

SUPPLEMENTARY MATERIALS

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eTable 1. Estimated mean values (95% confidence intervals) and adjusted^a proportion (95% confidence intervals) of baseline characteristics by vitamin D levels among subjects with NAFLD at baseline (n = 48 702)

Characteristics	Vitamin D levels (ng/mL)				<i>p</i> -trend
	<10	10-19	20-29	≥30	
Number of participants	6445	29 699	10 752	1806	
Age (years)	36.9 (36.7–37.1)	38.4 (38.3–38.4)	39.9 (39.7–40.0)	42.6 (42.2–42.9)	<0.001
Male (%)	62.3 (61.1–63.5)	83.3 (82.9–83.7)	89.3 (88.7–89.8)	88.8 (87.4–90.1)	<0.001
Alcohol intake (%) ^b	33.1 (31.9–34.3)	39.6 (39.0–40.1)	43.3 (42.4–44.1)	43.6 (41.4–45.7)	<0.001
Current smoker (%)	23.1 (22.0–24.3)	26.6 (26.1–27.1)	30.9 (30.1–31.7)	30.5 (28.4–32.5)	<0.001
HEPA (%)	10.7 (10.0–11.5)	12.9 (12.5–13.3)	15.7 (15.0–16.4)	20.4 (18.5–22.2)	<0.001
Education level (%) ^c	85.0 (84.2–85.8)	86.0 (85.7–86.4)	85.5 (84.8–86.1)	85.5 (83.9–87.0)	<0.001
History of diabetes (%)	3.6 (3.1–4.1)	3.8 (3.6–4.0)	3.6 (3.3–4.0)	4.4 (3.6–5.1)	<0.001
History of hypertension (%)	12.0 (11.2–12.9)	12.1 (11.8–12.5)	12.5 (11.9–13.1)	13.8 (12.4–15.2)	<0.001
History of CVD (%)	0.7 (0.5–0.9)	1.0 (0.9–1.1)	1.0 (0.8–1.2)	1.1 (0.7–1.5)	<0.001
Glucose-lowering medication (%)	2.5 (2.1–2.9)	2.8 (2.6–3.0)	2.7 (2.4–3.0)	3.2 (2.5–3.8)	0.339
Anti-lipid medication use (%)	4.4 (3.9–4.9)	3.8 (3.6–4.0)	3.9 (3.6–4.3)	4.0 (3.3–4.7)	<0.001
Multi-vitamin supplement (%)	7.5 (6.9–8.2)	10.8 (10.4–11.1)	16.7 (16.0–17.4)	23.4 (21.5–25.3)	<0.001
Vitamin D supplement (%)	0.3 (0.2–0.4)	0.6 (0.6–0.7)	1.3 (1.1–1.5)	4.6 (3.6–5.5)	<0.001
Calcium supplement (%)	0.3 (0.2–0.4)	0.4 (0.3–0.5)	0.7 (0.6–0.9)	1.4 (0.9–2.0)	<0.001
Season					
Spring	38.4 (37.2–39.6)	25.0 (24.5–25.5)	13.7 (13.1–14.4)	13.3 (11.7–14.9)	<0.001
Summer	19.9 (18.9–20.9)	29.5 (29.0–30.0)	38.1 (37.2–39.0)	38.4 (36.1–40.7)	<0.001
Fall	22.1 (21.1–23.1)	34.1 (41.2–43.1)	42.2 (41.2–43.1)	41.9 (39.6–44.2)	<0.001
Winter	20.4 (19.4–21.4)	11.4 (11.1–11.8)	7.4 (5.9–6.8)	6.9 (5.8–8.1)	<0.001
Obesity (%) ^d	59.0 (57.8–60.2)	61.7 (61.1–62.2)	63.2 (62.3–64.1)	60.5 (58.2–62.7)	<0.001
BMI (kg/m ²)	26.2 (26.1–26.2)	26.2 (26.1–26.2)	26.2 (26.1–26.3)	26.1 (25.9–26.2)	0.805
SBP (mmHg)	114.5 (114.3–114.8)	114.8 (114.6–114.9)	115.3 (115.1–115.5)	115.2 (114.6–115.7)	<0.001
DBP (mmHg)	73.8 (73.6–74.0)	74.1 (73.9–74.2)	74.3 (74.1–74.5)	73.9 (73.5–74.3)	0.013
Glucose (mg/dL)	98.7 (98.2–99.1)	99.1 (98.9–99.3)	99.0 (98.6–99.3)	98.7 (97.9–99.5)	0.987
Total cholesterol (mg/dL)	201.7 (200.8–202.6)	205.2 (204.8–205.6)	206.2 (205.6–206.9)	201.4 (199.7–203.0)	<0.001
GGT (U/L)	41.4 (40.3–42.5)	43.5 (43.0–44.0)	45.7 (44.9–46.6)	44.1 (42.0–46.1)	<0.001
ALT (U/L)	37.7 (36.9–38.4)	37.8 (37.5–38.1)	38.1 (37.6–38.6)	37.5 (36.1–38.8)	0.049
HOMA-IR	2.26 (2.22–2.30)	2.20 (2.18–2.22)	2.19 (2.15–2.22)	2.19 (2.11–2.27)	<0.001
Total energy intake (kcal/d) ^f	1673.7 (1654.8–1692.7)	1667.3 (1658.7–1675.8)	1646.1 (1631.7–1660.6)	1612.6 (1576.8–1648.4)	<0.001

