

Relationship between prostate volume, age and body mass index among patients with benign prostatic hyperplasia in the Niger Delta region, Nigeria

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Background: Benign prostatic hyperplasia (BPH) is a major cause of morbidity and mortality in African men. Several reports have shown a significant relationship between prostate volume (PV), age and body mass index (BMI) in men with BPH. However, there is a dearth of literature on this subject relating to Nigeria, especially the Niger Delta region. This study, therefore, seeks to ascertain the correlation between PV, age and BMI of men with BPH.

Methods: This prospective, observational hospital-based study was carried out at our health facility between November 2017 and October 2018. Eighty (80) patients participated in this study and were recruited at first contact in the urology clinic. Each patient's height and weight were measured and blood was taken for serum prostate-specific antigen (PSA) estimation. The PV was estimated by a transrectal ultrasound scan (TRUS). Patients with PSA values greater than 4 ng/ml had a TRUS biopsy of the prostate done to rule out malignancy. A standardised form was used to collect the patients' relevant information. Data were entered and analysed using Statistical Programming for Social Sciences version 22 (SPSS Inc., Chicago, IL, United States). For all statistical tests, $p < 0.05$ was regarded as significant.

Results: The mean age of the participants in this study was 68.12 years while the mean PV was 87.9 ml with a range of 34–234 ml. The mean BMI was 24.6 kg/m² with a range of 17.8–31.4 kg/m². There was no correlation between PV and patients' age ($p = 0.345$) or between PV and patients' BMI ($p = 0.410$).

Conclusion: There is no statistically significant correlation between PV, patients' age and BMI in this study. However, the equations and models generated from this study can facilitate further studies on prostate growth and may enhance the early diagnosis of BPH.

Keywords: prostate volume, benign prostatic hyperplasia, body mass index, age, prostate-specific antigen, prostate biopsy

Introduction

Benign prostatic hyperplasia (BPH) is a benign prostate pathology with a negative impact on the health-related quality of life of patients and their sexual function.¹ It is a common benign neoplastic condition affecting middle-aged and elderly men. Approximately 40% of men older than 60 years of age present with lower urinary tract symptoms (LUTS) as a result of benign prostatic hyperplasia.² Nwafor et al.³ reported that BPH was the most common prostate pathology, accounting for 62.85% of cases.

Various modalities are used to estimate prostate volume (PV). Digital rectal examination (DRE) is a useful tool in assessing patients with benign prostatic enlargement. It provides an estimate of the PV, though with poor reliability across observers.⁴ Other modalities which can be used for PV estimation include ultrasonography and magnetic resonance imaging (MRI)^{4,5} done through transrectal or transabdominal routes.

The association of BPH with ageing has been documented with an increase in its prevalence and incidence with age.⁶ Although PV increases in men from 40 years of age, there are different reports on the correlation between PV and age. Yang et al.⁷ in a study of 228 men aged 40–60 years, documented a relationship between PV and age. However, this report is at variance with what was documented in a study in Taiwan that indicated no significant influence of age on PV.⁸

Obesity has been noticed to have a direct relationship with PV with an increase in the transition zone. Obese men have larger PVs and lower testosterone concentrations.⁹ In another study, patients with a high BMI were observed to be at risk of an increased PV.¹⁰ Therefore, losing weight may result in a decrease in PV.

The aim of this study was to ascertain the correlation between PV, age and BMI in men with BPH in the Niger Delta region.

Patients and methods

This was a prospective, observational study carried out in the urology outpatient clinic of our health facility between October 2017 and September 2018.

The study population included all men who presented with LUTS who had DRE findings of BPH with total prostate-specific antigen (tPSA) of < 4 ng/ml, DRE findings of BPH with tPSA > 4 ng/ml, and histologically diagnosed BPH. Patients were excluded from this study if they had a DRE suggestive of prostate cancer, were on finasteride, had acute prostatitis, have had any form of prostate surgery, had histologically diagnosed cancer of the prostate, prostatic intra-epithelial neoplasm or atypical small acinar proliferation. The purpose of this research was communicated to the patients and informed consent was obtained.

A detailed clinical history and physical examination was done for each patient. A record of the patient's weight and height was

documented and a DRE was done. Approximately 5 ml of blood was collected under an aseptic condition from a peripheral vein and sent for PSA analysis. A transrectal ultrasound scan (TRUS) was done in the radiology unit for each patient for PV estimation. Additionally, a prostate biopsy was done in the same sitting for patients who had PSA levels > 4 ng/ml. Patients were encouraged to empty their bowel before the procedure. Prophylactic oral antibiotics (ciprofloxacin 500 mg and metronidazole 400 mg) were given for three days, starting about two hours before the procedure as per unit protocol. The left lateral decubitus position was used for both PV estimation and biopsy. The prostate gland was scanned, measuring the length, width and anterior-posterior diameter after setting the ultrasound machine to prostate mode. PV was calculated using the prolate ellipsoid formula (transverse diameter x longitudinal diameter x anteroposterior diameter x $\pi/6$). For patients who had indications for prostate biopsy (tPSA > 4 ng/ml), a Tru-Cut biopsy needle was introduced via the rubber tubing and extended core biopsies were obtained at the parasagittal plane for each lateral lobe taking biopsies from the apex, mid-portion and base, respectively. The tissues were immediately put inside a container with 10% buffered formalin and sent for histopathological analysis.

