

## 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. Genetically Informed Ancestry (GIA) and HARE Classification in the Million Veteran Program (MVP)**

		Genetically Informed Ancestry (GIA)					HARE total (not NA)
		AFR	EAS	EUR	AMR	NA	
Harmonized Ancestry and Race/Ethnicity (HARE)	Non-Hispanic Black	122,114	0	0	181	825	122,295
	Asian	2	6,684	32	25	1,586	6,743
	Non-Hispanic White	3	1	456,030	5,650	3,277	461,684
	Hispanic	190	28	485	51,195	285	51,898
	NA	1,019	363	1,173	4,060	3,374	
GIA Total (not NA)		122,309	6,713	456,547	57,051		

\* GIA super populations: AFR = African, EAS = East Asian, EUR = European, AMR = Ad Mixed American

**eTable 1 caption:** Agreement between HARE and GIA classifications were very high (>99%) for all ancestries except the AMR (Ad Mixed American) super population. 5,650 participants from the AMR-ancestry were classified as non-Hispanic White by the HARE algorithm, and a further 4,060 were excluded due to disagreement between self-identified race/ethnicity and GIA.

**eTable 2. Electronic Health Record Codes (ICD-9, ICD-10, CPT/HCPCS) for ASCVD Outcomes**

Outcome	ICD-9 Codes	ICD-10 Codes	CPT/HCPCS Codes
Composite ASCVD	Myocardial Infarction, Ischemic Stroke, or ASCVD Death Codes		
Composite ASCVD and Revascularization	Composite ASCVD, Percutaneous Coronary Intervention, and Coronary Artery Bypass Graft		
Myocardial Infarction	410, 411.0, I21, I22	410, 411.0, I21, I22	
Ischemic Stroke	433.x1, 434 (excluding 434.x0), 436, 437.0, 437.6	I63.xx9, I63.20, I63.22, I63.30, I63.40, I63.50, I63.59, I67.2, I67.6, I67.89	
ASCVD Death		I10, I11, I13, I16, I20-I25, I46, I63, I67, I70, I74, I75, G45	
Percutaneous Coronary Intervention			C9602-C9608, 92920-92921, 92924-92925, 92933-92934, 92937, 92995, 92966, 93540, 93564, 93570, 92928, 92929
Coronary Artery Bypass Graft			C9600-C9608, G8574, 33510-33523, 33533-33536, 33572, excluding 3351F, 3352F, 3353F, 33515

**eTable 3. Baseline Characteristics and ASCVD Events Stratified by Sex**

Baseline Characteristic	Number (%)		
	Total cohort (N = 79,151)	Male (n = 68,503)	Female (n = 10,648)
Follow-up, years, median (5th-95th percentile)	4.3 (0.7-6.9)	4.3 (0.7-6.9)	4.0 (0.5-6.8)
Age, mean (SD), y	57.8 (13.7)	59.3 (13.3)	48.6 (12.6)
<b>Cardiovascular Risk Factors</b>			
Total cholesterol, mean (SD), mg/dL	157.8 (40.6)	157.3 (40.3)	161.4 (42.3)
HDL-C, mean (SD), mg/dL	49.8 (17)	48.6 (16.6)	57.4 (17.4)
LDL-C, mean (SD), mg/dL	109.4 (33.3)	108.6 (33.2)	114.4 (34.1)
Systolic blood pressure, mean (SD), mm Hg	131.3 (13.4)	132.1 (13.2)	125.7 (13.1)
Current smoker	8,435 (10.7)	7,530 (11)	905 (8.5)
Former smoker	47,670 (60.2)	42,705 (62.3)	4,965 (46.6)
Never smoker	23,046 (29.1)	18,268 (26.7)	4,778 (44.9)
Diabetes	17,177 (21.7)	15,643 (22.8)	1,534 (14.4)
<b>Medications</b>			
Blood pressure treatment	36,673 (46.3)	33,365 (48.7)	3,308 (31.1)
<b>No. of events (2011 - 2018)</b>			
Composite ASCVD (%)	5,485 (6.9)	5,175 (7.6)	310 (2.9)
Composite ASCVD and revascularization (%)	6,628 (8.4)	6,265 (9.1)	363 (3.4)
ASCVD Death (%)	867 (1.1)	836 (1.2)	31 (0.3)
Acute ischemic stroke (%)	1,933 (2.4)	1,781 (2.6)	152 (1.4)
Myocardial Infarction (%)	3,186 (4)	3,036 (4.4)	150 (1.4)
<b>Crude Incidence rate / 10k Person Years (2011 - 2018)</b>			
Composite ASCVD (95% CI)	177.7 (173.0-182.5)	193.0 (187.8-198.3)	76.4 (68.2-85.4)
Composite ASCVD and revascularization (95% CI)	216.6 (211.4-221.9)	235.9 (230.1-241.8)	89.7 (80.7-99.5)
ASCVD Death (95% CI)	27.0 (25.2-28.8)	29.9 (27.9-32.0)	7.5 (5.1-10.6)
Acute ischemic stroke (95% CI)	61.0 (58.3-63.8)	64.5 (61.5-67.6)	37.2 (31.5-43.6)
Myocardial Infarction (95% CI)	100.9 (97.4-104.4)	110.5 (106.6-114.5)	36.5 (30.9-42.9)

