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General Obesity and Prostate Cancer in Relation to Abdominal Obesity and Ethnic Groups: A US Population-Based Cross-Sectional Study

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Background: Research suggests inconsistent evidence regarding the association between general obesity and prostate cancer among men in the United States. This study aimed to examine whether the association between general obesity and prostate cancer is influenced by abdominal obesity and ethnic groups.

Methods: The study utilized data from the National Health and Nutrition Examination Survey (NHANES). The analysis was restricted to non-Hispanic men (10,683 White and 6,020 Black). Obesity was defined as body mass index (BMI) ≥30 and abdominal obesity as waist circumference (WC) ≥102 cm.

Results: No significant difference was identified in the overall prevalence of prostate cancer between obese and non-obese (2.14% vs 2.25%, P = 0.678). When both obesity measures were combined, the general and abdominal obesity category was associated with a significant increase in the odds of prostate cancer in Black men [odds ratio (OR) = 1.49, 95% confidence interval (CI) (1.09, 2.04)], but not in White men [OR = 1.29, 95% CI (0.91, 1.82)]. In both Black [OR = 2.46, 95% CI (1.48, 4.06)] and White men [OR = 1.60, 95% CI (1.16, 2.21)], abdominal obesity was associated with significant increase in the odds of prostate cancer.

Conclusion: The association between general obesity and prevalence of prostate cancer depends on abdominal obesity and ethnic groups. Our study utilized a nationally representative survey and emphasized the potential of combined effect of general and abdominal obesity as a modifiable factor to decrease racial disparity in prostate cancer screening and poor outcomes.

Keywords: prostate cancer, waist circumference, obesity, Black men, racial disparity

Introduction

Prostate cancer remains a significant public health concern in the United States, representing the number one most common cancer diagnosed in men and the second leading cause of cancer-related mortality among men in 2022.[1] An estimated 268,490 new cases of prostate cancer were diagnosed and total prostate cancer-related deaths totaled 34,500 in the United States in 2022.[1,2] The introduction of prostate-specific antigen (PSA) testing in the early 1990s has led to increased detection of early-stage prostate cancer, which in some cases may not require surgical intervention or treatment.[3] Although the PSA alone is not sufficient to detect aggressive prostate cancer, it remains the most important marker for screening of prostate cancer.[4] Due to the potential harms of PSA tests such as overdiagnosis, overtreatment and anxiety, the population-based screening is currently not recommended and the decision to screen for prostate cancer relies mainly on two factors: age (55–69 years) and men's choice.[5] The identification of additional risk factors and associations to further differentiate which patients may benefit from screening is imperative, given the current US Preventive Services Task Force guidelines. For instance, race and ethnicity[6–8] and body fat indicators[9,10] are important factors to personalize prostate cancer risk and improve health outcomes.

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The association between obesity (measured by body mass index (BMI) and prostate cancer in the literature remains widely inconsistent, with existing studies and meta-analyses presenting positive,[11,12] negative,[13–16] or null associations.[17] Recently, obesity has garnered attention for its potential role in prostate cancer aggressiveness, as it is associated with high grade,[18] higher rate of cancer recurrence,[19] and increased mortality.[13,20,21]

The relationship between obesity and prostate cancer risk might differ across ethnic groups. There is evidence that BMI is inversely associated with prostate cancer risk in non-Hispanic White men but positively associated in non-Hispanic Black men.[22] This complex relationship in various ethnic groups can be further explored by measures of interrelation between body fat measurements such as obesity and abdominal obesity as defined by waist circumference (WC ≥ 102 cm). The association between abdominal obesity and prostate cancer also remains controversial, with some studies suggesting an elevated risk[15,23,24] and with others finding no apparent association.[25,26]

Conflicting evidence also exists on whether the association between BMI and risk of prostate cancer is related to abdominal obesity. A Korean study reported a strong association between BMI and prostate cancer in patients with high WC (WC ≥ 95 cm).[27] Abdominal obesity alone was not associated with prostate cancer, while increased risk was observed when the analysis was adjusted for BMI.[28] However, in a cohort of 46,094 men from the Cancer Prevention Study II Nutrition Cohort, WC was inversely associated with the rate of low-grade prostate cancer, but this association was not significant after adjustment for BMI.[25] The associations of general and abdominal obesity with prostate cancer have not been investigated in the National Health and Nutrition Examination Survey (NHANES). Our analysis used NHANES data collected over nine cycles (2001–2020).

The interaction effect between general and abdominal obesity on prostate cancer has not been widely studied, particularly in the ethnic populations of non-Hispanic Black and White men. We hypothesized that the association between general obesity and prostate cancer might be modified by abdominal obesity and that this association might vary by the ethnic groups. We utilized the extensive data available from a large population-based cross-sectional study to provide a more comprehensive understanding of whether there is an interaction effect between general and abdominal obesity on the prevalence of prostate cancer.

