SUPPLEMENTAL MATERIAL

Table S1. Description of PICOS* criteria for a systematically searched meta-analysis assessing the relative effects of red meat consumption on cardiovascular disease risk factors stratified by type of comparison diet.

Tables S2-5. Mean, SD, and mean differences for total, LDL, HDL cholesterol and triglycerides (mmol/L) in red meat intervention and comparison diet.

Table S6. Subgroup analyses on the relative effects of red meat intake on blood lipids and lipoproteins compared to all comparison diets together.

Figure S1. Random effects meta-analysis for changes in total:HDL cholesterol and HDL:LDL ratios (mmol/L) from controlled trials comparing red meat interventions with all comparison diets together.

Figure S2. Random effects meta-analysis for changes in VLDL cholesterol (mmol/L) from controlled trials comparing red meat interventions with all comparison diets together.

Figure S3. Random effects meta-analysis for changes in apolipoprotein A-1 and B (g/L) from controlled trials comparing red meat interventions with all comparison diets together.

Figure S4. Random effects meta-analysis for changes in systolic and diastolic blood pressure (mmHg) from controlled trials comparing red meat interventions with all comparison diets together.

Figure S5. Intervention-specific pre- to post-intervention changes in total cholesterol and triglyceride concentrations.

Figure S6. Intervention-specific pre- to post-intervention changes in LDL and HDL cholesterol concentrations.

Figures S7-10. Random effects meta-analysis for changes in total, LDL, HDL cholesterol and triglycerides concentrations (mmol/L) from controlled trials comparing red meat with comparison intervention stratified by comparison diet.

Supplemental Table 1. Description of PICOS* criteria for a systematically searched meta-analysis assessing the relative effects of red meat consumption on cardiovascular disease risk factors stratified by type of comparison group

Population	Adults aged >=18 years and not pregnant
Intervention	A diet containing red meat as the primary source of protein
Comparator	Comparison groups by comparison diet (high-quality plant protein sources, poultry/chicken/fish, fish only, poultry only, mixed animal protein, low-quality carbohydrates or usual diet)
Outcome	Changes in cardiovascular risk factors, specifically blood lipids, lipoproteins, apolipoproteins, and blood pressure from pre- to post-intervention
Study design	Randomized controlled trials
Research questions	What is the relative effect of consuming red meat on blood lipids, lipoproteins, apolipoproteins, and blood pressure and does this effect differ by the type of comparison group?
Search terms	PubMed Database: #1 "Meat"[MESH] OR "Meat Products"[MESH] OR "red meat" OR "beef" OR "pork" #2 "hypertension"[MESH] OR "Cholesterol, LDL"[MESH] OR "Cholesterol, HDL"[MESH] OR "Blood Pressure"[MESH] OR "lipoproteins"[MESH] Search: #1 AND #2 Filters: 1) Humans; 2) aged ≥18 years and 3) English

*PICOS: Population, Intervention, Comparator Outcome, Study design.

Supplemental Table 2. Mean, SD and mean differences for total cholesterol (mmol/L) in red meat and comparison diet

		Red meat interventions			Comparison diet					
Study	**Year**	**n**	**Mean (mmol/L)**	**SD**	**n**	**Mean (mmol/L)**	**SD**	**Mean difference**	**LCI**	**UCI**
High-quality plant protein										
Sinclair veg[1]	1987	10	-0.36	0.84	7	-0.42	0.68	0.06	-0.66	0.78
Prescott[2]	1998	25	-0.16	0.80	25	-0.25	0.81	0.09	-0.35	0.53
Haub[3]	2005	21	0.30	0.30	21	-0.06	0.07	0.36	0.23	0.49
de Mello veg[4]	2006	17	0.03	0.72	17	-0.26	0.71	0.29	-0.19	0.77
Liao[5]	2007	15	-0.47	0.47	15	-0.61	0.41	0.14	-0.18	0.46
Hosseinpour-Niazi[6]	2014	31	-0.46	0.70	31	-0.47	0.78	0.01	-0.36	0.38
Poultry and fish (all types)										
O'Brien HC G1[7]	1980	15	0.44	0.73	15	0.23	0.71	0.21	-0.30	0.72
O'Brien HC G2[7]	1980	14	0.26	0.53	14	0.49	0.53	-0.23	-0.62	0.16
O'Brien LC G1[7]	1980	15	0.31	0.61	15	0.23	0.72	0.08	-0.40	0.56
O'Brien LC G2[7]	1980	14	0.00	0.44	14	0.02	0.49	-0.02	-0.36	0.32
Flynn F1[8]	1981	31	-0.13	0.79	31	-0.02	1.00	-0.11	-0.56	0.34
Flynn F2[8]	1981	24	-0.03	0.69	24	0.18	0.80	-0.21	-0.63	0.21
Flynn M1[8]	1981	38	-0.10	0.60	38	-0.16	0.83	0.06	-0.27	0.39
Flynn M2[8]	1981	36	-0.10	0.73	36	0.20	0.81	-0.30	-0.66	0.06
Flynn Beef F1[9]	1982	12	-0.23	0.89	12	-0.13	1.02	-0.10	-0.87	0.67
Flynn Pork F1[9]	1982	12	-0.60	0.92	12	-0.13	1.02	-0.47	-1.24	0.30
Flynn Beef F2[9]	1982	17	0.13	0.72	17	0.39	0.74	-0.26	-0.75	0.23
Flynn Pork F2[9]	1982	17	-0.18	0.64	17	0.39	0.74	-0.57	-1.04	-0.10
Flynn Beef M1[9]	1982	21	-0.16	0.65	21	0.02	0.77	-0.18	-0.61	0.25
Flynn Pork M1[9]	1982	21	-0.24	0.65	21	0.02	0.77	-0.26	-0.69	0.17
Flynn Beef M2[9]	1982	26	-0.16	0.74	26	0.00	0.86	-0.16	-0.60	0.28
Flynn Pork M2[9]	1982	26	-0.49	0.70	26	0.00	0.86	-0.49	-0.92	-0.06
Davidson[10]	1999	89	-0.08	0.29	102	-0.13	0.39	0.05	-0.05	0.15
Wolmarans[11]	1999	39	-0.29	0.63	39	-0.45	0.55	0.16	-0.10	0.42
Zhang[12]	2012	32	-0.06	0.72	29	0.00	0.53	-0.06	-0.37	0.25
Sayer[13]	2015	19	-0.68	0.66	19	-0.36	0.68	-0.32	-0.75	0.11
Hill BOLD[14]	2015	20	-0.39	0.62	21	-0.41	0.47	0.02	-0.32	0.36
Hill BOLD+[14]	2015	21	-0.57	0.53	21	-0.41	0.47	-0.16	-0.46	0.14
Fish and seafood										
Sinclair SF[1]	1987	10	-0.36	0.84	10	-0.34	0.50	-0.02	-0.63	0.59
Sinclair TF[1]	1987	10	-0.36	0.84	11	-0.62	0.64	0.26	-0.38	0.90
Gascon[15]	1996	14	-0.34	0.42	14	-0.14	0.54	-0.20	-0.56	0.16
Beauchesne-Rondeau FD[16]	2003	17	-0.50	0.55	17	-0.30	0.64	-0.20	-0.60	0.20

Ouellet[17]	2008	18	-0.61	0.51	18	-0.25	0.55	-0.36	-0.71	-0.01
Navas-Carretero[18]	2009	25	-0.09	0.53	25	-0.10	0.64	0.01	-0.32	0.34
Lindqvist[19]	2009	35	-0.05	0.56	35	0.03	0.60	-0.08	-0.35	0.19
Zhang F[20]	2010	30	-0.07	0.51	30	-0.05	0.69	-0.02	-0.33	0.29
Zhang OF[20]	2010	30	-0.07	0.51	32	0.03	0.48	-0.10	-0.35	0.15
Grieger[21]	2014	37	-0.10	0.79	43	0.10	0.49	-0.20	-0.50	0.10
Aadland[22]	2015	19	-0.38	0.69	20	-0.37	0.53	-0.01	-0.40	0.38
Chicken or poultry										
Scott[23]	1994	19	-0.54	0.35	19	-0.70	0.59	0.16	-0.15	0.47
Melanson[24]	2003	21	-0.55	0.22	35	-0.49	0.12	-0.06	-0.16	0.04
Beauchesne-Rondeau CD[16]	2003	17	-0.50	0.55	17	-0.50	0.64	0.00	-0.40	0.40
de Mello CD[4]	2006	17	0.03	0.72	17	-0.28	0.69	0.31	-0.16	0.78
Mahon CD[25]	2007	14	-0.59	0.93	15	-0.49	1.24	-0.10	-0.89	0.69
Animal protein										
Mamo[26]	2005	10	-0.20	0.19	10	0.00	0.30	-0.20	-0.42	0.02
Nowson[27]	2009	46	0.33	1.00	47	0.38	1.25	-0.05	-0.51	0.41
Roussell BOLD[28]	2011	34	-0.47	0.45	33	-0.21	0.51	-0.26	-0.49	-0.03
Rousell BOLD+[28]	2011	34	-0.50	0.45	35	-0.48	0.52	-0.02	-0.25	0.21
Thorning cheese[29]	2015	14	-0.30	0.55	14	-0.19	0.78	-0.11	-0.61	0.39
Carbohydrates										
Mahon carb[25]	2007	15	-0.59	0.93	14	-1.14	1.71	0.55	-0.46	1.56
Foerster[30]	2014	20	-0.10	0.53	20	0.00	0.72	-0.10	-0.49	0.29
Thorning carb[29]	2015	14	-0.30	0.55	14	-0.47	0.68	0.17	-0.29	0.63
Usual diet										
Hodgson[31]	2006	29	-0.10	0.57	31	-0.10	0.59	0.00	-0.29	0.29
Murphy[32]	2012	72	-0.10	0.56	71	-0.20	0.65	0.10	-0.10	0.30

Mean changes for each group were calculated from values at follow-up minus values at baseline. SD, Standard Deviation; LCI, low confidence interval; UCI, upper confidence interval. HC G1, first group consuming high cholesterol diet; HC G2, second group consuming high cholesterol diet; LC G1, first group consuming low-cholesterol diet; LC G2, second group consuming low-cholesterol diet; F1, first female group; F2, second female group; M1, fist male group; M2, second male group; F, fish; OF, oily fish; C, chicken; carb, carbohydrates; veg, vegetarian.

Supplemental Table 3. Mean, SD and mean differences for LDL cholesterol (mmol/L) in red meat and comparison diet

		Red meat interventions			Comparison diet					
Study	**Year**	**n**	**Mean (mmol/L)**	**SD**	**n**	**Mean (mmol/L)**	**SD**	**Mean difference**	**LCI**	**UCI**
High quality plant protein										
Wiebe[33]	1984	8	-0.26	0.52	8	-0.12	0.54	-0.14	-0.66	0.38
Sinclair veg	1987	8	-0.41	1.01	7	-0.03	0.66	-0.38	-1.24	0.48
Ashton[34]	2000	42	-0.12	0.61	42	-0.20	0.70	0.08	-0.20	0.36
Haub	2005	21	0.30	0.40	21	-0.08	0.60	0.38	0.07	0.69
de Mello veg	2006	17	0.47	0.62	17	0.13	0.66	0.34	-0.09	0.77
Liao	2007	15	-0.23	0.43	15	-0.40	0.20	0.17	-0.07	0.41
Hosseinpour-Niazi	2014	31	-0.23	0.53	31	-0.54	0.60	0.31	0.03	0.59
Poultry and fish (all types)										
Davidson	1999	89	-0.08	0.29	102	-0.12	0.33	0.04	-0.05	0.13
Wolmarans	1999	28	0.12	0.63	28	-0.17	0.66	0.29	-0.05	0.63
Zhang	2012	32	-0.15	0.78	29	-0.11	0.50	-0.04	-0.37	0.29
Sayer	2015	19	-0.46	0.70	19	-0.32	0.63	-0.14	-0.56	0.28
Hill BOLD	2015	21	-0.28	0.57	21	-0.28	0.38	0.00	-0.29	0.29
Hill BOLD+	2015	22	-0.39	0.47	21	-0.28	0.38	-0.11	-0.37	0.15
Fish or seafood										
Sinclair SF	1987	7	-0.41	1.01	10	-0.17	0.48	-0.24	-1.05	0.57
Sinclair TF	1987	7	-0.41	1.01	8	-0.53	0.50	0.12	-0.71	0.95
Wolmarans[35]	1991	39	0.27	0.49	39	0.44	0.55	-0.17	-0.40	0.06
Gascon	1996	14	-0.26	0.34	14	-0.06	0.38	-0.20	-0.47	0.07
Beauchesne-Rondeau FD	2003	17	-0.30	0.58	17	-0.20	0.65	-0.10	-0.51	0.31
Ouellet	2008	18	-0.36	0.55	18	-0.05	0.42	-0.31	-0.63	0.01
Navas-Carretero	2009	25	-0.13	0.53	25	-0.19	0.66	0.06	-0.27	0.39
Lindqvist	2009	35	0.11	0.53	35	0.15	0.54	-0.04	-0.29	0.21
Zhang F	2010	30	0.03	0.47	30	0.22	0.79	-0.19	-0.52	0.14
Zhang OF	2010	30	0.03	0.47	32	0.29	0.59	-0.26	-0.53	0.01
Grieguer	2014	37	-0.10	0.42	43	0.20	0.52	-0.30	-0.51	-0.09
Aadland	2015	19	-0.26	0.61	20	-0.22	0.49	-0.04	-0.39	0.31
Chicken or poultry										
Scott	1994	19	0.46	0.43	19	0.55	0.35	-0.09	-0.34	0.16
Horrocks[36]	1999	20	-0.47	0.14	20	-0.45	0.12	-0.02	-0.10	0.06
Melanson	2003	21	0.25	0.13	35	0.37	0.36	-0.12	-0.25	0.01
Beauchesne-Rondeau CD	2003	17	-0.30	0.58	17	-0.40	0.62	0.10	-0.30	0.50
de Mello CD	2006	17	0.47	0.62	17	0.22	0.68	0.25	-0.19	0.69
Mahon CD	2007	14	-0.46	0.70	15	-0.41	1.16	-0.05	-0.74	0.64
Animal protein										

Mamo	2005	10	-0.20	0.20	10	-0.10	0.30	-0.10	-0.32	0.12
Nowson	2009	46	0.28	0.75	47	0.29	1.15	-0.01	-0.40	0.38
Rousell BOLD	2012	36	-0.37	0.39	33	-0.16	0.44	-0.21	-0.41	-0.01
Rousell 1 BOLD+	2012	36	-0.37	0.39	35	-0.38	0.43	0.01	-0.18	0.20
Thorning cheese	2015	14	-0.02	0.48	14	-0.18	0.62	0.16	-0.25	0.57
Carbohydrates										
Mahon carb	2007	14	-0.46	0.70	14	-0.52	1.29	0.06	-0.71	0.83
Thorning carb	2015	14	-0.02	0.48	14	-0.06	0.63	0.04	-0.38	0.46
Usual diet										
Hodgson	2006	29	0.00	0.53	31	-0.20	0.60	0.20	-0.09	0.49
Murphy	2012	71	-0.10	0.58	69	-0.10	0.65	0.00	-0.20	0.20

Mean changes for each group were calculated from values at follow-up minus values at baseline. SD, Standard Deviation; LCI, low confidence interval; UCI, upper confidence interval. HC G1, first group consuming high cholesterol diet; HC G2, second group consuming high cholesterol diet; LC G1, first group consuming low-cholesterol diet; LC G2, second group consuming low-cholesterol diet; F1, first female group; F2, second female group; M1, fist male group; M2, second male group; F, fish; OF, oily fish; C, chicken; carb, carbohydrates.

