The Economic Burden of Insulin Resistance, Obesity, and Cardiovascular Disease in Medicare Beneficiaries 65 Years of Age and Older

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Introduction

- Insulin resistance (IR) is thought to be a common pathogenic driver of cardiovascular disease (CVD) in patients with Type 2 Diabetes Mellitus (T2DM), metabolic syndrome (MetS) and nonalcoholic fatty liver disease (NAFLD)¹⁻⁴
- Obesity is also associated with increased CVD and increased medical costs independent of features of apparent IR⁵⁻⁸
- T2DM medical costs are well studied, but medical costs and CVD rates in patients with both IR and obesity are not well understood

Objective

• Evaluate CVD and medical costs in patients with IR and estimate the additional impact of obesity on CVD and medical costs

Methods

Data Source and Study Patients

- Data Source: Medicare Limited Data Set for 2013 and 2014, which contains demographic data and medical claims for a random sample of 5% of Medicare beneficiaries
- Study Design: Retrospective cohort study
- Study inclusion requirements
- ≥65 years of age Continuously enrolled in Medicare Fee-for-Service over the 24-month observation period (1/1/2013 – 12/31/2014)
- Study patients
- We used International Classification of Diseases, Ninth Revision (ICD-9) diagnosis codes to identify patients with IR conditions, which were T2DM, NAFLD, and/or a composite of hypertension, hyperlipidemia/hypertriglyceridemia and obesity (Table 1) We compared patients with IR to patients without IR, who had no evidence
- of these conditions
- We used ICD-9 diagnosis codes to identify patients with obesity, whether or not they also had IR (Table 1)

Table 1. Clinical Codes Used to Identify IR, Obesity, CVD and CVD Procedures

Condition	Definition	
Insulin Resistance Conditions		
T2DM*	ICD-9: 250.x0, 250.x2	
NAFLD	ICD-9: 571.8	
Metabolic Syndrome (dx)	ICD-9: 277.7	
Hypertriglyceridemia/ Hyperlipidemia	Hypertension* ICD-9: 401.x; 402.x-405.x*; Hypertriglyceridemia/Hyperlipidemia* ICD-9: 272.0, 272.1, 272.2, 272.4, 272.8, 272*	
Obesity	ICD-9: 278.x	
CVD and CVD Procedures		
AMI	ICD-9: 410.x	
Atherosclerosis	ICD-9: 414.0x	
Angina (stable or unstable)	ICD-9: 411.1, 411.81, 411.89, 413.x, 413.0, 413.1, 413.9	
Atrial Fibrillation	ICD-9: 427.31, 427.32	
Congestive Heart Failure	ICD-9: 427.31, 427.32	
Heart Transplant	ICD-9 (procedure): 37.51, 37.52, 37.53, 37.54, 37.55 or CPT 33945	
PCI	ICD-9 (procedure): 00.66, 36.01, 36.02, 36.03, 36.04, 36.06, 36.07, 36.09, 36.34 or CPT/HCPCS: or CPT: 92920, 92921, 92924, 92925, 92928, 92929, 92933, 92934, 92937, 92938, 92941, 92943, 92944, 92980-92984, 92986, 92987, 92990, 92995-92998	
CABG	ICD-9 (procedure): 36.10, 36.11, 36.12, 36.13, 36.14, 36.15, 36.16, 36.17, 36.19, 36.2 or CPT: 33510 to 33523; 33533 to 33536; 33545-33548	

*At least 2 diagnoses on separate days or (T2DM only) 1 inpatient diagnosis; patients with hypertension and hypertriglyceridemia/hyperlipidemia but no obesity were considered non-IR AMI: Acute Myocardial Infarction; PCI: Percutaneous Coronary Intervention; CABG: Coronary Artery Bypass Procedure

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Study Measures

- Patient age, sex, illness burden and cardiovascular comorbidities were identified in the first study year
- Total illness burden was assessed using the Charlson Comorbidity Index (CCI), which
 is a predictor of one-year mortality and a commonly used measure of illness burden CVD comorbidities were identified using ICD-9 codes (Table 1)
- CVD rates were identified in the first study year
- Rates of AMI, CVD procedures, hospitalizations and Centers for Medicare and Medicaid Services (CMS) expenditures were identified in the second study year using diagnosis and procedure codes (Table 1)
- Significance of differences, relative to patients without IR, was assessed using two-tailed

