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Insurance status as a modifier of the association between race and stage of prostate cancer diagnosis in Florida during 1995 and 2013

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ABSTRACT

Background: Cancer stage at diagnosis is a critical prognostic factor regarding a patient's health outcomes. It has yet to be shown whether insurance status across different race has any implications on the stage of disease at the time of diagnosis. This study aimed to investigate whether insurance status was a modifier of the association between race and stage of previously undetected prostate cancer at the time of diagnosis in Florida between 1995 and 2013.

Methods: Secondary data analysis of a cross-sectional survey using information from the Florida Cancer Data System (n = 224,819). Study participants included black and white males diagnosed with prostate cancer in Florida between 1995 and 2013. The main outcome variable was stage of prostate cancer at diagnosis. The main independent variable was race (black vs white). Adjusted logistic regression models were used to explore the association between race, insurance status and stage at diagnosis. Odds ratios (OR) and 95% confidence intervals (95% CI) were calculated.

Results: Black males were more likely to be diagnosed with late stage prostate cancer (OR 1.31; 95% CI 1.27–1.35). Being uninsured (OR 2.28; 95% CI 2.13–2.45) or having Medicaid (OR 1.84; 95% CI 1.70–1.98) was associated with a diagnosis of late stage cancer. Stratified analysis for health insurance revealed that blacks had an increased risk for late stage cancer if uninsured (OR 1.29; 95% CI 1.07–1.55) and if having Medicare (OR 1.39; 95% CI 1.31–1.48).

Conclusion: Insurance status may modify the effect of race on late stage prostate cancer in black patients.

1. Introduction

Prostate cancer is the most common cancer among men of all races in the United States, and is only second to lung cancer when considering the leading causes of cancer death among men [1]. According to the most recent incidence data available from the Centers for Disease Control and Prevention in 2015, there were 183,529 new reported cases of prostate cancer and 28,848 males were reported to have died of this disease in the United States [2].

Among the risk factors for this type of malignancy, race plays a significant role [3]. For reasons not well known, prostate cancer is more common in certain racial groups [3]. According to the Prostate Cancer Foundation, African American men were found to be at a disproportionately higher risk for developing prostate cancer (1.6 times higher risk) and were found to be 2.4 times more likely to die from this disease [4]. Additionally, black men tend to be diagnosed at a younger age with larger tumors [4]. Moreover, insurance status has previously been associated with differences in cancer stage at diagnosis. For instance, those identified as uninsured or Medicaid-insured were more likely to present with advanced stage cancer at the time of diagnosis as opposed to patients with private insurance [5]. Furthermore, minorities were more likely to be uninsured or Medicaid-insured in comparison to non-Hispanic white individuals [5].

When investigating race and insurance status for men living in Florida, it has been found that being black was associated with high risk of late stage prostate cancer, whereas having private or public

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insurance and/or having a high household income were variables associated with a reduced likelihood of having late-stage prostate cancer [8]. Studies assessing numerous variables that may be associated with prostate cancer trends among men in Florida revealed that income, marital status, education and type of insurance correlated significantly with level of knowledge concerning prostate cancer among blacks [6] while also demonstrating that native-born blacks have significantly higher knowledge on the subject compared to foreign-born blacks [7]. Some of the previous studies were limited due to the fact that they relied on self-reports by the participants in order to assess the study variables of interest [7] or did not include large population samples [6,7]. Within the studies found, particularly those relevant to the Florida population, it has yet to be shown whether race alone affects the severity of prostate cancer, or if the trend in insurance status among minorities, such as blacks, has any implications on the stage of disease at the time of diagnosis. The objective of our study was to investigate insurance status as an effect modifier of the association between race and stage of previously undetected prostate cancer at time of diagnosis in Florida during 1995 and 2013

2. Methods

2.1. Study design and population

For this secondary data analysis of a cross-sectional survey, information was obtained from the Florida Cancer Data System (FCDS), a Florida, statewide cancer surveillance system that has been collecting incidence data since 1981 [9]. This registry includes de-identified patient information for all cancer diagnoses in Florida. As required by Florida statute, Florida facilities are legislatively mandated to report any case of cancer, regardless of facility or network affiliation, or Class of Case [9]. Facilities must follow the case eligibility guidelines outlined by FCDS for cancer data reporting. All patients first seen as an inpatient, outpatient, or in an ambulatory care setting in a Florida facility on or after January 1, 1981 are reported in the registry, as long as they meet the criteria outlined by FCDS. Information from every facility is received electronically, and is then collected/abstracted by Certified Tumor Registrars (CTRs) for input into the registry. After reviewing these guidelines, as well as the data collection protocol for FCDS, information regarding the variables of interest were collected accordingly.

