

# Racial/ethnic differences in obesity and comorbidities between safety-net- and non safety-net integrated health systems

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## Abstract

Previous research shows that patients in integrated health systems experience fewer racial disparities compared with more traditional healthcare systems. Little is known about patterns of racial/ethnic disparities between safety-net and non safety-net integrated health systems.

We evaluated racial/ethnic differences in body mass index (BMI) and the Charlson comorbidity index from 3 non safety-net- and 1 safety-net integrated health systems in a cross-sectional study. Multinomial logistic regression modeled comorbidity and BMI on race/ethnicity and health care system type adjusting for age, sex, insurance, and zip-code-level income

The study included 1.38 million patients. Higher proportions of safety-net versus non safety-net patients had comorbidity score of 3+ (11.1% vs. 5.0%) and BMI  $\geq 35$  (27.7% vs. 15.8%). In both types of systems, blacks and Hispanics were more likely than whites to have higher BMIs. Whites were more likely than blacks or Hispanics to have higher comorbidity scores in a safety net system, but less likely to have higher scores in the non safety-nets. The odds of comorbidity score 3+ and BMI 35+ in blacks relative to whites were significantly lower in safety-net than in non safety-net settings.

Racial/ethnic differences were present within both safety-net and non safety-net integrated health systems, but patterns differed. Understanding patterns of racial/ethnic differences in health outcomes in safety-net and non safety-net integrated health systems is important to tailor interventions to eliminate racial/ethnic disparities in health and health care.

**Abbreviations:** Asian/PI = Asian/Pacific Islander, BMI = Body Mass Index, EMR = electronic medical record, KPNC = Kaiser Permanente Northern California, KPSC = Kaiser Permanente Southern California, NH = non-Hispanic, OR = odds ratio, PROSPR = population-based research optimizing screening through personalized regimens, UTSW = University of Texas-Southwestern Medical Center.

**Keywords:** body mass index, comorbidity, disparities, integrated health system, race/ethnicity

## 1. Introduction

Integrated health systems are considered optimal for population-based health management because they can provide comprehensive care to a defined population through a network of primary, specialty, and tertiary care providers, all sharing a common

electronic medical record (EMR).<sup>[1,2]</sup> In the United States, safety-net health systems deliver care to under- or uninsured, publicly insured, and other vulnerable populations.<sup>[3]</sup> Although there is some evidence that patients in non safety-net integrated systems such as Group Health, Geisinger Health System, and Kaiser Permanente experience fewer racial disparities compared to their

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counterparts in more traditional healthcare systems,<sup>[4]</sup> we know little about whether there are racial/ethnic disparities in integrated safety-net systems. The aim of this study is to examine how body mass index (BMI) and comorbidity burden—2 indicators of poor health status<sup>[5–11]</sup>—vary by race/ethnicity in safety-net and non safety-net integrated systems in the United States. To do this, we leveraged existing standardized multicenter data from the National Cancer Institute-funded Population-based Research Optimizing Screening through Personalized Regimens (PROSPR) consortium,<sup>[12,13]</sup> which includes clinical data on >1 million patients receiving care in integrated health systems.

## 2. Methods

### 2.1. Setting

PROSPR focuses on understanding and improving the colorectal cancer screening processes of care in diverse community healthcare settings and has been described previously.<sup>[12]</sup> This study includes data from 4 integrated healthcare delivery systems: 1 safety-net health system—Parkland Health & Hospital System/University of Texas-Southwestern Medical Center (Parkland-UTSW), and 3 non safety-net health systems—Group Health; Kaiser Permanente Northern California (KPNC) and Kaiser Permanente Southern California (KPSC). Institutional Review Boards of all participating organizations approved this study. All research teams contributed common, deidentifiable data to Fred Hutchinson Cancer Research Seattle (PROSPR statistical coordinating center). Data will be made publicly available in a data repository at the conclusion of the PROSPR study.

### 2.2. Study sample

We included men and women ages 50 to 63 years who were members of the PROSPR cohort between January 1, 2010 and December 31, 2012. For Group Health, KPNC, and KPSC, individuals were cohort-eligible if they were enrolled in the healthcare systems on or after January 1, 2010. However, because safety-net systems do not have enrolled members but rather provide services to under- and uninsured individuals who present for care, Parkland-UTSW cohort-eligible individuals were Dallas county residents with a primary care visit by January 1, 2010. Because PROSPR focused on understanding the colorectal cancer screening process, patients with a known history of partial or total colectomy, or a personal history of colorectal cancer, were excluded from the cohort.

