

Supplementary Table 4. Subgroup analyses of all-cause mortality, myocardial infarction, and stroke according to the variability of each metabolic variability score component (BMI, SBP, TC, and FBG)

eGFR category (mL/1.73 m ²)	Variability (VIM)	No. of subjects	Mortality				Myocardial infarction				Stroke							
			No. of events	Incidence rate ^a	Age-sex adjusted model, aHR (95% CI)	p for interaction	No. of events	Incidence rate ^a	Age-sex adjusted model, aHR (95% CI)	p for interaction	No. of events	Incidence rate ^a	Age-sex adjusted model, aHR (95% CI)	p for interaction				
BMI	ESKD	Q1 (low)	3,541	213	10.25	1 (Reference)	<0.001	92	4.46	1 (Reference)	0.008	0.02	73	3.54	1 (Reference)	<0.001	1 (Reference)	0.003
		Q2	3,484	250	12.22	1.31 (1.09-1.57)		81	3.99	0.95 (0.70-1.28)			97	4.79	1.47 (1.08-1.99)		1.46 (1.08-1.98)	
		Q3	3,713	264	12.18	1.35 (1.13-1.61)		100	4.67	1.15 (0.87-1.52)			80	3.72	1.17 (0.85-1.60)		1.14 (0.83-1.56)	
		Q4 (high)	4,589	584	22.55	2.24 (1.92-2.62)		168	6.57	1.54 (1.20-1.99)			171	6.69	1.90 (1.44-2.49)		1.83 (1.39-2.40)	
	<30	Q1 (low)	93,409	5,356	9.77	1 (Reference)		2,244	4.13	1 (Reference)			2,894	5.35	1 (Reference)		1 (Reference)	
		Q2	85,815	5,247	10.39	1.10 (1.06-1.14)		2,158	4.31	1.07 (1.01-1.14)			2,585	5.18	1.00 (0.95-1.05)		0.99 (0.94-1.04)	
		Q3	86,775	6,456	12.72	1.31 (1.26-1.35)		2,349	4.67	1.14 (1.08-1.21)			2,966	5.93	1.10 (1.05-1.16)		1.09 (1.03-1.14)	
		Q4 (high)	96,064	11,169	20.35	1.84 (1.78-1.90)		3,190	5.88	1.33 (1.26-1.41)			4,188	7.77	1.27 (1.21-1.33)		1.23 (1.17-1.29)	
	≥30, <60	Q1 (low)	1,320,657	26,574	3.36	1 (Reference)		15,030	1.91	1 (Reference)			16,591	2.11	1 (Reference)		1 (Reference)	
		Q2	1,293,358	26,475	3.39	1.10 (1.08-1.12)		14,288	1.84	1.02 (1.00-1.05)			15,447	1.99	1.02 (1.00-1.04)		1.01 (0.99-1.04)	
		Q3	1,253,727	29,282	3.88	1.25 (1.23-1.27)		14,413	1.92	1.08 (1.05-1.10)			16,050	2.14	1.09 (1.06-1.11)		1.08 (1.05-1.10)	
		Q4 (high)	1,183,312	40,687	5.78	1.71 (1.68-1.74)		15,208	2.17	1.19 (1.17-1.22)			17,908	2.56	1.18 (1.18-1.24)		1.18 (1.16-1.21)	
	≥60	Q1 (low)	1,075,303	14,727	2.28	1 (Reference)		9,039	1.40	1 (Reference)			8,830	1.37	1 (Reference)		1 (Reference)	
		Q2	1,110,240	15,469	2.30	1.10 (1.08-1.13)		9,087	1.36	1.03 (1.00-1.06)			8,896	1.33	1.02 (0.99-1.05)		1.05 (1.02-1.08)	
		Q3	1,148,649	17,224	2.48	1.24 (1.22-1.27)		9,516	1.38	1.09 (1.06-1.12)			9,258	1.34	1.10 (1.07-1.13)		1.09 (1.06-1.13)	
