Association of Traditional and Novel Lipid Indicators With the Hemorrhagic Phenotype in Adult Moyamoya Disease: Implications for Lipid Risk Stratification

Translational Stroke Research

Weihong Huang1,2†, Haoyang Xiong1,2†, Wenjing Chen4, Wei Liu3, Peicong Ge3, Yunhao Liu4, Xuefeng Tang4, Ziheng Yang4, Zhongji Yan4, Dong Zhang1,2*

1 Department of Neurosurgery, Beijing Hospital, National Center of Gerontology, Beijing 100730, China

2 Institute of Geriatric Medicine, Chinese Academy of Medical Sciences, Beijing, China

3 Department of Neurosurgery, Beijing Tiantan Hospital, Capital Medical University, Beijing 100070, China

4 School of Clinical Medical Sciences, Southwest Medical University, Luzhou, Sichuan, China

Corresponding author: Dong Zhang, Department of Neurosurgery, Beijing Hospital, National Center of Gerontology, Beijing 100730, China. Email: zhangdong0660@aliyun.com

Supplementary Materials

Supplementary Table 1. Associations of lipid parameters with the hemorrhagic phenotype after multiple imputation using MICE

TG	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<0.85)	Q2 (0.85–1.23)	Q3 (1.23–1.71)	Q4 (≥1.71)	
Model 1	0.888 (0.769, 1.026) 0.106	1	0.677 (0.473, 0.969) 0.033	0.695 (0.487, 0.994) 0.046	0.674 (0.471, 0.964) 0.031	0.040
Model 2	0.968 (0.841, 1.114) 0.647	1	0.749 (0.519, 1.083) 0.125	0.849 (0.584, 1.234) 0.390	0.893 (0.607, 1.314) 0.566	0.689
Model 3	0.965 (0.836, 1.115) 0.628	1	0.785 (0.539, 1.143) 0.207	0.885 (0.604, 1.298) 0.533	0.907 (0.610, 1.348) 0.629	0.751

TC	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<3.32)	Q2 (3.32–3.97)	Q3 (3.97–4.63)	Q4 (≥4.63)	
Model 1	1.562 (1.368, 1.783) <0.001	1	1.886 (1.231, 2.890) 0.004	3.315 (2.203, 4.987) <0.001	3.734 (2.488, 5.604) <0.001	<0.001
Model 2	1.578 (1.378, 1.807) <0.001	1	1.892 (1.229, 2.914) 0.004	3.393 (2.235, 5.151) <0.001	3.849 (2.547, 5.817) <0.001	<0.001
Model 3	1.525 (1.328, 1.751) <0.001	1	1.820 (1.173, 2.824) 0.008	3.147 (2.056, 4.816) <0.001	3.435 (2.254, 5.237) <0.001	<0.001

LDL-C	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<1.68)	Q2 (1.68–2.24)	Q3 (2.24–2.82)	Q4 (≥2.82)	
Model 1	1.697 (1.453, 1.981) <0.001	1	1.457 (0.959, 2.213) 0.078	2.552 (1.717, 3.793) <0.001	3.388 (2.293, 5.004) <0.001	<0.001
Model 2	1.744 (1.489, 2.044) <0.001	1	1.476 (0.968, 2.251) 0.071	2.719 (1.816, 4.070) <0.001	3.595 (2.418, 5.345) <0.001	<0.001

Model 3	1.676 (1.426, 1.969) <0.001	1	1.416 (0.922, 2.176) 0.112	2.482 (1.646, 3.744) <0.001	3.197 (2.134, 4.791) <0.001	<0.001

HDL-C						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<1.00)**	**Q2 (1.00–1.18)**	**Q3 (1.18–1.38)**	**Q4 (≥1.38)**	
Model 1	1.933 (1.285, 2.906) 0.002	1	1.300 (0.892, 1.895) 0.172	1.381 (0.954, 2.000) 0.088	1.833 (1.269, 2.648) 0.001	0.002
Model 2	1.517 (0.972, 2.366) 0.066	1	1.224 (0.834, 1.796) 0.302	1.204 (0.817, 1.774) 0.347	1.496 (1.001, 2.236) 0.049	0.068
Model 3	1.344 (0.850, 2.125) 0.206	1	1.102 (0.744, 1.631) 0.629	1.088 (0.731, 1.618) 0.679	1.321 (0.874, 1.998) 0.186	0.218

AIP						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<-0.18)**	**Q2 (-0.18–0.01)**	**Q3 (0.01–0.21)**	**Q4 (≥0.21)**	
Model 1	0.559 (0.362, 0.863) 0.009	1	0.621 (0.436, 0.884) 0.008	0.570 (0.396, 0.820) 0.002	0.613 (0.429, 0.875) 0.007	0.006
Model 2	0.808 (0.503, 1.297) 0.377	1	0.692 (0.481, 0.997) 0.048	0.714 (0.484, 1.052) 0.089	0.814 (0.549, 1.209) 0.309	0.346
Model 3	0.867 (0.536, 1.404) 0.562	1	0.741 (0.510, 1.076) 0.115	0.772 (0.520, 1.147) 0.200	0.867 (0.579, 1.300) 0.491	0.530

Non-HDL-C						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<2.14)**	**Q2 (2.14–2.74)**	**Q3 (2.74–3.38)**	**Q4 (≥3.38)**	
Model 1	1.518 (1.322, 1.743) <0.001	1	1.580 (1.041, 2.398) 0.032	2.859 (1.924, 4.249) <0.001	3.064 (2.066, 4.546) <0.001	<0.001
Model 2	1.584 (1.374, 1.826) <0.001	1	1.591 (1.043, 2.426) 0.031	3.022 (2.018, 4.527) <0.001	3.445 (2.301, 5.158) <0.001	<0.001
Model 3	1.537 (1.330, 1.776) <0.001	1	1.511 (0.983, 2.323) 0.060	2.807 (1.860, 4.236) <0.001	3.150 (2.087, 4.754) <0.001	<0.001

AC						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<1.72)**	**Q2 (1.72–2.26)**	**Q3 (2.26–3.02)**	**Q4 (≥3.02)**	
Model 1	1.193 (1.062, 1.341) 0.003	1	1.553 (1.064, 2.268) 0.022	1.308 (0.890, 1.922) 0.172	1.910 (1.317, 2.770) <0.001	0.003
Model 2	1.316 (1.160, 1.493) <0.001	1	1.706 (1.160, 2.509) 0.007	1.625 (1.091, 2.421) 0.017	2.560 (1.725, 3.799) <0.001	<0.001
Model 3	1.310 (1.154, 1.487) <0.001	1	1.719 (1.159, 2.549) 0.007	1.657 (1.103, 2.489) 0.015	2.503 (1.671, 3.750) <0.001	<0.001

CRI-I						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<2.72)**	**Q2 (2.72–3.26)**	**Q3 (3.26–4.02)**	**Q4 (≥4.02)**	
Model 1	1.193 (1.062, 1.341) 0.003	1	1.553 (1.064, 2.268) 0.022	1.308 (0.890, 1.922) 0.172	1.910 (1.317, 2.770) <0.001	0.003
Model 2	1.316 (1.160, 1.493) <0.001	1	1.706 (1.160, 2.509) 0.007	1.625 (1.091, 2.421) 0.017	2.560 (1.725, 3.799) <0.001	<0.001
Model 3	1.310 (1.154, 1.487) <0.001	1	1.719 (1.159, 2.549) 0.007	1.657 (1.103, 2.489) 0.015	2.503 (1.671, 3.750) <0.001	<0.001

CRI-II						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<1.39)**	**Q2 (1.39–1.85)**	**Q3 (1.85–2.46)**	**Q4 (≥2.46)**	
Model 1	1.319 (1.140, 1.525) <0.001	1	1.328 (0.906, 1.946) 0.146	1.447 (0.991, 2.114) 0.056	1.871 (1.292, 2.710) <0.001	<0.001
Model 2	1.484 (1.267, 1.737) <0.001	1	1.420 (0.962, 2.095) 0.077	1.689 (1.144, 2.493) 0.008	2.398 (1.624, 3.541) <0.001	<0.001
Model 3	1.457 (1.244, 1.707) <0.001	1	1.423 (0.956, 2.119) 0.082	1.659 (1.116, 2.466) 0.012	2.287 (1.536, 3.406) <0.001	<0.001

