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ORIGINAL RESEARCH

Correlation Between Prostate Volume and Lower Urinary Tract Symptoms: A Hospital-Based Study

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Abstract

Background: Lower urinary tract symptoms (LUTS) are manifestations of storage and voiding disorders involving the urinary bladder, urethra and the prostate gland. This study aimed to correlate prostate volume and lower urinary tract symptoms.

Method: This study was a prospective cross-sectional study carried out among 120 males aged 40 years and above who presented with LUTS for prostate ultrasonography at the Radiology department within a period of six months. Informed consent and ethical approval were obtained from participants before commencement of the study. Severity of LUTS was evaluated using the International Prostate Symptom Score (IPSS). Each question was scored between 0 to 5 and the sum recorded as total IPSS score. The total score was graded as mild (0-7), moderate (8-19) or severe (20-35). Quality of life due to urinary symptoms was also evaluated and scored between 0 (delighted) and 6 (terrible). Prostate volume estimation was done by transabdominal ultrasonography using an ultrasound scanner fitted with a 3.5-MHz curvilinear transducer (Logic F6, General Electric, USA, 2017). Measurements were taken and the average values computed; volume calculation was obtained by default using the inbuilt computer algorithm in the ultrasound machine. The data obtained were statistically analyzed using the Statistical Package for Social Sciences (SPSS) software version 24 (International Business Machines, USA, 2016), and the results presented in tables, charts, and percentages. Pearson's correlation coefficient was used to correlate between variables with P-values < 0.05 considered significant.

Results: Results showed that the cumulative mean age of the participants was 65.1 ± 9.6 years with majority of the participant's between 60 and 69 years. The most common presenting LUTS was nocturia (98.0%), followed by frequency (92.7%). Overall, the mean IPSS score was 13.2 ± 4.6 while quality of life (QoL) was 4.1 ± 1.2. The mean prostate volume was $69.8 \pm 63.5 cm^3$, with 79.2% of the subjects having a prostate volume $\geq 30 cm^3$. Pearson correlation between prostate volume and IPSS was significant ($r = 0.304$, $p = 0.001$).

Conclusion: The study established a positive significant correlation between prostate volume and International Prostate Symptoms Score (IPSS). This implies that sonographic PV assessment could be useful in objective assessment of LUTS severity and should be considered in management decisions and follow-up of patients with lower urinary tracts symptoms.

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Introduction

Lower urinary tract symptoms (LUTS) are manifestations of storage and voiding disturbances related to the urinary bladder, urethra and surrounding organs such as the prostate gland. They are amongst the commonest presentations in urology clinics, with prostatic diseases responsible for most cases (1). Surveys in Africa have reported that about one-in-four men older than 40 years have some degrees of LUTS (2). Prostatic pathologies, which include prostatitis, benign prostatic hyperplasia (BPH) and carcinoma of the prostate (CAP), are commonly associated with enlargement of the gland. Prostate enlargement leads to bladder outlet obstruction as a result of static compression due to the gland encroachment upon the prostatic urethra and bladder outlet, as well as dynamic obstruction owing to the contraction of prostatic smooth muscles (3).

LUTS can be broadly categorized into storage and voiding symptoms. The former includes urgency, frequency, nocturia, and urgency incontinence; while the latter comprise hesitancy, intermittency, straining, terminal dribbling and incomplete emptying. The term "post-micturition symptoms" is also increasingly being used to describe post-micturition dribble and incomplete emptying (4). International Prostate Symptom Score (IPSS) is a modification of the American Urological Association (AUA) symptom index adopted by the World Health Organization (WHO) as a useful subjective tool for LUTS assessment (4,5). The IPSS consists of seven questions that include voiding (incomplete emptying, intermittency, weak stream and straining) and storage (frequency, urgency and nocturia) symptoms. Each symptom is scored using a scale of 0 to 5. Additionally, quality of life due to the urinary symptoms is evaluated and scored between 0 (delighted) and 6 (terrible).

Prostate size evaluation could be done clinically using digital rectal examination. More accurate measurement of the prostate volume is by imaging, with ultrasonography (US) being the mainstay. Although other modalities such as magnetic resonance imaging, computed tomography, and radionuclear studies can readily image the gland, US is favored as the first-line modality because it is a safe, fast, non-invasive and non-ionizing but readily available and cost-effective imaging tool (6).

Prostate ultrasound scans can be performed using various approaches, including transabdominal, transrectal, and, less commonly, trans-perineal and transurethral (7,8). Although the transrectal route is generally favored for more accurate volume estimation and evaluation of prostate anatomy, studies have shown no statistically significant difference between the transabdominal and transrectal sonographic measurement of prostate volume for clinical purposes (8,9). The above reason, in addition to consideration of the patient's comfort, informed the choice of the transabdominal route for gross prostate volume evaluation in the index study.