### 2.3. Key measures

Data were obtained from administrative and clinical data sources, including the electronic health record. Dependent variables included two available health status indicators - BMI and comorbidity burden. BMI was calculated from height and weight obtained at time of patients' cohort entry. Comorbidity was measured with the Charlson score<sup>[14–16]</sup> by implementing a standardized electronic algorithm using a coding scheme<sup>[17]</sup> to identify ICD-9-CM codes for comorbid conditions associated with inpatient and outpatient care episodes during calendar year 2010. We created 4 categories of the Charlson score (0, 1, 2, and 3+), with higher scores representing greater illness burden. Independent variables were race/ethnicity (white non-Hispanic, black non-Hispanic, Asian/Pacific Islander non-Hispanic, or Hispanic) and health care system type (safety-net, non safety-net).

Covariates included age, sex, health insurance payer, and zip-code-level median household income.

### 2.4. Statistical analyses

We used descriptive statistics to characterize patients' demographic characteristics (age, sex, race/ethnicity, zip-code-level median income, insurance payer) and their BMI and comorbidity burden. Analyses excluded individuals with missing or unknown covariate values. We fit separate multinomial logistic regression models for safety-net and non safety-net systems to assess associations of race/ethnicity with BMI and comorbidity while adjusting for age, sex, insurance payer, and income. These models were used to estimate race/ethnicity-specific probabilities of a patient having each level of BMI or comorbidity separately within each type of system.<sup>[18]</sup> We also evaluated the interaction between race/ethnicity and type of integrated health system (non safety-net vs. safety-net) on outcomes. In a post-hoc analysis, we re-fit models after restricting the study sample to Medicaid patients. All analyses used SAS version 9.3 and R 3.2.0.<sup>[19,20]</sup>

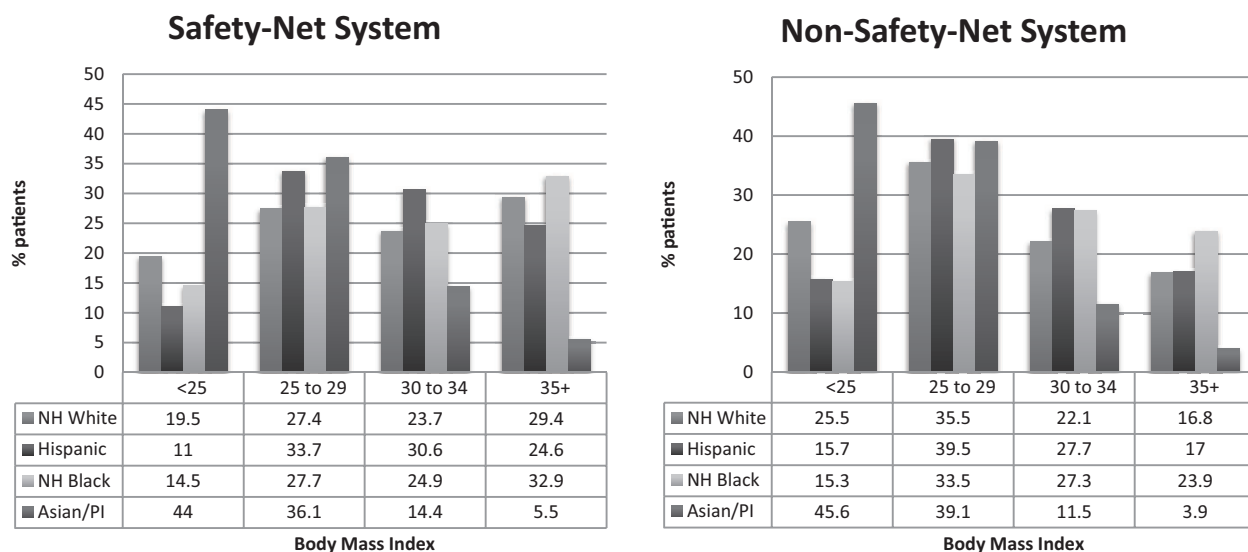
## 3. Results

The sample included 1,382,976 patients who were 50 to 63 years' old (Table 1). Age distributions were similar between safety-net and non safety-net patients. Compared to non safety-nets, the