^aAdjusted for age and sex; ^b ≥ 10 g/day; ^c \geq college graduate; ^d BMI ≥ 25 kg/m²; ^e waist circumference ≥ 90 cm for men and ≥ 85 cm for women; ^f among 103 514 participants with plausible estimated energy intake levels (within three standard deviations from the log-transformed mean energy intake). Abbreviations: ALT, alanine aminotransferase; BMI, body mass index; CVD, cardiovascular disease; DBP, diastolic blood pressure; GGT, gamma-glutamyl transferase; HEPA, health-enhancing physical activity; hs-CRP, high-sensitivity C-reactive protein; HOMA-IR, homeostasis model assessment of insulin resistance; NAFLD, non-alcoholic fatty liver disease; SBP, systolic blood pressure.

eTable 2. Estimated mean values (95% confidence intervals) and adjusted^a proportion (95% confidence intervals) of baseline characteristics by vitamin D change among subjects without NAFLD at baseline (n = 92 792)

Characteristics	Vitamin D levels (ng/mL)			
	<20 at visit 1 & <20 at visit 2	≥20 at visit 1 & <20 at visit 2	<20 at visit 1 & ≥20 at visit 2	≥20 at visit 1 & ≥20 at visit 2
	2	2	2	2
Number of participants	59 561	8583	13 690	10 958
Age (years)	36.1 (36.1–36.2)	36.9 (36.8–37.1)	35.2 (35.1–35.3)	38.1 (38.0–38.3)
Male (%)	34.6 (34.3–35.0)	49.9 (48.9–51.0)	39.8 (39.0–40.6)	55.5 (54.6–56.4)
Alcohol intake (%) ^b	22.5 (22.2–22.8)	25.0 (24.2–25.8)	24.7 (24.0–25.3)	27.0 (26.3–27.8)
Current smoker (%)	12.0 (11.8–12.3)	14.1 (13.5–14.7)	13.0 (12.5–13.5)	14.0 (13.5–14.5)
HEPA (%)	13.4 (13.1–13.7)	16.5 (15.8–17.3)	14.5 (13.9–15.1)	17.9 (17.2–18.6)
Education level (%) ^c	84.2 (83.9–84.5)	86.9 (86.2–87.6)	86.1 (85.5–86.7)	86.4 (85.7–87.1)
History of diabetes (%)	0.5 (0.4–0.5)	0.4 (0.3–0.5)	0.6 (0.4–0.7)	0.6 (0.5–0.7)
History of hypertension (%)	2.9 (2.7–3.0)	3.0 (2.7–3.3)	2.9 (2.6–3.2)	3.1 (2.8–3.4)
History of CVD (%)	0.4 (0.4–0.5)	0.6 (0.4–0.7)	0.5 (0.4–0.6)	0.5 (0.4–0.6)
Glucose-lowering medication (%)	0.3 (0.3–0.4)	0.2 (0.2–0.3)	0.3 (0.2–0.4)	0.3 (0.2–0.4)
Anti-lipid medication use (%)	0.7 (0.7–0.8)	0.9 (0.7–1.1)	0.7 (0.5–0.8)	0.9 (0.8–1.0)
Multi-vitamin supplement (%)	11.3 (11.1–11.6)	22.6 (21.7–23.5)	11.9 (11.3–12.4)	21.9 (21.1–22.6)
Vitamin D supplement (%)	0.8 (0.7–0.8)	2.7 (2.3–3.0)	1.1 (0.9–1.2)	3.5 (3.1–3.8)
Calcium supplement (%)	0.6 (0.6–0.7)	1.7 (1.4–2.0)	0.8 (0.6–0.9)	2.2 (1.9–2.5)
Season				
Spring	28.2 (27.9–28.6)	14.4 (13.7–15.2)	31.0 (30.2–31.7)	16.0 (15.3–16.7)
Summer	29.7 (29.4–30.1)	41.6 (40.5–42.6)	28.1 (27.3–28.8)	38.4 (37.5–39.3)
Fall	30.4 (30.0–30.8)	38.7 (37.6–39.7)	38.0 (27.2–28.7)	38.7 (37.8–39.6)
Winter	11.6 (11.4–11.9)	5.5 (5.0–6.0)	13.0 (12.4–13.6)	7.1 (6.6–7.6)
Obesity (%) ^d	9.8 (9.6–10.0)	10.5 (9.9–11.1)	10.3 (9.8–10.8)	11.0 (10.5–11.5)
BMI (kg/m ²)	21.7 (21.6–21.7)	21.7 (21.6–21.7)	21.7 (21.6–21.7)	21.8 (21.7–21.8)
SBP (mmHg)	103.7 (103.6–103.8)	103.6 (103.4–103.8)	104.0 (103.9–104.2)	104.3 (104.1–104.4)
DBP (mmHg)	66.4 (66.3–66.4)	66.5 (66.3–66.7)	66.5 (66.4–66.6)	66.6 (66.5–66.8)
Glucose (mg/dL)	91.3 (91.2–91.4)	91.2 (91.0–91.3)	91.3 (91.1–91.4)	91.3 (91.1–91.4)
Total cholesterol (mg/dL)	185.2 (184.9–185.4)	187.1 (186.5–187.7)	185.6 (185.1–186.1)	187.3 (186.8–187.9)
GGT (U/L)	19.4 (19.2–19.5)	20.6 (20.2–21.0)	20.0 (19.7–20.3)	21.4 (21.1–21.8)
ALT (U/L)	16.3 (16.2–16.4)	16.9 (16.7–17.2)	16.8 (16.6–17.0)	17.7 (17.5–17.9)
HOMA-IR	1.14 (1.14–1.15)	1.10 (1.08–1.11)	1.16 (1.14–1.17)	1.12 (1.11–1.13)
Total energy intake (kcal/d) ^f	1546.5 (1540.8–1552.1)	1532.6 (1517.8–1547.4)	1492.5 (1480.8–1504.2)	1506.9 (1493.6–1520.3)

