Body Mass Index as a Risk Factor for Prostate Cancer and Benign Prostate Hypertrophy: A Comparative Study at Three Reference Hospitals in Cameroon

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DOI: https://doi.org/10.24321/2454.8642.201817

Abstract

Introduction: Prostate cancer (PCa) is the second most commonly diagnosed cancer and the sixth most common cause of cancer-related mortality among men worldwide. Obesity increases the prevalence and mortality of multiple cancers. Consequently, the relationship between obesity and cancer is receiving more and more attention.

Objective: To evaluate the impact of body mass index (BMI) on prostate cancer detection and aggressiveness in Cameroonian population.

Methodology: This was a comparative cross-sectional study carried out at the hospitals in Cameroon. The study included Cameroonian who underwent prostate biopsies during a 9-year period, from 2008 to 2016. We analysed the BMI, age, prostate volume, and PSA of patients with prostate cancer in comparison with patients with benign prostate tissue who underwent prostate biopsies. Data entry was performed using CSpro 6.3.2, analysis was done using SPSS version 23.0.

Results: A total of 316 patients were included in our study, 158 PCa and 158 BPH. The patients had a mean age ± standard deviation of 67.8 ± 10.32 with a modal class of 61 and 70 years. In our study, the mean age ± SD of the PCa group (71.48 ± 8.96) was significantly greater than that of the BPH group (64.17 ± 10.31) (p<0.001).The PCa group had a mean BMI ± SD of 24.80 ± 4.07 while in the BPH group it was 24.49 ± 3.68, p = 0.472. Amongst the patients with high BMI, 71(52.2%) had prostate cancer while 65 (47.8%) had benign tissue. Amongst the patients with low BMI, 87(48.3%) had prostate cancer while 93 (51.4%) had benign tissue. The odds ratio was 1.168 with a 95% confidence interval of 0.748 to 1.823 (p>0.05). The median total PSA and the median PSA f/t ratio was significantly different in both groups (p<0.001 and p = 0.006). A Gleason score of 7 was the most frequent. Amongst those with a high BMI 77.5% (55) had a high Gleason score, which was significantly higher than the fraction in the low BMI group (60.9%) (53) (P = 0.026).

Conclusion: We therefore conclude that BMI is not an independent risk factor for the development of prostate cancer; rather, it is associated with High Gleason PCa.

Keywords: BPH, BMI, Gleason Score, Prostate cancer

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How to cite this article: Zacharie S, Nkapleweh LN, Achille M et al. Body Mass Index as a Risk Factor for Prostate Cancer and Benign Prostate Hypertrophy: A Comparative Study at Three Reference Hospitals in Cameroon. Rec Adv Path Lab Med 2018; 4(4): 18-22.
Introduction
Most new cases of cancers are now found in Africa and LMICs, increasing from 15% in 1970, to 56% in 2008, and projected to reach about 70% by 2030. Data from Benign Prostate hypertrophy are scarce in Africa, the disease affect about 350 men over 1000, aged between 60-69 Years. Prostate cancer (PCa) is the second most commonly diagnosed cancer and the fifth most common cause of cancer-related mortality among men worldwide. The incidence is particularly high among men of African descent. In the GLOBOCAN 2012 reports, prostate cancer incidence and mortality rates in Africa were reported to be 27.0 and 24.2 per 100,000 person-years, respectively. In Cameroon prostate cancer is the most commonly diagnosed cancer among men. Microscopically, the Gleason grading system, which is based solely upon architectural features of prostate cancer cells, closely correlates with clinical behaviour and is not affected by many socio demographic and clinical factors. Epidemiological studies have shown that obesity frequency in increasing and the prevalence and mortality of multiple cancers, consequently; this relationship between obesity and disease is receiving more and more attention.

Because obesity and prostate cancer affect substantial proportions of the male population, the association between the two is of great public health significance. Obesity has been consistently linked to higher PCa mortality. However, the relationship between obesity and risk of PCa is unclear, with individual studies showing conflicting results.

In order to contribute establish the relationship between body mass index and prostate cancer, we decided to carry out a study entitled “Body mass index as a risk factor for prostate cancer and benign prostate hypertrophy: a comparative study at three reference hospitals in Cameroon”. The aim was to elucidate the relationship between prostate cancer and body mass index.