Association between prostate size and lower urinary tract symptoms has been inconsistent. While some of the studies showed significant correlation (1,5,10), others did not demonstrate significant relationship (11,12,13,14). Evidently, knowledge of the true relationship between LUTS and prostate size in a given setting will facilitate decision making in terms of diagnosis and treatment planning. However, there is a paucity of studies done on this subject in the African population. Thus, this work is aimed at establishing the relationship between prostate volume and IPSS in African men presenting with lower urinary tract symptoms in a hospital setting.

Materials and methods

The study was a prospective cross-sectional study carried out at the Radiology Department of River State University Teaching Hospital, Port Harcourt, Nigeria between September 2020 and February 2021. One hundred and twenty (120) males were recruited who met the criteria of: age 40 years or older, had LUTS, and presented at the department for prostate ultrasonography. Patients were excluded from the study who had a history of prostatic surgery, were on 5-alpha reductase inhibitors and anti-androgens, or antipsychotic and anti-Parkinson's drugs and patients with recurrent urinary tract infection, as well as diabetics.

Informed consent was obtained from all the patients. Subjects' demographics were documented using data forms. Severity of LUTS was evaluated with International Prostate Symptom Score (IPSS). Subjects were presented with IPSS questionnaires, which comprise seven standard questions on urinary symptoms, and were requested to complete them with assistance of caregivers or a doctor where necessary. Each question was scored between 0 to 5 and the sum recorded as the total IPSS score, with a maximum of 35. The total score was graded as mild (0-7), moderate (8-19) or severe (20 -35). Quality of life due to urinary symptoms was also evaluated and scored between 0 (delighted) and 6 (terrible).

Prostate volume estimation was done by transabdominal ultrasonography using an ultrasound scanner fitted with a 3.5-MHz curvilinear transducer (Logic F6, General Electric, USA, 2017). Measurements were taken using acoustic gel to obliterate air interferences between the probe and the skin at full bladder. The prostate was evaluated by ensuring that the entire gland was seen in the plane. The sagittal plane was evaluated and the probe was then turned 90 degrees to evaluate the transverse plane. Three measurements were taken for each study and the average recorded to minimize error. The volume was obtained by measuring the height and length on the sagittal plane, while the width was measured on the transverse plane. Prostate volume was calculated using the inbuilt computer algorithm in the ultrasound machine based on the prostate ellipsoid formula (13):

$$\textit{Prostate volume (in } cm^3\textit{)} = \textit{length x height x width x 0.52}$$

where length, height and width were the maximum craniocaudal, anteroposterior and transverse diameters respectively (as shown in Figure 1).

The records from the data forms and questionnaires were input into a spreadsheet and descriptive statistical analysis performed using the Statistical Package for Social Sciences (SPSS) version 24 (International Business Machines, USA, 2016). Continuous variables were shown as mean ± standard deviation (M±SD) and presented in tables and charts, while categorical variables were presented as percentages. Pearson's correlation coefficient was applied to assess correlation between prostate volume and IPSS variables. P-values less than 0.05 were considered significant.

Ethical consideration

Ethical approval was obtained from the Ethical Committee of Rivers State University Teaching Hospital prior to commencement of the study. Participation was voluntary and recruitment was following documented informed consent.

Results

The cumulative mean age of the participants was 65.1 ± 9.6 years. The age group of 50-59 years accounted for 21.7% of the participants, while participants ages 70 years and above accounted for 31.7% with a mean of 73.82 ± 2.74 years (Table 1). Table 1 also shows that the majority of the participants were age 6069 years, accounting for 41.7% of the participants with a mean age of 65.76 ± 2.03 years.

The most common presenting LUTS was nocturia (98.0%), followed by frequency (92.7%), intermittency (83.3%), urgency (82.5%) and incomplete emptying (77.5%), while weak stream and straining were the least of the complaints, accounting for 65.0%. Overall, the mean IPSS score was 13.2 ± 4.6, while that of quality of life (QoL) was 4.1 ± 1.2. QoL assessments showed that the majority of patients were mostly dissatisfied with their symptoms (31.7%), as shown in Figure 2.

LUTS severity assessed with IPSS shows that the majority of participants (79.2%) presented with moderate symptoms (Figure 3). The mean prostate volume was 69.8 ± 63.5cm^3, the minimum and maximum volumes being 15.6 and 484.1cm^3 respectively; 79.2% of the subjects had enlarged prostate with volume ≥ 30cm^3. The Pearson correlation between prostate volume and IPSS was significant (r = 0.304, p = 0.001), as illustrated by the scatter plot in Figure 4.

