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Correlation of Prostate Volume with Age, Serum Prostate-Specific Antigen, and Symptom Severity in Men with Prostatic Enlargement in DELSUTH, Oghara

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Abstract

Background:

Benign prostatic hyperplasia (BPH) is a major cause of lower urinary tract symptoms (LUTS) in ageing men. Prostate volume (PV), serum prostate-specific antigen (PSA), and symptom severity assessed by the International Prostate Symptom Score (IPSS) are central to evaluation, yet their interrelationships remain inconsistent across populations.

Methods:

The aim of this study was to evaluate the correlation between prostate volume, age, serum PSA, and symptom severity among men with prostatic enlargement. A cross-sectional study was conducted among 72 men aged ≥ 40 years presenting with LUTS at DELSUTH, Oghara. PV was measured using transrectal ultrasonography (TRUS), PSA obtained from records, and symptom severity assessed using IPSS. Pearson's correlation and multivariate regression analyses were performed.

Results:

Mean age was 67.3 ± 10.5 years. Mean PV was 106.7 ± 71.2 mL, PSA 8.1 ± 7.7 ng/mL, and IPSS 23.3 ± 5.4. PV correlated significantly with age ($r = 0.366$, $p = 0.002$) and IPSS ($r = 0.393$, $p = 0.001$), but not with PSA ($r = 0.128$, $p = 0.284$). PSA showed weak correlation with IPSS ($r = 0.256$, $p = 0.030$). Regression analysis identified age and IPSS as independent predictors of PV.

Conclusion:

Prostate volume is more strongly associated with symptom severity and age than PSA. TRUS-derived PV remains a more reliable clinical indicator than PSA in symptomatic men.

BACKGROUND

Benign prostatic hyperplasia (BPH) is one of the most prevalent urological conditions affecting ageing men worldwide and represents a leading cause of lower urinary tract symptoms (LUTS),[1,2] occur commonly in men over 40 year [3,4]. with significant implications for quality of life and healthcare utilization. The global burden of BPH continues to rise due to increasing life expectancy, particularly in developing countries where access to early diagnostic and therapeutic interventions may be limited and late presentation is common[5].

BPH is an age-related non-malignant enlargement of the prostate gland which is common in the elderly and predominantly arises from the peripheral zone of the prostate gland [6]. CAP is also age-related;

however, it is a malignant condition of the prostate gland arising from the transitional zone and may present with LUTS as well as low back pain due to metastasis to the spine.[7,8]

Pathophysiologically, BPH is characterized by progressive stromal and epithelial proliferation within the transition zone of the prostate, resulting in glandular enlargement and varying degrees of bladder outlet obstruction[9]. This process is strongly age-dependent, with histological evidence of BPH observed in approximately 50% of men by the age of 60 and up to 90% by the ninth decade[10]. However, the relationship between anatomical enlargement and clinical symptomatology remains complex and often inconsistent.

Assessment of men with suspected prostatic enlargement typically involves a combination of clinical evaluation, biochemical markers, and imaging. Serum prostate-specific antigen (PSA) is widely used due to its accessibility, but its specificity is limited, as levels may be elevated in benign conditions such as BPH, prostatitis, and even after instrumentation [11,12]. PSA is a very important biomarker employed in studying diseases of the prostate gland. Normal PSA levels range from 0–4.0ng/ml, thus a PSA level greater than 4ng/ml is generally considered to be suspicious of prostate cancer. As the level increases to 10.0ng/ml and above, the probability of neoplastic changes increases dramatically;[13] However, not all men with prostate cancer have elevated PSA.[14] PSA has low specificity in detecting prostate cancer because increased concentrations have been found in patients with BPH, CAP, prostatitis and even from digital rectal examination.[15,16] Hence, biopsy with histology of the prostate is considered the gold standard for definitive diagnosis of CAP.

Consequently, PSA alone is an imperfect surrogate marker for prostate size or symptom severity.

Transrectal ultrasonography (TRUS) remains the gold standard imaging modality for accurate estimation of prostate volume (PV), providing reliable measurements that correlate with histological findings[17]. In parallel, symptom severity is commonly quantified using the International Prostate Symptom Score (IPSS), a validated tool that captures both obstructive and irritative urinary symptoms [18].

Within this framework, age is conceptualized as a primary biological driver of prostatic enlargement, prostate volume represents the structural manifestation of disease progression, PSA reflects prostatic epithelial activity but is influenced by multiple confounding factors, and symptom severity as measured by IPSS represents the clinical outcome. This integrated perspective suggests that while prostate enlargement may contribute to worsening symptoms, biochemical markers such as PSA may not reliably reflect either anatomical size or clinical severity.

Despite the widespread use of these parameters and extensive research, the relationships between prostate volume, PSA, and symptom severity remain inconsistent across populations. While some researchers have demonstrated significant correlations between PSA and PV [19,20] others report weak or non-significant associations[21]. Similarly, the relationship between PV and symptom severity is variable,

reflecting the multifactorial nature of LUTS, which may be influenced by bladder dysfunction, detrusor overactivity, and patient perception of symptoms[22].

In sub-Saharan Africa, data on these interrelationships remain limited, particularly in Nigeria, where late presentation and resource constraints may influence disease patterns[23]. Understanding these relationships in local populations is essential for optimizing diagnostic and management strategies.

This study therefore aimed to evaluate the correlation between prostate volume, age, serum PSA, and symptom severity among men with prostatic enlargement in DELSUTH, Oghara, Nigeria.

METHODOLOGY

This was a hospital-based cross-sectional study conducted in the Radiology Department of Delta State University Teaching Hospital (DELSUTH), Oghara, Nigeria, over a six-month period

The aim of this study was to evaluate the correlation between prostate volume, age, serum PSA, and symptom severity among men with prostatic enlargement.

The study population comprised adult male patients aged 40 years and above presenting with lower urinary tract symptoms suggestive of prostatic enlargement. Participants were recruited using a convenience sampling technique.