**Table 1**

**Demographic characteristics by system.**

	Safety-net integrated system	Non safety-net integrated systems
	N = 29,426, n (%)	N = 1,353,550, n (%)
Age, y		
50–54	13,345 (45.4)	616,277 (45.5)
55–59	10,002 (34.0)	427,646 (31.6)
60–63	6079 (20.6)	309,627 (22.9)
Race/ethnicity		
Non-Hispanic White	5228 (17.8)	748,350 (55.2)
Non-Hispanic Black	11,469 (39.0)	120,970 (8.9)
Hispanic	11,035 (37.5)	291,666 (21.6)
Asian/Pacific Islander	1694 (5.7)	192,564 (14.3)
Sex (female)	18,875 (64.1)	739,649 (54.6)
Insurance		
Private	2115 (7.2)	1253,791 (92.6)
Medicaid	3325 (11.3)	17,898 (1.3)
Medicare	3494 (11.9)	79,228 (5.9)
Uninsured	19,588 (66.6)	–
Other	904 (3.0)	2633 (0.2)
Median household income in zip code		
<\$30,000	4064 (13.9)	12,088 (0.9)
\$30,000–<40,000	10,595 (36.0)	62,094 (4.6)
\$40,000–<50,000	6767 (22.9)	165,972 (12.2)
\$50,000–<60,000	3308 (11.2)	249,552 (18.4)
\$60,000–<70,000	2716 (9.2)	234,069 (17.3)
\$70,000+	1976 (6.8)	629,775 (46.6)
Charlson comorbidity score		
0	13,089 (44.5)	939,380 (69.4)
1	10,089 (34.3)	248,217 (18.3)
2	2982 (10.1)	98,488 (7.3)
3+	3266 (11.1)	67,465 (5.0)
Body mass index, kg/m <sup>2</sup>		
Normal (<25)	4633 (15.7)	344,628 (25.5)
Overweight (25–29)	8931 (30.4)	494,609 (36.5)
Obese (30–34)	7697 (26.2)	301,151 (22.2)
Severely obese (≥35)	8165 (27.7)	213,162 (15.8)



NH=Non-Hispanic

Asian/PI = Asian/Pacific Islander

\*adjusted for age, sex, insurance, and zip-code-level median household income

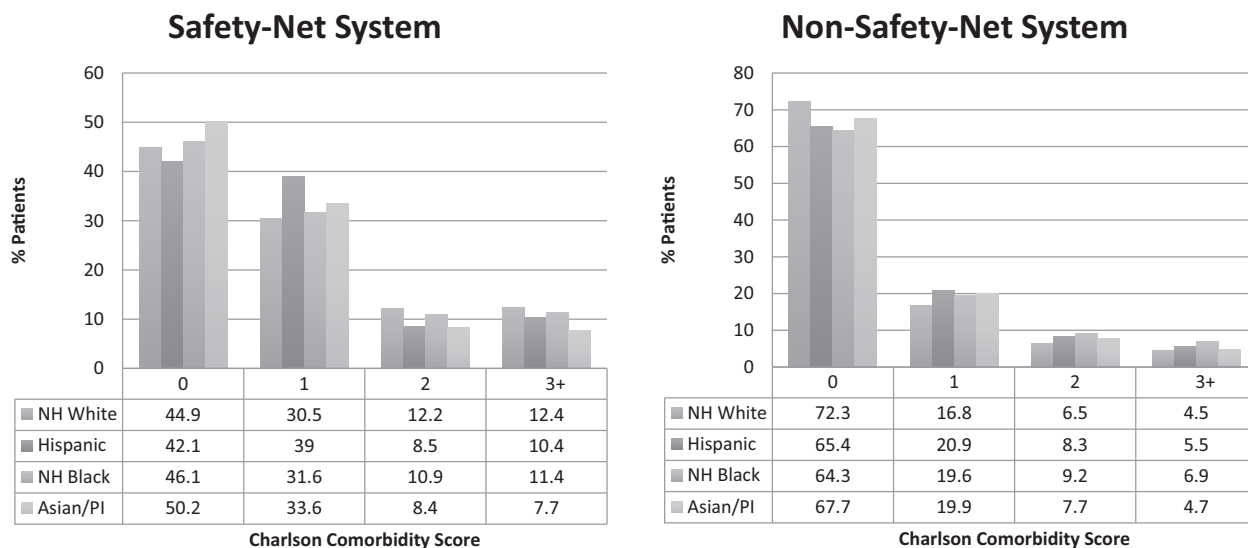
Figure 1. Adjusted percentages of body mass index by race/ethnicity stratified by type of integrated health system.

safety-net system had substantially higher proportions of racial/ethnic minorities, Medicaid and uninsured patients, and patients with zip code-level median household income <\$50,000. Overall, safety-net system had lower proportions of patients with comorbidity score of 0 and BMI <30 kg/m<sup>2</sup>.