The inclusion criteria for this study were black and white males with a prostate cancer diagnosis reported to FCDS and date of diagnosis between 1995 and 2013. Participants were excluded if they were missing data on race, stage of cancer at diagnosis and/or insurance status, or if their insurance status was unknown.

2.2. Study variables

Within the FCDS database, malignancies are assigned T, N, M and Stage Group values according to the American Joint Committee on Cancer Staging Manual [10]. The National Institute of Health, National Cancer Institute outlines the four stages of prostate cancer, how they are defined, and their respective clinical pictures. For the purposes of this study, the stage of previously undetected prostate cancer at diagnosis was categorized as “early” if FCDS assigned a Stage Group value of I or II, or as “late” if FCDS assigned a Stage Group value of III or IV at the time of diagnosis.

The data was then reviewed to identify each patient’s race: black and white. The race recorded into the FCDS database was retrieved from the patient’s medical record. However, if race was unknown or not stated in the medical record, CTRs followed specific guidelines found in the “Race and Nationality Descriptions from the 2000 Census and Bureau of Vital Statistics” to identify nationalities, from which race was inferred. The 2014 FCDS Data Acquisition Manual, Appendix D, may be referenced to review the Race Coding Instructions and Race and Nationality Descriptions from the 2000 Census and Bureau of Vital Statistics for more information regarding the guidelines in which race was determined. In this study, the variable of race was dichotomized into the categories of black and white.

Insurance status in FCDS was recorded as one of the following: Not insured; Not insured, self-pay; insurance, not otherwise specified (NOS); Private Insurance: Managed care, HMO, PPO; Private Insurance: Fee-for-Service; Medicaid; Medicaid administered through a Managed Care Plan; Medicare/Medicare, NOS; Medicare with supplement, NOS; Medicare administered through a Managed Care plan; Medicare with private supplement; Medicare with Medicaid eligibility; TRICARE; Military; Veterans Affairs; Indian/Public Health Service; Insurance Status Unknown. These categories were classified into four main groupings: uninsured (Not Insured; Not-Insured, self-pay), insured (Insurance, NOS; Private Insurance: Managed care, HMO, PPO; Fee-for-Service; TRICARE; Military; Veterans Affairs; Indian/Public Health Service), Medicaid (Medicaid; Medicaid administered through a Managed Care Plan) and Medicare (Medicare/Medicare, NOS; Medicare with supplement, NOS; Medicare administered through a Managed Care plan; Medicare with private supplement; Medicare with Medicaid eligibility). Those with unknown insurance status were not included in the analysis.

Age at the time of diagnosis was calculated using the date of birth as abstracted to FCDS from the patient record.

Geographic location was determined by the county reported for the participant at the time of diagnosis, as recorded by FCDS using the Federal Information Processing Standard county code. These counties were analyzed according to their region within the state of Florida. The regions, as identified by the American Red Cross, are as follows: North Florida, Central Florida and South Florida.

Tobacco use status is recorded in FCDS as one of the following six options: never used; current user; former user, quit within one year of the date of diagnosis; former user, quit more than one year prior to the date of diagnosis; former user, unknown when quit; unknown/not stated/no smoking specifics provided. To assess and adjust for tobacco use status, these responses were grouped into three major categories: never used; former; unknown tobacco use status.

Lastly, FCDS contains patient information regarding marital status, recorded as: single (never married); married (including common law); separated; divorced; widowed; unmarried or domestic partner (same sex or opposite sex, registered or unregistered); unknown. In order to better asses marital status as a covariate, the categories within FCDS were grouped into the following four groups: never married (single); married (married; unmarried or domestic partner); unmarried (separated; divorced; widowed); unknown.

