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Racial and Ethnic Postoperative Outcomes after Surgery: the Hispanic Paradox

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Abstract

BACKGROUND—The Hispanic population in the United States have previously been shown to have, in some cases, better health outcomes than non-Hispanic whites (NHW) despite having lower socioeconomic status and higher frequency of comorbidities. This epidemiologic finding is coined the Hispanic Paradox (HP). Few studies have evaluated if the HP exists in surgical patients. Our study aimed to examine postoperative complications between Hispanic and NHW patients undergoing low to high-risk procedures.

MATERIALS AND METHODS—We conducted a retrospective cohort study analyzing adult patients who underwent high- intermediate- and low-risk procedures. The Healthcare Cost and Utilization Project California State Inpatient Database between 2006 and 2011 was used to identify the patient cohort. Candidate variables for the adjusted model were determined a priori and included patient demographics with the ethnic group as the exposure of interest.

RESULTS—The median age for Hispanics was 52 (SD 19.3) years of age, and 38.8% were male (N = 87,837). A higher proportion of Hispanics had Medicaid insurance (23.9% vs. 3.8%) or were self-pay (14.2% vs. 4.5%) compared to NHW. In adjusted analysis, Hispanics had a higher odds risk for postoperative complications across all risk categories combined (OR 1.06, 95% CI 1.04 –

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Author Contributions:

Eguia and Kirshenbaum made the acquisition of data. Eguia, Cobb, Kirshenbaum, Janjua, Afshar, and Kuo analyzed and interpreted the data. Eguia, Afshar, and Kuo did drafting of the manuscript. Eguia, Cobb, Afshar, and Kuo made the critical revisions.

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1.09). They also had an increased in-hospital (OR 1.38, 95% CI 1.14 – 1.30) and 30-day mortality in high risk procedures (OR 1.34, 95% CI 1.19–1.51).

CONCLUSION—Hispanics undergoing low to high-risk surgery have worse outcomes compared to NHW. These results do not support the hypothesis of a Hispanic Paradox in surgical outcomes.

Keywords

Hispanic paradox; healthcare disparities; social determinants of health; Hispanic outcomes

INTRODUCTION

Hispanics and Latinos are a mixed heritage group who trace their origin or descent to Mexico, Dominican Republic, Puerto Rico, Cuba, Central and South America. They are the second largest ethnic group in the United States (US) and account for 18% of the US population. The Latino population has increased nine-fold since the 1960's. According to the Pew Research Center, Latinos are the second-fastest growing ethnic group with a 2.0% growth rate between 2015 and 2016.¹

Studies suggest that socioeconomic, environmental and access to health care influence the health of a population. Previous epidemiologic studies have shown an association between mortality and multiple socioeconomic characteristics including education, occupation, employment, health insurance, and poverty.² Other factors associated with socioeconomic status include intrauterine environment, prolonged exposure to stressful life events, and reaction to macro societal factors including income inequality.² In this regard, Latinos and Hispanics have worse access to health care insurance, lower average income, education and higher frequency of comorbidities which should suggest more deleterious outcomes than their non-Hispanic counterparts.³ However, multiple studies have demonstrated better health outcomes in Hispanics when compared to non-Hispanic whites (NHW).⁴ These repeated epidemiologic findings in Hispanic health, which was first noted by Kyriakos Markides in 1986, have earned the term Hispanic Paradox (HP).

Many studies have well-documented disparities between African Americans and white patients, but the difference in surgical outcomes between Hispanics and NHW undergoing surgery is not well defined in the literature.^{4,5} Additionally, few studies have evaluated the HP in surgical patients. We aim to examine in-hospital mortality, 30-day mortality and postoperative complications between Hispanic and NHW undergoing low to high-risk procedures. We hypothesize that Hispanics have worse outcomes than their NHW counterparts.

MATERIALS AND METHODS

DATA SOURCE AND PATIENT SELECTION

The Healthcare Cost and Utilization Project California (HCUP) State Inpatient Database (SID) between 2006 and 2011 was used to identify the patient cohort. The HCUP is an administrative data set composed of a family of healthcare databases developed through a Federal-State-Industry partnership sponsored by the Agency for Healthcare Research and

Quality (AHRQ). Each SID captures all inpatient stays at non-federal facilities for the respective state, regardless of primary payer. Encounters in the SID is obtained from participating state-level data organizations and are based on data abstracted from inpatient discharge records.

