

**SUPPLEMENTARY MATERIAL**

**Effect of Coenzyme Q10 supplementation on lipid and glycaemic profile: an  
umbrella review**

**Journal of Cardiovascular Development and Disease**

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**Table S1.** Excluded studies with justified reasons.

Reference	Main reason
Ayers J et al (2018) [1]	Not design of interest
Cogorno L et al (2023) [2]	Not design of interest
Chagan L et al (2002) [3]	Not design of interest
Pirro M et al (2016) [4]	Not intervention of interest
Aslani Z et al (2018) [5]	Not outcome of interest

#### Supplementary References

1. Ayers, J.; Cook, J.; Koenig, R.A.; Sisson, E.M.; Dixon, D.L. Recent Developments in the Role of Coenzyme Q10 for Coronary Heart Disease: A Systematic Review. *Curr. Atheroscler. Rep.* **2018**, *20*, 29.
2. Cogorno, L.; Formisano, E.; Vignati, A.; Prigione, A.; Tramacere, A.; Borgarelli, C.; Sukkar, S.G.; Pisciotta, L. Non-alcoholic fatty liver disease: Dietary and nutraceutical approaches. *Liver Res.* **2023**, *7*, 216–227.
3. Chagan, L.; Ioselovich, A.; Asherova, L.; Cheng, J. Use of alternative pharmacotherapy in management of cardiovascular diseases. *Am. J. Manag. Care* **2002**, *8*, 270–285.
4. Pirro, M.; Mannarino, M.R.; Bianconi, V.; Simental-Mendía, L.E.; Bagaglia, F.; Mannarino, E.; Sahebkar, A. The effects of a nutraceutical combination on plasma lipids and glucose: A systematic review and meta-analysis of randomized controlled trials. *Pharmacol. Res.* **2016**, *110*, 76–88.
5. Aslani, Z.; Shab-Bidar, S.; Fatahi, S.; Djafarian, K. Effect of Coenzyme Q10 Supplementation on Serum of High Sensitivity C-Reactive Protein Level in Patients with Cardiovascular Diseases: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Int J Prev Med* **2018**, *9*, doi:10.4103/ijpvm.IJPVM\\_263\\_17.

**Table S2.** Characteristics of the intervention and control groups.

Reference	Disease	Intervention	Type CoQ10	Comparator
Suksomboon N et al (2015)	Diabetes mellitus	CoQ10 + Usual treatment (Insulin, other antidiabetic drugs, antihypertensive drugs, lipid-lowering drugs, etc.)	Not specified	Placebo + Usual treatment
Moradi M et al (2016)	Various diseases	CoQ10 + Other drugs	Not specified	Placebo + Other drugs
Sahebkar A et al (2016)	Various diseases	CoQ10 or CoQ10 + Other drugs/supplements	Not specified	Placebo
Stojanović M et al (2017)	Various diseases	CoQ10 + Usual treatment (not specified)	Not specified	Placebo + Usual treatment (not specified)
Bakhshayeshkaram M et al (2018)	Coronary artery disease	CoQ10 + Usual treatment (not specified). One study: CoQ10 + other nutraceuticals	Not specified	Placebo + Usual treatment (not specified)
Jorat MV et al (2018)	Coronary artery disease	CoQ10 + Usual treatment (not specified). One study: CoQ10 + other nutraceuticals	Not specified	Placebo + Usual treatment (not specified)
Shi-Ying Z et al (2018)	Type 2 DM	CoQ10 + Usual treatment or CoQ10 + fenofibrate + Usual treatment (not specified)	Not specified	Placebo + Usual treatment or Placebo + fenofibrate + Usual treatment (not specified)
Sharifi N et al (2018)	Various diseases	CoQ10 + Usual treatment (not specified)	Not specified	Placebo + Usual treatment (not specified)
Zhang X et al (2019)	Diabetic kidney disease	CoQ10 or CoQ10 + Usual treatment (Insulin, atorvastatin)	Not specified	Placebo or Placebo + Usual treatment (Insulin, atorvastatin)
Dludla PV et al (2020)	Diabetes Mellitus and Metabolic Syndrome	CoQ10 + Usual treatment (not specified). One study: CoQ10 + vitamin E	Not specified	Placebo + Usual treatment (not specified)
Xu Y et al (2021)	Chronic kidney disease	CoQ10 + Usual treatment (not specified)	Not specified	Placebo + Usual treatment (not specified)
Zhang J et al (2021)	Polycystic ovary syndrome	CoQ10 or CoQ10 + Vitamin E	Not specified	Placebo or Placebo + Vitamin E