**eTable 4. Hazard Ratios for MVP Incident ASCVD Events for Low Traditional and Polygenic Risk Scores**

High PRS definition	Hazard Ratio (95% CI)					
	Non-Hispanic White		Non-Hispanic Black		Hispanic	
	Composite ASCVD Events	Polygenic Risk Score	Traditional Risk Score	Polygenic Risk Score	Traditional Risk Score	Polygenic Risk Score
Continuous per SD reduction	0.80 (0.77, 0.82)	0.48 (0.46, 0.50)	0.86 (0.81, 0.91)	0.45 (0.42, 0.48)	0.79 (0.72, 0.88)	0.35 (0.32, 0.40)
Bottom 20%*	0.75 (0.67, 0.84)	0.16 (0.13, 0.20)	0.95 (0.76, 1.19)	0.17 (0.12, 0.25)	0.74 (0.50, 1.10)	N/A
Bottom 10%	0.66 (0.58, 0.76)	0.10 (0.07, 0.14)	0.90 (0.68, 1.18)	N/A	0.76 (0.47, 1.24)	N/A
Bottom 5%	0.64 (0.54, 0.76)	N/A	0.79 (0.55, 1.15)	N/A	N/A	N/A
Bottom 1%	0.61 (0.42, 0.86)	N/A	N/A	N/A	N/A	N/A
Bottom 0.5%	N/A**	N/A	N/A	N/A	N/A	N/A
<b>Myocardial Infarction</b>						
Continuous per SD reduction	0.75 (0.73, 0.78)	0.52 (0.50, 0.54)	0.88 (0.82, 0.94)	0.47 (0.44, 0.51)	0.77 (0.68, 0.87)	0.36 (0.31, 0.41)
Bottom 20%	0.70 (0.61, 0.81)	0.19 (0.15, 0.24)	0.89 (0.67, 1.17)	0.23 (0.15, 0.35)	0.40 (0.25, 0.66)	N/A
Bottom 10%	0.63 (0.53, 0.75)	N/A	0.88 (0.63, 1.23)	N/A	0.52 (0.30, 0.91)	N/A
Bottom 5%	0.60 (0.48, 0.75)	N/A	0.62 (0.39, 0.99)	N/A	N/A	N/A
Bottom 1%	N/A	N/A	N/A	N/A	N/A	N/A
Bottom 0.5%	N/A	N/A	N/A	N/A	N/A	N/A
<b>Ischemic Stroke</b>						
Continuous per SD reduction	0.89 (0.84, 0.94)	0.48 (0.45, 0.52)	0.87 (0.78, 0.96)	0.43 (0.39, 0.48)	0.85 (0.69, 1.04)	0.36 (0.29, 0.44)
Bottom 20%	0.91 (0.72, 1.14)	0.23 (0.16, 0.33)	0.92 (0.63, 1.35)	N/A	0.76 (0.35, 1.63)	N/A
Bottom 10%	0.95 (0.73, 1.24)	N/A	0.75 (0.45, 1.24)	N/A	N/A	N/A
Bottom 5%	0.83 (0.59, 1.16)	N/A	0.97 (0.51, 1.83)	N/A	N/A	N/A
Bottom 1%	N/A	N/A	N/A	N/A	N/A	N/A
Bottom 0.5%	N/A	N/A	N/A	N/A	N/A	N/A
<b>ASCVD Death</b>						
Continuous per SD reduction	0.82 (0.77, 0.88)	0.29 (0.26, 0.32)	0.89 (0.77, 1.03)	0.31 (0.26, 0.37)	0.85 (0.68, 1.07)	0.25 (0.19, 0.34)
Bottom 20%	0.82 (0.62, 1.08)	N/A	0.58 (0.34, 0.99)	N/A	N/A	N/A
Bottom 10%	0.67 (0.48, 0.94)	N/A	0.78 (0.42, 1.44)	N/A	N/A	N/A
Bottom 5%	0.64 (0.42, 0.97)	N/A	N/A	N/A	N/A	N/A
Bottom 1%	N/A	N/A	N/A	N/A	N/A	N/A
Bottom 0.5%	N/A	N/A	N/A	N/A	N/A	N/A

\* Reference group = middle 10% (45th to 55th percentiles) of risk score

\*\* N/A = <10 events in the selected risk group.

