition.
SF34062	Numao S 2013	R34062	*P*	R34062; M10	Selected source: R34062.
SF34063	Nyhoff LM 2015	R34063	N2	None	Rest and exercise arms exist, but exact post-exercise offsets are unresolved and post-exercise GLP-1 error bars are unassigned. iAUC was assessed without reported numerical arm estimates.
SF34064	O'Connor 2006	R34064	*P*	R34064; M01; M04; M07	Selected source: R34064.
SF34065	Okada TE 2021	R34065	N1	None	Ketone versus dextrose ingestion with exercise in both conditions; no rest condition.

Family	Included study report(s)	Report ID(s)	Status	Selected sources / model codes	Reason or linkage
SF34066	Reynolds 2025	R34066	N1	None	Collagen-peptide versus placebo supplementation with exercise in both conditions; no rest condition.
SF34067	Shamlan 2017	R34067	N1	None	Two exercise-intensity protocols; no non-exercise comparator.
SF34068	Slater 2025	R34068	N1	None	Different pre-exercise feeding conditions, all followed by exercise; no rest condition.
SF34069	Ternhamar 2023	R34069	*P*	R34069; M09	Selected source: R34069.
SF34070	Ueda 2018	R34070	N1	None	Land versus water exercise in one cohort. The separate immersion-only cohort does not provide a matched resting contrast for that exercise cohort.
SF34071	Ueda SY 2009	R34071	*P*	R34071; M22	Selected source: R34071.
SF34072	Unick 2010	R34072	*P*	R34072; M07; M08; M09	Selected source: R34072.
SF34073	Vanderheyden 2020	R34073	N1	None	Bicarbonate versus placebo before the same interval exercise; no rest condition.
SF34074	Bornath DPD 2023	R34074	N2	None	Rest and exercise arms exist, but GLP-1 SD caps overlap and remain unassigned. Available summary AUC includes the breakfast interval rather than an isolated direct post-exercise window.
SF34075	Islam H 2017; McCarthy S 2026	R34075; R35440	*P*	R34075; M01; M03; M04; M05; M06; M11; M13; M14; M16; M21	Selected source: R34075.
SF34076	Matos 2018	R34076	*P*	R34076; M01; M02; M04; M05; M16; M17; M18; M19; M20; M22	Selected source: R34076.
SF34077	Ueda 2009	R34077	*P*	R34077; M22	Selected source: R34077.
SF34079	Bock PM 2022	R34079	N1	None	Single-group acute exercise study; no resting trial. GLP-1 is reported as medians and quartiles.
SF34080	BORNATH 2026; Bornath 2025; Tucker JAL 2026	R34080; R35429; R35445	*P*	R34080; M01; M03; M04; M05	Selected source: R34080.
SF35430	Chen 2022	R35430	N5	None	The protocol comprises fifteen 2-min walking breaks over 5 h rather than a single exercise-end-aligned bout. Extracted whole-period iAUC estimates and confidence intervals were not combined with total AUC, and time-point uncertainty/alignment remained unresolved.
SF35432	Deru 2023	R35432	*P*	R35432; M10	Selected source: R35432.
SF35433	Dipietro 2025	R35433	N1	None	Weight-loss responders versus nonresponders both perform an exercise challenge; no non-exercise condition.
SF35434	França 2026	R35434	N4	None	The available results are model-adjusted means and confidence intervals rather than the unadjusted arm summaries used in the specified SMD calculation. AUC-like summaries have an unresolved integration definition. These were not converted to raw arm SDs.