2.3. Statistical analysis

The data was analyzed using IBM SPSS 21. Descriptive analysis included absolute and relative frequencies for categorical variables and measures for central tendencies and dispersion for continuous variables. Bivariate analysis were performed to check for possible confounders using chi-square tests for the categorical variables and *t*-test for continuous ones. In order to assess the association between race, insurance status and stage of cancer diagnosis, binary logistic regression models were used. The Hosmer-Lemeshow test was used to check the model fit. Crude and adjusted odds ratios (OR) including the respective 95% confidence interval (95% CI) for the association between race and stage of prostate cancer at diagnosis were calculated and compared to the OR obtained when stratifying the data according to insurance status. To assess for effect modification of the aforementioned association, the interaction term race*insurance was assessed. A p-value of < 0.05 was considered statistically significant. The statistical models were adjusted for age, ethnicity, geographic location, tobacco use status, and marital status.

Table 1
Characteristics of prostate cancer patients in the United States between 1995 and 2013 according to race.

Characteristics	Race		p-value
	White (n = 195,325) (%)	Black (n = 29,494) (%)	
Age (years; mean (SD[a]))	68.3 (8.8)	65.6 (9.1)	< 0.001[b]
Year of Diagnosis (median (IQR[c]))	2004 (2000-2008)	2006 (2001-2009)	< 0.001[d]
Ethnicity			< 0.001
Non-Hispanic	87.4	97.1	
Hispanic	12.6	2.9	
Marital Status			< 0.001
Married	77.1	63.4	
Never married	8.1	17.3	
Unmarried	11.7	14.8	
Unknown	3.1	4.6	
Region			< 0.001
Southern	38.0	44.2	
Central	44.8	31.3	
Northern	17.1	24.5	
Tobacco use			< 0.001
Never	46.2	55.1	
Current	12.9	16.6	
Former	40.9	28.3	
Insurance status			< 0.001
Insured	37.3	47.4	
Uninsured	1.5	4.9	
Medicaid	1.3	5.0	
Medicare	59.9	42.8	

[a] Standard deviation.
[b] p-value was calculated using the independent *t*-test.
[c] Interquartile Range.
[d] p-value was calculated using the Mann-Whitney two-sample statistics.

2.4. Ethical considerations

This study was reviewed by the Florida International University (FIU) Office of Research Integrity and determined to be Not Human Subject Research (NHSR). As a result, the study did not require submission to and approval of the FIU Institutional Review Board (IRB). The privacy of all participants was maintained as all information utilized was secondary de-identified data obtained from the FCDS.

3. Results

Table 1 presents the characteristics of the study sample according to race. Most participants from both exposure groups fell within two major insurance categories, insured and Medicare. In total, 37.3% of whites and 47.4% of blacks were insured, while 59.9% of whites and 42.8% of blacks were Medicare-insured. These differences in insurance status among the two groups were statistically significant (p-value < 0.001). The average age for whites and blacks was 68.3 and 65.6 years, respectively, and was statistically significantly different between the two groups (p-value < 0.001). With regards to ethnicity, most participants from both racial groups identified as non-Hispanic with 87.4% of whites identifying as non-Hispanic and 97.1% of blacks identifying as non-Hispanic. Within the white population, 12.6% of participants identified as Hispanic and 2.9% of black participants identified as Hispanic.

Fig. 1 shows the health insurance of study population during 1995 and 2013. As can be observed, no major changes occurred during the study period. Approximately 40% of the study population was insured. The percentage of the study participants with Medicaid or self-pay was below 5% throughout the duration of the study.

As one of the interaction terms of race*insurance was statistically significant (Black*Medicare; OR 1.23 (95% CI 1.13–1.34) indicating possible effect modification, we decided to stratify the analysis according to insurance status (Table 2). When the data was stratified by insurance status, the only two insurance categories to demonstrate statistically significant odds for the association between race and stage of prostate cancer at diagnosis were the uninsured and Medicare-insured groups. The uninsured and Medicare categories had a statistically significant increase in the odds of late stage cancer for the black population of 26% (OR 1.26; 95% CI 1.05–1.52) and 32% (OR 1.32; 95% CI 1.25–1.41), respectively. For ethnicity, it was observed that only insured Hispanics had a statistically significantly decreased odds of late stage prostate cancer (OR 0.88; 95% CI 0.81 - 0.95) compared with non-Hispanics.

