

Discordance Between Apolipoprotein B (apoB) and LDL-Cholesterol (LDL-C) and Incident Hypertension Risk Among Patients With and Without Type 2 Diabetes (T2D): An Analysis of US Real-World Data

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Introduction

- Apolipoprotein B (ApoB) and low-density lipoprotein cholesterol (LDL-C) are atherogenic lipid markers that can predict the risk of cardiovascular-related outcomes, including hypertension.¹⁻³
- Discordance between ApoB and LDL-C values has been reported in approximately 20% of US adults.⁴
- Recommended in the National Lipid Association guidelines for routine lipid screening inclusion, apoB may be superior to LDL-C in risk assessment.⁵
- Currently, there is a lack of data on the levels of lipid discordance and subsequent cardiovascular-related risk among type 2 diabetes (T2D) patients.

Objective

- To evaluate the levels of discordance between ApoB and LDL-C and the odds of developing hypertension among adults overall and stratified by T2D status using US real-world data.

Methods

- This retrospective cohort study used data from the Veradigm Network EHR linked to claims from Komodo Health to identify adults with an ApoB and LDL-C value within 6 months of each other between January 1, 2017 and August 31, 2022.
- Patients were stratified by having evidence of T2D in baseline vs having no evidence of T2D throughout the study period.
- Level of discordance between ApoB and LDL-C were used to further categorize patients into four mutually exclusive groups using median lab values (ApoB median: 89 mg/dL; LDL-C: 100 mg/dL): ApoB-High/LDL-C-High (concordant high-risk), ApoB-High/LDL-C-Low (discordant high-risk), ApoB-Low/LDL-C-High (discordant low-risk), and ApoB-Low/LDL-C-Low (concordant low-risk).
- Demographics and clinical characteristics (including medication use) were assessed during baseline and cardiovascular event frequencies, including incident hypertension, are described during the 2-year follow-up period.
- Inverse probability treatment weighting⁶ was used to create a weighted study sample with the following variables: age, sex, race, geographic region, BMI, smoking status, systolic BP, T2D in baseline, baseline lipid-lowering medications use, and HDL-C. The final effective sample sizes are described in **Figure 1**. Logistic regression was used to assess the odds of developing incident hypertension and the risk among each cohort.
- Results reported are by discordant risk cohorts in the overall study population (among weighted cohorts) and by T2D status (among pre-weighted cohorts).

