Serum fat-soluble vitamins and the menstrual cycle in women of childbearing age

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Supplementary Materials

Table S1. Associations between fat-soluble vitamins and menstrual cycle in participants without abnormal thyroid function (n=3067)

Vitamin		Irregular cycle OR (95% CI)		Long cycle OR (95% CI)		Average length β (95% CI)
Vit A						
	T1	Ref.		Ref.		Ref.
	T2	1.09 (0.87, 1.37)		1.11 (0.87, 1.41)		1.18 (-0.41, 2.78)
	T3	**1.36 (1.08, 1.70)**		**1.31 (1.03, 1.67)**		**1.76 (0.14, 3.38)**
25(OH)D						
	T1	Ref.		Ref.		Ref.
	T2	0.87 (0.70, 1.08)		0.97 (0.77, 1.22)		0.10 (-1.50, 1.70)
	T3	0.92 (0.73, 1.15)		0.81 (0.63, 1.04)		-1.03 (-2.66, 0.59)
Vit D_3						
	T1	Ref.		Ref.		Ref.
	T2	0.81 (0.65, 1.00)		0.93 (0.74, 1.17)		-0.38 (-1.98, 1.21)
	T3	0.90 (0.72, 1.13)		0.80 (0.63, 1.03)		-0.81 (-2.44, 0.83)
Vit E						
	T1	Ref.		Ref.		Ref.
	T2	0.98 (0.79, 1.23)		1.00 (0.79, 1.27)		0.54 (-1.05, 2.13)
	T3	1.21 (0.97, 1.52)		1.23 (0.97, 1.56)		0.66 (-0.95, 2.27)
Vit K						
	T1	Ref.		Ref.		Ref.
	T2	1.20 (0.96, 1.51)		1.12 (0.88, 1.43)		-0.88 (-2.48, 0.71)
	T3	**1.38 (1.10, 1.73)**		**1.31 (1.03, 1.66)**		-0.21 (-1.81, 1.40)

OR: odds ratio; CI: confidence interval; T: tertile. Ref: reference. The concentrations of fat-soluble vitamins were treated as categorical variables with the lowest group as references. Models were adjusted for age, parity, abnormal pregnancy, BMI, and the number of days since the first day of the last period. Bold font indicates statistical significance.

Table S2. Associations between fat-soluble vitamins and menstrual cycle in participants without PCOS (n=2987)

Vitamin		Irregular cycle OR (95% CI)		Long cycle OR (95% CI)		Average length β (95% CI)
Vit A						
	T1	Ref.		Ref.		Ref.
	T2	1.10 (0.87, 1.39)		1.09 (0.85, 1.39)		0.45 (-0.87, 1.77)
	T3	**1.33 (1.05, 1.67)**		1.26 (0.99, 1.61)		**1.51 (0.17, 2.85)**
25(OH)D						
	T1	Ref.		Ref.		Ref.
	T2	0.87 (0.70, 1.09)		0.95 (0.75, 1.20)		-0.57 (-1.89, 0.75)
	T3	0.92 (0.73, 1.16)		0.81 (0.63, 1.04)		-1.06 (-2.40, 0.29)
Vit D_3						
	T1	Ref.		Ref.		Ref.
	T2	0.84 (0.67, 1.05)		0.94 (0.75, 1.19)		-0.87 (-2.19, 0.45)
	T3	0.92 (0.73, 1.15)		0.82 (0.64, 1.05)		-0.76 (-2.10, 0.58)
Vit E						
	T1	Ref.		Ref.		Ref.
	T2	0.98 (0.78, 1.23)		1.01 (0.79, 1.29)		0.35 (-0.97, 1.67)
	T3	1.18 (0.94, 1.48)		1.23 (0.97, 1.57)		0.84 (-0.49, 2.18)
Vit K						
	T1	Ref.		Ref.		Ref.
	T2	1.25 (0.99, 1.57)		1.12 (0.88, 1.43)		-0.22 (-1.54, 1.10)
	T3	**1.45 (1.15, 1.83)**		**1.30 (1.02, 1.66)**		0.48 (-0.86, 1.82)

OR: odds ratio; CI: confidence interval; T: tertile. Ref: reference. The concentrations of fat-soluble vitamins were treated as categorical variables with the lowest group as references. Models were adjusted for age, parity, abnormal thyroid function, abnormal pregnancy, BMI, and the number of days since the first day of the last period. Bold font indicates statistical significance.