Inclusion criteria included men aged ≥ 40 years with clinical features of LUTS who provided informed consent. Exclusion criteria included patients with urinary tract infection, known prostate malignancy, anal pathology contraindicating TRUS, recent urethral instrumentation, or significant systemic illness.

Prostate volume was measured using transrectal ultrasonography (TRUS) with a standardized protocol. Measurements of length (L), width (W), and height (H) were obtained, and prostate volume calculated using the ellipsoid formula:

$$PV = L \times W \times H \times 0.52$$

Corresponding line diagram of the transverse (axial) and longitudinal (sagittal) views of an enlarged prostate gland, with points AB for length, ED and EF for width and height respectively.

Serum PSA values were retrieved from patient medical records, ensuring tests were performed prior to any manipulation that could artificially elevate levels.

Symptom severity was assessed using the International Prostate Symptom Score (IPSS), which categorizes symptoms into mild (0–7), moderate (8–19), and severe (20–35).

Data were analyzed using SPSS version 22. Continuous variables were expressed as mean ± standard deviation. Pearson's correlation coefficient was used to assess relationships between variables.

Multivariate linear regression analysis was performed to identify independent predictors of prostate volume. Statistical significance was set at $p < 0.05$.

Ethical approval was obtained from the DELSUTH Ethics Committee.

RESULTS

Demographic Characteristics

- Mean age: 67.3 ± 10.5 years
- Majority: 67–76 years age group

Clinical Parameters

- Mean prostate volume (PV): 106.7 ± 71.2 mL
- Mean PSA: 8.1 ± 7.7 ng/mL
- Mean IPSS: 23.3 ± 5.4
- Majority (76.4%) had severe symptoms

Table 1
Frequency distribution of PSA values among men of different age groups

Age group	**PSA (ng/mL) n/total (%)**				***p* value**
	0–4	**4.1–10**	**10.1–20**	**> 20**	
46–56	10/12 (83.3)	1/12 (8.3)	1/12 (8.3)	0	**0.033***
57–66	9/20 (45.0)	7/20 (35.0)	2/20 (10.0)	2/20 (10.0)	0.143
67–76	10/27 (37.0)	6/27 (22.2)	9/27 (33.3)	2/27 (7.4)	0.762
77–86	1/10 (10.0)	1/10 (10.0)	7/10 (70.0)	1/10 (10.0)	0.006
87–96	1/3 (33.3)	2/3 (66.7)	0	0	0.386
Total	**31/72 (43.1)**	**17/72 (23.6)**	**19/72 (26.4)**	**5/72 (6.9)**	

PSA = prostate specific antigen***Statistically significant**

Table 2
PSA values among men of the different age groups

Age group (years)		Number	PSA (ng/mL)	
Group	**Mean ± SD**		**Mean ± SD**	**Range**
46–56	52.0 ± 3.3[a]	12	3.7 ± 2.7[a,c]	1.4–11.8
57–66	61.6 ± 3.2[b]	20	6.5 ± 6.6[a,b]	0.8–24.0
67–76	70.5 ± 2.6[c]	27	9.8 ± 9.3[a,b]	0.9–44.0
77–86	81.0 ± 2.4[d]	10	13.3 ± 6.8[b]	0.2–23.9
87–96	91.0 ± 1.7[e]	3	4.6 ± 3.8[a,b]	0.9–8.4
Total	**67.3 ± 10.5**	**72**	**8.1 ± 7.7**	**0.2–44.0**
p value	**0.000***		**0.020***	

PSA=prostate-specific antigen, ***statistically significant**

Tables 3 and 4 show the PV of the study population and the frequency distribution of the PV levels among men of the different age groups. The values of PV varied widely among the different age groups. Overall, 1(1.4%) had PV 31–40.9 mL³, 13 (18.1%) had PV of range 41–50.9 mL³, 29 (40.3%) had PV of between 51–100.9 mL³ and 29 (40.3%) had PV > 100 mL³. Only 1 (0.5%) individual in the age group 57–66 had PV < 40mL^3. About one third of all the men 29 (40.3%) had PV of 51–100.9 mL³, except the 67–76 years age group 14 (51.9%) with PV > 100 mL³ and 87–96 age group 3 (100%) with PV > 100 mL³.

Table 3
Frequency distribution of PV among the different age groups

Age group (Years)	**PV (mL³) n/total (%)**				***p* value**
	< 40	**41–50.9**	**51–100.9**	**> 100**	
46–56	0	4/12 (33.3)	7/12 (58.3)	1/12 (8.3)	**0.033***
57–66	1/20 (5.0)	4/20 (20.0)	8/20 (40.0)	7/20 (35.0)	0.527
67–76	0	4/27 (14.8)	9/27 (33.3)	14/27 (51.9)	0.448
77–86	0	1/10 (10.0)	5/10 (50.0)	4/10 (40.0)	0.918
87–96	0	0	0	3/3 (100)	0.246
Total	1/72 (1.4)	13/72 (18.1)	29/72 (40.3)	29/72 (40.3)	
PV = Prostate Volume					

*Statistically significant

Table 4
Prostate volume levels among men of the different age groups

Age group (years)		**Number**	**PV (mL³)**	
Group	**Mean ± SD**		**Mean ± SD**	**Range**
46–56	52.0 ± 3.3[a]	12	59.6 ± 18.0[a]	42.2–109.2
57–66	61.6 ± 3.2[b]	20	101.6 ± 86.6[a]	40.0–427.5
67–76	70.5 ± 2.6[c]	27	111.5 ± 51.7[a,b]	42.1–264.7
77–86	81.0 ± 2.4[d]	10	125.3 ± 83.4[a,b]	48.9–297.0
87–96	91.0 ± 1.7[e]	3	223.0 ± 71.1[b]	159.3–299.6
Total	**67.3 ± 10.5**	**72**	**106.7 ± 71.2**	**40.0–427.5**
p value	**0.000***		**0.004***	
PV=Prostate Volume ***statistically significant**				

Tables 5 and 6 show the combined frequencies and mean values of PV and PSA levels among men of the different age groups. The age group 67–76 years had 27 patients which is the highest number of patients in this study. (Table 7) The lowest mean PV and PSA values (59.6 ± 18.0 mL³ and 3.7 ± 2.7ng/mL respectively) were recorded in the youngest age group (46–56), while the highest mean PV (223.0 ± 71.1 mL³) was seen in the oldest age group (87–96). The highest mean PSA level of 13.3 ± 6.8

ng/mL was recorded in the age group of 77–86 years.(Table 8) PV and PSA values varied widely over the different age groups.