Figure 1: Patient Selection

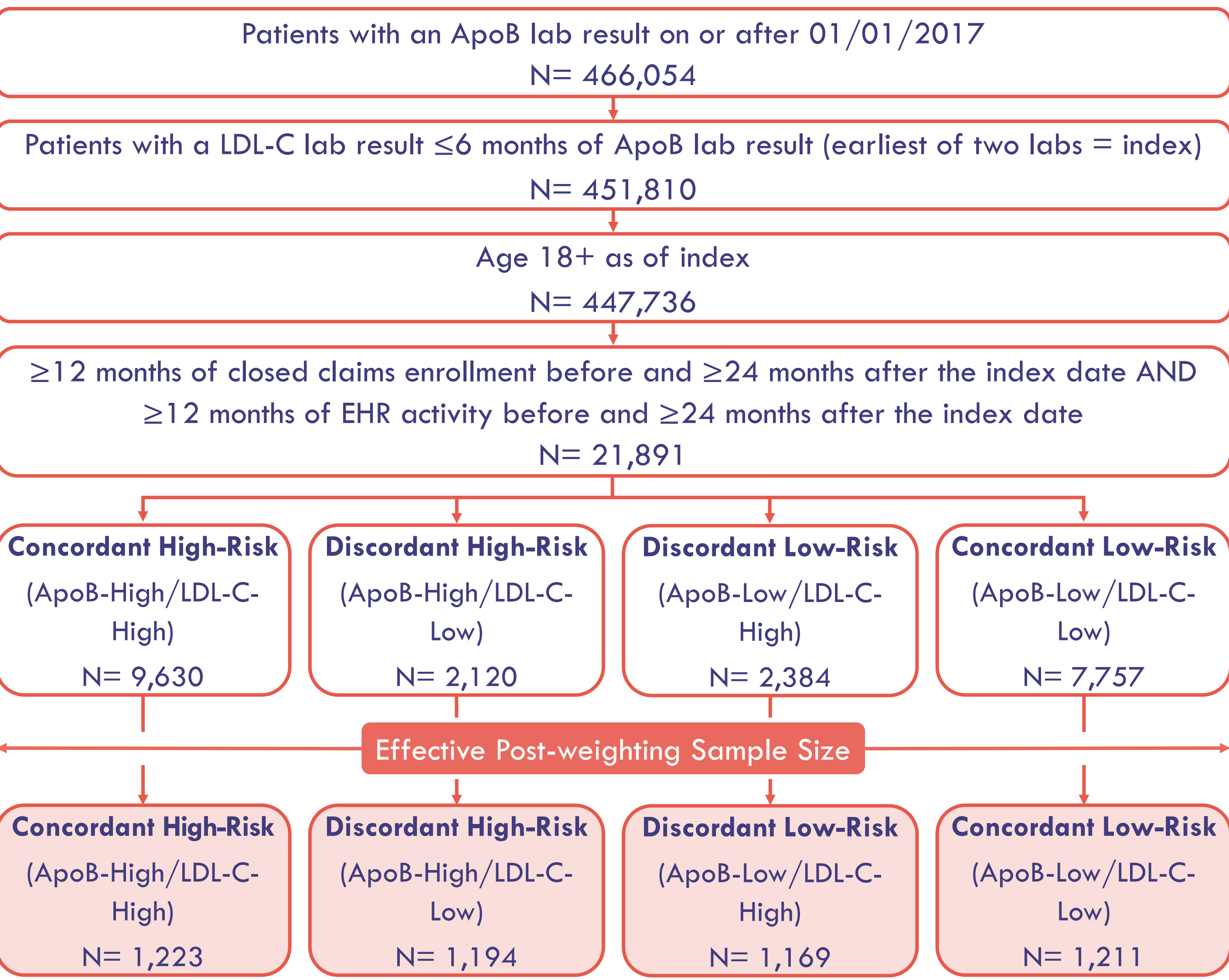


Table 1: Baseline Characteristics by Discordant Risk Cohorts in Overall Population, Weighted Cohorts