**eTable 5. Reclassification of 5-Year Predicted Myocardial Infarction Including Both Statin-Naïve and Statin Users**

Correctly  
Reclassified

Incorrectly  
Reclassified

**A. All participants**

		Traditional x Polygenic Risk Score (GxE) Model		
Events	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		786	186
> 3.75%		146	2360	2506 (72.1)
Total N (%)		932 (26.8)	2546 (73.2)	3478 (100)

		Traditional x Polygenic Risk Score (GxE) Model		
Nonevents	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		18657	1714
> 3.75%		2451	17432	19883 (49.4)
Total N (%)		21108 (52.4)	19146 (47.6)	40254 (100)

**B. Non-Hispanic White**

		Traditional x Polygenic Risk Score (GxE) Model		
Events	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		459	149
> 3.75%		125	1811	1936 (76.1)
Total N (%)		584 (23.0)	1960 (77.0)	2544 (100)

		Traditional x Polygenic Risk Score (GxE) Model		
Nonevents	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		10645	1392
> 3.75%		2111	13248	15359 (56.1)
Total N (%)		12756 (46.6)	14640 (53.4)	27396 (100)

**C. Non-Hispanic Black**

		Traditional x Polygenic Risk Score (GxE) Model		
Events	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		241	23
> 3.75%		14	403	417 (61.2)
Total N (%)		255 (37.4)	426 (62.6)	681 (100)

		Traditional x Polygenic Risk Score (GxE) Model		
Nonevents	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		5668	224
> 3.75%		200	3120	3320 (36.0)
Total N (%)		5868 (63.7)	3344 (36.3)	9212 (100)

**D. Hispanic**

		Traditional x Polygenic Risk Score (GxE) Model		
Events	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		86	14
> 3.75%		7	146	153 (60.5)
Total N (%)		93 (36.8)	160 (63.2)	253 (100)

		Traditional x Polygenic Risk Score (GxE) Model		
Nonevents	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		2344	98
> 3.75%		140	1064	1204 (33.0)
Total N (%)		2484 (68.1)	1162 (31.9)	3646 (100)

**eTable 6. Reclassification of 5-Year Predicted Acute Ischemic Stroke Including Both Statin-Naïve and Statin Users**

Correctly  
Reclassified

Incorrectly  
Reclassified

**A. All participants**

		Traditional x Polygenic Risk Score (GxE) Model		
Events	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		1276	49
> 3.75%		32	239	271 (17.0)
<b>Total N (%)</b>		1308 (82.0)	288 (18.0)	1596 (100)

		Traditional x Polygenic Risk Score (GxE) Model		
Nonevents	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		37290	534
> 3.75%		465	2249	2714 (6.7)
<b>Total N (%)</b>		37755 (93.1)	2783 (6.9)	40538 (100)

**B. Non-Hispanic White**

		Traditional x Polygenic Risk Score (GxE) Model		
Events	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		871	32
> 3.75%		21	124	145 (13.8)
<b>Total N (%)</b>		892 (85.1)	156 (14.9)	1048 (100)

		Traditional x Polygenic Risk Score (GxE) Model		
Nonevents	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		25853	354
> 3.75%		291	1186	1477 (5.3)
<b>Total N (%)</b>		26144 (94.4)	1540 (5.6)	27684 (100)

**C. Non-Hispanic Black**

		Traditional x Polygenic Risk Score (GxE) Model		
Events	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		303	15
> 3.75%		11	106	117 (26.9)
<b>Total N (%)</b>		314 (72.2)	121 (27.8)	435 (100)

		Traditional x Polygenic Risk Score (GxE) Model		
Nonevents	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		7922	164
> 3.75%		157	956	1113 (12.1)
<b>Total N (%)</b>		8079 (87.8)	1120 (12.2)	9199 (100)

**D. Hispanic**

		Traditional x Polygenic Risk Score (GxE) Model		
Events	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		102	2
> 3.75%		0	9	9 (8.0)
<b>Total N (%)</b>		102 (90.3)	11 (9.7)	113 (100)

		Traditional x Polygenic Risk Score (GxE) Model		
Nonevents	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		3515	16
> 3.75%		17	107	124 (3.4)
<b>Total N (%)</b>		3532 (96.6)	123 (3.4)	3655 (100)

**eTable 7. Reclassification of 5-Year Predicted ASCVD Death Including Both Statin-Naïve and Statin Users**

Correctly  
Reclassified

Incorrectly  
Reclassified

**A. All participants**

		Traditional x Polygenic Risk Score (GxE) Model		
Events	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		716	21
> 3.75%		15	172	187 (20.2)
<b>Total N (%)</b>		731 (79.1)	193 (20.9)	924 (100)

		Traditional x Polygenic Risk Score (GxE) Model		
Nonevents	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		38832	256
> 3.75%		249	1602	1851 (4.5)
<b>Total N (%)</b>		39081 (95.5)	1858 (4.5)	40939 (100)

**B. Non-Hispanic White**

		Traditional x Polygenic Risk Score (GxE) Model		
Events	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		508	19
> 3.75%		13	149	162 (23.5)
<b>Total N (%)</b>		521 (75.6)	168 (24.4)	689 (100)

		Traditional x Polygenic Risk Score (GxE) Model		
Nonevents	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		26142	231
> 3.75%		219	1332	1551 (5.6)
<b>Total N (%)</b>		26361 (94.4)	1563 (5.6)	27924 (100)

**C. Non-Hispanic Black**

		Traditional x Polygenic Risk Score (GxE) Model		
Events	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		155	2
> 3.75%		2	15	17 (9.8)
<b>Total N (%)</b>		157 (90.2)	17 (9.8)	174 (100)

