

Supplementary Materials

Table S1. Baseline characteristics of participants according to eGFR percentile groups.

Characteristics	eGFR percentile groups								<i>p</i> Value
	<5	5-19	20-34	35-49	50-64	65-79	80-95	95≤	
No. of subjects	7307	22,073	22,088	22,087	22,021	22,164	22,053	7369	
Male	3487 (47.7)	10,509 (47.6)	10,539 (47.7)	10,470 (47.4)	10,526 (47.8)	10,533 (47.5)	10,513 (47.7)	3499 (47.5)	<0.001
Age, year	36.8±7.1	36.7±7.0	36.8±6.8	36.4±6.9	35.7±7.0	36.5±6.7	35.6±6.9	35.5±7.0	<0.001
BMI, kg/m ²	22.4±2.8	22.2±2.7	22.2±2.7	22.1±2.7	22.0±2.7	22.0±2.7	22.0±2.7	22.1±2.8	<0.001
Obesity	1275 (17.5)	3374 (15.3)	3200 (14.5)	3133 (14.2)	2959 (13.5)	2910 (13.1)	2882 (13.1)	1059 (14.4)	<0.001
WC, cm	78.3±8.5	78.1±8.2	78.2±7.9	78.0±8.1	78.0±8.1	78.0±7.9	78.0±8.2	78.4±8.3	<0.001
FBG, mg/dL	92.5±10.7	92.4±9.2	92.5±9.5	92.3±9.3	92.3±9.9	92.4±10.4	92.2±11.0	92.2±12.9	0.009
Hemoglobin A1c, %	5.6±0.3	5.5±0.3	5.5±0.3	5.5±0.3	5.5±0.3	5.5±0.3	5.5±0.4	5.5±0.5	<0.001
HOMA-IR	0.97 (0.66-1.40)	0.98 (0.66-1.40)	0.99 (0.67-1.42)	1.01 (0.68-1.44)	1.01 (0.68-1.46)	1.01 (0.68-1.45)	1.05 (0.70-1.49)	1.09 (0.72-1.58)	<0.001
DM	91 (1.3)	192 (0.9)	238 (1.1)	205 (0.9)	226 (1.0)	280 (1.3)	91 (1.3)	192 (0.9)	<0.001
SBP, mmHg	107.6±12.8	107.0±12.4	106.8±12.3	106.8±12.3	106.5±12.1	106.4±12.1	106.3±12.0	106.4±12.5	<0.001
DBP, mmHg	68.91±9.4	68.37±9.2	68.23±9.2	68.07±9.2	67.94±9.1	67.79±9.0	67.62±9.1	68.91±9.4	<0.001
Hypertension	569 (7.8)	1311 (5.9)	1235 (5.6)	1216 (5.5)	1201 (5.5)	1150 (5.2)	569 (7.8)	1311 (5.9)	<0.001
AST, IU/L	19 (16-23)	19 (16-22)	18 (16-22)	18 (16-22)	18 (16-22)	18 (15-22)	18 (15-21)	18 (15-22)	<0.001
ALT, IU/L	15 (12-21)	15 (12-21)	15 (12-21)	15 (12-21)	15 (11-21)	15 (12-22)	15 (11-21)	16 (12-23)	<0.001
TC, mg/dL	193.9±32.6	191.2±32.1	189.6±31.6	188.7±31.3	187.7±31.2	186.4±31.2	184.8±31.3	183.8±33.3	<0.001
Triglyceride, mg/dL	79 (60-109)	78 (58-107)	78 (58-107)	77 (58-107)	77 (58-106)	78 (58-108)	77 (57-109)	81 (59-116)	<0.001
LDL, mg/dL	117.8±30.6	115.8±29.9	115.3±29.5	114.6±29.2	113.6±29.1	113.3±28.8	112.1±28.9	111.4±29.7	<0.001
HDL, mg/dL	62.4±15.2	62.2±14.6	61.7±14.3	61.7±14.4	62.0±14.5	61.6±14.4	61.6±14.5	62.0±15.0	<0.001
Dyslipidemia	986 (13.5)	2563 (11.6)	2441 (11.1)	2269 (10.3)	2217 (10.1)	2148 (9.7)	986 (13.5)	2563 (11.6)	<0.001
hs-CRP, mg/dL	0.03 (0.02-0.06)	0.03 (0.02-0.06)	0.03 (0.02-0.06)	0.03 (0.02-0.06)	0.03 (0.02-0.07)	0.03 (0.02-0.07)	0.04 (0.02-0.07)	0.04 (0.02-0.08)	<0.001
Creatinine, mg/dL	1.0 (0.9-1.2)	0.8 (0.8-1.1)	0.8 (0.7-1.0)	0.7 (0.7-1.0)	0.7 (0.7-1.0)	0.7 (0.6-0.9)	0.6 (0.6-0.8)	0.6 (0.5-0.8)	<0.001
eGFR, mL/min/1.73m ²	78.6±7.0	89.2±7.2	98.5±10.5	103.8±9.00	107.4±8.4	112.3±6.6	115.4±6.6	121.4±7.7	<0.001
Alcohol intake, g/day	4 (2-10)	4 (2-11)	4 (2-11)	4 (2-11)	4 (2-11)	4 (2-11)	4 (2-13)	4 (2-13)	0.040
Current smoker	1035 (14.2)	3398 (15.4)	3620 (16.4)	3546 (16.1)	3706 (16.8)	3941 (17.8)	3867 (17.5)	1284 (17.4)	<0.001
Exercise status									<0.001
< 3 times/week	5811 (79.5)	18,150 (82.2)	18,454 (83.6)	18,728 (84.8)	18,791 (85.3)	18,963 (85.6)	19,122 (86.7)	6438 (87.4)	
≥ 3 times/week	1249 (17.1)	3228 (14.6)	2976 (13.5)	2688 (12.2)	2666 (12.1)	2602 (11.7)	2377 (10.8)	757 (10.3)	