^aAdjusted for age and sex; ^b ≥ 10 g/day; ^c \geq college graduate; ^d BMI ≥ 25 kg/m²; ^e waist circumference ≥ 90 cm for men and ≥ 85 cm for women; ^f among 103 514 participants with plausible estimated energy intake levels (within three standard deviations from the log-transformed mean energy intake). Abbreviations: ALT, alanine aminotransferase; BMI, body mass index; CVD, cardiovascular disease; DBP, diastolic blood pressure; GGT, gamma-glutamyl transferase; HEPA, health-enhancing physical activity; hs-CRP, high-sensitivity C-reactive protein; HOMA-IR, homeostasis model assessment of insulin resistance; NAFLD, non-alcoholic fatty liver disease; SBP, systolic blood pressure.

eTable 3. Estimated mean values (95% confidence intervals) and adjusted^a proportion (95% confidence intervals) of baseline characteristics by vitamin D change among subjects with NAFLD at baseline (n = 30 848)

Characteristics	Vitamin D levels (ng/mL)			
	<20 at visit 1 & <20 at visit 2	≥20 at visit 1 & <20 at visit 2	<20 at visit 1 & ≥20 at visit 2	≥20 at visit 1 & ≥20 at visit 2
	2	2	2	2
Number of participants	19 377	3194	3893	4384
Age (years)	37.9 (37.8–38.0)	39.1 (38.9–39.4)	37.5 (37.3–37.7)	40.6 (40.5–40.8)
Male (%)	83.1 (82.5–83.6)	91.9 (90.9–92.8)	88.1 (87.1–89.1)	94.2 (93.5–94.9)
Alcohol intake (%) ^b	39.3 (38.6–39.9)	42.0 (40.4–43.7)	42.7 (41.2–44.2)	46.7 (45.3–48.1)
Current smoker (%)	27.9 (27.3–28.6)	32.4 (30.8–34.0)	30.6 (29.2–32.0)	35.4 (34.0–36.7)
HEPA (%)	11.5 (11.0–11.9)	15.2 (13.9–16.4)	12.9 (11.8–13.9)	15.1 (14.1–16.2)
Education level (%) ^c	87.5 (87.0–87.9)	86.3 (85.1–87.5)	87.8 (86.8–88.9)	86.7 (85.7–87.8)
History of diabetes (%)	3.8 (3.5–4.1)	4.0 (3.4–4.7)	4.0 (3.3–4.6)	4.1 (3.6–4.7)
History of hypertension (%)	11.9 (11.4–12.4)	12.8 (11.7–13.9)	12.7 (11.7–13.8)	12.4 (11.5–13.3)
History of CVD (%)	0.8 (0.6–0.9)	1.0 (0.7–1.3)	0.8 (0.5–1.1)	0.9 (0.6–1.1)
Glucose-lowering medication (%)	2.8 (2.6–3.0)	2.8 (2.3–3.4)	2.8 (2.3–3.4)	3.0 (2.6–3.4)
Anti-lipid medication use (%)	3.9 (3.7–4.2)	3.9 (3.3–4.6)	3.4 (2.8–4.0)	3.3 (2.8–3.8)
Multi-vitamin supplement (%)	10.9 (10.5–11.4)	18.2 (16.9–19.6)	10.6 (9.7–11.6)	18.3 (17.1–19.4)
Vitamin D supplement (%)	0.5 (0.4–0.6)	1.0 (0.7–1.4)	0.8 (0.5–1.1)	1.7 (1.3–2.1)
Calcium supplement (%)	0.3 (0.2–0.3)	0.5 (0.2–0.8)	0.4 (0.2–0.6)	0.8 (0.5–1.1)
Season				
Spring	26.0 (25.4–26.6)	12.1 (11.0–13.3)	29.5 (28.0–30.9)	12.3 (11.3–13.3)
Summer	28.9 (28.3–29.6)	42.3 (39.6–43.0)	25.5 (24.1–26.9)	36.4 (34.9–37.8)
Fall	34.3 (33.6–34.9)	43.4 (41.7–45.1)	32.9 (31.4–34.4)	46.5 (45.0–48.0)
Winter	10.8 (10.4–11.2)	3.4 (2.7–4.0)	12.1 (11.0–13.1)	5.1 (4.4–5.7)
Obesity (%) ^d	63.4 (62.7–64.1)	65.0 (63.3–66.6)	64.7 (63.2–66.2)	65.2 (63.7–66.6)
BMI (kg/m ²)	26.3 (26.2–26.3)	26.3 (26.2–26.4)	26.3 (26.2–26.4)	26.3 (26.2–26.4)
SBP (mmHg)	115.1 (114.9–115.3)	115.4 (115.0–115.8)	115.4 (115.1–115.8)	115.7 (115.4–116.1)
DBP (mmHg)	74.5 (74.4–74.6)	74.7 (74.3–75.0)	74.4 (74.2–74.7)	74.7 (74.4–75.0)
Glucose (mg/dL)	99.5 (99.2–99.7)	99.3 (98.7–99.9)	99.3 (98.7–99.9)	99.2 (98.6–99.7)
Total cholesterol (mg/dL)	206.3 (205.8–206.7)	208.2 (207.0–209.5)	205.0 (203.9–206.1)	205.9 (204.9–207.0)
GGT (U/L)	44.7 (44.2–45.3)	47.5 (46.2–48.9)	46.5 (45.3–47.7)	47.6 (46.4–48.7)
ALT (U/L)	39.7 (39.3–40.1)	39.4 (38.4–40.4)	39.8 (39.0–40.7)	40.0 (39.1–40.8)
HOMA-IR	2.24 (2.22–2.26)	2.16 (2.11–2.22)	2.29 (2.24–2.33)	2.20 (2.16–2.25)
Total energy intake (kcal/d) ^f	1709 (1699–1720)	1706 (1680–1732)	1673 (1650–1696)	1679 (1656–1701)