LCI						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<4.63)**	**Q2 (4.63–8.87)**	**Q3 (8.87–17.51)**	**Q4 (≥17.51)**	
Model 1	1.005 (0.999, 1.012) 0.120	1	1.156 (0.796, 1.678) 0.447	1.057 (0.725, 1.541) 0.773	1.600 (1.114, 2.297)	0.021

					0.011	
Model 2	1.009 (1.002, 1.016) 0.012	1	1.242 (0.849, 1.816) 0.263	1.317 (0.890, 1.947) 0.168	2.172 (1.475, 3.199) <0.001	<0.001
Model 3	1.009 (1.001, 1.016) 0.019	1	1.254 (0.851, 1.848) 0.253	1.300 (0.871, 1.939) 0.199	2.014 (1.355, 2.994) <0.001	<0.001

RC						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<0.30)**	**Q2 (0.30–0.42)**	**Q3 (0.42–0.57)**	**Q4 (≥0.57)**	
Model 1	1.046 (0.823, 1.330) 0.712	1	0.870 (0.603, 1.256) 0.458	1.068 (0.745, 1.531) 0.721	1.065 (0.744, 1.526) 0.729	0.506
Model 2	1.110 (0.869, 1.420) 0.403	1	0.897 (0.617, 1.305) 0.570	1.223 (0.842, 1.776) 0.290	1.248 (0.862, 1.807) 0.241	0.111
Model 3	1.119 (0.871, 1.436) 0.380	1	0.909 (0.619, 1.334) 0.624	1.237 (0.845, 1.811) 0.275	1.279 (0.875, 1.868) 0.204	0.095

RC/HDL-C						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<0.24)**	**Q2 (0.24–0.36)**	**Q3 (0.36–0.53)**	**Q4 (≥0.53)**	
Model 1	0.985 (0.761, 1.275) 0.908	1	0.845 (0.586, 1.217) 0.366	1.044 (0.731, 1.491) 0.815	0.860 (0.598, 1.238) 0.418	0.683
Model 2	1.082 (0.833, 1.406) 0.553	1	0.930 (0.641, 1.351) 0.705	1.296 (0.892, 1.884) 0.174	1.104 (0.752, 1.620) 0.613	0.319
Model 3	1.113 (0.853, 1.452) 0.429	1	0.981 (0.670, 1.436) 0.923	1.330 (0.909, 1.946) 0.142	1.195 (0.808, 1.769) 0.373	0.190

Abbreviations: OR, odds ratio; CI, confidence interval; AIP, atherogenic index of plasma; LCI, lipoprotein combined index; CRI-I, Castelli's index-I; CRI-II, Castelli's index-II; RC, remnant cholesterol; RC/HDL-C, remnant cholesterol/high-density lipoprotein cholesterol; AC, atherogenic coefficient; Non-HDL-C, non-high-density lipoprotein cholesterol.

Supplementary Table 2. Pairwise comparisons of C statistics between the basic model and selected lipid-augmented models using DeLong's test....

Model 1	Model 2	AUC difference (95% CI)	P value
Basic model	Basic model + TC	-0.037 (-0.059--0.015)	<0.001
Basic model	Basic model + LDL-C	-0.041 (-0.064--0.017)	<0.001
Basic model	Basic model + Non-HDL-C	-0.037 (-0.059--0.016)	<0.001
Basic model	Basic model + CRI-II	-0.024 (-0.043--0.006)	0.010
Basic model + TC	Basic model + LDL-C	-0.004 (-0.014-0.006)	0.476
Basic model + TC	Basic model + Non-HDL-C	-0.000 (-0.006-0.005)	0.935
Basic model + TC	Basic model + CRI-II	0.013 (-0.003-0.029)	0.121
Basic model + LDL-C	Basic model + Non-HDL-C	0.003 (-0.007-0.014)	0.502
Basic model + LDL-C	Basic model + CRI-II	0.017 (0.004-0.029)	0.011
Basic model + Non-HDL-C	Basic model + CRI-II	0.013 (0.000-0.026)	0.046

Note: The basic model included sex, age, BMI, hypertension, diabetes, smoking status, drinking status, bilateral involvement, and dichotomized Suzuki stage (≤4 vs >4). Missing BMI values were handled using multiple imputation before model fitting. Model discrimination was assessed using the C statistic (AUC), and pairwise differences in AUC were compared using DeLong's test.

Supplementary Table 3. Associations of lipid parameters with the hemorrhagic phenotype in the complete-case analysis

TG		
Continuous model	**Categorical model**	**P for trend**

	OR (95% CI) P value	Q1 (<0.85)	Q2 (0.85–1.23)	Q3 (1.23–1.71)	Q4 (≥1.71)	
Model 1	0.888 (0.769, 1.026) 0.106	1	0.677 (0.473, 0.969) 0.033	0.695 (0.487, 0.994) 0.046	0.674 (0.471, 0.964) 0.031	0.040
Model 2	0.978 (0.840, 1.138) 0.771	1	0.813 (0.548, 1.206) 0.303	0.895 (0.595, 1.346) 0.595	1.033 (0.680, 1.567) 0.880	0.819
Model 3	0.986 (0.845, 1.150) 0.857	1	0.840 (0.561, 1.258) 0.397	0.920 (0.605, 1.398) 0.696	1.069 (0.696, 1.641) 0.760	0.713

TC

	Continuous model	Categorical model				P for trend
	OR (95% CI) P value	**Q1 (<3.32)**	**Q2 (3.32–3.97)**	**Q3 (3.97–4.63)**	**Q4 (≥4.63)**	
Model 1	1.562 (1.368, 1.783) <0.001	1	1.886 (1.231, 2.890) 0.004	3.315 (2.203, 4.987) <0.001	3.734 (2.488, 5.604) <0.001	<0.001
Model 2	1.592 (1.376, 1.841) <0.001	1	2.176 (1.360, 3.480) 0.001	3.907 (2.471, 6.177) <0.001	4.248 (2.698, 6.687) <0.001	<0.001
Model 3	1.532 (1.320, 1.778) <0.001	1	2.139 (1.325, 3.453) 0.002	3.572 (2.238, 5.701) <0.001	3.805 (2.393, 6.050) <0.001	<0.001

LDL-C

	Continuous model	Categorical model				P for trend
	OR (95% CI) P value	**Q1 (<1.68)**	**Q2 (1.68–2.24)**	**Q3 (2.24–2.82)**	**Q4 (≥2.82)**	
Model 1	1.697 (1.453, 1.981)	1	1.457 (0.959, 2.213) 0.078	2.552 (1.717, 3.793)	3.388 (2.293, 5.004) <0.001	<0.001

	<0.001			<0.001		
Model 2	1.871 (1.567, 2.233) <0.001	1	1.772 (1.101, 2.852) 0.019	3.508 (2.223, 5.537) <0.001	4.173 (2.656, 6.557) <0.001	<0.001
Model 3	1.789 (1.493, 2.144) <0.001	1	1.706 (1.051, 2.770) 0.031	3.144 (1.975, 5.004) <0.001	3.689 (2.328, 5.846) <0.001	<0.001

HDL-C

	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI) P value	**Q1 (<1.00)**	**Q2 (1.00–1.18)**	**Q3 (1.18–1.38)**	**Q4 (≥1.38)**	
Model 1	1.933 (1.285, 2.906) 0.002	1	1.300 (0.892, 1.895) 0.172	1.381 (0.954, 2.000) 0.088	1.833 (1.269, 2.648) 0.001	0.002
Model 2	1.631 (0.992, 2.684) 0.054	1	1.367 (0.893, 2.094) 0.150	1.322 (0.861, 2.028) 0.202	1.564 (1.007, 2.428) 0.046	0.070
Model 3	1.382 (0.825, 2.313) 0.219	1	1.211 (0.783, 1.875) 0.389	1.159 (0.747, 1.800) 0.510	1.325 (0.842, 2.086) 0.224	0.283