Supplemental Table 4. Mean, SD and mean differences for HDL cholesterol (mmol/L) in red meat and comparison diet

		Red meat interventions			**Comparison diet**					
Study	**Year**	**n**	**Mean (mmol/L)**	**SD**	**n**	**Mean (mmol/L)**	**SD**	**Mean difference**	**LCI**	**UCI**
High-quality plant protein										
Wiebe	1984	8	0.04	0.14	8	-0.32	0.25	0.36	0.17	0.56
Sinclair veg	1987	8	0.10	0.37	7	-0.24	0.25	0.34	0.02	0.66
Prescott	1987	25	0.09	0.20	25	0.02	0.35	0.07	-0.09	0.23
Ashton	2000	42	0.07	0.18	42	0.00	0.22	0.07	-0.02	0.16
Haub	2005	21	0.08	0.10	21	-0.10	0.10	0.18	0.12	0.24
de Mello veg	2006	17	-0.03	0.16	17	-0.03	0.15	0.00	-0.10	0.10
Liao	2007	15	-0.05	0.13	15	-0.02	0.30	-0.03	-0.20	0.14
Hosseinpour-Niazi	2014	31	-0.04	0.17	31	0.02	0.18	-0.06	-0.15	0.03
Poultry and fish (all types)										
O'Brien HC G1	1980	15	0.05	0.10	15	0.11	0.18	-0.06	-0.16	0.04
O'Brien HC G2	1980	14	0.05	0.14	14	0.08	0.23	-0.03	-0.17	0.11
O'Brien LC G1	1980	15	0.13	0.10	15	0.03	0.18	0.10	0.00	0.20
O'Brien LC G2	1980	14	0.02	0.15	14	0.08	0.23	-0.06	-0.20	0.08
Flynn F1	1981	31	-0.18	0.22	31	0.00	0.37	-0.18	-0.33	-0.03
Flynn F2	1981	24	0.06	0.27	24	-0.24	0.40	0.30	0.11	0.49
Flynn M1	1981	38	-0.16	0.17	38	0.00	0.29	-0.16	-0.27	-0.06
Flynn M2	1981	36	-0.05	0.19	36	-0.08	0.28	0.03	-0.08	0.14
Flynn Beef F1	1982	12	-0.21	0.20	12	0.00	0.29	-0.21	-0.41	-0.01

Flynn Pork F1	1982	12	-0.16	0.19	12	0.00	0.29	-0.16	-0.36	0.04
Flynn Beef F2	1982	17	0.13	0.27	17	-0.15	0.36	0.28	0.07	0.49
Flynn Pork F2	1982	17	0.03	0.27	17	-0.15	0.36	0.18	-0.03	0.39
Flynn Beef M1	1982	21	-0.08	0.19	21	-0.08	0.31	0.00	-0.16	0.16
Flynn Pork M1	1982	21	-0.16	0.21	21	-0.08	0.31	-0.08	-0.24	0.08
Flynn Beef M2	1982	26	-0.08	0.19	26	-0.18	0.29	0.10	-0.03	0.23
Flynn Pork M2	1982	26	-0.08	0.20	26	-0.18	0.29	0.10	-0.04	0.24
Davidson	1999	89	0.03	0.14	102	0.02	0.23	0.01	-0.04	0.06
Zhang	2012	32	-0.08	0.14	29	-0.03	0.20	-0.05	-0.14	0.04
Sayer	2015	19	-0.16	0.21	19	-0.08	0.23	-0.08	-0.22	0.06
Hill BOLD	2015	21	0.00	0.08	21	0.01	0.12	0.00	-0.07	0.06
Hill BOLD+	2015	22	-0.08	0.10	21	0.01	0.12	-0.09	-0.15	-0.02
Fish or seafood										
Sinclair SF	1987	8	0.10	0.37	10	-0.10	0.31	0.20	-0.12	0.52
Sinclair TF	1987	8	0.10	0.37	8	-0.11	0.31	0.21	-0.12	0.54
Wolmarans	1991	28	-0.01	0.18	28	0.09	0.28	-0.10	-0.22	0.02
Gascon	1996	14	-0.09	0.13	14	-0.06	0.25	-0.03	-0.18	0.12
Beauchesne-Rondeau FD	2003	17	-0.01	0.08	17	0.02	0.16	-0.03	-0.11	0.05
Ouellet	2008	18	-0.03	0.17	18	-0.07	0.12	0.04	-0.06	0.14
Navas-Carretero	2009	25	0.02	0.16	25	0.12	0.16	-0.10	-0.18	-0.01
Lindqvist	2009	35	-0.01	0.10	35	0.04	0.17	-0.05	-0.12	0.02
Zhang TF	2010	30	-0.03	0.10	30	0.07	0.16	-0.10	-0.17	-0.03
Zhang OF	2010	30	-0.03	0.10	32	0.13	0.15	-0.16	-0.22	-0.10
Grieguer	2014	37	0.10	0.31	43	0.10	0.54	0.00	-0.19	0.19
Aadland	2015	19	-0.24	0.21	20	-0.09	0.18	-0.15	-0.27	-0.03
Chicken or poultry										
Scott	1994	19	-0.06	0.11	19	-0.12	0.15	0.06	-0.02	0.14
Wolmarans	1999	39	0.00	0.13	39	0.03	0.14	-0.03	-0.09	0.03
Melanson	2003	21	0.01	0.11	35	-0.04	0.03	0.05	0.00	0.10
Beuachesne-Rondeau CD	2003	17	-0.01	0.08	17	0.05	0.13	-0.06	-0.14	0.02
de Mello CD	2006	17	-0.03	0.16	17	-0.03	0.16	0.00	-0.11	0.11
Mahon CD	2007	14	-0.05	0.28	15	0.00	0.41	-0.05	-0.30	0.20
Animal protein										
Mamo	2005	10	0.00	0.05	10	0.00	0.08	0.00	-0.06	0.06
Nowson	2009	46	0.04	0.19	47	-0.02	0.28	0.06	-0.04	0.15
Rousell BOLD	2012	36	-0.10	0.20	33	-0.02	0.27	-0.08	-0.19	0.03
Roussell BOLD+	2012	36	-0.10	0.20	35	-0.12	0.27	0.02	-0.09	0.13
Thorning cheese	2015	14	-0.13	0.13	14	-0.17	0.23	0.04	-0.10	0.18
Carbohydrates										
Mahon carb	2007	14	-0.05	0.28	14	-0.31	0.40	0.26	0.00	0.52

Thorning carb	2015	14	-0.13	0.13	14	-0.23	0.20	0.10	-0.03	0.23
Usual diet										
Hodgson	2006	29	-0.01	0.23	31	-0.02	0.34	0.01	-0.14	0.16
Murphy	2012	72	0.00	0.17	71	-0.10	0.20	0.10	0.04	0.16

Mean changes for each group were calculated from values at follow-up minus values at baseline. SD, Standard Deviation; LCI, low confidence interval; UCI, upper confidence interval. HC G1, first group consuming high cholesterol diet; HC G2, second group consuming high cholesterol diet; LC G1, first group consuming low-cholesterol diet; LC G2, second group consuming low-cholesterol diet; F1, first female group; F2, second female group; M1, fist male group; M2, second male group; F, fish; OF, oily fish; C, chicken; carb, carbohydrates.

Supplemental Table 5. Mean, SD and mean differences for triglycerides (mmol/L) in red meat and comparison diet

		Red meat interventions			**Comparison diet**					
Study	**Year**	**n**	**Mean (mmol/L)**	**SD**	**n**	**Mean (mmol/L)**	**SD**	**Mean difference**	**LCI**	**UCI**
High-quality plant protein										
Sinclair veg	1987	10	0.11	0.31	7	0.06	0.21	0.05	-0.20	0.30
Prescott	1987	25	-0.06	0.56	25	0.18	0.60	-0.24	-0.56	0.08
Ashton	2000	42	-0.19	0.99	42	-0.34	0.83	0.15	-0.24	0.54
Haub	2005	21	-0.16	0.50	21	0.27	0.06	-0.43	-0.65	-0.22
Liao	2007	15	-0.25	0.52	15	-0.11	0.40	-0.14	-0.47	0.19
Hosseinpour-Niazi	2014	31	-0.22	0.10	31	-0.43	0.08	0.21	0.17	0.26
Poultry and fish (all types)										
Flynn F1	1981	31	-0.27	1.01	31	0.26	0.86	-0.53	-1.00	-0.06
Flynn F2	1981	24	-0.17	0.60	24	0.29	0.77	-0.46	-0.85	-0.07
Flynn M1	1981	38	0.13	0.38	38	-0.13	0.31	0.26	0.10	0.42
Flynn M2	1981	36	-0.15	0.67	36	-0.03	0.27	-0.12	-0.36	0.12
Flynn Beef F1	1982	12	0.29	0.58	12	-0.09	0.31	0.38	0.01	0.75
FlynnPork F1	1982	12	0.34	0.59	12	-0.31	0.23	0.65	0.29	1.01
Flynn Beef F2	1982	17	0.13	1.03	17	-0.15	0.53	0.28	-0.27	0.83
Flynn Pork F2	1982	17	0.03	1.03	17	-0.40	0.54	0.43	-0.12	0.98
Flynn Beef M1	1982	21	0.33	0.38	21	-0.05	0.29	0.38	0.18	0.58
Flynn Pork M1	1982	21	0.25	0.39	21	-0.17	0.29	0.42	0.21	0.63
Flynn Beef M2	1982	26	0.12	0.32	26	-0.29	0.72	0.41	0.11	0.71
Flynn Pork M2	1982	26	0.79	0.79	26	-0.45	0.76	1.24	0.82	1.66
Davidson	1999	89	-0.03	0.59	102	-0.03	0.41	0.00	-0.15	0.15
Zhang	2012	32	-0.21	0.63	29	-0.47	0.41	0.26	0.00	0.52
Sayer	2015	19	-0.10	0.49	19	-0.11	0.32	0.01	-0.25	0.27

Hill BOLD	2015	21	-0.29	0.54	21	-0.42	0.34	0.13	-0.14	0.40
Hill BOLD+	2015	22	-0.25	0.54	21	-0.42	0.34	0.17	-0.10	0.44
Fish or seafood										
Sinclair SF	1987	10	0.11	0.31	10	-0.10	0.10	0.21	0.01	0.41
Sinclair TF	1987	10	0.11	0.31	11	-0.03	0.22	0.14	-0.09	0.37
Gascon	1996	14	-0.01	0.21	14	-0.09	0.14	0.08	-0.05	0.21
Beauchesne-Rondeau FD	2003	17	-0.30	0.33	17	-0.30	0.27	0.00	-0.20	0.20
Ouellet	2008	18	-0.48	0.14	18	-0.25	0.13	-0.23	-0.32	-0.14
Navas-Carretero	2009	25	0.06	0.06	25	-0.02	0.11	0.08	0.03	0.13
Lindqvist	2009	31	-0.29	0.55	31	-0.35	0.46	0.06	-0.19	0.31
Zhang TF	2010	30	0.19	1.22	30	0.08	0.84	0.11	-0.42	0.64
Zhang OF	2010	30	0.19	1.22	32	-0.55	0.64	0.74	0.25	1.23
Grieguer	2014	37	-0.10	0.50	43	-0.10	0.44	0.00	-0.21	0.21
Aadland	2015	19	0.12	0.17	20	-0.17	0.27	0.29	0.15	0.43
Chicken or poultry										
Scott	1994	19	-0.02	0.54	19	-0.08	0.28	0.06	-0.21	0.33
Beauchesne-Rondeau CD	2003	17	-0.30	0.33	17	-0.40	0.27	0.10	-0.10	0.30
Melanson	2003	21	-0.29	1.21	35	-0.19	0.88	-0.10	-0.69	0.49
Mahon CD	2007	14	-0.26	0.50	16	-0.28	0.51	0.02	-0.34	0.38
Animal protein										
Mamo	2005	10	-0.10	0.34	10	0.20	0.20	-0.30	-0.54	-0.06
Nowson	2009	45	0.01	0.45	47	0.09	0.55	-0.08	-0.28	0.13
Roussell BOLD	2012	36	-0.07	0.31	33	-0.06	0.22	-0.01	-0.14	0.12
Rousell BOLD+	2012	36	-0.12	0.24	35	-0.04	0.22	-0.08	-0.19	0.03
Thorning chesee	2015	14	-0.16	0.31	14	0.03	0.33	-0.19	-0.43	0.05
Carbohydrates										
Mahon carb	2007	14	-0.26	0.50	14	-0.11	0.70	-0.15	-0.60	0.30
Thorning carb	2015	14	-0.16	0.31	14	0.05	0.24	-0.21	-0.42	-0.01
Foerster	2014	20	0.10	0.62	20	0.20	0.63	-0.10	-0.49	0.29
Usual diet										
Hodgson	2006	29	-0.05	0.99	31	0.01	0.54	-0.06	-0.47	0.35
Murphy	2012	71	-0.20	0.68	69	-0.10	0.55	-0.10	-0.31	0.11

Mean changes for each group were calculated from values at follow-up minus values at baseline. SD, Standard Deviation; LCI, low confidence interval; UCI, upper confidence interval. HC G1, first group consuming high cholesterol diet; HC G2, second group consuming high cholesterol diet; LC G1, first group consuming low-cholesterol diet; LC G2, second group consuming low-cholesterol diet; F1, first female group; F2, second female group; M1, fist male group; M2, second male group; F, fish; OF, oily fish; C, chicken; carb, carbohydrates.