^aAdjusted for age and sex; ^b ≥ 10 g/day; ^c \geq college graduate; ^d BMI ≥ 25 kg/m²; ^e waist circumference ≥ 90 cm for men and ≥ 85 cm for women; ^f among 103 514 participants with plausible estimated energy intake levels (within three standard deviations from the log-transformed mean energy intake). Abbreviations: ALT, alanine aminotransferase; BMI, body mass index; CVD, cardiovascular disease; DBP, diastolic blood pressure; GGT, gamma-glutamyl transferase; HEPA, health-enhancing physical activity; hs-CRP, high-sensitivity C-reactive protein; HOMA-IR, homeostasis model assessment of insulin resistance; NAFLD, non-alcoholic fatty liver disease; SBP, systolic blood pressure.

eTable 4. Estimated^a mean values (95% confidence intervals) and adjusted^a proportions (95% confidence intervals) of baseline characteristics by development of **NAFLD** among participants without NAFLD at baseline (n = 139 599)

Characteristics	No incident NAFLD	Incident NAFLD	P value
Number of participants	112 068	27 531	
Age (years)	35.9 (35.9-35.9)	37.1 (37.0-37.2)	<0.001
Male (%)	34.6 (34.3-34.8)	67.9 (67.4-68.5)	<0.001
Alcohol intake (%) ^b	24.8 (24.6-25.0)	26.1 (25.7-26.5)	<0.001
Current smoker (%)	12.0 (11.8-12.2)	15.1 (14.8-15.5)	<0.001
HEPA (%)	15.0 (14.8-15.2)	14.3 (13.9-14.7)	0.003
Education level (%) ^c	84.6 (84.4-84.8)	82.0 (81.5-82.5)	<0.001
History of diabetes (%)	0.6 (0.5-0.6)	1.0 (0.9-1.1)	<0.001
History of hypertension (%)	3.1 (3.0-3.2)	4.5 (4.3-4.7)	<0.001
History of CVD (%)	0.5 (0.5-0.6)	0.6 (0.5-0.7)	0.177
Glucose-lowering medication (%)	0.4 (0.3-0.4)	0.6 (0.5-0.7)	<0.001
Anti-lipid medication use (%)	0.9 (0.8-0.9)	1.5 (1.4-1.6)	<0.001
Multi-vitamin supplement (%)	12.2 (12.0-12.4)	13 (12.6-13.4)	<0.001
Vitamin D supplement (%)	1.3 (1.3-1.4)	1.3 (1.1-1.4)	0.732
Calcium supplement (%)	0.9 (0.8-0.9)	0.8 (0.7-0.9)	0.584
Season			
Spring	27.1 (26.8-27.4)	24.3 (23.7-24.8)	<0.001
Summer	31.4 (31.2-31.7)	31.0 (30.5-31.6)	0.246
Fall	29.0 (28.7-29.2)	33.3 (32.8-33.9)	<0.001
Winter	12.5 (12.3-12.7)	11.4 (11.0-11.8)	<0.001
Obesity (%) ^d	9.2 (9.0-9.4)	24.6 (24.1-25.1)	<0.001
BMI (kg/m ²)	21.6 (21.6-21.6)	23.3 (23.3-23.4)	<0.001
SBP (mmHg)	104.2 (104.1-104.2)	106.3 (106.2-106.4)	<0.001
DBP (mmHg)	66.5 (66.5-66.6)	68.0 (67.9-68.1)	<0.001
Glucose (mg/dl)	91.1 (91.1-91.2)	92.8 (92.7-92.9)	<0.001
Total cholesterol (mg/dl)	185.1 (184.9-185.3)	192.0 (191.6-192.4)	<0.001
GGT (U/L)	19.6 (19.5-19.8)	24.5 (24.2-24.7)	<0.001
ALT (U/L)	16.8 (16.7-16.8)	19.5 (19.4-19.7)	<0.001
HOMA-IR	1.14 (1.13-1.14)	1.45 (1.44-1.46)	<0.001