California was included in the study because they have a high percentage of verified patient identifiers and perform a high volume of the various low to high-risk surgeries chosen. Furthermore, the State of California has a large Hispanic and Latino Population. Hospital-level data such as, hospital size, residency training programs, full-time nurse staffing, bed size, and total admissions is obtained from the American Hospital Association Annual Survey Database; a survey that is released annually and is comprised of data from more than 6,000 hospitals and 400 health systems. This study is deemed exempt from institutional review board approval by the Loyola University Chicago because de-identified, publicly available data is used.

Inclusion criteria were all Hispanics and NHW that underwent any of the qualifying procedures. We excluded Black, Asian or Pacific Islander, Native American and those classified as others to prevent confounding by outcome differences in these various races/ethnicities. We created variables for Hispanics and non-Hispanic whites, using the race and ethnicity HCUP variable.

CATEGORIES OF RISK

Categories of high-, intermediate-, and low-risk surgeries were stratified using the American College of Cardiology/American Heart Association guidelines for cardiac risk of noncardiac surgery.^{5,6} The International Classification of Disease, 9th Revision, Clinical Modification codes (ICD-9) were used to identify patients who qualified as high-risk for esophagectomy, pancreatectomy, abdominal aortic aneurysm repair (AAA), and pneumonectomy. Intermediate-risk procedures included ICD-9 codes for total knee replacement, total hip replacement, carotid endarterectomy (CEA), colorectal, prostatectomy, and cystectomy. Low-risk included ICD-9 codes for a laparoscopic appendectomy, laparoscopic cholecystectomy, and mastectomy. (Supplemental Table 1)

STATISTICAL ANALYSIS

The primary outcomes were in-hospital mortality and 30-day mortality. The secondary outcome was a comparison of individual and composite postoperative complications for the following: pulmonary embolism (PE), myocardial infarction (MI), sepsis, urinary tract infection (UTI), pneumonia, deep venous thromboembolism (DVT), aspiration, cardiac complications, pulmonary insufficiency, acute renal failure, or intraoperative surgical complications. These complications were identified using ICD-9 codes. (Supplemental Table 2)

Descriptive statistics were performed with t-tests for continuous variables and chi-square tests for categorical variables. Variables for the adjusted model were determined a priori and included patient demographics with the ethnic group as the exposure of interest. Multivariable analyses were conducted using multilevel mixed-effects logistic regression for binary dependent variables. Procedure types were controlled for within each risk strata. The

following variables were forced into the mixed effect multivariable model: age, gender, income, insurance and Charlson comorbidity index. Postoperative complications were also stratified by time with 2006 as a reference to evaluate trends over time. Statistical analysis was performed in STATA MP, version 14 (Stata Corp, College Station, TX).

RESULTS

There was a total of 226,356 Hispanics and 746,140 NHW patients in our cohort. The median age for Hispanics was 52 (SD 19.3), and 38.8% (N = 87,837) were male. A higher proportion of Hispanics were on Medicaid insurance (23.9% vs. 3.8%) or were self-pay (14.2% vs. 4.5%) compared to NHW. Hispanics had a greater proportion of low household incomes at or below the poverty level (33.7% vs. 16. %) compared to NHW. Furthermore, the mean length of stay (LOS) was similar between Hispanics and NHW (4.51 vs. 4.49, P = 0.107). (Table 1–2)

The primary outcome was in-hospital mortality. In an unadjusted analysis of low-risk procedures Hispanics had a 45% decreased odd risk of in-hospital mortality (OR 0.55, CI 95% 0.47 – 0.64). After adjusting for potential confounders, there was no significant difference in in-hospital mortality between the groups. (0.93, 95% CI 0.79 – 1.09). For intermediate risk procedures Hispanics had a 37% increased odd risk (OR 1.37, 95% CI 1.30 – 1.46) of in-hospital mortality and after adjusting for potential confounders, Hispanics still had a 15% increased odds risk of in-hospital mortality (OR 1.15, 95% CI 1.08 – 1.23). For high-risk procedures, Hispanics had a 38% increased odds risk of in-hospital mortality for unadjusted (OR 1.38, 95% CI 1.23 – 1.55) and adjusted models (Figure 1, Supplemental Table 3)