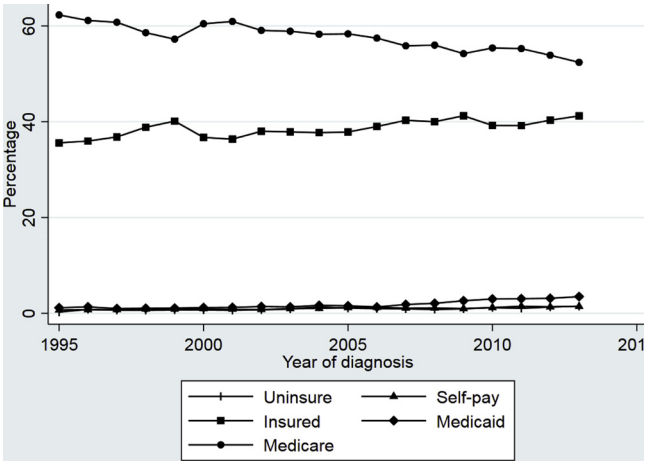

Fig. 1. Health insurance of study population during 1995 and 2013.

4. Discussion

In summary, our study identified that insurance status modifies the effect of race on late-stage prostate cancer in black patients, as demonstrated by the significant interaction between black race and Medicare insured participants in a multivarible binary logistic regression analysis. Among all participants regardless of race, those identified as uninsured and Medicaid-insured had greater odds of presenting with late stage prostate cancer at the time of diagnosis when compared with insured participants. Subsequently, when the data was stratified according to insurance status, it was found that blacks within the Medicare and uninsured categories continued to demonstrate a significantly increased odds of presenting with late stage prostate cancer.

Our findings were in agreement with other secondary data analyses that had been published in previous years. For example, Roetzheim et al. explored associations among our same study population by using FCDS and U.S. Census data to identify that there was a significantly greater risk of late stage prostate cancer diagnosis among African American men (OR 1.27; 95% CI 1.05–1.54) and uninsured patients of any race (OR 1.47; 95% CI 1.06–2.04) [11]. Similarly, a more recent study that also explored racial disparities in late stage prostate cancer diagnosis in Florida found that non-Hispanic blacks were 1.27 times more likely to present with late stage prostate cancer (95% CI 1.17–1.38) and uninsured men of any race were 2.75 times more likely to be diagnosed at a later stage (95% CI 2.37–3.20) [12]. Moreover, a study conducted in 2008 looked at a broader population sample by using information from the National Cancer Data Base to study associations among various cancer types and concluded that uninsured and Medicaid-insured patients had an increased risk of presenting with advanced stage disease [5]. They observed that when compared with whites, blacks were more likely to be uninsured (OR 3.0; 95% CI 2.9–3.0) or Medicaid-insured (OR 3.8; 95% CI 3.8–3.9) [5]. It has to be kept in mind that like our study, the cross-sectional design of previous

Table 2
Associations between study participants' characteristics and late stage prostate cancer according to insurance status in the United States between 1995 and 2013.