Total energy intake (kcal/d) ^f	1481.9 (1477.7-1486.1)	1545.3 (1536.6-1554.1)	<0.001
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^aAdjusted for age and sex; ^b ≥ 10 g/day; ^c \geq college graduate; ^d BMI ≥ 25 kg/m²; ^e waist circumference ≥ 90 cm for men and ≥ 85 cm for women; ^f among 103 514 participants with plausible estimated energy intake levels (within three standard deviations from the log-transformed mean energy intake).
Abbreviations: ALT, alanine aminotransferase; BMI, body mass index; CVD, cardiovascular disease; DBP, diastolic blood pressure; GGT, gamma-glutamyl transferase; HEPA, health-enhancing physical activity; hs-CRP, high-sensitivity C-reactive protein; HOMA-IR, homeostasis model assessment of insulin resistance; NAFLD, non-alcoholic fatty liver disease; SBP, systolic blood pressure.

eTable 5. Estimated^a mean values (95% confidence intervals) and adjusted^a proportions (95% confidence intervals) of baseline characteristics by resolution of NAFLD among participants with NAFLD at baseline (n = 30 848)

Characteristics	No NAFLD resolution	NAFLD resolution	P value
Number of participants	35 253	13 449	
Age (years)	38.5 (38.4-38.6)	39.1 (38.9-39.2)	<0.001
Male (%)	85.1 (84.7-85.4)	74.7 (73.9-75.4)	<0.001
Alcohol intake (%) ^b	39.2 (38.7-39.7)	41.6 (40.8-42.4)	<0.001
Current smoker (%)	27.6 (27.1-28.0)	26.9 (26.1-27.7)	0.162
HEPA (%)	13.4 (13.0-13.7)	13.9 (13.3-14.5)	0.132
Education level (%) ^c	85.2 (84.9-85.6)	86.9 (86.4-87.4)	<0.001
History of diabetes (%)	4.0 (3.8-4.2)	3.2 (2.9-3.5)	<0.001
History of hypertension (%)	13.1 (12.7-13.4)	10.2 (9.7-10.7)	<0.001
History of CVD (%)	1.0 (0.9-1.1)	1.0 (0.8-1.1)	0.962
Glucose-lowering medication	3.0 (2.8-3.1)	2.2 (2.0-2.5)	<0.001
Anti-lipid medication use (%)	4.1 (3.9-4.3)	3.2 (3.0-3.5)	<0.001
Multi-vitamin supplement (%)	11.6 (11.3-12.0)	13.6 (13.1-14.2)	<0.001
Vitamin D supplement (%)	0.9 (0.8-1.0)	0.9 (0.7-1.0)	0.676
Calcium supplement (%)	0.5 (0.4-0.5)	0.5 (0.4-0.6)	0.516
Season			
Spring	24.2 (23.7-24.6)	22.7 (22.0-23.4)	0.001
Summer	30.5 (30.0-31.0)	30.1 (29.3-30.9)	0.340
Fall	33.9 (33.4-34.4)	36.4 (35.6-37.2)	<0.001
Winter	11.4 (11.1-11.7)	10.9 (10.4-11.4)	0.118
Obesity (%) ^d	65.1 (64.6-65.6)	52.6 (51.7-53.4)	<0.001
BMI (kg/m ²)	26.4 (26.4-26.5)	25.4 (25.4-25.5)	<0.001
SBP (mmHg)	115.3 (115.2-115.4)	113.7 (113.5-113.9)	<0.001
DBP (mmHg)	74.3 (74.2-74.4)	73.4 (73.3-73.6)	<0.001
Glucose (mg/dl)	99.3 (99.1-99.5)	98.2 (97.9-98.5)	0.075
Total cholesterol (mg/dl)	205.3 (204.9-205.6)	203.7 (203.1-204.3)	<0.001
GGT (U/L)	45.2 (44.8-45.7)	39.8 (39.0-40.5)	<0.001
ALT (U/L)	40.5 (40.2-40.8)	30.7 (30.2-31.2)	<0.001
HOMA-IR	2.34 (2.32-2.36)	1.86 (1.83-1.89)	<0.001

Total energy intake (kcal/d) ^f	1656.3 (1648.3-1664.2)	1675.3 (1662.5-1688.2)	<0.001
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^aAdjusted for age and sex; ^b ≥ 10 g/day; ^c \geq college graduate; ^d BMI ≥ 25 kg/m²; ^e waist circumference ≥ 90 cm for men and ≥ 85 cm for women; ^f among 103 514 participants with plausible estimated energy intake levels (within three standard deviations from the log-transformed mean energy intake).
Abbreviations: ALT, alanine aminotransferase; BMI, body mass index; CVD, cardiovascular disease; DBP, diastolic blood pressure; GGT, gamma-glutamyl transferase; HEPA, health-enhancing physical activity; hs-CRP, high-sensitivity C-reactive protein; HOMA-IR, homeostasis model assessment of insulin resistance; NAFLD, non-alcoholic fatty liver disease; SBP, systolic blood pressure.

eTable 6. Development and resolution of non-alcoholic fatty liver disease (NAFLD) by 25(OH)D levels after further adjustment for HOMA-IR and glucose

