Lifestyle Interventions to Prevent Type 2 Diabetes in Women with A History of Gestational Diabetes: A Systematic Review and Meta-Analysis Through the Lens of Health Equity

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Outline:

Table S1. Search Strategy (MEDLINE)

#	Query
1	Diabetes, Gestational/
2	gestational diabetes.mp.
3	gestational diabetes mellitus.mp.
4	GDM.mp.
5	1 or 2 or 3 or 4
6	Diabetes Mellitus, Type 2/
7	Glucose Intolerance/
8	diabetes.mp.
9	diabetes mellitus.mp.
10	type 2 diabetes.mp.
11	type 2 diabetes mellitus.mp.
12	non-insulin dependent diabetes mellitus.mp.
13	NIDDM.mp.
14	impaired fasting glucose.mp.
15	IFG.mp.
16	Impaired glucose tolerance.mp.
17	IGT.mp.
18	maternal complication*.mp.
19	6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18
20	lifestyle.ab,ti.
21	behavio?r.ab,ti.
22	Diet*.ab,ti.
23	"diet reduce*".ab,ti.
24	"diet restricted*".ab,ti.
25	"nutriti*".ab,ti.
26	"educat*".ab,ti.
27	"exercis*".ab,ti.
28	"physical activit*".ab,ti.
29	20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28
30	"therap*".ab,ti.
31	"intervention*".ab,ti.
32	30 or 31
33	29 and 32
34	5 and 19 and 33

*= truncation

Table S2. Risk of bias assessment

a) **Risk of bias of the included RCT studies**

Study	Randomization process	Deviations from intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result	Overall Bias
Cheung 2011[58]	Some concerns	High	High	Some concerns	Some concerns	High
Cheung 2019/2022 [32, 59]	Some concerns	High	Low	Low	Low	High
Ferrara 2011[48]	Some concerns	Low	High	Low	Low	High
Hu 2012;[35] Liu 2018[61]	Low	Low	Low	Low	Some concerns	Some concerns
Kim 2012[63]	Some concerns	Low	Low	Low	Low	Some concerns
Lim 2021[41]	Low	Low	Low	Low	Low	Low
McIntyre 2012[68]	Low	Low	Low	Low	Low	Low
McManus 2018;[51] Barton 2019[69]	Some concerns	High	Low	Low	Low	High
Nicklas 2014[52]	Low	High	Low	Low	Some concerns	High
O'Dea 2015[54]	Low	Low	High	Low	Low	High
O'Reilly 2916/2019[33, 71]	Low	High	Low	Low	Low	High
Peacock 2015[53]	Low	High	High	Low	Some concerns	High
Perze-Ferre 2015[72]	Some concerns	High	Low	Low	Some concerns	High
Ratner 2008;[67] Aroda 2015;[66] Man 2021[47]	Low	Low	Low	Low	Low	Low
Reinhardt 2012[44]	Some concerns	High	Low	Some concerns	Some concerns	High
Rollo 2020[29]	Some concerns	High	High	Low	Some concerns	High
Shek 2014[74]	High	High	Low	Low	Some concerns	High
Sheng 2012[75]	Some concerns	High	Low	Some concerns	Low	High
Shyams 2013/2015[76, 77]	Low	Low	Low	Low	Some concerns	Some concerns
Smith 2014[55]	Some concerns	Low	High	Low	Some concerns	High

Tandon 2022[38]	Low	Low	Low	Low	Low	Low
Wien 1999[78]	Some concerns	High	Low	Low	Some concerns	High
Yu Xiao 2012[79]	Some concerns	High	Low	Some concerns	Low	High
Zilberman K. 2018[80]	High	High	Low	Low	Some concerns	High

b) Risk of bias of the included cluster-RCT studies

Study	Randomization process	Identification or recruitment of participants	Deviations from intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result	Overall Bias
Ferrara 2016[60]	Low	Low	Low	Low	Low	Low	Low
Guo 2021[43]; Chen 2022[45]; Zhong 2023[46]	Low	Low	Some concerns	Low	Low	Low	Some concerns
Holmes 2018[50]	Some concerns	Low	Low	High	Low	Some concerns	High
Lee 2022[65]	Low	Some concerns	High	High	Low	Low	High
Li 2021[40]	Low	Some concerns	Low	High	High	Low	High
Potzel 2022[56]	High	High	Low	Low	Some concerns	Some concerns	High

b) Risk of bias of the included non-RCT studies

Study	Confounding	Selection of participants	Classification of interventions	Deviations from intended interventions	Missing data	Measurement of outcomes	Selection of the reported result	Overall Bias
Kim 2021[64]	Low	Low	Low	Moderate	Moderate	Moderate	Low	Moderate
Geng 2014[49]	Serious	Moderate	Low	Moderate	Low	Low	Moderate	Serious

d) Quality assessment of the included single-arm studies

NOS criteria	Kapoor 2018	McCurley 2017	Brazeau 2014	Brokaw 2017	Philis-Tsimikas 2014	Lim 2017	Nicholson 2016	Rautio 2014
A. Selection (maximum of four stars)								
1. Representativeness of the exposed cohort	*	*	*	*	*	*	*	*
2. Selection of the non-exposed cohort								
3. Ascertainment of exposure		*			*	*	*	
4. Demonstration that outcome of interest was not present at the start of study	*	*	*	*	*	*	*	*
B. **Comparability (maximum of two stars)**								
1. Comparability of the cohort on the basis of the design or analysis	*			*	*	*		
C. Outcome (maximum of three stars)								
1. Assessment of outcome					*	*	*	*
2. Was follow-up long enough for outcomes to occur	*	*		*	*		*	*
3. Adequacy of follow-up of cohorts	*			*	*	*	*	
Total (maximum of nine stars)	5	4	2	5	7	6	6	4
The overall quality	Fair	Poor	Poor	Fair	Good	Fair	Fair	Poor

Note: * = Number of stars—Good Quality: 7-8 stars/points; Fair Quality: 5-6 stars /points; Poor Quality: 0 to 4 stars/points

e) Summary of risk of bias in RCT studies

Randomization process	Deviations from intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result	Overall Bias
Low= 14	Low = 13	Low = 20	Low = 24	Low = 16	Low =5
Some concerns = 13	Some concerns = 2	Some concerns = 0	Some concerns = 4	Some concerns = 13	Some concerns = 4
High = 3	High = 14	High = 9	High = 1	High = 0	High = 21

f) Summary of all risk of bias assessment results

	Summary	
RCT (Risk of bias)	**Non-RCT (Risk of bias)**	**Single-arm studies (Quality)**
Low = 5	Moderate = 1	Poor = 3
Some concerns = 4	Serious = 1	Fair = 4
High = 21		Good =1
Total=30	**Total =2**	**Total = 8**

Table S3. Subgroup analyses of the effect of lifestyle intervention in women with a history of gestational diabetes on incidence of T2DM by PROGRESS[a] framework

Analyses	Studies	Participants	Relative risk (95% CI)	I²	*p*-value for subgroup difference
Country					0.56
High-income	6	848	0.69 [0.49, 0.96]	10.4	
Middle-income	8	3220	0.79 [0.56, 1.11]	37.1	
Continent					0.22
Asia	8	3220	0.79 [0.56, 1.11]	37.1	
Australia	2	227	0.97 [0.62, 1.53]	0.0	
Europe	1	237	0.65 [0.31, 1.35]	NA	
North America	3	384	0.51 [0.33, 0.79]	0.0	
Educational status[b]					0.29
Mostly without tertiary education	1	332	0.17 [0.75, 1.85]	NA	
Mostly with tertiary education	6	2384	0.88 [0.66, 1.18]	0.0	
Income level[c]					0.34
Average or above:	2	172	0.17 [0.02, 1.39]	0.0	
Below average	3	611	0.261[0.13, 2.83]	0.0	

[a] PROGRESS (Place of Residence, Race/ethnicity/culture/language, Occupation, Gender/sex, Religion, Education, Socioeconomic status, and Social)

[b] Only seven studies reported educational status.

[c] Mean income level for the country during the same year in which the study was conducted was taken as a cut-off point; NA: Not applicable.

Note: Subgroup analysis for ethnicity, gender, religion and social capital could not be performed (Ethnicity: studies that report on ethnicity included a range of mixed ethnicity and were not mutually exclusive. Religion and social capital: not reported; Gender NA). No studies were from low-income countries, Africa, South America, or the Pacific.

Table S4. Subgroup analyses of the effect of lifestyle intervention in women with a history of gestational diabetes on bodyweight by PROGRESS[a] framework

Analyses	Studies	Participants	Mean difference, kg (95% CI)	I^2	p-value for subgroup difference
Place of residence					
Country					0.04
High-income	15	2779	−1.46 [−2.27, −0.66]	70.46	
Middle-income	6	2610	−0.11[−1.12, 0.89]	69.31	
Continent					0.49
Asia	8	2833	−0.31[−1.31, 0.69]	63.49	
Australia	7	622	−1.23[−2.17, −0.30]	49.90	
Europe	2	81	−1.97[−7.22, 3.28]	79.35	
North America	4	1853	−1.46[−3.17, 0.24]	82.87	
Educational status[b]					0.91
Mostly without tertiary education	2	402	−0.94[−3.86, 1.98]	0.0	
Mostly with tertiary education	11	2959	−1.11[−2.15, −0.07]	87.57	
Ethnicity[c]					0.11
East Asian	4	753	−0.43[−2.07, 1.22]	88.42	
Middle Eastern	1	104	−3.57[−9.80, −2.66]	NA	
South Asian	1	1601	0.00 [−1.74, 1.74]	NA	
White	2	133	−2.34[−3.66, −1.02]	38.81	
Income level[d]	4				0.11
Average or above:	5	677	−1.83[−2.94, −0.73]	72.91	
Below average	3	664	−0.07[−1.93, 1.80]	89.99	

[a] PROGRESS (Place of Residence, Race/ethnicity/culture/language, Occupation, Gender/sex, Religion, Education, Socioeconomic status, and Social)

[b] Thirteen studies reported educational status.

