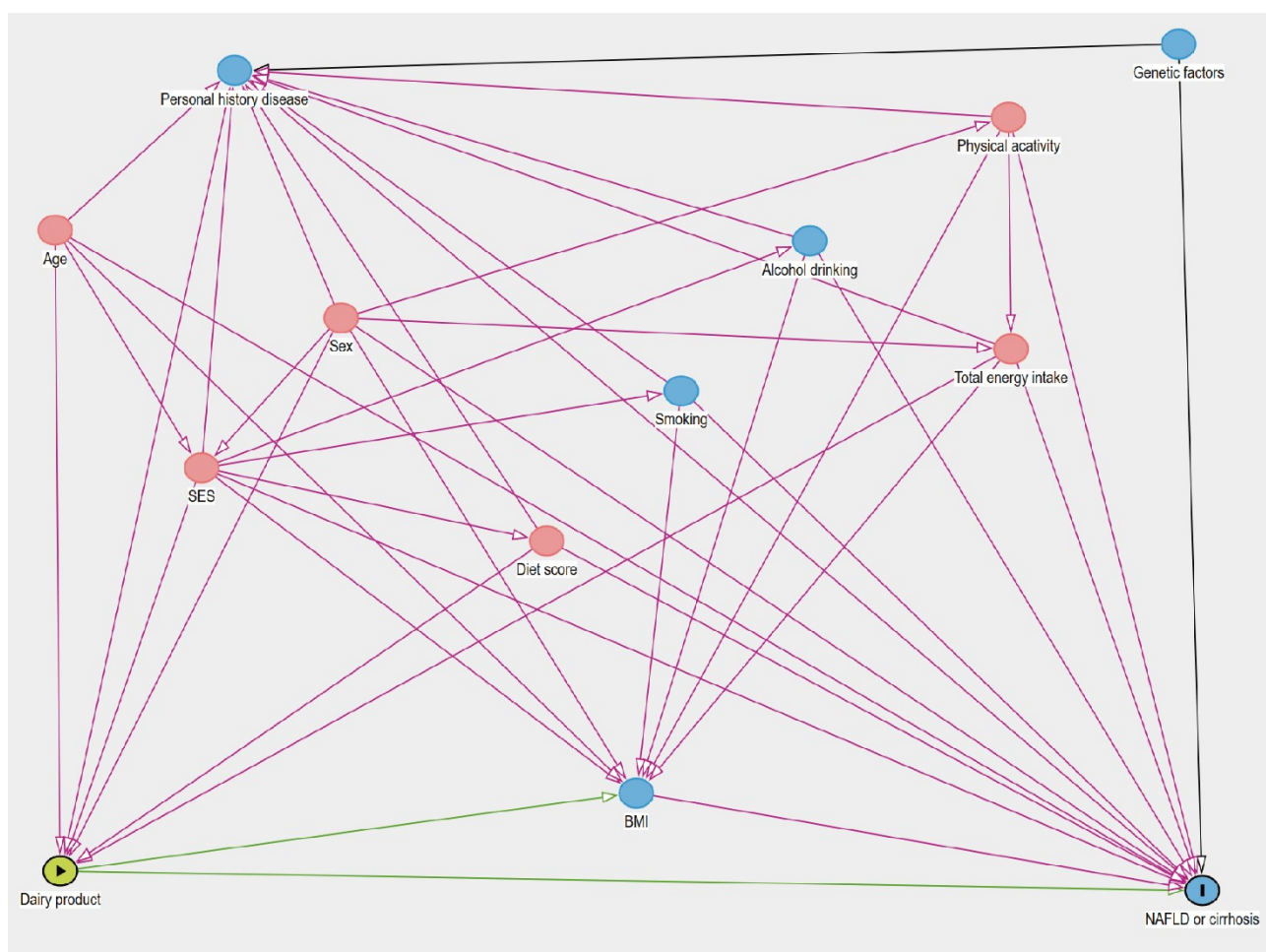


**Figure S1.** Directed acyclic graph (DAG) derived from literature and expert knowledge. Nodes represent variables and arrows represent causal associations. The exposure is different types of dairy products intake and the outcome is non-alcoholic fatty liver disease or cirrhosis. BMI, body mass index; NAFLD, non-alcoholic fatty liver disease; SES, socioeconomic status (including education level and Townsend deprivation index).



**Table S1. Classification and the fat content of dairy products.**

Dairy type	includes and fat content	Total dairy products	High-fat dairy products	Low-fat dairy products	Unfermented dairy products	Fermented dairy products
Whole milk	Whole milk >3.6 g fat per 100 g (cow, goat, sheep)	✓	✓		✓	
Semi-skimmed milk	Semi-skimmed milk >1 g fat per 100 g (cow, other)	✓		✓	✓	
Skimmed milk	Skimmed milk <1 g fat per 100 g (cow, cholesterol lowering, powdered)	✓		✓	✓	
Full fat yogurt	Whole milk yogurt (plain)	✓	✓			✓
Low fat yogurt	Fat free and lower fat yogurt, plain or flavored	✓		✓		✓
High-fat cheese	Cheese >17.5 g fat per 100 g, including hard cheese, soft cheese, spreadable, Blue, Feta, Mozzarella, Goats, other)	✓	✓			✓
Medium & low-fat cheese	Cheese ≤17.5g fat per 100 g, including hard and spreadable lower fat cheese, Cottage	✓		✓		✓

**Table S2. Definitions of NAFLD and other liver diseases**

	ICD-9	ICD-10
Nonalcoholic fatty liver disease	5718	K760
Nonalcoholic steato hepatitis		K758
Alcohol related liver disease	571, 5710, 5711, 5712, 5713	K70
Viral hepatitis	70	B16, B17, B18, B19
Autoimmune liver disease	5716, 5761	K830, K743, K754
Cirrhosis	27103, 4562, 5712, 5715, 57150, 57151, 57152, 57158, 57159, 5716	I850, I859, K703, K704, K717, K721, K744, K745, K746, K766, K767
Other liver diseases <sup>a</sup>	2750, 2751, 2776, 4530, 5714, 5716, 5715, 4561, 54621, 4560, 45620, 7895, 5722, 5724, 5723, 1550, 152,	E831, E830, E880, I820, K765, K739, K732, K744, K745, C220, C229
Alcohol/drug use disorder	303, 3050, 291, 3575, 4255, 5353, 9801, 9809, 3051, 3052, 3053, 3054, 3055, 3056, 3057, 3058, 3059	F10, E244, G621, I426, K292, G312, G721, K852, K860, T510, T519, F11, F12, F13, F14, F16, F18, F19

<sup>a</sup> Other liver diseases including liver diseases as well as liver cancer mentioned in ICD-9 and ICD-10 coding.