AIP

	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI) P value	**Q1 (<-0.18)**	**Q2 (-0.18–0.01)**	**Q3 (0.01–0.21)**	**Q4 (≥0.21)**	
Model 1	0.559 (0.362, 0.863) 0.009	1	0.621 (0.436, 0.884) 0.008	0.570 (0.396, 0.820) 0.002	0.613 (0.429, 0.875) 0.007	0.006
Model 2	0.898 (0.536, 1.506) 0.684	1	0.645 (0.436, 0.955) 0.028	0.789 (0.518, 1.201)	0.830 (0.541, 1.272) 0.392	0.554

				0.269		
Model 3	1.008 (0.594, 1.712) 0.976	1	0.695 (0.465, 1.038) 0.075	0.864 (0.562, 1.327) 0.504	0.917 (0.591, 1.422) 0.698	0.886

Non-HDL-C

	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI) P value	**Q1 (<2.14)**	**Q2 (2.14–2.74)**	**Q3 (2.74–3.38)**	**Q4 (≥3.38)**	
Model 1	1.518 (1.322, 1.743) <0.001	1	1.580 (1.041, 2.398) 0.032	2.859 (1.924, 4.249) <0.001	3.064 (2.066, 4.546) <0.001	<0.001
Model 2	1.606 (1.377, 1.872) <0.001	1	1.637 (1.044, 2.567) 0.032	3.127 (2.028, 4.820) <0.001	3.621 (2.356, 5.564) <0.001	<0.001
Model 3	1.556 (1.330, 1.819) <0.001	1	1.567 (0.990, 2.480) 0.055	2.884 (1.855, 4.484) <0.001	3.321 (2.141, 5.149) <0.001	<0.001

AC

	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI) P value	**Q1 (<1.72)**	**Q2 (1.72–2.26)**	**Q3 (2.26–3.02)**	**Q4 (≥3.02)**	
Model 1	1.193 (1.062, 1.341) 0.003	1	1.553 (1.064, 2.268) 0.022	1.308 (0.890, 1.922) 0.172	1.910 (1.317, 2.770) <0.001	0.003
Model 2	1.323 (1.153, 1.517) <0.001	1	1.563 (1.038, 2.355) 0.033	1.659 (1.086, 2.534) 0.019	2.622 (1.722, 3.994) <0.001	<0.001
Model 3	1.323 (1.152, 1.520)	1	1.567 (1.031, 2.384) 0.036	1.690 (1.097, 2.605)	2.612 (1.696, 4.024) <0.001	<0.001

	<0.001			0.017		

CRI-I						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI) P value	**Q1 (<2.72)**	**Q2 (2.72–3.26)**	**Q3 (3.26–4.02)**	**Q4 (≥4.02)**	
Model 1	1.193 (1.062, 1.341) 0.003	1	1.553 (1.064, 2.268) 0.022	1.308 (0.890, 1.922) 0.172	1.910 (1.317, 2.770) <0.001	0.003
Model 2	1.323 (1.153, 1.517) <0.001	1	1.563 (1.038, 2.355) 0.033	1.659 (1.086, 2.534) 0.019	2.622 (1.722, 3.994) <0.001	<0.001
Model 3	1.323 (1.152, 1.520) <0.001	1	1.567 (1.031, 2.384) 0.036	1.690 (1.097, 2.605) 0.017	2.612 (1.696, 4.024) <0.001	<0.001

CRI-II						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI) P value	**Q1 (<1.39)**	**Q2 (1.39–1.85)**	**Q3 (1.85–2.46)**	**Q4 (≥2.46)**	
Model 1	1.319 (1.140, 1.525) <0.001	1	1.328 (0.906, 1.946) 0.146	1.447 (0.991, 2.114) 0.056	1.871 (1.292, 2.710) <0.001	<0.001
Model 2	1.566 (1.313, 1.867) <0.001	1	1.489 (0.973, 2.280) 0.067	1.897 (1.238, 2.907) 0.003	2.679 (1.746, 4.110) <0.001	<0.001
Model 3	1.544 (1.293, 1.844) <0.001	1	1.465 (0.946, 2.267) 0.087	1.839 (1.190, 2.843) 0.006	2.569 (1.657, 3.982) <0.001	<0.001

LCI						
	Continuous model	Categorical model				P for trend
	OR (95% CI) P value	Q1 (<4.63)	Q2 (4.63–8.87)	Q3 (8.87–17.51)	Q4 (≥17.51)	
Model 1	1.005 (0.999, 1.012) 0.120	1	1.156 (0.796, 1.678) 0.447	1.057 (0.725, 1.541) 0.773	1.600 (1.114, 2.297) 0.011	0.021
Model 2	1.010 (1.002, 1.017) 0.014	1	1.063 (0.700, 1.613) 0.775	1.430 (0.946, 2.163) 0.090	2.406 (1.592, 3.637) <0.001	<0.001
Model 3	1.009 (1.002, 1.017) 0.017	1	1.062 (0.693, 1.627) 0.783	1.387 (0.908, 2.119) 0.130	2.256 (1.476, 3.447) <0.001	<0.001

RC						
	Continuous model	Categorical model				P for trend
	OR (95% CI) P value	Q1 (<0.3)	Q2 (0.3–0.42)	Q3 (0.42–0.57)	Q4 (≥0.57)	
Model 1	1.046 (0.823, 1.330) 0.712	1	0.870 (0.603, 1.256) 0.458	1.068 (0.745, 1.531) 0.721	1.065 (0.744, 1.526) 0.729	0.506
Model 2	1.066 (0.771, 1.474) 0.699	1	0.913 (0.612, 1.361) 0.654	1.256 (0.842, 1.875) 0.264	1.353 (0.898, 2.039) 0.148	0.069
Model 3	1.085 (0.781, 1.507) 0.626	1	0.937 (0.622, 1.412) 0.756	1.291 (0.857, 1.944) 0.222	1.435 (0.942, 2.185) 0.093	0.043

RC/HDL-C						
	Continuous model	Categorical model				P for trend

	OR (95% CI) P value	Q1 (<0.24)	Q2 (0.24–0.36)	Q3 (0.36–0.53)	Q4 (≥0.53)	
Model 1	0.985 (0.761, 1.275) 0.908	1	0.845 (0.586, 1.217) 0.366	1.044 (0.731, 1.491) 0.815	0.860 (0.598, 1.238) 0.418	0.683
Model 2	0.991 (0.698, 1.408) 0.960	1	0.974 (0.655, 1.449) 0.896	1.453 (0.977, 2.162) 0.065	1.084 (0.704, 1.669) 0.715	0.306
Model 3	1.046 (0.736, 1.488) 0.801	1	1.027 (0.684, 1.540) 0.899	1.524 (1.016, 2.286) 0.042	1.222 (0.785, 1.902) 0.375	0.133

Note: Model 1 was unadjusted. Model 2 was adjusted for sex, age, and BMI. Model 3 was further adjusted for hypertension, diabetes, smoking, drinking, bilateral involvement, and dichotomized Suzuki stage (≤4 vs >4). For categorical models, quartile 1 was used as the reference category. P for trend was calculated by entering quartile categories (1-4) as an ordinal variable.Variables analyzed: TG, TC, LDL-C, HDL-C,AIP, Non-HDL-C, AC, CRI-I, CRI-II, LCI, RC, and RC/HDL-C.