Table S3. Associations between fat-soluble vitamins and menstrual cycle in participants younger than 40 years old (n=3035)

Vitamin		Irregular cycle OR (95% CI)		Long cycle OR (95% CI)		Average length β (95% CI)
Vit A						
	T1	Ref.		Ref.		Ref.
	T2	1.13 (0.90, 1.42)		1.11 (0.87, 1.41)		1.25 (-0.33, 2.82)
	T3	**1.38 (1.10, 1.73)**		**1.32 (1.04, 1.67)**		**1.92 (0.33, 3.52)**
25(OH)D						
	T1	Ref.		Ref.		Ref.
	T2	0.88 (0.70, 1.09)		0.95 (0.76, 1.20)		-0.03 (-1.61, 1.55)
	T3	0.94 (0.75, 1.18)		0.82 (0.64, 1.04)		-0.92 (-2.52, 0.68)
Vit D_3						
	T1	Ref.		Ref.		Ref.
	T2	0.83 (0.66, 1.03)		0.92 (0.73, 1.15)		-0.46 (-2.03, 1.12)
	T3	0.90 (0.72, 0.13)		0.80 (0.63, 0.03)		-0.71 (-2.32, 0.89)
Vit E						
	T1	Ref.		Ref.		Ref.
	T2	1.03 (0.82, 1.29)		1.02 (0.80, 1.30)		0.57 (-1.02, 2.16)
	T3	1.16 (0.92, 1.45)		1.21 (0.95, 1.54)		0.61 (-1.00, 2.21)
Vit K						
	T1	Ref.		Ref.		Ref.
	T2	1.24 (0.99, 1.55)		1.15 (0.91, 1.47)		-0.42 (-2.00, 1.15)
	T3	**1.44 (1.15, 1.82)**		**1.28 (1.01, 1.63)**		0.02 (-1.57, 1.61)

OR: odds ratio; CI: confidence interval; T: tertile. Ref: reference. The concentrations of fat-soluble vitamins were treated as categorical variables with the lowest group as references. Models were adjusted for age, parity, abnormal thyroid function, abnormal pregnancy, BMI, and the number of days since the first day of the last period. Bold font indicates statistical significance.

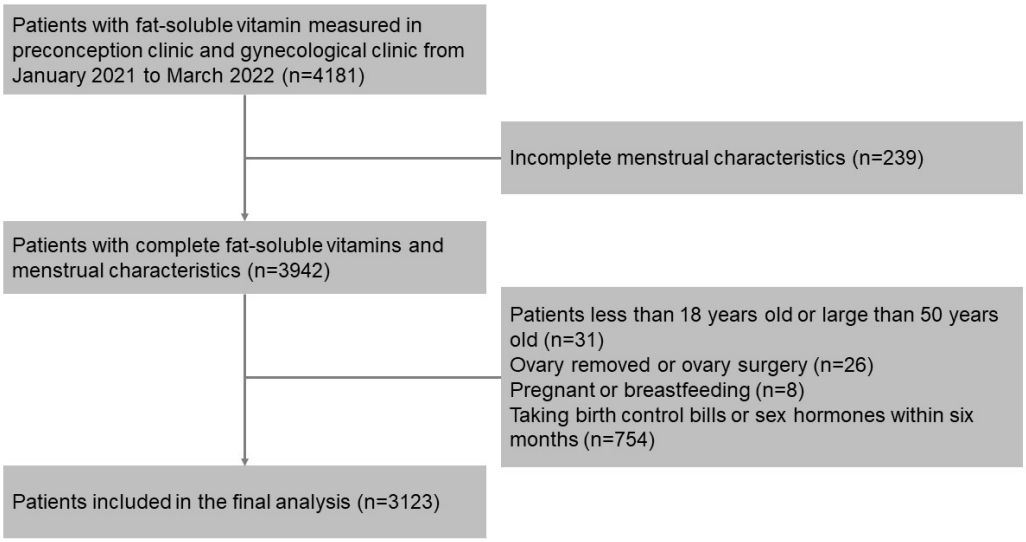


Fig. S1. Flowchart of the study population.