[c] Studies that did not report on ethnicity and those with mixed ethnicity were excluded. East Asian: three studies from China and one from South Korea. White: two from Ireland and two from Australia. South Asian: from India and Middle Eastern from Israel, including Jews and Bedouins.

[d] Mean income level for the country during the same year in which the study was conducted was taken as a cut-off point; Not applicable.

Note: subgroup analysis for gender, religion and social capital, could not be performed (Religion and social capital: not reported; Gender NA). There were no studies from low-income country, Africa, South America or the Pacific.

Table S5. Subgroup analyses of the effect of lifestyle intervention in women with a history of gestational diabetes on BMI by PROGRESS[a] framework

Analyses	Studies	Participants	Mean difference, kg (95% CI)	I²	p-value for subgroup difference
Country					0.28
High-income	10	527	−0.60[−1.07, −0.13]	42.06	
Middle-income	5	1059	0.26[−1.23, 1.75]	98.90	
Continent					0.91
Asia	6	1163	0.02[−1.38, 1.42]	98.66	
Australia	4	129	−0.44[−1.13, 0.25]	34.14	
Europe	2	80	−0.67[−2.52, 1.18]	75.69	
North America	3	214	−0.55[−1.59, 0.48]	68.78	
Educational status[b]					0.31
Mostly without tertiary education	1	104	−1.61[−3.87, 0.65]	NA	
Mostly with tertiary education	8	1189	−0.40[−1.00, 0.21]	88.87	
Ethnicity[c]					0.19
East Asian	4	982	0.65[−0.95, −2.25]	99.15	
Middle Eastern	1	104	−1.61[−3.87, 0.65]	NA	
White	3	103	−0.79[−1.66, −0.07]	0.0	
Income level[d]					0.64
Average or above:	4	1041	−0.48[−1.16, 0.19]	58.07	
Below average	3	312	−0.14[−1.44, 1.16]	91.35	

[a] PROGRESS (Place of Residence, Race/ethnicity/culture/language, Occupation, Gender/sex, Religion, Education, Socioeconomic status, and Social)

[b] Eight studies reported educational status.

[c] Studies that did not report on ethnicity and those with mixed ethnicity were excluded. East Asian: All from China. White: two from Ireland and one from Australia. Middle Eastern from Israel, including Jews and Bedouins.

[d] Mean income level for the country during the same year in which the study was conducted was taken as a cut-off point; Not applicable.

Note: subgroup analysis for gender, religion and social capital, could not be performed (Religion and social capital: not reported; Gender NA). There was no study from low-income country, Africa, South America or the Pacific.

Figure S1. Funnel plots for publication bias of studies testing the effect of lifestyle intervention on Type 2 diabetes and body weight
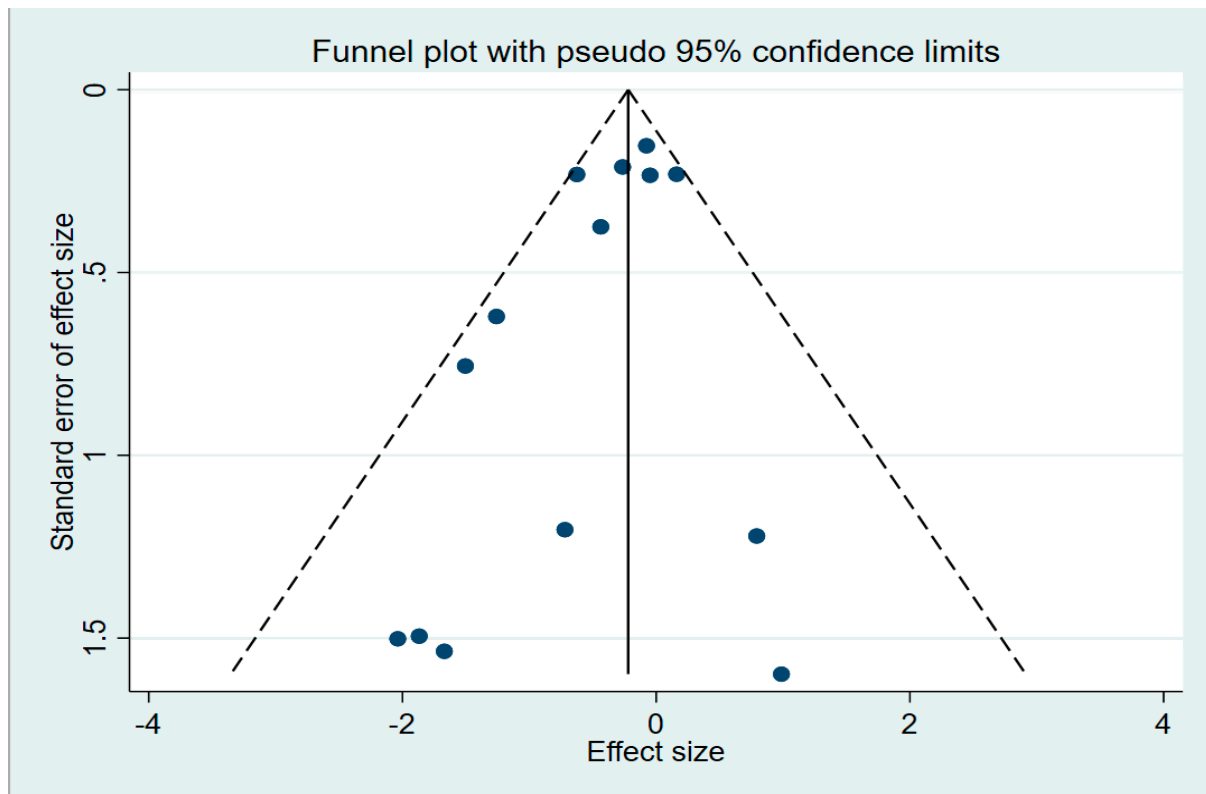
A) Type 2 diabetes: Egger's test P = 0.090

Funnel plot
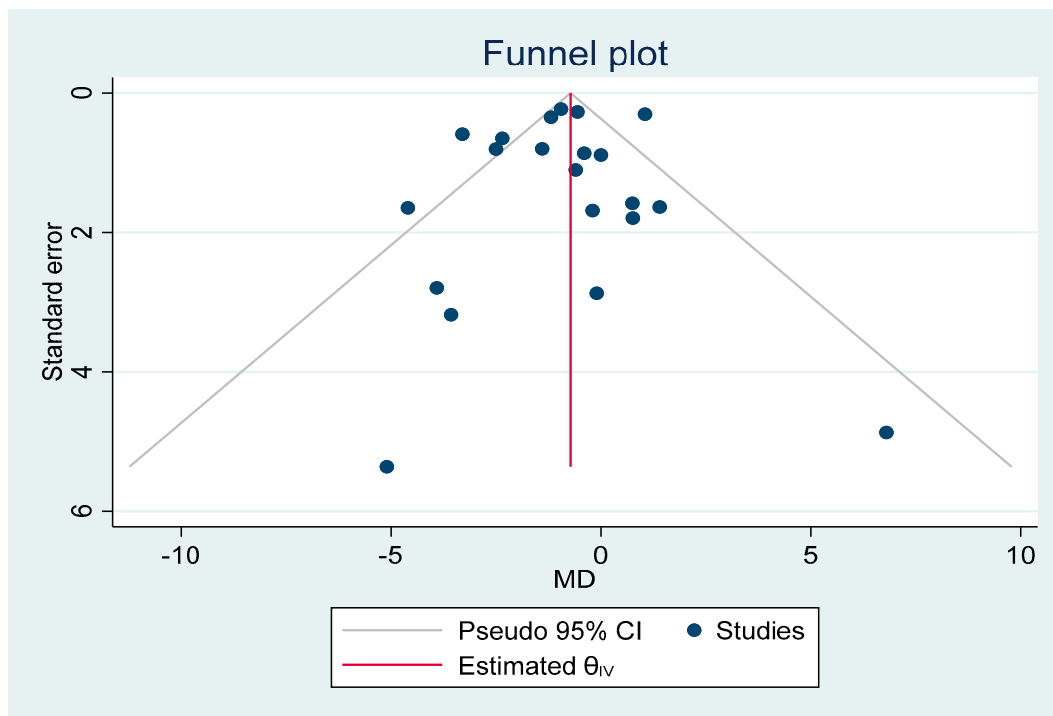
B) Body weight: Egger's test P = 0.995
Figure S2. Forest plots