Characteristics	Insured Adjusted OR[a] (95% CI[b])	Uninsured Adjusted OR (95% CI)	Medicaid Adjusted OR (95% CI)	Medicare Adjusted OR (95% CI)
Race				
White	Reference	Reference	Reference	Reference
Black	1.04 (0.98–1.11)	1.26 (1.05–1.52)	1.11 (0.90–1.40)	1.32 (1.25–1.41)
Age	0.99 (0.98–0.99)	1.0 (0.99–1.01)	0.99 (0.98–1.00)	1.02 (1.01–1.02)
Ethnicity				
Non-Hispanic	Reference	Reference	Reference	Reference
Hispanic	0.88 (0.81–0.95)	1.21 (0.99–1.49)	1.04 (0.83–1.31)	1.02 (0.95–1.10)
Marital Status				
Married	Reference	Reference	Reference	Reference
Never married	1.00 (0.93–1.08)	1.50 (1.23–1.83)	1.32 (1.07–1.64)	1.40 (1.30–1.49)
Unmarried	1.05 (0.98–1.13)	1.38 (1.11–1.72)	1.22 (0.96 – 1.55)	1.35 (1.28–1.42)
Unknown	0.79 (0.68–0.93)	0.81 (0.53–1.24)	0.64 (0.41 – 1.00)	0.81 (0.71 – 0.93)
Region				
Southern	Reference	Reference	Reference	Reference
Central	1.10 (1.04–1.15)	1.30(1.07–1.59)	1.03 (0.83–1.28)	1.08 (1.03–1.13)
Northern	1.21 (1.14–1.30)	1.04 (0.81–1.32)	1.19 (0.92–1.54)	1.19 (1.12–1.25)
Tobacco Use				
Never Used	Reference	Reference	Reference	Reference
Current User	1.31 (1.23–1.40)	1.37 (1.12–1.68)	1.24 (1.00–1.54)	1.21 (1.14–1.29)
Former User	1.04 (0.99–1.10)	0.94 (0.77–1.14)	0.96 (0.77–1.20)	0.90 (0.86–0.94)
Year of Diagnosis	0.99 (0.99 – 1.00)	0.99 (0.97–1.00)	1.01 (0.99–1.03)	0.99 (0.99–1.00)

[a] Odds ratio.
[b] Confidence interval.

studies does not allow causal inference. Additionally, these studies relied on secondary data and were lacking information regarding important prognostic factors such as existing comorbidities and family history of cancer. A recent secondary data analysis studied the modification that insurance status has on the effect of race and treatment received for prostate cancer. They found that insurance coverage was associated with a reduction in racial disparity between black and white patients regarding receipt of definitive therapy for prostate cancer [13]. The value added by our study was that it investigated whether insurance status modified the association between race and stage of prostate cancer at the time of diagnosis.

According to scientific literature, blacks have a higher incidence and prevalence of late stage prostate cancer at the time of diagnosis [1]. One possible suggestion for this discrepancy includes a cultural hesitation to seek preventive medical interventions, underlining the importance for further research that explores the implications of cultural differences in the aforementioned disparities. Additionally, the literature review found that black men tend to be diagnosed at a younger age with larger tumors [4]. Similarly, African Americans have been found to have a higher prostate specific antigen (PSA) at the time of diagnosis [13]. As with various aspects of healthcare, socioeconomic factors may play a major role in the timely diagnosis of prostate cancer among men in Florida. Historically, it has been widely observed that minorities such as blacks and Hispanics are often of lower socioeconomic status [12], and thus may be more likely to encounter barriers in accessing healthcare coverage. The stratified analysis in this study revealed that blacks within the Medicare and uninsured categories demonstrated a significantly increased odds of presenting with late stage prostate cancer. Because Medicare coverage is not accessible before the age of 65, it is possible that these participants did not have adequate healthcare plans prior to this and therefore did not have access to adequate and timely services.

Regarding this study's findings revealing that uninsured and Medicaid-insured participants have a greater risk of late stage disease, we suggest that the association for uninsured participants may be explained by the lack of resources and funds available to these individuals. As such, it may be inferred that those without insurance are less likely to receive screening and other important preventive services. However, in regards to Medicaid-insured participants, it is presumed that these individuals have access to adequate medical services. Therefore, the increased risk of presenting with an unfavorable prostate cancer prognosis under this coverage must be explored. It may be postulated that Medicaid plans do not foster the appropriate continuous coverage that promotes adequate preventive care. The aforementioned results are in accordance with the study by Fedewa et al. which found insurance status to be strongly associated with disease severity among individuals with prostate cancer where those participants that were uninsured or Medicaid-insured had an increased odds of advanced Gleason Score compared to privately insured patients (uninsured OR: 1.97; 95% CI; 1.82–2.12, Medicaid OR: 1.67; 95% CI, 1.55–1.79) [14]. These associations may be attributed to lack of access to preventive services such as PSA screening, decreased medical literacy, and barriers to medical evaluation.