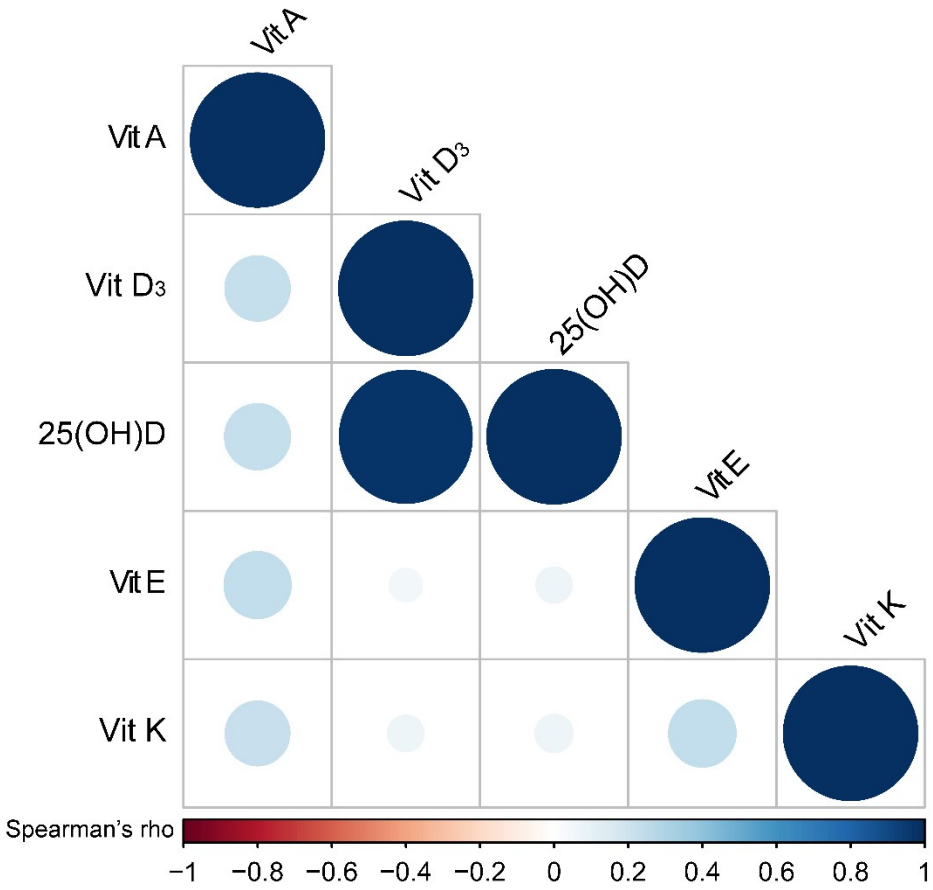


Fig. S2. Spearman correlations between fat-soluble vitamins.