Study ID	RR (95% CI)	% Weight (DL)
HIC		
Cheung 2011	2.68 (0.12, 61.58)	0.58
McManus 2018	0.19 (0.01, 3.82)	0.62
Wein 1999	0.95 (0.60, 1.51)	14.65
Man 2021; Aroda 2015	0.54 (0.34, 0.84)	14.80
Nicklas 2014	0.15 (0.01, 2.89)	0.66
Perez-Ferre 2015	0.65 (0.31, 1.35)	7.98
DL Subtotal (I^2 = 10.4%)	0.69 (0.49, 0.96)	39.29
MIC		
Geng 2014	0.22 (0.05, 0.98)	2.43
Hu 2012; Liu 2018	2.21 (0.20, 24.16)	0.98
Lee 2022	1.17 (0.75, 1.85)	14.85
Sheng 2012	0.13 (0.01, 2.48)	0.65
Tandon 2022	0.93 (0.69, 1.25)	21.07
Yu Xiao 2012	0.28 (0.08, 0.96)	3.48
Shyam 2013/2015	0.49 (0.05, 5.15)	1.01
Shek 2014	0.77 (0.51, 1.16)	16.25
DL Subtotal (I^2 = 37.1%)	0.79 (0.56, 1.11)	60.71
DL Overall (I^2 = 28.8%)	0.76 (0.59, 0.96)	100.00

NOTE: Weights are from random effects analysis

.00687   1   146

Figure S2.1. The effect of lifestyle intervention on T2DM by country according to the World Bank classification (subgroup differences: p-value=0.556)[35, 38, 47, 49, 51, 52, 58, 65, 72, 74-79].
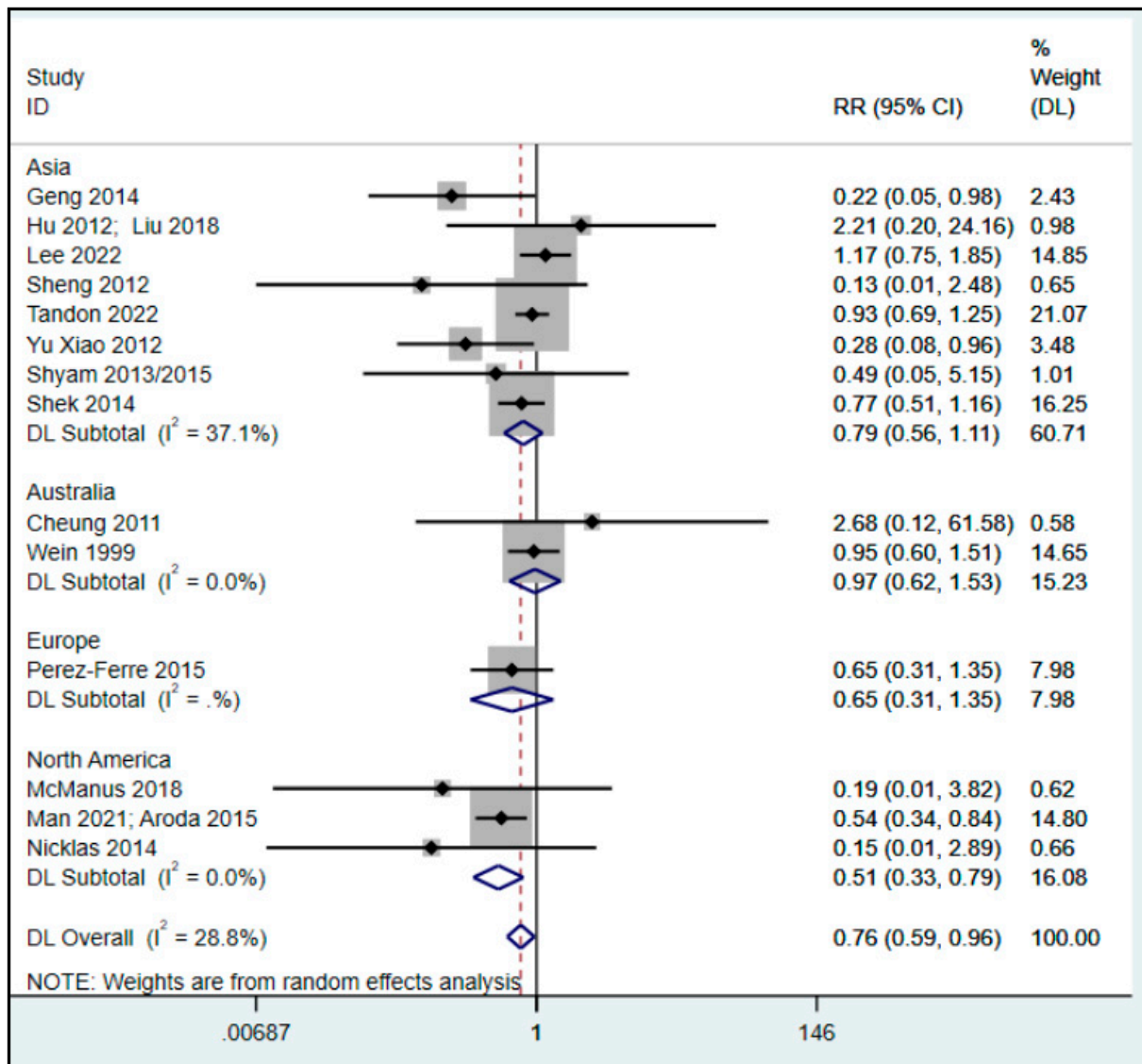
Figure S2.2. The effect of lifestyle intervention on T2DM by continent (subgroup differences: p-value=0.219) [35, 38, 47, 49, 51, 52, 58, 65, 72, 74-79].

Figure S2.3. The effect of lifestyle intervention on T2DM by educational status. (subgroup differences: p-value=0.298) [35, 38, 51, 52, 61, 65, 75-77].

Figure S2.4. The effect of lifestyle intervention on T2DM by income. (subgroup differences: p-value=0.336) [35, 38, 51, 52, 61, 65, 75-77].