Family	Included study report(s)	Report ID(s)	Status	Selected sources / model codes	Reason or linkage
SF35435	Halliday 2021; Tobin SY 2021	R35435; R35444	*P*	R35435; M01; M04; M05; M06; M11; M15; M16; M17; M19; M20; M22	Selected source: R35435.
SF35437	Kojima C 2019	R35437	N1	None	GLP-1 was not measured in the non-exercise condition. Energy-intake information exists for that condition, but meal/exposure timing compatibility with the exercise arms was unresolved in the extraction; no eligible matched comparison was selected.
SF35438	Larson-Meyer DE 2012	R35438	*P*	R35438; M16; M17; M19; M22	Selected source: R35438.
SF35439	McCarthy 2024	R35439	N1	None	Timing of carbohydrate ingestion during otherwise equivalent exercise in type 1 diabetes; no rest condition. Hormone-specific *n* is also unresolved.
SF35441	McCarthy SF 2023	R35441	N2	None	Matched rest/exercise conditions exist, but GLP-1 and appetite trajectory SDs are not recoverable from overlapping caps. Available overall appetite summaries are time-averaged AUC; energy intake is daily food-log intake rather than the pooled ad libitum meal outcome.
SF35442	McCarthy 2024	R35442	N2	None	Matched rest/resistance conditions exist, but trajectory SDs are missing and duration/clock matching is unresolved. Available AUC and daily dietary-log summaries are not the corresponding time-point/ad libitum-meal estimands.
SF35443	Moniz SC 2023	R35443	N1	None	Follicular versus luteal phase comparisons both include exercise; no rest condition.

Part C. Report-to-family assignments for all 59 included reports. A report marked “No” may be a linked secondary publication from a family that contributes through another report.

Report	Family	Study	Report contributes	Family contributes	Model codes	Source selection / noncontribution explanation
R34036	SF34036	Alghamdi 2025	Yes	Yes	M01; M02; M04; M05; M07; M08	Selected numerical report(s): R34036.
R34037	SF34037	Bailey DP 2015	No	No	None	Four exercise conditions compare intensity and hypoxia. No non-exercise condition in the extracted design.
R34038	SF34038	Brown 2016	No	No	None	All conditions undertake the same exercise; the contrast is dairy/CHO/water recovery nutrition.
R34039	SF34039	Campbell 2015	No	No	None	Both conditions undertake exercise; the contrast is post-exercise meal glycaemic index.
R34040	SF34040	Dekker 2010	No	No	None	The extracted GLP-1 results are geometric means with a pooled SEM; arithmetic arm-specific dispersion was not recovered. Numerical AUC estimates with usable uncertainty were not available in the extraction.
R34041	SF34041	Douglas 2017	Yes	Yes	M07; M08; M22	Change-score SEMs are converted to SDs using outcome-specific sample sizes. GLP-1 subsets (n = 18/22) and absolute ad libitum energy-intake cohorts (n = 22/25) are kept distinct.