**Table S3. SNPs used for creating the NAFLD-GRS**

Gene Locus	Chr	SNP	Risk allele	Reference allele	Beta
<i>PNPLA3</i>	22	rs738409	G	C	0.594
<i>TM6SF2</i>	19	rs58542926	T	C	0.166
<i>MBOAT7</i>	19	rs641738	T	C	0.073
<i>GCKR</i>	2	rs1260326	T	C	0.271
<i>HSD17B13</i>	4	rs72613567	T	TA	0.216

Abbreviations: Chr, chromosome; GRS, genetic risk score; SNP, single nucleotide polymorphism.

**Table S4. SNPs used for creating the cirrhosis-GRS**

Gene Locus	Chr	SNP	Risk allele	Reference allele	Beta
<i>in or near MARC1</i>	1	rs2642438	T	A	0.139
<i>HSD17B13</i>	4	rs72613567	T	TA	0.301
<i>TM6SF2</i>	19	rs58542926	T	C	0.495
<i>PNPLA3</i>	22	rs738409	G	C	0.718
<i>HFE</i>	6	rs1800562	A	G	0.307
<i>SERPINA</i>	14	rs28929474	T	C	1.095

Abbreviations: Chr, chromosome; GRS, genetic risk score; SNP, single nucleotide polymorphism.

**Table S5. Association between NAFLD-GRS and risk of NAFLD <sup>a</sup>**

	$\leq$ median NAFLD-GRS	$>$ median NAFLD-GRS	per SD increment of NAFLD-GRS
Median (min, max)	0.56 (0.00, 0.81)	1.15 (0.81, 2.64)	
Number of participants	96,637	93,508	
Number of cases	636	876	
PYs	1,112,693	1,076,951	
Model 1	1.00 (reference)	1.43 (1.29, 1.58)	1.24 (1.18, 1.30)
Model 2	1.00 (reference)	1.45 (1.31, 1.60)	1.25 (1.20, 1.32)
Model 3	1.00 (reference)	1.45 (1.31, 1.60)	1.25 (1.19, 1.31)

Abbreviations: BMI, body mass index; NAFLD-GRS, NAFLD genetic risk score; PYs, person-years.

<sup>a</sup> Hazard ratios (95% confidence interval) (all such values).

Model 1 was crude model.

Model 2 was adjusted for age, sex, and BMI.

Model 3 was additionally adjusted for total energy intake, diet score, smoking status, alcohol intake, educational level, Townsend deprivation index, physical activity, hypertension, diabetes, cancer, cardiovascular disease, first 10 principal components of ancestry, and genotype measurement batch.

**Table S6. Association between cirrhosis-GRS and risk of cirrhosis <sup>a</sup>**

	≤ median cirrhosis-GRS	> median cirrhosis-GRS	per SD increment of cirrhosis-GRS
Median (min, max)	0.74 (0.00, 1.00)	1.46 (1.00, 4.56)	
Number of participants	96,407	93,738	
Number of cases	232	324	
PYs	1,109,820	1,079,824	
Model 1	1.00 (reference)	1.44 (1.21, 1.70)	1.36 (1.27, 1.47)
Model 2	1.00 (reference)	1.45 (1.22, 1.71)	1.37 (1.28, 1.48)
Model 3	1.00 (reference)	1.47 (1.24, 1.74)	1.39 (1.29, 1.50)

Abbreviations: BMI, body mass index; cirrhosis-GRS, cirrhosis genetic risk score; PYs, person-years.

<sup>a</sup> Hazard ratios (95% confidence interval) (all such values).

Model 1 was crude model.

Model 2 was adjusted for age, sex, and BMI.

Model 3 was additionally adjusted for total energy intake, diet score, smoking status, alcohol intake, educational level, Townsend deprivation index, physical activity, hypertension, diabetes, cancer, cardiovascular disease, first 10 principal components of ancestry, and genotype measurement batch.

**Table S7. Association between dairy consumption and risk of NAFLD according to NAFLD-GRS in the UK Biobank Cohort <sup>a</sup>**

	Quartiles of dairy consumption				<i>P</i> for trend <sup>b</sup>	<i>P</i> for interaction <sup>b</sup>
	Quartile 1	Quartile 2	Quartile 3	Quartile 4		
<b>Total dairy products</b>						0.58
≤ median NAFLD-GRS	1.00 (reference)	0.95 (0.76, 1.18)	1.07 (0.86, 1.32)	0.94 (0.75, 1.19)	0.89	
> median NAFLD-GRS	1.00 (reference)	0.97 (0.81, 1.16)	0.84 (0.70, 1.02)	0.81 (0.67, 0.98)	0.01	
<b>High-fat dairy products</b>						0.56
≤ median NAFLD-GRS	1.00 (reference)	0.81 (0.62, 1.05)	0.85 (0.69, 1.06)	0.88 (0.72, 1.08)	0.14	
> median NAFLD-GRS	1.00 (reference)	1.07 (0.87, 1.31)	0.82 (0.68, 0.99)	1.03 (0.87, 1.22)	0.70	
<b>low-fat dairy products</b>						0.55
≤ median NAFLD-GRS	1.00 (reference)	0.99 (0.80, 1.23)	1.07 (0.87, 1.31)	0.84 (0.66, 1.08)	0.43	
> median NAFLD-GRS	1.00 (reference)	1.00 (0.84, 1.19)	0.81 (0.68, 0.97)	0.75 (0.61, 0.93)	<0.01	
<b>Unfermented dairy products</b>						0.98
≤ median NAFLD-GRS	1.00 (reference)	0.95 (0.77, 1.17)	1.08 (0.87, 1.35)	0.85 (0.68, 1.06)	0.33	
> median NAFLD-GRS	1.00	0.95 (0.80, 1.19)	0.79 (0.65, 0.93)	0.86 (0.72, 0.99)	0.04	

	(reference)	1.13)	0.96)	1.04)	
<b>Fermented dairy products</b>					0.45
≤ median NAFLD-GRS	1.00 (reference)	1.04 (0.83, 1.29)	1.04 (0.85, 1.28)	0.89 (0.71, 1.12)	0.43
> median NAFLD-GRS	1.00 (reference)	0.81 (0.67, 0.98)	0.86 (0.72, 1.02)	0.75 (0.62, 0.91)	<0.01

Abbreviations: BMI, body mass index; NAFLD-GRS, NAFLD-genetic risk score.

Adjusted for age, sex, BMI, total energy intake, diet score, smoking status, alcohol intake, educational level, Townsend deprivation index, physical activity, hypertension, diabetes, cancer, cardiovascular disease, first 10 principal components of ancestry, and genotype measurement batch.

<sup>a</sup> Hazard ratio (95% confidence interval) obtained by using Cox proportional hazard model.

<sup>b</sup> Obtained by using the multivariable Cox proportional hazard model.