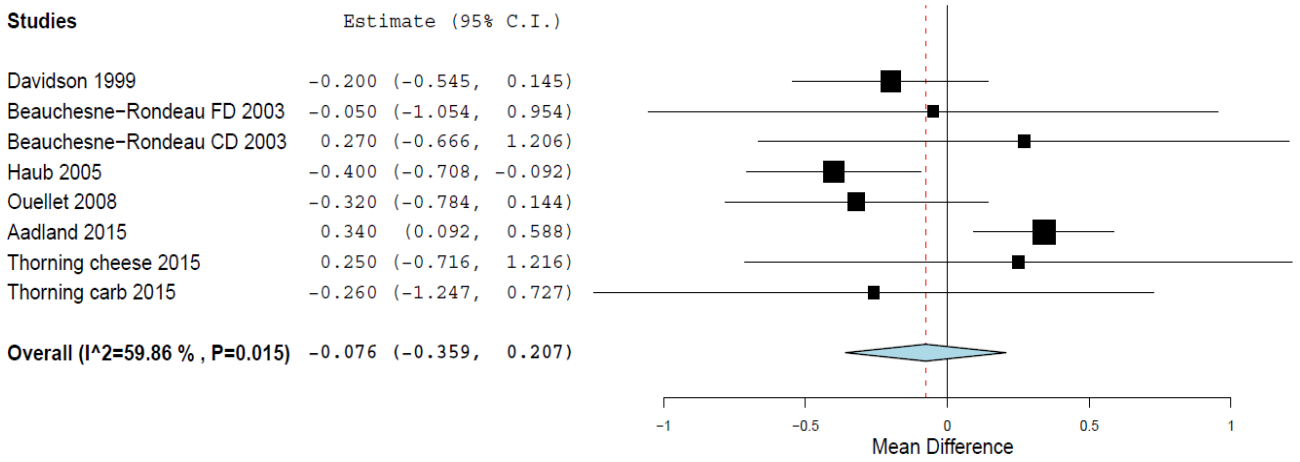
Supplemental Table 6. Subgroup analyses on the relative effects of red meat intake on blood lipids and lipoproteins compared to all comparison diets together								
	Total Cholesterol		**LDL-cholesterol**		**HDL-cholesterol**		**Triglycerides**	
	Mean Difference (95% CI)	n	Mean Difference (95% CI)	n	Mean Difference (95% CI)	n	Mean Difference (95% CI)	n
Subgroups								
Follow-up > 6 weeks in red meat and comparison diet	-0.06 (-0.14 to 0.02)	31	-0.003 (-0.091 to 0.085)	17	-0.01 (-0.05 to 0.03)	30	0.10 (0.02 to 0.19)	30
Follow-up < 6 weeks in red meat and comparison	-0.03 (-0.10 to 0.05)	23	-0.04 (-0.09 to 0.01)	23	0.01 (-0.03 to 0.05)	26	0.01 (-0.07 to 0.09)	18
Crossover design	-0.09 (-0.16 to -0.03)	35	-0.01 (-0.09 to 0.06)	21	-0.003 (-0.03 to 0.03)	38	0.11 (0.03 to 0.19)	30
Parallel design	0.01 (-0.07 to 0.09)	19	-0.03 (-0.10 to 0.03)	19	0.01 (-0.03 to 0.05)	18	-0.02 (-0.13 to 0.07)	18
Quality ≥ 20 in red meat and comparison diet	-0.02 (-0.10 to 0.07)	24	-0.03 (-0.10 to 0.04)	24	-0.01 (-0.05 to 0.03)	24	-0.02 (-0.10 to 0.07)	23
Quality < 20 in red meat and comparison	-0.07 (-0.14 to 0.01)	30	0.001 (-0.05 to 0.05)	16	0.01 (-0.02 to 0.05)	32	0.10 (-0.02 to 0.22)	25
High dietary adherence in red meat and comparison diet	0.02 (-0.06 to 0.10)	23	-0.02 (-0.09 to 0.05)	25	0.004 (-0.04 to 0.04)	26	0.28 (-0.05 to 0.11)	21
Low dietary adherence in red meat and comparison diet	-0.13 (-0.20 to -0.05)	31	-0.03 (-0.09 to 0.04)	15	-0.001 (-0.04 to 0.03)	30	0.10 (-0.01 to 0.22)	27
Red meat interventions using only lean red meat	-0.05 (-0.12 to -0.02)	19	-0.08 (-0.15 to -0.02)	19	0.03 (-0.01 to 0.06)	20	0.01 (-0.08 to 0.09)	17
Red meat interventions allowing non-lean	-0.05 (-0.13 to 0.04)	35	0.04 (-0.03 to 0.11)	21	-0.01 (-0.05 to 0.03)	36	0.10 (0.02 to 0.18)	31

red meat								
Normal cholesterol in both red meat and comparison diet	-0.08 (-0.19 to 0.03)	25	-0.02 (-0.09 to 0.06)	11	0.03 (-0.02 to 0.08)	28	0.15 (0.03 to 0.26)	22
Hypercholesterolemia in both red meat and comparison diet	-0.03 (-0.11 to 0.05)	13	-0.04 (-0.12 to 0.03)	13	-0.03 (-0.07 to 0.01)	13	0.02 (-0.08 to 0.11)	12
Red meat interventions funded by the red meat industry	-0.06 (-0.15 to 0.03)	26	-0.01 (-0.08 to 0.05)	18	0.02 (-0.02 to 0.05)	26	0.11 (0.00 to 0.22)	25
Red meat interventions not funded by the red meat industry	-0.05 (-0.12 to 0.02)	28	-0.04 (-0.12 to 0.04)	22	-0.01 (-0.05 to 0.03)	30	0.03 (-0.06 to 0.12)	23
Saturated fat intake higher in red meat than comparison diet	-0.04 (-0.15 to 0.06)	26	-0.002 (-0.116 to 0.113)	15	0.01 (-0.04 to 0.06)	27	0.17 (0.05 to 0.28)	24
Saturated fat intake higher in comparison diet	-0.14 (-0.29 to 0.01)	5	-0.13 (-0.27 to 0.00)	4	-0.04 (-0.09 to 0.01)	5	0.02 (-0.10 to 0.13)	5
Saturated fat intake not different between red meat and comparison diet	-0.04 (-0.13 to 0.05)	13	-0.02 (-0.11 to 0.08)	14	0.00 (-0.05 to 0.04)	14	-0.01 (-0.11 to 0.09)	13

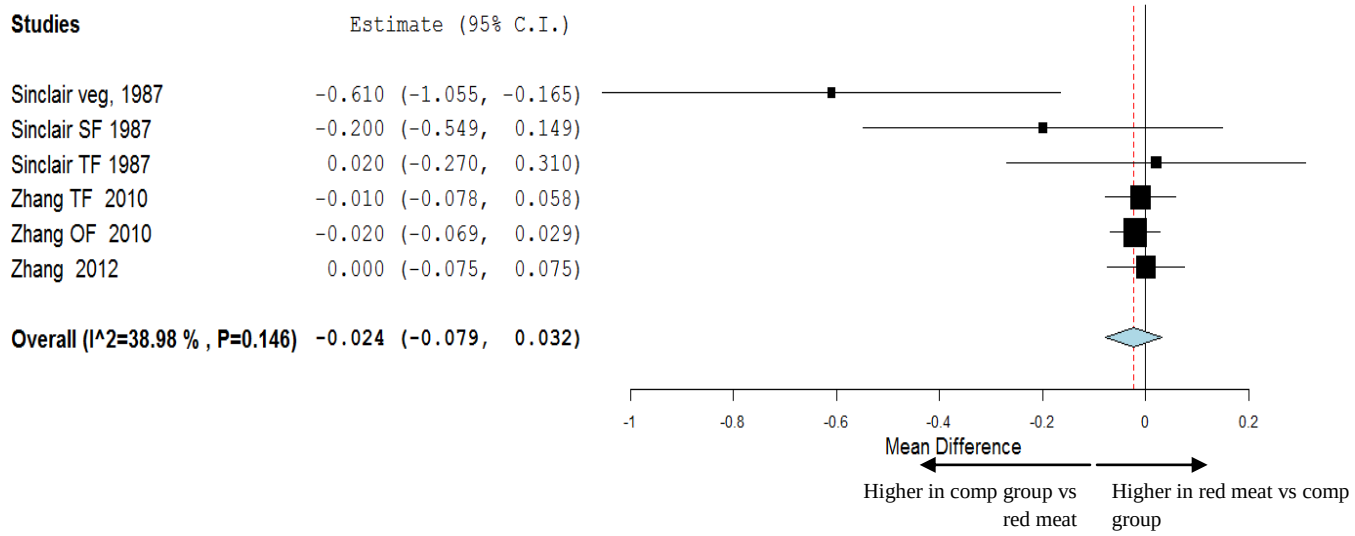
Random effects model meta-analysis for changes in blood lipids from randomized controlled trials comparing red meat interventions with a comparison group. Positive values for total cholesterol, LDL, and triglycerides indicate that blood lipids were higher in the red meat compared to comparison groups. Positive values indicate that HDL was higher in the comparison diet compared to red meat intervention. Adherence measured using the question "Was there high adherence to the intervention protocols for each treatment group?" in the quality score. n indicates the number of intervention comparisons.

Supplemental Figure 1. Random effects meta-analysis for changes in total:HDL cholesterol and HDL:LDL ratios (mmol/L) from randomized controlled trials comparing red meat interventions with all comparison diets together.

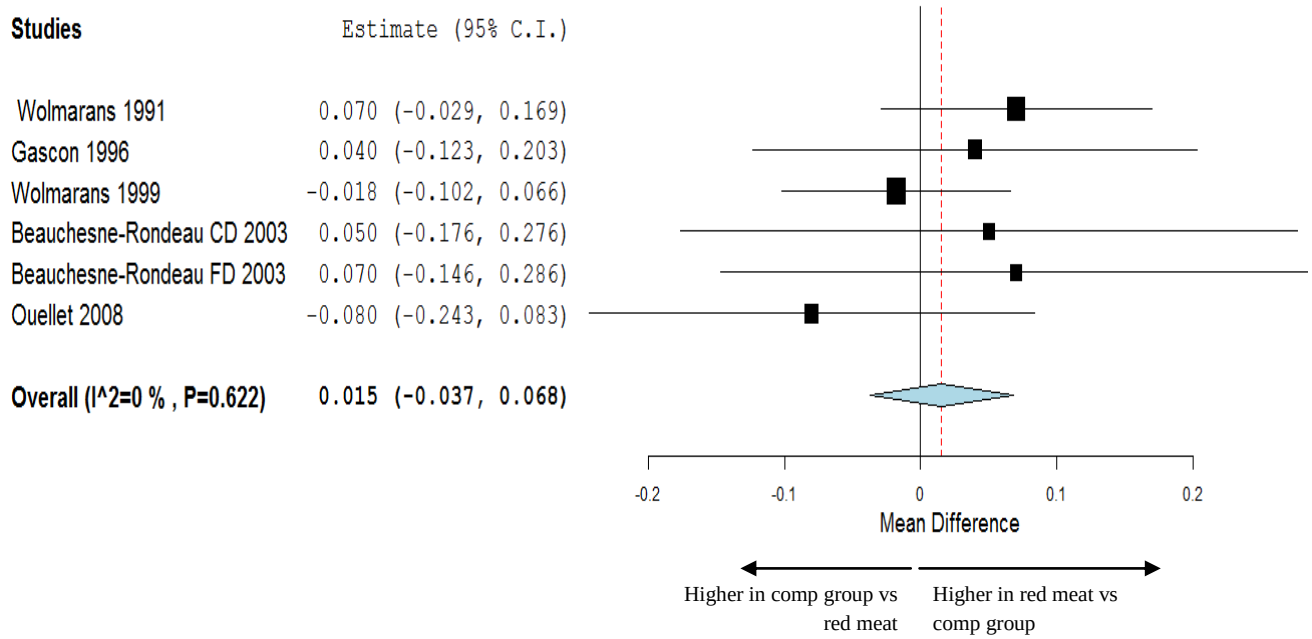
A) TOTAL:HDL cholesterol ratio



B) HDL:LDL cholesterol ratio

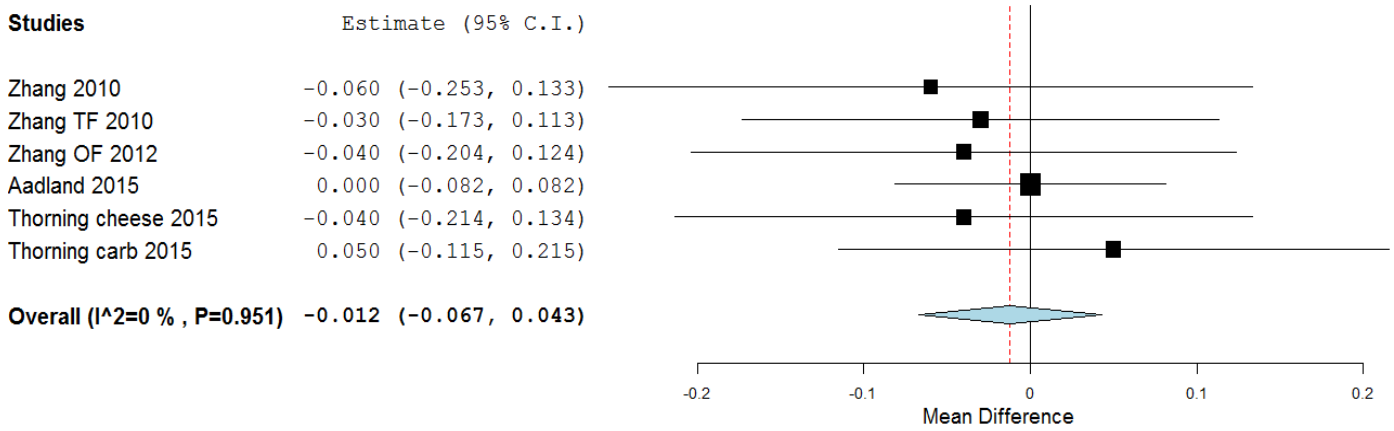


Supplemental Figure 2. Random effects meta-analysis for changes in VLDL cholesterol (mmol/L) from randomized controlled trials comparing red meat interventions with all comparison diets together.

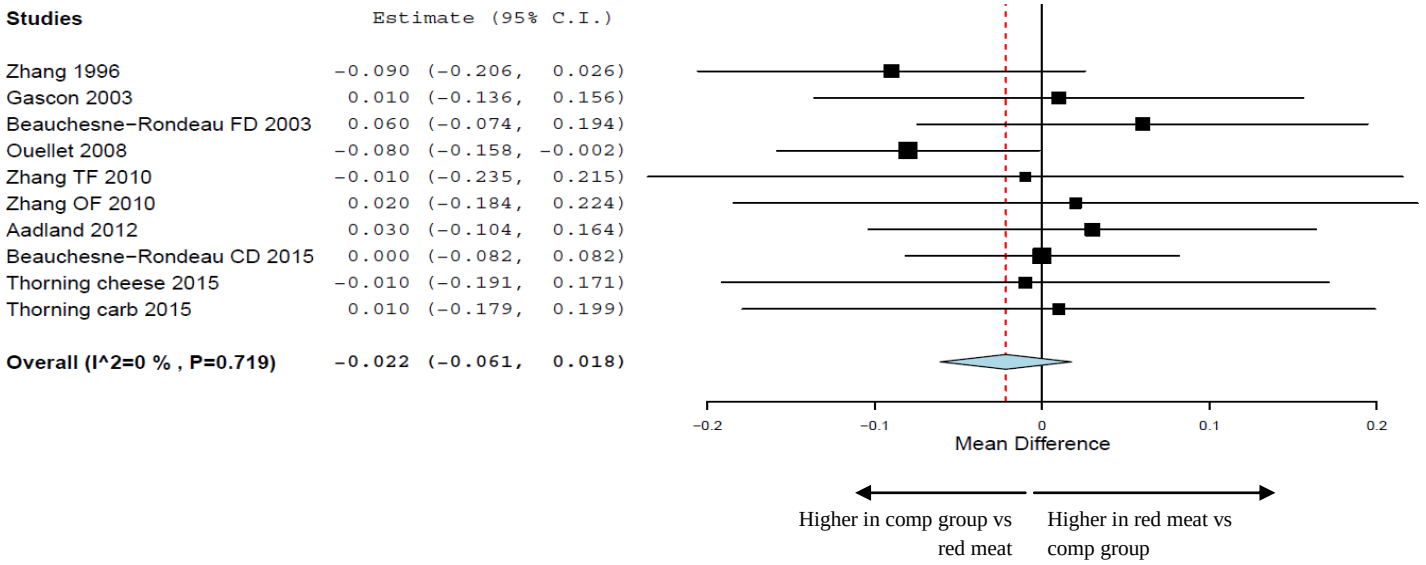


Supplemental Figure 3. Random effects meta-analysis for changes in apolipoprotein A-1 and B (mg/dL) from randomized controlled trials comparing red meat interventions with all comparison diets together.