Next, we evaluated 30-day mortality. In an unadjusted analysis of low-risk procedures, Hispanics had a 45% decreased odd risk of 30-day mortality (OR 0.55, 95% CI 0.47–0.64). After adjusting for potential confounders, there was no significant increased odds risk (OR 0.88, 95% CI 0.77 – 1.01). In an unadjusted analysis of intermediate and high procedures, Hispanics had a 41% (OR 1.41, 95% CI 1.33–1.50) and 44% (OR 1.44, 95% CI 1.28 – 1.62) increased odd risk of 30-day mortality respectively. In the risk-adjusted model, these differences persist as Hispanics had an 11% increased odds-risk after intermediate-risk procedures (OR 1.11, 95% CI 1.05 – 1.18) and 34% increased odds risk after high-risk procedures (OR 1.34, 95% CI 1.19 – 1.51) of 30-day mortality. (Figure 2, Supplemental Table 3)

In our secondary analysis, we evaluated individual and composite postoperative complications. Hispanics had a greater proportion of UTI following an appendectomy (1.79% vs. 1.26%, p <.001) compared to NHW. After risk adjustment, they were found to be at a 45% increased odd risk of getting a UTI (OR 1.45, 95% CI 1.26 – 1.67). For intermediate risk procedures Hispanics undergoing CEA had a greater proportion of sepsis (0.12% vs. 0.08%, p <.001), UTI (1.89% vs. 1.82%, p <.001), pneumonia (1.31% vs. 0.90%) and surgical site infection (0.21% vs. 0.09%) compared to NHW. In a risk-adjusted model, Hispanics had a increased odd risk of 83% of developing sepsis (OR 1.83 95% CI 1.26 – 2.68), 48% of UTI (OR 1.48, 95% CI 1.16 – 1.90), 41% of pneumonia (OR 1.48, 95% CI

1.10 – 1.81) and 227% of surgical site infection (OR 2.27, 95% CI 1.17 – 4.39). Also, Hispanic patients undergoing colorectal surgeries had a greater proportion of UTI (3.54% vs. 2.89%) and surgical site infection (5.42% vs. 4.39%) compared to NHW. Following risk adjustment, Hispanics had an increased odds risk of 12% of having a UTI (OR 1.12, 95% CI 1.04 – 1.22) and 9% of developing a surgical site infection (OR 1.09, 95% CI 1.02 – 1.17). For high risk procedures Hispanics who underwent a AAA repair had a greater proportion of developing sepsis (1.94% vs. 1.14%, $p < .001$) and pneumonia (5.58% vs. 4.24%, $p < .001$) compared to NHW. In risk-adjusted analysis, Hispanics had an increased odds risk of 36% of developing sepsis (OR 1.36, 95% CI 1.10 – 1.68) and 26% of developing pneumonia (OR 1.26, 95% CI 1.04 – 1.52). (Supplemental Table 4–9) In our composite analysis, we found that overall Hispanics had a 6% increased odds risk of postoperative complications compared to NHW (OR 1.06, 95% CI 1.04 – 1.09). When analyzing procedures by risk strata, Hispanics had a 21% increased odds risk of postoperative complications after low risk procedures (OR 1.21, 95% CI 1.16– 1.25), 14% after intermediate-risk procedures (OR 1.14, 95% CI 1.11 – 1.17) and 22% after high risk procedures (OR 1.22, 95% CI 1.14 – 1.30). (Figure 3)

