

Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

eTable 1. Coronary Artery Disease Definitions Across Myocardial Infarction Genetics Consortium and DiscovEHR Cohorts

Cohort	Enrollment Location	Dates of Sequencing	CAD Cases	Controls	CAD Definition	Control Definition	N (%) with Lipid Levels Available
ATVB ¹	Italy	2013 – 2014	1791	1719	MI in men or women ≤45y	No history of thromboembolic disease	3180 (91%)
EOMI ²	United States	2010 – 2014	989	1471	MI (men ≤50y or women ≤60y)	Hospital-based, no report of MI by history	1463 (59%)
JHS ³	United States	2013 – 2014	18	693	Prevalent CHD (self-reported or electrocardiographic evidence of MI) and incident CHD (MI or coronary revascularization) in men ≤50y or women ≤60y	Free of CHD at baseline and during follow-up	616 (87%)
Leicester MI ⁴	United Kingdom	2015	1201	1090	MI in men or women age ≤60y	Controls ≥64y without reported CAD history	459 (20%)
North German MI ⁵	Germany	2014 – 2015	858	878	MI in men and women ≤60y	Controls without CAD; men and women ≤65y	0 (0%)
South German MI ⁶	Germany	2014	400	398	MI in men ≤40y or women ≤55y	Controls without CAD, men ≥ 65y and women ≥75y	639 (80%)
OHS ⁷	Canada	2013 – 2014	572	968	MI or CABG or angiographic disease (>50% stenosis) in men ≤50y or women ≤60y), without type 2 diabetes	Asymptomatic	1382 (90%)
PROCARDIS ⁸	United Kingdom, Italy, Sweden, Germany	2013	914	910	MI (men ≤50y or women ≤60y)	No history of CAD	1430 (78%)
PROMIS ⁹	Pakistan	2014 – 2015	3026	3877	MI, age ≤50y	Age and gender frequency-matched; no history of MI/CVD	6640 (96%)

REGICOR ¹⁰	Spain	2013 – 2014	369	391	MI in men ≤50y or women ≤60y	Controls from a population-based study; free of MI, coronary revascularization; ≥55y and <80y	391 (51%)
DiscovEHR ¹¹	United States	2014 – 2015	4107	20251	History of coronary revascularization, acute coronary syndrome, ischemic heart disease, or exertional angina with angiographic evidence of obstructive coronary disease (>50% stenosis in at least one major epicardial vessel) in men <55y or women <65y	Absence of CAD case criteria or electronic health record problem list diagnosis code indicating CAD	17207 (71%)

ATVB: Atherosclerosis, Thrombosis and Vascular Biology Italian Study; EOMI: NHLBI Exome Sequencing Project Early-Onset Myocardial Infarction; JHS: Jackson Heart Study; Leicester MI: Leicester Myocardial Infarction Study; North German MI: North German Myocardial Infarction Study; South German MI: South German Myocardial Infarction Study; OHS: Ottawa Heart Study; PROCARDIS: Precocious coronary artery disease; PROMIS: Pakistan Risk of Myocardial Infarction Study; REGICOR: Registre Gironi del COR (Gerona Heart Registry) study.

CAD: coronary artery disease; MI: myocardial infarction; CHD: coronary heart disease; CABG: Coronary artery bypass grafting; CVD: cardiovascular disease.

eTable 2. Rare Damaging Mutations in *LPL* and Coronary Artery Disease in the Myocardial Infarction Genetics Consortium Cohorts

