The flowchart of data filter of study participants in NHANES 2017-2018 (Supplemental Figure 1)

Participants aged 12 years and over at enrollment for whom elastography measurements using the FibroScan® were allowed in the NHANES Mobile Examination Center	6401
Inclusion criteria	
Participants aged 18 years and over at enrollment for whom elastography measurements using the FibroScan® were allowed in the NHANES Mobile Examination Center	5533
Exclusion criteria	
1) Ineligible elastography exam status	258
2) Not done elastography exam status	156
3) individuals who are infected with hepatitis B	28
4) individuals who are infected with hepatitis C	52
5) significant alcohol consumption (>30 g/day for male and >20 g/day for female)	84
6) individuals with incomplete value information on VA (retinol) concentration	233
Final adult sample sizes for analysis	4723

Supplemental Table 1. The number of subjects with complete data available for analysis, NHANES 2017-2018

Adults (>=18 yr)	N	Adults (>=18 yr)	N	Adults (>=18 yr)	N
Serum VA	4 723	Health insurance	4 711	Weight	4 688
CAP	4 723	BMI	4 683	WC	4 546
Sex	4 723	Cigarette use	4 723	Sleep time	4 674
Age	4 723	Alcohol use	4 454	Sedentary activity	4 714
Race	4 723	CRP	4 654	Fasting insulin	2 245
PIR	4 126	Energy intake	3 803	Fasting glucose	2 278
Education	4 675	Moderate recreational activities	4 723	TG	2 252

Abbreviations:

NAFLD: nonalcoholic fatty liver disease, VA: vitamin A, CAP: controlled attenuation parameter, PIR: the ratio of family income to poverty, BMI: body mass index, CRP: C-reactive protein, WC: waist

circumference, TG: triglycerides.

Supplemental Table 2. Univariate analysis adjusted for sociodemographic variables and socioeconomic status variables, NHANES 2017-2018

NAFLD (CAP)	(N) Mean (95%CI)	β (95%CI)	(N) % (95%CI)	OR (95%CI)
BMI (%)				
<25	(1257) 215 (212 ,219)	Ref.	(1257) 12.5 (9.2 ,15.8)	Ref.
≥25, <30	(1491) 256 (252 ,260)	33.92 (29.73, 38.11)	(1491) 45.4 (40.9 ,49.8)	4.98 (3.54, 7.00)
≥30	(1935) 299 (295 ,304)	78.95 (73.69, 84.22)	(1935) 75.2 (71.2 ,79.2)	21.56 (13.62, 34.13)
Cigarette use (%)				
<100 cigarettes in life	(2834) 258 (255 ,262)	Ref.	(2834) 46.3 (43.8 ,48.7)	Ref.
≥100 cigarettes in life	(1889) 271 (266 ,275)	5.49 (0.17, 10.82)	(1889) 53.3 (49.5 ,57.1)	1.11 (0.91, 1.36)
Alcohol use (%)				
Never or Rarely	(2550) 267 (262 ,272)	Ref.	(2550) 51.9 (48.7 ,55.0)	Ref.
Sometimes	(876) 257 (249 ,264)	-6.94 (-17.16, 3.29)	(876) 43.9 (40.0 ,47.8)	0.79 (0.63, 1.00)
Often	(1028) 263 (254 ,272)	-3.43 (-12.82, 5.97)	(1028) 48.1 (41.7 ,54.5)	0.90 (0.65, 1.24)
CRP (%)				
Tertile1	(1538) 239 (234 ,244)	Ref.	(1538) 31.3 (26.4 ,36.2)	Ref.
Tertile2	(1559) 268 (263 ,274)	24.43 (16.73, 32.13)	(1559) 52.9 (49.4 ,56.4)	2.25 (1.68, 3.01)
Tertile3	(1557) 285 (281 ,289)	45.23 (39.63, 50.82)	(1557) 64.9 (61.7 ,68.0)	4.29 (3.22, 5.70)
Energy intake (%)				
Tertile1	(1263) 257 (252 ,261)	Ref.	(1263) 44.1 (40.3 ,48.0)	Ref.
Tertile2	(1268) 261 (257 ,266)	3.33 (-2.29, 8.94)	(1268) 47.9 (44.4 ,51.3)	1.16 (0.97, 1.39)
Tertile3	(1272) 269 (263 ,275)	6.56 (0.51, 12.61)	(1272) 53.2 (50.0 ,56.4)	1.33 (1.11, 1.59)
Moderate recreational activities				
Yes	(1937) 258 (253 ,263)	Ref.	(1937) 44.8 (41.5 ,48.1)	Ref.
No	(2786) 268 (265 ,271)	8.26 (3.10, 13.43)	(2786) 52.9 (50.5 ,55.4)	1.33 (1.14, 1.56)