		Traditional x Polygenic Risk Score (GxE) Model		
Nonevents	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		9099	18
> 3.75%		23	194	217 (2.3)
<b>Total N (%)</b>		9122 (97.7)	212 (2.3)	9334 (100)

**D. Hispanic**

		Traditional x Polygenic Risk Score (GxE) Model		
Events	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		53	0
> 3.75%		0	8	8 (13.1)
<b>Total N (%)</b>		53 (86.9)	8 (13.1)	61 (100)

		Traditional x Polygenic Risk Score (GxE) Model		
Nonevents	Traditional Model	≤ 3.75%	> 3.75%	Total N (%)
	≤ 3.75%		3591	7
> 3.75%		7	76	83 (2.3)
<b>Total N (%)</b>		3598 (97.7)	83 (2.3)	3681 (100)

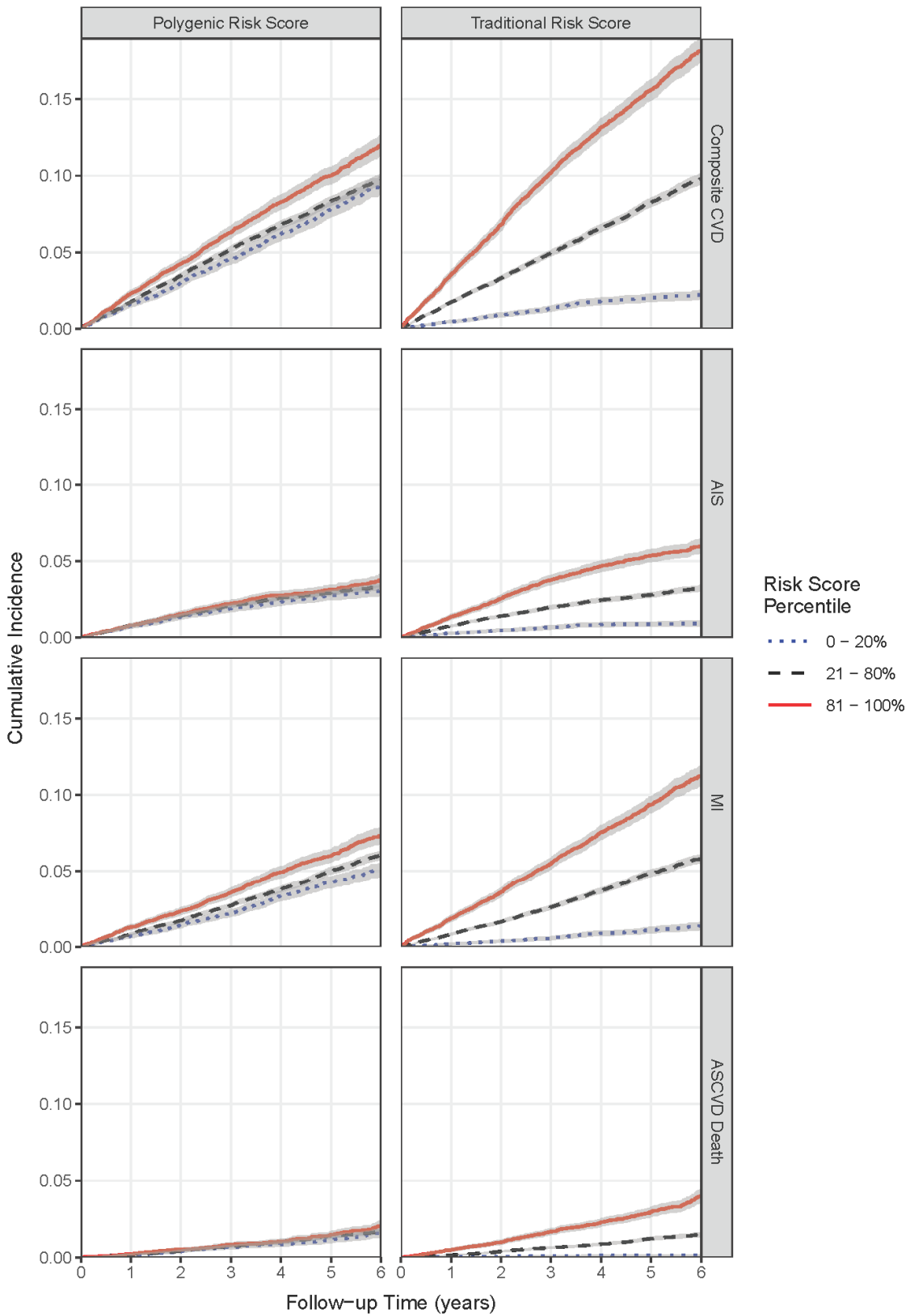


**eTable 8. Net Reclassification Improvement From Inclusion of Polygenic Scores Stratified by Age and Sex**

5-year Risk Group	Subgroup	Net Reclassified		Total N		NRI+	NRI-	NRI [95% CI]
		Event	Non-Event	Event	Non-event			
Intermediate (3.75% - 10%)	Male	-4	110	4731	23856	-0.08%	0.46%	0.38% [0.07%, 0.68%]
	Female	20	-6	287	3450	6.97%	-0.17%	6.79% [3.01%, 10.58%]
	>55 yrs	-6	72	4151	18267	-0.14%	0.39%	0.25% [0.03%, 0.47%]
	40 to 55 yrs	-2	122	777	6526	-0.26%	1.87%	1.61% [-0.07%, 3.30%]
High (≥10%)	Male	62	140	4731	23856	1.31%	0.59%	1.90% [0.97%, 2.82%]
	Female	5	15	287	3450	1.74%	0.43%	2.18% [0.11%, 4.24%]