Kim Y et al (2022)	Type II DM	CoQ10 + insulin/other antidiabetic drugs	Not specified	Placebo + insulin/other antidiabetic drugs
Liang Y et al (2022)	Various diseases	CoQ10	All ubiquinone except one study	Placebo or simvastatin/fenofibrate/omega-3/vitamin E
Liu Z et al (2022)	Various diseases	CoQ10 or CoQ10 + Usual treatment (atorvastatin, simvastatin, fenofibrate, exercise, tocopherol, omega-3, carnitine)	All ubiquinone except two studies	Placebo or Placebo + Usual treatment (atorvastatin, simvastatin, fenofibrate, exercise, tocopherol, omega-3, carnitine))
Zhang T et al (2022)	Polycystic ovary syndrome	CoQ10 or CoQ10 + Usual treatment (metformin, vitamin E, clomiphene, omega-3)	Not specified	Placebo or Placebo + Usual treatment (metformin, vitamin E, clomiphene, omega-3)
Aldekani A et al (2023)	Non-alcoholic fatty liver	CoQ10 + Usual treatment (not specified) or CoQ10 + Usual treatment + other nutraceuticals	Not specified	Placebo + Usual treatment (not specified) or Placebo + Usual treatment + other nutraceuticals

**Table S3.** Subgroup studies.

- Effect of CoQ10 on lipid profile.

Reference	Subgroup	TC	LDL-C	HDL-C	TG	LPA
<b>By dosage</b>						
Sahebkar A et al (2016)	< 150 mg	-	-	-	-	-9.24 (-15.19, -3.29)
	> 150 mg	-	-	-	-	-2.75 (-4.28, -1.23)
Bakhshayeshkaram M.et.al (2018)	< 200 mg	-1.05 (-1.68, -0.43)	-	-	-0.97 (-1.81, -0.13)	-
	> 200 mg	-0.28 (-0.52, -0.05)	-	-	-0.09 (-0.59, 0.40)	-
Jorat MV et al (2018)	< 150 mg	-1.53 (-2.83, -0.23)	-0.24 (-0.64, 0.16)	0.66 (0.03, 1.30)	-	-1.79 (-4.98, 1.40)
	> 150 mg	-0.52 (-1.78, 0.73)	-0.53 (-1.64, 0.57)	2.58 (-2.65, 7.81)	-	0.13 (-0.39, 0.66)
Liu Z et al (2022)	< 200 mg	-2.55 (-5.79, 0.70)	-3.45 (-7.03, 0.13)	0.87 (-0.60, 2.34)	-10.11 (-18.78, -1.43)	-
	> 200 mg	-2.30 (-11.12, -3.23)	-2.81 (-5.90, 0.29)	0.82 (-0.21, 1.86)	-8.37 (-14.79, -1.94)	-
Ardekani A et al (2023)	< 100 mg	-17.17 (-30.76, -3.57)	-6.43 (-24.32, 11.45)	0.12 (-4.48, 4.72)	-28.31 (-77.90, 21.27)	-