Table 5
Combined Frequency distribution of PV and PSA among men of different age groups

Age group	PV (mL^3) n/total (%)				*p* value	PSA (ng/mL) n/total (%)				*p* value
	< 40	**41–50.9**	**51–100.9**	**> 100**		**0–4**	**4.1–10**	**10.1–20**	**> 20**	
46–56	0	4/12 (33.3)	7/12 (58.3)	1/12 (8.3)	**0.033***	10/12 (83.3)	1/12 (8.3)	1/12 (8.3)	0	**0.033***
57–66	1/20 (5.0)	4/20 (20.0)	8/20 (40.0)	7/20 (35.0)	0.527	9/20 (45.0)	7/20 (35.0)	2/20 (10.0)	2/20 (10.0)	0.143
67–76	0	4/27 (14.8)	9/27 (33.3)	14/27 (51.9)	0.448	10/27 (37.0)	6/27 (22.2)	9/27 (33.3)	2/27 (7.4)	0.762
77–86	0	1/10 (10.0)	5/10 (50.0)	4/10 (40.0)	0.918	1/10 (10.0)	1/10 (10.0)	7/10 (70.0)	1/10 (10.0)	0.006
87–96	0	0	0	3/3 (100)	0.246	1/3 (33.3)	2/3 (66.7)	0	0	0.386
Total	1/72 (1.4)	13/72 (18.1)	29/72 (40.3)	29/72 (40.3)		31/72 (43.1)	17/72 (23.6)	19/72 (26.4)	5/72 (6.9)	

PV = Means followed by the same alphabets are statistically similar (the age group) while means followed by different alphabets are statistically different.

PV=prostate volume, PSA=prostate specific antigen, ***statistically significant**

Table 6
Combined Mean Prostate volume and PSA levels among men of the different age groups

Age group (years)		Number	PV (mL³)		PSA (ng/mL)	
Group	**Mean ± SD**		**Mean ± SD**	**Range**	**Mean ± SD**	**Range**
46–56	52.0 ± 3.3[a]	12	59.6 ± 18.0[a]	42.2–109.2	3.7 ± 2.7[a,c]	1.4–11.8
57–66	61.6 ± 3.2[b]	20	101.6 ± 86.6[a]	40.0–427.5	6.5 ± 6.6[a,b]	0.8–24.0
67–76	70.5 ± 2.6[c]	27	111.5 ± 51.7[a,b]	42.1–264.7	9.8 ± 9.3[a,b]	0.9–44.0
77–86	81.0 ± 2.4[d]	10	125.3 ± 83.4[a,b]	48.9–297.0	13.3 ± 6.8[b]	0.2–23.9
87–96	91.0 ± 1.7[e]	3	223.0 ± 71.1[b]	159.3–299.6	4.6 ± 3.8[a,b]	0.9–8.4
p value	**0.000***		**0.004***		**0.020***	

NB: Means followed by the same alphabets are statistically similar while means followed by different alphabets are statistically different. PV=prostate volume, PSA=prostate-specific antigen, ***statistically significant**

Table 7 illustrates the percentage differences of PV and PSA. PV percentage differences in the 87–96 years age group (63.8%) was higher than those found in the 67–76 and 77–86 years age groups (58.4% and 60.5%, respectively) while the percentage difference of PSA in the 87–96 years age group (65.6%) was lower than those found in the 67–76 and 77–86 years age groups (100.2% and 103.3%, respectively).

Table 7
Percentage differences in mean PV and mean PSA in consecutive age groups, as compared to the reference points of the 46–56 years age groups

Age group (years)	PV		PSA	
	% difference	***p* value***	**% difference**	***p* value***
46–56	RP = 59.6 ± 18.0	n/a	RP = 3.7 ± 2.7	n/a
57–66	64.5%	0.997	84.8%	0.000
67–76	58.4%	1.000	100.2%	0.000
77–86	60.5%	1.000	103.3%	0.000
87–96	63.8%	1.000	65.6%	0.318

**p* values for the differences of mean PV and mean PSA in consecutive age groups as compared to reference point.

PV=prostate volume, PSA=prostate-specific antigen, RP=reference point, n/a = not applicable.

*Statistically significant

Table 8 and Figs. 2 to 4 illustrate the correlation between age and PV, age and PSA and PSA and PV. Statistically significant but weak positive correlations were found between age and PV (Correlation coefficient (r) = 0.366, p = 0.002), age and PSA (Correlation coefficient (r) = 0.313, p = 0.007). However, a statistically non-significant and very weak positive correlation was found between PV and PSA (Correlation coefficient (r) = 0.128, p = 0.284).

Table 8
Correlation matrices of Age with PV and PSA

		Age	PV (ml³)	PSA ng/mL
Age	Pearson Correlation	1	0.366	0.313
	Sig. (2-tailed)		**0.002***	**0.007***
	N	72	72	72
PV (ml³)	Pearson Correlation	0.366	1	0.128
	Sig. (2-tailed)	**0.002***		0.284
	N	72	72	72
PSA ng/mL	Pearson Correlation	0.313	0.128	1
	Sig. (2-tailed)	**0.007***	0.284	
	N	72	72	72
PV = prostate volume, PSA = prostate specific antigen				

*Statistically significant

Table 9 and Figs. 11 and 12 illustrate the correlations between IPSS and PV, IPSS and PSA. A statistically significant but weak positive correlation was found between IPSS and PV (Correlation coefficient (r) = 0.393, p = 0.001) and IPSS and PSA (Correlation coefficient (r) = 0.256, p = 0.030).