	>55 yrs	31	194	4151	18267	0.75%	1.06%	1.81% [0.81%, 2.81%]
	40 to 55 yrs	33	-69	777	6526	4.25%	-1.06%	3.19% [1.41%, 4.97%]

eTable 8 contains an abbreviated reclassification table for all ancestries combined. Net reclassified events are the number of events reclassified upwards (into the Intermediate or High risk groups) minus the number of events reclassified downwards. Net reclassified non-events are the number of non-events reclassified downwards minus the number of events reclassified upwards. The traditional model includes age, sex, and 5 principal components of genetic ancestry (to be comparable to the genetic model), and the 5-year risk cutoffs are half the clinically relevant 10-year risk thresholds from the ACC2019 guidelines. Among ASCVD events in the middle-aged subgroup (ages 40 to 55 years), the net proportion of correct reclassifications was  $NRI+ = 33/777 = 4.25\%$ , and among non-events was  $NRI- = -69/6526 = -1.06\%$ . The overall net reclassification index is defined as the sum of the net reclassification proportions for events and nonevents ( $NRI = 4.25\% + -1.06\% = 3.19\%$ ).

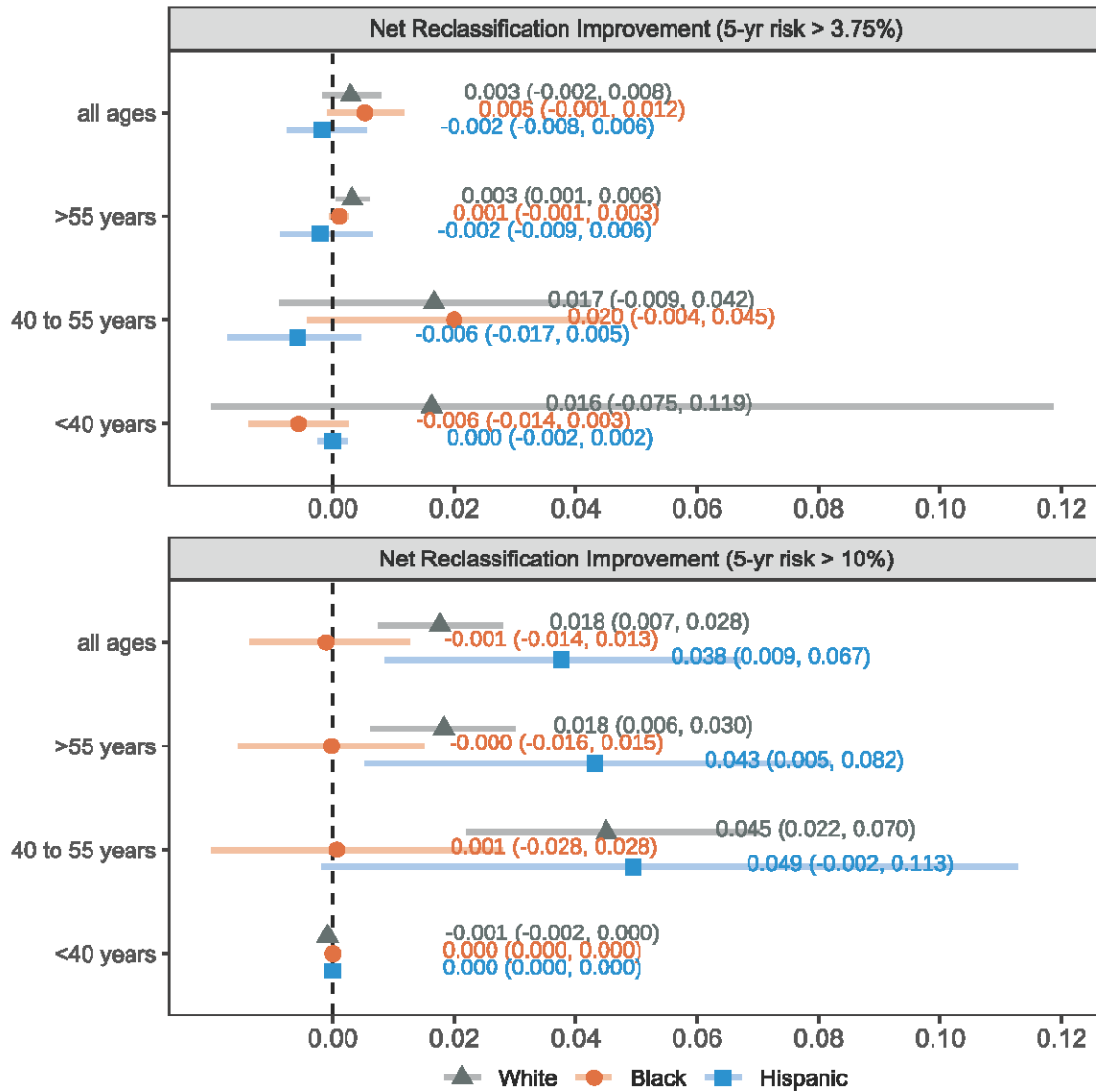
**eFigure 1. Cumulative Incidence of ASCVD Events**