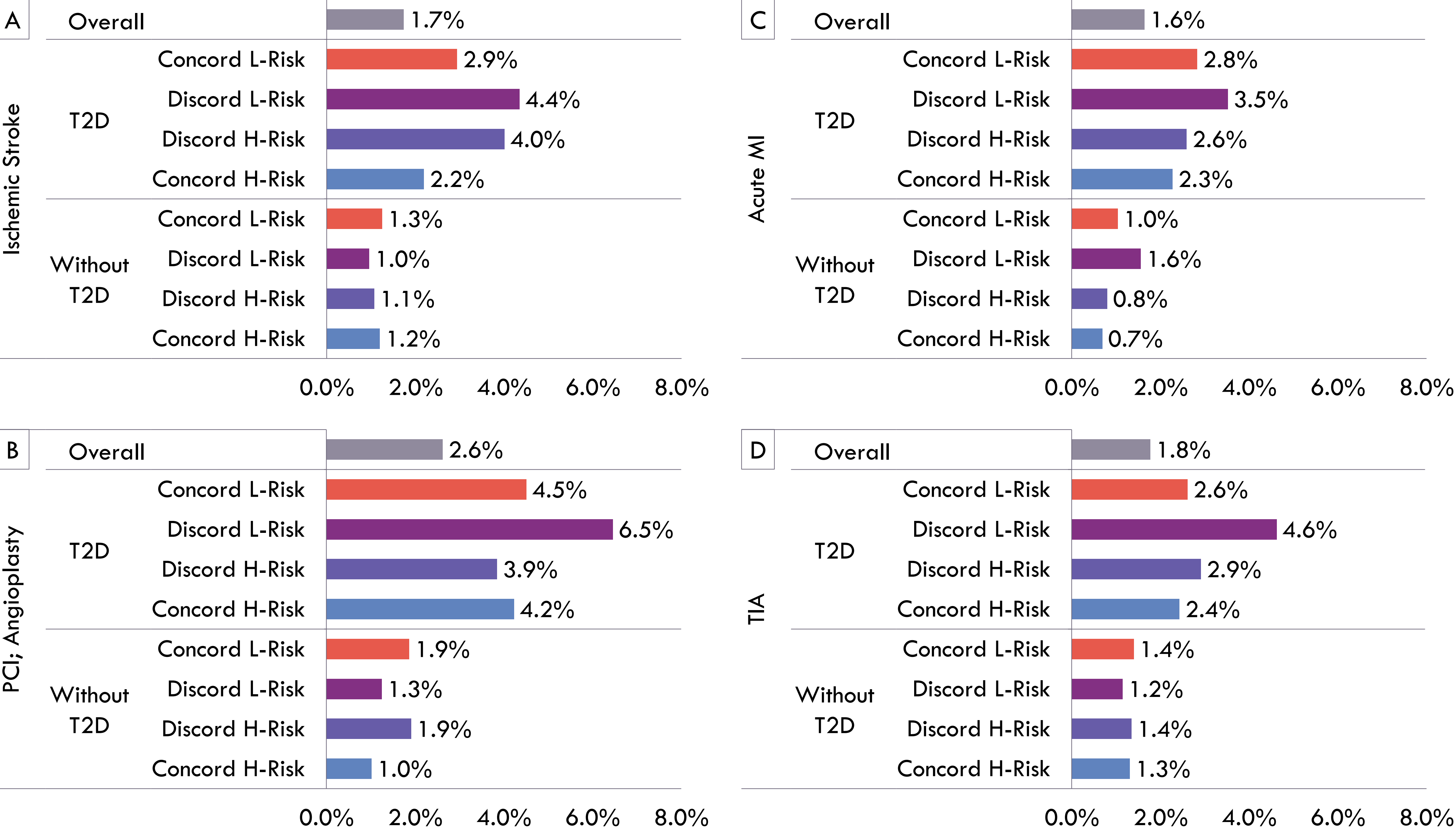
	Concordant High-Risk N= 1,223	Discordant High-Risk N= 1,194	Discordant Low-Risk N= 1,169	Concordant Low-Risk N= 1,211
Age, Mean (SD)	55 (12.0)	56 (13.1)	55 (13.3)	54 (15.4)
Sex, N (%)				
Male	566 (46.3%)	554 (46.4%)	548 (46.9%)	546 (45.1%)
Female	657 (53.7%)	640 (53.6%)	621 (53.1%)	664 (54.9%)
Race, N (%)				
White	822 (67.2%)	812 (68.0%)	787 (67.3%)	807 (66.7%)
Black	109 (8.9%)	105 (8.8%)	100 (8.6%)	107 (8.9%)
Asian	52 (4.2%)	52 (4.4%)	54 (4.6%)	51 (4.2%)
Other	138 (11.3%)	125 (10.5%)	131 (11.2%)	139 (11.5%)
Unknown/Not Reported	102 (8.4%)	100 (8.4%)	98 (8.4%)	107 (8.8%)
Ethnicity, N (%)				
Hispanic	80 (6.5%)	85 (7.1%)	79 (6.7%)	79 (6.5%)
Non-Hispanic or Unknown	1,144 (93.5%)	1,108 (92.9%)	1,090 (93.3%)	1,132 (93.5%)
Geographic Region, N (%)				
Northeast	110 (9.0%)	108 (9.1%)	111 (9.5%)	108 (8.9%)
Midwest	142 (11.6%)	139 (11.6%)	129 (11.1%)	144 (11.9%)