Data collection was done using a standardised form. All relevant information, including biodata, clinical, radiological and laboratory findings, were recorded on the predesigned form and then transferred into a spreadsheet for analysis. The statistical analysis was done with Statistical Programming for Social Sciences version 22 (SPSS Inc., Chicago, IL, United States). The mean and standard deviation (SD) were calculated for age, BMI, PV and PSA, while frequency and percentage were used to summarise the level of education, and participants' medical and social history. Pearson's correlation coefficient was used to test the strength of the relationship between age, BMI, free PSA, total PSA and PV. Simple linear regression was used to quantify the linear relationship between age, BMI and PV. The *p*-value was set at 0.05.

Results

A total of 80 patients who met the inclusion criteria were recruited for this study. The demographic and medical data and PVs are presented in Table I. The greatest proportion (67.5%) of the participants were between 60 and 79 years of age. The age range for the population studied was between 51 and 104 years of age, with a mean age of 68.12 years (SD $\pm$ 9). Most of the participants (41.3%) were in the 60–69 years of age category. The PV values ranged from 34.0 g to 234.0 g with a mean of 87.9 g (SD $\pm$ 40.4).

The BMI of the participants ranged from 17.8 kg/m² to 31.4 kg/m². Six participants were obese.

There was no statistically significant difference between PV and age (*p* = 0.345) or PV and BMI (*p* = 0.410). The PV and age were weakly correlated (*r* = 0.107). Similarly, a weak correlation was observed between the PV and the BMI of the participants (*r* = 0.104) (Table II).

A linear regression was performed to predict PV from age. The equation for the model was $y = 0.4779x + 55.304$. For a unit change

Table I: Demographic and medical characteristics, and prostatic indices of participants

Variables	Frequency	Per cent (%)
Age group (years)		
50–59	16	20.00
60–69	33	41.30
70–79	21	26.20
> 80	10	12.50
Level of education		
Primary	34	42.40
Secondary	17	21.30
Tertiary	29	36.30
Medical history		
Hypertension	34	42.50
Diabetes	7	8.75
Cardiovascular accident	3	3.75
No comorbidities	36	45.00
Social history		
Alcohol intake	11	13.75
Cigarette smoking	3	3.75
Non-smoker and non-alcoholics	66	82.50
Body mass index		
Normal	47	58.80
Overweight	27	33.70
Obese	6	7.50
Prostatic volume		
30–100 ml	59	73.80
> 100–235 ml	21	26.20

Table II: Correlation between age, BMI and PV

Variables	rho (<i>r</i>)	<i>p</i> -value	Regression model
Age vs PV	0.107	0.345	$y = 0.4779x + 55.304$
BMI vs PV	0.104	0.410	$y = 1.257x + 57.221$

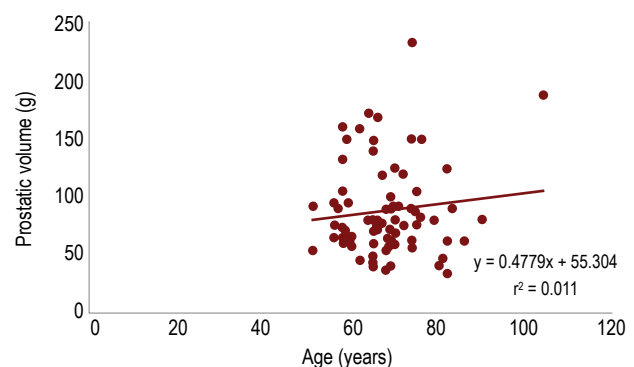


Figure 1: Relationship between age and PV

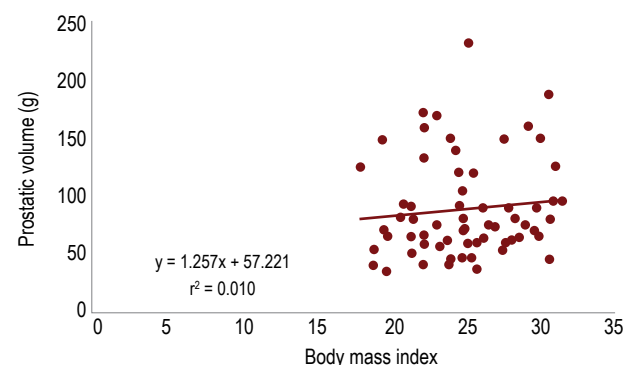


Figure 2: Relationship between BMI and PV

in age, PV changes by 0.4779. Age explains only 1.1% of the variation in PV (Figure 1).