**Table S8. Association between dairy consumption and risk of cirrhosis according to cirrhosis-GRS in the UK Biobank Cohort <sup>a</sup>**

	Quartiles of dairy consumption				<i>P</i> for trend <sup>b</sup>	<i>P</i> for interaction <sup>b</sup>
	Quartile 1	Quartile 2	Quartile 3	Quartile 4		
<b>Total dairy products</b>						0.32
≤ median NAFLD-GRS	1.00 (reference)	0.60 (0.42, 0.85)	0.76 (0.55, 1.07)	0.52 (0.35, 0.78)	<0.01	
> median NAFLD-GRS	1.00 (reference)	1.15 (0.85, 1.56)	1.01 (0.73, 1.39)	0.99 (0.71, 1.37)	0.72	
<b>High-fat dairy products</b>						0.16
≤ median NAFLD-GRS	1.00 (reference)	0.94 (0.63, 1.40)	0.75 (0.52, 1.09)	0.89 (0.64, 1.25)	0.28	
> median NAFLD-GRS	1.00 (reference)	0.73 (0.50, 1.08)	0.89 (0.66, 1.21)	1.04 (0.79, 1.36)	0.89	
<b>low-fat dairy products</b>						0.14
≤ median NAFLD-GRS	1.00 (reference)	0.64 (0.44, 0.91)	0.86 (0.63, 1.17)	0.51 (0.33, 0.80)	0.01	
> median NAFLD-GRS	1.00 (reference)	1.19 (0.89, 1.59)	1.01 (0.76, 1.35)	0.81 (0.57, 1.15)	0.25	
<b>Unfermented dairy products</b>						0.36
≤ median NAFLD-GRS	1.00 (reference)	0.59 (0.42, 0.83)	0.74 (0.52, 1.05)	0.54 (0.37, 0.79)	<0.01	
> median NAFLD-GRS	1.00	1.09 (0.81, 1.46)	1.03 (0.75, 1.35)	0.96 (0.70, 1.25)	0.71	

	(reference)	1.47)	1.42)	1.31)		
<b>Fermented dairy products</b>						0.08
≤ median NAFLD-GRS	1.00 (reference)	0.92 (0.65, 1.30)	0.88 (0.63, 1.23)	0.62 (0.42, 0.92)	0.03	
> median NAFLD-GRS	1.00 (reference)	0.71 (0.51, 0.97)	0.78 (0.58, 1.03)	0.80 (0.59, 1.08)	0.12	

Abbreviations: BMI, body mass index; cirrhosis-GRS, cirrhosis-genetic risk score.

Adjusted for age, sex, BMI, total energy intake, diet score, smoking status, alcohol intake, educational level, Townsend deprivation index, physical activity, hypertension, diabetes, cancer, cardiovascular disease, first 10 principal components of ancestry, and genotype measurement batch.

<sup>a</sup> Hazard ratio (95% confidence interval) obtained by using Cox proportional hazard model.

<sup>b</sup> Obtained by using the multivariable Cox proportional hazard model.

**Table S9. Association between dairy products consumption and risk of NAFLD, excluded incident NAFLD cases in the first three years of follow-up (n=189,970) <sup>a</sup>**

	Quartiles of dairy products consumption (servings/day)				<i>P</i> for trend <sup>b</sup>
	Quartile 1	Quartile 2	Quartile 3	Quartile 4	
<b>Total dairy products</b>					
Median (min, max) intake	1.33 (0.00, 2.75)	4.00 (2.80, 4.83)	5.50 (4.88, 6.33)	7.50 (6.38, 10.3)	
Number of participants	47,690	47,961	46,874	47,445	
Number of cases	360	339	329	309	
PYs	546,154	552,191	539,384	546,727	
Model 1	1.00 (reference)	0.93 (0.80, 1.08)	0.93 (0.80, 1.08)	0.86 (0.74, 1.00)	0.06
Model 2	1.00 (reference)	0.90 (0.78, 1.05)	0.92 (0.80, 1.07)	0.85 (0.73, 0.99)	0.06
Model 3	1.00 (reference)	0.91 (0.78, 1.05)	0.94 (0.81, 1.09)	0.87 (0.74, 1.01)	0.11
<b>High-fat dairy products</b>					
Median (min, max) intake	0.00 (0.00, 0.00)	0.25 (0.10, 0.33)	0.50 (0.38, 0.83)	1.17 (0.85, 6.50)	
Number of participants	75,054	26,257	41,621	47,038	
Number of cases	611	170	232	324	
PYs	858,538	304,607	481,135	540,177	
Model 1	1.00 (reference)	0.78 (0.66, 0.93)	0.68 (0.58, 0.79)	0.84 (0.74, 0.97)	<0.001
Model 2	1.00 (reference)	0.85 (0.72, 1.01)	0.76 (0.66, 0.89)	0.94 (0.82, 1.08)	0.07
Model 3	1.00 (reference)	0.92 (0.78, 1.09)	0.82 (0.71, 0.96)	0.95 (0.83, 1.10)	0.04
<b>Low-fat dairy products</b>					
Median (min, max) intake	0.67 (0.00, 2.00)	3.33 (2.08, 4.00)	5.00 (4.06, 6.00)	7.00 (6.05, 9.25)	
Number of participants	54,824	44,100	55,408	35,638	

Number of cases	417	326	376	218	
PYs	627,291	507,651	638,112	411,401	
Model 1	1.00 (reference)	0.97 (0.84, 1.12)	0.89 (0.77, 1.02)	0.8 (0.68, 0.94)	<0.01
Model 2	1.00 (reference)	0.94 (0.81, 1.08)	0.87 (0.75, 1.00)	0.77 (0.65, 0.90)	<0.001
Model 3	1.00 (reference)	0.96 (0.83, 1.11)	0.90 (0.78, 1.04)	0.80 (0.67, 0.94)	<0.01
<b>Unfermented dairy products</b>					
Median (min, max) intake	0.67 (0.00, 2.00)	3.38 (2.08, 4.00)	5.00 (4.05, 5.50)	6.50 (5.56, 9.00)	
Number of participants	52,898	49,921	40,799	46,352	
Number of cases	398	352	274	313	
PYs	605,373	575,085	470,034	533,963	
Model 1	1.00 (reference)	0.93 (0.81, 1.07)	0.89 (0.76, 1.03)	0.89 (0.77, 1.04)	0.10
Model 2	1.00 (reference)	0.93 (0.80, 1.07)	0.91 (0.78, 1.06)	0.88 (0.76, 1.03)	0.10
Model 3	1.00 (reference)	0.94 (0.81, 1.08)	0.94 (0.80, 1.09)	0.89 (0.76, 1.03)	0.14
<b>Fermented dairy products</b>					
Median (min, max) intake	0.00 (0.00, 0.25)	0.50 (0.30, 0.70)	1.00 (0.75, 1.00)	1.63 (1.10, 4.50)	
Number of participants	54,200	40,202	48,686	46,882	
Number of cases	462	258	350	267	
PYs	619,975	463,853	560,340	540,288	
Model 1	1.00 (reference)	0.74 (0.64, 0.87)	0.84 (0.73, 0.96)	0.66 (0.57, 0.77)	<0.0001
Model 2	1.00 (reference)	0.81 (0.69, 0.94)	0.89 (0.78, 1.03)	0.72 (0.62, 0.83)	<0.0001
Model 3	1.00 (reference)	0.85 (0.73, 0.99)	0.94 (0.82, 1.08)	0.78 (0.67, 0.91)	<0.01

Abbreviations: BMI, body mass index; NAFLD-GRS, NAFLD-genetic risk score; PYs, person-years.