Table 9
Correlation matrices of IPSS with PV and PSA

		IPSS	PV (ml³)	PSA ng/mL
IPSS	Pearson Correlation	1	0.393	0.256
	Sig. (2-tailed)		**0.001***	**0.030***
	N	72	72	72
PV (ml³)	Pearson Correlation	0.393	1	0.128
	Sig. (2-tailed)	**0.001***		0.284
	N	72	72	72
PSA ng/mL	Pearson Correlation	0.256	0.128	1
	Sig. (2-tailed)	**0.030***	0.284	
	N	72	72	72
IPSS = International prostate symptoms score, PV = prostate volume, PSA = prostate specific antigen				
* Statistically significant				

Table 10
Correlation Analysis

Variables	**Correlation (r)**	**p-value**	**Interpretation**
Age vs PV	0.366	0.002	Significant
Age vs PSA	0.313	0.007	Significant
PV vs PSA	0.128	0.284	Not significant
PV vs IPSS	0.393	0.001	Significant
PSA vs IPSS	0.256	0.030	Weak significant

- Significant correlation: PV vs Age, PV vs IPSS.

Table 11
Multiple linear regression analysis

Variable	β Coefficient	Standard Error (SE)	95% Confidence Interval	p-value	Interpretation
Age	0.366	0.112	0.145–0.587	0.002	Significant predictor
IPSS	0.393	0.105	0.184–0.602	0.001	Significant predictor
PSA	0.128	0.118	-0.105–0.361	0.284	Not significant

Multiple linear regression analysis was performed to determine the independent predictors of prostate volume. Age, IPSS, and PSA were entered into the model.

The analysis demonstrated that **age (β = 0.366, p = 0.002)** and **IPSS (β = 0.393, p = 0.001)** were statistically significant independent predictors of prostate volume. In contrast, **PSA (β = 0.128, p = 0.284)** did not show a statistically significant association with prostate volume.

The model indicates that increasing age and higher symptom severity are independently associated with increased prostate volume, while PSA does not independently predict prostate size in this cohort.

DISCUSSION

This study provides important insight into the interrelationship between prostate volume, age, serum PSA, and symptom severity in a cohort of Nigerian men with clinically significant prostatic enlargement. The findings demonstrate that prostate volume correlates significantly with age and symptom severity, while its relationship with PSA is weak and not statistically significant, reinforcing the complexity of prostatic disease and its evaluation.

The observed mean age of 67.3 years aligns closely with previous studies by Ahmed *et al* [24](62.5 years) and Udeh *et al*[25] (65.6 ± 9.84 years) respectively, Nigerian and African studies, supporting the well-established concept that BPH is predominantly a disease of ageing men[1,23]. Age-related hormonal changes, particularly alterations in androgen–estrogen balance and increased dihydrotestosterone activity, contribute to progressive stromal and epithelial proliferation within the prostate [26]. The moderate correlation observed between age and prostate volume in this study further supports the biological model of BPH as a cumulative, time-dependent process.

The relatively large mean prostate volume observed in this cohort (106.7 mL) is notably higher than the findings by some Nigerian authors[27,24,25,28] and likely reflects late presentation and referral bias inherent in tertiary hospital settings. Studies in developed populations often report smaller mean volumes, likely due to earlier detection and intervention[29]. This highlights a key regional difference and underscores the importance of contextualizing prostate disease within healthcare access and health-seeking behavior. Geographical and dietary variations have also been attributed as responsible for this difference in PV as

has been postulated in a study carried out among different ethnic groups of a Caucasian population. Much lower values of mean PV have been documented among the Caucasians.[28,30]

PV of 31.7 ± 16.1cc was recorded in Korea by Sung and co workers[28] while 30.3 ± 9.8 and 49.0 ± 26.9cm3 were obtained from studies in Europe and America.[30] Geographical and racial differences; greater health awareness and early presentation to the clinic by men with symptoms of enlarged prostate in the Caucasian studies may account for these lower mean values of PV. The same variance was seen in the PSA pattern between negroid and non-negrioid studies. 45, 66–69.

This study also demonstrated that as the patients advance in age, the increase in PV becomes statistically significant.[31–32]

This present study demonstrated significant correlation between age and PV (Table 5, 6 and Fig. 2) which implies that as a patient advance in age, the prostate gland increases in volume and size. This is in agreement with studies carried out in Nigeria by Badmus[27] in Ile-Ife and Ofoha[32] in Jos. in South – Western and North-Central region respectively. Furthermore, similar studies outside the shores of Nigeria have corroborated this finding of statistically significant correlation between PV and age;[33,34,35] The study of Ida Bagus and collaegues[34] in Indonesia on the evaluation of 1,638 patients with BPH also showed the increase in prostate gland volume with advancing age ($r = 0.12$, $P < 00001$). Conversely, a few studies demonstrated that age did not significantly correlate with PV.[36,37] Chang and co-workers[36] studied 223 subjects with mean age of 71.4years (range 42 to 89) in Taiwan, Barcelona. This disparity may be attributed to early presentation of patients to clinic in the Western world, racial, environmental, dietary factors and sample size differences.

Another major finding of this study is the absence of a significant correlation between prostate volume and PSA. At variance to this, are Nigerian studies and a study done in Japan[25.38] which found significant positive correlation between PV and PSA. Furthermore, Mosli and colleagues[39] in Saudi demonstrated that the relationship of PV with PSA varied widely over different age groups and different races as their findings showed that the PV and PSA in the men was not similar to that of the white men. The variations in the above studies on PV and PSA may be explained by the differences in geographical locations and race in some of the studies. While PSA has traditionally been considered a surrogate marker for prostate size, its clinical utility in this regard has increasingly been questioned[18]. PSA production is influenced by multiple factors beyond glandular volume, including inflammation, microvascular permeability, and subclinical malignancy[19]. The wide variability of PSA observed in this study further weakens its reliability as a proxy for anatomical enlargement.