South	618 (50.5%)	605 (50.7%)	598 (51.2%)	610 (50.4%)
West	345 (28.2%)	335 (28.1%)	327 (28.0%)	341 (28.2%)
Unknown/Not Reported	55 (12.0)	56 (13.1)	55 (13.3)	54 (15.4)
BMI, Mean (SD)	29.9 (5.4)	29.8 (5.7)	29.9 (5.7)	29.9 (6.0)
Smoking Status, N (%)				
Current	112 (9.2%)	108 (9.1%)	111 (9.5%)	114 (9.4%)
Former	122 (9.9%)	113 (9.5%)	115 (9.9%)	116 (9.6%)
Never	302 (24.7%)	301 (25.2%)	282 (24.1%)	299 (24.7%)
Unknown/Not Reported	688 (56.2%)	671 (56.2%)	661 (56.6%)	682 (56.3%)
ASCVD Score, Mean (SD)	10.8% (0.13)	10.8% (0.13)	11.6% (0.15)	10.8% (0.15)
Lab/Vital Results, Mean (SD)				
Systolic Blood Pressure	127.5 (16.3)	127.7 (16.3)	127.7 (16.4)	127.4 (16.4)
Diastolic Blood Pressure	78.2 (9.9)	77.8 (9.7)	77.8 (10.0)	77.1 (15.4)
Total Cholesterol	221.5 (38.2)	188.9 (41.2)	194.2 (31.1)	149.6 (25.7)
HDL Cholesterol	51.3 (14.6)	52.0 (17.3)	53.9 (15.7)	51.6 (16.0)