Materials and Methods

Study Design

This study utilized data from the NHANES cross-sectional population-based surveys. A series of independent surveys have been conducted since 1999 by the National Center for Health Statistics of the Centers for Disease Control and Prevention (CDC). The CDC uses a stratified, multi-stage probability sampling design to routinely collect data from a non-institutionalized civilian population.[29]

Study Population

We included data of adult men, who were 18 years and older at the time of screening, from the NHANES 2001–2020-March. We combined eight two-year samples (2001 to 2016) with a prepandemic 3.2-year sample (2017 to 2020-March) to increase the precision of our estimates. We applied survey weights to calculate nationally representative estimates. The total participants during this period was 97,657. We excluded 49,483 women and 20,297 respondents aged 17 and below. We also excluded 1,671 respondents who reported a diagnosis of cancer other than prostate cancer. We restricted our final analytic file to two non-Hispanic populations totaling 16,703 (10,683 White and 6,020 Black). Other ethnic groups (Pacific Islanders and Native Americans) were not included in the analysis due to the small sample sizes. Also, there is no known genetic link to prostate cancer in these minorities, whereas 1) Black men have a higher burden of obesity,[30] 2) Black men were diagnosed at younger ages,[31] and 3) Black men were diagnosed with higher grades and stages.[6–8] This study received ethical approval from the Uniformed Services University Institutional Review Board (Protocol # DBS.2024.766).

Data Collection

In this study, we merged public files on demographics (DEMO), ages at 1st cancer diagnosis using the questionnaire for medical conditions (MCQ230), and body fat indicator measures (BMX). Age at screening (18 years and ≥ 75 years) and high school or less (yes/no) were included to control for their potential confounding effects. Non-Hispanic race/ethnicity (White and Black) was used as a stratifying covariate. The primary outcome was the first prostate cancer diagnosis and that was identified based on the response to two questions: "Have you ever been told by a doctor or other health professional that you had cancer or a malignancy of any kind?" and first cancer type "What kind of cancer was it?" Participants were categorized into prostate cancer status (yes/no). As part of the NHANES survey, the body fatness data were measured in Mobile Examination Centers by trained health technicians. Abdominal obesity was defined as a WC of 102 cm or greater.[32] General obesity was defined as a BMI of 30 kg/m^2 or greater.[33] We also examined several mutually exclusive classes of obesity indicators, including four categories: 1) general and abdominal obesity, 2) abdominal obesity without general obesity (or abdominal obesity only), 3) general obesity without abdominal obesity (or general obesity only), and 4) none of the two (the reference group).

Statistical Analysis

The data analysis was conducted using SAS 9.4 SURVEYFREQ and SURVEYLOGISTIC (SAS Institute Inc., Cary, NC) which accounted for the NHANES 2001–2020-March survey weights in all estimations. However, because we combined several cycles, we adjusted survey weights to generate representative US population estimates by covering a 19.2-year period: 16-years (2001–2002 to 2015–2016) and 3.2-years (2017–2020-March pre-pandemic data).[34] We calculated the overall weighted prevalence estimates (%) and 95% confidence interval (CI) for prostate cancer status, general obesity, and abdominal obesity. Weighted prevalence estimates were compared using the Rao-Scott chi-square test. Bivariate analysis was performed to estimate the weighted prevalence of prostate cancer by obesity indicators and potential confounders (age and education). We assessed unadjusted relationships between potential confounders, obesity indicators, and prostate cancer. The moderator effect was tested with an interaction term between abdominal obesity (yes/no) and general obesity (yes/no) in predicting prostate cancer, using three weighted logistic regression models. In this moderator analysis, Model 1 controlled for no demographic characteristics, Model 2 controlled for age, and Model 3 controlled for age and education level. Odds ratio (OR) and 95% CI of first prostate cancer diagnosis were reported. We computed the area under the receiver operating characteristic curve (AUC-ROC) to evaluate the utility of obesity indicators and their combination for predicting prostate cancer. We stratified all the analyses by race/ethnicity, non-Hispanic Black and White.

Data Availability

The raw data generated in this study are publicly available: the National Health and Nutrition Evaluation Survey (NHANES) from 2001 to 2020-March.

Results

The analytic sample consisted of 16,703 men with weighted mean age at the time of examination of 45.2 years old (SE = 0.24) years and the weighted mean age at 1st prostate cancer diagnosis was 66.0 (SE = 0.47) years. Missingness rates in reporting BMI and WC were 5.53% and 7.93%, respectively, which were less than 10%. Table 1 showed the sample characteristics and the prevalence of prostate cancer by the sample characteristics. The overall prevalence estimates of general and abdominal obesity were 32.33% (95% CI: 31.21–33.45%) and 41.64% (95% CI: 40.43–42.85%), respectively. In our sample, a large percentage (29.32%) of men were generally and abdominally obese, 12.14% abdominally obese only, and 1.86% generally obese only.