	> 100 mg	3.89 (-5.72, 13.51)	2.73 (-4.77, 10.24)	-1.22 (-3.70, 1.24)	-6.12 (-23.40, 11.14)	-
<b>By length</b>						
Sahebkar A et al (2016)	< 8 weeks	-	-	-	-	-3.14 (-4.92, -1.36)
	> 8 weeks	-	-	-	-	-11.72 (-21.01, 2.42)
Bakhshayeshkaram M.et.al (2018)	< 12 weeks	-0.70 (-1.46, 0.06)	-	-	-0.68 (-1.32, -0.04)	-
	> 12 weeks	-0.53 (-0.92, -0.13)	-	-	0.03 (-0.81, 0.87)	-
Jorat MV et al (2018)	< 8 weeks	0.06 (-0.26, 0.39)	-0.12 (-0.55, 0.30)	0.24 (-0.30, 0.78)	-	-1.64 (-5.14, 1.87)
	> 8 weeks	-1.94 (3.33, -0.54)	-0.62 (-1.55, 0.31)	3.14 (-0.96, 7.24)	-	-0.18 (-0.69, 0.32)
Sharifi N et al (2018)	< 12 weeks	-0.11 (-1.04, 0.81)	-0.06 (-0.87, 0.74)	-0.24 (-1.19, 0.71)	-0.51 (-1.14, 0.13)	-
	> 12 weeks	-0.05 (-0.34, 0.25)	0.11 (-0.08, 0.30)	0.27 (-0.14, 0.67)	-0.17 (-0.44, 0.11)	-
Liu Z et al (2022)	< 12 weeks	-7.95 (-11.99, -3.91)	-2.40 (-4.30, -0.50)	0.15 (-0.81, 1.11)	-6.36 (-15.02, 2.30)	-
	> 12 weeks	-5.53 (-8.40, -2.66)	-2.74 (-5.91, 0.43)	1.28 (-0.13, 2.68)	-10.50 (-16.76, -4.24)	-
Ardekani A et al (2023)	4 weeks	-0.2 (-13.31, 12.91)	1.2 (-10.46, 12.86)	-0.2 (-4.43, 4.03)	-0.8 (-22.59, 20.99)	-
	12 weeks	-8.33 (-27.3, 10.63)	-3.19 (-16.75, 10.35)	-0.45 (-3.51, 2.59)	-25.25 (-55.35, 4.84)	-
<b>Type of intervention</b>						
Bakhshayeshkaram M et al (2018)	With other supplements	-0.39 (-0.81, 0.02)	-	-	-0.41 (-1.24, 0.43)	-
	Without other supplements	-0.75 (-1.33, -0.18)	-	-	-0.30 (-1.00, 0.39)	-
Jorat MV et al (2018)	With other supplements	-4.50 (-13.39, 4.39)	-	-	-	-
	Without other supplements	-0.32 (-0.85, 0.22)	-0.37 (-0.87, 0.13)	1.30 (0.20, 2.41)	-	-1.12 (-2.84, 0.61)
Liu Z et al (2022)	With other supplements	-2.69 (-7.64, 2.27)	-3.78 (-7.28, -0.28)	1.05 (-0.22, 2.32)	-8.36 (-19.20, 2.49)	-
	Without other supplements	-6.40 (-9.73, -3.07)	-2.93 (-5.59, -0.26)	0.72 (-0.36, 1.79)	-9.30 (-15.08, -3.53)	-
<b>Basal covariates</b>						
Sharifi N et al (2018)	With diabetes	-0.34 (-1.07, 0.39)	-0.20 (-0.74, 0.34)	-0.37 (-1.17, 0.42)	-0.72 (-1.38, -0.07)	-
	Without diabetes	0.08 (-0.39, 0.54)	0.23 (-0.16, 0.61)	0.42 (0.00, 0.82)	-0.01 (-0.03, 0.12)	-
Liu Z et al (2022)	Healthy	-12.30 (-14.89, -9.71)	-5.00 (-15.55, 5.55)	0.16 (-2.42, 2.73)	-6.47 (-29.99, 17.05)	-
	Diabetes	-2.08 (-6.18, 2.03)	0.00 (-4.18, -4.19)	0.17 (-1.37, 1.71)	-7.40 (-13.96, -0.84)	-
	Dyslipidaemia	-4.53 (-15.96, 6.89)	-2.78 (-9.11, 3.56)	3.69 (0.09, 7.30)	-9.81 (-26.67, 7.06)	-
	CVD	-0.98 (-3.66, 1.71)	-1.34 (-3.50, 0.82)	0.91 (-1.10, 2.91)	-4.76 (-13.48, 3.96)	-
	CKD	-11.72 (-26.88, 3.44)	-5.81 (-10.09, -1.53)	-2.69 (-4.82, -0.56)	-8.68 (-14.05, 8.68)	-
	Other diseases	-6.51 (-13.04, 0.02)	-9.19 (-15.14, -3.24)	0.73 (-0.32, 1.78)	-8.57 (-16.47, -0.66)	-
	Ubiquinone	-5.68 (-8.61, -2.75)	-3.02 (-5.32, -0.72)	0.77 (-0.05, 1.60)	-9.10 (-14.08, -4.11)	-
	Ubiquinol	0.47 (-13.81, 14.75)	-3.40 (-12.91, 6.11)	4.74 (-1.81, 11.30)	8.36 (-88.89, 105.61)	-
<b>High quality</b>						
Sharifi N et al (2018)	-	-0.07 (-0.45, 0.31)	0.04 (-0.27, -0.36)	0.10 (-0.32, 0.51)	-0.28 (-0.56, -0.00)	-

- Effect of CoQ10 on glycaemic profile.