Variant (CHR:POS_REF/ALT)	dbSNP ID	Consequence	Protein Change or Splice Site	Median Triglyceride Level, mg/dL	N of 12,395 Controls	N of 10,138 CAD Cases	N of 22,533 Study Participants
Loss of Function Variants (n = 8)							
8:19797040_G/C		Splice Site	c.88+1G>C	137	0	2	2
8:19805729_C/CT		Frameshift	p.Arg44LysfsTer4	N/A	0	1	1
8:19805777_G/T	rs375484335	Premature Stop	p.Gly59Ter	105	1	0	1
8:19809303_G/A		Premature Stop	p.Trp91Ter	347	0	1	1
8:19809427_C/T	rs118204058	Premature Stop	p.Gln133Ter	229	1	0	1
8:19813360_C/T		Premature Stop	p.Gln262Ter	115	0	1	1
8:19816770_G/C		Splice Site	c.1019-1G>C	453	0	1	1
8:19818531_G/A		Premature Stop	p.Trp420Ter	205	0	1	1
ClinVar Pathogenic Variants (n = 6)							
8:19811733_G/A	rs118204057	Missense	p.Gly215Glu	N/A	3	9	12
8:19811790_C/T	rs118204060	Missense	p.Pro234Leu	136	0	2	2
8:19811844_T/C	rs118204080	Missense	p.Ile252Thr	N/A	1	2	3
8:19813384_C/T	rs118204077	Missense	p.Arg270Cys	172	0	1	1
8:19813405_G/A	rs118204068	Missense	p.Asp277Asn	249	0	1	1
8:19818446_C/G	rs118204078	Missense	p.Leu392Val	126	1	0	1
Predicted Damaging Missense Variants (n = 38)							
8:19805708_G/C	rs1801177	Missense	p.Asp36His	N/A	2	0	2
8:19805713_C/G	rs374067507	Missense	p.Ile37Met	186	1	0	1
8:19805715_A/G	rs142501489	Missense	p.Glu38Gly	49	1	0	1
8:19805736_C/A	rs143944126	Missense	p.Thr45Asn	N/A	2	0	2
8:19805844_G/A		Missense	p.Gly81Asp	154	0	1	1
8:19809298_A/G		Missense	p.Ser90Gly	N/A	1	1	2
8:19809316_G/C	rs373088068	Missense	p.Val96Leu	N/A	2	3	5
8:19809322_G/A	rs145657341	Missense	p.Ala98Thr	N/A	1	0	1
8:19809335_G/A		Missense	p.Arg102Lys	277	0	1	1

8:19809341_C/G		Missense	p.Pro104Arg	403	1	0	1
8:19809377_G/A		Missense	p.Arg116Gln	392	2	0	2
8:19809403_G/A	rs199675233	Missense	p.Ala125Thr	N/A	2	3	5
8:19809416_A/C	rs140903633	Missense	p.Lys129Thr	89	1	1	2
8:19809425_G/T		Missense	p.Gly132Val	273	0	1	1
8:19810916_A/C		Missense	p.Lys175Asn	N/A	1	0	1
8:19811636_G/C		Missense	p.Asp183His	N/A	0	1	1
8:19811642_G/A		Missense	p.Ala185Thr	112	0	1	1
8:19811678_C/T		Missense	p.Arg197Cys	428	1	0	1
8:19811679_G/A	rs372668179	Missense	p.Arg197His	N/A	1	0	1
8:19811679_G/T	rs372668179	Missense	p.Arg197Leu	829	0	1	1
8:19811711_G/A	rs568397156	Missense	p.Val208Ile	N/A	0	1	1
8:19811720_A/T		Missense	p.Thr211Ser	182	0	1	1
8:19811721_C/A		Missense	p.Thr211Lys	348	1	0	1
8:19811765_C/A		Missense	p.Pro226Thr	163	1	0	1
8:19811774_C/G		Missense	p.His229Asp	N/A	0	2	2
8:19811784_T/G		Missense	p.Ile232Ser	N/A	0	2	2
8:19813371_G/C		Missense	p.Lys265Asn	103	1	0	1
8:19813411_C/G	rs371282890	Missense	p.Leu279Val	250	1	1	2
8:19813438_G/C	rs1800011	Missense	p.Ala288Pro	63	0	1	1
8:19813448_G/T		Missense	p.Cys291Phe	532	0	1	1
8:19813534_G/T		Missense	p.Val320Phe	N/A	2	8	10
8:19816784_A/T		Missense	p.Gln344His	279	1	0	1
8:19816866_G/C		Missense	p.Glu372Gln	N/A	0	1	1
8:19816878_A/T		Missense	p.Ile376Phe	81	1	0	1
8:19818430_T/G		Missense	p.Asn386Lys	85	1	0	1
8:19818435_C/G		Missense	p.Thr388Ser	201	0	1	1
8:19818435_C/T		Missense	p.Thr388Ile	201	2	4	6
8:19818441_C/G	rs141502542	Missense	p.Ser390Cys	136	0	1	1

