Supplementary Table 1. Effect of covariates, missingness and modelling technique on estimated serum 25(OH)D coefficient for models with SBP, log HDL-C and log Homa-IR as outcomes

Outcome	Covariate	Covariate p[1]	(A) Final reported Hierarchical LMM	p	(B) Hierarchical LMM unadjusted reduced sample	p	(C) Hierarchical LMM adjusted reduced sample	p	(D) Clustered analysis adjusted reduced sample	p	(E) Clustered analysis adjusted with MLE	p
			Serum 25(OH)D coefficient and p values									
SBP			0.00225	0.806								
	Alcohol	0.006			0.00848	0.41	0.00448	0.67	0.00565	0.60	0.00305	0.74
	Family income	0.23			-0.00189	0.87	-0.00346	0.77	-0.00227	0.85	0.00459	0.62
	Smoking	0.998			-0.00151	0.87	-0.00151	0.87	0.00149	0.88	0.00676	0.47
	Physical activity	0.82			0.00159	0.87	0.00277	0.78	0.00510	0.62	0.00828	0.39
	Race[2]	0.38					0.00082	0.93	0.00451	0.64		
log HDL-C			0.00010	0.528								
	Alcohol	<0.001			0.00006	0.76	-0.00004	0.81	0.00006	0.76	0.00009	0.65
	Family income	0.56			-0.00004	0.87	-0.00005	0.81	0.00001	0.98	0.00020	0.30
	Smoking	0.34			0.00011	0.53	0.00011	0.52	0.00020	0.32	0.00022	0.23
	Physical activity	0.18			0.00009	0.60	0.00003	0.85	0.00006	0.79	0.00013	0.51
	Race[2]	0.034					0.00016	0.34	0.00031	0.10		
log Homa-IR			-0.00216	<0.001								
	Alcohol	0.84			-0.00223	<0.001	-0.00222	<0.001	-0.00231	<0.001	-0.00223	<0.001
	Family income	0.64			-0.00226	0.002	-0.00219	0.002	-0.00237	0.003	-0.00222	<0.001
	Smoking	0.85			-0.00209	<0.001	-0.00208	<0.001	-0.00220	<0.001	-0.00226	<0.001
	Physical activity	0.12			-0.00230	<0.001	-0.00208	0.001	-0.00214	0.001	-0.00201	0.001
	Race[2]	0.68					-0.00221	<0.001	-0.00235	<0.001		

(A): Hierarchical LMM adjusting for sex and BMI, reported as final model

(B): Hierarchical LMM based on sample with covariate data (reduced due to missing data on covariate), without covariate included in the model

(C): Hierarchical LMM (B) with covariate included in the model

(D): Clustered analysis of model with covariate included without MLE

(E): Same as (D) with MLE for missing covariate data

The difference between Models C and D illustrates the difference between Hierarchical LMM and clustered analysis, which tends to result in a loss of power.

The difference between Models D and F illustrates the potential impact of missing data.

[1]In Hierarchical LMM in reduced sample

[2]No missing data

No data supplied for BMI outcome as no covariates were significantly associated with outcome.

25(OH)D, 25-hydroxyvitamin D; BMI, body mass index; HC, hormonal contraception; HDL-C, high-density lipoprotein cholesterol; HOMA, homeostatic model assessment for insulin resistance; LMM, linear mixed model; MLE, maximum likelihood estimation; SBP, systolic blood pressure

Supplementary Table 2. Effect of covariates, missingness and modelling technique on estimated serum 25(OH)D coefficient for models with log triglycerides as outcome