Objectives
The objectives were to:
- Describe the general characteristics of our study population.
- Analyse the BMI of patients with prostate cancer in comparison with patients without Prostate cancer who underwent prostate biopsies.
- Compare patients with benign prostate tissue and patients with prostate cancer with respect to age, DRE, and PSA.
- Bring forth the relationship between Gleason score and BMI in patients with prostate cancer who underwent biopsy.

Materials and Methods
A comparative cross-sectional study was carried out at the Yaoundé Central Hospital, the Yaoundé general hospital and the Douala general hospital from the 5th December 2016 to the 30th April 2017. The study enrolled patients who underwent prostate biopsies from the year 2008 to the year 2016.

The patient’s files from those consulted for uro genital disease (A total number of 476/ 533) were studied at the archives at the morbid anatomy, and surgical units of the Douala general hospital ( 150/175 ) the Yaoundé general hospital (150/160 ) as well as the Yaoundé central hospital (176/198 ). These are reference hospitals for the management of patients with prostate cancer in Cameroon. The study enrolled Cameroonian patients from whom a prostate biopsy was done.

Inclusion Criteria
- Cameroonian from whom a transrectal core needle prostate biopsy was done.

Exclusion Criteria
- Patients whose complete results are not available in the patients file including Gleason grade for patients with prostate cancer.
- Patients whose files did not have a record of the patients’ weight during the diagnostic process.
- Patients who took any 5 alpha reductase inhibitor medications prior to biopsy, notably Finasteride and Dutasteride.
- Patients on anti-androgenic hormone therapy notably for the treatment of infertility.

Procedure
We found data from files of patients from 3 different hospitals in Cameroon, the Yaoundé central hospital, the Yaoundé general hospital, as well as the Douala general hospital. Those specialized services have demographic data, Body mass Index, height, Weight, Prostate Biopsy with histopathology results in the patient files. Prostate – Specific Antigen was determined from blood collection in the medical biology within of respective Hospital.

We went to the urology services of the three reference hospitals respectively to study their registers in search of patients from whom a prostate biopsy was requested. We then collected all necessary patient information. If the register did not have the histology results, we went to the morbid anatomy unit to find it. Archives were consulted if information was still not complete.

At the morbid anatomy unit, we looked for the prostate biopsy results, all in the same phase of the study. We then divided them into prostate cancer (with attributed their Gleason scores) and benign groups.

Data Analysis and Statistical Methods
Data was analysed with the aid of the statistical package for social sciences (SPSS) version 23.0. Univariate analyses for continuous variables were presented as means and standard deviations while qualitative variables were presented as

ISSN: 2454-8642
DOI: https://doi.org/10.24321/2454.8642.201817
frequencies and percentages. Chi square test ($\chi^2$) was used to find the association between categorical variables. The odds ratio was used to quantify the degree of association.

Differences between means were compared using the student t test (normally distributed data) or Mann Whitney u test (skewed data). In this way, independent associations between exposure variables and outcome variables were tested to determine significant predictors. All tests were considered statistically significant at $p < 0.05$.

\[ \text{BMI} = \frac{m}{h^2} \]

Definition of Terms

- BMI is calculated using an individual’s weight and (kilograms per square meter) derived from Quetelet’s formula Where m and h are the subject’s weight and height respectively.
- We considered a BMI less than 25 to be a low BMI and a BMI greater than or equal to 25 to be a high BMI.\(^{13}\)
- Gleason scores less than 7 are low Gleason scores, whereas those with 7 and above are said to have high Gleason scores.\(^{14}\)
- Patient is said to have prostate cancer when there is histologic confirmation of the presence of malignancy, and a Gleason grade is attributed as necessary.
- Patient is said to have a benign tissue when there is absence of malignancy in the prostate histologic specimen, notably an adenoma or an adenomyoma.

Results

During our study period a total number of 476 patient files were eligible, amongst which 225 were prostate cancers and 251 were benign prostate hypertrophies. We eliminated a total of 67 patients from the PCa group and 93 patients from the BPH group because they fulfilled our exclusion criteria. Hence, a total number of 67 patients from the PCa group and 93 patients from the BPH group were included in the study. All prostate cancers were adenocarcinomas.

Characteristics of the Study Population

Mean Age and Body Mass Index:

The mean age ± standard deviation of our 316 participants was 67.8 ± 10.32 (Range 38 to 94). The mean age ± SD of the PCa group (71.48 ± 8.96) was significantly greater than the BPH group (64.17 ± 10.31) with a P value <0.001 (Table 1).