The carrier counts across coronary artery disease case and control participants of the Myocardial Infarction Genetics Consortium studies are provided for each of 52 *LPL* variants. CHR: Chromosome; POS: Chromosomal positions based on the hg19 build of the human reference genome; REF: Reference allele; ALT: Alternate allele; N/A: Not available.

eTable 3. Baseline Characteristics of Myocardial Infarction Genetics Consortium Cohorts According to Damaging *LPL* Mutation Status

	<i>LPL</i> Mutation Negative (N = 22,436)	<i>LPL</i> Mutation Positive (N = 97)
Age, years	50 (44 – 64)	50 (44 – 59)
Male Gender	16,888 (75%)	75 (78%)
Race		
White	14,162 (63%)	54 (56%)
Black	1,286 (6%)	2 (2%)
South Asian	6,862 (31%)	41 (42%)
Other	126 (0.6%)	0 (0%)
Hypertension	6,626 (44%)	33 (45%)
Diabetes Mellitus	4,109 (22%)	23 (29%)
Current Smoking	6,692 (33%)	36 (41%)
Total Cholesterol, mg/dL	203 (173 – 239)	203 (180 – 236)
LDL Cholesterol, mg/dL	127 (100 – 160)	120 (104 – 149)
HDL Cholesterol, mg/dL	40 (32 – 50)	37 (30 – 42)
Triglycerides, mg/dL	147 (99 – 217)	183 (135 – 274)
Remnant Cholesterol, mg/dL	30 (20 – 43)	37 (26 – 54)
Lipid-lowering Medication	3,198 (17%)	14 (18%)
Coronary Artery Disease	10,078 (45%)	60 (62%)

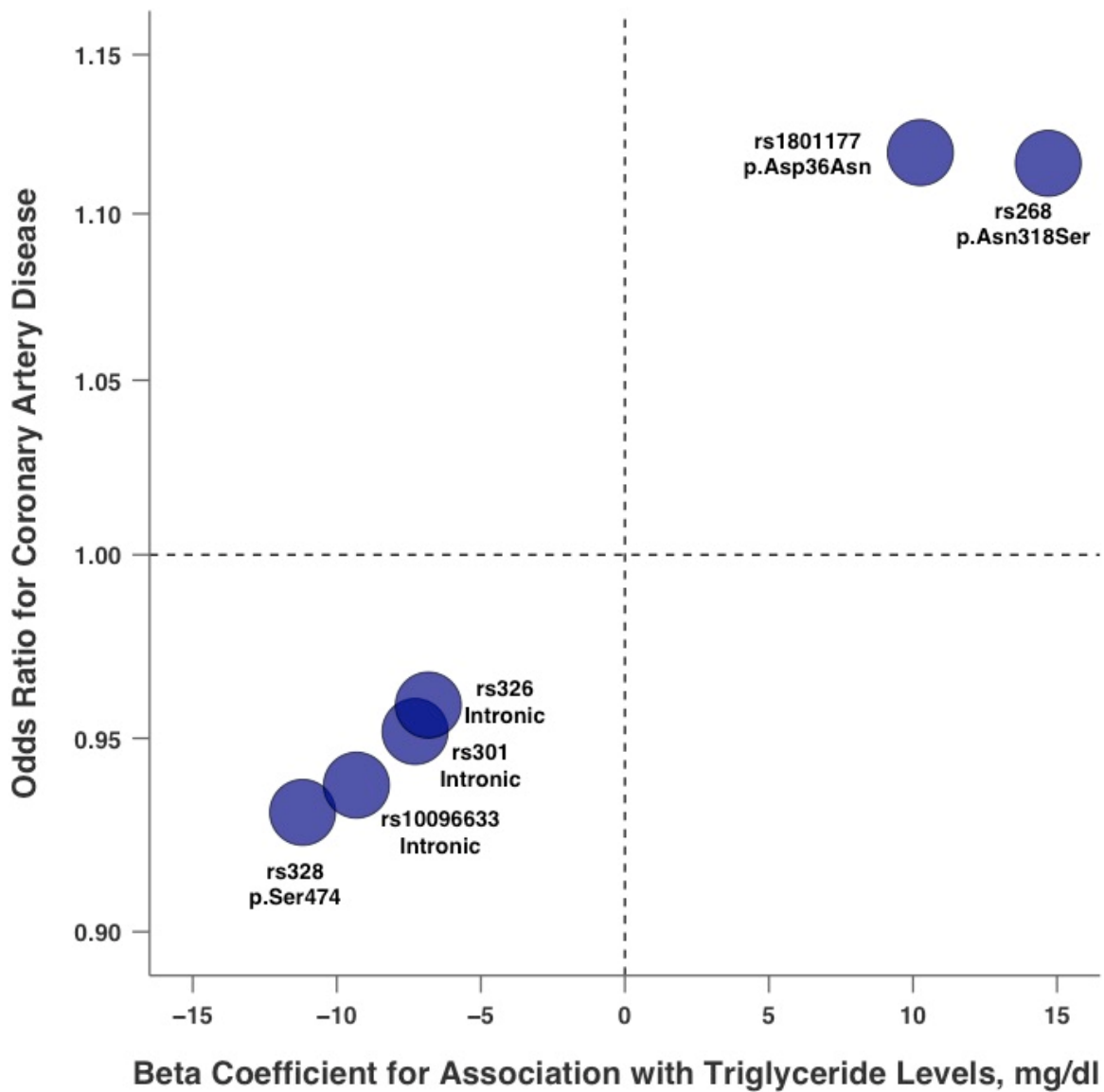
Values represent n (% of individuals with nonmissing data), or median (interquartile range, IQR). SI conversion factor: To convert cholesterol to mmol/L, multiply values by 0.0259. To convert triglyceride levels to mmol/l, multiply values by 0.01129.