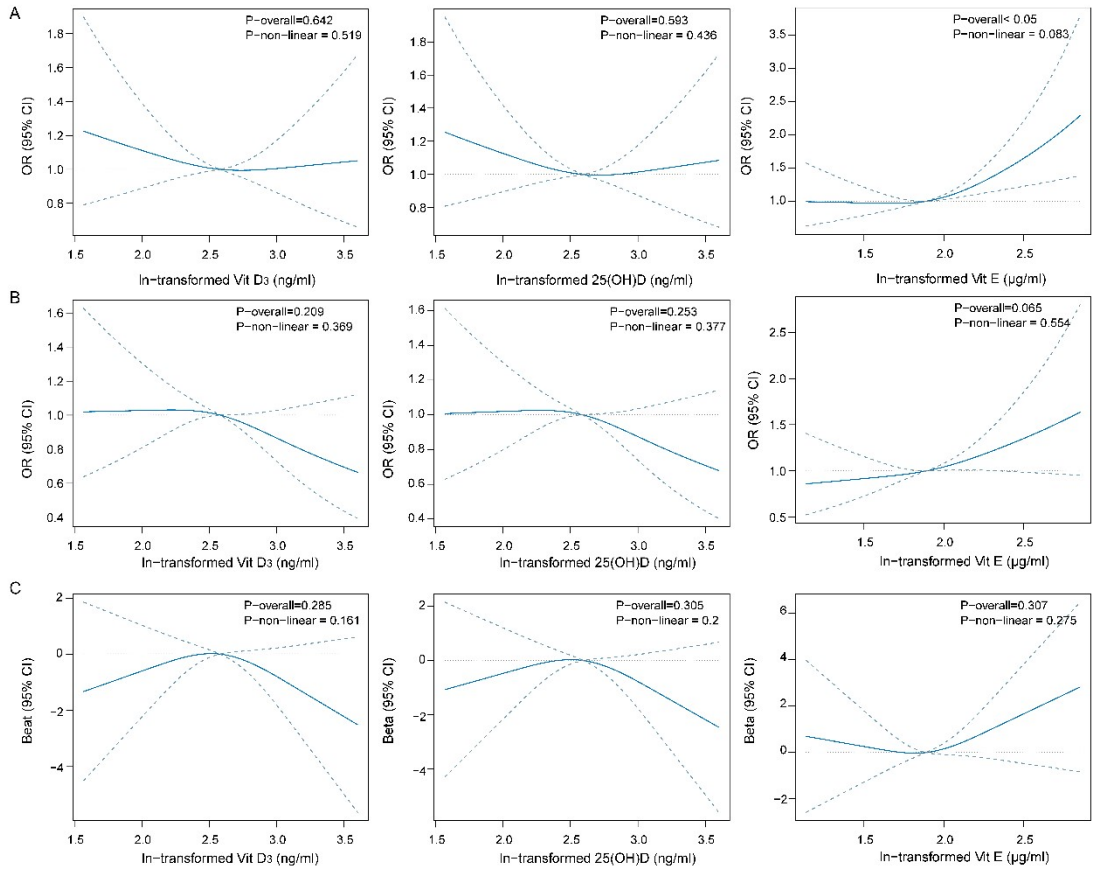
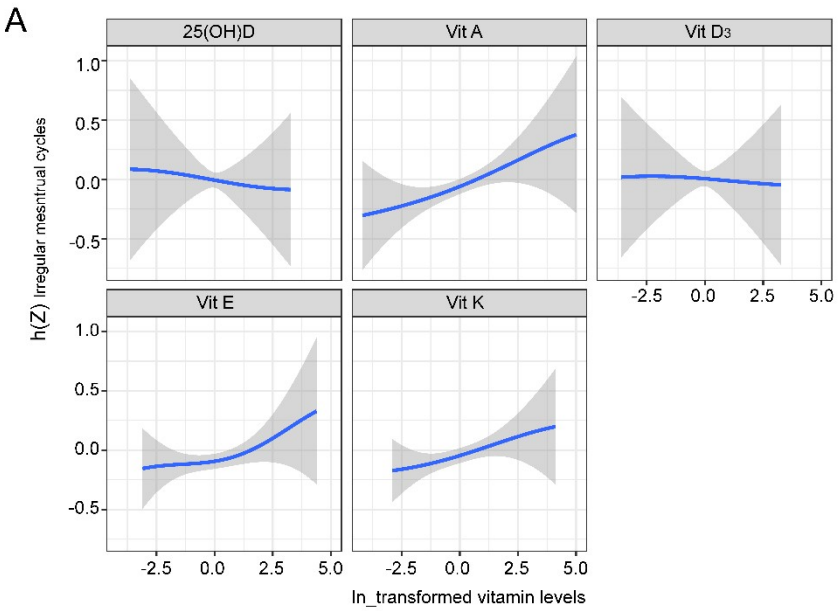
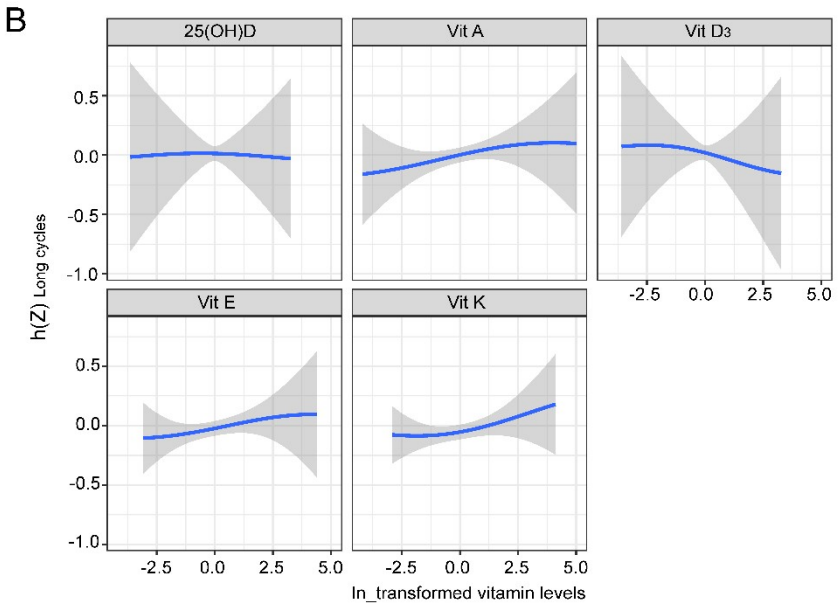