Reference	Subgroup	FPG	HA1C	FI	HOMA-IR
<b>Dosage</b>					
Moradi M et al (2016)	< 200 mg	-0.36 (-0.67, -0.05)	-0.04 (-0.35, 0.26)	-	-
	>200 mg	-0.13 (-0.34, 0.08)	-0.06 (0.27, 0.15)	-	-
Stojanović M et al (2017)	< 200 mg	-0.84 (-1.37, -0.31)	-	-	-
	>200 mg	-0.01 (-0.32, 0.29)	-	-	-
Bakhshayeshkaram M.et.al (2018)	< 200 mg	-0.45 (-0.71, -0.18)	-	-0.98 (-1.57, -0.40)	-0.94 (-1.52, 0.35)
	> 200 mg	0.62 (0.13, 1.11)	-	0.49 (0.01, 0.97)	0.66 (0.17, 1.15)
Liang Y et al (2022)	< 200 mg	-13.21 (-18.43, -7.98)	-0.47 (-0.83, -0.12)	-1.71 (-2.57, -0.85)	-0.97 (-1.44, -0.50)
	> 200 mg	-0.71 (-3.42, 1.99)	-0.03 (-0.15, 0.10)	-0.43 (-2.12, 1.27)	-0.54 (-1.17, 0.10)
<b>Length</b>					
Moradi M et al (2016)	< 20 weeks	-0.22 (-0.41, -0.04)	-0.08 (-0.28, 0.12)	-	-
	> 20 weeks	-0.03 (-0.54, 0.48)	0.02 (-0.32, 0.37)	-	-
Stojanović M et al (2017)	< 12 weeks	-0.60 (-1.07, -0.12)	-	-	-
	> 12 weeks	-0.14 (-0.49, 0.20)	-	-	-
Bakhshayeshkaram M.et.al (2018)	< 12 weeks	0.23 (-0.56, 1.02)	-	0.49 (0.01, 0.97)	0.66 (0.17, 1.15)
	> 12 weeks	-0.64 (1.21, -0.07)	-	-0.98 (-1.57, -0.40)	-0.94 (-1.52, -0.35)
Liang Y et al (2022)	< 12 weeks	-2.41 (-6.87, 2.06)	-0.06 (-0.28, 0.16)	-0.59 (-1.59, 0.42)	-0.24 (-0.52, 0.05)
	> 12 weeks	-7.59 (-11.66, -3.52)	-0.14 (-0.27, 0.00)	-1.51 (-2.52, -0.50)	-1.03 (-1.40, -0.65)
<b>Type of intervention</b>					
Moradi M et al (2016)	With other supplements	0.08 (-0.30, 0.47)	-	-	-
	Without other supplements	-0.27 (-0.47, -0.08)	-	-	-
Bakhshayeshkaram M et al (2018)	With other supplements	-0.01 (-0.87, 0.84)	-	0.44 (-0.25, 1.13)	0.54 -0.16, 1.23)
	Without other supplements	0.04 (-1.32, 1.41)	-	-0.23 (-1.73, 1.26)	-0.09 (-1.77, 1.59)
<b>Basal covariates</b>					
Stojanović M et al (2017)	FPG: < 140 mg/dL	-1.40 (-6.80, 3.80)	-	-	-
	FPG: > 140 mg/dL	-12.80 (-22.30, -3.10)	-	-	-
	FPG: < 108 mg/dL	0.00 (-5.20, 5.00)	-	-	-
	FPG: > 108 mg/dL	-11.70 (-19.30, -4.00)	-	-	-
<b>High quality</b>					
Kim Y et al (2022)	-	-8.84 (-16.94, -0.75)	-0.23 (-0.40, -0.05)	-	-0.83 (-2.12, 0.47)

**Table S4.** Risk of bias assessment.

Reference	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Overall
Suksomboon N et al (2015)	YES	NO	YES	PY	YES	YES	YES	YES	YES	NO	YES	NO	NO	NO	YES	YES	Critically low