ASCVD, atherosclerotic cardiovascular disease; BMI, body mass index; HDL, high-density lipoprotein; SD, standard deviation.

Results

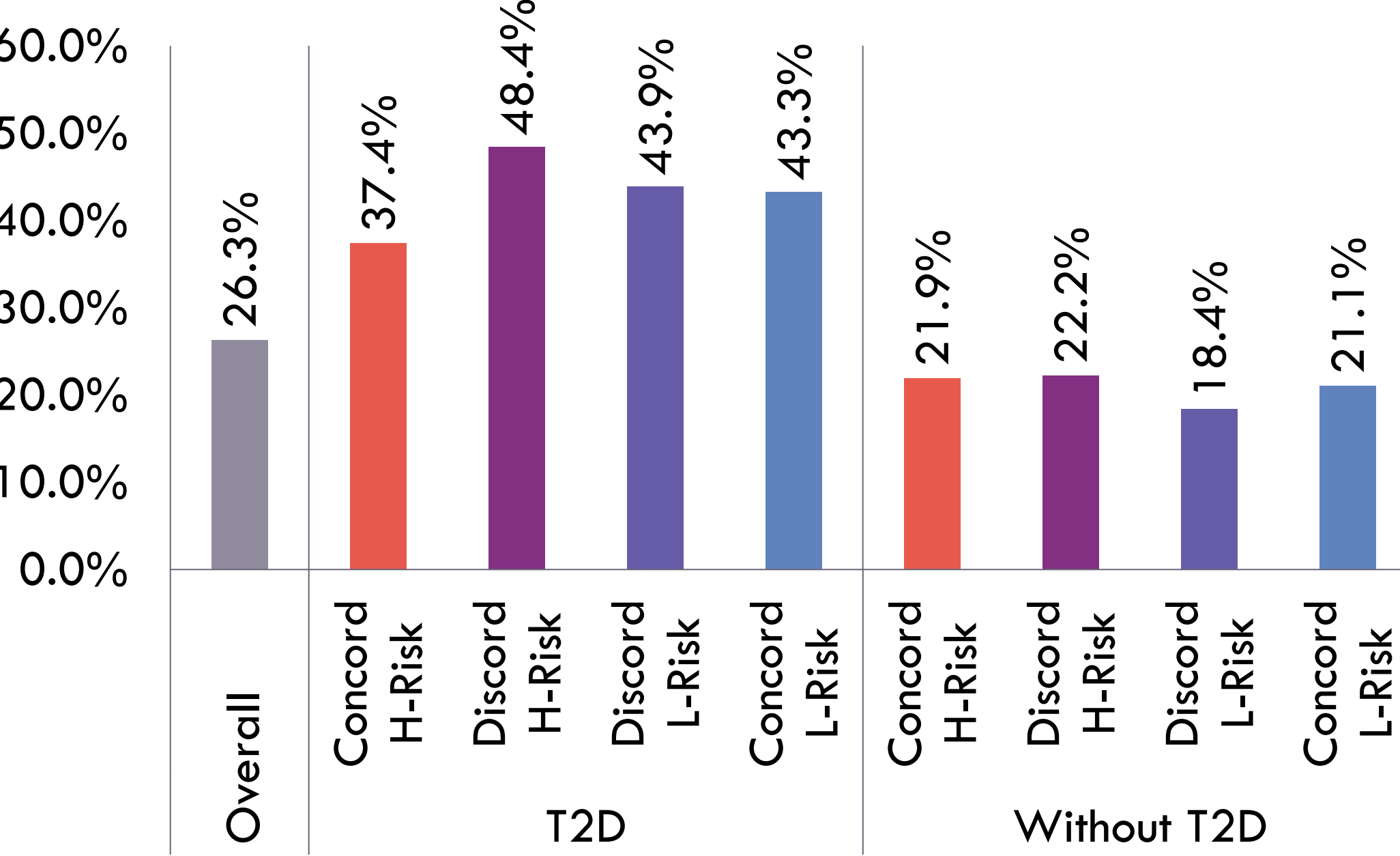
- Of the 5,551 with and 14,549 adults without T2D included, **about 21% were apoB/LDL-C discordant** (pre-weighting).
- Post weighting, 4,797 patients were included in the analysis, where mean (SD) age was 55 (13.5) years, 54% were female, and overall mean (SD) BMI was 29.9 (5.7).
- Baseline ASCVD score was 11% overall; the rate of hypertension was 51.8% overall, and highest among the discordant high-risk group (53.3%).
- Less than half of the overall cohort had evidence of baseline lipid-lowering therapy use (44.3%).
- Over the 24-month follow-up period, the rate of percutaneous coronary intervention (PCI; angioplasty) in the overall cohort was 2.6% (**Figure 2B**) but was highest in the discordant low-risk group (3.2%).
- More than one-fourth of patients overall (26.3%) developed incident hypertension (**Figure 3**), with the highest rate among those with discordant high-risk levels (27.5%).
- When examining the risk of incident hypertension among the overall weighted cohorts (i.e., not stratified by T2D status), ASCVD was an independent predictor of risk, whereas discordance categories did not reach statistical significance (with the exception of the discordant low-risk group, which had slightly decreased odds of developing incident hypertension vs concordant low-risk group) (**Figure 4**).
- Among patients without T2D, baseline lipid-lowering therapy use was associated with increased odds of developing incident hypertension, potentially as a proxy for severity of disease.
- Of those with T2D, the discordant high-risk group trended toward a higher odds of developing hypertension (OR: 1.5, 95% CI: 0.6-3.5).
- Similarly, of those without T2D, the odds of incident hypertension was highest amongst the discordant high-risk cohort (OR: 0.9, 95% CI: 0.6-1.3).