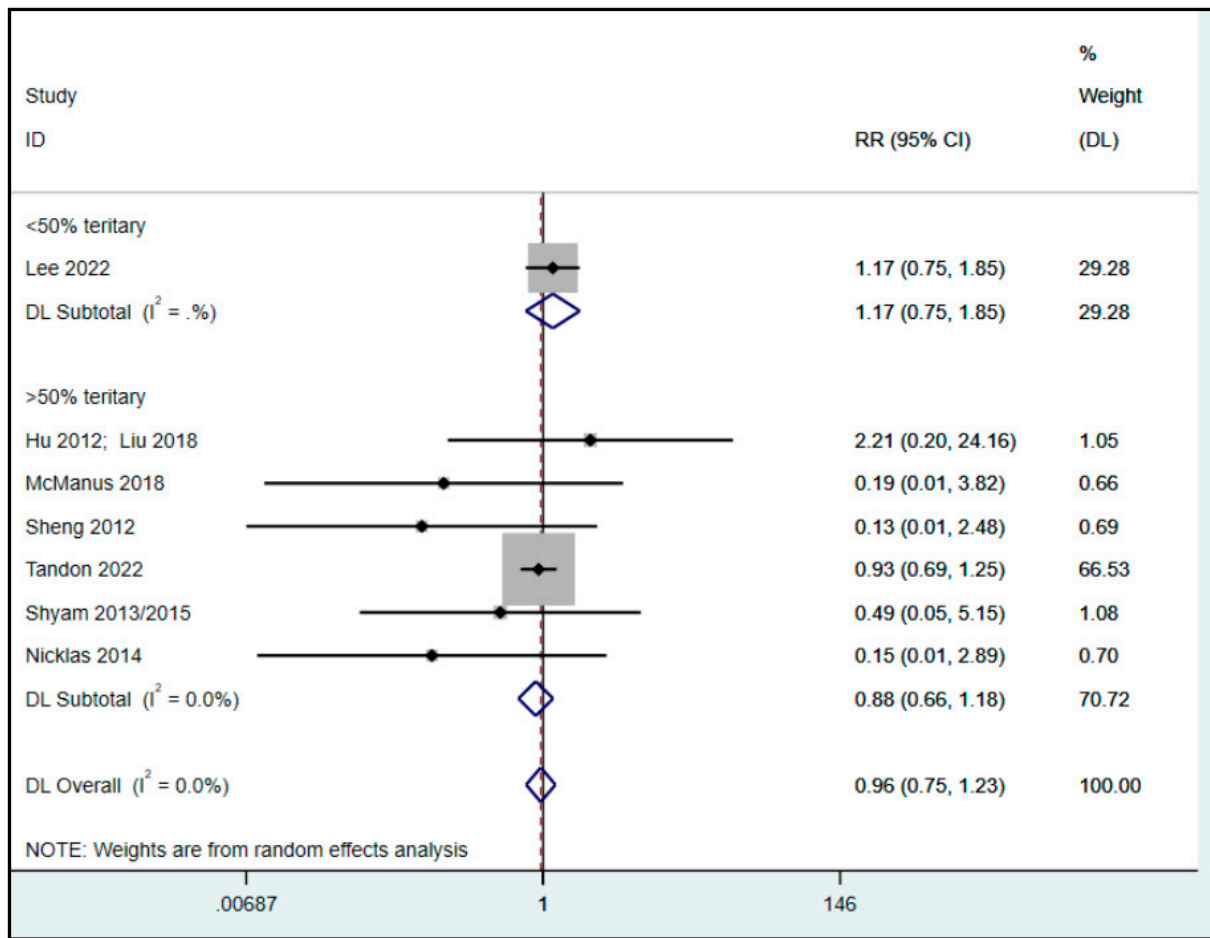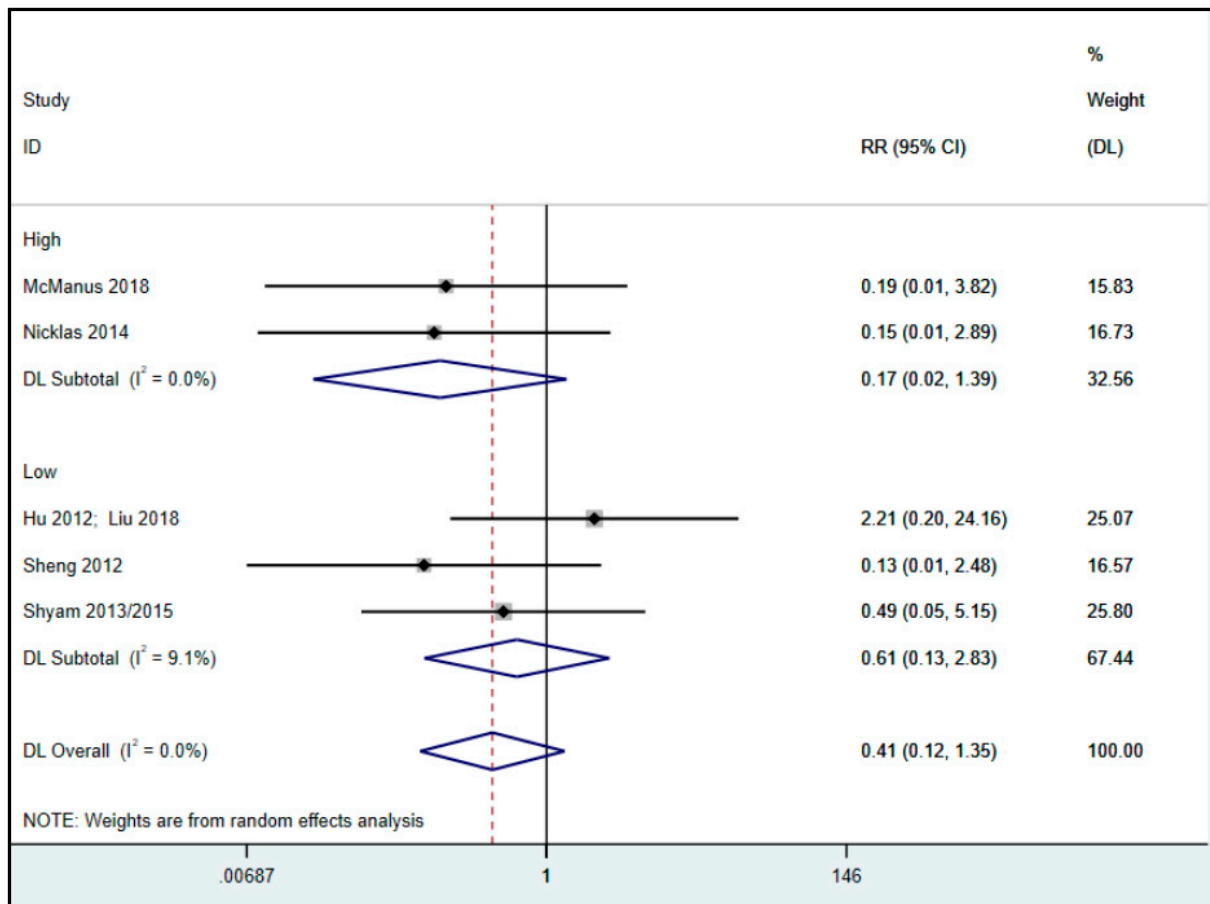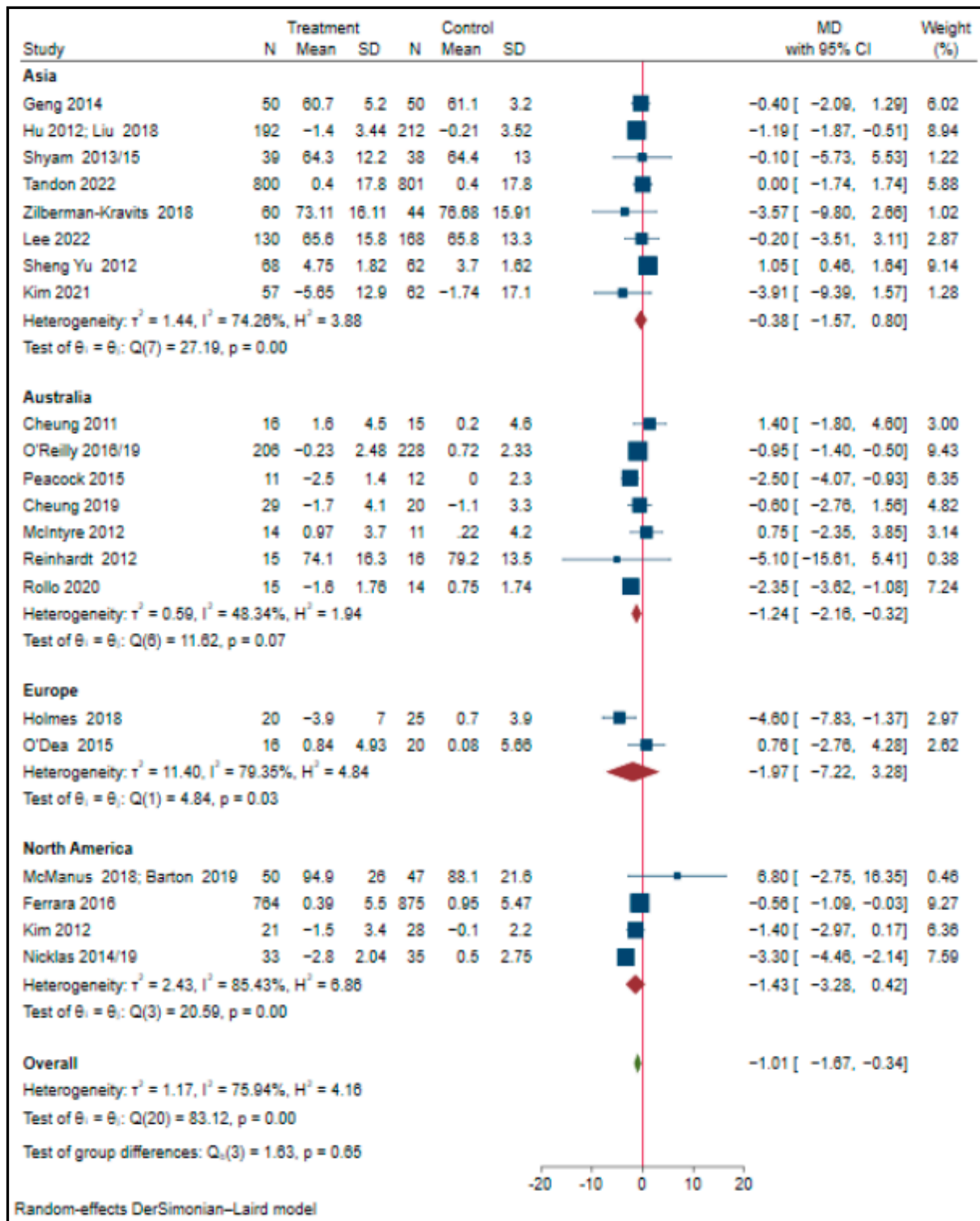| Study	Treatment N	Mean	SD	Control N	Mean	SD	MD with 95% CI	Weight (%)
Asia								
Geng 2014	50	60.7	5.2	50	61.1	3.2	−0.40 [−2.09, 1.29]	6.02
Hu 2012; Liu 2018	192	−1.4	3.44	212	−0.21	3.52	−1.19 [−1.87, −0.51]	8.94
Shyam 2013/15	39	64.3	12.2	38	64.4	13	−0.10 [−5.73, 5.53]	1.22
Tandon 2022	800	0.4	17.8	801	0.4	17.8	0.00 [−1.74, 1.74]	5.88
Zilberman-Kravits 2018	60	73.11	16.11	44	76.68	15.91	−3.57 [−9.80, 2.66]	1.02
Lee 2022	130	65.6	15.8	168	65.8	13.3	−0.20 [−3.51, 3.11]	2.87
Sheng Yu 2012	68	4.75	1.82	62	3.7	1.62	1.05 [0.46, 1.64]	9.14
Kim 2021	57	−5.65	12.9	62	−1.74	17.1	−3.91 [−9.39, 1.57]	1.28
Heterogeneity: τ^2 = 1.44, I^2 = 74.26%, H^2 = 3.88							−0.38 [−1.57, 0.80]	
Test of $\theta_i = \theta_j$: Q(7) = 27.19, p = 0.00								
Australia								
Cheung 2011	16	1.6	4.5	15	0.2	4.6	1.40 [−1.80, 4.60]	3.00
O'Reilly 2016/19	206	−0.23	2.48	228	0.72	2.33	−0.95 [−1.40, −0.50]	9.43
Peacock 2015	11	−2.5	1.4	12	0	2.3	−2.50 [−4.07, −0.93]	6.35
Cheung 2019	29	−1.7	4.1	20	−1.1	3.3	−0.60 [−2.76, 1.56]	4.82
McIntyre 2012	14	0.97	3.7	11	.22	4.2	0.75 [−2.35, 3.85]	3.14
Reinhardt 2012	15	74.1	16.3	16	79.2	13.5	−5.10 [−15.61, 5.41]	0.38
Rollo 2020	15	−1.6	1.76	14	0.75	1.74	−2.35 [−3.62, −1.08]	7.24
Heterogeneity: τ^2 = 0.59, I^2 = 48.34%, H^2 = 1.94							−1.24 [−2.16, −0.32]	
Test of $\theta_i = \theta_j$: Q(6) = 11.62, p = 0.07								
Europe								
Holmes 2018	20	−3.9	7	25	0.7	3.9	−4.60 [−7.83, −1.37]	2.97
O'Dea 2015	16	0.84	4.93	20	0.08	5.66	0.76 [−2.76, 4.28]	2.62
Heterogeneity: τ^2 = 11.40, I^2 = 79.35%, H^2 = 4.84							−1.97 [−7.22, 3.28]	
Test of $\theta_i = \theta_j$: Q(1) = 4.84, p = 0.03								
North America								
McManus 2018; Barton 2019	50	94.9	26	47	88.1	21.6	6.80 [−2.75, 16.35]	0.46
Ferrara 2016	764	0.39	5.5	875	0.95	5.47	−0.56 [−1.09, −0.03]	9.27
Kim 2012	21	−1.5	3.4	28	−0.1	2.2	−1.40 [−2.97, 0.17]	6.36
Nicklas 2014/19	33	−2.8	2.04	35	0.5	2.75	−3.30 [−4.46, −2.14]	7.59
Heterogeneity: τ^2 = 2.43, I^2 = 85.43%, H^2 = 6.86							−1.43 [−3.28, 0.42]	
Test of $\theta_i = \theta_j$: Q(3) = 20.59, p = 0.00								
Overall							−1.01 [−1.67, −0.34]	
Heterogeneity: τ^2 = 1.17, I^2 = 75.94%, H^2 = 4.16								
Test of $\theta_i = \theta_j$: Q(20) = 83.12, p = 0.00								
Test of group differences: Q_b(3) = 1.63, p = 0.65								