25(OH)D levels (ng/mL)	Among participants without NAFLD at baseline (n = 139 599)	Among participants with NAFLD at baseline (n = 48 702)
	Multivariable-adjusted HR (95% confidence intervals) ^a for incident NAFLD	Multivariable-adjusted HR (95% confidence intervals) ^a for resolution of NAFLD
<10	1.00 (reference)	1.00 (reference)
10-19	0.90 (0.86–0.93)	1.08 (1.02–1.13)
20-29	0.82 (0.78–0.85)	1.11 (1.04–1.18)
≥30	0.73 (0.68–0.78)	1.21 (1.09–1.34)
<i>p</i> -trend	<0.001	<0.001

^a Estimated from Cox proportional hazards models. Multivariable model 3 was adjusted for age, sex, center, year of screening examination, alcohol consumption, smoking, physical activity, total energy intake, education level, BMI, medication for hyperlipidemia, glucose-lowering medication, multi-vitamin supplements, vitamin D supplements, calcium supplements, HOMA-IR and glucose.

Abbreviations: BMI, body mass index; HOMA-IR, homeostasis model assessment of insulin resistance; HR, hazard ratio

eTable 7. Development and resolution of non-alcoholic fatty liver disease (NAFLD) by 25(OH)D levels after further adjustment for waist circumference among participants with available waist circumferences

25(OH)D levels (ng/mL)	Among participants without NAFLD at baseline (n = 138 962)	Among participants with NAFLD at baseline (n = 48 680)
	Multivariable-adjusted HR (95% confidence intervals) ^a for incident NAFLD	Multivariable-adjusted HR (95% confidence intervals) ^a for resolution of NAFLD
<10	1.00 (reference)	1.00 (reference)
10-19	0.89 (0.86–0.92)	1.09 (1.03–1.15)
20-29	0.82 (0.78–0.85)	1.13 (1.06–1.21)
≥30	0.72 (0.67–0.78)	1.21 (1.09–1.34)
<i>p</i> -trend	<0.001	<0.001

^a Estimated from Cox proportional hazards models. Multivariable model was adjusted for age, sex, center, year of screening examination, alcohol consumption, smoking, physical activity, total energy intake, education level, BMI, medication for hyperlipidemia, glucose-lowering medication, multi-vitamin supplements, vitamin D supplements, calcium supplements, and waist circumference.

Abbreviations: BMI, body mass index; HR, hazard ratio

eTable 8. Resolution of non-alcoholic fatty liver disease (NAFLD) by 25(OH)D levels according to vitamin D supplementation among participants with NAFLD at baseline (n = 48 702)

25(OH)D levels (ng/mL)	Multivariable-adjusted HR (95% confidence intervals) ^a for resolution of NAFLD		P for interaction
	No vitamin D supplements (n = 48 271)	Vitamin D supplements (n = 431)	
<10	1.00 (reference)	1.00 (reference)	0.719
10-19	1.09 (1.03–1.15)	0.93 (0.44–1.94)	
20-29	1.13 (1.06–1.21)	0.96 (0.45–2.05)	
≥30	1.22 (1.10–1.36)	0.81 (0.36–1.84)	
<i>p</i> -trend	<0.001	0.636	

^a Estimated from Cox proportional hazards models. Multivariable model was adjusted for age, sex, center, year of screening examination, alcohol consumption, smoking, physical activity, total energy intake, education level, BMI, medication for hyperlipidemia, glucose-lowering medication, multi-vitamin supplements, and calcium supplements.

Abbreviations: BMI, body mass index; HR, hazard ratio

eTable 9. Development and resolution of non-alcoholic fatty liver disease (NAFLD) by binary categories of 25(OH)D concentration at two examinations after further adjustment for HOMA-IR and glucose

25(OH)D changes (ng/mL)		Among participants without NAFLD at baseline (n = 92 792)	Among participants with NAFLD at baseline (n = 30 848)
Visit 1	Visit 2	Multivariable-adjusted HR (95% confidence intervals) ^a for incident NAFLD	Multivariable-adjusted HR (95% confidence intervals) ^a for resolution of NAFLD
<20	<20	1.00 (reference)	1.00 (reference)
≥20	<20	0.93 (0.87–0.98)	0.96 (0.88–1.06)
<20	≥20	0.87 (0.82–0.91)	1.02 (0.94–1.12)
≥20	≥20	0.80 (0.76–0.85)	1.09 (1.01–1.19)

^a Estimated from Cox proportional hazards models. Multivariable model 3 was adjusted for age, sex, center, year of screening examination, alcohol consumption, smoking, physical activity, total energy intake, education level, BMI, medication for hyperlipidemia, glucose-lowering medication, multi-vitamin supplements, vitamin D supplements, calcium supplements, HOMA-IR and glucose.