Supplementary Table 4. Associations of lipid parameters in asymptomatic versus hemorrhagic patients under multivariable logistic regression

TG						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<0.85)**	**Q2 (0.85–1.23)**	**Q3 (1.23–1.71)**	**Q4 (≥1.71)**	
Model 1	0.833 (0.686, 1.012) 0.065	1	0.662 (0.353, 1.241) 0.198	0.765 (0.403, 1.452) 0.413	0.559 (0.304, 1.028) 0.061	0.098
Model 2	0.858 (0.701, 1.050) 0.136	1	0.684 (0.359, 1.307) 0.250	0.807 (0.413, 1.577) 0.531	0.603 (0.311, 1.171) 0.136	0.205
Model 3	0.853 (0.694, 1.048) 0.131	1	0.640 (0.329, 1.245) 0.189	0.787 (0.396, 1.565) 0.495	0.607 (0.307, 1.203) 0.153	0.234

TC

	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<3.32)	Q2 (3.32–3.97)	Q3 (3.97–4.63)	Q4 (≥4.63)	
Model 1	1.297 (1.038, 1.621) 0.022	1	1.843 (0.963, 3.525) 0.065	3.890 (1.971, 7.675) <0.001	2.573 (1.388, 4.769) 0.003	0.001
Model 2	1.352 (1.078, 1.696) 0.009	1	1.999 (1.023, 3.906) 0.043	4.452 (2.207, 8.978) <0.001	2.948 (1.559, 5.576) <0.001	<0.001
Model 3	1.290 (1.024, 1.626) 0.031	1	1.824 (0.914, 3.640) 0.088	4.088 (1.982, 8.430) <0.001	2.697 (1.391, 5.227) 0.003	0.001

LDL-C

	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<1.68)	Q2 (1.68–2.24)	Q3 (2.24–2.82)	Q4 (≥2.82)	
Model 1	1.415 (1.087, 1.842) 0.010	1	1.547 (0.810, 2.954) 0.186	3.369 (1.705, 6.656) <0.001	2.205 (1.210, 4.017) 0.010	0.004
Model 2	1.470 (1.124, 1.921) 0.005	1	1.526 (0.789, 2.952) 0.209	3.513 (1.759, 7.019) <0.001	2.410 (1.305, 4.453) 0.005	0.002
Model 3	1.432 (1.089, 1.882) 0.010	1	1.474 (0.749, 2.903) 0.262	3.254 (1.595, 6.635) 0.001	2.280 (1.204, 4.318) 0.011	0.004

HDL-C

	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<1.00)	Q2 (1.00–1.18)	Q3 (1.18–1.38)	Q4 (≥1.38)	
Model 1	2.092 (0.995, 4.395) 0.051	1	1.654 (0.895, 3.058) 0.108	1.734 (0.946, 3.179) 0.075	2.112 (1.145, 3.898) 0.017	0.019
Model 2	2.511 (1.084, 5.820) 0.032	1	1.862 (0.988, 3.510) 0.055	1.970 (1.029, 3.772) 0.041	2.569 (1.296, 5.091) 0.007	0.009
Model 3	1.954 (0.829, 4.609) 0.126	1	1.450 (0.746, 2.819) 0.273	1.716 (0.870, 3.385) 0.119	2.103 (1.032, 4.285) 0.041	0.039

AIP

	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<-0.18)	Q2 (-0.18–0.01)	Q3 (0.01–0.21)	Q4 (≥0.21)	
Model 1	0.426 (0.203, 0.896) 0.024	1	0.553 (0.292, 1.048) 0.069	0.525 (0.274, 1.009) 0.053	0.465 (0.249, 0.871) 0.017	0.020

Model 2	0.415 (0.181, 0.952) 0.038	1	0.529 (0.274, 1.023) 0.058	0.516 (0.256, 1.036) 0.063	0.441 (0.221, 0.881) 0.020	0.030
Model 3	0.464 (0.197, 1.093) 0.079	1	0.545 (0.276, 1.077) 0.081	0.497 (0.243, 1.015) 0.055	0.479 (0.234, 0.977) 0.043	0.051

Non-HDL-C						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<2.14)**	**Q2 (2.14–2.74)**	**Q3 (2.74–3.38)**	**Q4 (≥3.38)**	
Model 1	1.240 (0.983, 1.565) 0.069	1	2.087 (1.078, 4.040) 0.029	3.513 (1.818, 6.787) <0.001	2.235 (1.230, 4.059) 0.008	0.007
Model 2	1.298 (1.025, 1.642) 0.030	1	2.168 (1.105, 4.253) 0.024	3.879 (1.977, 7.612) <0.001	2.589 (1.399, 4.792) 0.002	0.002
Model 3	1.254 (0.987, 1.595) 0.064	1	1.959 (0.980, 3.915) 0.057	3.624 (1.804, 7.278) <0.001	2.387 (1.260, 4.522) 0.008	0.005

AC						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<1.72)**	**Q2 (1.72–2.26)**	**Q3 (2.26–3.02)**	**Q4 (≥3.02)**	
Model 1	1.058 (0.867, 1.292) 0.578	1	1.510 (0.792, 2.877) 0.211	1.102 (0.588, 2.066) 0.761	1.492 (0.801, 2.779) 0.208	0.389
Model 2	1.093 (0.881, 1.354) 0.419	1	1.706 (0.880, 3.309) 0.114	1.253 (0.649, 2.419) 0.502	1.757 (0.906, 3.408) 0.096	0.213
Model 3	1.105 (0.886, 1.379) 0.375	1	1.790 (0.903, 3.548) 0.095	1.224 (0.618, 2.427) 0.562	1.867 (0.938, 3.716) 0.075	0.194

CRI-I						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<2.72)**	**Q2 (2.72–3.26)**	**Q3 (3.26–4.02)**	**Q4 (≥4.02)**	
Model 1	1.058 (0.867, 1.292) 0.578	1	1.510 (0.792, 2.877) 0.211	1.102 (0.588, 2.066) 0.761	1.492 (0.801, 2.779) 0.208	0.389
Model 2	1.093 (0.881, 1.354) 0.419	1	1.706 (0.880, 3.309) 0.114	1.253 (0.649, 2.419) 0.502	1.757 (0.906, 3.408) 0.096	0.213
Model 3	1.105 (0.886, 1.379) 0.375	1	1.790 (0.903, 3.548) 0.095	1.224 (0.618, 2.427) 0.562	1.867 (0.938, 3.716) 0.075	0.194

CRI-II						
	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<1.39)	Q2 (1.39–1.85)	Q3 (1.85–2.46)	Q4 (≥2.46)	
Model 1	1.144 (0.888, 1.473) 0.299	1	1.035 (0.553, 1.938) 0.915	1.323 (0.694, 2.521) 0.396	1.464 (0.779, 2.748) 0.236	0.164
Model 2	1.186 (0.905, 1.556) 0.217	1	1.024 (0.539, 1.945) 0.942	1.450 (0.746, 2.818) 0.273	1.641 (0.846, 3.183) 0.143	0.082
Model 3	1.213 (0.918, 1.603) 0.175	1	1.034 (0.532, 2.008) 0.922	1.380 (0.693, 2.750) 0.360	1.769 (0.886, 3.531) 0.106	0.067

LCI						
	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<4.63)	Q2 (4.63–8.87)	Q3 (8.87–17.51)	Q4 (≥17.51)	
Model 1	0.997 (0.987, 1.007) 0.538	1	1.266 (0.656, 2.444) 0.482	0.869 (0.466, 1.622) 0.659	1.167 (0.632, 2.154) 0.622	0.897
Model 2	0.999 (0.988, 1.009) 0.799	1	1.323 (0.678, 2.580) 0.411	1.012 (0.529, 1.937) 0.972	1.355 (0.708, 2.590) 0.359	0.518
Model 3	0.998 (0.988, 1.009) 0.762	1	1.299 (0.655, 2.578) 0.454	0.989 (0.506, 1.932) 0.974	1.270 (0.651, 2.475) 0.483	0.663

RC						
	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<0.3)	Q2 (0.3–0.42)	Q3 (0.42–0.57)	Q4 (≥0.57)	
Model 1	0.875 (0.614, 1.247) 0.459	1	0.848 (0.461, 1.557) 0.595	1.120 (0.602, 2.082) 0.720	1.134 (0.610, 2.107) 0.692	0.520
Model 2	0.928 (0.646, 1.334) 0.687	1	0.842 (0.452, 1.568) 0.588	1.272 (0.670, 2.417) 0.462	1.237 (0.650, 2.355) 0.517	0.318
Model 3	0.888 (0.611, 1.289) 0.531	1	0.833 (0.437, 1.587) 0.579	1.378 (0.710, 2.676) 0.343	1.154 (0.595, 2.238) 0.672	0.401

RC/HDL-C

	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<0.24)	Q2 (0.24–0.36)	Q3 (0.36–0.53)	Q4 (≥0.53)	
Model 1	0.888 (0.604, 1.306) 0.545	1	0.759 (0.409, 1.411) 0.384	1.024 (0.545, 1.924) 0.942	0.797 (0.428, 1.486) 0.476	0.707
Model 2	0.926 (0.623, 1.377) 0.705	1	0.856 (0.454, 1.614) 0.632	1.132 (0.579, 2.212) 0.717	0.895 (0.462, 1.736) 0.743	0.931
Model 3	0.915 (0.607, 1.378) 0.670	1	0.880 (0.459, 1.686) 0.699	1.099 (0.553, 2.183) 0.788	0.969 (0.488, 1.921) 0.927	0.932

Note: Model 1 was unadjusted. Model 2 was adjusted for sex, age, and BMI. Model 3 was further adjusted for hypertension, diabetes, smoking, drinking, bilateral involvement, and dichotomized Suzuki stage (≤4 vs >4). For categorical models, quartile 1 was used as the reference category. P for trend was calculated by entering quartile categories (1-4) as an ordinal variable.