Results

Demographics and Health Status

- IR and non-IR patients were similar in age, but significantly more IR patients were male, more were black, and more were from the South (all P < 0.0001)
- Obesity rates were nearly 8 times higher in IR patients (24.1% vs. 3.1%; P < 0.0001)
- IR patients also had a significantly greater illness burden, as measured by the CCI
- Rates of any CVD were 1.5 times higher for IR patients, compared to non-IR (P < 0.0001)

Table 2. Patient Demographics, Health Status and CVD Rates

	Patients without Insulin Resistance	Patients with Insulin Resistance*
AGE (Mean, SD)	75.9 (7.59)	75.3 (7.09)
Female (%)	59.4%	54.4%
Geographic Region		
Northeast (%)	18.5%	18.8%
Midwest (%)	23.1%	23.3%
South (%)	39.4%	41.6%
West (%)	18.7%	16.0%
Race		
White (%)	89.3%	82.3%
Black (%)	5.8%	10.7%
Asian (%)	1.5%	2.1%
Hispanic (%)	1.1%	2.0%
CCI (Mean, SD)	1.00 (1.5)	2.0 (2.0)
Obesity (%)	3.1%	24.1%
Any Cardiovascular Disorder (%)	36.0%	55.5%

* All measures are significantly different for IR, compared to non-IR, at P < 0.0001, except for Midwest (which is not significant at P < 0.05)

CVD, AMI and CVD Procedures in Patients with Obesity

- Among obese patients, CVD rates were 1.7 times higher in those with IR (Figure 1a)
- Rates of any CVD, specific CVD conditions, AMI and CVD procedures were significantly higher in obese IR patients, compared to obese non-IR
- Rates of angina and diastolic heart failure were over 3 times higher (Figure 1a) • Rates of Congestive Heart Failure, were nearly twice as high (Figure 1a)
- Rates of AMI were 2.6 times higher (Figure 1b)
- Rates of CABG and PCI were 3 and 3.6 times higher, respectively (Figure 1b)