Conversely, the significant correlation between prostate volume and symptom severity provides clinically meaningful insight. This is similar to finding in other studies. 77 Although the strength of the association was modest, it suggests that increasing gland size contributes to worsening bladder outlet obstruction and LUTS. However, the relatively low coefficient of determination indicates that a substantial proportion of symptom variability is explained by factors other than prostate size. These include detrusor

overactivity, bladder compliance, and neural regulation of micturition[20]. In a study done by Lim et al, it was demonstrated that each unit increase of serum PSA only influenced 1.89% of change in symptom score, hence it cannot accurately grade the symptomatic severity in BPH patients which is also seen in other causes of prostate enlargement.[40]

This however, is in contrast with the observation made by Ucer[41] in a study on 1408 subjects using TRUS in Manisa, Turkey and discovered that there was no significant correlation between IPSS and PSA.

The weak correlation between PSA and symptom severity in this index study, further reinforces the limited clinical role of PSA in assessing disease burden. While PSA may have prognostic value in certain contexts, particularly in predicting disease progression, it does not reliably reflect symptom severity[21].

Importantly, the findings from the multivariate regression analysis provide important insight into the independent determinants of prostate volume. While univariate correlations suggested relationships between several variables, regression analysis clarified that **age and symptom severity (IPSS) are the true independent predictors of prostate volume**, whereas PSA loses statistical significance after adjustment.

The independent effect of age on prostate volume reinforces the well-established role of ageing as a key driver of prostatic enlargement through cumulative hormonal and cellular changes. Similarly, the independent association between IPSS and prostate volume suggests that anatomical enlargement contributes meaningfully to symptom burden, likely through mechanisms of bladder outlet obstruction.

In contrast, the lack of an independent association between PSA and prostate volume highlights the limitations of PSA as a surrogate marker for gland size. Although PSA may correlate weakly with prostate volume in unadjusted analyses, its variability due to inflammation, subclinical pathology, and individual biological differences reduces its predictive reliability when other factors are considered. This finding strengthens the argument for prioritizing imaging-based assessment over biochemical markers in symptomatic patients.

Taken together, these findings suggest a hierarchy of clinical relevance, with prostate volume and symptom assessment providing more meaningful information than PSA alone. This has important implications in resource-limited settings, where over-reliance on PSA may lead to misinterpretation and unnecessary interventions.

Furthermore, the relatively weak correlations observed across all variables highlight the multifactorial nature of LUTS and prostatic disease. Future studies incorporating additional parameters such as intravesical prostatic protrusion, bladder wall thickness, and urodynamic studies may provide a more comprehensive understanding.

CONCLUSION

Prostate volume demonstrates significant association with age and symptom severity but not with serum PSA levels. These findings suggest that TRUS-derived prostate volume is a more reliable indicator of clinical disease burden than PSA in men with prostatic enlargement. A comprehensive assessment integrating imaging and symptom evaluation is essential for optimal clinical decision-making.

Abbreviations

BPH ……..Benign Prostatic Hyperplasia

CI……..Confidence Interval
IPSS……..International Prostate Symptom Score
LUTS……Lower Urinary Tract Symptoms
PSA…… Prostate-Specific Antigen
PV……Prostate Volume
SE……Standard Error
SPSS……Statistical Package for the Social Sciences
TRUS……Transrectal Ultrasonography

Declarations

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Author Contribution

A.R conceived the study, designed the methodology, collected and analysed the data, N.I.A drafted and organised the manuscript. All authors reviewed and approved the final manuscript.

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Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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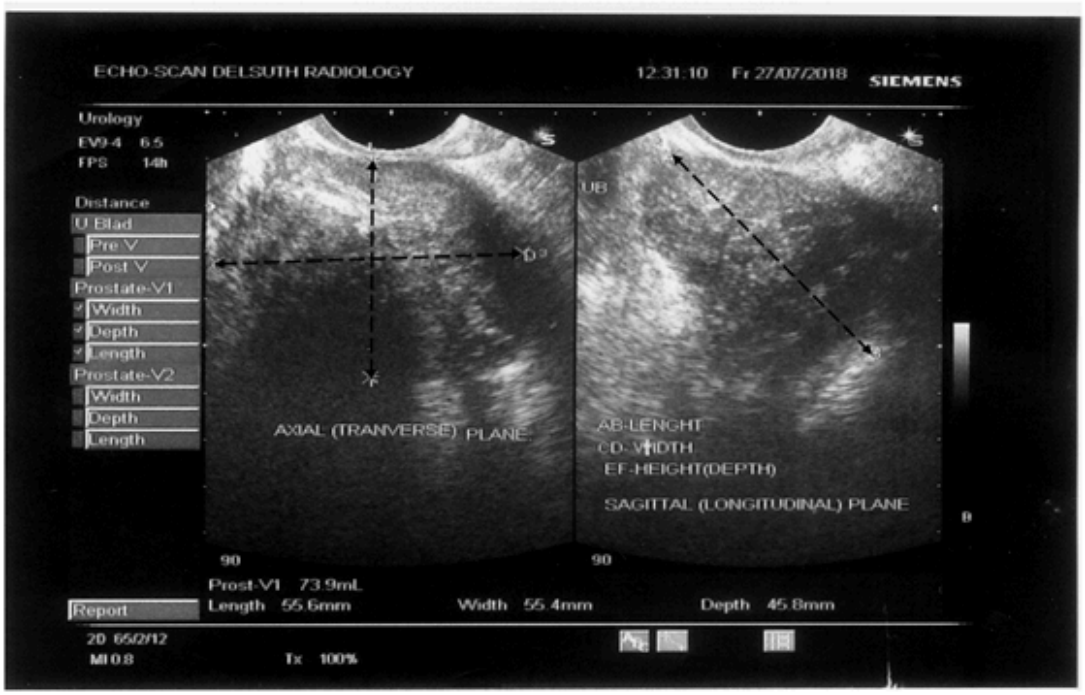
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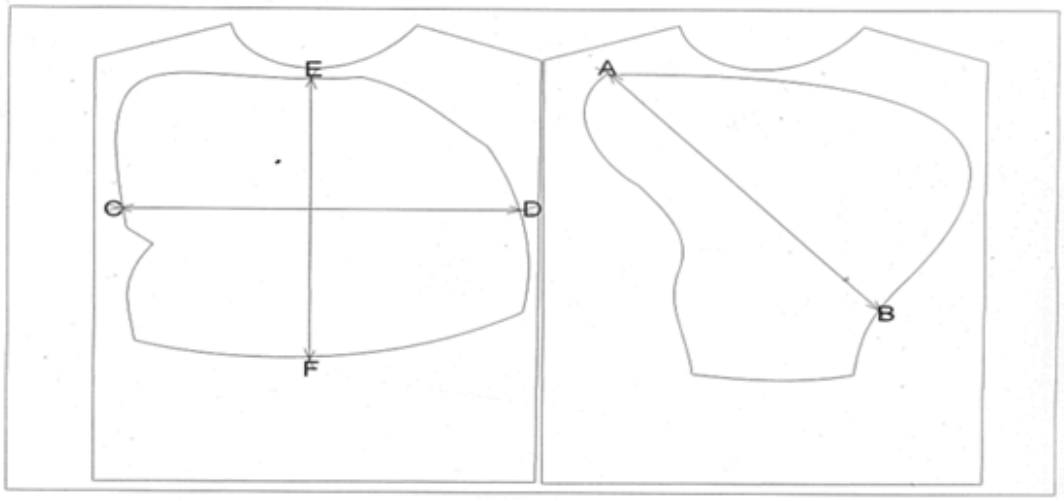
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Figures