<sup>a</sup> Hazard ratios (95% confidence interval) (all such values).

<sup>b</sup> *P* for trend was calculated across quartiles using multivariable Cox regression models.

Model 1 was crude model.

Model 2 was adjusted for age, sex, and BMI.

Model 3 was additionally adjusted for total energy intake, diet score, smoking status, alcohol intake, educational level, Townsend deprivation index, physical activity, hypertension, diabetes, cancer, cardiovascular disease, NAFLD-GRS, first 10 principal components of ancestry, and genotype measurement batch.

**Table S10. Association between dairy products consumption and risk of cirrhosis, excluded incident cirrhosis cases in the first three years of follow-up (n=190,091) <sup>a</sup>**

	Quartiles of dairy products consumption (servings/day)				<i>P</i> for trend <sup>b</sup>
	Quartile 1	Quartile 2	Quartile 3	Quartile 4	
<b>Total dairy products</b>					
Median (min, max) intake	1.33 (0.00, 2.75)	4.00 (2.80, 4.83)	5.50 (4.87, 6.33)	7.50 (6.38, 10.3)	
Number of participants	47,708	47,995	46,894	47,464	
Number of cases	131	124	120	97	
PYs	547,518	553,573	540,520	547,877	
Model 1	1.00 (reference)	0.94 (0.73, 1.20)	0.93 (0.73, 1.19)	0.74 (0.57, 0.96)	0.04
Model 2	1.00 (reference)	0.71 (0.52, 0.96)	0.77 (0.60, 0.99)	0.91 (0.73, 1.14)	<0.01
Model 3	1.00 (reference)	0.94 (0.73, 1.20)	0.96 (0.75, 1.23)	0.78 (0.59, 1.03)	0.11
<b>High-fat dairy products</b>					
Median (min, max) intake	0.00 (0.00, 0.00)	0.25 (0.10, 0.33)	0.50 (0.38, 0.83)	1.17 (0.85, 6.50)	
Number of participants	75,091	26,270	41,641	47,059	
Number of cases	217	50	86	119	
PYs	860,787	305,300	482,009	541,392	
Model 1	1.00 (reference)	0.65 (0.48, 0.88)	0.71 (0.55, 0.91)	0.87 (0.70, 1.09)	0.09
Model 2	1.00 (reference)	0.71 (0.52, 0.96)	0.77 (0.60, 0.99)	0.91 (0.73, 1.14)	0.23
Model 3	1.00 (reference)	0.79 (0.58, 1.08)	0.86 (0.67, 1.11)	0.96 (0.76, 1.21)	0.22
<b>Low-fat dairy products</b>					
Median (min, max) intake	0.67 (0.00, 2.00)	3.33 (2.08, 4.00)	5.00 (4.06, 6.00)	7.00 (6.05, 9.25)	
Number of participants	54,842	44,133	55,436	35,650	

Number of cases	149	117	144	62	
PYs	628,839	509,023	639,390	412,237	
Model 1	1.00 (reference)	0.97 (0.76, 1.24)	0.95 (0.76, 1.20)	0.64 (0.47, 0.85)	0.01
Model 2	1.00 (reference)	0.94 (0.74, 1.20)	0.90 (0.71, 1.13)	0.59 (0.44, 0.79)	<0.001
Model 3	1.00 (reference)	0.97 (0.76, 1.24)	0.98 (0.78, 1.24)	0.68 (0.50, 0.92)	0.05
<b>Unfermented dairy products</b>					
Median (min, max) intake	0.67 (0.00, 2.00)	3.38 (2.08, 4.00)	5.00 (4.05, 5.50)	6.50 (5.56, 9.00)	
Number of participants	52,920	49,959	40,813	46,369	
Number of cases	143	127	102	100	
PYs	606,910	576,549	470,911	535,118	
Model 1	1.00 (reference)	0.94 (0.74, 1.19)	0.92 (0.71, 1.19)	0.80 (0.62, 1.03)	0.09
Model 2	1.00 (reference)	0.90 (0.71, 1.14)	0.87 (0.68, 1.13)	0.72 (0.56, 0.93)	0.01
Model 3	1.00 (reference)	0.91 (0.72, 1.16)	0.95 (0.73, 1.23)	0.78 (0.60, 1.02)	0.1
<b>Fermented dairy products</b>					
Median (min, max) intake	0.00 (0.00, 0.25)	0.50 (0.30, 0.70)	1.00 (0.75, 1.00)	1.83 (1.10, 4.50)	
Number of participants	54,222	40,230	48,701	46,908	
Number of cases	176	91	111	94	
PYs	621,636	464,928	561,565	541,359	
Model 1	1.00 (reference)	0.69 (0.54, 0.89)	0.70 (0.55, 0.89)	0.61 (0.48, 0.79)	<0.0001
Model 2	1.00 (reference)	0.75 (0.58, 0.96)	0.76 (0.60, 0.96)	0.68 (0.53, 0.87)	<0.01
Model 3	1.00 (reference)	0.80 (0.62, 1.03)	0.82 (0.65, 1.04)	0.78 (0.60, 1.00)	0.04

Abbreviations: BMI, body mass index; cirrhosis-GRS, cirrhosis genetic risk score; PYs, person-years.

<sup>a</sup> Hazard ratios (95% confidence interval) (all such values).

<sup>b</sup> *P* for trend was calculated across quartiles using multivariable Cox regression models.

Model 1 was crude model.

Model 2 was adjusted for age, sex, and BMI.

Model 3 was additionally adjusted for total energy intake, diet score, smoking status, alcohol intake, educational level, Townsend deprivation index, physical activity, hypertension, diabetes, cancer, cardiovascular disease, cirrhosis-GRS, first 10 principal components of ancestry, and genotype measurement batch.