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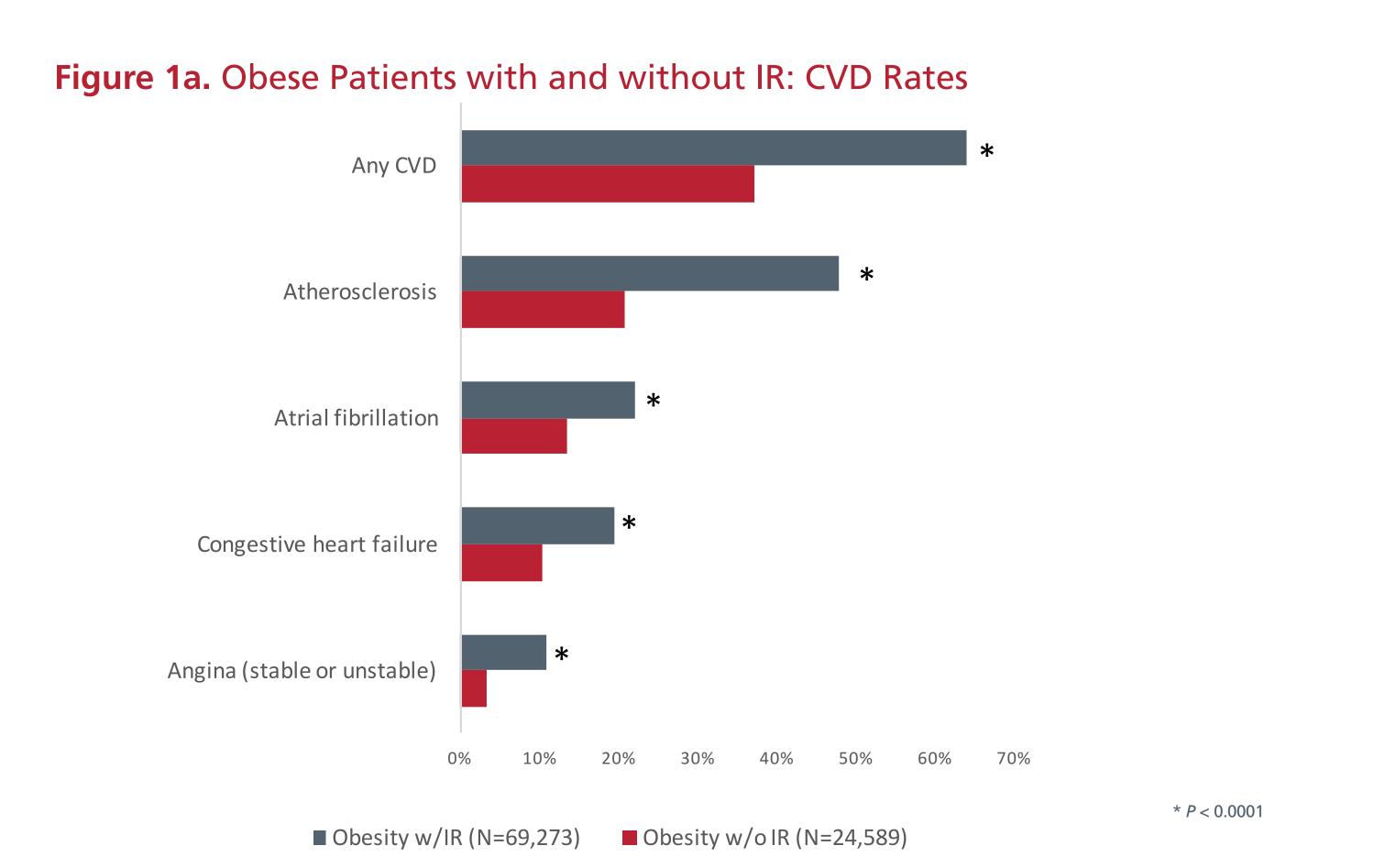
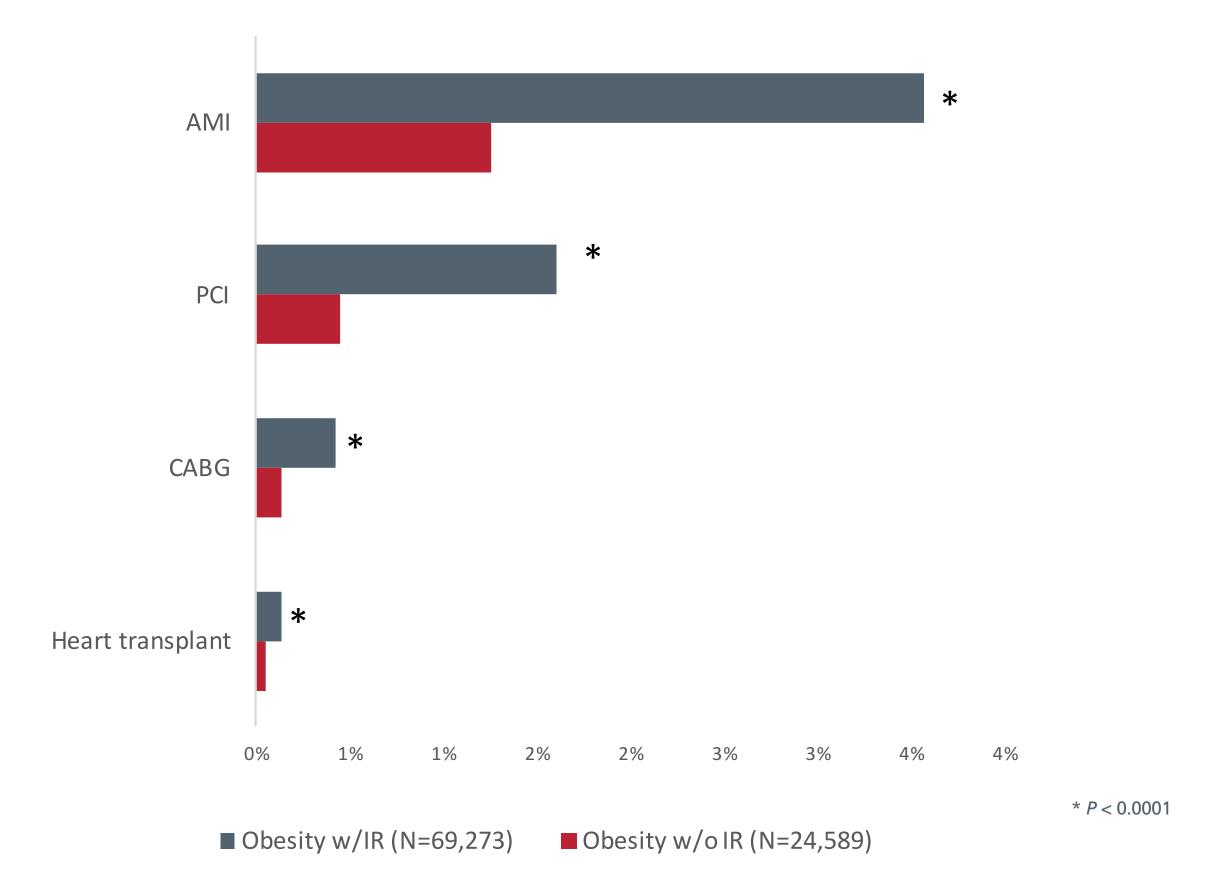