**eFigure 1 caption:** Cumulative incidence of Composite ASCVD, Acute Ischemic Stroke, Myocardial Infarction (MI), and ASCVD Death are plotted over 6 years of follow up according to percentile groups for Polygenic Risk Scores and Traditional Risk Scores.

**Key:** Risk score percentile 0-20% (dotted, blue), 21-80% (dashed, black), 81-100% (solid, red).

**eFigure 2. Categorical Net Reclassification Index for Incident Composite ASCVD Among Statin-Naïve Participants Outcomes Stratified by Age Group**



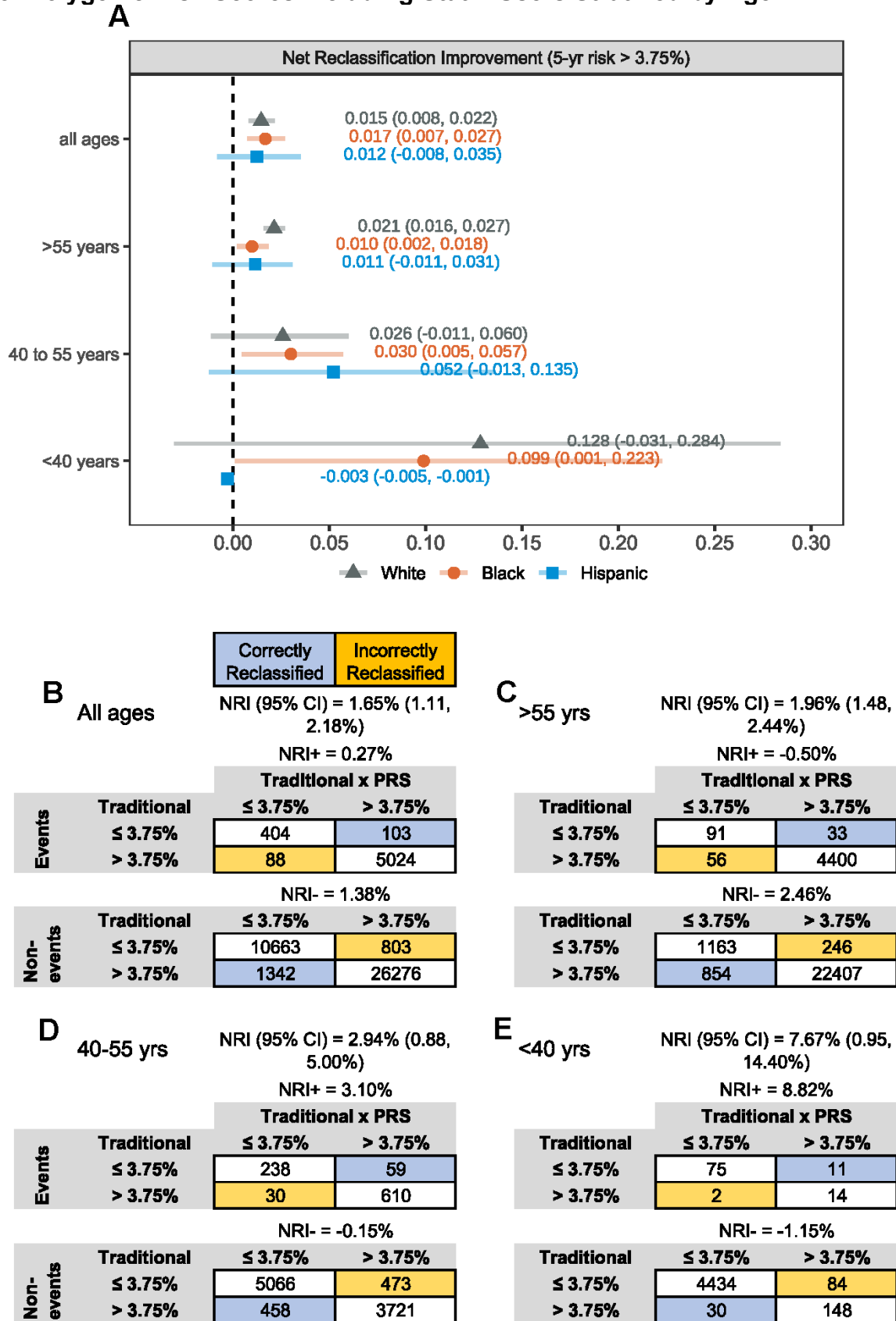
**eFigure 2 caption:**

**Top Panel:** Categorical Net Reclassification Improvement for intermediate risk (5-year risk >3.75%) among statin-naïve patients is shown for Composite ASCVD, Myocardial Infarction, Ischemic Stroke, and ASCVD Death.