Report	Family	Study	Report contributes	Family contributes	Model codes	Source selection / noncontribution explanation
R34042	SF34042	Eshghi 2013	No	No	None	Figure provides GLP-1 means/SEM, but *n*=9 or10 is not allocated to conditions/time points. Exact analysis denominators are absent; exercise comparison is also fixed-order within drug periods.
R34043	SF34043	Eshghi 2017	Yes	Yes	M01; M03; M04; M07; M10	The immediate endpoint after the first 90-min bout enters the direct-exercise synthesis. Later outcomes retain their nutritional/delayed contexts. Exercise duration represents the first bout, not the combined 180-min daily volume.
R34044	SF34044	Gil 2025	No	No	None	Exercise before versus after bariatric surgery in the same cohort; no matched rest/no-exercise condition.
R34045	SF34045	Gordon 2022	Yes	Yes	M10	Selected numerical report(s): R34045.
R34046	SF34046	Hallworth JR 2017	No	Yes	None	Overlapping female report; the combined-sex R34049 source was selected for the matched MICT/SIT/control trajectories. Report-specific *n*=9 is not substituted for the *n*=11 female cohort in R34049.
R34048	SF34046	Hazell 2017	No	Yes	None	Overlapping male report; combined report R34049 supplies the selected MICT/SIT/control observations. Additional HICT hormone contrasts have unresolved SD assignments. The distinct HICT hunger contrast is not represented in these pools.
R34049	SF34046	Hazell 2017	Yes	Yes	M01; M02; M04; M06; M11; M13; M16; M17	The combined report (10 men, 11 women) supplies matched MICT/SIT/control trajectories. Matching observations in R34046 and R34048 are not entered a second time. Hormone and hunger estimates digitised from figures are flagged as approximate.
R34047	SF34047	Hamilton 2020	No	No	None	Hamilton2020/2023 share participants and recovery-beverage condition. All conditions include exercise; contrasts are recovery nutrition/prebiotic supplementation.
R35436	SF34047	Hamilton 2023	No	No	None	Hamilton2020/2023 share participants and recovery-beverage condition. All conditions include exercise; contrasts are recovery nutrition/prebiotic supplementation.
R34050	SF34050	Heden TD 2013	Yes	Yes	M10	Selected numerical report(s): R34050.
R34051	SF34051	Hochsmann 2025	Yes	Yes	M01; M02; M04; M11; M12; M14; M16; M17; M18	Selected numerical report(s): R34051.
R34052	SF34052	Holliday 2017	Yes	Yes	M01; M02; M04; M05; M11; M13; M14; M16; M21; M22	Selected numerical report(s): R34052.
R34053	SF34053	Holliday 2017	Yes	Yes	M01; M02; M04; M05; M06; M07; M08; M14; M16; M21; M22	Ghrelin, appetite and intake use $n = 8$. The GLP-1 subset of $n = 7$ is inferred from four male and three female individual profiles and is examined in the inferred-denominator sensitivity analysis.
R34054	SF34054	Howe 2016	No	No	None	Moderate versus high-intensity exercise only; no resting control.

Report	Family	Study	Report contributes	Family contributes	Model codes	Source selection / noncontribution explanation
R34055	SF34055	Khodabandeh 2024	Yes	Yes	M01; M02; M04; M05; M09; M11; M12; M15; M16; M21; M22	Selected numerical report(s): R34055.
R34057	SF34057	Li 2023	Yes	Yes	M01; M04; M11; M16; M18; M19; M22	Selected numerical report(s): R34057.
R34058	SF34058	Maffeis C 2013	No	No	None	Different meals after the same exercise bout; no non-exercise condition.
R34059	SF34059	Mandic 2019	No	No	None	A resting condition exists, but GLP-1 blood sample counts vary and are not reported by arm/time. Some conditions also differ in ambient temperature; feeding is ad libitum. Existing data do not establish a complete comparable GLP-1 effect with variance.
R34060	SF34060	Mattin 2018	No	No	None	Exercise/rest mean trajectories are extracted, but overlapping GLP-1 and appetite error bars are not assigned reliably; paired numerical effects with usable dispersion are absent.
R34061	SF34061	McIver 2019	No	No	None	Fasted versus fed exercise; no non-exercise condition.
R34062	SF34062	Numao S 2013	Yes	Yes	M10	Selected numerical report(s): R34062.
R34063	SF34063	Nyhoff LM 2015	No	No	None	Rest and exercise arms exist, but exact post-exercise offsets are unresolved and post-exercise GLP-1 error bars are unassigned. iAUC was assessed without reported numerical arm estimates.
R34064	SF34064	O'Connor 2006	Yes	Yes	M01; M04; M07	An exercise-end sample preceding the post-exercise drink was eligible for the direct synthesis. Later comparisons were restricted by nutritional context and comparator matching.
R34065	SF34065	Okada TE 2021	No	No	None	Ketone versus dextrose ingestion with exercise in both conditions; no rest condition.
R34066	SF34066	Reynolds 2025	No	No	None	Collagen-peptide versus placebo supplementation with exercise in both conditions; no rest condition.
R34067	SF34067	Shamlan 2017	No	No	None	Two exercise-intensity protocols; no non-exercise comparator.
R34068	SF34068	Slater 2025	No	No	None	Different pre-exercise feeding conditions, all followed by exercise; no rest condition.
R34069	SF34069	Ternhamar 2023	Yes	Yes	M09	Selected numerical report(s): R34069.
R34070	SF34070	Ueda 2018	No	No	None	Land versus water exercise in one cohort. The separate immersion-only cohort does not provide a matched resting contrast for that exercise cohort.
R34071	SF34071	Ueda SY 2009	Yes	Yes	M22	Selected numerical report(s): R34071.
R34072	SF34072	Unick 2010	Yes	Yes	M07; M08; M09	Selected numerical report(s): R34072.
R34073	SF34073	Vanderheyden 2020	No	No	None	Bicarbonate versus placebo before the same interval exercise; no rest condition.