The overall prevalence estimate of prostate cancer was 2.25% (95% CI: 2.00–2.50%). No significant difference was identified in the overall prevalence of prostate cancer between obese (2.14%) and non-obese (2.25%), P = 0.678. Men with abdominal obesity without general obesity have significantly higher prevalence of prostate cancer (4.28%) compared to men with both general and abdominal obesity (2.23%), men with neither abdominal obesity nor general obesity (1.70%), and men with general obesity without abdominal obesity (0.18%), P < 0.0001. This association remains significant after stratification by race/ethnicity, where Black men with abdominal obesity without general obesity (7.21%) have the highest prevalence of prostate cancer, followed by White men with abdominal obesity without general obesity (4.09%) (Figure 1).

Table 1 Sample Characteristics and Weighted Prevalence of Prostate Cancer (NHANES 2001–2020)

Characteristics	Category	n	Overall Weighted %	Weighted Prevalence Of Prostate Cancer		P-value
				n	%	
Prostate cancer status	No	16045	97.75			
	Yes	658	2.25			
Ethnicity	Non-Hispanic Black	6020	14.40	232	2.53	0.148
	Non-Hispanic White	10683	85.60	426	2.20	
Age 75 or older	No	14722	94.26	312	1.29	<0.001
	Yes	1981	5.74	346	18.06	
High School or less	Missing	1116	3.81			
	No	8232	58.37	348	2.38	0.645
	Yes	7355	37.82	308	2.26	
General obesity	Missing	1099	5.53			
	No	10298	62.14	404	2.25	0.678
	Yes	5306	32.33	195	2.14	
Abdominal obesity	Missing	1587	7.93			
	No	8387	50.42	244	1.65	<0.001
	Yes	6729	41.64	330	2.84	
Obesity indicators	Missing	1671	8.23			
	None	8014	48.46	239	1.70	<0.001
	General Obesity only	334	1.86	2	0.18	
	Abdominal obesity only	1941	12.14	148	4.28	
	Obesity & Abdominal obesity	4743	29.32	180	2.23	

Notes: Abdominal obesity was defined by as a waist circumference (WC) of 102 cm or greater. General obesity was defined as a body mass index (BMI) of 30 kg/m^2 or greater.
Abbreviations: 95% CI, 95% Confidence Limits; LCL, Lower Confidence Limit; UCL, Upper Confidence Limit; SE, standard errors.

The unadjusted relationships between the obesity indicators, the potential confounders, and prostate cancer by race/ethnicity are illustrated in Table 2. Men age 75 or older and men with abdominal obesity had higher odds of prostate cancer regardless of their race/ethnicity. Without adjustment for abdominal obesity, there was no association between general obesity and the prevalence of prostate cancer, neither in the overall sample nor by race/ethnicity. While abdominal obesity without general obesity had a significant association with the prevalence of prostate cancer, regardless of race/ethnicity, obesity without abdominal obesity was a protective factor against prostate cancer in White men but not Black men. Conversely, the presence of both general and abdominal obesity was a significant predictor of prostate cancer in Black men but not White men.

The role of abdominal obesity as a moderator in the relationship between general obesity and prostate cancer by race/ethnicity was also assessed (Table 3). The associations remain consistent after adjusting for potential confounders. For instance, after adjustment for age and education, general and abdominal obesity category was associated with a significant increase in the odds of prostate cancer in Black men, but not in White men. In both race/ethnicity Black and White men, abdominal obesity was only strongly associated with significant increase in the odds of prostate cancer,

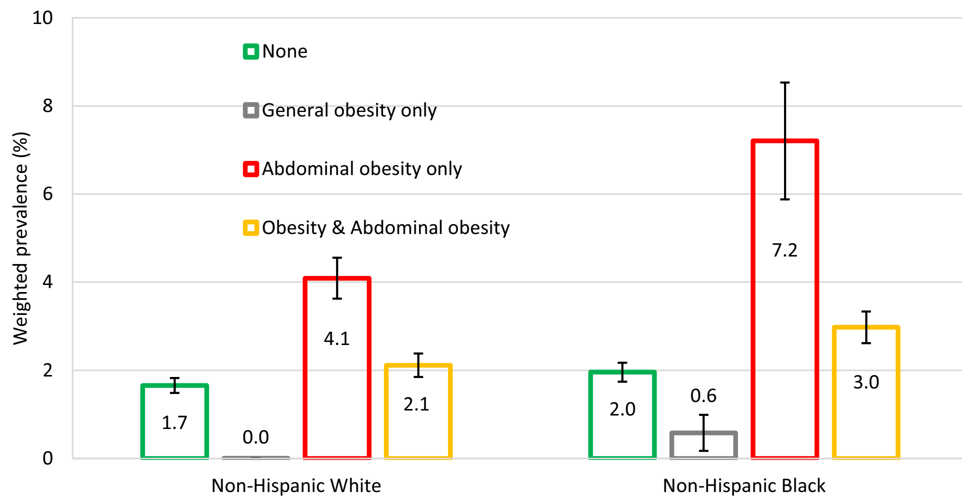

Figure 1 The effect of obesity indicators on the prevalence of prostate cancer by ethnicity (NHANES 2001–2020).
Notes: Unadjusted weighted prevalence estimates (in percentage %) of prostate cancer by ethnicity and obesity indicators. Error bars represent ± SE.

whereas general obesity only was associated with significant decrease n the odds of prostate cancer in White men, but not Black men. Almost none of the generally obese White had prostate cancer.