		Q4 (high)	1,208,926	23,554	3.25	1.68 (1.64-1.71)		10,177	1.41	1.19 (1.16-1.23)			10,148	1.41	1.20 (1.17-1.24)		1.19 (1.15-1.22)	
SBP	ESKD	Q1 (low)	3,466	237	11.77	1 (Reference)	<0.001	86	4.31	1 (Reference)	0.01	0.019	83	4.16	1 (Reference)	0.82	1 (Reference)	0.84
		Q2	3,332	213	10.88	0.98 (0.82-1.18)		73	3.76	0.91 (0.66-1.24)			74	3.81	0.90 (0.66-1.23)		0.95 (0.70-1.31)	
		Q3	3,597	294	14.02	1.23 (1.04-1.46)		104	5.01	1.19 (0.90-1.59)			99	4.76	1.17 (0.88-1.56)		1.15 (0.86-1.53)	
		Q4 (high)	4,932	567	20.17	1.51 (1.29-1.75)		178	6.41	1.39 (1.07-1.79)			165	5.94	1.33 (1.03-1.72)		1.22 (0.94-1.59)	
	<30	Q1 (low)	84,221	5,778	11.78	1 (Reference)		2,125	4.37	1 (Reference)			2,705	5.59	1 (Reference)		1 (Reference)	
		Q2	78,124	5,094	11.13	1.00 (0.97-1.04)		1,875	4.13	0.98 (0.93-1.05)			2,447	5.42	1.03 (0.92-1.05)		1.03 (0.97-1.08)	
		Q3	85,645	6,412	12.79	1.08 (1.05-1.12)		2,351	4.74	1.08 (1.02-1.15)			2,933	5.93	1.07 (1.01-1.13)		1.04 (0.99-1.10)	
		Q4 (high)	114,073	10,944	16.57	1.28 (1.24-1.32)		3,590	5.50	1.18 (1.12-1.24)			4,548	7.00	1.14 (1.09-1.20)		1.10 (1.05-1.15)	
	≥30, <60	Q1 (low)	1,264,376	27,272	3.61	1 (Reference)		14,169	1.88	1 (Reference)			15,210	2.02	1 (Reference)		1 (Reference)	
		Q2	1,252,837	25,511	3.38	1.04 (1.02-1.05)		13,002	1.73	0.98 (0.95-1.00)			13,948	1.86	0.98 (0.95-1.00)		1.00 (0.98-1.03)	
		Q3	1,264,286	29,298	3.84	1.09 (1.07-1.11)		14,199	1.87	1.01 (0.98-1.03)			15,975	2.11	1.07 (1.04-1.09)		1.04 (1.02-1.07)	
		Q4 (high)	1,269,555	40,937	5.40	1.26 (1.24-1.28)		17,569	2.33	1.11 (1.09-1.14)			20,863	2.77	1.07 (1.05-1.10)		1.12 (1.10-1.15)	
	≥60	Q1 (low)	1,140,837	15,761	2.31	1 (Reference)		8,914	1.31	1 (Reference)			8,648	1.27	1 (Reference)		1 (Reference)	
		Q2	1,156,040	15,707	2.25	1.06 (1.04-1.08)		8,818	1.27	1.01 (0.99-1.04)			8,482	1.18	1.02 (0.99-1.05)		0.99 (0.96-1.02)	
		Q3	1,141,832	17,504	2.53	1.11 (1.08-1.13)		9,447	1.37	1.05 (1.02-1.08)			9,105	1.32	1.04 (1.01-1.07)		1.03 (1.00-1.06)	
		Q4 (high)	1,104,409	22,002	3.32	1.22 (1.20-1.25)		10,640	1.61	1.12 (1.09-1.16)			11,197	1.70	1.16 (1.13-1.19)		1.11 (1.08-1.15)	

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Supplementary Table 4. Continued

eGFR category (mL/min/1.73 m ²)	Variability (VIM)	No. of subjects	Mortality				Myocardial Infarction				Stroke							
			No. of events	Incidence rate ^a	Age-sex adjusted model aHR (95% CI)	p for interaction	No. of events	Incidence rate ^a	Age-sex adjusted model aHR (95% CI)	p for interaction	No. of events	Incidence rate ^a	Age-sex adjusted model aHR (95% CI)	p for interaction				