Covariate	Covariate p[1]	(A) Final reported Hierarchical LMM	p	(B) Hierarchical LMM unadjusted reduced sample	p	(C) Hierarchical LMM adjusted reduced sample	p	(D) Clustered analysis adjusted reduced sample	p	(E) Clustered analysis adjusted with MLE	p
		Serum 25(OH)D coefficient and p values									
25(OH)D		0.00228	0.003								
Sex*25(OH)D											
Females using HC		-0.00026	0.78								
Males		-0.00212	0.016								
Alcohol	0.002										
25(OH)D				0.00212	0.012	0.00204	0.015	0.00155	0.067	0.00170	0.023
Sex*25(OH)D											
Females using HC				-0.00006	0.96	-0.00008	0.94	-0.00022	0.84	-0.00069	0.49
Males				-0.00211	0.033	-0.00225	0.022	-0.00176	0.093	-0.00151	0.11
Family income	0.851										
25(OH)D				0.00276	0.005	0.00275	0.005	0.00203	0.02	0.00175	0.02
Sex*25(OH)D											
Females using HC				-0.00023	0.84	-0.00021	0.85	-0.00061	0.58	-0.00064	0.52
Males				-0.00238	0.035	-0.00237	0.035	-0.00127	0.29	-0.00135	0.15
Smoking	0.003										
25(OH)D				0.00224	0.003	0.00217	0.004	0.00180	0.02	0.00171	0.022
Sex*25(OH)D											
Females using HC				-0.00023	0.81	-0.00009	0.92	-0.00054	0.6	-0.00050	0.62
Males				-0.00227	0.011	-0.00227	0.011	-0.00166	0.085	-0.00142	0.13
Physical activity	0.122										
25(OH)D				0.00230	0.004	0.00247	0.002	0.00217	0.01	0.00201	0.008
Sex*25(OH)D											

Females using HC		-0.00022	0.83	-0.00027	0.79	-0.00069	0.52	-0.00078	0.43
Males		-0.00241	0.011	-0.00243	0.01	-0.00187	0.07	-0.00144	0.12
Race[2]	0.276								
25(OH)D				0.00237	0.002	0.00186	0.014		
Sex*25(OH)D									
Females using HC				-0.00030	0.75	-0.00070	0.48		
Males				-0.00215	0.015	-0.00140	0.14		

(A): Hierarchical LMM adjusting for sex and BMI, reported as final model

(B): Hierarchical LMM based on sample with covariate data (reduced due to missing data on covariate), without covariate included in the model

(C): Hierarchical LMM (B) with covariate included in the model

(D): Clustered analysis of model with covariate included without MLE

(E): Same as (D) with MLE for missing covariate data

The difference between Models C and D illustrates the difference between Hierarchical LMM and clustered analysis, which tends to result in a loss of power.

The difference between Models D and F illustrates the potential impact of missing data.

[1]In Hierarchical LMM in reduced sample

[2]No missing data

25(OH)D, 25-hydroxyvitamin D; BMI, body mass index; HC, hormonal contraception; HDL-C, high-density lipoprotein cholesterol; HOMA, homeostatic model assessment for insulin resistance; LMM, linear mixed model; MLE, maximum likelihood estimation; SBP, systolic blood pressure

Supplementary Table 3. Associations between serum 25-hydroxyvitamin D and log HDL-C

Variable	Coefficient (95% CI)[1]	*p*
25(OH)D (nmol/L)	0.0001 (-0.0002, 0.0004)	0.528
Time		
17 year follow-up	Reference	
20 year follow-up	0.04 (0.03, 0.06)	<0.001
Sex		
Female not using HC	Reference	
Female using HC	-0.01 (-0.03, 0.01)	0.441
Male	-0.15 (-0.17, -0.13)	<0.001
Body mass index (kg/m^2)	-0.01 (-0.02, -0.01)	<0.001
Constant	0.65 (0.59, 0.71)	<0.001

[1]Estimated difference in log high-density lipoprotein from the reference category of categorical variables or per 1 unit increase of continuous variables

25(OH)D, 25-hydroxyvitamin D; HC, hormonal contraception

Supplementary Table 4. Associations between serum 25-hydroxyvitamin D and SBP

Variable	Coefficient (95% CI)[1]	*p*
25(OH)D (nmol/L)	0.002 (-0.02, 0.02)	0.820
Time		
17 year follow-up	Reference	
20 year follow-up	1.10 (0.34, 1.86)	0.005
Sex		
Female not using HC	Reference	
Female using HC	2.02 (0.71, 3.33)	0.003
Male	12.20 (11.04, -13.35)	<0.001
Body mass index (kg/m^2)	0.74 (0.64, 0.841)	<0.001
Constant	91.47 (88.42, 94.52)	<0.001

[1]Estimated difference in systolic blood pressure from the reference category of categorical variables or per 1 unit increase of continuous variables

25(OH)D, 25-hydroxyvitamin D; HC, hormonal contraception