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Investigating the Relationship Between Fatty Liver Disease and Prostate Cancer in U.S. Adults: A Population-Based Study

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Introduction

Prostate cancer remains one of the most commonly diagnosed cancers in men globally, while non-alcoholic fatty liver disease (NAFLD) has emerged as a leading chronic liver condition, affecting approximately one-quarter of the world's population. Given the overlap in metabolic risk factors and shared pathways such as chronic inflammation and hormonal dysregulation, there is growing interest in understanding whether NAFLD contributes to prostate cancer risk. This study aimed to evaluate whether men with a history of NAFLD have increased odds of reporting prostate cancer in a nationally representative U.S. sample.

Methods

Data were drawn from the 2021–2023 cycles of the National Health and Nutrition Examination Survey (NHANES). Adult male participants with available data on liver health, cancer history, and demographic characteristics were included. Prostate cancer and NAFLD status were determined through self-reported diagnoses. Logistic regression was used to assess the association between NAFLD and prostate cancer, adjusting for age, race/ethnicity, education, and marital status.

Results

Among 11,900 participants, 227 (1.9%) reported a diagnosis of fatty liver and 5,558 were male. Prostate cancer was not significantly associated with NAFLD after adjusting for covariates (OR = 0.83, 95% CI: 0.24–2.82, $p = 0.774$). However, older age was strongly associated with increased prostate cancer risk (OR = 1.10 per year, $p < 0.001$). Being not married was associated with lower odds of prostate cancer (OR = 0.52, $p = 0.002$), and White participants had significantly lower odds than Black participants (OR = 0.33, $p = 0.001$).

Conclusion

This analysis did not identify a significant association between NAFLD and prostate cancer, aligning with prior studies showing inconclusive or null results. Despite biological plausibility through mechanisms such as insulin resistance and systemic inflammation, NAFLD's role in prostate carcinogenesis remains uncertain. In contrast to more established associations between NAFLD and colorectal cancer, the link to prostate cancer appears weaker or more complex. Future research using biopsy-confirmed liver disease and prospective data may clarify these relationships.

Prostate cancer is a significant health issue, particularly among older men, ranking as the second most common cancer in men worldwide after skin cancer. Annually, over one million men receive a prostate cancer diagnosis, and approximately 375,000 die from the disease.^{1,2} Despite notable advancements in early screening and treatment, prostate cancer remains a critical public health challenge.³ Simultaneously, non-alcoholic fatty liver disease (NAFLD)

prevalence has markedly increased, primarily due to rising rates of obesity and associated metabolic disorders, such as insulin resistance.^{4,5} Currently, NAFLD affects about one in four individuals globally. It is commonly linked with chronic inflammation and hormonal imbalances, potentially contributing to cancer development beyond the liver and colon, including prostate cancer.^{6,7} Although NAFLD and prostate cancer share certain risk factors, the precise

Table 1. Demographic and Clinical Characteristics by Fatty Liver Status

	No Fatty Liver N (%)	Fatty Liver N (%)	Total N (%)
Total	11,673 (98.1%)	227 (1.9%)	11,900
Age (Mean ± SD)	37.93 ± 25.64	55.88 ± 15.43	—
Gender			
Male	5,474 (46.9%)	84 (37.0%)	5,558 (46.7%)
Female	6,199 (53.1%)	143 (63.0%)	6,342 (53.3%)
Race			
Black	1,583 (15.7%)	11 (5.6%)	1,594 (15.5%)
Hispanic	2,415 (24.0%)	63 (32.1%)	2,478 (24.3%)
White	6,082 (60.3%)	122 (62.2%)	6,204 (60.2%)
Education			
<9th grade	348 (4.6%)	19 (8.8%)	367 (4.7%)
9–11th grade	640 (8.5%)	23 (10.6%)	663 (8.6%)
HS grad/GED	1,691 (22.4%)	54 (25.0%)	1,745 (22.5%)
Some college/AA	2,296 (30.5%)	65 (30.1%)	2,361 (30.5%)
College grad+	2,561 (34.0%)	55 (25.5%)	2,616 (33.1%)
Marital Status			
Married	3,997 (53.0%)	124 (57.4%)	4,121 (53.0%)
Not Married	3,539 (47.0%)	92 (42.6%)	3,631 (47.0%)

relationship between them remains unclear. Given their growing prevalence, understanding any potential connection is essential. This study utilized data from the National Health and Nutrition Examination Survey (NHANES) to investigate if men with NAFLD were more likely to report a history of prostate cancer, controlling for demographic factors like age, race, education, and marital status.⁸

METHODS

This analysis utilized data from the National Health and Nutrition Examination Survey (NHANES), drawing on responses collected between 2021 and 2023. Participants were included if they had available data on liver conditions, cancer history, and relevant demographic information. Prostate cancer status was determined based on participant responses indicating a history of prostate cancer as their first, second, or third type of cancer. Fatty liver status was assessed based on a self-reported diagnosis.