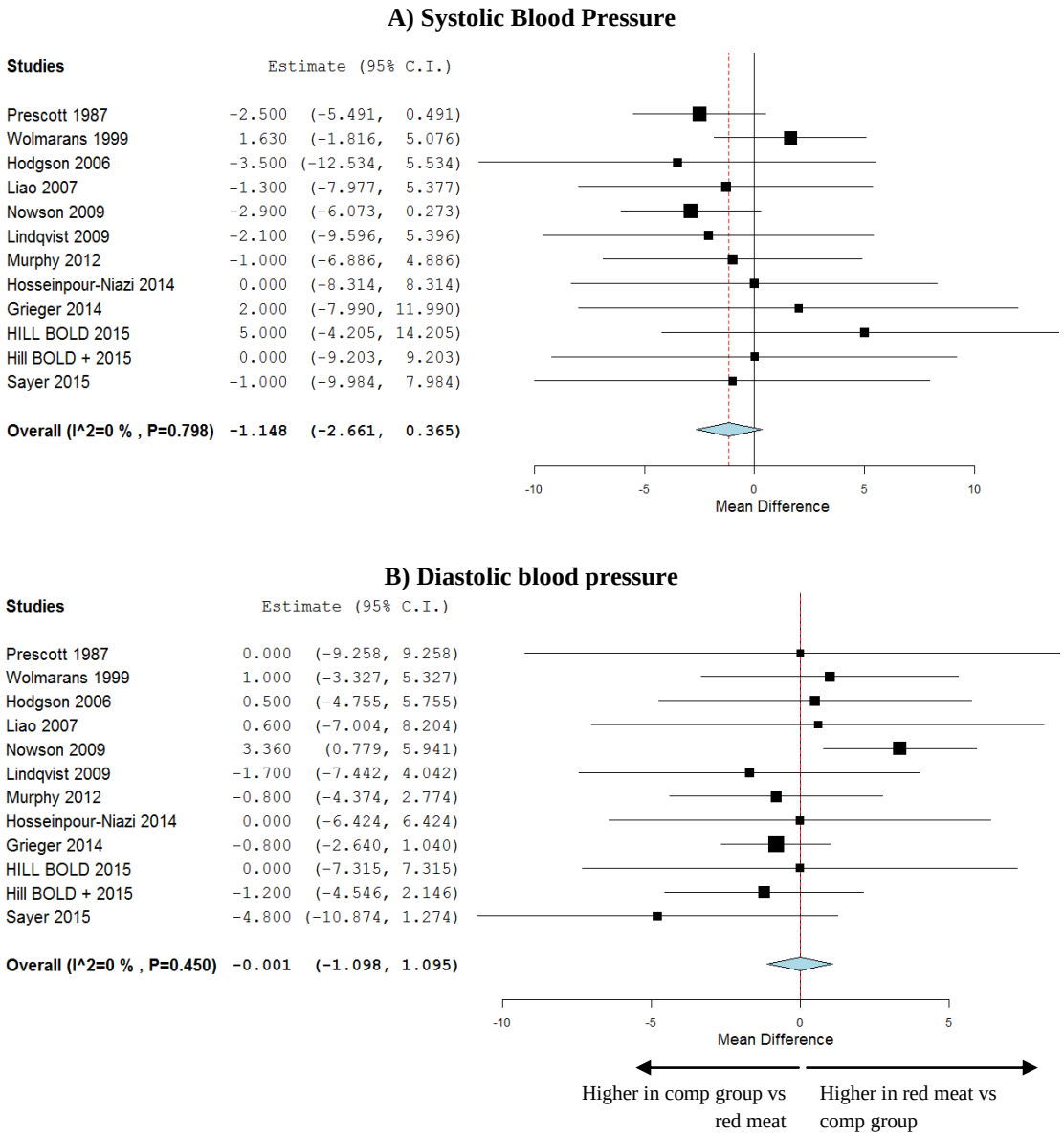
A) Apolipoprotein A-1



B) Apolipoprotein B

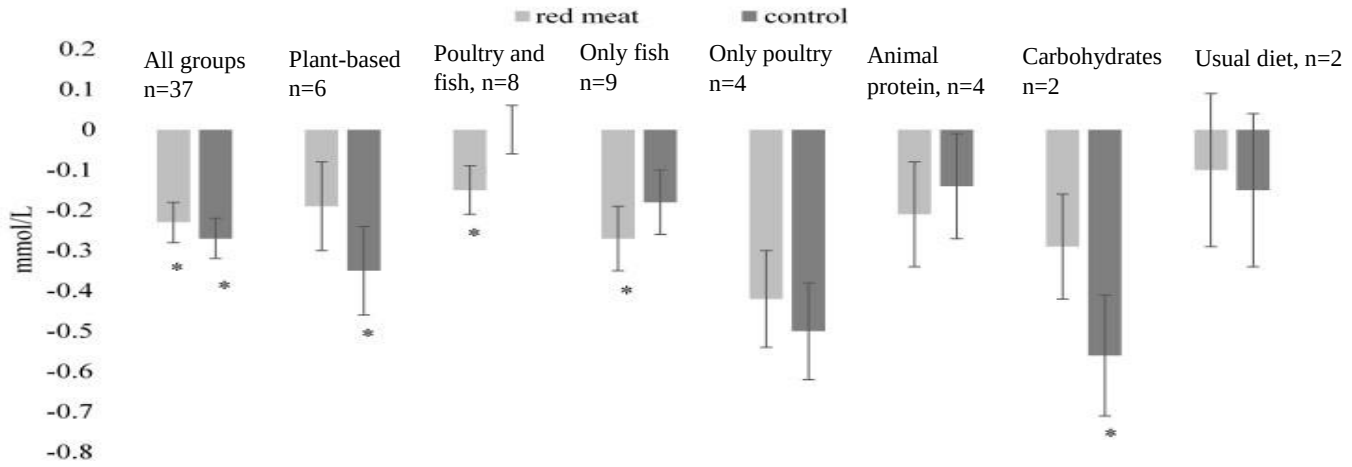


Supplemental Figure 4. Random effects meta-analysis for changes in systolic and diastolic blood pressure (mmHg) from randomized controlled trials comparing red meat interventions with all comparison diets together.

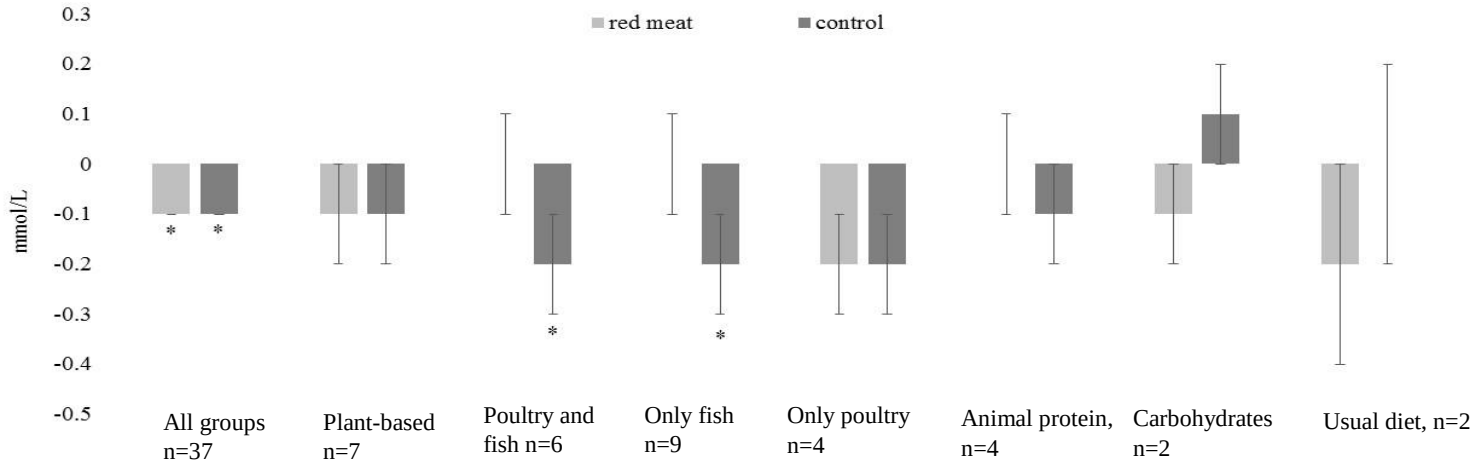


Supplemental Figure 5. Intervention-specific changes from pre- to post-intervention in total cholesterol and triglycerides concentrations.

A) Total cholesterol



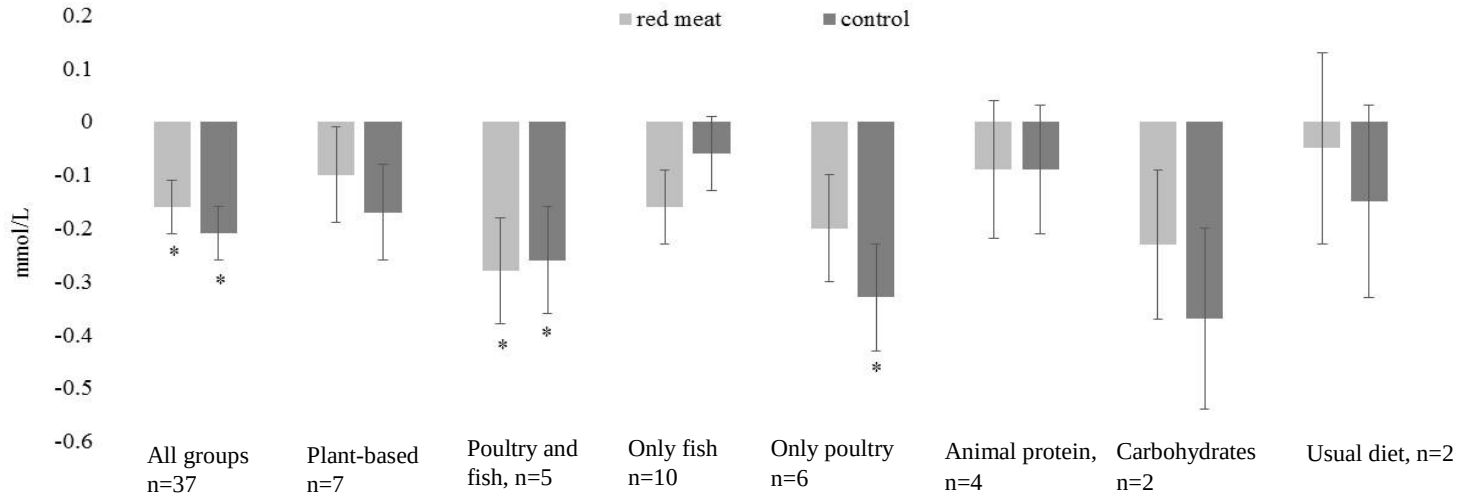
B) Triglycerides



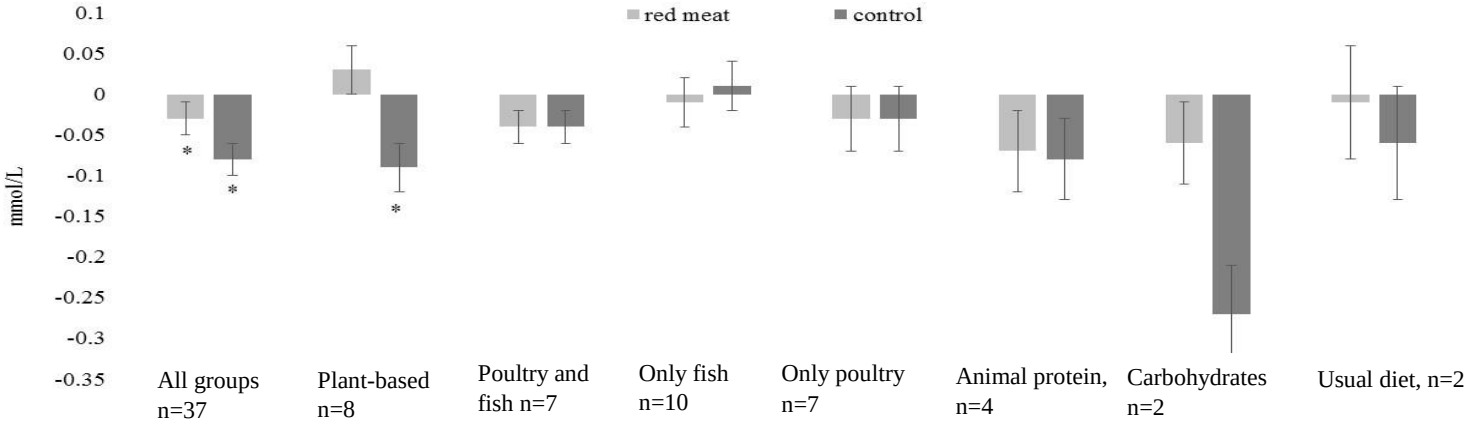
Changes in **total cholesterol and triglycerides** from pre to post intervention are represented graphically as LS means ± SE of LS mean. *indicates a significant change from pre-to post-intervention analyzed via a repeated measures ANOVA adjusted for sample size and length of intervention.