Random-effects DerSimonian–Laird model

Figure S2.5. The effect of lifestyle intervention on body weight by continent [29, 32, 33, 35, 38, 44, 49-54, 58, 60, 61, 63-65, 68, 69, 71, 75-77, 80].
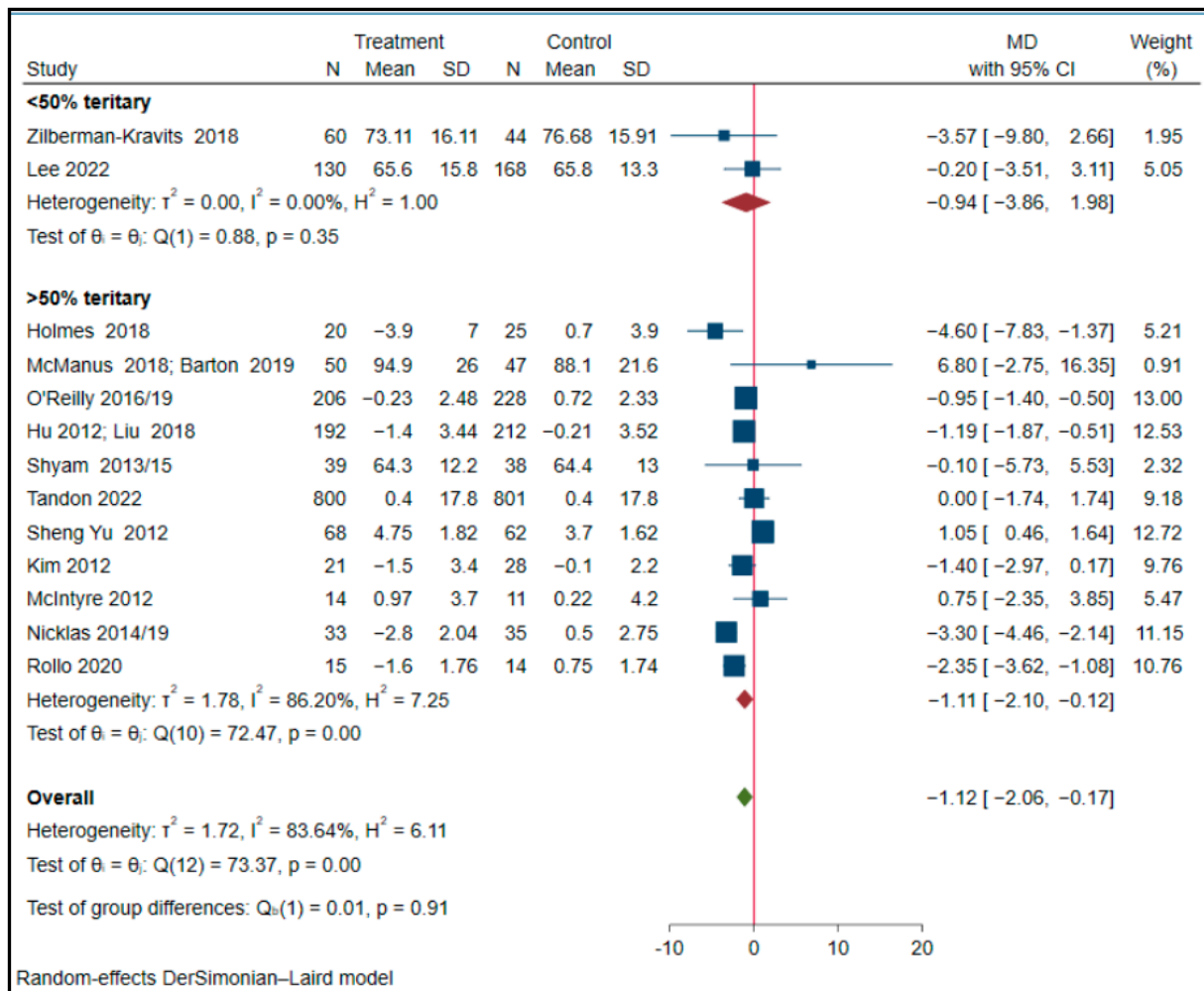
Study	Treatment N	Treatment Mean	Treatment SD	Control N	Control Mean	Control SD		MD with 95% CI	Weight (%)
<50% teritary									
Zilberman-Kravits 2018	60	73.11	16.11	44	76.68	15.91		−3.57 [−9.80, 2.66]	1.95
Lee 2022	130	65.6	15.8	168	65.8	13.3		−0.20 [−3.51, 3.11]	5.05
Heterogeneity: $\tau^2 = 0.00$, $I^2 = 0.00\%$, $H^2 = 1.00$								−0.94 [−3.86, 1.98]	
Test of $\theta_i = \theta_j$: Q(1) = 0.88, p = 0.35									
>50% teritary									
Holmes 2018	20	−3.9	7	25	0.7	3.9		−4.60 [−7.83, −1.37]	5.21
McManus 2018; Barton 2019	50	94.9	26	47	88.1	21.6		6.80 [−2.75, 16.35]	0.91
O'Reilly 2016/19	206	−0.23	2.48	228	0.72	2.33		−0.95 [−1.40, −0.50]	13.00
Hu 2012; Liu 2018	192	−1.4	3.44	212	−0.21	3.52		−1.19 [−1.87, −0.51]	12.53
Shyam 2013/15	39	64.3	12.2	38	64.4	13		−0.10 [−5.73, 5.53]	2.32
Tandon 2022	800	0.4	17.8	801	0.4	17.8		0.00 [−1.74, 1.74]	9.18
Sheng Yu 2012	68	4.75	1.82	62	3.7	1.62		1.05 [0.46, 1.64]	12.72
Kim 2012	21	−1.5	3.4	28	−0.1	2.2		−1.40 [−2.97, 0.17]	9.76
McIntyre 2012	14	0.97	3.7	11	0.22	4.2		0.75 [−2.35, 3.85]	5.47
Nicklas 2014/19	33	−2.8	2.04	35	0.5	2.75		−3.30 [−4.46, −2.14]	11.15
Rollo 2020	15	−1.6	1.76	14	0.75	1.74		−2.35 [−3.62, −1.08]	10.76
Heterogeneity: $\tau^2 = 1.78$, $I^2 = 86.20\%$, $H^2 = 7.25$								−1.11 [−2.10, −0.12]	
Test of $\theta_i = \theta_j$: Q(10) = 72.47, p = 0.00									
Overall								−1.12 [−2.06, −0.17]	
Heterogeneity: $\tau^2 = 1.72$, $I^2 = 83.64\%$, $H^2 = 6.11$									
Test of $\theta_i = \theta_j$: Q(12) = 73.37, p = 0.00									
Test of group differences: $Q_b(1) = 0.01$, p = 0.91									