Discussion

In this study, the average age was 65.1 ± 9.6 years. The majority of patients were in the age range of 60-69 years (41.7%). These findings are similar to the mean ages of 64.2 ± 9.0 and 64.4 ± 8.9 years reported locally by Awaisu et al. (5) in Zaria (North-West Nigeria), Badmus et al. (15) in Ifẹ̀ (South-West Nigeria), and 64.10 years by Rupam D. (16) in India. Similarly, the peak age of 60-69 age range with the highest frequency of 41.7% is in tandem with related work done in Nigeria by Udeh et al. (17), in Enugu (South-East) and Mohammed et al. (18) in Zaria, with the highest frequencies of 46% and 34.5%, respectively, recorded within the same age range. Also in Ghana, Mbouche et al. (19) had the peak age group in the same range, with 44.7% frequency. This supports the fact that prostatic enlargement and the resultant lower urinary tract symptoms are prevalent in the elderly (19).

The most common presenting symptom was nocturia (98.0%), followed by frequency (92.7%), which was consistent

Figure 1. Transabdominal sonograms showing prostate volume evaluation using static grayscale images of the prostate gland in longitudinal (A) and transverse (B) sections.

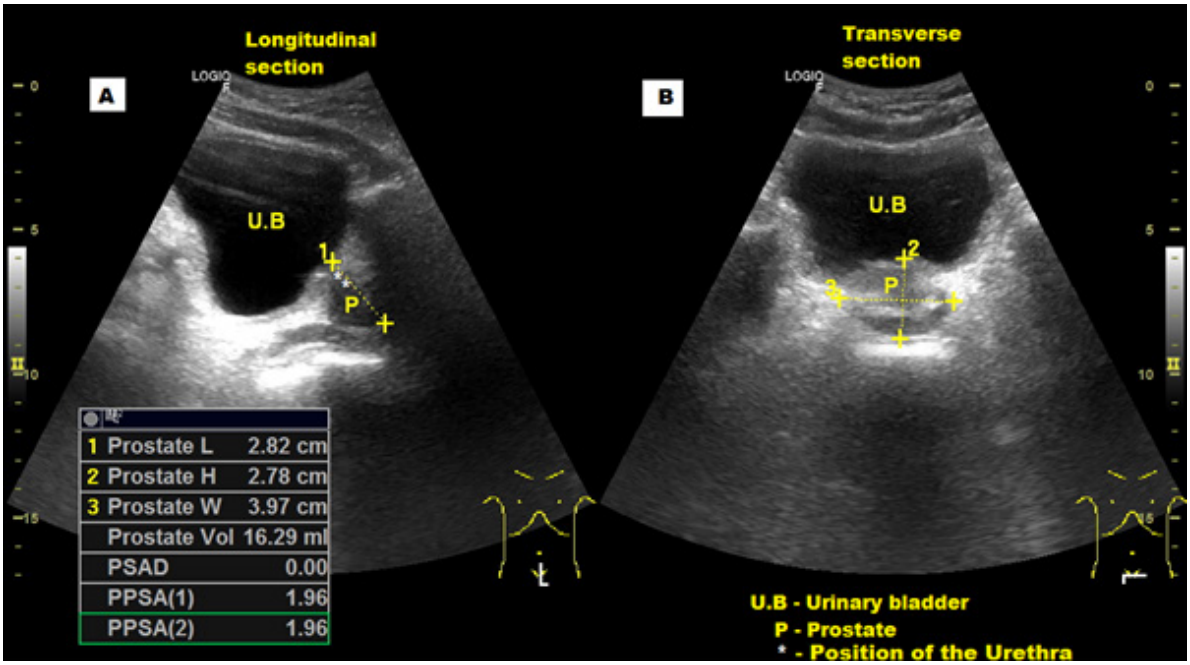


Table 1. Age group distribution of the participants.

Age group (in years)	Frequency	Percentage (%)	Mean(±SD)
40 – 49	6	5.0	45.12±2.79
50 – 59	26	21.7	55.69±1.78
60 – 69	50	41.7	65.76±2.02
≥ 70	38	31.7	73.82±2.74
Total	120	100.0	65.10±9.6

Figure 2. Quality of life of participants.