eTable 4. Association of Damaging *LPL* Mutations With Circulating Lipids by Rare Variant Class in the Myocardial Infarction Genetics Consortium Studies

Variant Class	Loss of Function	ClinVar Pathogenic	Predicted Damaging Missense	Combined
Beta Coefficient for Association with Total Cholesterol Levels, mg/dL (95% CI)	+ 30.4 (-5.0 – 65.9) P = 0.09	+ 8.1 (-20.9 – 37.1) P = 0.58	- 5.5 (-19.3 – 8.3) P = 0.44	+ 0.7 (-11.1 – 12.5) P = 0.91
Beta Coefficient for Association with LDL Cholesterol Levels, mg/dL (95% CI)	+ 22.5 (-11.0 – 5.6) P = 0.19	+ 6.9 (-18.7 – 32.6) P = 0.60	- 9.3 (-21.8 – 3.3) P = 0.15	- 3.2 (-13.9 – 7.5) P = 0.56
Beta Coefficient for Association with HDL Cholesterol Levels, mg/dL (95% CI)	- 4.0 (-13.0 – 4.9) P = 0.38	- 3.8 (-10.6 – 3.1) P = 0.28	- 3.2 (-6.5 – 0.1) P = 0.06	- 3.4 (-6.2 – -0.6) P = 0.02
Beta Coefficient for Association with Remnant Cholesterol Levels, mg/dL (95% CI)	+ 4.4 (-9.7 – 18.4) P = 0.54	+ 5.7 (-5.1 – 16.4) P = 0.30	+ 5.2 (-7.5 – 10.6) P = 0.05	+ 5.2 (0.7 – 9.8) P = 0.02
Beta Coefficient for Association with Triglyceride Levels, mg/dL (95% CI)	+35.6 (-4.8 – 119.4) P = 0.41	+ 18.2 (-50.3 – 86.7) P = 0.60	+ 25.6 (-7.3 – 58.5) P = 0.13	+ 25.6 (-2.5 – 53.5) P = 0.07

Beta coefficients derived from linear regression analysis that included adjustment for age, age², gender, cohort, and the first five principal components of ancestry. To convert cholesterol to mmol/L, multiply values by 0.0259. To convert triglyceride levels to mmol/L, multiply values by 0.01129.

eFigure. Association of Common Variants in *LPL* With Circulating Triglycerides and Odds of Coronary Artery Disease