FBG	ESKD	Q1 (low)	154	11.66	1 (Reference)	<0.001	61	4.07	1 (Reference)	<0.001	67	4.37	1 (Reference)	<0.001	67	4.37	1 (Reference)	<0.001
		Q2	201	11.75	1.10 (0.92-1.32)		57	4.54	1.18 (0.87-1.58)		58	4.05	1.00 (0.74-1.35)		58	4.05	1.00 (0.74-1.35)	
		Q3	3,502	12.35	1.19 (1.00-1.42)		102	3.82	1.01 (0.74-1.38)		87	3.58	0.90 (0.66-1.23)		87	3.58	0.90 (0.66-1.23)	
		Q4 (high)	5,896	21.27	1.90 (1.63-2.21)		221	7.04	1.77 (1.37-2.30)		209	6.62	1.58 (1.17-1.97)		209	6.62	1.58 (1.17-1.97)	
	<30	Q1 (low)	76,762	11.16	1 (Reference)		1,805	4.08	1 (Reference)		2,468	5.37	1 (Reference)		2,468	5.37	1 (Reference)	
		Q2	73,903	11.77	1.11 (1.07-1.15)		1,924	4.26	1.08 (1.02-1.15)		2,396	5.37	1.07 (1.00-1.13)		2,396	5.37	1.07 (1.00-1.13)	
		Q3	81,861	12.66	1.20 (1.16-1.25)		2,128	4.50	1.15 (1.09-1.22)		2,751	5.93	1.10 (1.04-1.17)		2,751	5.93	1.10 (1.04-1.17)	
		Q4 (high)	129,537	17.26	1.54 (1.49-1.59)		4,084	5.99	1.47 (1.40-1.56)		5,018	7.40	1.31 (1.24-1.38)		5,018	7.40	1.31 (1.24-1.38)	
	≥30, <60	Q1 (low)	1,275,916	26.973	3.72 (1 (Reference)		13,669	1.83	1 (Reference)		15,165	2.11	1 (Reference)		15,165	2.11	1 (Reference)	
		Q2	1,263,593	26.044	3.63 (1.04-1.08)		13,118	1.83	1.06 (1.03-1.08)		14,354	2.04	1.04 (1.02-1.07)		14,354	2.04	1.04 (1.02-1.07)	
		Q3	1,253,378	28.870	3.92 (1.15-1.19)		13,962	1.91	1.13 (1.10-1.15)		15,631	2.11	1.09 (1.06-1.11)		15,631	2.11	1.09 (1.06-1.11)	
		Q4 (high)	1,258,167	41.131	5.02 (1.38-1.42)		18,290	2.26	1.28 (1.26-1.31)		20,846	2.52	1.17 (1.14-1.20)		20,846	2.52	1.17 (1.14-1.20)	
	≥60	Q1 (low)	1,137,274	14.895	2.37 (1 (Reference)		8,531	1.32	1 (Reference)		8,302	1.34	1 (Reference)		8,302	1.34	1 (Reference)	
		Q2	1,152,403	15.096	2.37 (1.06-1.11)		8,570	1.32	1.05 (1.02-1.09)		8,226	1.28	1.04 (1.01-1.07)		8,226	1.28	1.04 (1.01-1.07)	
		Q3	1,154,151	16.991	2.48 (1.14-1.19)		9,228	1.34	1.10 (1.06-1.13)		9,077	1.32	1.06 (1.03-1.08)		9,077	1.32	1.06 (1.03-1.08)	
		Q4 (high)	1,099,290	23.892	3.14 (1.37-1.43)		11,490	1.55	1.24 (1.21-1.28)		11,527	1.51	1.14 (1.11-1.17)		11,527	1.51	1.14 (1.11-1.17)	
TC	ESKD	Q1 (low)	237	8.96	1 (Reference)	<0.001	82	3.57	1 (Reference)	<0.001	88	3.93	1 (Reference)	0.15	88	3.93	1 (Reference)	0.15
		Q2	3,492	11.41	1.34 (1.09-1.66)		92	3.25	0.94 (0.65-1.34)		82	3.31	0.88 (0.62-1.24)		82	3.31	0.88 (0.62-1.24)	
		Q3	3,623	13.46	1.69 (1.39-2.06)		80	5.05	1.49 (1.09-2.05)		75	4.30	1.44 (1.05-1.97)		75	4.30	1.44 (1.05-1.97)	