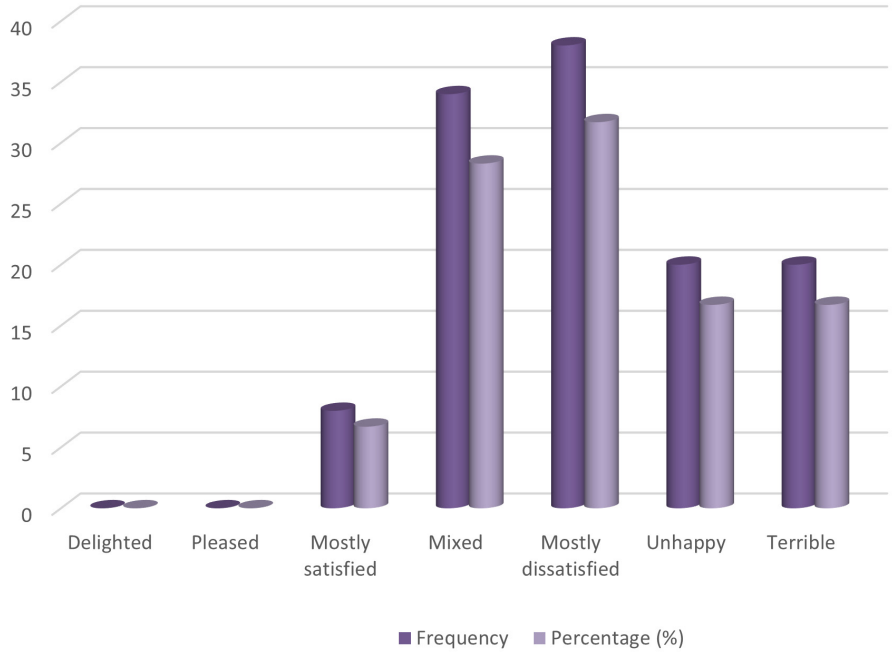
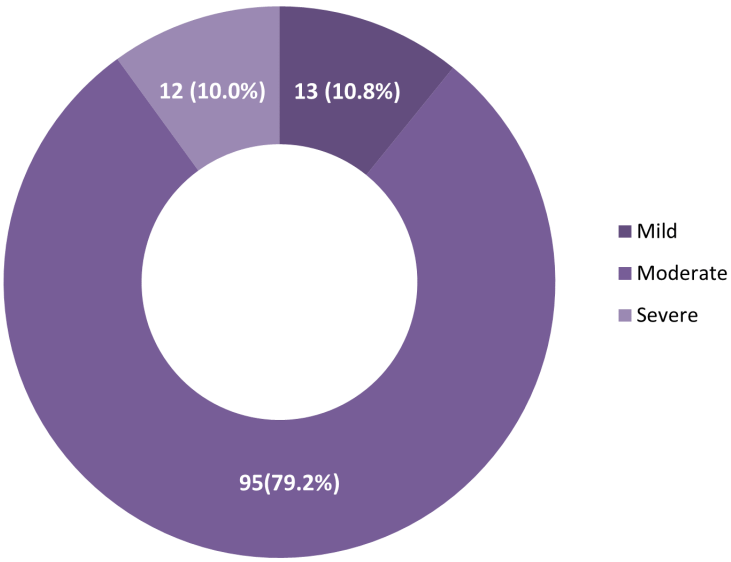


Figure 3. Percentage of participants with mild, moderate and severe IPSS grade.