Supplemental Figure 6. Intervention-specific changes from pre- to post-intervention in LDL and HDL cholesterol concentrations

A) LDL cholesterol



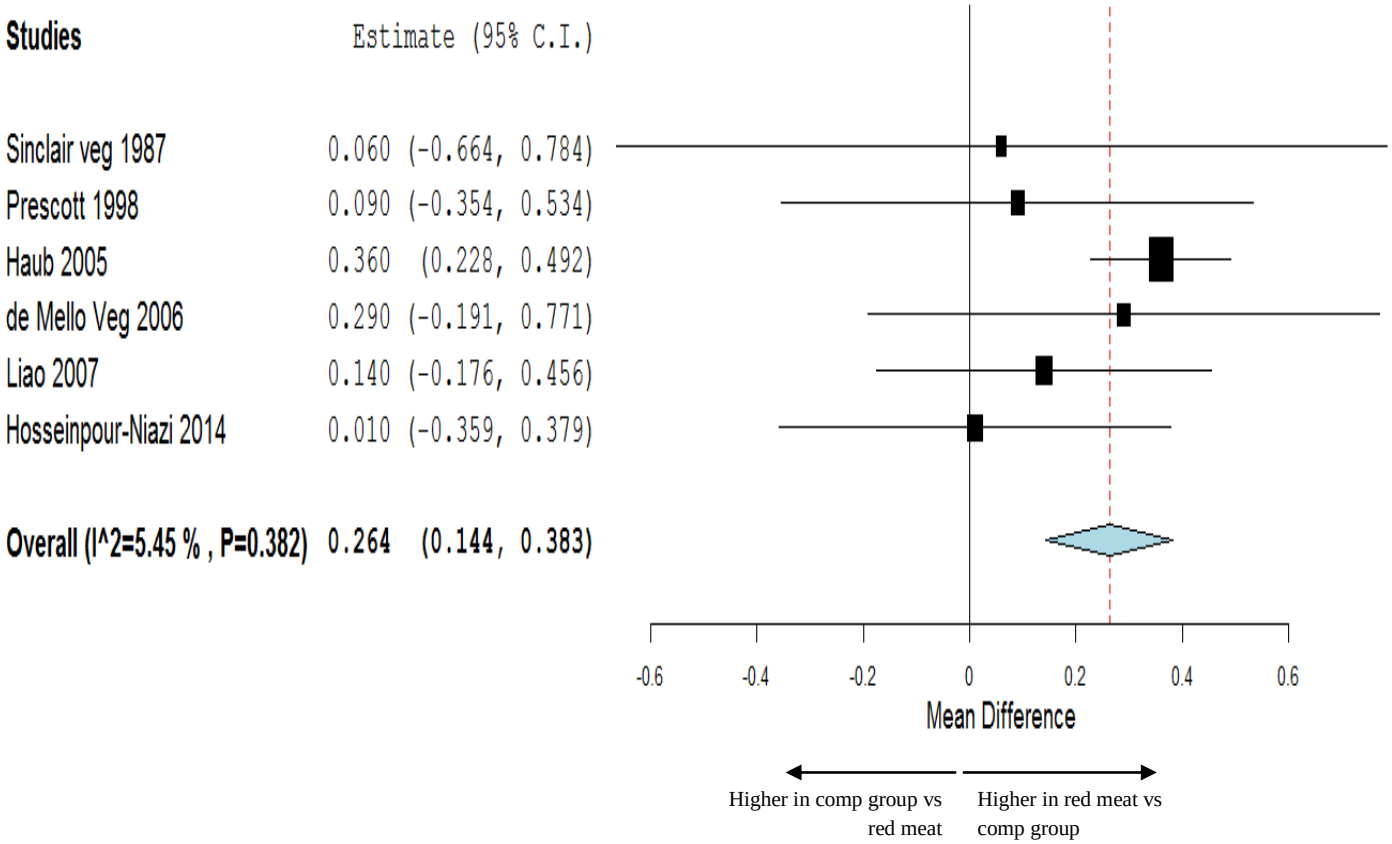
B) HDL cholesterol



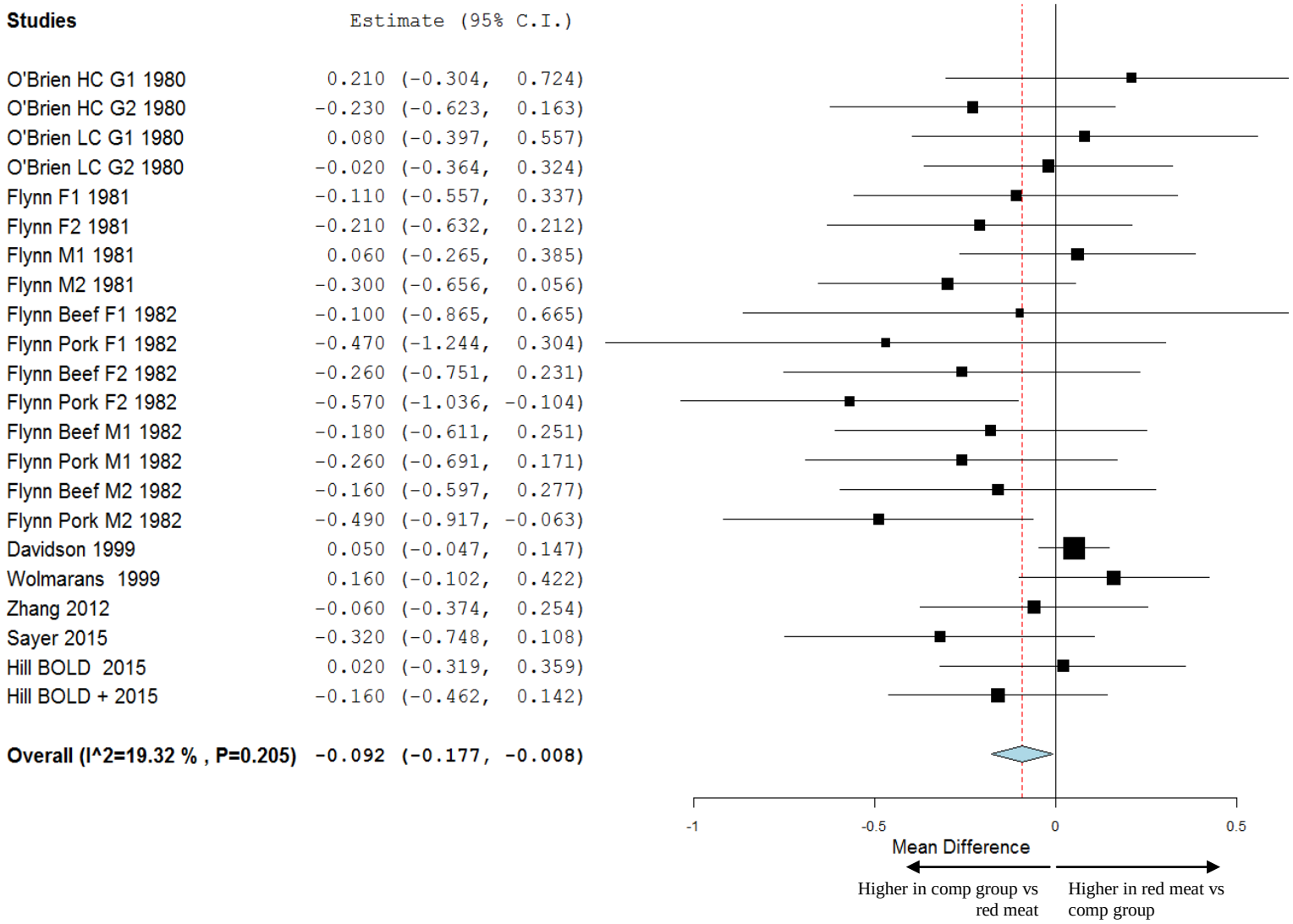
Changes in **LDL and HDL cholesterol** from pre to post intervention are represented graphically as LS means ± SE of LS mean. *indicates a significant change over time within intervention analyzed via a repeated measures ANOVA adjusted for sample size and length of intervention.

Supplemental Figure 7. Random effects meta-analysis for changes in blood total cholesterol concentrations (mmol/L) from controlled trials comparing red meat interventions with comparison interventions stratified by comparison diets.

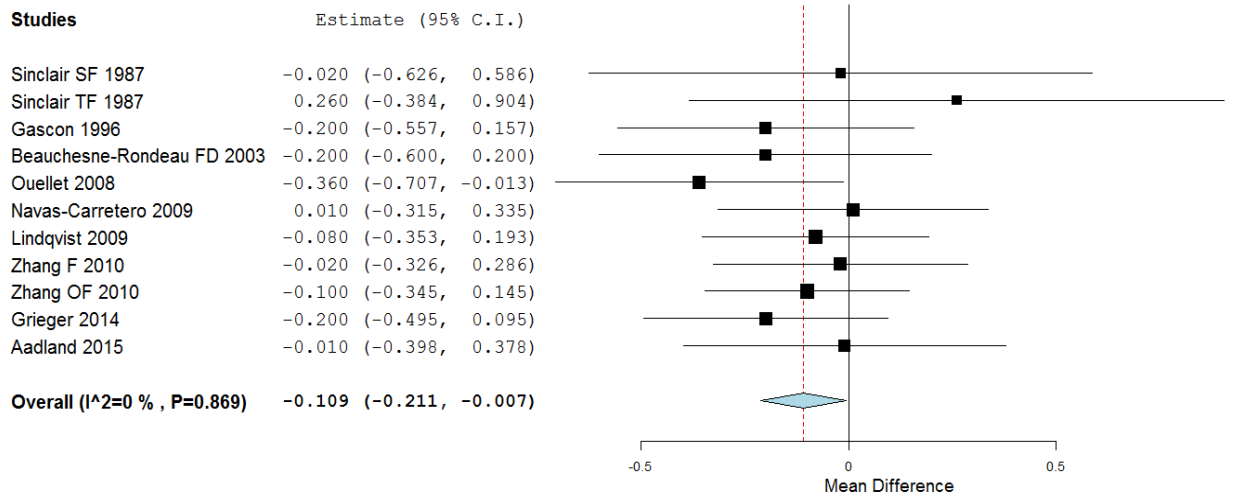
A) High-quality plant foods (legumes, soy, nuts and other plant protein sources)



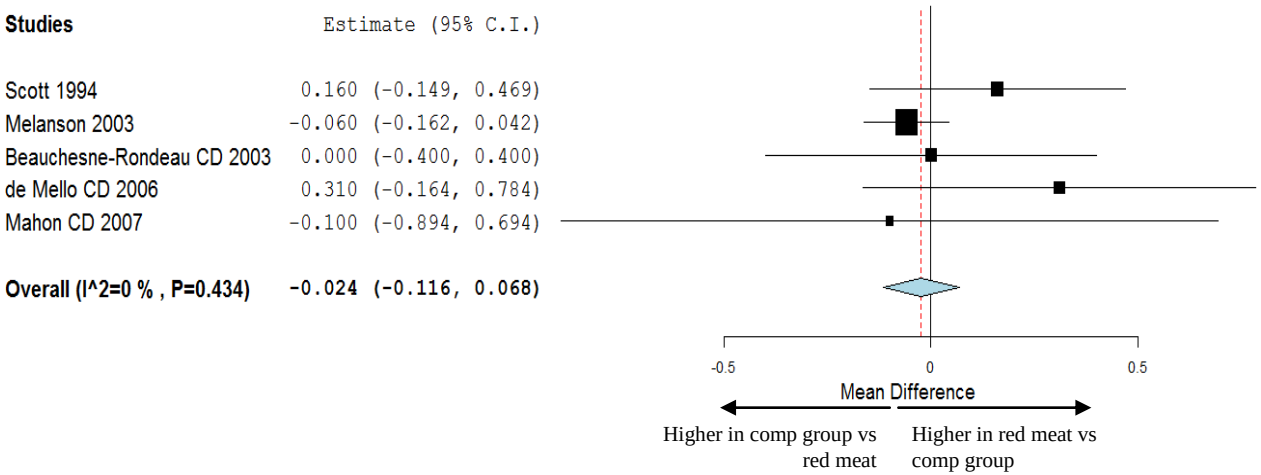
B) Comparison group combining protein sources from chicken, poultry, and all types of fish



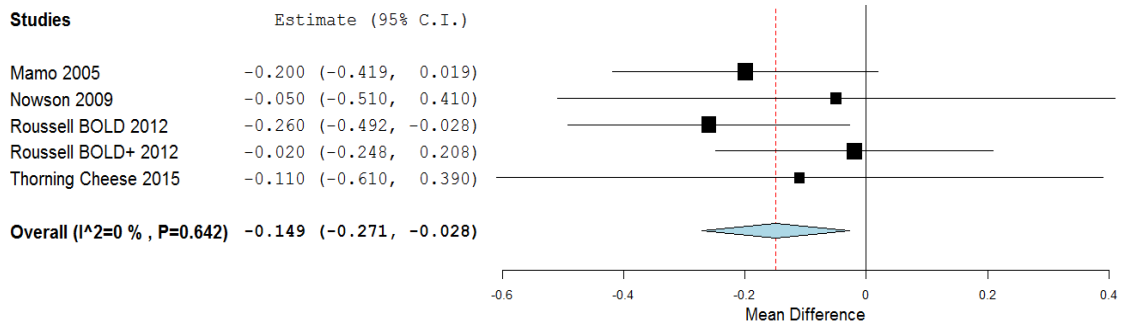
C) Comparison group protein sources fish only (fish, fatty fish and seafood)



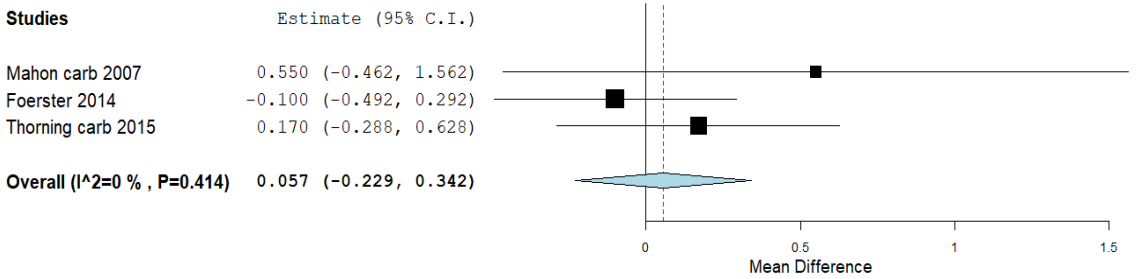
D) Comparison group combining protein sources from chicken and poultry



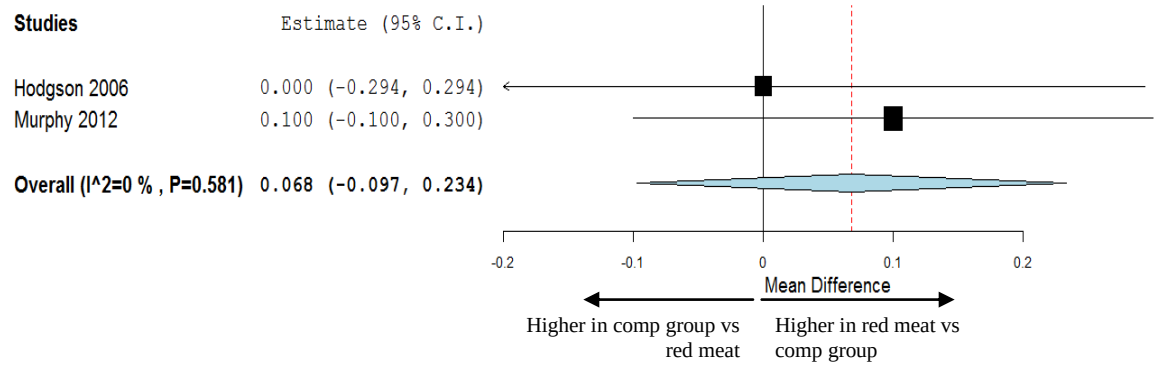
E) Comparison group combining animal protein (fish, poultry, red meat, and dairy)