Supplementary Table 5. Associations of lipid parameters in ischemic versus hemorrhagic patients under multivariable logistic regression

TG

	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<0.85)	Q2 (0.85–1.23)	Q3 (1.23–1.71)	Q4 (≥1.71)	
Model 1	0.898 (0.773, 1.043) 0.158	1	0.679 (0.471, 0.979) 0.038	0.687 (0.478, 0.988) 0.043	0.693 (0.481, 1.000) 0.050	0.057
Model 2	0.986 (0.904, 1.077) 0.761	1	0.772 (0.529, 1.125) 0.178	0.856 (0.584, 1.254) 0.425	0.955 (0.642, 1.419) 0.819	0.907
Model 3	0.983 (0.879, 1.100) 0.769	1	0.813 (0.552, 1.196) 0.293	0.899 (0.607, 1.329) 0.592	0.968 (0.644, 1.455) 0.877	0.964

TC

	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<3.32)	Q2 (3.32–3.97)	Q3 (3.97–4.63)	Q4 (≥4.63)	
Model 1	1.675 (1.454, 1.929) <0.001	1	1.892 (1.229, 2.913) 0.004	3.251 (2.150, 4.916) <0.001	3.970 (2.625, 6.005) <0.001	<0.001

Model 2	1.702 (1.471, 1.969) <0.001	1	1.888 (1.218, 2.925) 0.004	3.299 (2.160, 5.040) <0.001	4.129 (2.706, 6.299) <0.001	<0.001
Model 3	1.638 (1.412, 1.901) <0.001	1	1.829 (1.170, 2.859) 0.008	3.077 (1.996, 4.744) <0.001	3.670 (2.383, 5.654) <0.001	<0.001

LDL-C						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<1.68)**	**Q2 (1.68–2.24)**	**Q3 (2.24–2.82)**	**Q4 (≥2.82)**	
Model 1	1.773 (1.507, 2.085) <0.001	1	1.446 (0.947, 2.207) 0.088	2.470 (1.654, 3.690) <0.001	3.655 (2.452, 5.447) <0.001	<0.001
Model 2	1.841 (1.558, 2.176) <0.001	1	1.468 (0.956, 2.254) 0.079	2.667 (1.770, 4.018) <0.001	3.967 (2.639, 5.964) <0.001	<0.001
Model 3	1.765 (1.489, 2.092) <0.001	1	1.429 (0.923, 2.212) 0.110	2.459 (1.619, 3.737) <0.001	3.549 (2.341, 5.380) <0.001	<0.001

HDL-C						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<1.00)**	**Q2 (1.00–1.18)**	**Q3 (1.18–1.38)**	**Q4 (≥1.38)**	
Model 1	1.930 (1.270, 2.931) 0.002	1	1.255 (0.856, 1.841) 0.245	1.335 (0.916, 1.946) 0.133	1.793 (1.232, 2.610) 0.002	0.003
Model 2	1.473 (0.936, 2.318) 0.094	1	1.162 (0.785, 1.719) 0.453	1.148 (0.775, 1.700) 0.492	1.411 (0.937, 2.125) 0.099	0.125
Model 3	1.273 (0.797, 2.035) 0.312	1	1.041 (0.695, 1.557) 0.847	1.022 (0.682, 1.532) 0.915	1.216 (0.796, 1.857) 0.366	0.402
AIP						
	Continuous model	**Categorical model**				**P for trend**
	OR (95% CI), P value	**Q1 (<-0.18)**	**Q2 (-0.18–0.01)**	**Q3 (0.01–0.21)**	**Q4 (≥0.21)**	
Model 1	0.580 (0.373, 0.902) 0.016	1	0.630 (0.440, 0.904) 0.012	0.576 (0.398, 0.834) 0.004	0.637 (0.443, 0.918) 0.015	0.012
Model 2	0.880 (0.544, 1.424) 0.603	1	0.723 (0.498, 1.049) 0.088	0.741 (0.499, 1.102) 0.139	0.886 (0.592, 1.327) 0.558	0.577
Model 3	0.948 (0.580, 1.549) 0.831	1	0.775 (0.529, 1.135) 0.190	0.817 (0.545, 1.224) 0.327	0.949 (0.627, 1.436) 0.805	0.838

Non-HDL-C						
	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<2.14)	Q2 (2.14–2.74)	Q3 (2.74–3.38)	Q4 (≥3.38)	
Model 1	1.637 (1.411, 1.898) <0.001	1	1.526 (1.001, 2.327) 0.050	2.783 (1.862, 4.159) <0.001	3.241 (2.167, 4.848) <0.001	<0.001
Model 2	1.729 (1.481, 2.019) <0.001	1	1.535 (1.000, 2.356) 0.050	2.965 (1.963, 4.479) <0.001	3.736 (2.466, 5.661) <0.001	<0.001
Model 3	1.676 (1.432, 1.961) <0.001	1	1.473 (0.951, 2.280) 0.082	2.784 (1.828, 4.241) <0.001	3.443 (2.252, 5.264) <0.001	<0.001

AC						
	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<1.72)	Q2 (1.72–2.26)	Q3 (2.26–3.02)	Q4 (≥3.02)	
Model 1	1.222 (1.081, 1.381) 0.001	1	1.559 (1.062, 2.289) 0.023	1.340 (0.906, 1.981) 0.143	1.980 (1.355, 2.892) <0.001	0.002
Model 2	1.369 (1.196, 1.567) <0.001	1	1.752 (1.181, 2.598) 0.005	1.678 (1.116, 2.522) 0.013	2.767 (1.840, 4.161) <0.001	<0.001
Model 3	1.367 (1.194, 1.566) <0.001	1	1.784 (1.191, 2.670) 0.005	1.757 (1.159, 2.666) 0.008	2.756 (1.812, 4.193) <0.001	<0.001

CRI-I						
	Continuous model	Categorical model				P for trend
	OR (95% CI), P value	Q1 (<2.72)	Q2 (2.72–3.26)	Q3 (3.26–4.02)	Q4 (≥4.02)	
Model 1	1.222 (1.081, 1.381) 0.001	1	1.559 (1.062, 2.289) 0.023	1.340 (0.906, 1.981) 0.143	1.980 (1.355, 2.892) <0.001	0.002
Model 2	1.369 (1.196, 1.567) <0.001	1	1.752 (1.181, 2.598) 0.005	1.678 (1.116, 2.522) 0.013	2.767 (1.840, 4.161) <0.001	<0.001
Model 3	1.367 (1.194, 1.566) <0.001	1	1.784 (1.191, 2.670) 0.005	1.757 (1.159, 2.666) 0.008	2.756 (1.812, 4.193) <0.001	<0.001

CRI-II						
	Continuous model	Categorical model				P for trend

	OR (95% CI), P value	Q1 (<1.39)	Q2 (1.39–1.85)	Q3 (1.85–2.46)	Q4 (≥2.46)	
Model 1	1.355 (1.164, 1.577) <0.001	1	1.375 (0.932, 2.028) 0.108	1.464 (0.997, 2.151) 0.052	1.936 (1.327, 2.824) <0.001	<0.001
Model 2	1.561 (1.322, 1.843) <0.001	1	1.483 (0.996, 2.207) 0.052	1.727 (1.161, 2.568) 0.007	2.552 (1.713, 3.802) <0.001	<0.001
Model 3	1.533 (1.297, 1.813) <0.001	1	1.500 (0.998, 2.255) 0.051	1.726 (1.152, 2.587) 0.008	2.461 (1.635, 3.704) <0.001	<0.001