**Bottom Panel:** Categorical Net Reclassification Improvement for high risk (5-year risk >10%) among statin-naïve patients is shown for Composite ASCVD, Myocardial Infarction, Ischemic Stroke, and ASCVD Death.

**Key:** Estimates and 95% confidence intervals are shown for White (black, triangle), Black (red, circle), and Hispanic (blue, square) population groups.

**eFigure 3. Net Reclassification Index for Intermediate Risk (5-year risk > 3.75%) From Inclusion of Polygenic Risk Scores Including Statin Users Stratified by Age**

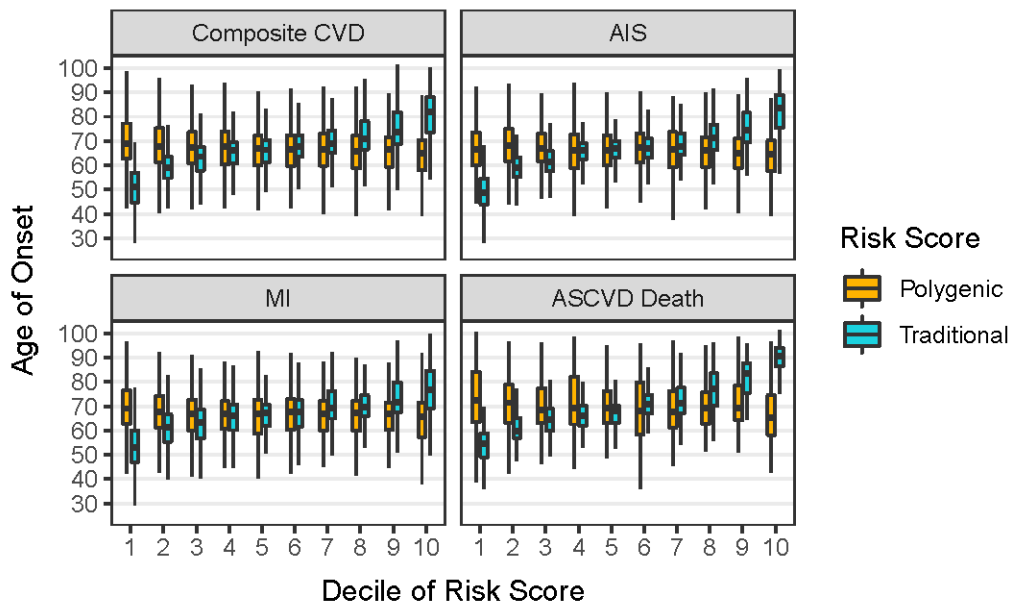


**eFigure 3 caption:** Panel A presents net reclassification improvement (NRI) from the addition of polygenic scores to the traditional risk model for each ASCVD outcome, stratified by ancestry and age group. Panels B to E contain

reclassification tables for all ancestries combined, stratified by age group. Rows refer to predicted 5-year risk categories from the traditional risk model, and columns refer to predicted risk from the combined traditional and polygenic risk score model. Blue cells indicate correct reclassifications: i.e. the GxE model predicted a higher risk group, compared to the traditional model, for a patient who experienced an event, or a lower risk group for a non-event. Orange shaded cells highlight incorrect reclassifications. The traditional model includes age, sex, and 5 principal components of genetic ancestry (to be comparable to the genetic model), and the risk cutoff (>3.75%) represents a clinically relevant 5-year risk. Among ASCVD events in the youngest subgroup (ages < 40, panel E), the net proportion of correct reclassifications was  $NRI+ = (11-2)/102 = 8.82\%$ , and among non-events was  $NRI- = (30-84)/4696 = -1.15\%$ . The overall net reclassification index is defined as the sum of the net reclassification proportions for events and nonevents ( $NRI = 8.82\% + -1.15\% = 7.67\%$ ).