Data in the table:

Univariate analysis: adjusted for sociodemographic variables including Sex, Race and Age + socioeconomic status variables including PIR, Education, Health insurance.

For continuous variables: survey-weighted mean (95% CI), For categorical variables: survey-weighted percentage (95% CI), N: Number of observed, For CAP: survey-weighted β (95% CI), For liver steatosis: survey-weighted OR (95% CI).

Abbreviations:

CI: 95% confidence interval, OR: odds ratio, BMI: body mass index, PIR: the ratio of family income to poverty, CAP: controlled attenuation parameter, CRP: C-reactive protein.

Supplemental Table 3. Associations between serum VA and NAFLD among US adults in sensitivity analysis, NHANES 2017-2018

Factors	>=18 yr Adults			
	Complete exam (n=4 385)		95% population (n=4 488)	
	β (95%CI)	OR (95%CI)	β (95%CI)	OR (95%CI)
Serum VA (per-SD change)	3.00 (1.31, 4.70)	1.20 (1.10, 1.32)	3.01 (1.21, 4.81)	1.17 (1.07, 1.28)
Subgroups				
Tertile1	Ref.	Ref.	Ref.	Ref.
Tertile2	5.72 (0.53, 10.91)	1.19 (0.97, 1.46)	4.18 (-0.94, 9.30)	1.10 (0.87, 1.39)
Tertile3	8.66 (5.04, 12.28)	1.51 (1.22, 1.86)	7.49 (3.56, 11.42)	1.35 (1.08, 1.69)

Data in the table:

β: CAP; OR: NAFLD (CAP cut-off point of 263 dB/m)

Model: adjustment of sociodemographic variables including Sex, Race and Age + socioeconomic status variables including PIR, Education, Health insurance + health-related variables including BMI, Cigarette use, Alcohol use, CRP, Energy intake and Moderate recreational activities.

Abbreviations:

NAFLD: nonalcoholic fatty liver disease, CI: 95% confidence interval, OR: odds ratio, BMI: body mass index, PIR: the ratio of family income to poverty, CAP: controlled attenuation parameter, CRP: C-reactive protein, VA: vitamin A.

Supplemental Table 4. Subgroup analyses between serum VA and NAFLD when stratified by WC tertile among US adults, NHANES 2017-2018

	WC tertile 1 (56.4-91.8)	WC tertile 2 (91.9-106.1)	WC tertile 3 (106.2-169.5)	P-interaction
No.	1511	1518	1517	
CAP (dB/m)	β (95%CI)	β (95%CI)	β (95%CI)	
Serum VA (per-SD change)	**8.46 (4.93, 12.00)**	1.43 (-1.99, 4.85)	0.56 (-3.43, 4.55)	0.0059
Subgroups				0.0338
Tertile1	Ref.	Ref.	Ref.	
Tertile2	4.32 (-2.84, 11.49)	5.47 (-7.66, 18.60)	2.83 (-8.17, 13.82)	
Tertile3	**15.91 (8.71, 23.11)**	5.06 (-4.29, 14.40)	6.51 (-2.83, 15.86)	
CAP (%)	OR (95%CI)	OR (95%CI)	OR (95%CI)	
Serum VA (per-SD change)	**1.68 (1.26, 2.25)**	1.05 (0.88, 1.24)	1.17 (1.00, 1.37)	0.0081
Subgroups				0.1748
Tertile1	**Ref.**	Ref.	Ref.	
Tertile2	**1.77 (1.17, 2.68)**	1.22 (0.76, 1.94)	0.78 (0.52, 1.18)	
Tertile3	**2.79 (1.73, 4.51)**	1.16 (0.69, 1.94)	1.33 (0.86, 2.04)	

Data in the table:

The association between serum VA (per-SD or tertile increment) and the degree of NAFLD in three WC subgroups. Values were adjusted for Sex, Race, Age, PIR, Education, Health insurance, Cigarette use, Alcohol use, CRP, Energy intake and Moderate recreational activities.