LCI						
	Continuous model		**Categorical model**			**P for trend**
	OR (95% CI), P value	**Q1 (<4.63)**	**Q2 (4.63–8.87)**	**Q3 (8.87–17.51)**	**Q4 (≥17.51)**	
Model 1	1.008 (1.000, 1.016) 0.038	1	1.143 (0.783, 1.669) 0.489	1.087 (0.741, 1.594) 0.671	1.678 (1.160, 2.429) 0.006	0.010
Model 2	1.013 (1.005, 1.021) 0.001	1	1.223 (0.830, 1.801) 0.308	1.384 (0.927, 2.067) 0.112	2.382 (1.600, 3.545) <0.001	<0.001
Model 3	1.013 (1.004, 1.021) 0.003	1	1.247 (0.839, 1.853) 0.274	1.388 (0.920, 2.093) 0.118	2.227 (1.481, 3.350) <0.001	<0.001

RC						
	Continuous model		**Categorical model**			**P for trend**
	OR (95% CI), P value	**Q1 (<0.3)**	**Q2 (0.3–0.42)**	**Q3 (0.42–0.57)**	**Q4 (≥0.57)**	
Model 1	1.097 (0.836, 1.440) 0.505	1	0.873 (0.601, 1.270) 0.479	1.061 (0.735, 1.532) 0.753	1.056 (0.732, 1.523) 0.770	0.555
Model 2	1.165 (0.877, 1.548) 0.292	1	0.902 (0.614, 1.323) 0.596	1.227 (0.837, 1.800) 0.294	1.250 (0.854, 1.830) 0.251	0.120
Model 3	1.187 (0.887, 1.588) 0.248	1	0.910 (0.615, 1.349) 0.640	1.230 (0.831, 1.821) 0.300	1.293 (0.874, 1.912) 0.198	0.098

RC/HDL-C						
	Continuous model		**Categorical model**			**P for trend**
	OR (95% CI), P value	**Q1 (<0.24)**	**Q2 (0.24–0.36)**	**Q3 (0.36–0.53)**	**Q4 (≥0.53)**	
Model 1	1.004 (0.764, 1.319) 0.980	1	0.858 (0.591, 1.245) 0.419	1.046 (0.727, 1.505) 0.807	0.869 (0.600, 1.260) 0.460	0.713

Model 2	1.102 (0.833, 1.457) 0.498	1	0.939 (0.641, 1.375) 0.747	1.333 (0.908, 1.959) 0.142	1.140 (0.770, 1.689) 0.512	0.252
Model 3	1.149 (0.863, 1.530) 0.342	1	0.983 (0.665, 1.452) 0.930	1.369 (0.925, 2.027) 0.116	1.239 (0.828, 1.854) 0.297	0.141

Note: Model 1 was unadjusted. Model 2 was adjusted for sex, age, and BMI. Model 3 was further adjusted for hypertension, diabetes, smoking, drinking, bilateral involvement, and dichotomized Suzuki stage (≤4 vs >4). For categorical models, quartile 1 was used as the reference category. P for trend was calculated by entering quartile categories (1-4) as an ordinal variable.

Supplementary Table 6. Subgroup analyses of associations between key lipid parameters and the risk of hemorrhage

Subgroups	Event/Total	OR (95% CI)	P value	P for interaction
TC				
Age				
<42 y	151/560	1.504 (1.217-1.860)	<0.001	
≥42 y	168/616	1.557 (1.290-1.880)	<0.001	0.726
Sex				
Female	188/654	1.584 (1.312-1.913)	<0.001	
Male	131/522	1.525 (1.235-1.881)	<0.001	0.884
Hypertension				
No	232/728	1.669 (1.392-2.003)	<0.001	
Yes	87/448	1.417 (1.138-1.765)	0.002	0.129
BMI				

<28	270/902	1.543 (1.320-1.804)	<0.001	
≥28	49/274	1.425 (1.021-1.990)	0.037	0.577
LDL-C				
Age				
<42 y	151/560	1.703 (1.338-2.168)	<0.001	
≥42 y	168/616	1.702 (1.362-2.128)	<0.001	0.973
Sex				
Female	188/654	1.820 (1.459-2.270)	<0.001	
Male	131/522	1.618 (1.264-2.071)	<0.001	0.525
Hypertension				
No	232/728	1.790 (1.461-2.192)	<0.001	
Yes	87/448	1.606 (1.207-2.136)	0.001	0.482
BMI				
<28	270/902	1.620 (1.352-1.942)	<0.001	
≥28	49/274	1.892 (1.164-3.076)	0.010	0.603
Non-HDL-C				
Age				
<42 y	151/560	1.468 (1.181-1.824)	<0.001	
≥42 y	168/616	1.630 (1.331-1.997)	<0.001	0.439
Sex				
Female	188/654	1.601 (1.312-1.953)	<0.001	
Male	131/522	1.549 (1.246-1.926)	<0.001	0.974
Hypertension				
No	232/728	1.650 (1.364-1.996)	<0.001	
Yes	87/448	1.472 (1.171-1.850)	<0.001	0.351
BMI				
<28	270/902	1.537 (1.304-1.811)	<0.001	
≥28	49/274	1.440 (1.016-2.041)	0.040	0.730

AC				
Age				
<42 y	151/560	1.215 (1.013-1.457)	0.036	
≥42 y	168/616	1.491 (1.230-1.808)	<0.001	0.129
Sex				
Female	188/654	1.337 (1.110-1.611)	0.002	
Male	131/522	1.331 (1.113-1.593)	0.002	0.689
Hypertension				
No	232/728	1.259 (1.066-1.487)	0.007	
Yes	87/448	1.440 (1.158-1.790)	0.001	0.268
BMI				
<28	270/902	1.284 (1.110-1.485)	<0.001	
≥28	49/274	1.268 (0.931-1.728)	0.132	0.926
CRI-I				
Age				
<42 y	151/560	1.215 (1.013-1.457)	0.036	
≥42 y	168/616	1.491 (1.230-1.808)	<0.001	0.129
Sex				
Female	188/654	1.337 (1.110-1.611)	0.002	
Male	131/522	1.331 (1.113-1.593)	0.002	0.689
Hypertension				
No	232/728	1.259 (1.066-1.487)	0.007	
Yes	87/448	1.440 (1.158-1.790)	0.001	0.268
BMI				
<28	270/902	1.284 (1.110-1.485)	<0.001	
≥28	49/274	1.268 (0.931-1.728)	0.132	0.926
CRI-II				
Age				

<42 y	151/560	1.398 (1.125-1.737)	0.002	
≥42 y	168/616	1.640 (1.289-2.086)	<0.001	0.346
Sex				
Female	188/654	1.575 (1.242-1.998)	<0.001	
Male	131/522	1.427 (1.147-1.775)	0.001	0.771
Hypertension				
No	232/728	1.446 (1.182-1.770)	<0.001	
Yes	87/448	1.541 (1.165-2.037)	0.002	0.526
BMI				
<28	270/902	1.409 (1.175-1.690)	<0.001	
≥28	49/274	1.448 (0.963-2.178)	0.075	0.785
LCI				
Age				
<42 y	151/560	1.008 (0.997-1.020)	0.166	
≥42 y	168/616	1.010 (1.000-1.020)	0.052	0.792
Sex				
Female	188/654	1.009 (0.999-1.019)	0.076	
Male	131/522	1.010 (1.000-1.021)	0.060	0.587
Hypertension				
No	232/728	1.009 (0.999-1.020)	0.088	
Yes	87/448	1.009 (0.999-1.020)	0.077	0.922
BMI				
<28	270/902	1.009 (1.000-1.019)	0.049	
≥28	49/274	1.006 (0.992-1.019)	0.427	0.752

Note: Models were adjusted for sex, age, BMI, hypertension, diabetes, smoking status, drinking status, bilateral involvement, and dichotomized Suzuki stage (≤4 vs >4).