In the final part of our analysis, we evaluated temporal trends for our primary and secondary outcomes. There was a down trending odd risk of Hispanic in-hospital mortality from 2007 to 2011 using 2006 as a reference for low (OR 0.83, 95% CI 0.63 – 1.10 vs. OR 0.58, 95% CI 0.43 – 0.77) and intermediate risk procedures (OR 1.05, 95% CI 0.95 – 1.17 vs. OR 0.77, 95% CI 0.69 – 0.86). There was no significant change from 2007 to 2011 in high-risk procedures (OR 1.29, 95% CI 1.07–1.55 vs. OR 0.90 CI 0.75 – 1.10). There was a downtrend in the odd risk of Hispanics 30-day mortality for low (OR 0.82, 95% CI 0.62 – 1.09 vs. OR 0.54, 95% CI 0.40 – 0.73) and intermediate risk (OR 1.05, 95% CI 0.95 – 1.17 vs. OR 0.68, 95% CI 0.61 – 0.76) procedures. There was no significant change from 2007 to 2011 in high-risk procedures (OR 1.31 95% CI 1.09 – 1.59 vs. OR 0.82 95% CI 0.67 – 1.00). Lastly, for low-risk procedures, there was an increased odd risk of postoperative complications from 2007 to 2011 (OR 0.98, 95% CI 0.92 – 1.05 vs. OR 1.28, 95% CI). There was no significant change in the odd risk for intermediate (OR 0.84, 95% CI 0.81 – 0.88 vs. OR 0.98, 95% CI 0.94 – 1.02) and high-risk procedures (OR 0.68, 95% CI 0.62 – 0.76 vs. OR 0.86 95% CI 0.77–0.95). (Supplemental Table 10)

DISCUSSION

The United States is one of the most industrialized nations yet has significant health and mortality disparities by socioeconomic status relative to other industrialized countries.⁷ We demonstrate that these inequities also exist in surgical cohorts with disparate socioeconomic status between Hispanics and NHW. The Hispanic group also had worse health outcomes after surgical procedures of any risk level. Similarly, Hispanics experienced a greater in-hospital and 30-day mortality rate in patients after an intermediate risk or higher procedure. These findings are contradictory to prior epidemiologic studies describing a HP.^{8–10}

A study by Cortes-Bergoderi, performed a systemic review and a meta-analysis of cohort studies comparing cardiovascular (CV) mortality and all-cause mortality between Hispanics and NHW in the United States. He found an association between Hispanic ethnicity and

lower CV mortality (OR 0.67, 95% CI, 0.57 – 0.78) and lower all-cause mortality (OR 0.72, 95% CI 0.63 – 0.82).¹¹ This was further demonstrated in a study by Malagon-Blackwell who performed an observational retrospective cohort study of Hispanic and non-Hispanic women with endometrial cancer. They found that five-year survival was slightly higher for Hispanic women versus NHW women. On multivariable analysis adjusted for measured confounders, Hispanic women lived longer than NHW women.⁴ In our analysis of a broad range of low to high-risk surgical procedures, we found that Hispanics have increased odds risk of in-hospital mortality and 30-day mortality compared to NHW after intermediate and high-risk procedures. These findings refute previously published data. Mortality was not changed between the groups after low-risk procedures, and we suspect that this occurred because of the inherent overall low risk in these procedures regardless of age, sex, or race/ethnicity. In the higher risk groups, the rates of adverse events were greater, so macro environmental factors may disproportionately affect Hispanic patients.

In a study by Ravi et al., which looked at patients undergoing primary cancer and noncancerous surgical procedures found that Hispanics were more likely to experience the prolonged length of stay and were at higher odds of dying within 30 days after colectomy, heart valve repair/replacement, or AAA repair.¹¹ Our study also found that Hispanics have higher odds of postoperative complications when examined with all risk strata groups combined. Furthermore, we found Hispanics were at increased risk-adjusted odds of getting a UTI after an appendectomy. Also, sepsis, UTI, pneumonia and surgical site infection after CEA. Furthermore, Hispanic patients undergoing colorectal surgeries had an adjusted odd risk of having a UTI and developing a surgical site infection. Lastly, Hispanics who underwent an AAA repair had a greater odd risk of developing sepsis and pneumonia. The long and controversial debate of HP does not appear to hold true for surgical patients. Our study shows that there are specific areas where Hispanics have worse outcomes compared to NHW, explicitly following surgical intervention. It would benefit institutions to pursue quality improvement projects targeted to reduce disparities that affect the Hispanics population undergoing a variety of low to high-risk procedures.