**Table S11. Association between dairy products consumption and risk of NAFLD with heavy alcohol consumption (n=155,111) <sup>a</sup>**

	Quartiles of dairy products consumption (servings/day)				<i>P</i> for trend <sup>b</sup>
	Quartile 1	Quartile 2	Quartile 3	Quartile 4	
<b>Total dairy products</b>					
Median (min, max) intake	1.50 (0.00, 3.00)	4.25 (3.08, 5.00)	6.00 (5.05, 6.50)	7.50 (6.55, 10.3)	
Number of participants	45,134	41,077	33,274	35,626	
Number of cases	379	345	255	257	
PYs	516,545	472,082	383,005	410,228	
Model 1	1.00 (reference)	1.00 (0.86, 1.15)	0.91 (0.77, 1.06)	0.86 (0.73, 1.00)	0.03
Model 2	1.00 (reference)	1.00 (0.86, 1.15)	0.92 (0.79, 1.08)	0.87 (0.74, 1.01)	0.05
Model 3	1.00 (reference)	1.02 (0.88, 1.18)	0.95 (0.81, 1.12)	0.86 (0.73, 1.02)	0.06
<b>High-fat dairy products</b>					
Median (min, max) intake	0.00 (0.00, 0.00)	0.25 (0.10, 0.30)	0.50 (0.33, 0.83)	1.17 (0.88, 6.50)	
Number of participants	62,164	15,730	39,529	37,688	
Number of cases	582	112	260	282	
PYs	710,466	182,694	456,284	432,416	
Model 1	1.00 (reference)	0.75 (0.61, 0.92)	0.69 (0.6, 0.8)	0.80 (0.69, 0.92)	<0.0001
Model 2	1.00 (reference)	0.83 (0.68, 1.02)	0.79 (0.68, 0.91)	0.91 (0.79, 1.05)	0.03
Model 3	1.00 (reference)	0.91 (0.74, 1.11)	0.85 (0.73, 0.98)	0.90 (0.78, 1.05)	0.06
<b>Low-fat dairy products</b>					
Median (min, max) intake	0.67 (0.00, 2.00)	3.33 (2.08, 4.00)	5.00 (4.06, 6.00)	7.00 (6.05, 9.25)	
Number of participants	43,724	34,627	45,742	31,018	

Number of cases	360	301	358	217	
PYs	499,919	397,949	526,359	357,633	
Model 1	1.00 (reference)	1.05 (0.90, 1.22)	0.95 (0.82, 1.09)	0.84 (0.71, 1.00)	0.03
Model 2	1.00 (reference)	1.01 (0.87, 1.18)	0.92 (0.80, 1.07)	0.81 (0.68, 0.95)	<0.01
Model 3	1.00 (reference)	1.05 (0.90, 1.22)	0.96 (0.83, 1.11)	0.82 (0.69, 0.98)	0.03
<b>Unfermented dairy products</b>					
Median (min, max) intake	0.67 (0.00, 2.00)	3.40 (2.08, 4.00)	5.00 (4.05, 5.67)	6.50 (5.70, 9.00)	
Number of participants	42,264	39,351	35,245	38,251	
Number of cases	353	323	271	289	
PYs	483,268	452,715	405,803	440,074	
Model 1	1.00 (reference)	0.98 (0.84, 1.14)	0.91 (0.78, 1.07)	0.90 (0.77, 1.05)	0.14
Model 2	1.00 (reference)	0.97 (0.83, 1.13)	0.94 (0.80, 1.10)	0.89 (0.76, 1.04)	0.12
Model 3	1.00 (reference)	0.99 (0.85, 1.15)	0.97 (0.83, 1.14)	0.87 (0.74, 1.03)	0.10
<b>Fermented dairy products</b>					
Median (min, max) intake	0.00 (0.00, 0.25)	0.50 (0.30, 0.70)	1.00 (0.75, 1.13)	1.67 (1.17, 4.50)	
Number of participants	43,373	32,521	41,447	37,770	
Number of cases	428	238	319	251	
PYs	495,683	374,706	476,972	434,499	
Model 1	1.00 (reference)	0.73 (0.63, 0.86)	0.77 (0.67, 0.90)	0.67 (0.57, 0.78)	<0.0001
Model 2	1.00 (reference)	0.80 (0.68, 0.94)	0.83 (0.72, 0.96)	0.72 (0.62, 0.85)	<0.0001
Model 3	1.00 (reference)	0.84 (0.72, 0.98)	0.87 (0.75, 1.01)	0.78 (0.66, 0.91)	<0.01

Abbreviations: BMI, body mass index; NAFLD-GRS, NAFLD-genetic risk score; PYs, person-years.

<sup>a</sup> Hazard ratios (95% confidence interval) (all such values).

<sup>b</sup> *P* for trend was calculated across quartiles using multivariable Cox regression models.

Model 1 was crude model.

Model 2 was adjusted for age, sex, and BMI.

Model 3 was additionally adjusted for total energy intake, diet score, smoking status, alcohol intake, educational level, Townsend deprivation index, physical activity, hypertension, diabetes, cancer, cardiovascular disease, NAFLD-GRS, first 10 principal components of ancestry, and genotype measurement batch.

**Table S12. Association between dairy products consumption and risk of cirrhosis with heavy alcohol consumption (n=155,111) <sup>a</sup>**

	Quartiles of dairy products consumption (servings/day)				<i>P</i> for trend <sup>b</sup>
	Quartile 1	Quartile 2	Quartile 3	Quartile 4	
<b>Total dairy products</b>					
Median (min, max) intake	1.50 (0.00, 3.00)	4.25 (3.08, 5.00)	6.00 (5.05, 6.50)	7.50 (6.55, 10.3)	
Number of participants	45,134	41,077	33,274	35,626	
Number of cases	122	114	91	78	
PYs	517,904	473,251	383,804	411,102	
Model 1	1.00 (reference)	1.02 (0.79, 1.32)	1.01 (0.77, 1.32)	0.81 (0.61, 1.07)	0.18
Model 2	1.00 (reference)	0.96 (0.75, 1.24)	0.93 (0.71, 1.22)	0.72 (0.54, 0.96)	0.03
Model 3	1.00 (reference)	0.98 (0.75, 1.26)	0.96 (0.73, 1.26)	0.74 (0.55, 0.99)	0.06
<b>High-fat dairy products</b>					
Median (min, max) intake	0.00 (0.00, 0.00)	0.25 (0.10, 0.30)	0.50 (0.33, 0.83)	1.17 (0.88, 6.50)	
Number of participants	62,164	15,730	39,529	37,688	
Number of cases	189	42	86	88	
PYs	712,388	183,058	457,163	433,452	
Model 1	1.00 (reference)	0.87 (0.62, 1.21)	0.71 (0.55, 0.91)	0.77 (0.60, 0.99)	<0.01
Model 2	1.00 (reference)	0.95 (0.68, 1.33)	0.78 (0.60, 1.00)	0.81 (0.63, 1.05)	0.04
Model 3	1.00 (reference)	1.06 (0.75, 1.48)	0.86 (0.67, 1.12)	0.86 (0.67, 1.12)	0.17
<b>Low-fat dairy products</b>					
Median (min, max) intake	0.67 (0.00, 2.00)	3.33 (2.08, 4.00)	5.00 (4.06, 6.00)	7.00 (6.05, 9.25)	
Number of participants	43,724	34,627	45,742	31,018	