Supplementary Table 7. Mediation analysis of BMI in the associations between traditional and nontraditional lipid parameters and the risk of hemorrhage

Lipid traits	Direct effect		Indirect effect		Total effect		Mediation proportion		
	β	P value	β	P value	β	P value	β	95%CI	P value
TG	-0.0289	0.688	-0.0004	0.775	-0.0913	0.218	0.41%	-2.9%–3.7%	0.806
TC	0.4256	<0.001	-0.0140	0.229	0.4079	<0.001	-3.42%	-9.1%–2.3%	0.239
LDL-C	0.5249	<0.001	-0.0328	0.061	0.4889	<0.001	-6.71%	-14.1%–0.7%	0.074
HDL-C	0.2758	0.239	0.1921	0.002	0.4662	0.039	41.20%	-6.1%–88.5%	0.088
AIP	-0.1066	0.664	-0.2778	0.001	-0.3889	0.097	71.43%	-23.8%–166.7%	0.142
Non-HDL-C	0.4353	<0.001	-0.0370	0.014	0.3932	<0.001	-9.40%	-17.7%–-1.1%	0.026
AC	0.2758	<0.001	-0.0644	<0.001	0.2092	<0.001	-30.77%	-55.8%–-5.7%	0.016
CRI-I	0.2758	<0.001	-0.0644	<0.001	0.2092	<0.001	-30.77%	-55.8%–-5.7%	0.016
CRI-II	0.3882	<0.001	-0.0799	0.001	0.3056	<0.001	-26.14%	-46.8%–-5.5%	0.013
LCI	0.0091	0.015	-0.0030	0.002	0.0061	0.093	-48.40%	-113.3%–16.5%	0.144
RC	0.1092	0.392	-0.0370	0.157	0.0671	0.594	-55.10%	-286.1%–175.9%	0.640
RC/HDL-C	0.1053	0.437	-0.0523	0.062	0.0464	0.730	-112.90%	-788.0%–562.2%	0.743

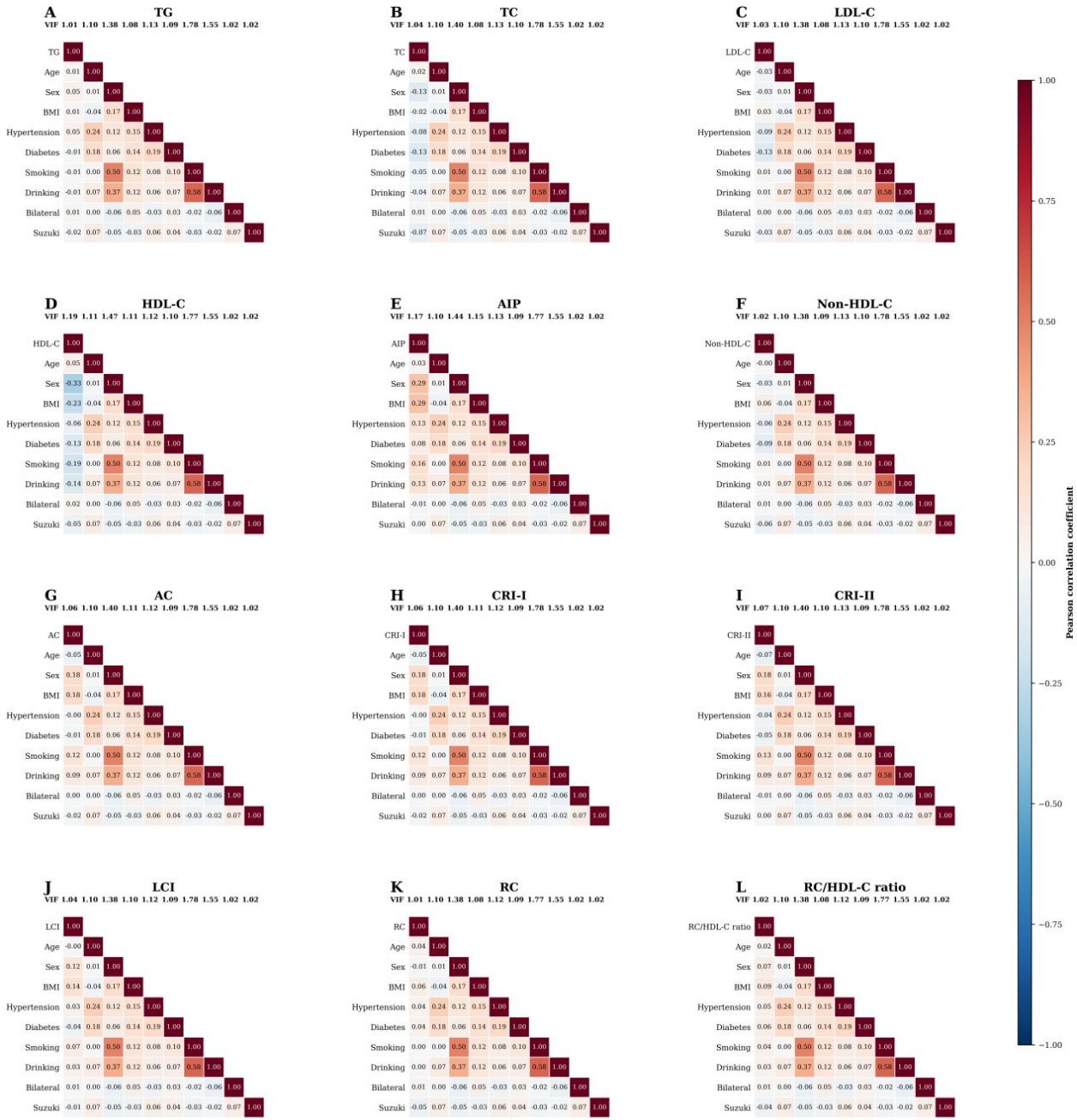
Notes:

1. Missing BMI values were handled using MICE with 20 imputations.

2. Mediator model: linear regression for BMI; outcome model: logistic regression for hemorrhagic phenotype.

3. Models adjusted for age, sex, hypertension, diabetes, smoking, alcohol consumption, laterality, and Suzuki stage.

4. β for direct, indirect, and total effects are reported on the logit scale. A negative mediation proportion indicates suppression.