Demographic covariates included age (continuous), gender, race/ethnicity (categorized as Hispanic, Black, or White), educational attainment (ranging from less than 9th grade to college graduate), and marital status (married vs. not married). All variables were harmonized across datasets and merged using the unique respondent identifier (SEQN).

Logistic regression was used to examine whether having a history of fatty liver was associated with increased odds of prostate cancer diagnosis, adjusting for the demographic variables. Statistical significance was determined using a two-sided p-value threshold of 0.05. Analyses were conducted using R version 4.2.0.

RESULTS

A total of 11,900 participants were included in the analysis, of whom 227 (1.9%) reported a diagnosis of fatty liver and 11,673 (98.1%) did not ([Table 1](#)). Participants with fatty liver were older on average (55.88 ± 15.43 years) compared to those without fatty liver (37.93 ± 25.64 years). The fatty liver group had a higher proportion of females (63.0%) compared to the non-fatty liver group (53.1%).

The racial distribution showed that the majority of both groups were White, although White participants were slightly more represented among those with fatty liver (62.2%) than those without (60.3%). Hispanic participants made up a higher proportion of the fatty liver group (32.1%) than the non-fatty liver group (24.0%), while Black participants were underrepresented among those with fatty liver (5.6%) compared to those without (15.7%).

In terms of educational attainment, those with fatty liver had a lower proportion of college graduates (25.5%) compared to those without fatty liver (34.0%). A slightly higher percentage of the fatty liver group had less than a high school education. Marital status distributions were similar between groups, with just over half of participants in each group reporting they were married.

A logistic regression model was used to assess whether fatty liver status was associated with a history of prostate cancer, adjusting for age, marital status, education, and race ([Table 2](#)). Fatty liver was not significantly associated with prostate cancer (OR = 0.83, 95% CI: 0.24–2.82, $p = 0.774$). However, increasing age was strongly associated with higher odds of prostate cancer (OR = 1.09, 95% CI:

Table 2. Logistic Regression Results Examining the Association Between Fatty Liver and Prostate Cancer

Variable	Odds Ratio (OR)	95% CI	P-value
Fatty liver	0.83	0.24 – 2.30	0.774
Age (years)	1.10 ***	1.06 – 1.13	<0.001
Not Married	0.52 **	0.35 – 0.82	0.002
Education: 9–11th grade	0.49	0.13 – 1.99	0.313
Education: High school/GED	1.62	0.58 – 4.59	0.355
Education: Some college/AA	1.41	0.51 – 3.91	0.509
Education: College grad+	1.99	0.73 – 5.44	0.18
Race: Hispanic	0.63	0.25 – 1.47	0.337
Race: White	0.33 **	0.17 – 0.69	0.001

Significance Legend

*p < 0.05

**p < 0.01

***p < 0.001

1.06–1.12, $p < 0.001$). Being not married was associated with significantly lower odds of prostate cancer compared to being married (OR = 0.52, 95% CI: 0.34–0.81, $p = 0.002$). Additionally, White participants had significantly lower odds of prostate cancer compared to Black participants (OR = 0.33, 95% CI: 0.17–0.66, $p = 0.001$).

DISCUSSION

Our NHANES analysis did not indicate a significant association between NAFLD and prostate cancer, aligning with previous studies reporting similarly unclear links. For example, a Swedish biopsy-confirmed NAFLD study found no increased prostate cancer incidence, despite increased risks of other cancers, such as liver cancer.⁹ Some studies suggest modest associations between metabolic-associated fatty liver disease (MAFLD) and prostate cancer, but findings remain inconsistent.^{10,11}

Potential biological mechanisms linking NAFLD to cancer include elevated insulin levels, chronic inflammation, and hormonal disturbances, factors prevalent in NAFLD that may promote carcinogenesis. However, the relationship between obesity and prostate cancer remains ambig-

ous compared to other cancers, possibly contributing to inconsistent findings regarding NAFLD's role.

In contrast, NAFLD's association with colorectal cancer is well-established, suggesting variability in NAFLD's oncogenic potential across different cancers. Challenges specific to prostate cancer research, such as inconsistent screening practices and difficulties differentiating NAFLD from more severe liver conditions (e.g., NASH), also complicate this area of study.

CONCLUSION

This study found no clear link between NAFLD and prostate cancer, though biological plausibility exists. Current research lacks robust evidence, highlighting the need for further studies with precise diagnostics and longitudinal designs. Regardless, addressing NAFLD remains crucial for overall health, irrespective of its role in prostate cancer development.

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