Number of cases	106	97	138	64	
PYs	501,229	399,050	527,411	358,372	
Model 1	1.00 (reference)	1.15 (0.87, 1.51)	1.24 (0.96, 1.60)	0.85 (0.62, 1.15)	0.71
Model 2	1.00 (reference)	1.11 (0.84, 1.46)	1.15 (0.89, 1.48)	0.75 (0.55, 1.02)	0.12
Model 3	1.00 (reference)	1.13 (0.86, 1.49)	1.19 (0.92, 1.54)	0.79 (0.57, 1.07)	0.29
<b>Unfermented dairy products</b>					
Median (min, max) intake	0.67 (0.00, 2.00)	3.40 (2.08, 4.00)	5.00 (4.05, 5.67)	6.50 (5.70, 9.00)	
Number of participants	42,264	39,351	35,245	38,251	
Number of cases	106	104	96	99	
PYs	484,562	453,886	406,612	441,000	
Model 1	1.00 (reference)	1.05 (0.80, 1.37)	1.08 (0.82, 1.42)	1.03 (0.78, 1.35)	0.79
Model 2	1.00 (reference)	0.99 (0.76, 1.30)	0.99 (0.75, 1.31)	0.89 (0.68, 1.18)	0.45
Model 3	1.00 (reference)	0.99 (0.76, 1.30)	1.02 (0.77, 1.35)	0.89 (0.67, 1.18)	0.48
<b>Fermented dairy products</b>					
Median (min, max) intake	0.00 (0.00, 0.25)	0.50 (0.30, 0.70)	1.00 (0.75, 1.13)	1.67 (1.17, 4.50)	
Number of participants	43,373	32,521	41,447	37,770	
Number of cases	153	79	98	75	
PYs	497,091	375,548	477,999	435,423	
Model 1	1.00 (reference)	0.68 (0.52, 0.90)	0.67 (0.52, 0.86)	0.56 (0.42, 0.74)	<0.0001
Model 2	1.00 (reference)	0.74 (0.56, 0.97)	0.72 (0.56, 0.92)	0.61 (0.47, 0.81)	<0.01
Model 3	1.00 (reference)	0.79 (0.60, 1.04)	0.76 (0.59, 0.98)	0.68 (0.52, 0.91)	0.02

Abbreviations: BMI, body mass index; cirrhosis-GRS, cirrhosis genetic risk score; PYs, person-years.

<sup>a</sup> Hazard ratios (95% confidence interval) (all such values).

<sup>b</sup> *P* for trend was calculated across quartiles using multivariable Cox regression models.

Model 1 was crude model.

Model 2 was adjusted for age, sex, and BMI.

Model 3 was additionally adjusted for total energy intake, diet score, smoking status, alcohol intake, educational level, Townsend deprivation index, physical activity, hypertension, diabetes, cancer, cardiovascular disease, cirrhosis-GRS, first 10 principal components of ancestry, and genotype measurement batch.

**Table S13. Association between dairy products consumption (g/day) and risk of NAFLD (n=190,145) <sup>a</sup>**

	Quartiles of dairy products consumption (g/day)				<i>P</i> for trend <sup>b</sup>
	Quartile 1	Quartile 2	Quartile 3	Quartile 4	
<b>Total dairy products</b>					
Median (min, max) intake	97.5 (0.00, 160.0)	210.0 (160.1, 256.8)	302.5 (256.8, 356.3)	435.0 (356.3, 510.0)	
Number of participants	47,647	47,441	47,581	47,476	
Number of cases	431	368	359	354	
PYs	543,996	545,213	548,069	547,465	
Model 1	1.00 (reference)	0.85 (0.74, 0.98)	0.83 (0.72, 0.95)	0.82 (0.71, 0.94)	<0.01
Model 2	1.00 (reference)	0.86 (0.75, 0.99)	0.86 (0.74, 0.99)	0.84 (0.73, 0.97)	0.02
Model 3	1.00 (reference)	0.86 (0.75, 0.99)	0.87 (0.76, 1.00)	0.87 (0.76, 1.01)	0.08
<b>High-fat dairy products</b>					
Median (min, max) intake	0.00 (0.00, 0.00)	10.0 (1.50, 13.3)	25.6 (13.5, 40.0)	83.3 (40.4, 161.7)	
Number of participants	75,128	25,462	55,128	34,427	
Number of cases	685	193	390	244	
PYs	858,666	294,959	635,168	395,949	
Model 1	1.00 (reference)	0.82 (0.70, 0.96)	0.77 (0.68, 0.87)	0.77 (0.67, 0.89)	<0.0001
Model 2	1.00 (reference)	0.90 (0.76, 1.05)	0.84 (0.74, 0.95)	0.93 (0.80, 1.08)	0.04
Model 3	1.00 (reference)	0.94 (0.80, 1.11)	0.87 (0.77, 0.99)	0.97 (0.83, 1.12)	0.16
<b>Low-fat dairy products</b>					
Median (min, max) intake	35.0 (0.00,	175.0 (120.3,	268.3 (220.1,	400.0 (319.7,	

	120.0)	220.0)	319.6)	470.0)	
Number of participants	47,961	47,128	47,524	47,532	
Number of cases	427	376	363	346	
PYs	548,024	542,297	547,258	547,164	
Model 1	1.00 (reference)	0.89 (0.77, 1.02)	0.85 (0.74, 0.98)	0.81 (0.70, 0.94)	<0.01
Model 2	1.00 (reference)	0.86 (0.75, 0.99)	0.84 (0.73, 0.97)	0.80 (0.69, 0.92)	<0.01
Model 3	1.00 (reference)	0.87 (0.76, 1.00)	0.86 (0.75, 0.99)	0.82 (0.71, 0.95)	<0.01

**Unfermented dairy products**

Median (min, max) intake	35.0 (0.00, 105.0)	170.0 (105.4, 205.0)	240.0 (205.1, 280.0)	346.8 (280.0, 414.8)	
Number of participants	49,589	49,529	43,588	47,439	
Number of cases	434	398	327	353	
PYs	566,988	569,944	501,847	545,964	
Model 1	1.00 (reference)	0.91 (0.80, 1.05)	0.85 (0.74, 0.98)	0.85 (0.74, 0.97)	0.01
Model 2	1.00 (reference)	0.91 (0.80, 1.04)	0.87 (0.75, 1.00)	0.87 (0.75, 1.00)	0.03
Model 3	1.00 (reference)	0.91 (0.80, 1.05)	0.86 (0.75, 1.00)	0.87 (0.75, 1.00)	0.03

**Fermented dairy products**

Median (min, max) intake	0.00 (0.00, 0.00)	20.0 (1.50, 39.5)	62.5 (40.0, 102.5)	132.5 (103.0, 165.0)	
Number of participants	51,260	35,509	56,343	47,033	
Number of cases	480	279	403	350	
PYs	584,011	405,497	653,411	541,823	



Model 1	1.00 (reference)	0.83 (0.72, 0.97)	0.75 (0.66, 0.86)	0.79 (0.69, 0.90)	<0.0001
Model 2	1.00 (reference)	0.93 (0.80, 1.07)	0.83 (0.73, 0.95)	0.85 (0.74, 0.98)	<0.01
Model 3	1.00 (reference)	0.97 (0.84, 1.12)	0.88 (0.77, 1.01)	0.93 (0.81, 1.07)	0.14

Abbreviations: BMI, body mass index; NAFLD-GRS, NAFLD-genetic risk score; PYs, person-years.