The combined effect of BMI and WC improved the predictive accuracy for prostate cancer in both Black (Figure 2A) and White men (Figure 2B). The ROC curves in Black men were slightly higher than in White men (BMI: AUC = 0.54 vs 0.50, WC: AUC = 0.63 vs 0.58, and their combination: AUC = 0.74 vs 0.72, respectively).

Discussion

We sought to understand the interrelationship between BMI and WC and their contribution to prostate cancer. We analyzed data collected over the last two decades to evaluate obesity indicators (general and abdominal obesity) and their combined effects on the prevalence of prostate cancer in different race/ethnicity groups. This is the first study to assess the combined effect of BMI and WC in NHANES participants. Although obesity and abdominal obesity are lifestyle

Table 2 Unadjusted Relationship Between Demographic, Body Fat Indicators, and Prostate Cancer by Ethnicity (NHANES 2001–2020)

	Overall N= 16703			Non-Hispanic Black N= 6020			Non-Hispanic White N= 10683		
Factors	**OR**	**LCL**	**UCL**	**OR**	**LCL**	**UCL**	**OR**	**LCL**	**UCL**
Age 75 or older	**16.87**	**13.51**	**21.07**	**11.79**	**8.49**	**16.37**	**18.30**	**14.28**	**23.4**
High School or less	0.949	0.758	1.187	0.85	0.63	1.13	0.96	0.74	1.24
General obesity	0.949	0.741	1.217	1.15	0.89	1.50	0.91	0.67	1.23
Abdominal obesity	**1.74**	**1.388**	**2.181**	**1.94**	**1.45**	**2.60**	**1.73**	**1.33**	**2.25**
Obesity indicators									
General Obesity only vs none	**0.102**	**0.025**	**0.418**	0.29	0.07	1.25	**0.00**	**0.00**	**0.00**
Abdominal obesity only vs none	**2.578**	**1.97**	**3.373**	**3.89**	**2.44**	**6.21**	**2.53**	**1.88**	**3.42**
Obesity & Abdominal obesity vs none	**1.317**	**0.998**	**1.74**	**1.54**	**1.13**	**2.09**	**1.28**	**0.92**	**1.79**

Notes: Abdominal obesity was defined by as a waist circumference (WC) of 102 cm or greater. General obesity was defined as a body mass index (BMI) of 30 kg/m^2 or greater. **Boldface** indicates statistical significance (p=0.05).
Abbreviations: 95% CI, 95% Confidence Limits; LCL, Lower Confidence Limit; UCL, Upper Confidence Limit; OR, Odds ratio.

Table 3 Moderator Effect of Abdominal Obesity on the Relationship Between General Obesity and Prostate Cancer by Ethnicity (NHANES 2001–2020)

	Interaction effects		Overall N= 16703			Non-Hispanic Black N= 6020			Non-Hispanic White N= 10683		
			95% CI			95% CI			95% CI		
	Abdominal obesity	General obesity	OR	LCL	UCL	OR	LCL	UCL	OR	LCL	UCL
Model 1*	Yes	Yes	1.32	0.99	1.74	**1.54**	**1.13**	**2.09**	1.28	0.92	1.79
	Yes	No	**2.58**	**1.97**	**3.37**	**3.89**	**2.44**	**6.21**	**2.53**	**1.88**	**3.42**
	No	Yes	**0.10**	**0.03**	**0.42**	0.29	0.07	1.25	**0.00**	**0.00**	**0.00**
Model 2†	Yes	Yes	**1.35**	**1.01**	**1.80**	**1.57**	**1.14**	**2.15**	1.32	0.93	1.87
	Yes	No	**1.68**	**1.26**	**2.24**	**2.63**	**1.59**	**4.33**	**1.65**	**1.19**	**2.28**
	No	Yes	**0.14**	**0.03**	**0.57**	0.35	0.09	1.45	**0.00**	**0.00**	**0.00**
Model 3‡	Yes	Yes	1.31	0.98	1.75	**1.49**	**1.09**	**2.04**	1.29	0.91	1.82
	Yes	No	**1.61**	**1.21**	**2.15**	**2.46**	**1.48**	**4.06**	**1.60**	**1.16**	**2.21**
	No	Yes	**0.14**	**0.03**	**0.57**	0.35	0.09	1.44	**0.00**	**0.00**	**0.00**

Notes: *. Unadjusted; †. Adjusted for age; ‡. Adjusted for age and education level. Abdominal obesity was defined by as a waist circumference (WC) of 102 cm or greater. General obesity was defined as a body mass index (BMI) of 30 kg /m2 or greater. **Boldface** indicates statistical significance (p=0.05).
Abbreviations: 5% CI, 95% Confidence Limits; LCL, Lower Confidence Limit; UCL, Upper Confidence Limit; OR, Odds ratio.