Figure 1 shows adjusted percentages of patients within BMI categories, by race/ethnicity, among safety-net and non safety-net settings. In the safety-net system, Hispanics were more likely than whites to have BMIs in the overweight (25–29 kg/m<sup>2</sup>) and obese

ranges (30–34 kg/m<sup>2</sup>) but less likely to be severely obese (BMI ≥35 kg/m<sup>2</sup>) (24.6% vs. 29.4%). A higher proportion of blacks as compared to whites had BMI ≥35 kg/m<sup>2</sup> (32.9% vs. 29.4%). Within non safety-net systems, Hispanics were more likely than whites to be overweight and obese, whereas a higher proportion of blacks than whites were obese and severely obese. Asian/Pacific Islanders were more likely than whites to have a normal BMI in both types of systems.

Figure 2 shows adjusted percentages of patients with 0, 1, 2, and 3+ comorbidity scores by race/ethnicity for the 2 types of



NH=Non-Hispanic

Asian/PI = Asian/Pacific Islander

\*\*adjusted for age, sex, insurance, and zip-code-level median household income

Figure 2. Adjusted percentages of comorbidity by race/ethnicity stratified by type of integrated health system.

**Table 2**

**Adjusted odds ratios and 95% confidence intervals\* for the interaction between patients' race/ethnicity and system type on body mass index and comorbidity (odds ratio estimates represent odds of body mass index/comorbidity for safety-net system as compared to non safety-net systems).**

	Race/ethnicity			
	Non-Hispanic White	Non-Hispanic Black	Hispanic	Asian/Pacific Islander
Body mass index				
<25	1.0	1.0	1.0	1.0
25–<30	1.0	0.86 (0.78, 0.96)	1.26 (1.13, 1.40)	1.04 (0.91, 1.20)
30–<34	1.0	0.71 (0.64, 0.79)	1.21 (1.08, 1.35)	1.03 (0.87, 1.22)
≥35	1.0	0.68 (0.62, 0.75)	0.98 (0.88, 1.09)	0.70 (0.54, 0.89)
Comorbidity score				
0	1.0	1.0	1.0	1.0
1	1.0	0.76 (0.70, 0.82)	0.99 (0.91, 1.07)	0.74 (0.66, 0.84)
2	1.0	0.53 (0.48, 0.60)	0.52 (0.47, 0.59)	0.44 (0.36, 0.55)
3+	1.0	0.48 (0.43, 0.53)	0.62 (0.55, 0.69)	0.46 (0.37, 0.58)

\* Adjusted for age, sex, insurance, and zip-code-level median household income.

integrated systems. In the safety-net, fewer Hispanics and blacks had comorbidity scores of 2 (8.5% Hispanics, 10.9% blacks vs. 12.2% for whites) and/or 3+ (10.4% Hispanics, 11.4% blacks vs. 12.4% for whites). Conversely, within the non safety-nets, a higher proportion of blacks and Hispanics than whites had comorbidity scores of  $\geq 1$ , with blacks having highest scores (6.9% vs. 4.5% for whites).

Table 2 presents adjusted odds ratios (ORs) and 95% confidence intervals (CIs) from multinomial logistic regression models evaluating interaction of race/ethnicity with BMI and comorbidity by system type (safety-net vs. non safety-net). We observed an interaction between race/ethnicity and system type for BMI. Blacks in the safety-net compared to non safety-net had lower odds of being overweight, obese, or severely obese relative to whites. For instance, blacks relative to whites in the safety-net had 32% lower odds of having BMI  $\geq 35$  kg/m<sup>2</sup> as compared to blacks in the non safety-nets (OR=0.68, 95% CI: 0.62, 0.75). Hispanics relative to whites in the safety-net as compared to non safety-net had significantly higher odds of being overweight (OR for BMI 25–29 kg/m<sup>2</sup>=1.26, 95% CI: 1.13, 1.40) or obese (OR for BMI  $\geq 35$  kg/m<sup>2</sup>=1.21, 95% CI: 1.08, 1.35), but there was no difference between the 2 types of systems in patients' odds of being severely obese (BMIs  $\geq 35$ ). We also observed differences in the association between race/ethnicity and comorbidity burden by system type. Relative to whites, blacks, Hispanics, and Asian/Pacific Islanders in the safety-net had lower odds of comorbidity scores  $\geq 1$  compared to the same groups in the non safety-net systems.