Report	Family	Study	Report contributes	Family contributes	Model codes	Source selection / noncontribution explanation
R34074	SF34074	Bornath DPD 2023	No	No	None	Rest and exercise arms exist, but GLP-1 SD caps overlap and remain unassigned. Available summary AUC includes the breakfast interval rather than an isolated direct post-exercise window.
R34075	SF34075	Islam H 2017	Yes	Yes	M01; M03; M04; M05; M06; M11; M13; M14; M16; M21	Selected numerical report(s): R34075.
R35440	SF34075	McCarthy S 2026	No	Yes	None	Expanded sex-comparison report partly reuses the Islam R34075 male cohort and supplies no additional matched resting trial; its aggregate overlapping data are not entered independently.
R34076	SF34076	Matos 2018	Yes	Yes	M01; M02; M04; M05; M16; M17; M18; M19; M20; M22	Selected numerical report(s): R34076.
R34077	SF34077	Ueda 2009	Yes	Yes	M22	Selected numerical report(s): R34077.
R34079	SF34079	Bock PM 2022	No	No	None	Single-group acute exercise study; no resting trial. GLP-1 is reported as medians and quartiles.
R34080	SF34080	Bornath 2025	Yes	Yes	M01; M03; M04; M05	Selected numerical report(s): R34080.
R35429	SF34080	BORNATH 2026	No	Yes	None	Related menstrual-phase/sex-comparison report with participant overlap and no additional matched resting contrast selected; the family is represented quantitatively by R34080.
R35445	SF34080	Tucker JAL 2026	No	Yes	None	Related menstrual-phase/sex-comparison report with participant overlap and no additional matched resting contrast selected; the family is represented quantitatively by R34080.
R35430	SF35430	Chen 2022	No	No	None	The protocol comprises fifteen 2-min walking breaks over 5 h rather than a single exercise-end-aligned bout. Extracted whole-period iAUC estimates and confidence intervals were not combined with total AUC, and time-point uncertainty/alignment remained unresolved.
R35432	SF35432	Deru 2023	Yes	Yes	M10	Selected numerical report(s): R35432.
R35433	SF35433	Dipietro 2025	No	No	None	Weight-loss responders versus nonresponders both perform an exercise challenge; no non-exercise condition.
R35434	SF35434	França 2026	No	No	None	The available results are model-adjusted means and confidence intervals rather than the unadjusted arm summaries used in the specified SMD calculation. AUC-like summaries have an unresolved integration definition. These were not converted to raw arm SDs.
R35435	SF35435	Halliday 2021	Yes	Yes	M01; M04; M05; M06; M11; M15; M16; M17; M19; M20; M22	Selected numerical report(s): R35435.
R35444	SF35435	Tobin SY 2021	No	Yes	None	Secondary sex-stratified analysis of the Halliday R35435 trial, not a separate independent study. The original pooled report supplies the quantitative records; subgroup denominators differ by outcome.