factors and preventable, they remain risk factors for increased aggressiveness of prostate cancer and mortality.[8,15,20,24,35] Our findings suggest that WC might modify the association between BMI and prostate cancer. There is a need to evaluate data on obesity and prostate cancer by distinguishing separate effects from the combined effect of BMI and WC.[27,28]

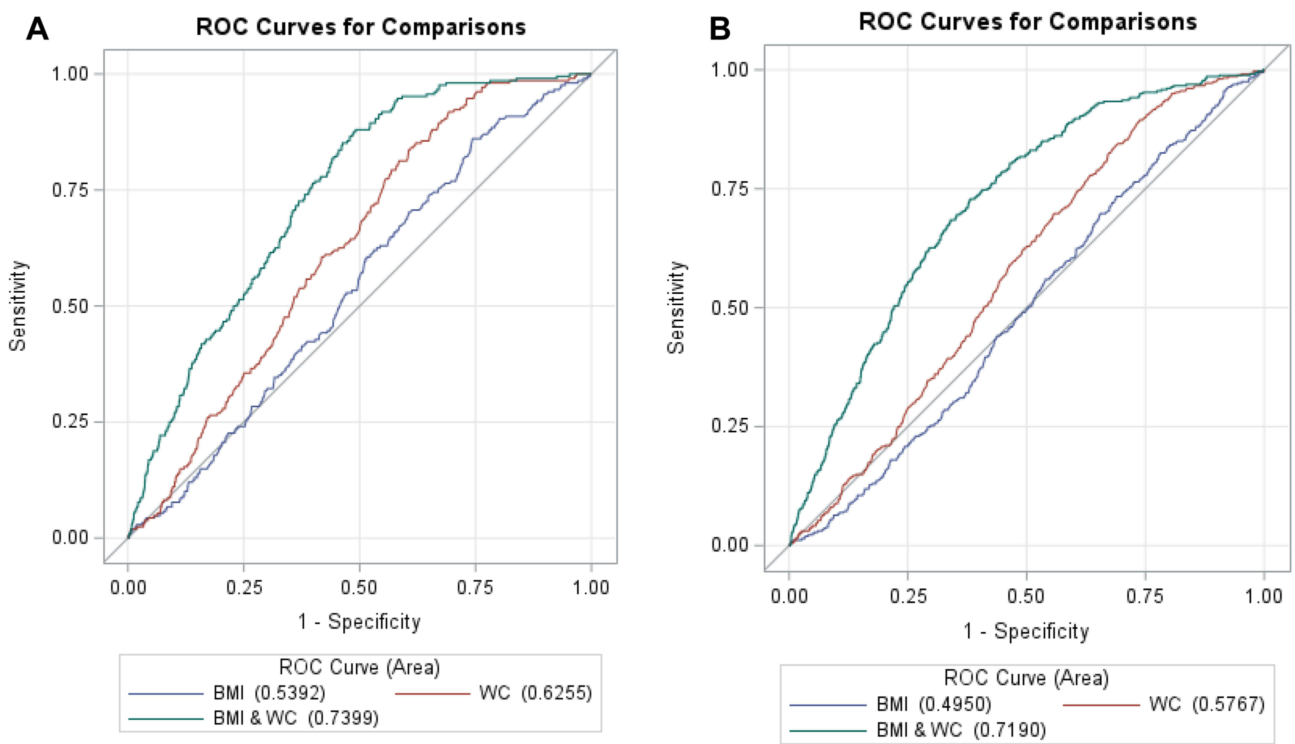

Figure 2 (**A**) ROC curves of BMI, WC, and their combination in Non-Hispanic Black men. (**B**) ROC curves of BMI, WC, and their combination in Non-Hispanic White men.

The current published data on obesity indicators and prostate cancer are not consistent. Some studies have found that obesity increases prostate cancer risk,[11,12,15,23,24] while others have shown a decreased risk,[13–16] or no such association.[17,25,26] The present study shows that the overall prevalence estimates of prostate cancer were quite similar across general obesity categories (2.14% yes vs 2.25% no), but significantly vary across abdominal obesity categories (2.84% yes vs 1.65% no). When both obesity measures were combined, the prevalence estimates in men with neither general obesity nor abdominal obesity, obesity only, abdominal obesity only, and both were 1.70%, 0.18%, 4.28%, and 2.23%, respectively. This might explain the discrepancy between previous epidemiologic studies, as the majority of currently published data evaluated general obesity as a separate effect rather than the combined effect of BMI and WC.

Despite its use of various cut-point values for BMI and WC, a large study utilized data from Cancer Prevention Study II Nutrition Cohort revealing that WC as a categorical and continuous covariate was not associated with low-grade (Gleason score < 8) or high-grade (Gleason score ≥ 8) prostate cancer after adjustment for BMI.[25] In our study, we found that abdominal obesity only (WC ≥ 102 cm and BMI < 30 kg/m^2) was associated with prostate cancer. However, their approach did not investigate the combined effect of BMI and WC on prostate cancer grades, which might explain the discrepancy between their findings and the present study.