After restricting analyses to Medicaid patients in both types of systems, BMI distributions by race/ethnicity were similar to the unrestricted sample. However, comorbidity scores for Medicaid patients were higher for all racial/ethnic groups including whites in both types of health systems (data not shown). Estimates from multinomial logistic regression models were similar to those described in Table 2.

#### 4. Discussion

This is the first large-scale study comparing racial/ethnic differences in indicators of poor health status among patients in safety-net and non safety-net integrated systems. Obesity and high comorbidity burden are established indicators of poor health status and associated with significant mortality and morbidity.<sup>[5–11]</sup> The strength of this analysis is the focus on 2 very

important, modifiable health status variables with downstream implications for health outcomes for a large sample of 1.3 million patients across multiple health care systems.

Previous research in non safety-net integrated systems had shown fewer disparities by race, perhaps because all patients had health insurance. As few integrated health care systems serve uninsured patients, opportunities for assessment of within- and between-system differences in integrated systems serving insured versus safety-net patients are limited. With its diverse composition of health care settings, the PROSPR Consortium provided a unique opportunity to examine this research question. Overall, as expected, we found that a greater proportion of safety-net patients had higher BMIs and higher comorbidity scores than non safety-net patients. However, our examination of race/ethnicity between the system types revealed some unexpected results. After accounting for age, sex, insurance, and zip-code-level median household income, we observed reverse associations between race/ethnicity and comorbidities in the safety-net versus non safety-net systems. Relative to black patients, white patients had higher BMI and higher comorbidity scores in the safety-net system, whereas they had lower scores in the non safety-net settings.

We examined disparities exclusively in integrated settings to decrease potential biases related to availability of health care insurance. We hypothesized that receiving care in an integrated system in which care is coordinated might result in reduced racial/ethnic disparities. Instead, we found significant racial/ethnic differences within both settings, with differing patterns between the 2. These findings may be important to consider when designing and implementing health care delivery interventions to reduce disparities in both safety net and non safety-net systems. For instance, interventions to reduce disparities in care are often targeted to black and Hispanic populations because, in most insured settings, they comprise the minority of patients and, compared to whites, they generally have more risk factors, receive fewer services, and have poorer health outcomes.<sup>[21–26]</sup> However, blacks and Hispanics comprise the majority of patients in safety-net settings, which may partially explain why, in the safety-net system represented in this study, they appear to be less vulnerable than their white counterparts. Our finding that white safety-net patients had higher comorbidity than non-whites suggests that adverse socioeconomic factors among whites may have worse detrimental influences on their health and health outcomes. A significant body of research has focused on tailoring interventions

to minorities because of the poor health outcomes they experience. However, our findings suggest that whites in safety-net settings are more vulnerable than non-whites and interventions to improve outcomes may need to specifically target whites.

## 5. Limitations

First, this is a cross-sectional study and only correlation can be gleaned, not causation. Second, it is possible that our findings stemmed mainly from differences in the composition of the populations served by the 2 system types. To evaluate this, we reran a post-hoc analyses using a relatively homogeneous subsample of only Medicaid-insured patients from the safety-net and non safety-net systems (N=21,223, data not shown). Findings revealed similar racial/ethnic patterns as the unrestricted analyses, suggesting that type of integrated health system may be a contributing factor. Third, this study's generalizability to other integrated health systems needs to be considered in interpreting findings. The one safety-net system included limits generalizability to other safety-net system, although Parkland patients' are sociodemographically similar to other safety-net populations.<sup>[12,27]</sup> Finally, although the different integrated systems represented in this article may have some variations in their models of integration, they all have the same Epic EMR system and through their collaborative work in PROSPR, standardized common measures used in this study. Although outcomes such as mortality or disability would be desirable, those data were not available in the PROSPR cohort. However, both BMI and comorbidities are associated with higher morbidity and mortality<sup>[5-11]</sup> and ours is the first study to date to examine this across such large cohorts from different systems.

## 6. Conclusions

On examining racial/ethnic differences within and across integrated health systems, we found that safety-net patients had a higher prevalence of obesity and comorbidity than non safety-net patients, but racial/ethnic disparities were present within each system type. BMIs were higher for blacks and Hispanics than for whites in both types of health systems. Whereas non-white patients experienced higher comorbidity burden in the non safety-net systems, non-whites in the safety-net system had fewer comorbidities. Understanding patterns of racial/ethnic differences in health outcomes in safety-net and non safety-net integrated health systems is important to tailor interventions to eliminate racial/ethnic disparities in health and health care.

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