F) Comparison group replacement with carbohydrates

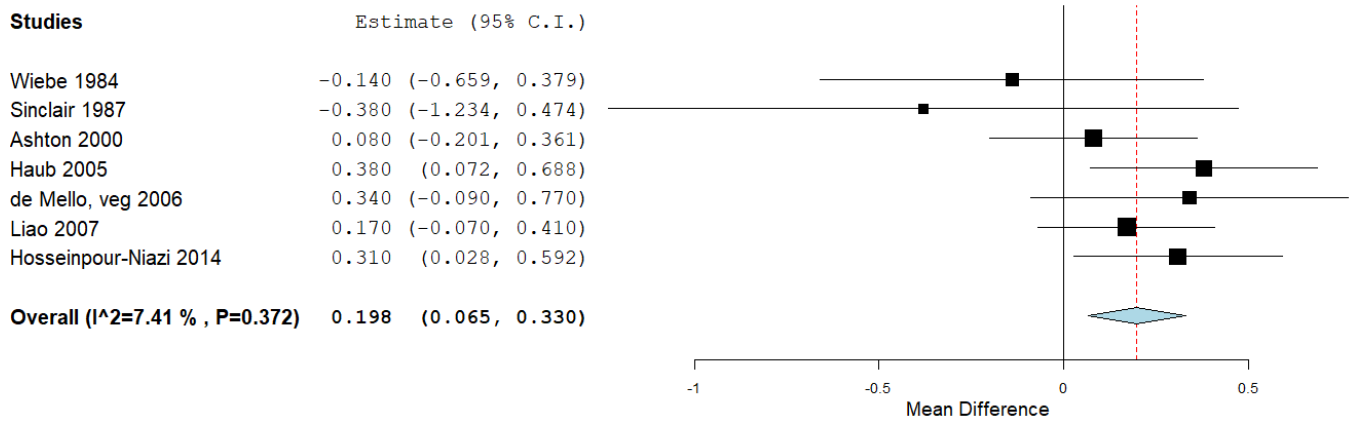


G) Comparison group replacement with usual diet

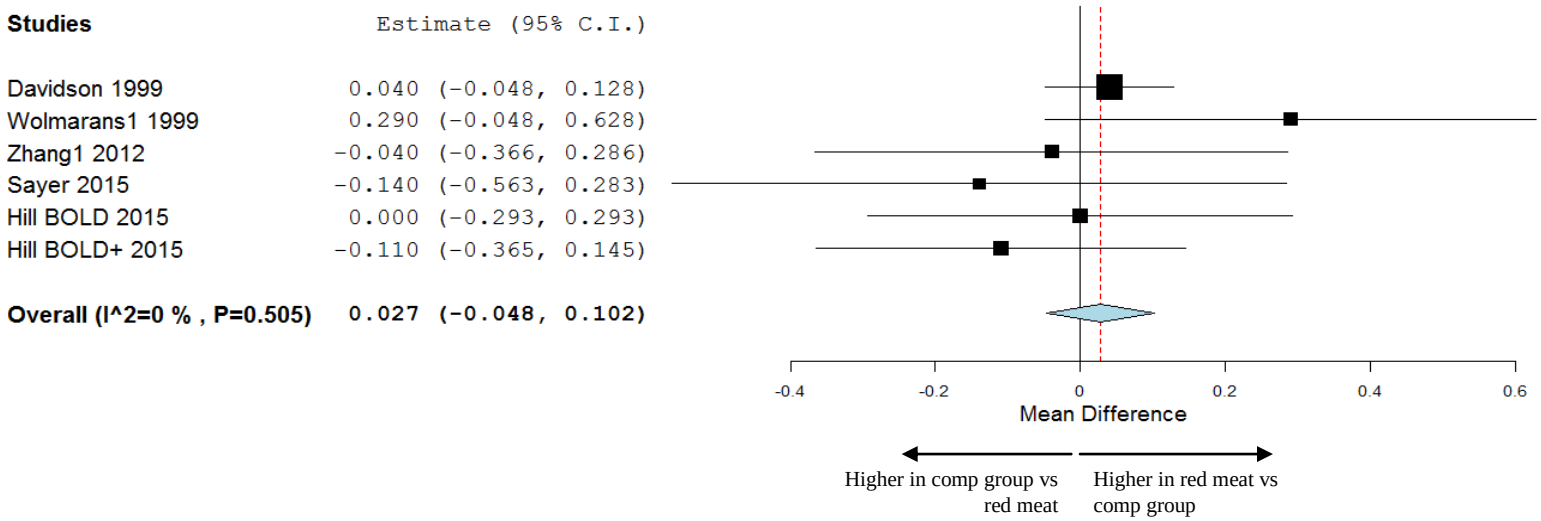


Supplemental Figure 8. Random effects meta-analysis for changes in LDL cholesterol concentrations (mmol/L) from controlled trials comparing red meat interventions with comparison interventions stratified by comparison diet.

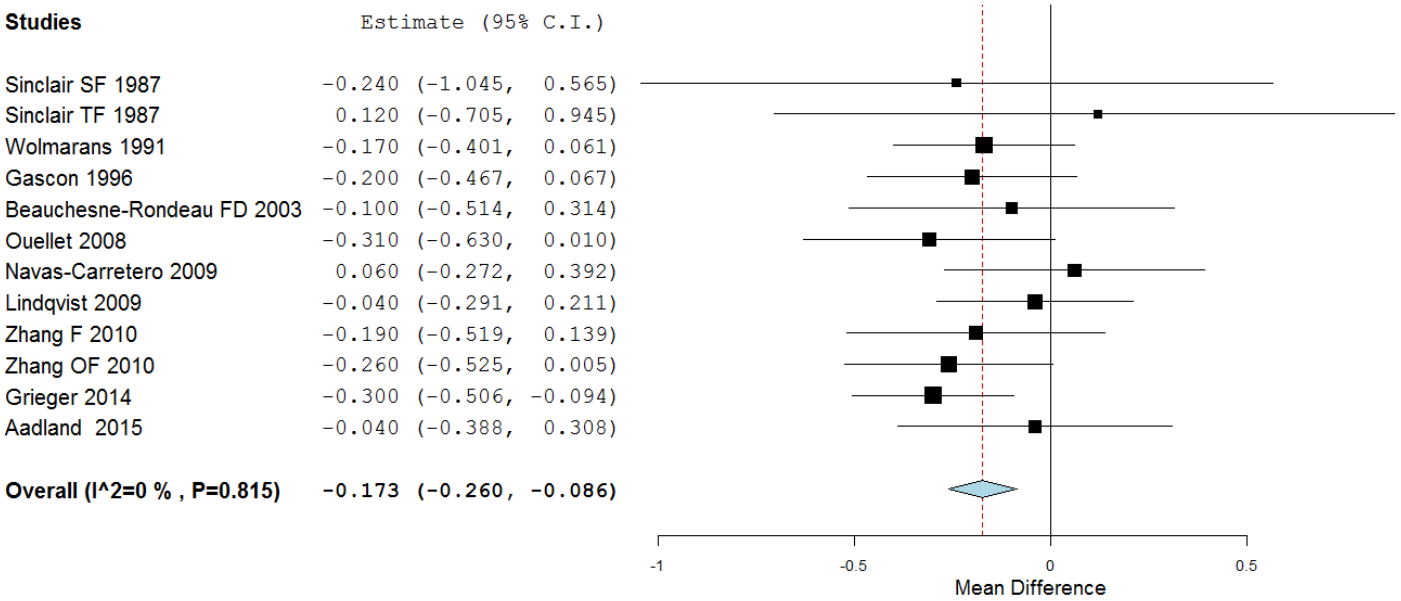
A) High-quality plant foods (legumes, soy, nuts and other plant protein sources)



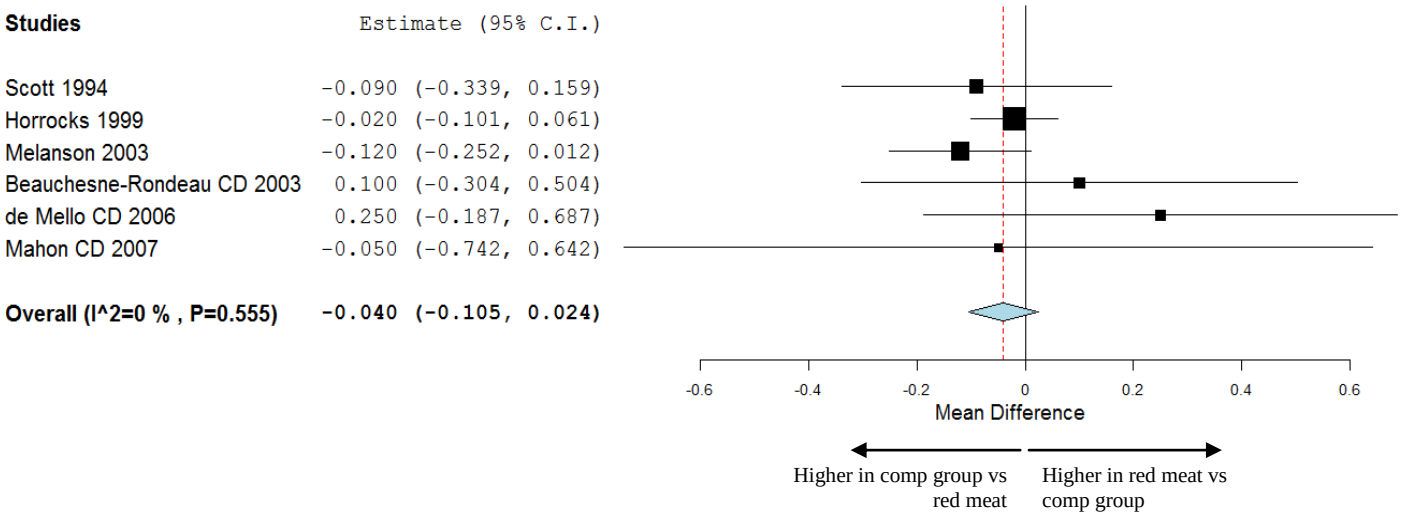
B) Comparison group combining protein sources from chicken, poultry, and all types of fish



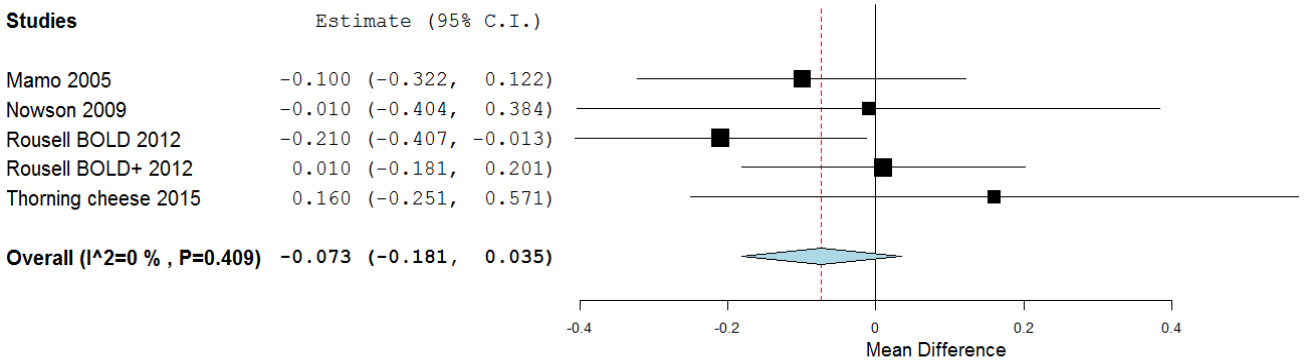
C) Comparison group protein sources fish only (fish, fatty fish and seafood)



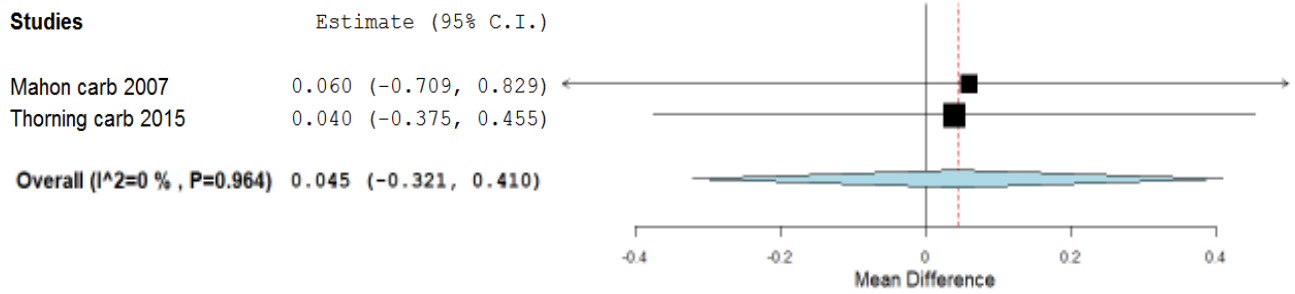
D) Comparison group combining protein sources from chicken and poultry



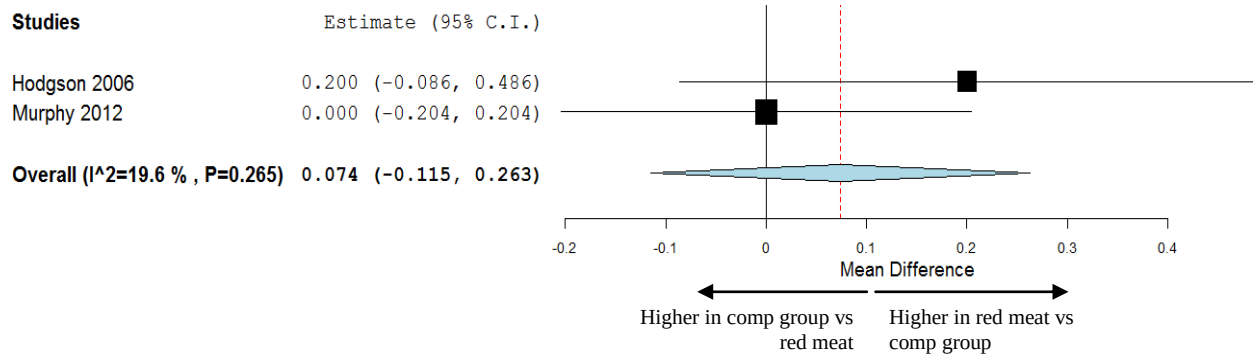
E) Comparison group combining animal protein (fish, poultry, red meat, and dairy)