Though many studies have investigated the contribution of BMI and WC as separate effects, few studies have documented the combined effect of BMI and WC on prostate cancer. Our regression analysis findings were consistent with an age-matched (±5 years) Canadian study that evaluated the relationship between obesity indicators and prostate cancer.[28] They found BMI to be associated with a decreased prostate cancer incidence, whereas abdominal obesity increased prostate cancer incidence when the analysis adjusted for BMI. A Korean study reported that the association between obesity and prostate cancer might depend on abdominal obesity.[27] Although this study used lower cut-point values for abdominal obesity (eg, WC ≥ 90 cm) and obesity (eg, BMI ≥ 25 kg/m^2), our study remains consistent with their findings, and revealed a significant association between abdominal obesity without general obesity and the presence of both general and abdominal obesity with prostate cancer. Strategies to identify prostate cancer and its progression should include fat distribution as adipose tissues can cause long-term inflammation and insulin resistance, which could be potential mechanisms for initiation or progression of prostate cancer.[36]

The link between the combined effect of BMI and WC and prostate cancer is not well described in race/ethnicity populations. We sought to determine race/ethnicity differences in the association between obesity indicators and prostate cancer. Our findings were consistent with Beebe-Dimmer et al as their study shows obesity provided a protective effect against prostate cancer among White men (OR 0.51, 95% CI 0.33–0.80), but no effect against prostate cancer in Black men (OR 1.15, 95% CI 0.70–1.89).[37] Another study by Beebe-Dimmer et al shows abdominal obesity was strongly associated with prostate cancer in Black men.[38] Our results suggest that abdominal obesity only (based on WC ≥ 102 and BMI < 30) might be problematic for both Black and White men, whereas general and abdominal obesity (based on BMI ≥ 30 and WC ≥ 102) might be problematic for Black men. The racial/ethnic differences in combined obesity indicators and prostate cancer might be explained by the tumor biology due to the underlying genetic factors.[39,40] The combined effect of BMI and WC can be assessed in future studies as modifiable factors to improve screening strategies and prevent prostate cancer–related mortality. Managing and mentoring WC and BMI might decrease the racial disparity in prostate cancer incidence.

Limitations

The results of this study must be viewed in the context of certain limitations. Despite the large sample, causal inferences could not be implied due to the nature of the study design. Self-reported prostate cancer history of participants might underestimate the true prevalence of prostate cancer in the US population. Gleason score and prostate cancer grades were not reported in NHANES. BMI and WC cut-point values might differ across ethnicities and/or countries (eg, Korea, WC ≥90). The NHANES did not incorporate additional indicators of fat distribution, such as waist-to-hip ratio and collective visceral and subcutaneous adipose tissues, when estimating abdominal obesity. The body fat measures were obtained at the time of screening which after the prostate cancer diagnosis and might not reflect measurements at the time of diagnosis. Future studies on combined obesity indicators and prostate cancer and poor outcomes must consider temporality and account for the race-specific and other fat distribution indicators. Race-specific prospective studies can be conducted on prostate cancer risk categories or Gleason grade to determine if patients with "abdominal obesity only" have more aggressive prostate cancer than patients with general obesity; however, this may not be technically feasible given the large number of patients required for adequate power.

Conclusion

The association between general obesity and prevalence of prostate cancer depends on abdominal obesity and ethnic groups. This study illustrates that WC is a potential classifier of prostate cancer as it shows variation in the prevalence of prostate cancer by general obesity within the same and different racial and ethnic groups. The results of the present investigation demonstrate the importance of incorporating obesity indicators to address prostate cancer racial disparity in screening and poor outcomes. These differences in the combined obesity effect of BMI and WC and the prevalence of prostate cancer might also be explained by underlying genetic factors.

Ethical Considerations

This study received ethical approval from the Uniformed Services University Institutional Review Board (Protocol # DBS.2024.766).

Ethics Approval and Consent to Participate

Not applicable. This is an analysis of secondary data without identifiers.

Consent for Publication

Not Applicable.