The HP has been a topic of interest in the medical literature and has been described concerning renal disease, cardiovascular disease, breast cancer and gynecological malignancies, but limited data exist on surgical patients.^{4,12,13} Our analysis appears to refute the HP given the worse outcomes in postoperative complications, in-hospital and 30-day mortality. As previous studies have noted, Hispanics suffer from higher rates of poverty and face multiple barriers to quality health care such as access to healthcare insurance and lack of cultural and language congruency with healthcare providers.⁴ Studies which have examined the HP have associated low mortality rates in the Hispanic population to two possible phenomena: a “salmon bias” and a “healthy migrant effect”.^{10,13} The salmon bias refers to Hispanic patients that may return to their country of origin when they retire or develop a fatal illness, leading to loss of follow up and an association with apparent lower mortality.¹⁰ The healthy migrant effect suggests that Hispanics who migrate to the U.S. are overall healthier than other Hispanics.¹⁰ This was not the case in our study, where we found that Hispanics have worse outcomes in postoperative complications, in-hospital and 30-day mortality. We believe further research is needed to understand healthcare facility factors, which may contribute to healthcare disparities. Also, more research is needed in

understanding the etiology and causal pathway of health disparities in the Hispanic population that reach beyond race. Similarly, identify modifiable barrier and cost-effective factors to reduce and eliminate surgical disparities.

A limitation of this study includes the use of an administrative dataset, which does not contain detailed clinical information such as laboratory results and physiologic measures which may contribute to patient outcomes. Furthermore, there may be inherent under or over coding of ICD-9 codes. This study is only limited to the state of California, therefore, may not be generalizable to the rest of the country and most recent trends. Lastly, the Hispanic population is a heterogeneous group of people which is not accounted for in our data. There may be variability in results for various subgroups of Hispanics.

CONCLUSION

Hispanics undergoing low to high-risk surgery do not have better health outcomes relative to NHW in postoperative complications, in-hospital mortality or 30-day mortality. In a state-wide database of a large Hispanic and NHW population, the HP is not a phenomenon that occurred in patients at risk for surgical complications.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Figure 1. Risk-Adjusted Odds Risk of In-Hospital Mortality

* Mixed Effects Logistic Regression adjusted for age, gender, income, insurance and Charlson Comorbidities Index

Figure 2. Risk-Adjusted Odds Risk of 30-day Mortality

* Mixed Effects Logistic Regression adjusted for age, gender, income, insurance and Charlson Comorbidities Index

Figure 3. Risk-Adjusted Odds Risk of Postoperative Complications

* Mixed Effects Logistic Regression adjusted for age, gender, income, insurance and Charlson Comorbidities Index

Table 1**Demographics and Characteristics of Cohort**

	White (N = 746,140)		Hispanic (N = 226,356)		P
Age (<i>Mean, SD</i>)	66	15	52	19	0.001
Male	341,634	45.8%	87,837	38.8%	0.001
Charlson Comorbidity Index	3	116,895	27,221	12.0%	0.001
LOS 3, (<i>Mean, SD</i>)	4.51	20.03	4.49	15.77	0.107
Primary Payer					
Medicare	385,110	51.6%	66,597	29.4%	0.001
Medicaid	28,259	3.8%	54,196	23.9%	0.001
Private	298,955	40.1%	73,436	32.4%	0.001
Self-Pay	33,746	4.5%	32,089	14.2%	0.001
Income Quartile					
1st	120,286	16.1%	76,383	33.7%	0.001
2nd	164,460	22.0%	70,333	31.1%	0.001
3rd	206,612	27.7%	51,554	22.8%	0.001
4th	238,880	32.0%	24,591	10.9%	0.001

Table 2

Procedures by Race and Ethnicity

Procedure	White (N = 746,140)	Hispanic (N = 226,356)	P
Low Risk			
Appendectomy	50,777 6.8%	31,000 13.7%	0.001
Cholecystectomy	102,199 13.7%	86,851 38.4%	0.001
Breast	34,544 4.6%	8,332 3.7%	0.001
Knee	195,876 26.3%	37,934 16.8%	0.001
Hip	114,131 15.3%	10,362 4.6%	0.001
Intermediate Risk			
CEA	35,353 4.7%	4,874 2.2%	0.001
Colorectal	108,409 14.5%	26,040 11.5%	0.001
Prostatectomy	58,354 7.8%	13,669 6.0%	0.001
Bladder	5,382 0.7%	836 0.4%	0.001
High Risk			
Pancreatectomy	5,226 0.7%	1,581 0.7%	0.290
AAA	17,390 2.3%	1,985 0.9%	0.290
Esophagectomy	3,015 0.4%	801 0.4%	0.024
Lung	15,484 2.1%	2,091 0.9%	0.001