Variant rsID	Variant Class	Protein Change	Minor Allele (Frequency)	TG Beta, mg/dl (95%CI)	CAD Odds Ratio (95%CI)	P Value (CAD)
rs1801177	Missense	Asp36Asn	A (1.9%)	10.3 (9.0 – 11.5)	1.12 (1.04 – 1.20)	0.002
rs268	Missense	Asn318Ser	G (2.1%)	14.7 (13.5 – 15.9)	1.12 (1.04 – 1.19)	0.0011
rs301	Intronic	--	C (23%)	-7.3 (-7.7 – -6.9)	0.95 (0.93 – 0.97)	8.7 x10 ⁻⁶
rs326	Intronic	--	G (29%)	-6.8 (-7.2 – -6.5)	0.96 (0.94 – 0.98)	5.0 x10 ⁻⁵
rs328	Premature Stop	Ser474Ter	G (1.0%)	-11.2 (-11.7 – -10.7)	0.93 (0.90 – 0.96)	5.0 x10 ⁻⁶
rs10096633	Intronic	NA	T (13%)	-9.3 (-9.8 – -8.9)	0.94 (0.91 – 0.96)	7.0 x10 ⁻⁶

For each variant, Beta coefficient for normalized triglyceride (TG) levels is plotted against odds ratio for coronary artery disease (CAD). Each of the six variants was an independent predictor of triglyceride concentrations in an analysis of up to 305,699 individuals from 73 cohorts of the Global Lipids Genetics Consortium. These same variants were linked to CAD in up to 120,600 individuals in the CARDIoGRAM Exome Consortium study.⁵*P-value < 5 x 10⁻⁸ for each.

eReferences

1. Atherosclerosis, Thrombosis, and Vascular Biology Italian Study Group. No evidence of association between prothrombotic gene polymorphisms and the development of acute myocardial infarction at a young age. *Circulation* 2003;107:1117-22.
2. Do R, Stitzel NO, Won H-H, et al. Exome sequencing identifies multiple rare alleles at LDLR and APOA5 that confer risk for myocardial infarction. *Nature* 2015;519:102-106.
3. Taylor HA Jr, Wilson JG, Jones DW, et al. Toward resolution of cardiovascular health disparities in African Americans: design and methods of the Jackson Heart Study. *Ethn Dis*. 2005;15(4 Suppl 6):S6-4-17.
4. Samani NJ, Erdmann J, Hall AS, et al. Genomewide association analysis of coronary artery disease. *N Engl J Med*. 2007;357(5):443-53.
5. Myocardial Infarction Genetics and CARDIoGRAM Exome Consortia Investigators. Coding Variation in ANGPTL4, LPL, and SVEP1 and the Risk of Coronary Disease. *N Engl J Med*. 2016;374(12):1134-44.
6. Crosby J, Peloso GM, Auer PL, et al. Loss-of-function mutations in APOC3, triglycerides, and coronary disease. *N Engl J Med*. 2014;371:22-31.
7. McPherson R, Pertsemlidis A, Kavaslar N, et al. A common allele on chromosome 9 associated with coronary heart disease. *Science* 2007;316:1488- 91.
8. Clarke R, Peden JF, Hopewell JC, et al. Genetic variants associated with Lp(a) lipoprotein level and coronary disease. *N Engl J Med*. 2009;361:2518-28.
9. Saleheen D, Zaidi M, Rasheed A, et al. The Pakistan Risk of Myocardial Infarction Study: a resource for the study of genetic, lifestyle and other determinants of myocardial infarction in South Asia. *Eur J Epidemiol*. 2009;24:329-38.
10. Sentí M, Tomás M, Marrugat J, Elosua R. Paraoxonase1-192 polymorphism modulates the nonfatal myocardial infarction risk associated with decreased HDLs. *Arterioscler Thromb Vasc Biol*. 2001;21:415- 20.
11. Dewey FE, Gusarova V, O'Dushlaine C, et al. Inactivating Variants in ANGPTL4 and Risk of Coronary Artery Disease. *N Engl J Med*. 2016;374(12):1123-33.

eAppendix. Members of the Myocardial Infarction Genetics Consortium, DiscovEHR Study Group, CARDIoGRAM Exome Consortium, and Global Lipids Genetics Consortium

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Additional information on the DiscovEHR study group is available at: <http://discovehrshare.com>.

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