F) Comparison group replacement with carbohydrates

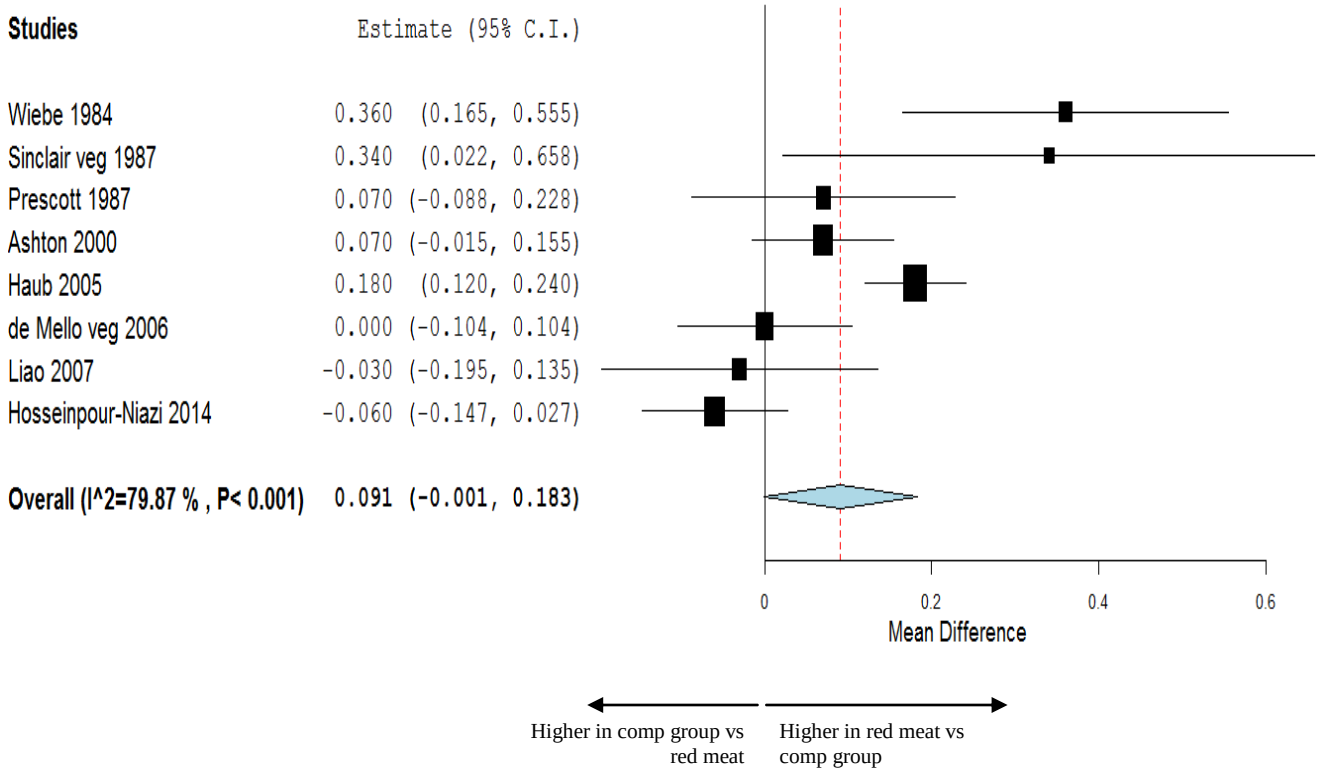


G) Comparison group replacement with usual diet

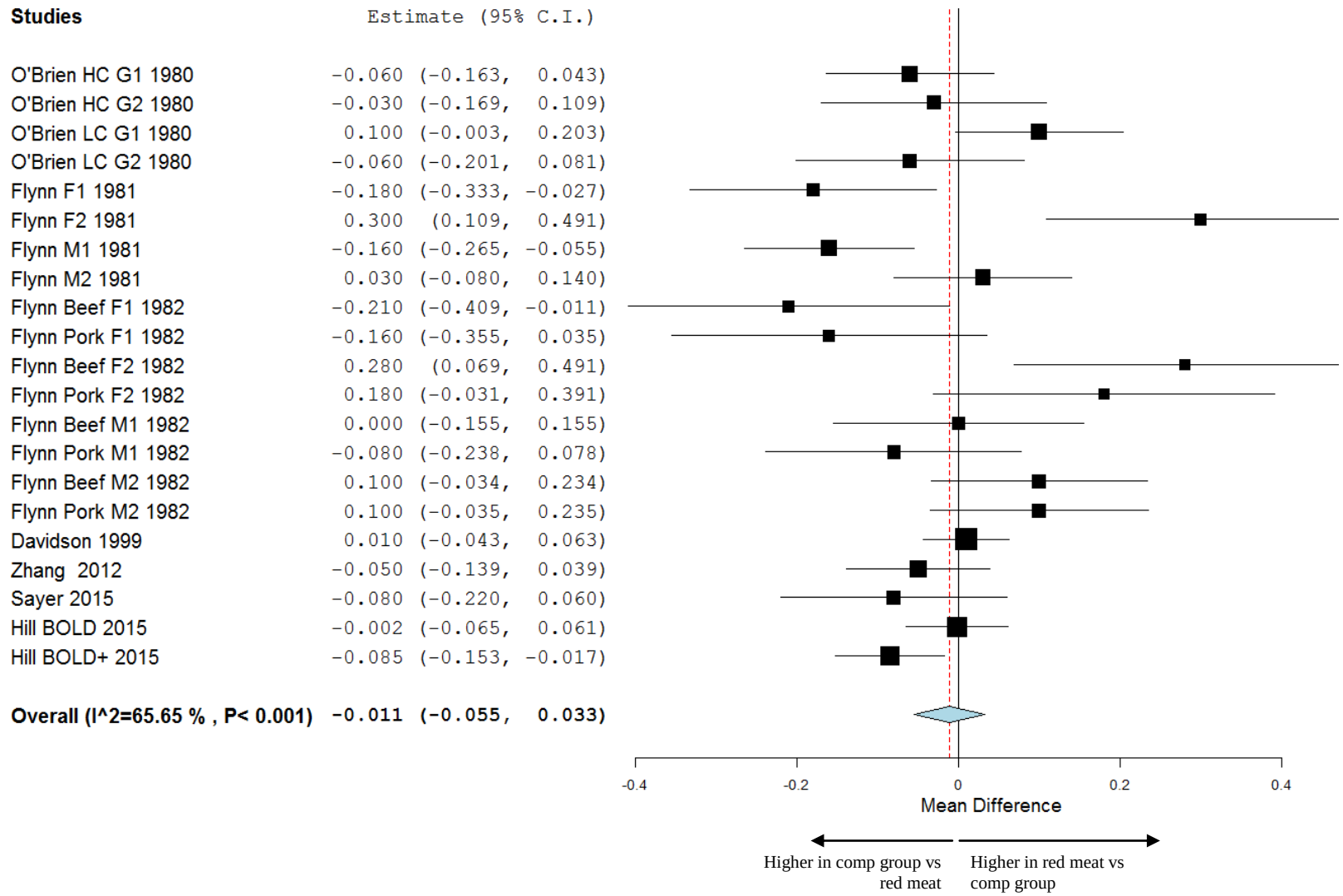


Supplemental Figure 9. Random effects meta-analysis for changes in HDL cholesterol concentrations (mmol/L) from randomized controlled trials comparing red meat interventions with comparison interventions stratified by comparison diets.

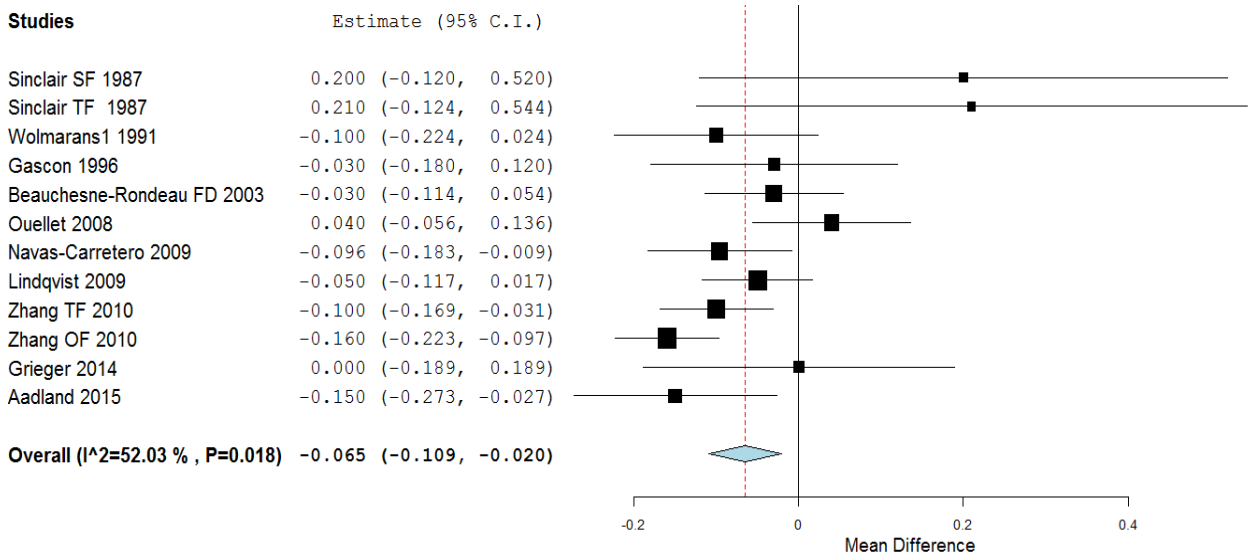
A) High-quality plant foods (legumes, soy, nuts and other plant protein sources)



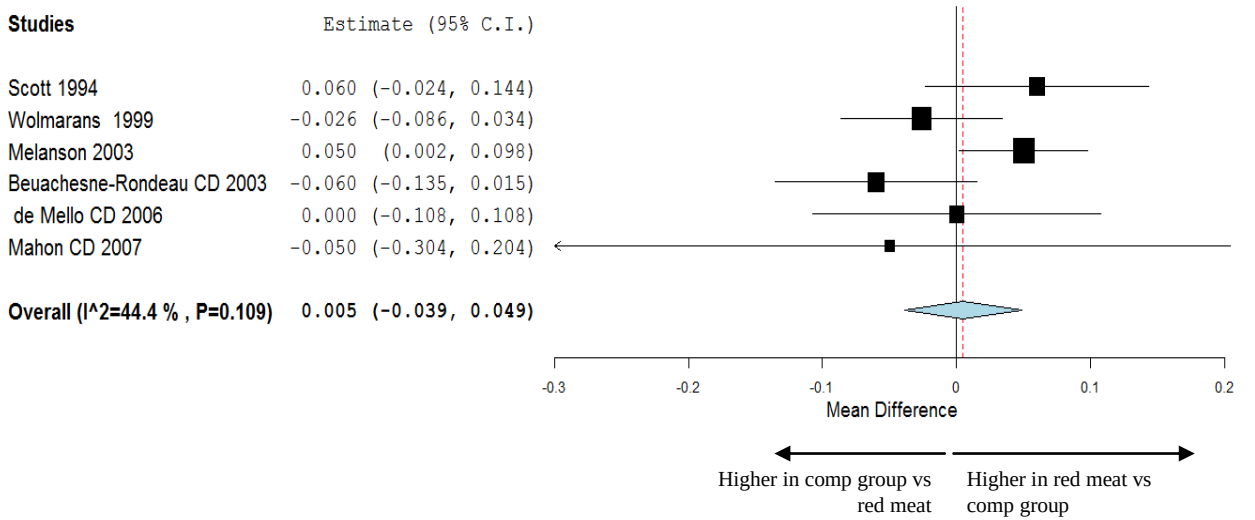
B) Comparison group combining protein sources from chicken, poultry, and all types of fish



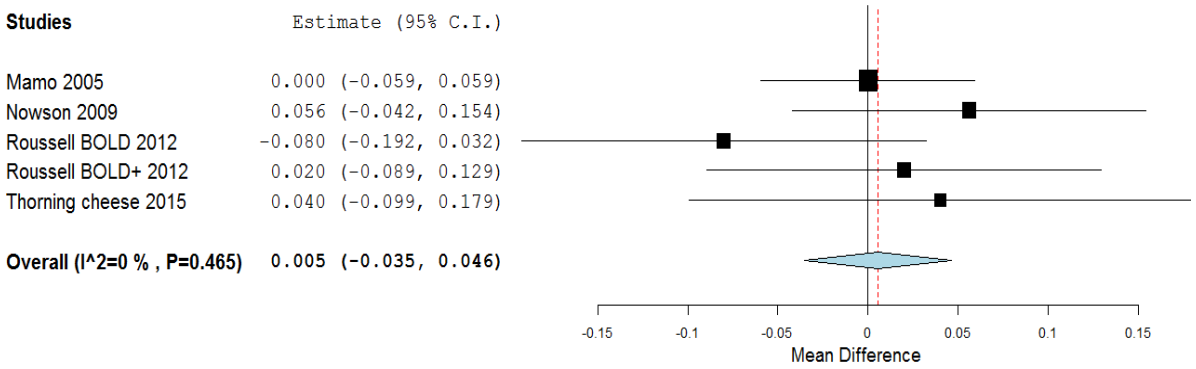
C) Comparison group protein sources fish only (fish, fatty fish and seafood)



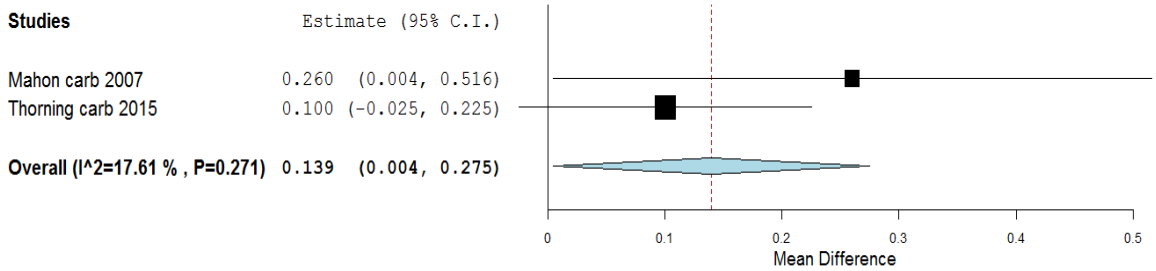
D) Comparison group combining protein sources from chicken and poultry



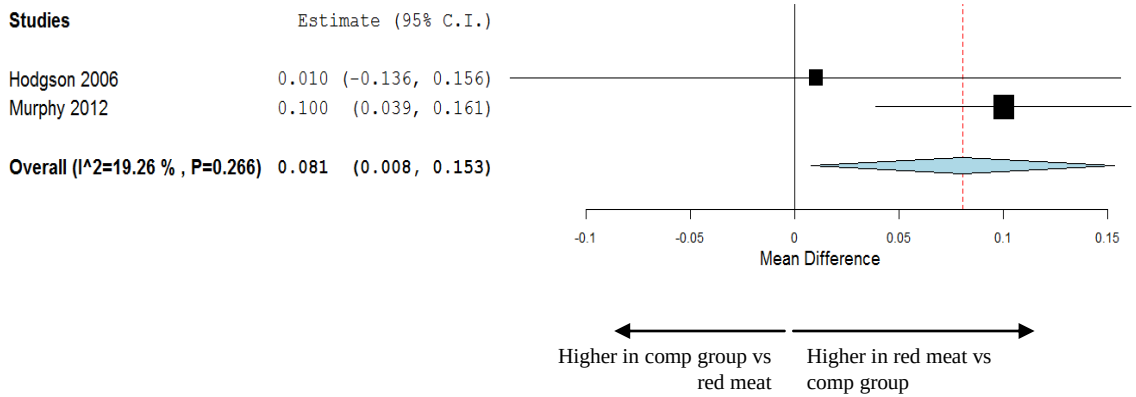
E) Comparison group combining animal protein (fish, poultry, red meat, and dairy)