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References

1. Siegel RL, Miller KD, Fuchs HE, Jemal A. Cancer statistics, 2021. *Ca Cancer J Clin*. 2021;71(1):7–33. doi:10.3322/caac.21654
2. Tsodikov A, Gulati R, Heijnsdijk EA, et al. Reconciling the effects of screening on prostate cancer mortality in the ERSPC and PLCO trials. *Ann Internal Med*. 2017;167(7):449–455. doi:10.7326/M16-2586
3. Marcus PM, Prorok PC, Miller AB, DeVoto EJ, Kramer BS. Conceptualizing overdiagnosis in cancer screening. *J National Cancer Inst*. 2015;107 (4):djv014. doi:10.1093/jnci/djv014
4. Moul JW, Sesterhenn IA, Connelly RR, et al. Prostate-specific antigen values at the time of prostate cancer diagnosis in African-American men. *JAMA*. 1995;274(16):1277–1281. doi:10.1001/jama.1995.03530160029029
5. Grossman DC, Curry SJ, Owens DK, US Preventive Services Task Force. Screening for Prostate Cancer: US preventive services task force recommendation statement. *JAMA*. 2018;319(18):1901–1913. doi:10.1001/jama.2018.3710

6. Alexander M, Zhu K, Cullen J, et al. Race and overall survival in men diagnosed with prostate cancer in the department of defense military health system, 1990–2010. *Cancer Causes Control*. 2019;30(6):627–635. doi:10.1007/s10552-019-01163-5
7. Hoffman RM, Gilliland FD, Eley JW, et al. Racial and ethnic differences in advanced-stage prostate cancer: the prostate cancer outcomes study. *J National Cancer Inst*. 2001;93(5):388–395. doi:10.1093/jnci/93.5.388
8. Su LJ, Arab L, Steck SE, et al. Obesity and prostate cancer aggressiveness among African and Caucasian Americans in a population-based study. *Cancer Epidemiol Biomarkers Prev*. 2011;20(5):844–853. doi:10.1158/1055-9965.EPI-10-0684
9. Allott EH, Masko EM, Freedland SJ. Obesity and prostate cancer: weighing the evidence. *Europ urol*. 2013;63(5):800–809. doi:10.1016/j.eururo.2012.11.013
10. Bandini M, Gandaglia G, Briganti A. Obesity and prostate cancer. *Current Opinion in Urology*. 2017;27(5):415–421. doi:10.1097/MOU.0000000000000424
11. Zhu D, Toker M, Shyr W, Fram E, Watts KL, Agalliu I. Association of obesity and diabetes with prostate cancer risk groups in a multiethnic population. *Clin Genitourinary Cancer*. 2022;20(3):299. doi:10.1016/j.clgc.2022.01.016
12. Agalliu I, Lin WK, Zhang JS, et al. Overall and central obesity and prostate cancer risk in African men. *Cancer Causes Control*. 2022;1–7.
13. Hurwitz LM, Dogbe N, Barry KH, Koutros S, Berndt SI. Obesity and prostate cancer screening, incidence, and mortality in the prostate, lung, colorectal, and ovarian cancer screening trial. *JNCI J National Cancer Inst*. 2023; 115:djad113.
14. Yuan C, Jian Z, Feng S, et al. Do obesity-related traits affect prostate cancer risk through serum testosterone? A Mendelian randomization study. *Cancers*. 2023;15(19):4884. doi:10.3390/cancers15194884
15. Vallières E, Mésidor M, Roy-Gagnon MH, Richard H, Parent MÉ. General and abdominal obesity trajectories across adulthood, and risk of prostate cancer: results from the PROtEuS study, Montreal, Canada. *Cancer Causes Control*. 2021;32:653–665.
16. Lu Y, Edwards A, Chen Z, et al. Insufficient lycopene intake is associated with high risk of prostate cancer: a cross-sectional study from the national health and nutrition examination survey (2003–2010). *Front Public Health*. 2021;9:792572. doi:10.3389/fpubh.2021.792572
17. Zhang X, Zhou G, Sun BO, et al. Impact of obesity upon prostate cancer-associated mortality: a meta analysis of 17 cohort studies. *Oncol Lett*. 2015;9(3):1307–1312. doi:10.3892/ol.2014.2841
18. Nair-Shalliker V, Bang A, Egger S, et al. Family history, obesity, urological factors and diabetic medications and their associations with risk of prostate cancer diagnosis in a large prospective study. *Br. J. Cancer*. 2022;127(4):735–746. doi:10.1038/s41416-022-01827-1
19. Rivera-Izquierdo M, Perez de Rojas J, Martínez-Ruiz V, Arrabal-Polo MA, Pérez-Gómez B, Jiménez-Moleón JJ. Obesity and biochemical recurrence in clinically localised prostate cancer: a systematic review and meta-analysis of 86,490 patients. *Prostate Cancer and Prostatic Diseases*. 2022;25(3):411–421. doi:10.1038/s41391-021-00481-7
20. Vidal AC, Oyekunle T, Howard LE, et al. Obesity, race, and long-term prostate cancer outcomes. *Cancer*. 2020;126(16):3733–3741. doi:10.1002/cncr.32906
21. Rivera-Izquierdo M, Pérez de Rojas J, Martínez-Ruiz V, et al. Obesity as a risk factor for prostate cancer mortality: a systematic review and dose-response meta-analysis of 280,199 patients. *Cancers*. 2021;13(16):4169. doi:10.3390/cancers13164169