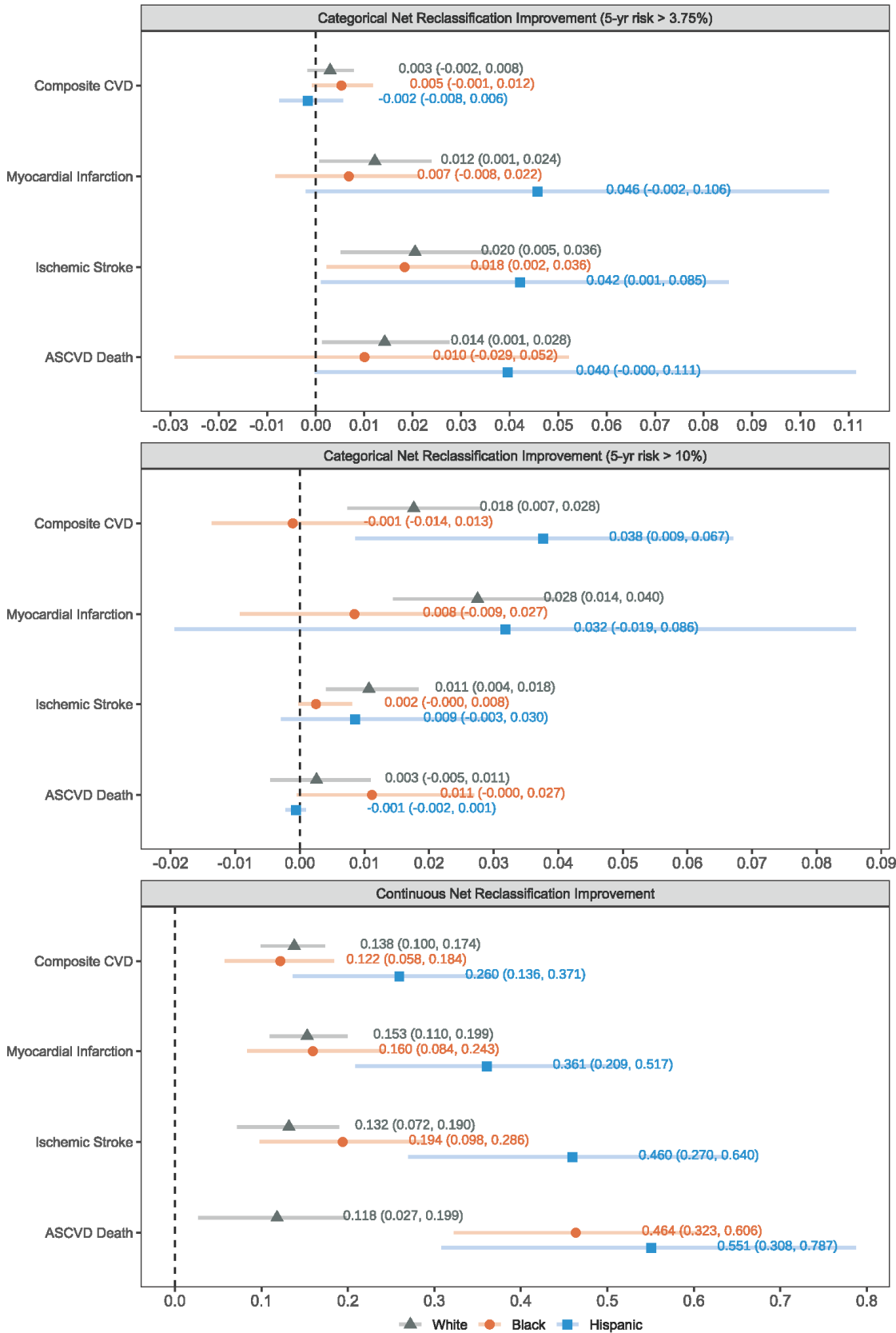
**Key:** Estimates and 95% confidence intervals are shown for White (black, triangle), Black (red, circle), and Hispanic (blue, square) population groups.

### eFigure 4. Age of Onset for Incident Composite ASCVD Events



**eFigure 4 Caption:** Boxplots are shown for the age of onset of incident ASCVD events by decile of traditional and polygenic risk scores. The lower and upper hinges correspond to the first and third quartiles (25<sup>th</sup> and 75<sup>th</sup> percentiles) of age of onset within each risk score decile, while the whiskers extend from the lower (or upper) hinge to the smallest (or largest) observed age that is at most 1.5 times the interquartile range (IQR = 25<sup>th</sup> – 75<sup>th</sup> percentile) away from the box. Median age at incident event increased monotonically across deciles of traditional risk score by approximately 2.8 years per decile for composite ASCVD events, 3.1 years for ischemic stroke, 1.7 years for MI, and 3.9 years for ASCVD death. For composite ASCVD, this translated to a difference of 25 years between median age of onset in the lowest decile (50 years) compared to the top decile (75 years). On the other hand, age of onset decreased slightly across deciles of PRS by approximately 0.3 years per decile for composite ASCVD and 0.4 years per decile for ASCVD death; age of onset was effectively constant at approximately 65 years of age across deciles of PRS for ischemic stroke and MI.

# eFigure 5. Continuous and Categorical Net Reclassification Index for Incident ASCVD Outcomes



eFigure 5 caption:

**Top Panel:** Categorical Net Reclassification Improvement for intermediate risk (5-year risk >3.75%) is shown for Composite ASCVD, Myocardial Infarction, Ischemic Stroke, and ASCVD Death.

**Middle Panel:** Categorical Net Reclassification Improvement for high risk (5-year risk >10%) is shown for Composite ASCVD, Myocardial Infarction, Ischemic Stroke, and ASCVD Death.

**Bottom Panel:** Continuous Net Reclassification Improvement for 5-year risk is shown for Composite ASCVD, Myocardial Infarction, Ischemic Stroke, and ASCVD Death.

**Key:** Estimates and 95% confidence intervals are shown for White (black, triangle), Black (red, circle), and Hispanic (blue, square) population groups.