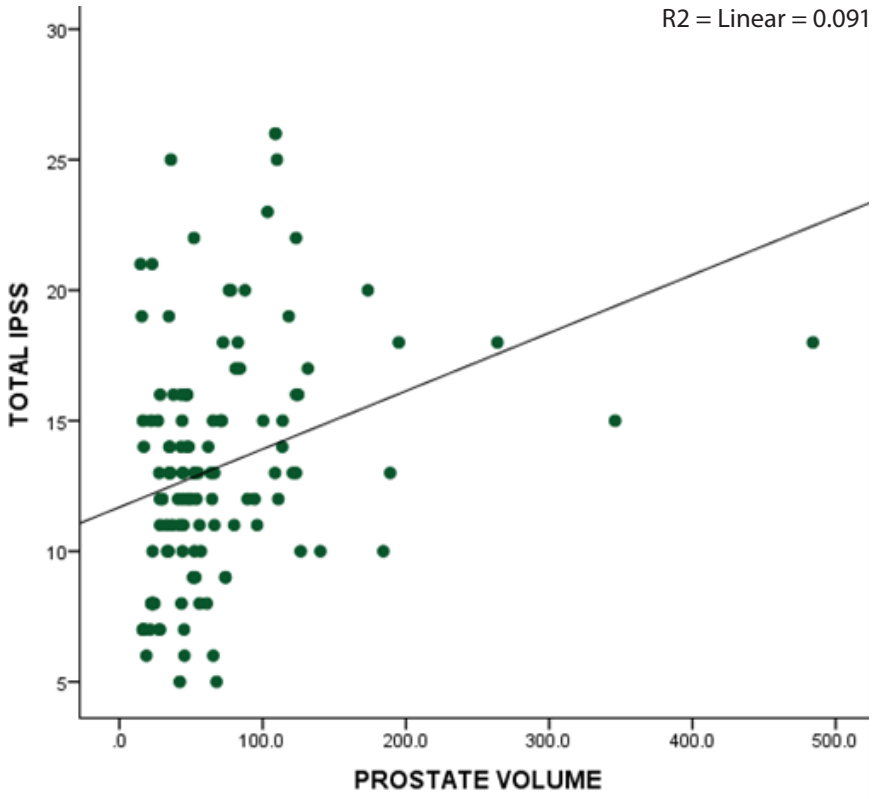


Figure 4. Scatter plot of correlation between prostate volume and IPSS.

with the finding by Awaisu et al. (5). The mean IPSS and QoL scores of 13.2 ± 4.6 and 4.1 ± 1.2, respectively, are close to the scores of 14.58 ± 6.17 and 3.13 ± 1.22 recorded by Mbouche et al. (19). In contrast, Agrawal et al. (11) recorded a higher mean IPSS of 23.5 ± 2.8 in a similar study done in Nepal. Different health-seeking behaviors and late presentation may be responsible for the variance. In the assessment of quality of life, the majority of patients were mostly dissatisfied, whereas the great majority of respondents in a similar study conducted in Ghana (19) were unhappy with the symptoms. The mild difference may be due to differences in symptom perception by patients in different settings. Furthermore, the vast majority (79.2%) of patients presented with moderate symptoms, which is similar to the findings of Ofoha et al. (12) and Nyawali et al. (20)

The mean transabdominal sonographic prostate volume was 69.84cm^3 ± 63.5cm^3. In a related study on transrectal prostate volume correlation with prostate-specific antigen level in the same study setting, Robinson (7) reported a mean volume of 66.13 ± 30.43cm^3. However, a higher mean of 83.8 ± 37.7cm^3 was reported by Badmus et al. (15) in Ifẹ̀, and Mohammed et al. (19) recorded 56.2 ± 42.7cm^3 in Zaria. The differences may be attributed to the larger sample size in the former and the use of transrectal approach by the latter. However, the above local figures are higher than the mean prostate volumes of 42.5cm^3, 40.1cm^3 and 48.0cm^3 obtained in Pakistan (21), Sweden (22), and the United States (23) respectively. This could be explained by geographical and racial diversity, as well as earlier presentation of patients in developed countries.

The relationship between prostate size and LUTS has been inconsistent. Different studies have shown significant correlation, either positive or negative, while others have recorded no statistically significant association. The index study found significant positive correlation between PV and IPSS ($r = 0.304$, $p = 0.001$). This finding is in tandem with the report by Awaisu et al. (5) from Zaria ($r = 0.179$, $p = 0.002$) and similar studies performed in India (1) and Sri Lanka (10) ($p < 0.003$ and $p < 0.001$ respectively).

In contrast, Agrawal et al. (11) reported no significant correlation between PV and total IPSS amongst Asian populations (at the B.P Koirala institute of Health Sciences, in the sub-metropolitan city of Dharan in Sunsari district) which is in line with findings in local studies done in Jos and Ekiti by Ofoha et al. (12) and Ojewola et al. (13) ($r = 0.13$, $p = 0.18$; $p = 0.57$, $p = 0.339$), respectively. Ojewola et al.'s study was community-based and the sample size of 615 men was also larger than that of the index study, with greater than 43% subjects younger than 60 years; while Ofoha et al. (12) recruited a wider age range of 21 to 85 years, within which a lower mean PV of 57.8cm^3 and narrow range of 20 to 195cm^3 were recorded. The above difference in methodology and key variables, as well as the subjectivity of self-administered IPSS questionnaire for LUTS assessment, may account for the disparity with the outcome of the index study.

Conclusion

This study established a positive significant correlation between prostate volume and International Prostate Symptoms Score (IPSS). This implies that sonographic PV assessment could be useful in objective assessment of LUTS severity and should be considered in management decisions, including prognostic and follow-up purposes, for patients with lower urinary tract symptoms.

Lastly, in view of variance in research findings on this subject and different practical clinical experiences, further studies are recommended in other settings in Nigeria and other African countries, including community-based surveys, to expand the existing body of knowledge.

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Conflicts of interest

The authors report no conflicts of interest.

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