A
TG
VIF 1.01 1.10 1.38 1.08 1.13 1.09 1.78 1.55 1.02 1.02
TG 1.00
Age 0.01 1.00
Sex 0.05 0.01 1.00
BMI 0.01 -0.04 0.17 1.00
Hypertension 0.05 0.24 0.12 0.15 1.00
Diabetes -0.01 0.18 0.06 0.14 0.19 1.00
Smoking -0.01 0.00 0.50 0.12 0.08 0.10 1.00
Drinking -0.01 0.07 0.37 0.12 0.06 0.07 0.58 1.00
Bilateral 0.01 0.00 -0.06 0.05 -0.03 0.03 -0.02 -0.06 1.00
Suzuki -0.02 0.07 -0.05 -0.03 0.06 0.04 -0.03 -0.02 0.07 1.00
B
TC
VIF 1.04 1.10 1.40 1.08 1.13 1.10 1.78 1.55 1.02 1.02
TC 1.00
Age 0.02 1.00
Sex -0.13 0.01 1.00
BMI -0.02 -0.04 0.17 1.00
Hypertension -0.08 0.24 0.12 0.15 1.00
Diabetes -0.13 0.18 0.06 0.14 0.19 1.00
Smoking -0.05 0.00 0.50 0.12 0.08 0.10 1.00
Drinking -0.04 0.07 0.37 0.12 0.06 0.07 0.58 1.00
Bilateral 0.01 0.00 -0.06 0.05 -0.03 0.03 -0.02 -0.06 1.00
Suzuki -0.07 0.07 -0.05 -0.03 0.06 0.04 -0.03 -0.02 0.07 1.00
C
LDL-C
VIF 1.03 1.10 1.38 1.08 1.13 1.10 1.78 1.55 1.02 1.02
LDL-C 1.00
Age -0.03 1.00
Sex -0.03 0.01 1.00
BMI 0.03 -0.04 0.17 1.00
Hypertension -0.09 0.24 0.12 0.15 1.00
Diabetes -0.13 0.18 0.06 0.14 0.19 1.00
Smoking 0.01 0.00 0.50 0.12 0.08 0.10 1.00
Drinking 0.01 0.07 0.37 0.12 0.06 0.07 0.58 1.00
Bilateral 0.00 0.00 -0.06 0.05 -0.03 0.03 -0.02 -0.06 1.00
Suzuki -0.03 0.07 -0.05 -0.03 0.06 0.04 -0.03 -0.02 0.07 1.00
D
HDL-C
VIF 1.19 1.11 1.47 1.11 1.12 1.10 1.77 1.55 1.02 1.02
HDL-C 1.00
Age 0.05 1.00
Sex -0.33 0.01 1.00
BMI -0.23 -0.04 0.17 1.00
Hypertension -0.06 0.24 0.12 0.15 1.00
Diabetes -0.13 0.18 0.06 0.14 0.19 1.00
Smoking -0.19 0.00 0.50 0.12 0.08 0.10 1.00
Drinking -0.14 0.07 0.37 0.12 0.06 0.07 0.58 1.00
Bilateral 0.02 0.00 -0.06 0.05 -0.03 0.03 -0.02 -0.06 1.00
Suzuki -0.05 0.07 -0.05 -0.03 0.06 0.04 -0.03 -0.02 0.07 1.00
E
AIP
VIF 1.17 1.10 1.44 1.15 1.13 1.09 1.77 1.55 1.02 1.02
AIP 1.00
Age 0.03 1.00
Sex 0.29 0.01 1.00
BMI 0.29 -0.04 0.17 1.00
Hypertension 0.13 0.24 0.12 0.15 1.00
Diabetes 0.08 0.18 0.06 0.14 0.19 1.00
Smoking 0.16 0.00 0.50 0.12 0.08 0.10 1.00
Drinking 0.13 0.07 0.37 0.12 0.06 0.07 0.58 1.00
Bilateral -0.01 0.00 -0.06 0.05 -0.03 0.03 -0.02 -0.06 1.00
Suzuki 0.00 0.07 -0.05 -0.03 0.06 0.04 -0.03 -0.02 0.07 1.00
F
Non-HDL-C
VIF 1.02 1.10 1.38 1.09 1.13 1.10 1.78 1.55 1.02 1.02
Non-HDL-C 1.00
Age -0.00 1.00
Sex -0.03 0.01 1.00
BMI 0.06 -0.04 0.17 1.00
Hypertension -0.06 0.24 0.12 0.15 1.00
Diabetes -0.09 0.18 0.06 0.14 0.19 1.00
Smoking 0.01 0.00 0.50 0.12 0.08 0.10 1.00
Drinking 0.01 0.07 0.37 0.12 0.06 0.07 0.58 1.00
Bilateral 0.01 0.00 -0.06 0.05 -0.03 0.03 -0.02 -0.06 1.00
Suzuki -0.06 0.07 -0.05 -0.03 0.06 0.04 -0.03 -0.02 0.07 1.00
G
AC
VIF 1.06 1.10 1.40 1.11 1.12 1.09 1.78 1.55 1.02 1.02
AC 1.00
Age -0.05 1.00
Sex 0.18 0.01 1.00
BMI 0.18 -0.04 0.17 1.00
Hypertension -0.00 0.24 0.12 0.15 1.00
Diabetes -0.01 0.18 0.06 0.14 0.19 1.00
Smoking 0.12 0.00 0.50 0.12 0.08 0.10 1.00
Drinking 0.09 0.07 0.37 0.12 0.06 0.07 0.58 1.00
Bilateral 0.00 0.00 -0.06 0.05 -0.03 0.03 -0.02 -0.06 1.00
Suzuki -0.02 0.07 -0.05 -0.03 0.06 0.04 -0.03 -0.02 0.07 1.00
H
CRI-I
VIF 1.06 1.10 1.40 1.11 1.12 1.09 1.78 1.55 1.02 1.02
CRI-I 1.00
Age -0.05 1.00
Sex 0.18 0.01 1.00
BMI 0.18 -0.04 0.17 1.00
Hypertension -0.00 0.24 0.12 0.15 1.00
Diabetes -0.01 0.18 0.06 0.14 0.19 1.00
Smoking 0.12 0.00 0.50 0.12 0.08 0.10 1.00
Drinking 0.09 0.07 0.37 0.12 0.06 0.07 0.58 1.00
Bilateral 0.00 0.00 -0.06 0.05 -0.03 0.03 -0.02 -0.06 1.00
Suzuki -0.02 0.07 -0.05 -0.03 0.06 0.04 -0.03 -0.02 0.07 1.00
I
CRI-II
VIF 1.07 1.10 1.40 1.10 1.13 1.09 1.78 1.55 1.02 1.02
CRI-II 1.00
Age -0.07 1.00
Sex 0.18 0.01 1.00
BMI 0.16 -0.04 0.17 1.00
Hypertension -0.04 0.24 0.12 0.15 1.00
Diabetes -0.05 0.18 0.06 0.14 0.19 1.00
Smoking 0.13 0.00 0.50 0.12 0.08 0.10 1.00
Drinking 0.09 0.07 0.37 0.12 0.06 0.07 0.58 1.00
Bilateral -0.01 0.00 -0.06 0.05 -0.03 0.03 -0.02 -0.06 1.00
Suzuki 0.00 0.07 -0.05 -0.03 0.06 0.04 -0.03 -0.02 0.07 1.00
J
LCI
VIF 1.04 1.10 1.38 1.10 1.12 1.09 1.78 1.55 1.02 1.02
LCI 1.00
Age -0.00 1.00
Sex 0.12 0.01 1.00
BMI 0.14 -0.04 0.17 1.00
Hypertension 0.03 0.24 0.12 0.15 1.00
Diabetes -0.04 0.18 0.06 0.14 0.19 1.00
Smoking 0.07 0.00 0.50 0.12 0.08 0.10 1.00
Drinking 0.03 0.07 0.37 0.12 0.06 0.07 0.58 1.00
Bilateral 0.01 0.00 -0.06 0.05 -0.03 0.03 -0.02 -0.06 1.00
Suzuki -0.01 0.07 -0.05 -0.03 0.06 0.04 -0.03 -0.02 0.07 1.00
K
RC
VIF 1.01 1.10 1.38 1.08 1.12 1.09 1.77 1.55 1.02 1.02
RC 1.00
Age 0.01 1.00
Sex -0.01 0.01 1.00
BMI 0.06 -0.04 0.17 1.00
Hypertension 0.04 0.24 0.12 0.15 1.00
Diabetes 0.04 0.18 0.06 0.14 0.19 1.00
Smoking 0.00 0.00 0.50 0.12 0.08 0.10 1.00
Drinking 0.00 0.07 0.37 0.12 0.06 0.07 0.58 1.00
Bilateral 0.01 0.00 -0.06 0.05 -0.03 0.03 -0.02 -0.06 1.00
Suzuki -0.05 0.07 -0.05 -0.03 0.06 0.04 -0.03 -0.02 0.07 1.00
L
RC/HDL-C ratio
VIF 1.02 1.10 1.38 1.08 1.12 1.09 1.77 1.55 1.02 1.02
RC/HDL-C ratio 1.00
Age 0.02 1.00
Sex 0.07 0.01 1.00
BMI 0.09 -0.04 0.17 1.00
Hypertension 0.05 0.24 0.12 0.15 1.00
Diabetes 0.06 0.18 0.06 0.14 0.19 1.00
Smoking 0.04 0.00 0.50 0.12 0.08 0.10 1.00
Drinking 0.03 0.07 0.37 0.12 0.06 0.07 0.58 1.00
Bilateral 0.01 0.00 -0.06 0.05 -0.03 0.03 -0.02 -0.06 1.00
Suzuki -0.04 0.07 -0.05 -0.03 0.06 0.04 -0.03 -0.02 0.07 1.00
Pearson correlation coefficient
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00

Supplementary Fig. 1. Pearson correlation matrix and variance inflation factor (VIF) assessment of lipid parameters and model covariates