Axial view **Sagittal view**

A



Axial view **Sagittal view**

B

Figure 1

a: A trans-rectal sonogram, transverse (axial) and longitudinal (sagittal) views of an enlarged prostate gland, showing points of measurement for volume (indicated by cursors.)

b: Corresponding line diagram of the transverse (axial) and longitudinal (sagittal) views of an enlarged prostate gland, with points AB for length, ED and EF for width and height respectively.

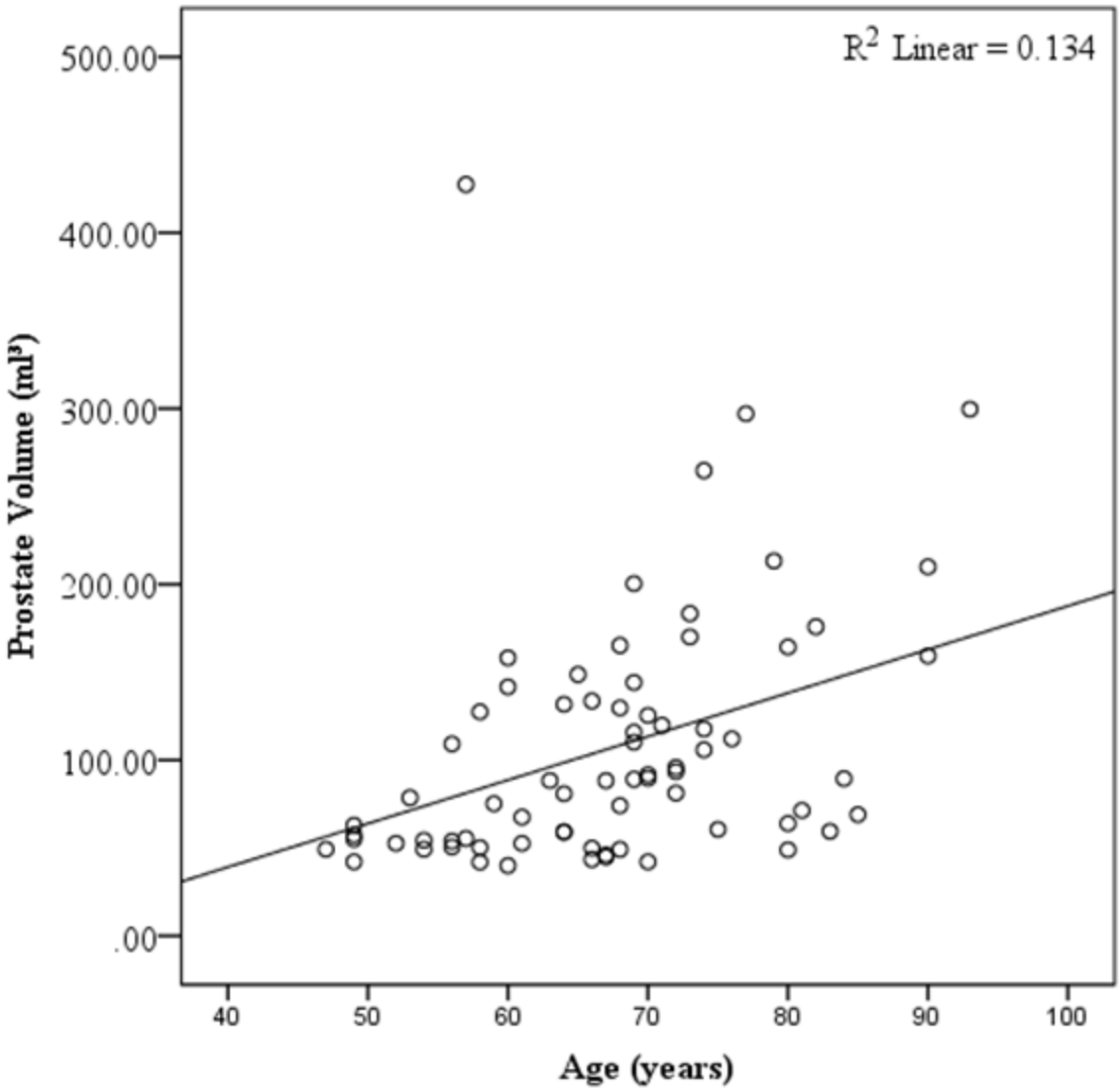


Figure 2

Pearson's correlation coefficient between age and prostate volume

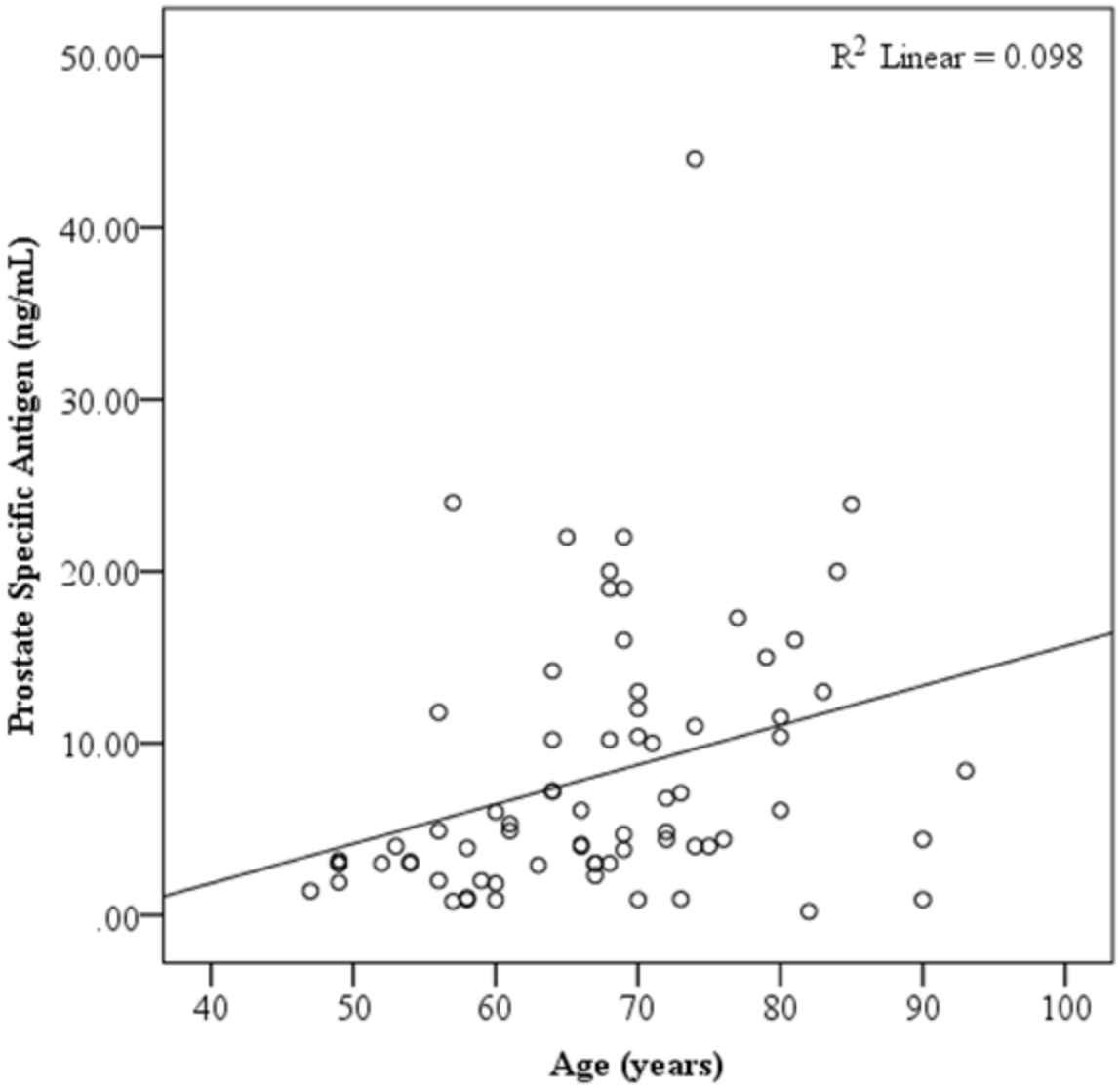