The mean BMI ± SD of our participants was 24.80 ± 4.07 with a minimum BMI of 16.4 and a maximum BMI of 34.26. The mean BMI of our patients was similar in both groups.

Analysis and Comparison of BMI in Both Groups

A total of 71 (52.2%) patients with PCa had a high BMI. This was similar to the number of patients with high BMI who did not have PCa; 65 (47.8%). The odds ratio was 1.168 with a 95% confidence interval of 0.748-1.823 (Table 2).

<table>
<thead>
<tr>
<th>Variables</th>
<th>PCa number (%)</th>
<th>BPH number (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High BMI</td>
<td>71 (52.2%)</td>
<td>65 (47.8%)</td>
<td>136</td>
</tr>
<tr>
<td>Low BMI</td>
<td>87 (48.3%)</td>
<td>93 (51.4%)</td>
<td>180</td>
</tr>
<tr>
<td>Total</td>
<td>158</td>
<td>158</td>
<td>316</td>
</tr>
</tbody>
</table>

Comparison of Free PSA, total PSA and PSA f/t Ratio

We compared the 2 groups of patients for free PSA, total PSA and PSA f/t ratio. The median total PSA and the median PSA f/t ratio was significantly different in both groups ($p < 0.001$ and $p = 0.006$).

Gleason Trends

Gleason Score Frequency

Amongst the patients in the PCa group, the Gleason scores varied with a minimum value of 4 and a maximum value of 10. A total of 58(36.7%) patients had a Gleason score of 7, making the Gleason score of 7 the most frequent (Table 4).

Comparison of the Age Ranges and the Gleason Score

The number of patients with a high Gleason score increased progressively as the age increased up to 80 years, then started decreasing. On the other hand, the number of patients with a low Gleason score increased progressively.
to about 70 years, then decreased as the age increased. There was no overall significance in the trends as the age increased between the 2 groups. The modal class for the high Gleason group was 71 to 80 years, whereas the modal class for the low Gleason group was 61 to 70 years (Table 5).

### Table 5. Frequency of the combined Gleason Score

<table>
<thead>
<tr>
<th>Gleason score</th>
<th>Number</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>8</td>
<td>5.1%</td>
</tr>
<tr>
<td>5</td>
<td>11</td>
<td>7%</td>
</tr>
<tr>
<td>6</td>
<td>31</td>
<td>19.6%</td>
</tr>
<tr>
<td>7</td>
<td>58</td>
<td>36.7%</td>
</tr>
<tr>
<td>8</td>
<td>39</td>
<td>24.7%</td>
</tr>
<tr>
<td>9</td>
<td>7</td>
<td>4.4%</td>
</tr>
<tr>
<td>10</td>
<td>4</td>
<td>2.5%</td>
</tr>
<tr>
<td>Total</td>
<td>158</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Table 5. Age group comparison between patients with high and low Gleason scores

<table>
<thead>
<tr>
<th>Age ranges</th>
<th>High Gleason number (%)</th>
<th>Low Gleason number (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50</td>
<td>0 (0.0%)</td>
<td>1 (100.0%)</td>
<td>1</td>
</tr>
<tr>
<td>51-60</td>
<td>14 (87.5%)</td>
<td>2 (12.5%)</td>
<td>16</td>
</tr>
<tr>
<td>61-70</td>
<td>33 (53.2%)</td>
<td>29 (46.8%)</td>
<td>62</td>
</tr>
<tr>
<td>71-80</td>
<td>43 (75.4%)</td>
<td>14 (24.6%)</td>
<td>57</td>
</tr>
<tr>
<td>&gt;80</td>
<td>18 (81.8%)</td>
<td>4 (18.2%)</td>
<td>22</td>
</tr>
</tbody>
</table>

**Relationship between Gleason scores and BMI in Patients with PCa**

Within the group of 158 patients with PCa, 108 had a high Gleason, and 50 had a low Gleason. Amongst the 71 patients with a high BMI, 55 (77.5%) had a high Gleason, and 16 (22.5%) had a low Gleason. Amongst the 87 with a low BMI, 53 (60.9%) had a high Gleason and 34 (39.1%) had a low Gleason. This was significantly different with (p = 0.026) an OR of 2.205 and a 95% CI of 1.091 to 4.459.