		Q4 (high)	4,720	20.29	2.43 (1.79-2.54)		187	6.67	1.78 (1.34-2.36)		176	6.30	1.56 (1.17-2.07)		176	6.30	1.49 (1.13-1.96)	
	<30	Q1 (low)	89,233	11.83	1 (Reference)		2,104	4.06	1 (Reference)		2,756	5.58	1 (Reference)		2,756	5.58	1 (Reference)	
		Q2	84,124	12.01	1.06 (1.02-1.10)		2,076	4.48	1.14 (1.06-1.21)		2,611	5.61	1.12 (1.05-1.20)		2,611	5.61	1.12 (1.05-1.20)	
		Q3	86,185	12.52	1.10 (1.06-1.14)		2,250	4.48	1.13 (1.06-1.20)		2,948	5.82	1.09 (1.02-1.16)		2,948	5.82	1.07 (1.02-1.13)	
		Q4 (high)	102,521	15.65	1.27 (1.23-1.31)		3,511	5.51	1.30 (1.23-1.37)		4,318	6.81	1.15 (1.09-1.22)		4,318	6.81	1.15 (1.09-1.22)	
	≥30, <60	Q1 (low)	1,297,473	28.722	3.54 (1 (Reference)		14,088	1.79	1 (Reference)		16,209	2.00	1 (Reference)		16,209	2.00	1 (Reference)	
		Q2	1,272,234	27.848	3.42 (1.02-1.06)		13,964	1.73	1.01 (0.99-1.03)		15,547	1.89	1.00 (0.98-1.03)		15,547	1.89	1.01 (0.99-1.03)	
		Q3	1,255,243	29.605	3.82 (1.06-1.14)		14,382	1.86	1.05 (1.03-1.08)		15,854	2.08	1.02 (1.00-1.05)		15,854	2.08	1.02 (1.00-1.05)	
		Q4 (high)	1,221,104	36.843	5.49 (1.21-1.25)		16,505	2.45	1.16 (1.13-1.18)		18,386	2.80	1.04 (1.02-1.06)		18,386	2.80	1.04 (1.02-1.06)	
	≥60	Q1 (low)	1,102,290	15.575	2.19 (1 (Reference)		8,675	1.26	1 (Reference)		8,771	1.22	1 (Reference)		8,771	1.22	1 (Reference)	
		Q2	1,127,820	16.072	2.17 (1.02-1.07)		8,968	1.23	1.01 (0.98-1.04)		8,646	1.18	1.00 (0.97-1.03)		8,646	1.18	1.00 (0.97-1.03)	
		Q3	1,148,470	17.243	2.44 (1.09-1.14)		9,303	1.33	1.05 (1.02-1.08)		9,136	1.31	1.03 (1.00-1.06)		9,136	1.31	1.03 (1.00-1.06)	
		Q4 (high)	1,164,538	22.084	3.64 (1.26-1.31)		10,873	1.75	1.17 (1.14-1.20)		10,579	1.76	1.06 (1.03-1.09)		10,579	1.76	1.06 (1.03-1.09)	

aHR, adjusted hazard ratio; BMI, body mass index; CI, confidence interval; eGFR, estimated glomerular filtration rate; ESKD, end-stage kidney disease; FBG, fasting blood glucose; HR, hazard ratio; SBP, systolic blood pressure; Q, quartile; TC, total cholesterol; VIM, variability independent of the mean. ^aThe number of high-variability components was calculated by summing the presence of high variability (Q4) in a metabolic parameter from each metabolic syndrome domain (BMI, FBG, SBP, and TC). ^bIncidence rate (/1,000 person-years). ^cThe multivariable model was adjusted for age, sex, low-income status, current smoking, alcohol consumption, regular physical activity, history of diabetes mellitus, hypertension, dyslipidemia, and BMI.