<sup>a</sup> Hazard ratios (95% confidence interval) (all such values).

<sup>b</sup> *P* for trend was calculated across quartiles using multivariable Cox regression models.

Model 1 was crude model.

Model 2 was adjusted for age, sex, and BMI.

Model 3 was additionally adjusted for total energy intake, diet score, smoking status, alcohol intake, educational level, Townsend deprivation index, physical activity, hypertension, diabetes, cancer, cardiovascular disease, NAFLD-GRS, first 10 principal components of ancestry, and genotype measurement batch.

**Table S14. Association between dairy products consumption (g/day) and risk of cirrhosis (n=190,145) <sup>a</sup>**

	Quartiles of dairy products consumption (g/day)				<i>P</i> for trend <sup>b</sup>
	Quartile 1	Quartile 2	Quartile 3	Quartile 4	
<b>Total dairy products</b>					
Median (min, max) intake	97.5 (0.00, 160.0)	210.0 (160.1, 256.8)	302.5 (256.8, 356.3)	435.0 (356.3, 510.0)	
Number of participants	47,647	47,441	47,581	47,476	
Number of cases	174	136	127	119	
PYs	545,404	546,436	549,215	548,590	
Model 1	1.00 (reference)	0.78 (0.63, 0.98)	0.73 (0.58, 0.91)	0.68 (0.54, 0.86)	<0.001
Model 2	1.00 (reference)	0.74 (0.59, 0.93)	0.71 (0.56, 0.89)	0.66 (0.53, 0.84)	<0.001
Model 3	1.00 (reference)	0.78 (0.62, 0.97)	0.78 (0.62, 0.98)	0.77 (0.61, 0.98)	0.03
<b>High-fat dairy products</b>					
Median (min, max) intake	0.00 (0.00, 0.00)	10.0 (1.50, 13.3)	25.6 (13.5, 40.0)	83.3 (40.4, 161.7)	
Number of participants	75,128	25,462	55,128	34,427	
Number of cases	254	60	150	92	
PYs	860,857	295,662	636,428	396,698	
Model 1	1.00 (reference)	0.69 (0.52, 0.91)	0.80 (0.65, 0.98)	0.79 (0.62, 1.00)	0.02
Model 2	1.00 (reference)	0.75 (0.56, 0.99)	0.84 (0.69, 1.03)	0.86 (0.68, 1.09)	0.11
Model 3	1.00 (reference)	0.79 (0.60, 1.05)	0.86 (0.70, 1.05)	0.88 (0.69, 1.12)	0.15
<b>Low-fat dairy products</b>					
Median (min, max) intake	35.0 (0.00,	175.0 (120.3,	268.3 (220.1,	400.0 (319.7,	

	120.0)	220.0)	319.6)	470.0)	
Number of participants	47,961	47,128	47,524	47,532	
Number of cases	180	135	127	114	
PYs	549,416	543,476	548,468	548,285	
Model 1	1.00 (reference)	0.76 (0.61, 0.95)	0.71 (0.56, 0.89)	0.63 (0.50, 0.80)	<0.0001
Model 2	1.00 (reference)	0.73 (0.59, 0.92)	0.68 (0.54, 0.85)	0.61 (0.48, 0.77)	<0.0001
Model 3	1.00 (reference)	0.76 (0.61, 0.95)	0.75 (0.59, 0.94)	0.71 (0.56, 0.90)	<0.01

**Unfermented dairy products**

Median (min, max) intake	35.0 (0.00, 105.0)	170.0 (105.4, 205.0)	240.0 (205.1, 280.0)	346.8 (280.0, 414.8)	
Number of participants	49,589	49,529	43,588	47,439	
Number of cases	178	145	118	115	
PYs	568,420	571,172	502,901	547,152	
Model 1	1.00 (reference)	0.81 (0.65, 1.01)	0.75 (0.60, 0.95)	0.67 (0.53, 0.85)	<0.001
Model 2	1.00 (reference)	0.77 (0.62, 0.96)	0.71 (0.56, 0.89)	0.63 (0.50, 0.79)	<0.0001
Model 3	1.00 (reference)	0.78 (0.63, 0.98)	0.74 (0.59, 0.94)	0.69 (0.54, 0.87)	<0.01

**Fermented dairy products**

Median (min, max) intake	0.00 (0.00, 0.00)	20.0 (1.50, 39.5)	62.5 (40.0, 102.5)	132.5 (103.0, 165.0)	
Number of participants	51,260	35,509	56,343	47,033	
Number of cases	210	97	131	118	
PYs	585,514	406,445	654,748	542,938	

Model 1	1.00 (reference)	0.66 (0.52, 0.84)	0.56 (0.45, 0.70)	0.61 (0.49, 0.76)	<0.0001
Model 2	1.00 (reference)	0.71 (0.56, 0.90)	0.62 (0.50, 0.77)	0.68 (0.54, 0.85)	<0.0001
Model 3	1.00 (reference)	0.73 (0.57, 0.93)	0.67 (0.54, 0.83)	0.79 (0.63, 1.00)	<0.01

Abbreviations: BMI, body mass index; cirrhosis-GRS, cirrhosis genetic risk score; PYs, person-years.

<sup>a</sup> Hazard ratios (95% confidence interval) (all such values).

<sup>b</sup> *P* for trend was calculated across quartiles using multivariable Cox regression models.

Model 1 was crude model.

Model 2 was adjusted for age, sex, and BMI.

Model 3 was additionally adjusted for total energy intake, diet score, smoking status, alcohol intake, educational level, Townsend deprivation index, physical activity, hypertension, diabetes, cancer, cardiovascular disease, cirrhosis-GRS, first 10 principal components of ancestry, and genotype measurement batch.