F) Comparison group replacement with carbohydrates

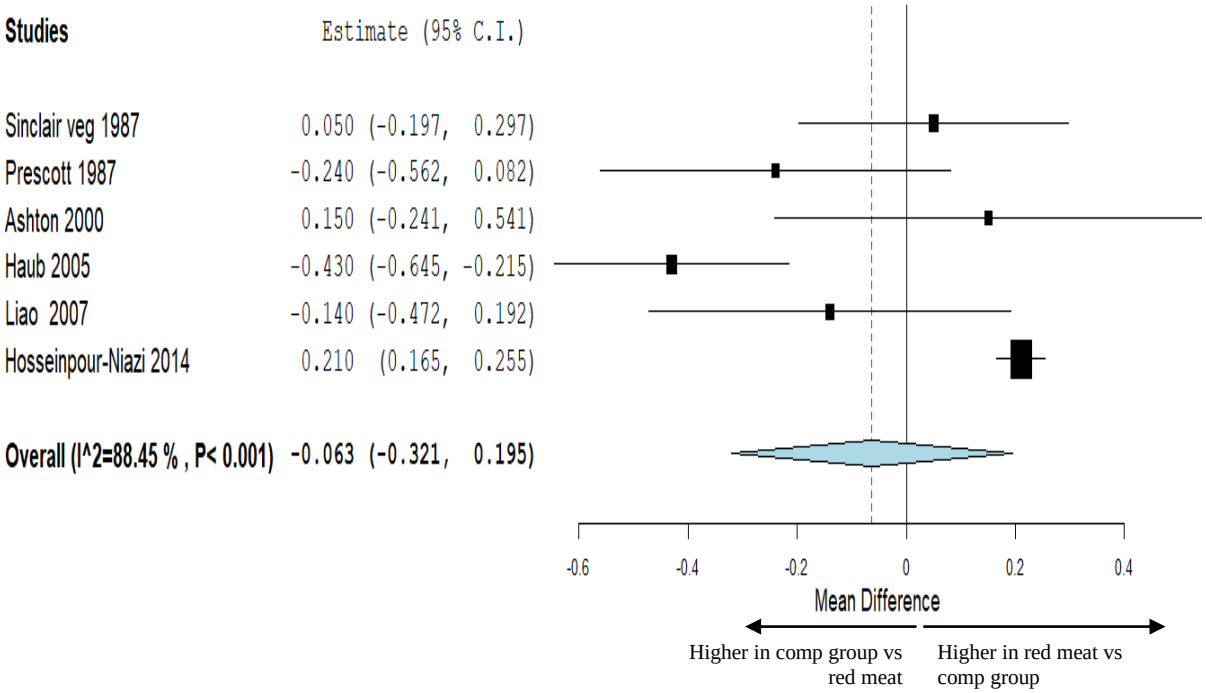


G) Comparison group replacement with usual diet

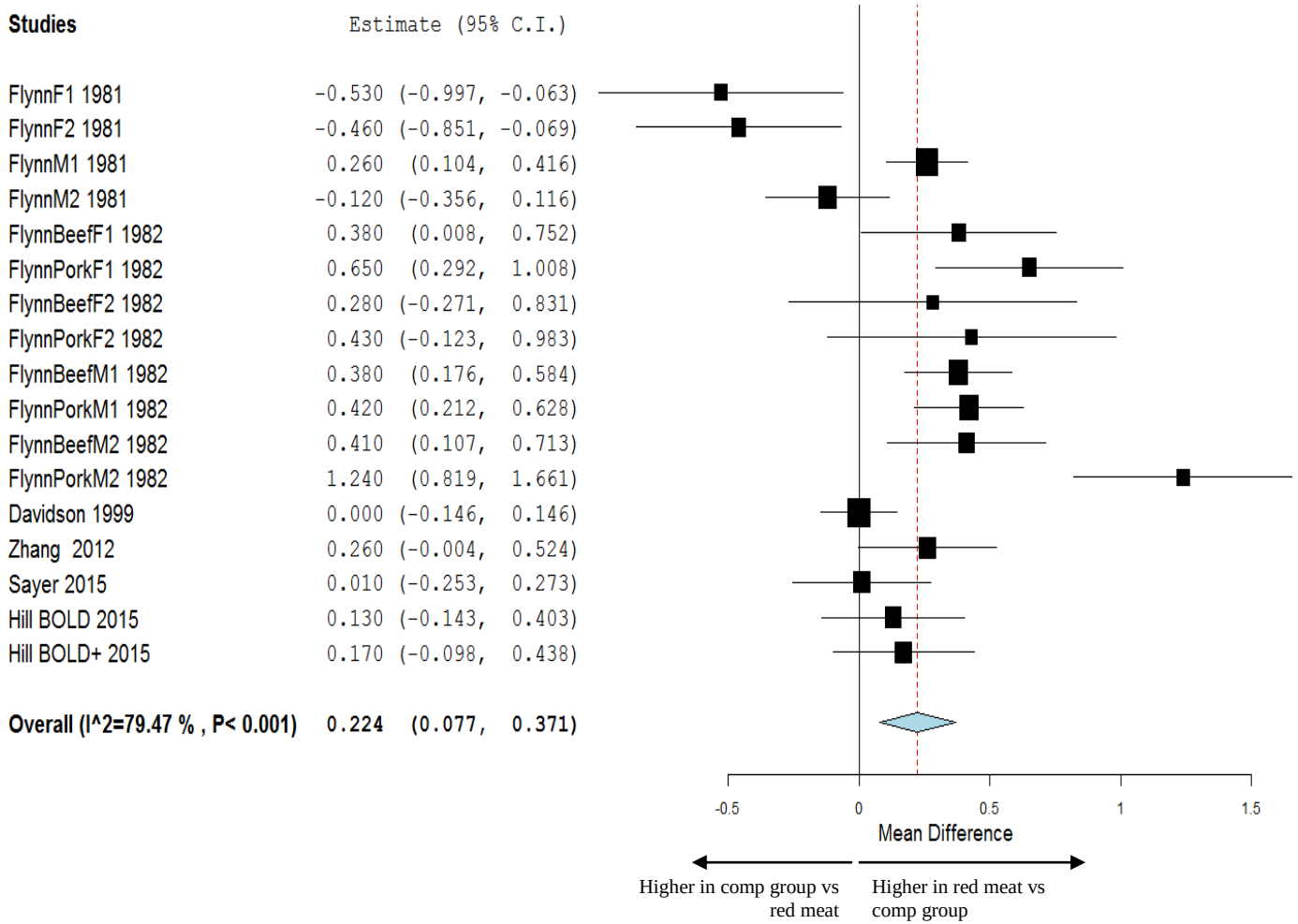


Supplemental Figure 10. Random effects meta-analysis for changes in triglyceride concentrations (mmol/L) from randomized controlled trials comparing red meat interventions with comparison interventions stratified by comparison diets.

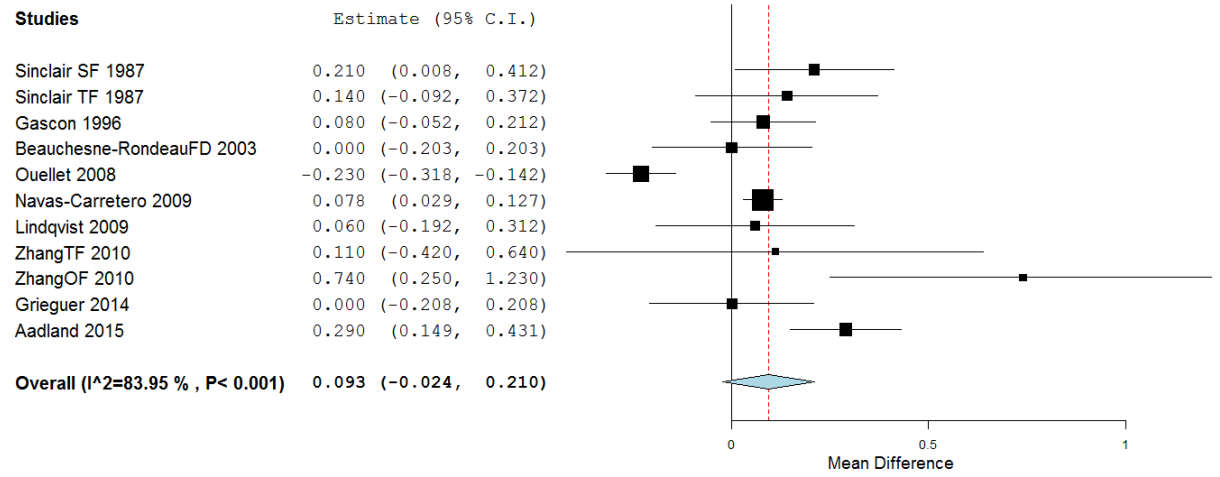
A) High-quality plant foods (legumes, soy, nuts and other plant protein sources)



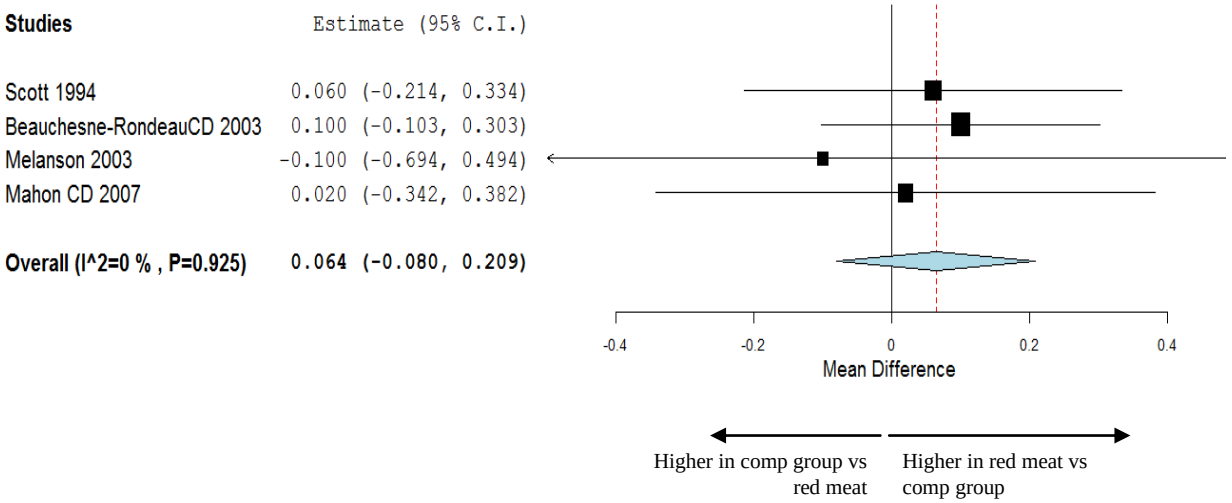
B) Comparison group combining protein sources from chicken, poultry, and all types of fish



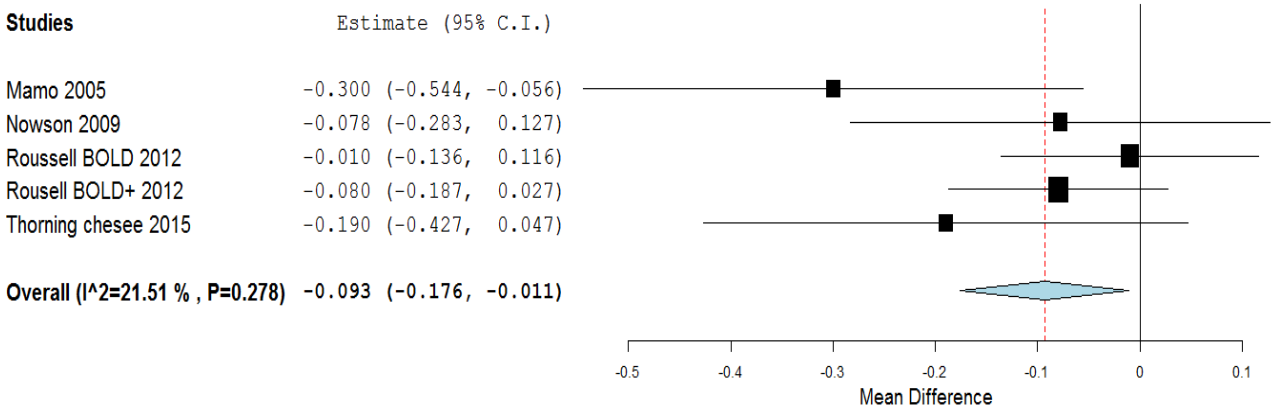
C) Comparison group protein sources fish only (fish, fatty fish and seafood)



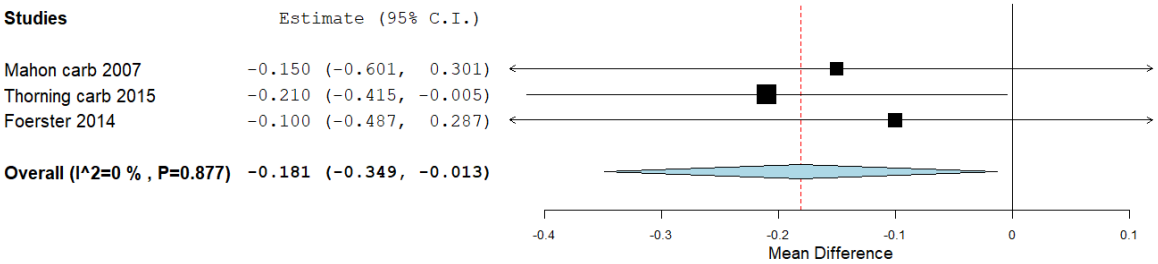
D) Comparison group combining protein sources from chicken and poultry



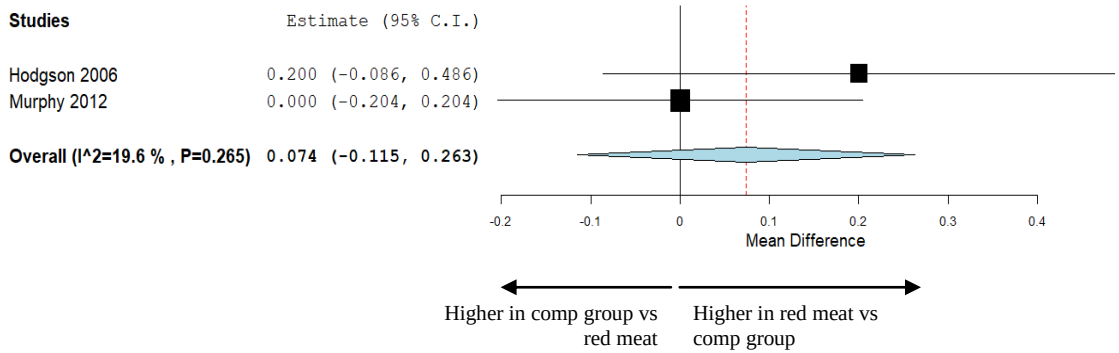
E) Comparison group combining animal protein (fish, poultry, red meat, and dairy)



F) Comparison group replacement with carbohydrates



G) Comparison group replacement with usual diet



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