Abbreviations: BMI, body mass index; HOMA-IR, homeostasis model assessment of insulin resistance; HR, hazard ratio

eTable 10. Development and resolution of non-alcoholic fatty liver disease (NAFLD) by binary categories of 25(OH)D concentration at two examinations after further adjustment for waist circumference among participants with available waist circumference

25(OH)D changes (ng/mL)		Among participants without NAFLD at baseline (n = 92 347)	Among participants with NAFLD at baseline (n = 30 835)
Visit 1	Visit 2	Multivariable-adjusted HR (95% confidence intervals) ^a for incident NAFLD	Multivariable-adjusted HR (95% confidence intervals) ^a for resolution of NAFLD
<20	<20	1.00 (reference)	1.00 (reference)
≥20	<20	0.93 (0.87–0.98)	0.97 (0.88–1.06)
<20	≥20	0.87 (0.82–0.91)	1.02 (0.94–1.12)
≥20	≥20	0.81 (0.77–0.86)	1.10 (1.01–1.19)

^a Estimated from Cox proportional hazards models. Multivariable model was adjusted for age, sex, center, year of screening examination, alcohol consumption, smoking, physical activity, total energy intake, education level, BMI, medication for hyperlipidemia, glucose-lowering medication, multi-vitamin supplements, vitamin D supplements, calcium supplements, and waist circumference.

Abbreviations: BMI, body mass index; HR, hazard ratio

eTable 11. Resolution of non-alcoholic fatty liver disease (NAFLD) by binary categories of 25(OH)D concentration at two examinations according to vitamin D supplements among participants with NAFLD at baseline (n = 30 848)

25(OH)D changes (ng/mL)		Multivariable-adjusted HR (95% confidence intervals) ^a for resolution of NAFLD		<i>P</i> for interaction
Visit 1	Visit 2	No vitamin D supplements (n = 30 621)	Vitamin D supplements (n = 227)	
<20	<20	1.00 (reference)	1.00 (reference)	0.638
≥20	<20	0.98 (0.89–1.07)	0.46 (0.11–1.98)	
<20	≥20	1.03 (0.94–1.12)	0.64 (0.19–2.19)	
≥20	≥20	1.10 (1.01–1.19)	1.16 (0.57–2.35)	

^a Estimated from Cox proportional hazards models. Multivariable model was adjusted for age, sex, center, year of screening examination, alcohol consumption, smoking, physical activity, total energy intake, education level, BMI, medication for hyperlipidemia, glucose-lowering medication, multi-vitamin supplements, and calcium supplements.

Abbreviations: BMI, body mass index; HR, hazard ratio

eTable 12. Development and resolution of non-alcoholic fatty liver disease (NAFLD) by 25(OH)D levels according to glucose-lowering medication

25(OH)D levels (ng/mL)	Multivariable-adjusted HR (95% confidence intervals) ^a for incident NAFLD Among participants without NAFLD at baseline (n = 139 599)		<i>P</i> for interaction	Multivariable-adjusted HR (95% confidence intervals) ^a for resolution of NAFLD among participants with NAFLD at baseline (n = 48 702)		<i>P</i> for interaction
	No glucose-lowering medication (n = 139 012)	Glucose-lowering medication (n = 587)		No glucose-lowering medication (n = 47 346)	Glucose-lowering medication (n = 1356)	
<10	1.00 (reference)	1.00 (reference)	0.674	1.00 (reference)	1.00 (reference)	0.152
10-19	0.89 (0.86–0.92)	1.01 (0.63–1.63)		1.08 (1.02–1.14)	1.26 (0.84–1.88)	
20-29	0.81 (0.78–0.85)	0.76 (0.46–1.28)		1.13 (1.06–1.20)	1.50 (0.98–2.31)	
≥30	0.72 (0.67–0.77)	0.70 (0.36–1.34)		1.19 (1.07–1.32)	2.04 (1.22–3.41)	
<i>p</i> -trend	<0.001	0.094		<0.001	0.003	

^a Estimated from Cox proportional hazards models. Multivariable model was adjusted for age, sex, center, year of screening examination, alcohol consumption, smoking, physical activity, total energy intake, education level, BMI, medication for hyperlipidemia, multi-vitamin supplements, vitamin D supplements, and calcium supplements.

Abbreviations: HR, hazard ratio

eTable 13. Development and resolution of non-alcoholic fatty liver disease (NAFLD) by binary categories of 25(OH)D concentration at two examinations according to glucose-lowering medication among participants with NAFLD at baseline

25(OH)D changes (ng/mL)		Multivariable-adjusted HR (95% confidence intervals) ^a for incident NAFLD Among participants without NAFLD at baseline (n = 92 792)		<i>P</i> for interaction	Multivariable-adjusted HR (95% confidence intervals) ^a for resolution of NAFLD among participants with NAFLD at baseline (n = 30 848)		<i>P</i> for interaction
Visit 1	Visit 2	No glucose-lowering medication (n = 92 519)	Glucose-lowering medication (n = 273)		No glucose-lowering medication (n = 29 971)	Glucose-lowering medication (n = 877)	
<20	<20	1.00 (reference)	1.00 (reference)	0.944	1.00 (reference)	1.00 (reference)	0.490
≥20	<20	0.92 (0.87–0.98)	0.74 (0.29–1.87)		0.96 (0.88–1.06)	1.22 (0.73–2.02)	
<20	≥20	0.87 (0.82–0.91)	0.75 (0.33–1.67)		1.03 (0.94–1.12)	0.73 (0.40–1.34)	
≥20	≥20	0.80 (0.76–0.85)	0.71 (0.40–1.28)		1.10 (1.01–1.19)	1.17 (0.78–1.76)	

^a Estimated from Cox proportional hazards models. Multivariable model was adjusted for age, sex, center, year of screening examination, alcohol consumption, smoking, physical activity, total energy intake, education level, BMI, medication for hyperlipidemia, multi-vitamin supplements, vitamin D supplements, and calcium supplements.