-10   0   10   20

Random-effects DerSimonian–Laird model

Figure S2.6. The effect of lifestyle intervention on body weight by educational status [29, 33, 35, 38, 50-52, 61, 63, 65, 68, 69, 71, 75-77, 80].
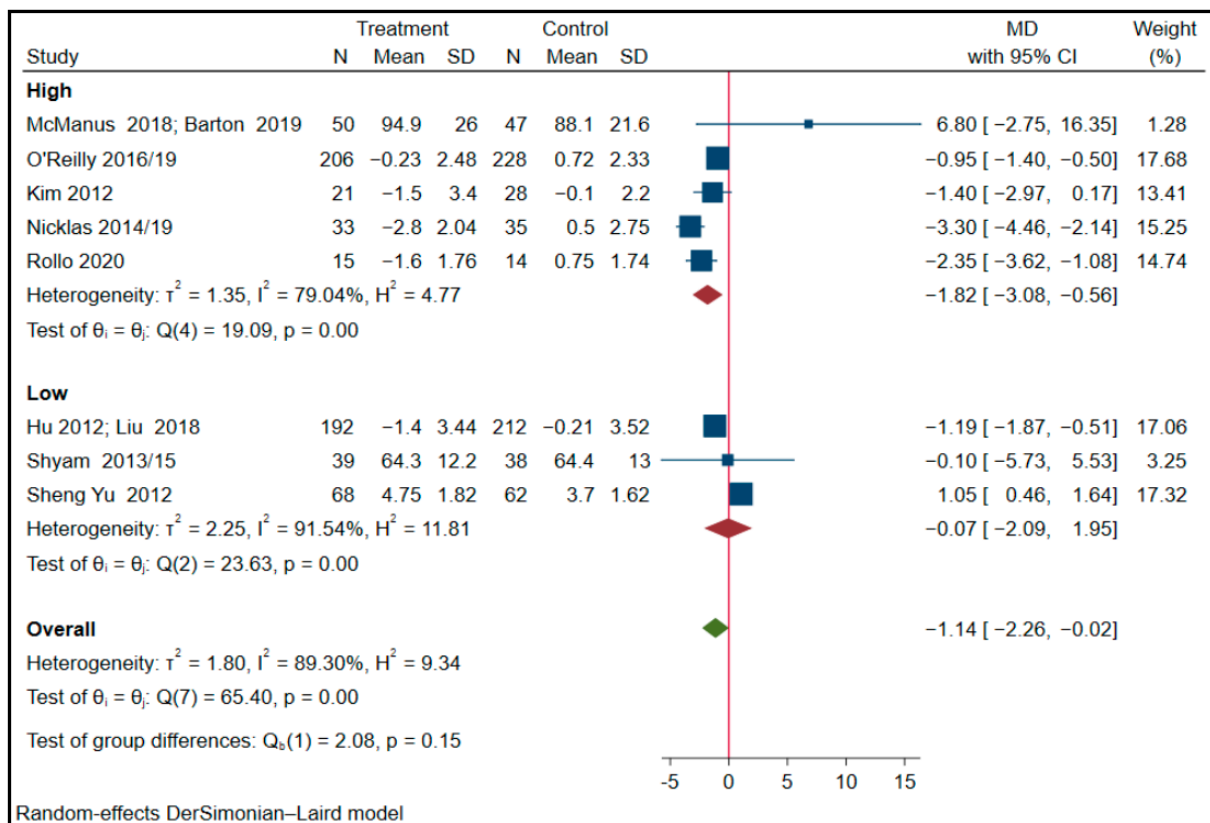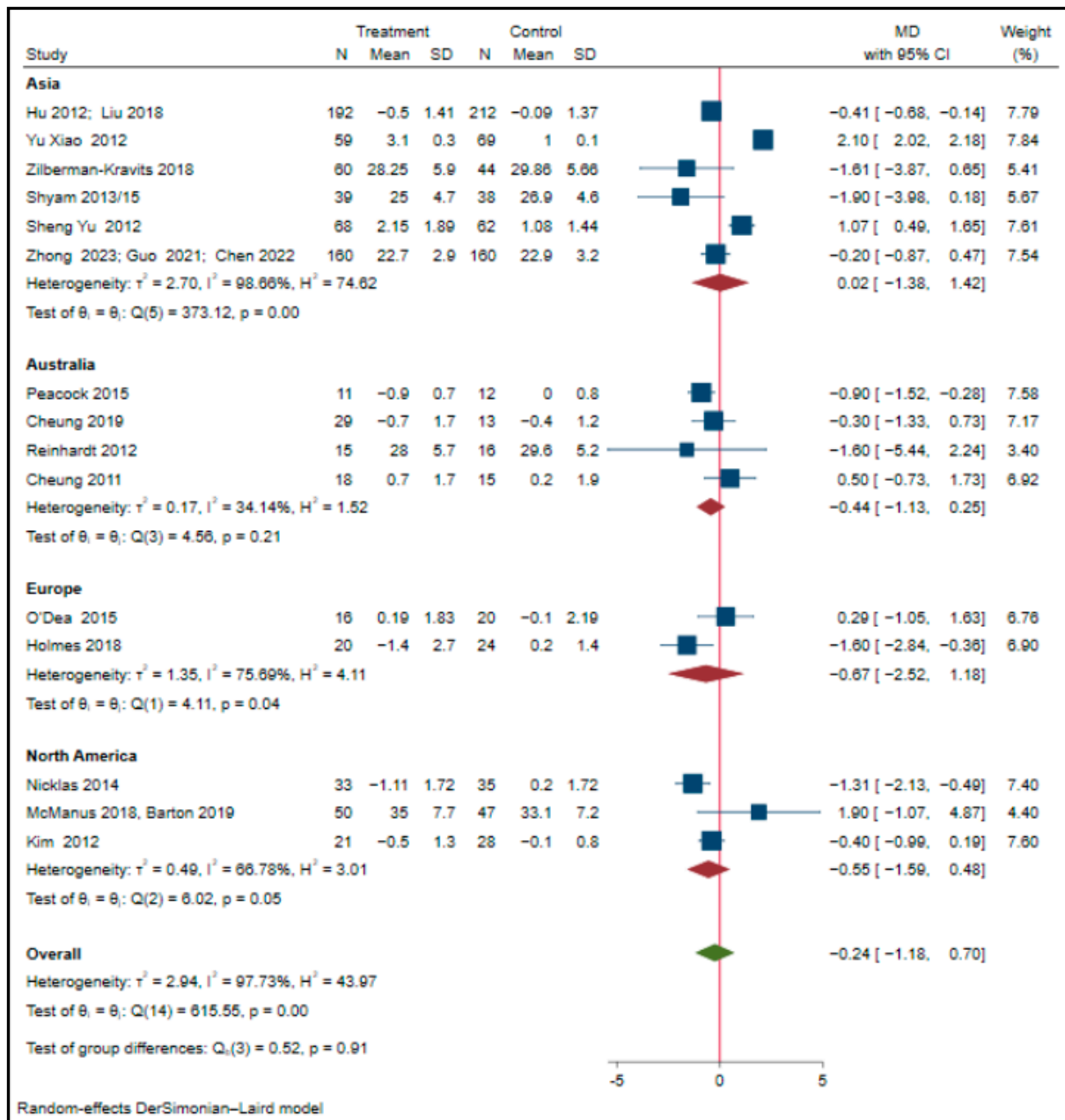
Study	Treatment N	Treatment Mean	Treatment SD	Control N	Control Mean	Control SD		MD with 95% CI	Weight (%)
High									
McManus 2018; Barton 2019	50	94.9	26	47	88.1	21.6		6.80 [−2.75, 16.35]	1.28
O'Reilly 2016/19	206	−0.23	2.48	228	0.72	2.33		−0.95 [−1.40, −0.50]	17.68
Kim 2012	21	−1.5	3.4	28	−0.1	2.2		−1.40 [−2.97, 0.17]	13.41
Nicklas 2014/19	33	−2.8	2.04	35	0.5	2.75		−3.30 [−4.46, −2.14]	15.25
Rollo 2020	15	−1.6	1.76	14	0.75	1.74		−2.35 [−3.62, −1.08]	14.74
Heterogeneity: $\tau^2 = 1.35$, $I^2 = 79.04\%$, $H^2 = 4.77$								−1.82 [−3.08, −0.56]	
Test of $\theta_i = \theta_j$: Q(4) = 19.09, p = 0.00									
Low									
Hu 2012; Liu 2018	192	−1.4	3.44	212	−0.21	3.52		−1.19 [−1.87, −0.51]	17.06
Shyam 2013/15	39	64.3	12.2	38	64.4	13		−0.10 [−5.73, 5.53]	3.25
Sheng Yu 2012	68	4.75	1.82	62	3.7	1.62		1.05 [0.46, 1.64]	17.32
Heterogeneity: $\tau^2 = 2.25$, $I^2 = 91.54\%$, $H^2 = 11.81$								−0.07 [−2.09, 1.95]	
Test of $\theta_i = \theta_j$: Q(2) = 23.63, p = 0.00									
Overall								−1.14 [−2.26, −0.02]	
Heterogeneity: $\tau^2 = 1.80$, $I^2 = 89.30\%$, $H^2 = 9.34$									
Test of $\theta_i = \theta_j$: Q(7) = 65.40, p = 0.00									
Test of group differences: $Q_b(1) = 2.08$, p = 0.15									

-5 0 5 10 15

Random-effects DerSimonian–Laird model

Figure S2.7. The effect of lifestyle intervention on body weight by income [29, 33, 35, 51, 52, 61, 63, 69, 71, 75-77].