NFS	-2.90±0.96	-2.96±0.94	-3.00±0.94	-3.04±0.95	-3.09±0.94	-3.09±0.94	-3.17±0.96	-3.20±0.97	<0.001
FIB-4	0.75 (0.6-0.94)	0.72 (0.58-0.91)	0.71 (0.57-0.89)	0.7 (0.56-0.87)	0.68 (0.55-0.85)	0.68 (0.55-0.86)	0.65 (0.53-0.82)	0.64 (0.51-0.81)	<0.001

Values are expressed as n (%), mean±standard deviation, percentage, or median (interquartile range).

ALT: alanine aminotransferase, AST: aspartate aminotransferase, BMI: body mass index, DM: diabetes mellitus, eGFR: estimated glomerular filtration rate, FBG: fasting blood glucose, FIB-4: fibrosis-4, HDL: high density lipoprotein, hs-CRP: high-sensitivity C-reactive protein, HOMA-IR: homeostasis model assessment of insulin resistance, LDL: low density lipoprotein, NAFLD: nonalcoholic fatty liver disease, NFS: NAFLD fibrosis score, SBP: systolic blood pressure, TC: total cholesterol, WC: waist circumference.

Table S2. Incidence and hazard ratios for development of NAFLD according to eGFR percentile groups.

Percentile Group of eGFR	No. of Participants	Cases, <i>n</i>	IR, per 1000 PY	HR (95% CI)			
				Model 1	Model 2	Model 3	Model 4
<5	7307	1462	46.09 (43.79–48.51)	0.85 (0.80–0.90)	0.88 (0.83–0.93)	0.88 (0.83–0.94)	0.89 (0.84–0.95)
5–19	22,073	4436	47.02 (45.66–48.43)	0.91 (0.87–0.95)	0.94 (0.90–0.98)	0.94 (0.90–0.98)	0.95 (0.91–0.99)
20–34	22,088	4478	47.63 (46.26–49.05)	0.95 (0.91–0.99)	0.96 (0.92–1.01)	0.97 (0.93–1.01)	0.98 (0.93–1.02)
35–49	22,087	4445	48.51 (47.1–49.95)	0.99 (0.95–1.03)	0.99 (0.95–1.03)	0.99 (0.95–1.04)	0.99 (0.95–1.03)
50–64	22,021	4245	47.34 (45.94–48.78)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
65–79	22,164	4514	51.03 (49.56–52.54)	1.09 (1.04–1.13)	1.06 (1.02–1.11)	1.07 (1.02–1.11)	1.07 (1.03–1.12)
80–94	22,053	4402	52.71 (51.17–54.29)	1.17 (1.12–1.22)	1.11 (1.07–1.16)	1.11 (1.07–1.16)	1.12 (1.07–1.17)
≥95	7369	1428	56.26 (53.41–59.25)	1.35 (1.27–1.44)	1.21 (1.14–1.28)	1.21 (1.14–1.29)	1.20 (1.13–1.28)

