



## Original article

## The effect of socioeconomic status, race, and insurance type on newly diagnosed metastatic prostate cancer in the United States (2004–2013)

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## Abstract

**Background:** Understanding the characteristics of men who initially present with metastatic prostate cancer (mPCa) can better enable directed improvement initiatives. The objective of this study was to assess the relationship between socioeconomic status (SES) and newly diagnosed mPCa.

**Materials Methods:** All men diagnosed with PCa in the National Cancer Data Base from 2004 to 2013 were identified. Characteristics of men presenting with and without metastatic disease were compared. A 4-level composite metric of SES was created using Census-based income and education data. Multivariable logistic regression was used to evaluate the association between SES, race/ethnicity, and insurance and the risk of presenting with mPCa at the time of diagnosis.

**Results:** Of 1,034,754 patients diagnosed with PCa, 4% had mPCa at initial presentation. Lower SES (first vs. fourth quartile; odds ratio [OR] = 1.39, 95% CI: 1.35–1.44), black and Hispanic race/ethnicity (vs. white; OR = 1.47, 95% CI: 1.43–1.51 and OR = 1.22, 95% CI: 1.17–1.28, respectively), and having Medicaid or no insurance (vs. Medicare or private; OR = 3.91, 95% CI: 3.78–4.05) were each independently associated with higher odds of presenting with mPCa after adjusting for all other covariates.

**Conclusions:** Lower SES, race/ethnicity, and having Medicaid or no insurance were each independently associated with higher odds of presenting with metastases at the time of PCa diagnosis. Our findings may partially explain current PCa outcomes disparities and inform future efforts to reduce disparities. © 2017 Elsevier Inc. All rights reserved.

**Keywords:** Prostatic neoplasms; United States; Epidemiology; Neoplasm metastasis

## 1. Introduction

A stage migration away from advanced and metastatic prostate cancer (mPCa) occurred after prostate-specific antigen (PSA)-based screening became more prevalent in the 1990s [1]. Accordingly, there was a significant decline

in PCa mortality since men were more often diagnosed at a localized, curable stage. Over the last several years, screening recommendations have evolved [2,3], and there has been a decline in PCa screening and diagnosis [4]. Some have postulated that these factors may have contributed to recent decreases in the diagnosis of low-risk PCa and may eventually lead to increases in advanced PCa cases [4]. The current profile of men presenting with mPCa is poorly understood and the complex association between socio-demographics and stage at presentation may relate.

Socioeconomic status (SES), race, and insurance status have each been implicated as factors affecting stage at diagnosis of PCa [5–8], however, prior studies have been

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limited by small sample size or inability to evaluate the independent effect of each variable simultaneously. Evaluating the role of socioeconomic and demographics in the diagnosis of mPCa may reveal particularly vulnerable populations and improve disparities in outcomes.

It was our hypothesis that lower SES is independently associated with a higher odds of mPCa at the time of PCa diagnosis regardless of race or insurance status. We therefore used a large national cancer registry to compare socioeconomic, demographic, and clinical characteristics of men presenting with and without mPCa.

## 2. Materials and methods

### 2.1. Data source and patients

Data was sourced from the participant user file of the National Cancer Data Base (NCDB), an oncology registry developed by the American College of Surgeons' Commission on Cancer and the American Cancer Society [9]. The NCDB is composed of over 1,500 Commission-accredited hospitals and captures data on about 40% of PCa cases in the United States [9,10].

All men diagnosed with adenocarcinoma of the prostate from 2004 through 2013 were identified. Only men treated at facilities that contributed patient data for every study year were included to avoid bias in temporal trends ( $n = 1,127,078$ ). Men were excluded if data on American Joint Committee on Cancer clinical nodal and metastatic stage were missing ( $n = 32,531$ ; 2.9%). Men with missing SES data were also excluded ( $n = 59,793$ ; 5%).

### 2.2. Patient and reporting hospital characteristics

Patient characteristics assessed included year of diagnosis, age, Charlson-Deyo Comorbidity Index [11], geographic region, insurance type, and patient's county population. Race and ethnicity were defined as non-Hispanic white, non-Hispanic black, Hispanic, and other/unknown. Hospital type were designated by the Commission on Cancer as a community program if they treat fewer than 500 cancer patients annually, and a comprehensive and academic program if they treat greater than 500. Academic programs also provide at least 4 graduate medical education programs [12]. Reporting hospital location was categorized as New England, Middle Atlantic, Southeast, Great Lakes, South, Midwest, West, Mountain, and Pacific.

Gleason score was determined from the largest histologic specimen available. Accordingly, radical prostatectomy pathologic Gleason score is used in lieu of prostate needle biopsy Gleason score when available. For the years 2010 to 2013, both biopsy Gleason score and radical prostatectomy Gleason score were recorded.

### 2.3. Socioeconomic status

The NCDB used American Community Survey data from 2008 through 2012 to categorize each patient into national quartiles of median household income and percentage of adults who did not graduate high-school based on patient ZIP Code Tabulation Areas.

We created a single, 4-level measure of SES based on 16 possible combined values for each patients' quartiles of zip code income and education, following methods originally used to study the association of SES with breast cancer mortality [13]. To estimate joint zip code income and education SES levels, we used logistic regression to rank the odds ratios (ORs) of the likelihood of mPCa for all 16 zip code strata. Based on these results we empirically derived 4 mutually exclusive SES categories based on nonoverlapping 95% CIs, with the highest SES group being composed of patients from the highest quartiles of both education and income.

As an additional independent indicator of SES and access to care, insurance status (or coverage) was dichotomized as uninsured or Medicaid vs. other insurance (private or Medicare).

### 2.4. Outcome variable and statistical analysis

Our primary outcome was the presence of local or distant mPCa at time of diagnosis. This was defined as any patient with cN1 or cM1 as determined by American Joint Committee on Cancer tumor, node, and metastasis clinical staging. Unadjusted rates and categorical variables were compared using chi-squared testing. Multivariable logistic regression was used to test the significance of associations between patient socio-demographic characteristics, tumor, and reporting hospital characteristics, and the likelihood of a patient presenting with metastatic disease while adjusting for covariates that were selected a priori. Stata 13.0 (College Station, TX) was used for all statistical tests. All tests were 2-tailed and  $P < 0.05$  was considered statistically significant. This study of deidentified, publicly available data was determined to be exempt by the Northwestern University Institutional Review Board.

## 3. Results

### 3.1. Patient characteristics

In our cohort of 1,034,754 men diagnosed with adenocarcinoma of the prostate during the study period, 4.0% presented with mPCa. Men were clinically node positive (N+) in 1.5% of cases, clinically metastatic (M+) in 3.3%, and both (N+M+) in 0.8%. Full cohort demographic details can be found in [Supplemental Table S1](#). Black (5.9%) and Hispanic (6.2%) men had higher unadjusted percentages of metastases on presentation than white men

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