22. Barrington WE, Schenk JM, Etzioni R, et al. Difference in association of obesity with prostate cancer risk between US African American and non-Hispanic white men in the Selenium and Vitamin E Cancer Prevention Trial (SELECT). *JAMA Oncol*. 2015;1(3):342–349. doi:10.1001/jamaoncol.2015.0513
23. Hurwitz LM, Yeboah ED, Biritwum RB, et al. Overall and abdominal obesity and prostate cancer risk in a West African population: an analysis of the Ghana prostate study. *Int J Cancer*. 2020;147(10):2669–2676. doi:10.1002/ijc.33026
24. De Nunzio C, Albisinni S, Freedland SJ, et al. Abdominal obesity as risk factor for prostate cancer diagnosis and high grade disease: a prospective multicenter Italian cohort study. *In Urol Oncol*. 2013;31(7):997–1002. doi:10.1016/j.urolonc.2011.08.007
25. Stevens VL, Jacobs EJ, Maliniak ML, Patel AV, Gapstur SM. No association of waist circumference and prostate cancer in the Cancer Prevention Study II nutrition cohort. *Cancer Epidemiol Biomarkers Prev*. 2017;26(12):1812–1814. doi:10.1158/1055-9965.EPI-17-0802
26. Lavalette C, Trétarre B, Rebillard X, Lamy PJ, Cénée S, Menegaux F. Abdominal obesity and prostate cancer risk: epidemiological evidence from the EPICAP study. *Oncotarget*. 2018;9(77):34485. doi:10.18632/oncotarget.26128
27. Choi JB, Myong JP, Lee Y, et al. Does increased body mass index lead to elevated prostate cancer risk? It depends on waist circumference. *BMC Cancer*. 2020;20(1):1–8. doi:10.1186/s12885-020-07089-5
28. Boehm K, Sun M, Larcher A, et al. Waist circumference, waist-Hip ratio, body mass index, and prostate cancer risk: results from the North-American case-control study prostate cancer & environment study *Urologic Oncology: Seminars and Original Investigations*. Vol. 33(11): Elsevier:494–e1. 2015
29. National Center for Health Statistics (NCHS). National Health and Nutrition Examination Survey Data. Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Available from: http://www.cdc.gov/nchs/data_access/data_linkage/mortality/nhanes3_linkage.htm. Accessed December 8, 2023.
30. Hales CM, Carroll MD, Fryar CD, Ogden CL. Prevalence of obesity among adults and youth: United States. 2015–2016.
31. Batura D, Patel A, Gandhi A, et al. Ethnic differences in prostate cancer presentation: a time for testing advocacy. *World j Urol*. 2023;41:1–7.
32. Seo DC, Choe S, Torabi MR. Is waist circumference≥ 102/88 cm better than body mass index≥ 30 to predict hypertension and diabetes development regardless of gender, age group, and race/ethnicity? Meta-analysis. *Preventive Med*. 2017;97:100–108. doi:10.1016/j.ypmed.2017.01.012
33. Centers for Disease Control and Prevention. Defining adult overweight & obesity. Available from: https://www.cdc.gov/obesity/basics/adult-defining.html. Accessed December 8, 2023.
34. National Center for Health Statistics. NHANES analytic guidance and brief overview for the 2017–March 2020 pre-pandemic data files, 2021. Available from: https://wwwn.cdc.gov/nchs/nhanes/continuousnhanes/overviewbrief.aspx?Cycle=2017-2020. Accessed December 8, 2023.
35. Saha A, Kolonin MG, DiGiovanni J, Yap T. Obesity and prostate cancer—microenvironmental roles of adipose tissue. *Nat Rev Urol*. 2023;20(1):1–8. doi:10.1038/s41585-022-00661-7
36. Langlais CS, Graff RE, Van Blarigan EL, et al. Postdiagnostic inflammatory, hyperinsulinemic, and insulin-resistant diets and lifestyles and the risk of prostate cancer progression and mortality. *Cancer Epidemiol Biomarkers Prev*. 2022;31(9):1760–1768. doi:10.1158/1055-9965.EPI-22-0147
37. Beebe-Dimmer JL, Nock NL, Neslund-Dudas C, et al. Racial differences in risk of prostate cancer associated with metabolic syndrome. *Urology*. 2009;74(1):185–190. doi:10.1016/j.urology.2009.03.013

38. Beebe-Dimmer JL, Dunn RL, Sarma AV, Montie JE, Cooney KA. Features of the metabolic syndrome and prostate cancer in African-American men. *Cancer: Interdiscip Int J Am Cancer Soc*. 2007;109(5):875–881. doi:10.1002/cncr.22461
39. Park SY, Haiman CA, Cheng I, et al. Racial/ethnic differences in lifestyle-related factors and prostate cancer risk: the multiethnic cohort study. *Cancer Causes Control*. 2015;26(10):1507–1515. doi:10.1007/s10552-015-0644-y
40. Mahal BA, Gerke T, Awasthi S, et al. Prostate cancer racial disparities: a systematic review by the prostate cancer foundation panel. *Eur Urol Oncol*. 2022;5(1):18–29. doi:10.1016/j.euo.2021.07.006