Figure 1b. Obese Patients with and without IR: AMI and CVD Procedure Rates



Hospitalizations and Medical Expenditures

- Hospitalization rates were nearly twice as high for IR patients, compared to non-IR (0.45 vs. 0.25; P < 0.0001), with highest rates for obese IR (Figure 2)
- Medical expenditures for IR patients were 1.6 times higher, compared to non-IR (\$12,724 vs. \$8,015 per patient; P < 0.0001), with highest spending for obese IR (Figure 3)
- Higher spending rates reflected significantly greater expenditures for hospitalizations, outpatient services and skilled nursing facility stays, with highest spending for obese IR in each setting (Figure 3; *P* < 0.0001)
- Among non-IR patients, hospitalization rates were 1.25 times higher and expenditures 1.3 times higher for obese patients, compared to non-obese (Figures 2 and 3; All P < 0.0001)

Figure 2. Hospitalization Rates

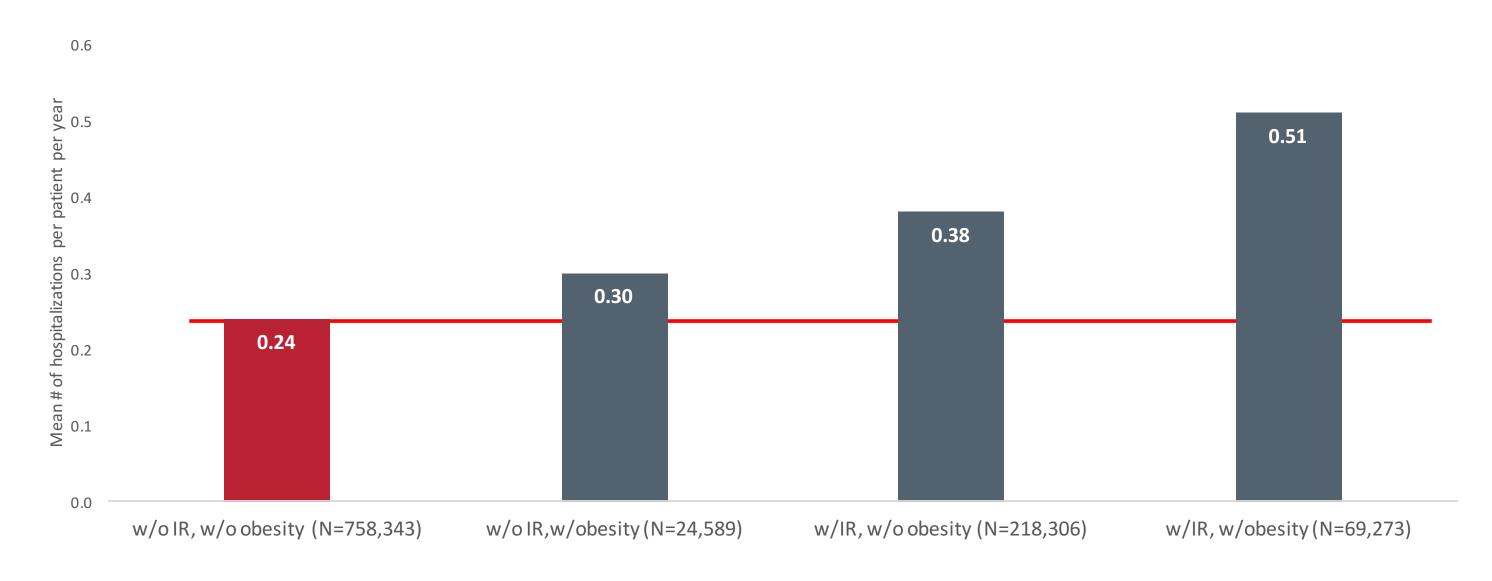
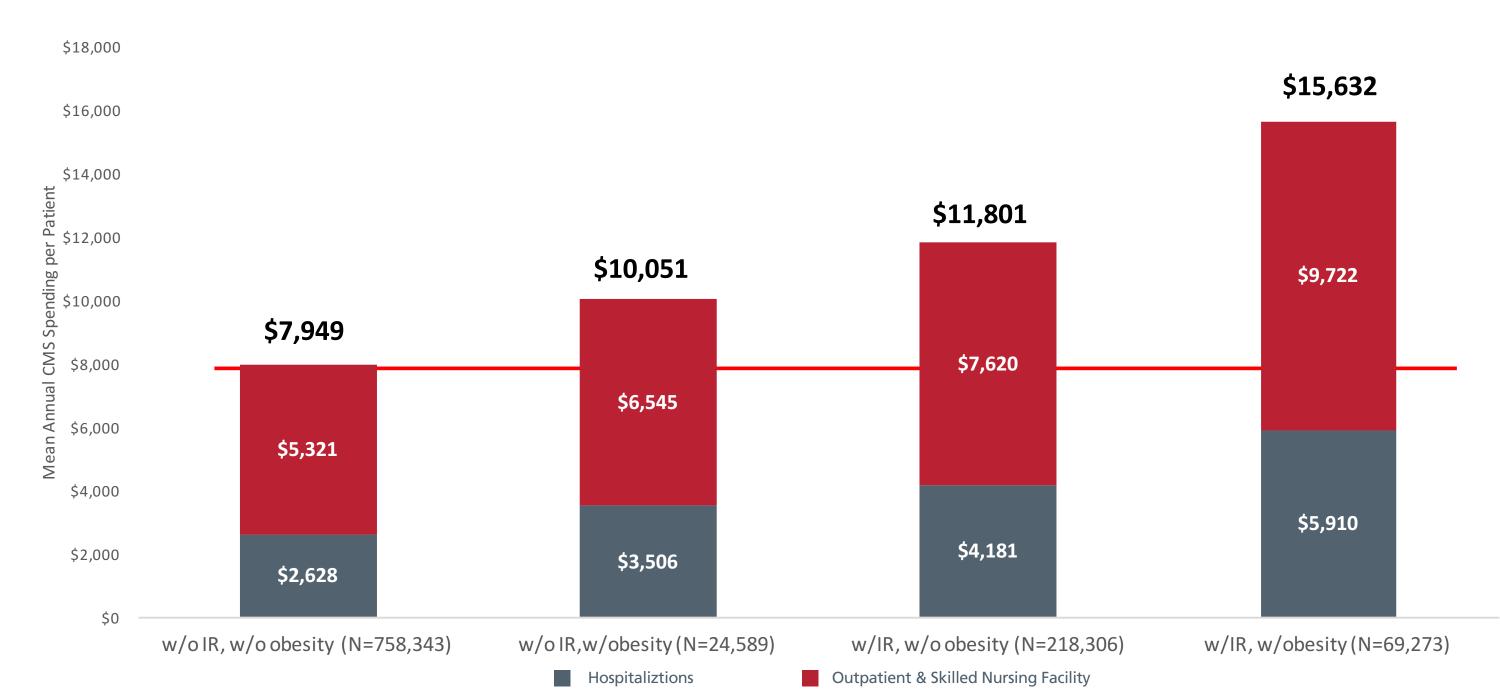


Figure 3. Medicare Spending



Limitations

- Our use of insurance claims to identify patients with IR conditions and obesity relies on the accuracy of diagnosis codes recorded in these data
- Obesity may be under-coded and it is possible that a larger proportion of IR patients are obese • This study of elderly Medicare Fee-for-Service patients may not be generalizable to Medicaid, commercially insured patients, or patients outside the U.S.
- Prescription medication costs are excluded from our estimates of spending
- The longitudinal effects of IR on CVD and medical expenditures will be greater than observed over the limited timeframe of our study

Conclusions

- Rates of CVD, CVD procedures and AMI are significantly higher in IR patients, compared to non-IR
- Among obese patients, those with IR have significantly higher rates of CVD, AMI and CVD procedures, suggesting the exacerbating effect of obesity on cardiovascular disease
- Medical expenditures and hospitalization rates are also significantly higher in IR patients, compared to non-IR, and are highest among obese IR patients
- The cost differential between IR and non-IR highlights the importance of addressing the mechanisms, diagnosis, and directed treatment of insulin resistance, in addition to addressing its effects on end organs
- Insulin resistance may be under-diagnosed in claims data, suggesting that the CVD and economic burden of IR may be even highers

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DISCLOSURES

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