Fig. S3. RCS regression analysis of fat-soluble vitamins with irregular menstrual cycles (A), long menstrual cycles (B), and average menstrual cycle length (C). The median concentrations of fat-soluble vitamins were selected as the reference level. The blue full lines indicate estimated ORs or beta, and the dotted lines represent 95% CI. Models were adjusted for age, parity, abnormal thyroid function, abnormal pregnancy, BMI, and the number of days since the first day of the last period.


A
25(OH)D
Vit A
Vit D3
Vit E
Vit K
h(Z) Irregular mesntrual cycles
1.0
0.5
0.0
-0.5
-2.5
0.0
2.5
5.0
ln_transformed vitamin levels


B
25(OH)D
Vit A
Vit D3
Vit E
Vit K
h(Z) Long cycles
0.5
0.0
-0.5
-1.0
-2.5
0.0
2.5
5.0
ln_transformed vitamin levels

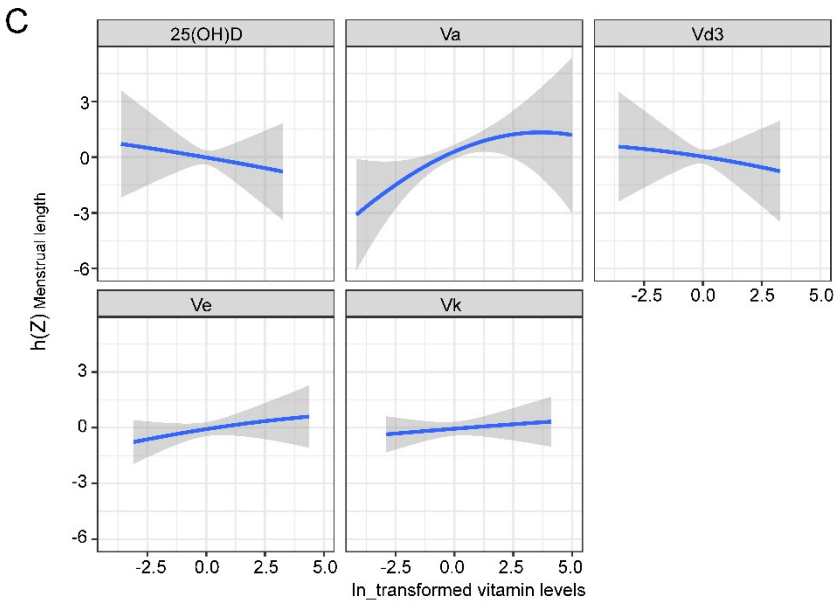

C
25(OH)D
Va
Vd3
Ve
Vk
h(Z) Menstrual length
3
0
-3
-6
-2.5
0.0
2.5
5.0
ln_transformed vitamin levels

Fig. S4. Dose-response curve of one fat-soluble vitamin and irregular menstrual cycles (A), long cycles (B), and menstrual cycle length (C) with fixing all the other vitamins at their median levels by BKMR model. Models were adjusted for age, parity, abnormal thyroid function, abnormal pregnancy, BMI, and the number of days since the first day of the last period.