### Table 6. Relationship between BMI and Gleason scores of patients with PCa

<table>
<thead>
<tr>
<th></th>
<th>High Gleason (%)</th>
<th>Low Gleason (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High BMI</td>
<td>55 (77.5%)</td>
<td>16 (22.5%)</td>
<td>71</td>
</tr>
<tr>
<td>Low BMI</td>
<td>53 (60.9%)</td>
<td>34 (39.1%)</td>
<td>87</td>
</tr>
<tr>
<td>Total</td>
<td>108</td>
<td>50</td>
<td>158</td>
</tr>
</tbody>
</table>

P = 0.026; odds ratio = 2.205; CI = (1.091 – 4.459).

**Discussion**

We carried out our study at the Yaoundé central hospital, the Yaoundé general hospital and the Douala general hospital in Cameroon. The first two are located at the core of the capital of the country while the third is located at the economic capital of the country of Cameroon. These are reference centres with renowned specialists in the domain of urology, oncology, radiology and morbidity anatomy for the management notably of prostate cancer and urologic pathologies. These hospitals are also pilot centres for research on prostate cancer with specialised facilities and dedicated staff offering the best services to patients.

Our patients’ ages at diagnosis ranged from 38 to 94 with a mean age ± standard deviation of 67.8 ± 10.32. The highest number of patients (modal class) had an age between 61 and 70 years. These results are similar to the findings by Angwafo FF et al. in a case series from the “Centre Hospitalier Universitaire” and the Yaoundé central hospital in Cameroon. They found an average age at diagnosis of prostate cancer of 68.6 years with an age range of 49 to 91 years. Nwofor et al in Nigeria found a peak age at diagnosis of PCa between 70 and 79 years. Zhou Feng et al had similar results in their prostate cancer in this study. These results are consistent with those found by Zhou Feng et al in 2016 in a similar study in China. Worth noting here is the fact that Asian patients may differ from African population in several clinicopathological aspects.

We compared the 2 groups of patients for free PSA, total PSA and PSA f/t ratio. The median values were significantly different in both groups (p = 0.02, p<0.001 and p = 0.008) (Table 3). Zhou Feng et al had similar results in their comparison of patients with prostate cancer and those without. These results imply that a higher total PSA, free PSA and PSA f/t ratio is associated with a higher tendency of having PCa with respect to BPH.

Amongst the patients in the PCa group, the Gleason scores varied with a minimum value of 4 and a maximum value of 10. A Gleason score of 7 was the most frequent and the majority of patients had a high Gleason score (Gleason ≥7). The number of patients with a high Gleason score increased...
progressively as the age increased up to 80 years, then started decreasing (Table 4 and 5). This trend was similar in both groups (p for trend = 0.108). Fouda et al.16 carried out a study on ambulatory transrectal prostate biopsy at the Yaoundé central hospital and found that a Gleason score of 4 was the most common. They also found that majority of the patients had a Gleason score less than 6 (84.32%). This contrast from our study could be explained by the differences in sampling methods. Their sample included patients who came in for annual checkup thereby leading to early detection and hence the low Gleason scores. Also, due to our recruitment procedure, we might have found mostly patients with advanced disease and hence our high Gleason score findings. This is however, not necessarily a reflection of the actual situation in the country. The overall increase in the number of patients up to 80 years, then drop in effective as age increases can be explained by the poor prognosis of patients with prostate cancer as well as the comorbidities associated with ageing.

In this retrospective study of patients who underwent prostate biopsy, 77.5% (55) of those with a high BMI also had a high Gleason score, which was significantly higher than the fraction in the low BMI group (60.9%) (53) (P = 0.026) (Table VI). Liang Y et al. performed a logistic regression, adjusting for age, race, rectal examination, family history of PCa, past medical history, etc.17 They found that BMI is positively associated with PCa and high Gleason prostate cancer (HGPCa). In addition, Lee A et al. observed that BMIs in Asian men correlated with the results of prostate biopsy.18 This suggests that obese patients will increase the HGPCa positivity rate for prostate punctures. Due to significant inconsistencies in documentation we were unable to analyse the patients' ultrasound results.

Conclusion

Based on the findings of our study, we draw the following conclusions:

- The average age at diagnosis of prostate cancer is higher than that of benign prostate hypertrophy.
- Overweight and obesity are not associated with the prevalence of prostate cancer.
- The prevalence of prostate cancer is associated with the patient’s age, total PSA and PSA f/t ratio at diagnosis.
- A BMI provides predictive information about the risk of HGPCa and is an important factor affecting the Gleason score of prostate biopsies.

Conflict of Interest: None

References


Date of Submission: 2018-10-22
Date of Acceptance: 2018-10-31