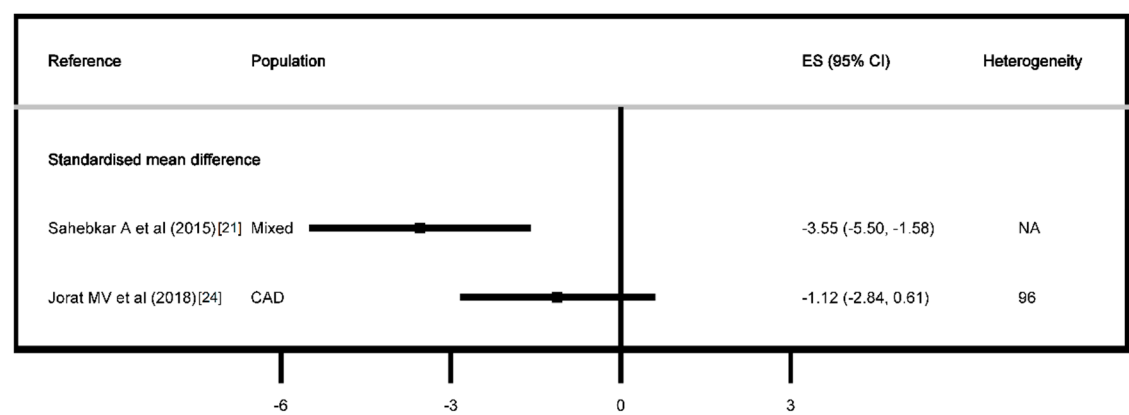
Sahebkar A et al (2016)	YES	NO	YES	PY	NO	NO	NO	YES	YES	NO	YES	NO	YES	YES	YES	NO	Critically low
Moradi M et al (2016)	YES	NO	YES	PY	NO	YES	NO	YES	NO	NO	YES	NO	NO	YES	YES	YES	Critically low
Stojanović M et al (2017)	YES	NO	YES	PY	NO	NO	NO	YES	YES	NO	YES	YES	YES	YES	YES	YES	Critically low
Jorat MV et al (2018)	YES	NO	YES	PY	YES	YES	NO	YES	YES	NO	YES	NO	YES	YES	YES	YES	Critically low
Shi-Ying Z et al (2018)	YES	YES	YES	PY	YES	YES	NO	YES	YES	NO	YES	YES	YES	YES	YES	YES	Low
Sharifi N et al (2018)	YES	YES	YES	PY	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	High
Bakhshayeshkaram M et al (2018)	YES	NO	YES	PY	YES	YES	NO	YES	YES	NO	YES	NO	YES	YES	YES	YES	Critically low
Zhang X et al (2019)	YES	NO	YES	PY	YES	YES	NO	YES	YES	NO	YES	YES	YES	YES	YES	YES	Critically low
Dludla PV et al (2020)	YES	NO	YES	PY	YES	YES	YES	YES	YES	NO	YES	NO	YES	YES	YES	YES	Low
Xu Y et al (2021)	YES	YES	YES	PY	YES	YES	NO	YES	YES	NO	YES	YES	NO	NO	YES	YES	Critically low
Zhang J et al (2021)	YES	YES	YES	PY	YES	YES	NO	YES	YES	NO	YES	YES	YES	YES	YES	YES	Low
Liang Y et al (2022)	YES	YES	YES	PY	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	Low
Zhang T et al (2022)	YES	YES	YES	PY	YES	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	NO	Low
Kim Y et al (2022)	YES	YES	YES	PY	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	High
Liu Z et al (2022)	YES	YES	YES	PY	YES	YES	NO	YES	YES	YES	YES	NO	YES	YES	YES	YES	Low
Ardekani A et al (2023)	YES	NO	YES	PY	YES	YES	NO	YES	YES	NO	YES	NO	YES	YES	YES	YES	Critically low



**Table S5.** Quality of evidence assessment.

Nº studies	Design	RoB	Assessment				Quality
			Inconsistence	Indirect evidence	Imprecision	Others	
A. Total Cholesterol							
13	RCT	Very serious	Not serious	Not serious	Serious	None	Very low
B. LDL-C							
13	RCT	Very serious	Not serious	Not serious	No seria	None	Low
C. HDL-C							
13	RCT	Very serious	Not serious	Not serious	Serious	None	Very low
D. Triglycerides							
13	RCT	Very serious	Not serious	Not serious	Serious	None	Very low
E. Lp(a)							
2	RCT	Serious	Serious	Not serious	Very serious	None	Very low
F. FPG							
12	RCT	Serious	Not serious	Not serious	Serious	Strong association	Moderate
G. HbA1c							
9	RCT	Serious	Not serious	Not serious	Not serious	Strong association	High
H. Fasting insulin							
8	RCT	Serious	Not serious	Not serious	Serious	None	Low
I. HOMA-IR							
7	RCT	Serious	Not serious	Not serious	Very serious	None	Very low

**Figure S1.** Effect of CoQ10 supplementation on Lp(a).



#### **Appendix S1.** Search strategy.

- Medline, Scopus, Web of Science, and Cochrane Library

("coenzyme q10" OR q10 OR ubiquinol OR ubiquinone) AND (dyslipidemia OR "lipidic profile" OR cholesterol OR hdl OR "High-density lipoprotein" OR ldl OR "low-density lipoprotein" OR triglycerides OR "lipoprotein A" OR "fasting blood glucose" OR "basal blood glucose" OR "basal glycemia" OR "fasting glucose" OR "glycated hemoglobin" OR a1c OR "fasting insulin" OR "homa-ir") AND ("systematic review" OR "meta-analysis")

- Grey literature

Not specified.