Figure S2.8. The effect of lifestyle intervention on body weight by ethnicity (Studies with mixed ethnicity and those with unknown ethnicity were excluded) [29, 35, 38, 49, 50, 53, 54, 61, 64, 75, 80].
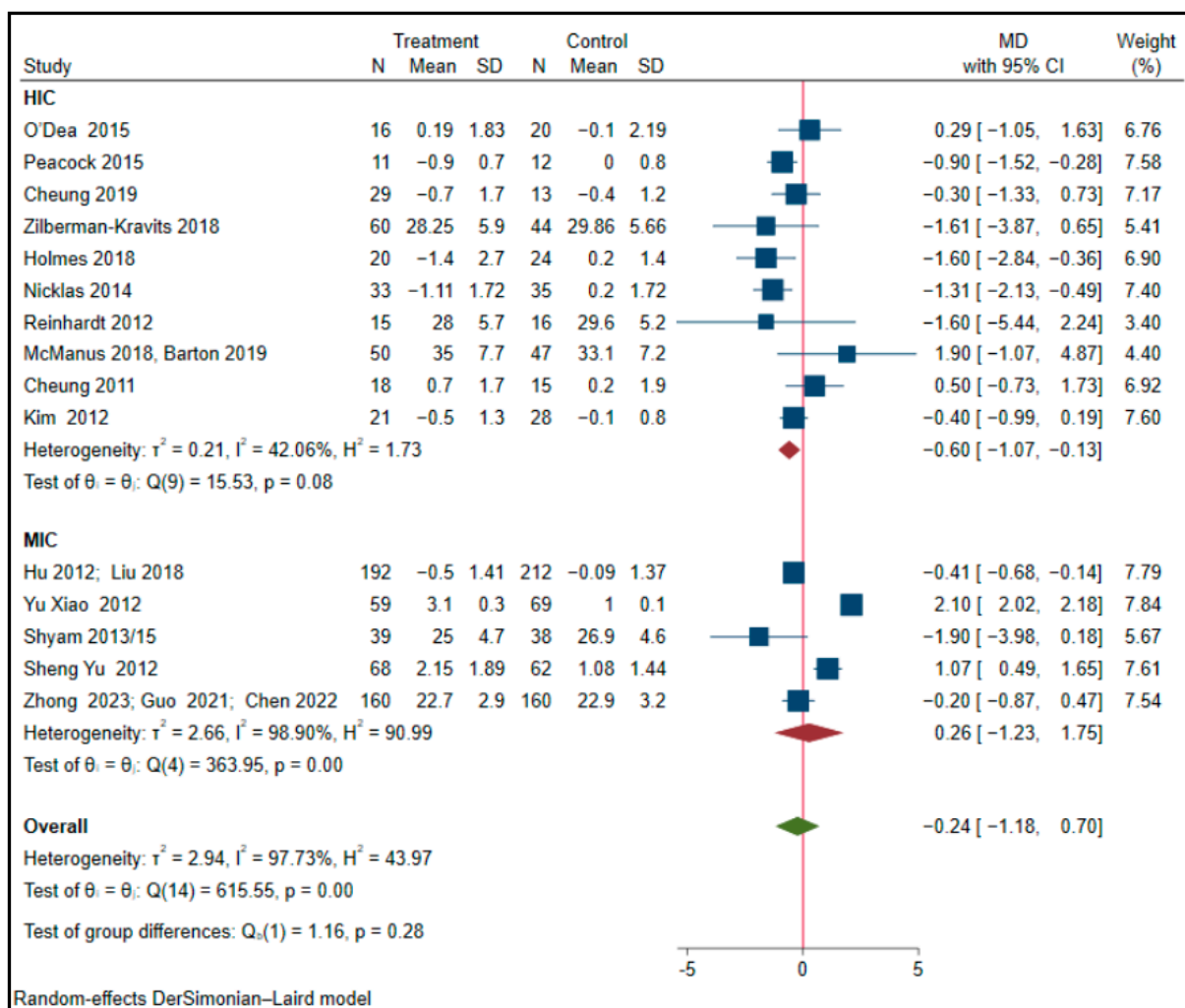
Figure S2.9. The effect of lifestyle intervention on BMI by country income classification according to the World Bank [32, 35, 43-46, 50-54, 58, 61, 63, 69, 75-77, 79, 80].

Study	Treatment N	Treatment Mean	Treatment SD	Control N	Control Mean	Control SD	MD with 95% CI	Weight (%)
Asia								
Hu 2012; Liu 2018	192	−0.5	1.41	212	−0.09	1.37	−0.41 [−0.68, −0.14]	7.79
Yu Xiao 2012	59	3.1	0.3	69	1	0.1	2.10 [2.02, 2.18]	7.84
Zilberman-Kravits 2018	60	28.25	5.9	44	29.86	5.66	−1.61 [−3.87, 0.65]	5.41
Shyam 2013/15	39	25	4.7	38	26.9	4.6	−1.90 [−3.98, 0.18]	5.67
Sheng Yu 2012	68	2.15	1.89	62	1.08	1.44	1.07 [0.49, 1.65]	7.61
Zhong 2023; Guo 2021; Chen 2022	160	22.7	2.9	160	22.9	3.2	−0.20 [−0.87, 0.47]	7.54
Heterogeneity: $\tau^2 = 2.70$, $I^2 = 98.66\%$, $H^2 = 74.62$							0.02 [−1.38, 1.42]	
Test of $\theta_i = \theta_j$: Q(5) = 373.12, p = 0.00								
Australia								
Peacock 2015	11	−0.9	0.7	12	0	0.8	−0.90 [−1.52, −0.28]	7.58
Cheung 2019	29	−0.7	1.7	13	−0.4	1.2	−0.30 [−1.33, 0.73]	7.17
Reinhardt 2012	15	28	5.7	16	29.6	5.2	−1.60 [−5.44, 2.24]	3.40
Cheung 2011	18	0.7	1.7	15	0.2	1.9	0.50 [−0.73, 1.73]	6.92
Heterogeneity: $\tau^2 = 0.17$, $I^2 = 34.14\%$, $H^2 = 1.52$							−0.44 [−1.13, 0.25]	
Test of $\theta_i = \theta_j$: Q(3) = 4.56, p = 0.21								
Europe								
O'Dea 2015	16	0.19	1.83	20	−0.1	2.19	0.29 [−1.05, 1.63]	6.76
Holmes 2018	20	−1.4	2.7	24	0.2	1.4	−1.60 [−2.84, −0.36]	6.90
Heterogeneity: $\tau^2 = 1.35$, $I^2 = 75.69\%$, $H^2 = 4.11$							−0.67 [−2.52, 1.18]	
Test of $\theta_i = \theta_j$: Q(1) = 4.11, p = 0.04								
North America								
Nicklas 2014	33	−1.11	1.72	35	0.2	1.72	−1.31 [−2.13, −0.49]	7.40
McManus 2018, Barton 2019	50	35	7.7	47	33.1	7.2	1.90 [−1.07, 4.87]	4.40
Kim 2012	21	−0.5	1.3	28	−0.1	0.8	−0.40 [−0.99, 0.19]	7.60
Heterogeneity: $\tau^2 = 0.49$, $I^2 = 66.78\%$, $H^2 = 3.01$							−0.55 [−1.59, 0.48]	
Test of $\theta_i = \theta_j$: Q(2) = 6.02, p = 0.05								
Overall							−0.24 [−1.18, 0.70]	
Heterogeneity: $\tau^2 = 2.94$, $I^2 = 97.73\%$, $H^2 = 43.97$								
Test of $\theta_i = \theta_j$: Q(14) = 615.55, p = 0.00								
Test of group differences: $Q_b(3) = 0.52$, p = 0.91								