Figure 2: Rate of Incident Cardiovascular-Related Conditions and Procedures in Overall Population and by T2D Status, Follow-Up Period, Weighted Cohorts



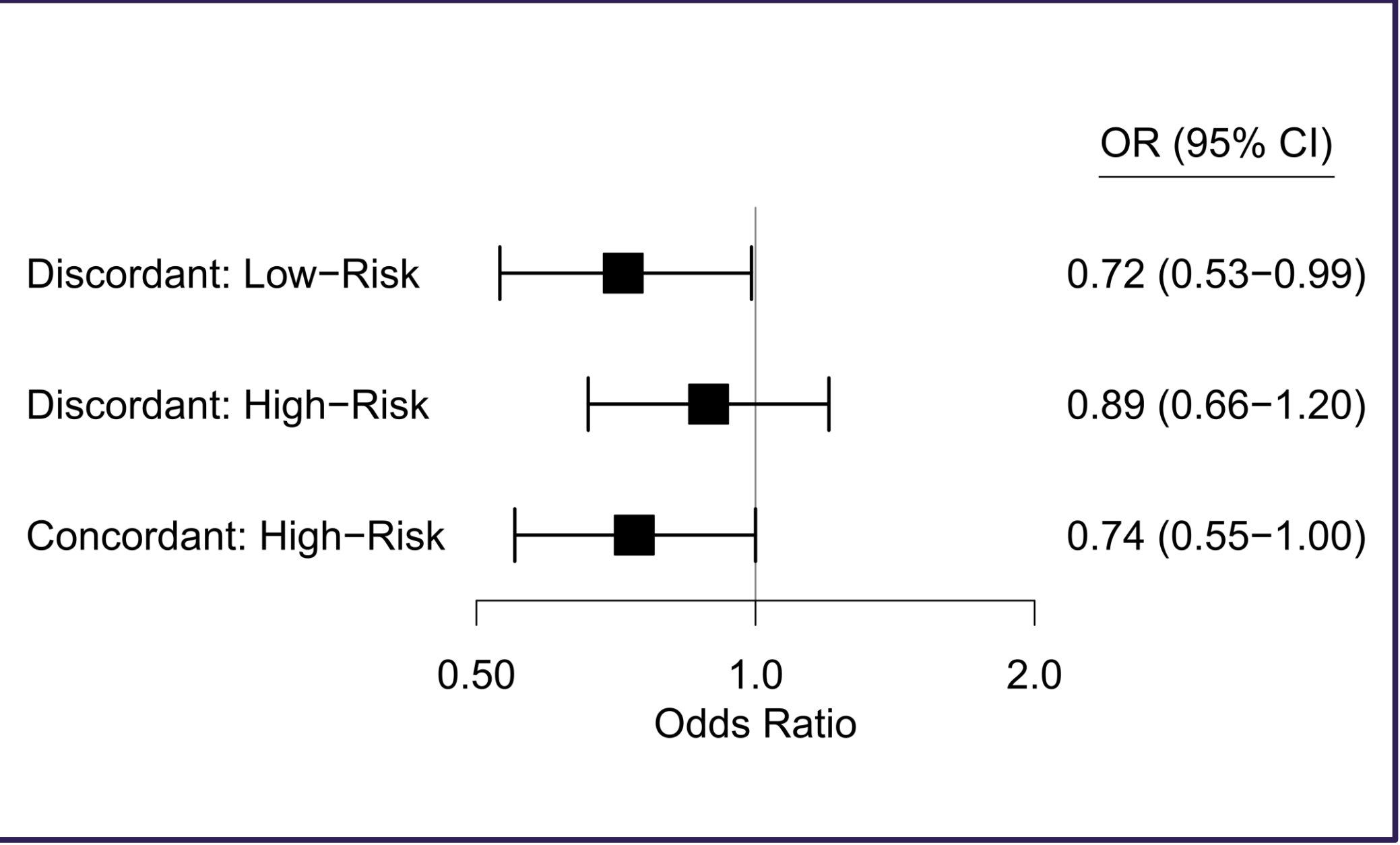
Concord, concordant; Discord, discordant; H-Risk, high-risk; L-Risk, low-risk; MI, myocardial infarction; PCI, percutaneous coronary intervention; T2D, type 2 diabetes; TIA, transient ischemic attack.

Figure 3: Rate of Incident Hypertension in Overall Population and by T2D Status, Follow-Up Period, Weighted Cohorts



Logistic regression model adjusted for age, sex, race, region, smoking status, BMI, systolic BP, ASCVD score, baseline T2D, baseline lipid-lowering medications use, and HDL-C. CI, confidence interval; Concord, concordant; Discord, discordant; H-Risk, high-risk; L-Risk, low-risk; OR, odds ratio; T2D, type 2 diabetes.

Figure 4: Odds of Incident Hypertension in Overall Population, Follow-Up Period, Weighted Cohorts (Ref: Concordant Low-Risk)



Conclusions

- A significant proportion of the US adult population is discordant in their ApoB/LDL-C values.
- In this study, despite a significant rate of baseline cardiovascular disease, less than 50% of patients were on a lipid-lowering therapy.
- Discordant high-risk patients had the highest rate of incident hypertension over a 2-year follow-up period overall (28%) and especially among patients with T2D (48%).
- Our study suggests that ApoB provides a more accurate picture of the atherogenic lipid burden when compared to LDL-C, especially when LDL-C appears “normal” and current standard screening protocols can often miss this important subset of the population.

References

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Disclosures

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