Model 1: adjusted for age, sex, center, and muscle mass. Model 2: additionally adjusted for BMI, smoking status, regular exercise, history of diabetes, dyslipidemia, and hypertension. Model 3: additionally adjusted for hs-CRP and HOMA-IR. Model 4: additionally adjusted for alcohol intake and ALT. BMI: body mass index, CI: confidence interval, eGFR: estimated glomerular filtration rate, HOMA-IR: homeostasis model assessment of insulin resistance, HR: hazard ratio, hs-CRP: high-sensitivity C-reactive protein, IR: incidence rate, NAFLD: nonalcoholic fatty liver disease, PY: person years.

Table S3. Risk of advanced liver fibrosis based on NFS according to eGFR percentile in patients with NAFLD.

Percentile Group of eGFR	No. of Participants	Cases, <i>n</i>	IR, per 1000 PY	HR (95% CI)			
				Model 1	Model 2	Model 3	Model 4
<5	512	136	65.21 (55.13–77.15)	0.95 (0.77–1.17)	0.95 (0.77–1.18)	0.96 (0.78–1.19)	1.01 (0.81–1.26)
5–19	1382	349	61.38 (55.27–68.17)	0.97 (0.82–1.14)	1.03 (0.88–1.21)	1.05 (0.89–1.24)	1.06 (0.89–1.27)
20–34	1236	301	58.85 (52.57–65.89)	0.95 (0.80–1.12)	1.03 (0.87–1.22)	1.05 (0.88–1.25)	1.06 (0.88–1.26)
35–49	1185	296	61.31 (54.71–68.71)	1.02 (0.86–1.21)	1.08 (0.91–1.28)	1.09 (0.92–1.29)	1.10 (0.92–1.32)
50–64	1037	252	58.77 (51.94–66.49)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
65–79	1063	259	61.24 (54.22–69.17)	1.03 (0.87–1.23)	1.06 (0.89–1.26)	1.08 (0.90–1.29)	1.12 (0.93–1.34)
80–94	976	253	66.92 (59.16–75.69)	1.18 (0.99–1.41)	1.11 (0.94–1.33)	1.15 (0.97–1.38)	1.17 (0.97–1.41)
≥95	304	83	77.36 (62.39–95.93)	1.50 (1.17–1.93)	1.37 (1.07–1.76)	1.42 (1.11–1.82)	1.43 (1.10–1.86)

Model 1: adjusted for age, sex, center, and muscle mass. Model 2: additionally adjusted for BMI, smoking status, regular exercise, history of diabetes, dyslipidemia, and hypertension. Model 3: additionally adjusted for hs-CRP and HOMA-IR. Model 4: additionally adjusted for alcohol intake and ALT. BMI: body mass index, CI: confidence interval, eGFR: estimated glomerular filtration rate, HOMA-IR: homeostasis model assessment of insulin resistance, HR: hazard ratio, hs-CRP: high-sensitivity C-reactive protein, IR: incidence rate, NAFLD: nonalcoholic fatty liver disease, PY: person years.

Table S4. Risk of advanced liver fibrosis based on FIB-4 by hyperfiltration status in patient with NAFLD.

eGFR status at baseline	No. of participants	Cases, n	IR, per 1,000 PY	HR (95% CI)		
				Model 1	Model 2	Model 3
Non-GHF ^a	6,446	1,128	44.02 (41.52-46.66)	1 (reference)	1 (reference)	1 (reference)
GHF ^a	304	83	77.36 (62.39-95.93)	1.14 (0.85-1.54)	1.17 (0.87-1.57)	1.21 (0.90-1.64)

^a GHF was defined as an eGFR value above the 95th percentile for each sex and age group of study participants.