Abbreviations:

CI: 95% confidence interval, OR: odds ratio, WC: waist circumference, PIR: the ratio of family income to poverty, CAP: controlled attenuation parameter, CRP: C-reactive protein, VA: vitamin A.

Supplemental Table 5. Subgroup analyses between serum VA and NAFLD when stratified by weight tertile among US adults, NHANES 2017-2018

|	Weight tertile 1 (36.2-70.8)	Weight tertile 2 (70.9-88.3)	Weight tertile 3 (88.4-242.6)	P-interaction
No.	1555	1567	1566	
CAP (dB/m)	β (95%CI)	β (95%CI)	β (95%CI)	
Serum VA (per-SD change)	**8.15 (5.00, 11.30)**	1.04 (-2.80, 4.88)	1.24 (-3.89, 6.37)	0.0044
Subgroups				0.0013
Tertile1	**Ref.**	Ref.	Ref.	
Tertile2	4.95 (-1.85, 11.76)	3.41 (-4.90, 11.72)	4.56 (-6.80, 15.92)	
Tertile3	**17.33 (12.24, 22.42)**	2.86 (-5.47, 11.20)	5.78 (-5.15, 16.71)	
CAP (%)	**OR (95%CI)**	OR (95%CI)	OR (95%CI)	
Serum VA (per-SD change)	**1.48 (1.19, 1.83)**	1.05 (0.87, 1.27)	1.21 (0.99, 1.47)	0.0650
Subgroups				<0.0001
Tertile1	**Ref.**	Ref.	Ref.	
Tertile2	**1.77 (1.36, 2.32)**	0.99 (0.70, 1.41)	0.99 (0.65, 1.53)	
Tertile3	**2.45 (1.85, 3.25)**	1.07 (0.71, 1.62)	1.31 (0.78, 2.20)	

Data in the table:

The association between serum VA (per-SD or tertile increment) and the degree of NAFLD in three weight subgroups. Values were adjusted for Sex, Race, Age, PIR, Education, Health insurance, Cigarette use, Alcohol use, CRP, Energy intake and Moderate recreational activities.

Abbreviations:

CI: 95% confidence interval, OR: odds ratio, PIR: the ratio of family income to poverty, CAP: controlled attenuation parameter, CRP: C-reactive protein, VA: vitamin A.
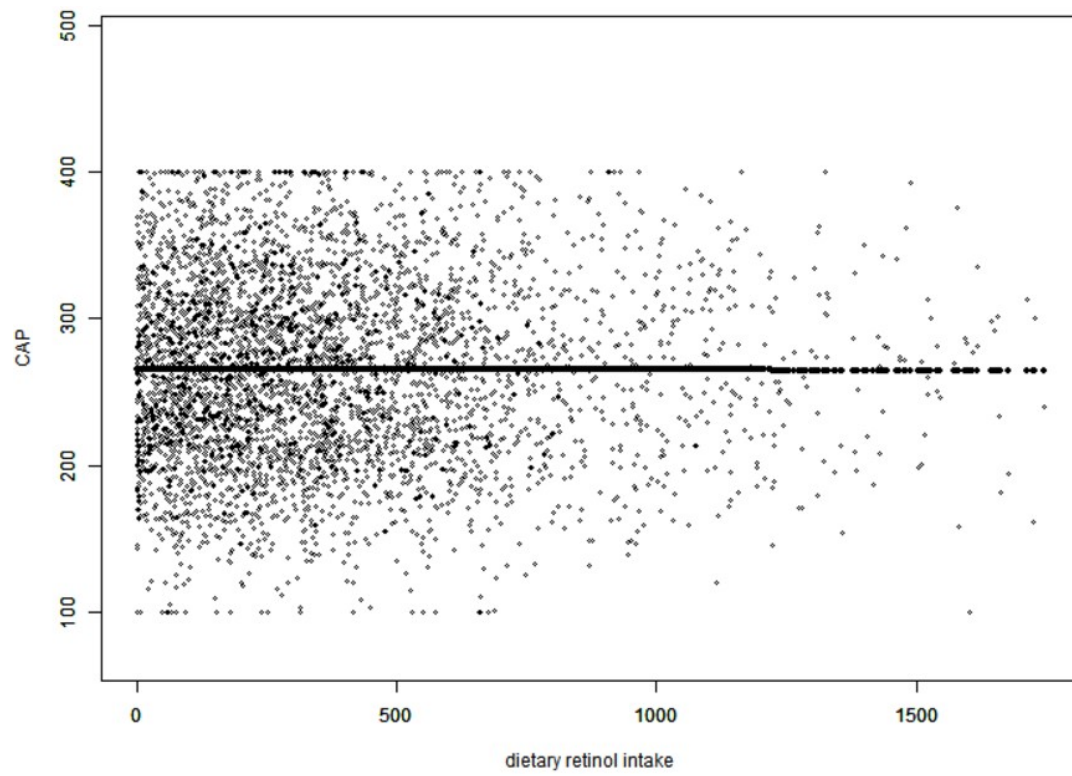
Supplemental Figure 2. The spline smoothing plot of serum VA and CAP in different BMI groups among adults
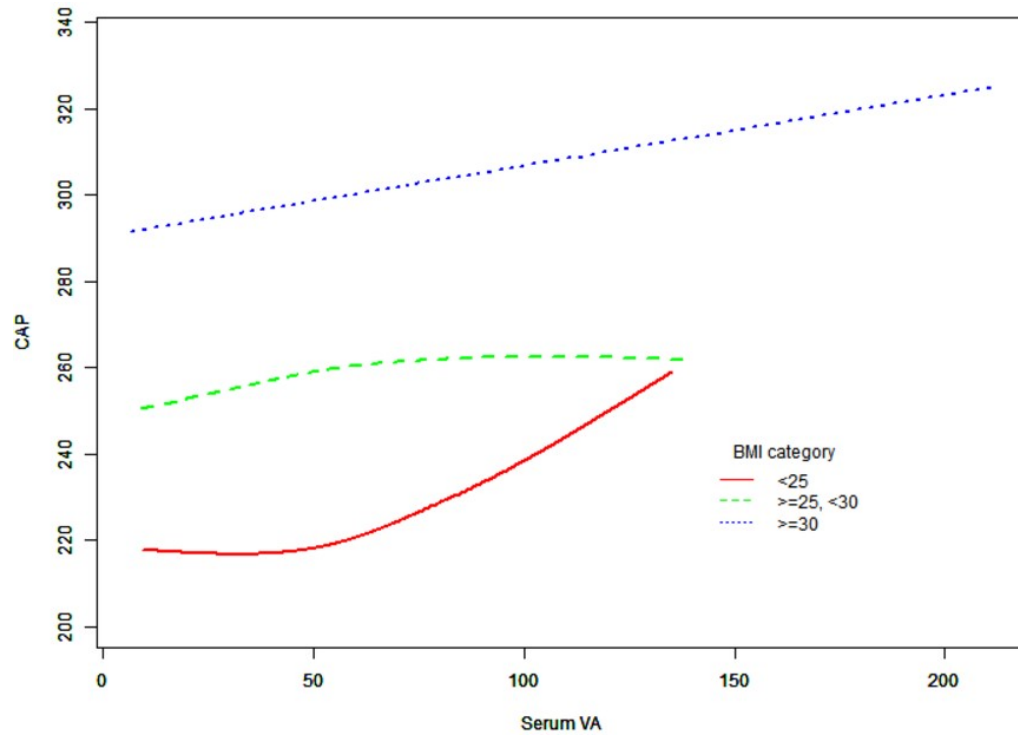
Abbreviations:

CAP: controlled attenuation parameter, VA: vitamin A.

Supplemental Figure 3. The scatter plot of dietary retinol intake and CAP among adults.

Abbreviations:

CAP: controlled attenuation parameter.