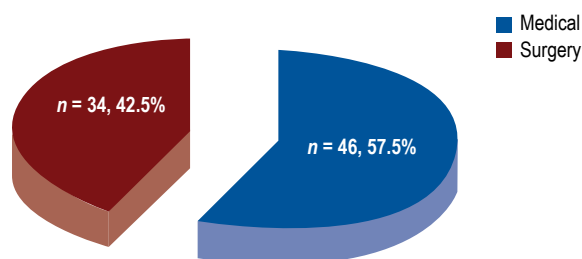


Figure 3: Treatment options for participants following the BPH diagnosis

A linear regression was also performed to predict PV from BMI. The equation for the model was $y = 1.257x + 57.221$. For a unit change in BMI, PV changes by 1.257. BMI explains only 1.0% of the variation in PV (Figure 2).

The majority of the participants ($n = 46$, 57.5%) had medical management of BPH following diagnosis (Figure 3).

Discussion

Benign prostatic hypertrophy is the most common cause of lower urinary tract symptoms and bladder outlet obstruction in men aged 50 years and older. PV is crucial in the preoperative evaluation of patients for prostate surgery and plays a major role in deciding the option of surgical management for patients with benign prostatic enlargement.^{2,7}

The impact of patients' age and BMI on the PV have been variously studied with varied results on the correlations between these variables.^{4,7-9} Understanding the relationship between PV, age and BMI may be helpful in the diagnosis and management of patients with BPH, which probably could slow down its progression.^{7,9} The goals of this study were to ascertain the correlation between PV and the age of the patient, as well as between PV and the patients' BMI.

The mean PV of 87.9 ml found in this study is higher than in Caucasians (43.7 ml)¹¹ and Asians (36.9 ml)¹² but compares favourably with some reports from other parts of Nigeria and Africa.^{3,13} The higher PVs seen in Blacks have been variously attributed to increased sexual activities from polygamy, late presentation of patients to the clinic, and racial predisposition.^{7,8,13,14}

The mean BMI of 24.6 kg/m² in this study is on par with previous studies in Nigeria and other parts of the world.^{14,15} Eighty per cent (80%) of the participants in this study were older than 60 years and 7.5% of the participants were obese. This obesity rate compares favourably with the 3.6% and the 14.8% rates reported by Ukoli et al.¹⁴ among the rural and urban Nigerian population, respectively.

There was no significant difference between PV and BMI in this study. This finding corroborated the report by Dahle et al.¹⁶ who found no significant relationship between BMI and either BPH or LUTS. Gupta et al.¹⁷ and Fritschi et al.¹⁸ further opined that there was no link between BMI and BPH. However, Zucchetto et al.'s report¹⁹ was indeterminate on BMI and PV, while others have reported an association between BMI and PV. Parsons et al.²⁰ and Matsuda et al.²¹ found a correlation between PV and BMI in their studies. In the study by Matsuda et al.²¹ among Japanese men, PV estimation was done by weighing specimens obtained from open

prostatectomy. This could have resulted in an underestimation of PV. Another cause of this differing result could have been the sample size. Smaller studies are more likely to show no association between obesity and PV, whereas larger studies more often show an association between these two aspects.

This study showed no correlation between PV and age. This finding is contrary to what was found among men in Indonesia and India where PV increased with age in men with biopsy-proven BPH.²²

Treatment of BPH at our health facility is either medical or surgical. Medical treatment includes the use of α -blockers or 5- α -reductase inhibitors, or a combination of both. Transurethral resection of the prostate (TURP) remains the gold standard in the surgical treatment of BPH.²³ Open prostatectomy using transvesical and retropubic approaches is currently the main surgical option for the management of BPH at our health facility as TURP and other surgical options of management are scarcely available.

Some limitations of this study were its small sample size, the exclusion of patients with hard nodular on the basis of digital rectal examination only, as well as the fact that patients who had PSA less than 4 ng/ml were not subjected to prostate biopsy.

Conclusion

There was no correlation between PV and age or between PV and BMI in this study. The equations and models generated from this study, however, could facilitate further studies on the rate of prostate growth and may enhance the early diagnosis of BPH.

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Conflict of interest

The authors declare no conflict of interest.

Ethical approval

This study was approved by the Ethics and Research Committee of ISTH, Irrua, Edo State (ethical approval number: ADM/PERS/154/Vol.1/86).

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