Further analysis of the data in this study revealed various secondary findings of interest. The adjusted logistic regression analysis demonstrated that current smokers had increased odds of presenting with late stage prostate cancer when compared with males who have never used tobacco. Tobacco use has been demonstrated to be a risk factor for late stage prostate cancer. A systematic review and meta-analysis of tobacco use and prostate cancer mortality demonstrated smoking to be a modifiable risk factor as the study identified current cigarette smoking to be associated with an increased risk of prostate cancer death (RR: 1.24; 95% CI, 1.18–1.31) [15]. Additionally, secondary findings in this study demonstrated that differences in marital status accounted for increased odds of late stage prostate cancer, as was evidenced in men who identified as never married or unmarried (separated; divorced; widowed). Prior studies have elucidated similar trends regarding marital status, as it was found to be an independent predictor of prostate cancer-specific mortality and overall mortality in men with prostate cancer [16]. In a study by Tyson et al. unmarried men had a 40% increase in the relative risk of prostate cancer-specific mortality (HR 1.40; 95% CI 1.35–1.44) and a 51% increase in overall mortality (HR 1.51; 95% CI 1.48–1.54) [16]. Similarly, another study revealed that men who are not married were more likely to be diagnosed with late stage prostate cancer in Florida [12]. However, it has to be kept in mind that by the main purpose of including control factors in the multivariable model is not to estimate the independent association of each one of them, but to control for their potential confounding effect. The actual

set of control variables was chosen to control for confounding while estimating the association between race and stage at diagnosis. The appropriate set of control factors, for any other independent variables, for instance marital status, could be different, and therefore, the "adjusted" OR for, for instance, marital status might not be the best unbiased estimation.

Naturally, our study had some limitations. As a cross-sectional study, causality cannot be established. Additionally, we relied on data from the FCDS from 1995 to 2013, which limits the potential for generalizability of results to states other than Florida. Because the study was based on secondary data, there were a number of variables that could not be assessed, such as family history of prostate cancer, comorbidities among participants, and length of insurance coverage before the time of diagnosis. In addition, there was no data to suggest genetic testing had been completed for any of the individuals in the study population. Thus, the impact of genetic mutations associated with the development of prostate cancer could not be assessed. Lastly, the FCDS did not specifically define the participants as “early” or “late” stage regarding their diagnosis. To resolve this, we utilized the staging system from the database to define our two categories by grouping those with Stage Group I and II into “early” stage and those with Stage Group III and IV into “late” stage.

5. Conclusions

In conclusion, insurance status may play an important role in the effect of race on late stage prostate cancer in black patients. This discovery may change the way healthcare is promoted among different racial and socioeconomic classes in order to more effectively address the already known racial disparities among men with prostate cancer. In turn, shedding light on the effect modification implicated by insurance status will allow for proper acquisition of services by correctly targeting vulnerable groups of individuals in order to improve the delivery of superior and personalized medical care. Our results also motivate us to say that providing health insurance coverage is not enough to close the gap among the observed disparities, highlighted by the fact that Medicaid-insured participants still demonstrated increased odds of presenting with late stage disease. Taking this a step further, we recommend an initiative to incentivize providers to participate in Medicaid coverage, possibly allowing for an expansion in services provided to these patients. Furthermore, having identified regional differences among patients diagnosed with late stage prostate cancer, we suggest that public health initiatives target areas with the most disparities. For example, community-wide health projects such as health fairs may be implemented within high risk regions in Florida with the objective of promoting shared decision making regarding appropriate screening based on the recommendations made by the United States Preventative Screening Task Force and the American Urological Association regarding PSA and digital rectal examination for early detection of prostate cancer. Furthermore, future studies may assess health disparity and survival according to race in prostate cancer patients after diagnosis as it has been shown that insured men with prostate cancer are less likely to present with metastatic disease, more likely to be treated if they develop high-risk disease and are more likely to survive their cancer [17,18]. In addition, Afro-American men with high-risk prostate cancer were also significantly less likely to receive potentially life-saving definitive treatment when compared with white men [19].

Conflict of interest

None.

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Authorship contribution

TB, ER, JM, AMN and NCB planned the study. TB, ER, JM, GC and PR analyzed data. All authors interpreted the data. ER, TB, JM drafted the first draft version of the article. NCB, GC, PR and AMN revised it critically for important intellectual content. All authors have read and approved the final version of the manuscript.

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