Random-effects DerSimonian–Laird model

Figure S2.10. The effect of lifestyle intervention on BMI by continent [29, 32, 33, 35, 38, 44, 49-54, 58, 60, 61, 63-65, 68, 71, 75-77, 80].
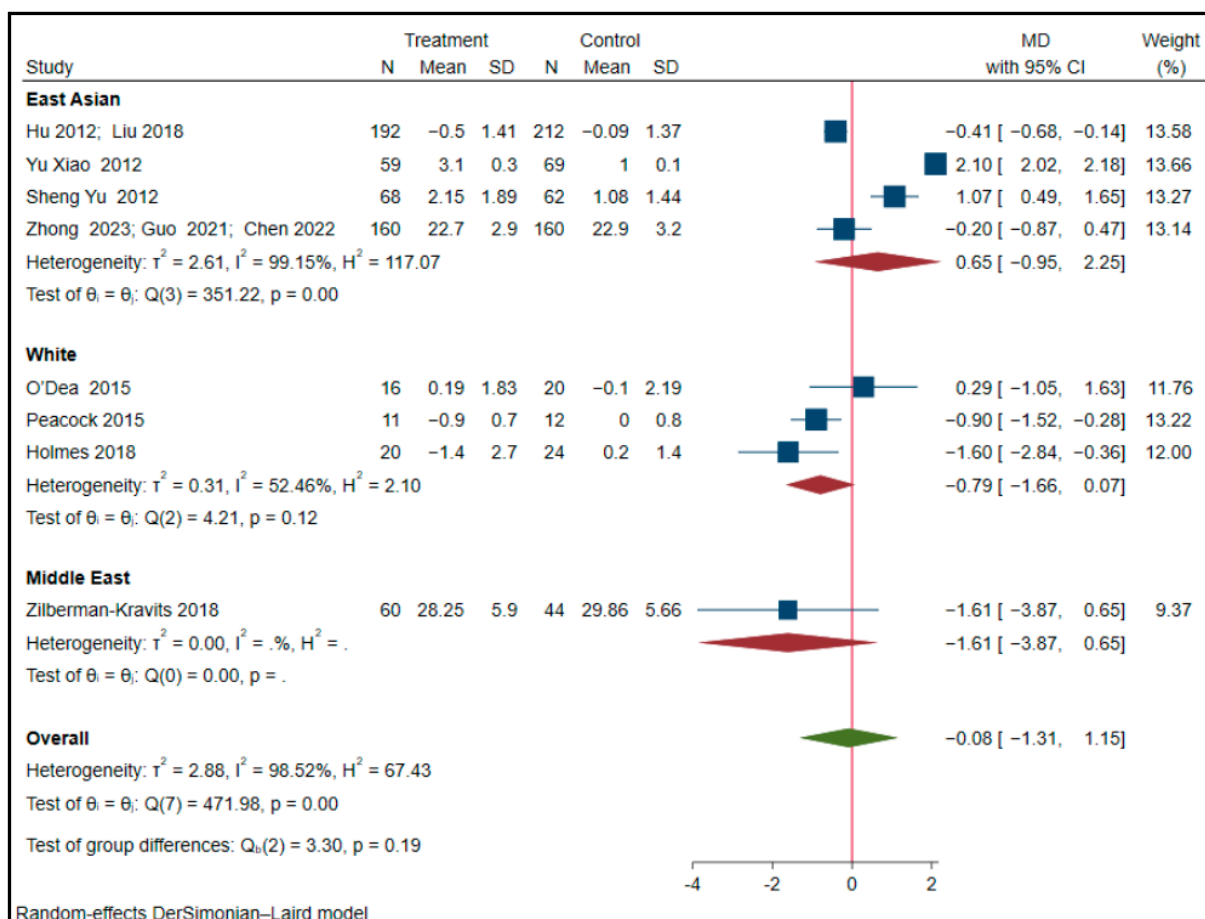
Figure S2.11. The effect of lifestyle intervention on BMI by ethnicity Studies with mixed ethnicity and those with unknown ethnicity were excluded) [35, 43, 45, 46, 50, 53, 54, 61, 75, 79, 80].
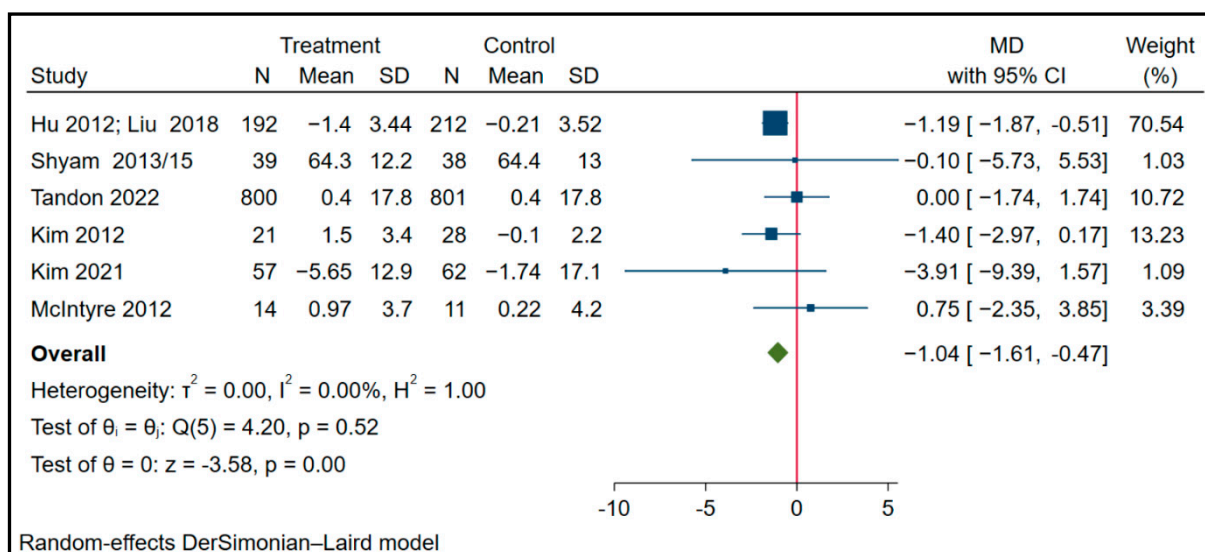
Figure S2.12 Sensitivity analysis (The effect of lifestyle intervention on body weight after excluding studies with a high risk of bias [35, 38, 61, 63, 64, 68, 76, 77].

Study	Treatment N	Treatment Mean	Treatment SD	Control N	Control Mean	Control SD	MD with 95% CI	Weight (%)
<50% teritary								
Zilberman-Kravits 2018	60	28.25	5.9	44	29.86	5.66	−1.61 [−3.87, 0.65]	4.93
Heterogeneity: $\tau^2 = 0.00$, $I^2 = .\%$, $H^2 = .$							−1.61 [−3.87, 0.65]	
Test of $\theta_i = \theta_j$: Q(0) = 0.00, p = .								
>50% teritary								
Hu 2012; Liu 2018	192	−0.5	1.41	212	−0.09	1.37	−0.41 [−0.68, −0.14]	17.47
Shyam 2013/15	39	25	4.7	38	26.9	4.6	−1.90 [−3.98, 0.18]	5.54
Holmes 2018	20	−1.4	2.7	24	0.2	1.4	−1.60 [−2.84, −0.36]	10.02
Nicklas 2014	33	−1.11	1.72	35	0.2	1.72	−1.31 [−2.13, −0.49]	13.42
McManus 2018, Barton 2019	50	35	7.7	47	33.1	7.2	1.90 [−1.07, 4.87]	3.21
Sheng Yu 2012	68	2.15	1.89	62	1.08	1.44	1.07 [0.49, 1.65]	15.40
Kim 2012	21	−0.5	1.3	28	−0.1	0.8	−0.40 [−0.99, 0.19]	15.33
Zhong 2023; Guo 2021; Chen 2022	160	22.7	2.9	160	22.9	3.2	−0.20 [−0.87, 0.47]	14.68
Heterogeneity: $\tau^2 = 0.50$, $I^2 = 80.87\%$, $H^2 = 5.23$							−0.40 [−1.00, 0.21]	
Test of $\theta_i = \theta_j$: Q(7) = 36.58, p = 0.00								
Overall							−0.46 [−1.04, 0.13]	
Heterogeneity: $\tau^2 = 0.49$, $I^2 = 78.87\%$, $H^2 = 4.73$								
Test of $\theta_i = \theta_j$: Q(8) = 37.87, p = 0.00								
Test of group differences: $Q_b(1) = 1.03$, p = 0.31								

Random-effects DerSimonian–Laird model

Figure S2.13. The effect of lifestyle intervention on BMI by educational status [35, 43, 45, 46, 50-52, 61, 63, 69, 75-77, 80]
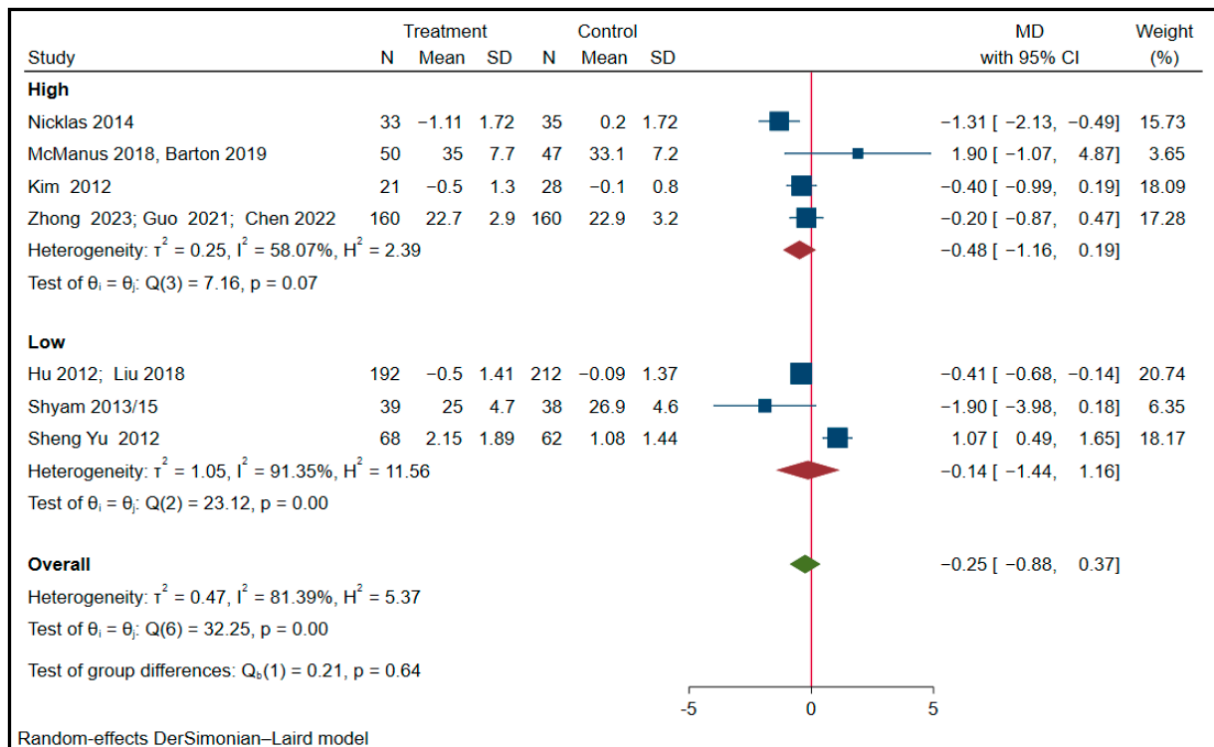
Figure S2.14. The effect of lifestyle intervention on BMI by income [35, 43, 45, 46, 51, 52, 61, 63, 69, 75-77]

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