Report	Family	Study	Report contributes	Family contributes	Model codes	Source selection / noncontribution explanation
R35437	SF35437	Kojima C 2019	No	No	None	GLP-1 was not measured in the non-exercise condition. Energy-intake information exists for that condition, but meal/exposure timing compatibility with the exercise arms was unresolved in the extraction; no eligible matched comparison was selected.
R35438	SF35438	Larson-Meyer DE 2012	Yes	Yes	M16; M17; M19; M22	Selected numerical report(s): R35438.
R35439	SF35439	McCarthy 2024	No	No	None	Timing of carbohydrate ingestion during otherwise equivalent exercise in type 1 diabetes; no rest condition. Hormone-specific *n* is also unresolved.
R35441	SF35441	McCarthy SF 2023	No	No	None	Matched rest/exercise conditions exist, but GLP-1 and appetite trajectory SDs are not recoverable from overlapping caps. Available overall appetite summaries are time-averaged AUC; energy intake is daily food-log intake rather than the pooled ad libitum meal outcome.
R35442	SF35442	McCarthy 2024	No	No	None	Matched rest/resistance conditions exist, but trajectory SDs are missing and duration/clock matching is unresolved. Available AUC and daily dietary-log summaries are not the corresponding time-point/ad libitum-meal estimands.
R35443	SF35443	Moniz SC 2023	No	No	None	Follicular versus luteal phase comparisons both include exercise; no rest condition.

Supplementary Table S19. Data sources and analytical decisions

This table describes source selection, outcome-specific denominators and timing decisions. Processed numerical inputs, uncertainty flags and exact model membership are provided in Supplementary_Data_and_Code.xlsx. Values digitised from figures are approximate.

Source	Selected data	Analytical definition	Relevant qualification
Hazell 2017, Eur J Appl Physiol; SF34046 / R34049; doi:10.1007/s00421-017-3547-7	The combined report provides 10 men and 11 women and is selected once for overlapping MICT/SIT/control GLP-1, PYY and hunger contrasts.	Eight contrasts per outcome cover two exercise protocols, two sex strata and two sampling times (exercise end and 90 min). Figure error bars are SD.	The report shares participants with Hallworth 2017 and the male-only Hazell report. The female stratum of 11 differs from the earlier female-only report of 9. Means and SDs derived from figures remain approximate.
Hazell family: timing and protocol coverage	Hormone changes use the pre-exercise baseline; hunger changes use the pre-breakfast baseline. A standardised breakfast preceded exercise, with no additional meal before the 90-min sample.	Core exercise duration is 30 min for MICT and 23 min for SIT, excluding warm-up, cool-down and time-matching rest.	The earlier male-only HICT arm is distinct from the selected MICT/SIT arms. HICT hormone SDs remain unresolved and its separate hunger data are not represented in these pools. Figure 3 and Table 1 absolute values were not mixed; common within-figure units cancel in the SMD.
Douglas 2017; SF34041 / R34041; doi:10.1038/ijo.2017.181	Fed GLP-1 observations use outcome-specific subsets of 18 lean and 22 overweight/obese participants. Absolute buffet intake uses complete cohorts of 22 and 25.	Control/exercise intake means (SD), kJ: lean 3183 (1389) / 3062 (1730); overweight/obese 3465 (1572) / 3542 (1791).	Relative energy intake is a different estimand and was not substituted for absolute ad libitum intake.
Holliday 2017; SF34053 / R34053; doi:10.3390/nu9040362	Eight participants contribute to ghrelin, appetite and intake. The GLP-1 subset is inferred as seven from individual response descriptions.	Text summaries use mean/SD. Trajectory-figure SEMs are converted to SD using the outcome denominator. Body-text appetite values are used at 0 and 30 min.	The inferred GLP-1 denominator is flagged and examined in Table S16 Part B. The buffet begins 120 min after exercise; the 150-min GLP-1 sample is postmeal.
Eshghi 2017; SF34043 / R34043	First-bout exercise-end active-GLP-1 contrasts are included for healthy and type 2 diabetes cohorts.	Duration is the first 90-min bout, rather than the combined 180-min daily exercise volume.	The later bout occurred in a different fed context. Healthy participants used no glucose-lowering medication; metformin was withheld in the diabetes test conditions.
O'Connor 2006; SF34064 / R34064	The matched exercise-end GLP-1 contrast before administration of the recovery drink is included in the direct acute pool.	Later nutrient-challenge observations are assigned to the postprandial/challenge pool.	Pre-drink and post-drink observations represent different physiological contexts.