Abbreviations: HR, hazard ratio

eTable 14. Development and resolution of non-alcoholic fatty liver disease (NAFLD) based on 25(OH)D levels among participants with alanine transaminase (ALT) <36 IU/L

25(OH)D levels (ng/mL)	Among participants without NAFLD at baseline (n = 132 666)	Among participants with NAFLD at baseline (n = 29 829)
	Multivariable-adjusted HR (95% confidence intervals) ^a for incident NAFLD	Multivariable-adjusted HR (95% confidence intervals) ^a for resolution of NAFLD
<10	1.00 (reference)	1.00 (reference)
10-19	0.89 (0.86–0.92)	1.11 (1.05–1.18)
20-29	0.81 (0.78–0.85)	1.12 (1.04–1.20)
≥30	0.73 (0.68–0.79)	1.19 (1.06–1.34)
<i>p</i> -trend	<0.001	0.002

^a Estimated from Cox proportional hazards models. Multivariable model was adjusted for age, sex, center, year of screening examination, alcohol consumption, smoking, physical activity, total energy intake, education level, BMI, medication for hyperlipidemia, glucose-lowering medication, multi-vitamin supplements, vitamin D supplements, and calcium supplements
Abbreviations: ALT, alanine transaminase; BMI, body mass index; HR, hazard ratio

eTable 15. Development and resolution of non-alcoholic fatty liver disease (NAFLD) by binary categories of 25(OH)D concentration in two examinations among participants with alanine transaminase (ALT) <36 IU/L

25(OH)D changes (ng/mL)		Among participants without NAFLD at baseline (n = 89 021)	Among participants with NAFLD at baseline (n = 17 743)
Visit 1	Visit 2	Multivariable-adjusted HR (95% confidence intervals) ^a for incident NAFLD	Multivariable-adjusted HR (95% confidence intervals) ^a for resolution of NAFLD
<20	<20	1.00 (reference)	1.00 (reference)
≥20	<20	0.93 (0.87–0.99)	0.89 (0.80–1.002)
<20	≥20	0.87 (0.82–0.91)	1.05 (0.94–1.16)
≥20	≥20	0.79 (0.75–0.84)	1.04 (0.94–1.15)

^a Estimated from Cox proportional hazards models. Multivariable model was adjusted for age, sex, center, year of screening examination, alcohol consumption, smoking, physical activity, total energy intake, education level, BMI, medication for hyperlipidemia, glucose-lowering medication, multi-vitamin supplements, vitamin D supplements, and calcium supplements.

Abbreviations: ALT, alanine transaminase; BMI, body mass index; HR, hazard ratio

eTable 16. Development and resolution of elevated ALT (≥ 36 IU/L) by 25(OH)D levels

25(OH)D levels (ng/mL)	Among participants with ALT < 36 IU/L at baseline (n = 162 495)	Among participants with ALT ≥ 36 IU/L at baseline (n = 25 806)
	Multivariable-adjusted HR (95% confidence intervals) ^a for development of elevated ALT	Multivariable-adjusted HR (95% confidence intervals) ^a for resolution of elevated ALT
<10	1.00 (reference)	1.00 (reference)
10-19	0.95 (0.92–0.99)	1.04 (0.98–1.09)
20-29	0.92 (0.88–0.96)	1.07 (1.01–1.13)
≥ 30	0.89 (0.83–0.95)	1.15 (1.05–1.25)
<i>p</i> -trend	<0.001	0.002

^a Estimated from Cox proportional hazards models. Multivariable model was adjusted for age, sex, center, year of screening examination, alcohol consumption, smoking, physical activity, total energy intake, education level, BMI, medication for hyperlipidemia, glucose-lowering medication, multi-vitamin supplements, vitamin D supplements, and calcium supplements

Abbreviations: ALT, alanine transaminase; BMI, body mass index; HR, hazard ratio

eTable 17. Development and resolution of non-alcoholic fatty liver disease (NAFLD) by binary categories of 25(OH)D concentration at two examinations

25(OH)D changes (ng/mL)		Among participants with ALT<36 IU/L at baseline (n = 110 727)	Among participants with ALT≥36 IU/L at baseline (n = 9906)
Visit 1	Visit 2	Multivariable-adjusted HR (95% confidence intervals) ^a for development of elevated ALT	Multivariable-adjusted HR (95% confidence intervals) ^a for resolution of elevated ALT
<20	<20	1.00 (reference)	1.00 (reference)
≥20	<20	0.98 (0.92–1.03)	1.05 (0.95–1.15)
<20	≥20	0.96 (0.91–1.01)	0.99 (0.90–1.08)
≥20	≥20	0.95 (0.90–0.99)	1.04 (0.95–1.14)

^a Estimated from Cox proportional hazards models. Multivariable model was adjusted for age, sex, center, year of screening examination, alcohol consumption, smoking, physical activity, total energy intake, education level, BMI, medication for hyperlipidemia, glucose-lowering medication, multi-vitamin supplements, vitamin D supplements, and calcium supplements.

Abbreviations: ALT, alanine transaminase; HR, hazard ratio