Model 1: adjusted for age, sex, center, and muscle mass.

Model 2: additionally adjusted for BMI, smoking status, regular exercise, history of diabetes, dyslipidemia, and hypertension.

Model 3: additionally adjusted for hs-CRP and HOMA-IR.

BMI, body mass index; CI, confidence interval; eGFR, estimated glomerular filtration rate; FIB-4, fibrosis-4; GHF, glomerular hyperfiltration; HOMA-IR, homeostasis model assessment of insulin resistance; HR, hazard ratio; hs-CRP, high-sensitivity C-reactive protein; IR, incidence rate; NAFLD, nonalcoholic fatty liver disease; NFS, NAFLD fibrosis score; Non-GHF, non- glomerular hyperfiltration; PY person-years.

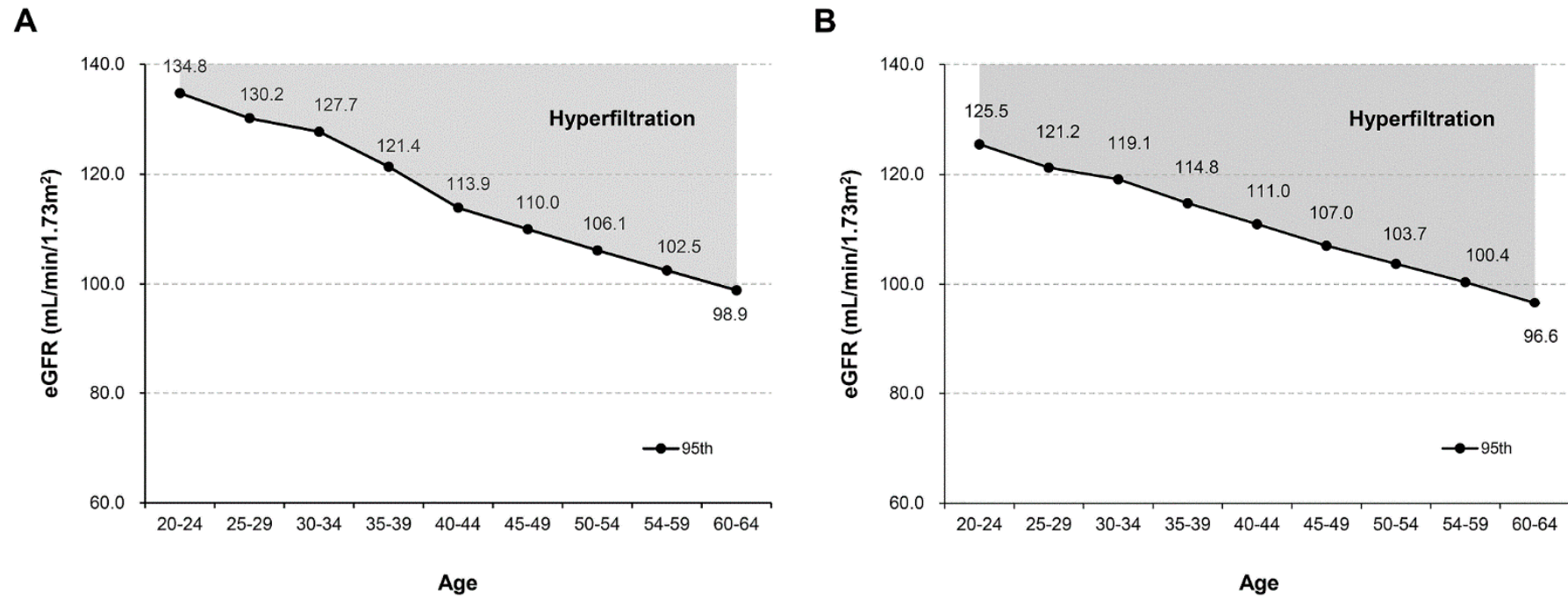
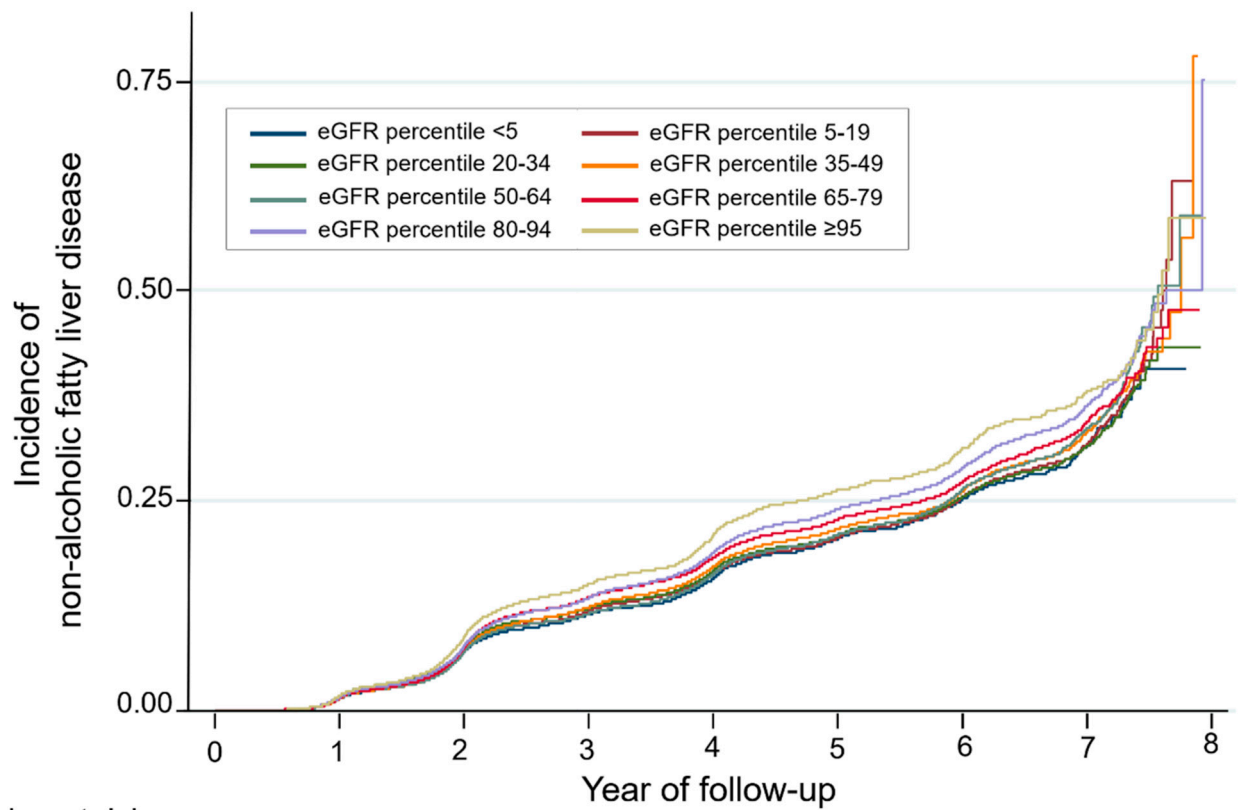


Figure S1. Distribution of eGFR corresponding to the definition of hyperfiltration according to age in (A) male and (B) female.
eGFR: estimated glomerular filtration rate.



Number at risk

eGFR percentile <5	7,333	7,069	6,095	5,221	4,155	3,174	1,810	394
eGFR percentile 5-19	22,103	21,332	18,166	15,445	12,137	9,255	5,205	1,128
eGFR percentile 20-34	22,213	21,416	18,083	15,205	12,030	9,236	5,534	1,402
eGFR percentile 35-49	22,047	21,277	17,851	14,697	11,397	8,622	4,822	1,037
eGFR percentile 50-64	22,156	21,409	17,769	14,550	11,083	8,129	4,474	1,064
eGFR percentile 65-79	22,130	21,293	17,363	13,691	10,555	7,939	4,676	1,151
eGFR percentile 80-94	22,109	21,207	16,663	12,880	9,439	6,831	3,861	978
eGFR percentile ≥95	7,388	7,027	5,168	3,623	2,511	1,774	980	268

Figure S2. Cumulative incidence of NAFLD according to eGFR percentile groups at baseline during the follow-up period. NAFLD: nonalcoholic fatty liver disease, eGFR: estimated glomerular filtration rate.