**Table S15. Association between dairy consumption and risk of NAFLD according to healthy diet score in the UK Biobank Cohort <sup>a</sup>**

	Quartiles of dairy consumption				<i>P</i> for trend b	<i>P</i> for interaction b
	Q1	Q2	Q3	Q4		
<b>Total dairy products</b>						0.26
low healthy diet score	1.00 (reference)	1.00 (0.84, 1.20)	0.82 (0.67, 1.00)	0.90 (0.74, 1.10)	0.11	
high healthy diet score	1.00 (reference)	0.92 (0.74, 1.13)	1.09 (0.89, 1.34)	0.86 (0.69, 1.07)	0.49	
<b>High-fat dairy products</b>						0.11
low healthy diet score	1.00 (reference)	1.08 (0.86, 1.35)	1.00 (0.85, 1.18)	1.17 (0.95, 1.45)	0.31	
high healthy diet score	1.00 (reference)	0.99 (0.81, 1.22)	1.07 (0.86, 1.32)	0.90 (0.72, 1.12)	0.47	
<b>low-fat dairy products</b>						0.19
low healthy diet score	1.00 (reference)	0.98 (0.82, 1.18)	0.78 (0.65, 0.93)	0.76 (0.61, 0.94)	<0.01	
high healthy diet score	1.00 (reference)	0.79 (0.60, 1.03)	0.79 (0.65, 0.96)	0.77 (0.63, 0.94)	<0.01	
<b>Unfermented dairy products</b>						0.24
low healthy diet score	1.00 (reference)	0.97 (0.81, 1.16)	0.82 (0.67, 1.00)	0.84 (0.69, 1.03)	0.03	
high healthy diet score	1.00 (reference)	0.90 (0.74, 1.09)	1.01 (0.81, 1.26)	0.86 (0.69, 1.06)	0.29	

<b>Fermented dairy products</b>						0.65
low healthy diet score	1.00 (reference)	0.94 (0.79, 1.13)	0.83 (0.68, 1.02)	0.81 (0.67, 0.99)	0.04	
high healthy diet score	1.00 (reference)	0.93 (0.76, 1.13)	0.75 (0.61, 0.92)	0.78 (0.63, 0.96)	<0.01	

Abbreviations: BMI, body mass index; NAFLD-GRS, NAFLD-genetic risk score.

Adjusted for age, sex, BMI, total energy intake, diet score, smoking status, alcohol intake, educational level, Townsend deprivation index, physical activity, hypertension, diabetes, cancer, cardiovascular disease, NAFLD-GRS, first 10 principal components of ancestry, and genotype measurement batch.

<sup>a</sup> Hazard ratio (95% confidence interval) obtained by using Cox proportional hazard model.

<sup>b</sup> Obtained by using the multivariable Cox proportional hazard model.

**Table S16. Association between dairy consumption and risk of cirrhosis according to healthy diet score in the UK Biobank Cohort <sup>a</sup>**

	Quartiles of dairy consumption				<i>P</i> for trend b	<i>P</i> for interaction b
	Q1	Q2	Q3	Q4		
<b>Total dairy products</b>						0.32
low healthy diet score	1.00 (reference)	0.74 (0.55, 0.98)	0.69 (0.50, 0.96)	0.78 (0.57, 1.07)	0.08	
high healthy diet score	1.00 (reference)	0.99 (0.70, 1.40)	1.20 (0.86, 1.67)	0.74 (0.50, 1.10)	0.38	
<b>High-fat dairy products</b>						0.16
low healthy diet score	1.00 (reference)	0.76 (0.51, 1.14)	0.90 (0.69, 1.17)	1.05 (0.75, 1.46)	0.89	
high healthy diet score	1.00 (reference)	0.97 (0.63, 1.49)	0.85 (0.61, 1.17)	0.86 (0.61, 1.20)	0.26	
<b>low-fat dairy products</b>						0.14
low healthy diet score	1.00 (reference)	0.87 (0.65, 1.16)	0.70 (0.52, 0.94)	0.70 (0.49, 0.99)	0.01	
high healthy diet score	1.00 (reference)	0.95 (0.68, 1.34)	1.38 (0.98, 1.94)	0.71 (0.47, 1.05)	0.42	
<b>Unfermented dairy products</b>						0.36
low healthy diet score	1.00 (reference)	0.77 (0.57, 1.03)	0.56 (0.40, 0.78)	0.79 (0.58, 1.08)	0.04	
high healthy diet score	1.00 (reference)	1.37 (0.96, 1.94)	0.84 (0.60, 1.17)	0.69 (0.46, 1.01)	0.07	

<b>Fermented dairy products</b>						0.08
low healthy diet score	1.00 (reference)	0.69 (0.51, 0.94)	0.70 (0.52, 0.93)	0.67 (0.48, 0.93)	<0.01	
high healthy diet score	1.00 (reference)	0.86 (0.61, 1.21)	0.82 (0.59, 1.15)	0.77 (0.53, 1.11)	0.14	

Abbreviations: BMI, body mass index; cirrhosis-GRS, cirrhosis-genetic risk score.

Adjusted for age, sex, BMI, total energy intake, diet score, smoking status, alcohol intake, educational level, Townsend deprivation index, physical activity, hypertension, diabetes, cancer, cardiovascular disease, cirrhosis-GRS, first 10 principal components of ancestry, and genotype measurement batch.

<sup>a</sup> Hazard ratio (95% confidence interval) obtained by using Cox proportional hazard model.

<sup>b</sup> Obtained by using the multivariable Cox proportional hazard model.



**Table S17. Comparison of included and excluded participants <sup>a</sup>**

Characteristics	Excluded participants	Included participants	P value <sup>b</sup>
No. of participants	312,244	190,145	
NAFLD genetic risk score	0.81 (0.54, 1.15)	0.81 (0.56, 1.15)	0.04
Cirrhosis genetic risk score	0.94 (0.74, 1.46)	1.00 (0.74, 1.46)	0.62
Age (years)	58.0 (50.0, 64.0)	57.0 (50.0, 63.0)	<0.0001
Sex (male, %)	44.8	46.1	<0.0001
BMI (kg/m <sup>2</sup> )	27.1 (24.4, 30.3)	26.2 (23.7, 29.2)	<0.0001
Townson depreitive index	-1.93 (-3.54, 1.01)	-2.41 (-3.78, -0.16)	<0.0001
Education level (college or higher, %)	34.4	46.6	
PA (MET × hour/week)	29.9 (13, 62.5)	28.9 (13.7, 55.1)	<0.0001
Smoking status (%)			<0.0001
Current smoker	12.5	7.55	
Ex-smoker	33.8	36.1	
Non-smoker	53.8	56.4	
Drinking status (%)			<0.0001
Current drinker	94.6	90.3	
Ex-drinker	2.80	4.11	
Non-drinker	2.57	5.63	
Healthy diet score	3.00 (3.00, 4.00)	4.00 (3.00, 4.00)	<0.0001
Individual history of disease (%)			
Hypertension	23.1	27.9	<0.0001
Diabetes	5.07	3.09	<0.0001
Cardiovascular disease	0.11	1.52	<0.0001

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Cancer	10.6	0.61	<0.0001
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BMI, body mass index; MET, metabolic equivalent; PA, physical activity.

<sup>a</sup> Continuous variables are expressed as medians (P25, P75) and categorical variables are expressed as percentages.

<sup>b</sup> P values are based on Wilcoxon signed-rank test or chi-square test.