Source	Selected data	Analytical definition	Relevant qualification
Matos 2018; SF34076 / R34076	Raw-concentration observations from Figure 3A are selected for the matched exercise–rest contrasts.	Percentage-transformed representations of the same observations in Figure 3B are not counted again.	Each underlying comparison contributes once to an applicable outcome model.
Delayed GLP-1 (M10)	Forty-four delayed observations from five families are included.	Eligibility is determined from observation-level timing (>6 h), rather than a report-level label. Next-day nutrient-challenge and prolonged-fasting contexts are retained as delayed observations.	These observations are not a common longitudinal continuation of the direct-recovery cohorts and do not establish when the initial response ended.

Supplementary Table S20. Registered analysis plan and implementation

The registered analysis plan is PROSPERO CRD420261506079, version 1.0, registered on 14 September 2026. The table distinguishes retained specifications from additional operational decisions and implementation differences.

Item	Registered analysis plan	Implementation	Explanation
Review question and eligibility	Human acute structured exercise; randomized and nonrandomized designs; endogenous GLP-1; exercise–rest contrasts primary and head-to-head exercise evidence separate.	The population, intervention, comparator framework and outcome hierarchy were retained.	PROSPERO CRD420261506079.
Database coverage	CENTRAL, CNKI, Embase, PubMed, SCIE and SSCI.	PubMed, Embase, Cochrane Library, Web of Science Core Collection, CNKI and SPORTDiscus.	SPORTDiscus was added. SCIE and SSCI are Web of Science indexes. Full strategies and search dates are in Table S1.
Additional identification routes	Author/expert contact, backward/forward citations, conference proceedings, theses/dissertations and study registers.	The completed review reports the six database searches detailed in Table S1.	No separate retrieval yield is reported for the other planned identification routes.
Effect sizes and multilevel inference	Hedges' g; crossover SMCRP; paired $r = 0.50$ with $r = 0.30/0.70$ sensitivity; three-level REML; family-cluster CR2/Satterthwaite.	These principal specifications were retained. The primary sampling-variance matrix is diagonal, with correlated sampling matrices examined in sensitivity analyses.	Table S16 distinguishes the covariance bridge from changes in paired r.
GLP-1 contexts and recovery windows	Direct responses in the first 120 min before subsequent caloric intake; postprandial/challenge and delayed >6-h contexts separate.	Context separation was retained; estimable recovery windows were pooled separately.	Time-window comparisons involve different sets of families and do not themselves establish response duration.
Head-to-head exercise comparisons	Eligible head-to-head comparisons were to be analysed separately from exercise–rest contrasts.	Head-to-head evidence is described qualitatively; a separate common-estimand meta-analysis is not reported.	Contrasts were heterogeneous and compatible numerical inputs were insufficient. No head-to-head ranking is claimed.
Moderator analysis	Participant and exercise modifiers; regression at ≥7 families and ≥3 distinct values; linear primary and quadratic exploratory.	Regression criteria were retained. Binary cutoffs were age 30 years, BMI 25 kg/m^2, duration 45 min and female proportion 50%. Subgroups required ≥5 families overall and ≥2 per category.	Binary cutoffs and subgroup minima are exploratory operational specifications, not registered thresholds.
Within-family covariance	Sensitivity analyses using alternative within-family correlations; numerical ρ values not specified.	Working ρ values of 0.30, 0.50 and 0.70 were used.	These values implement the broader registered sensitivity plan. The $\rho = 0.50$ bridge is distinct from the diagonal-V primary analysis.
Risk of bias and certainty	RoB 2, ROBINS-I and outcome-level GRADE.	The specified tools were retained. Report-level assessment counts correspond to the 59 included reports, clustered within 52 families.	GRADE judgments apply to the evidence contributing to each pooled outcome.