Figure 3

Pearson's correlation coefficient between age and PSA

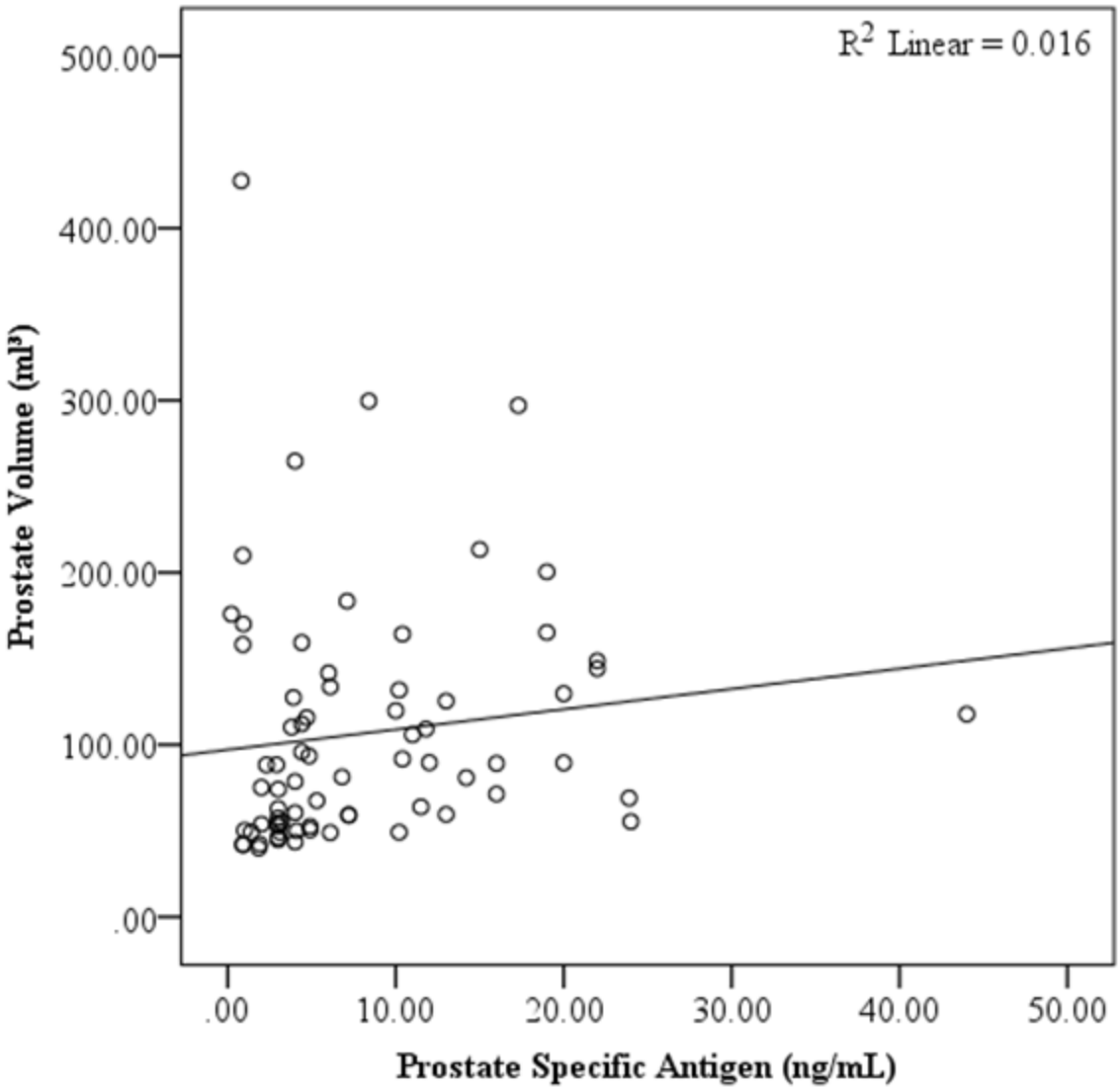


Figure 4

Pearson's correlation coefficient between PV and PSA

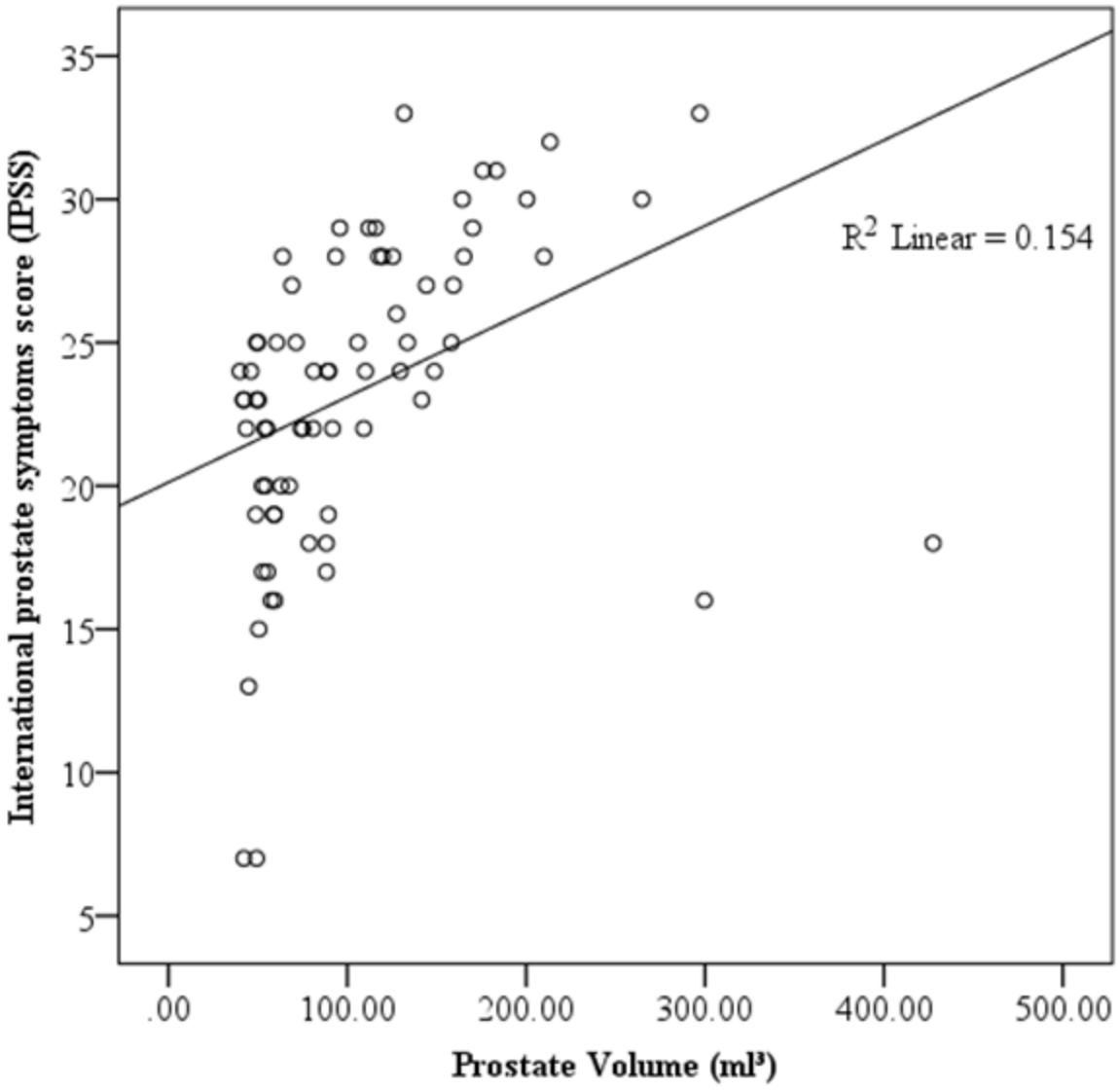


Figure 5

Scatter plot showing correlation between prostate volume and IPSS score

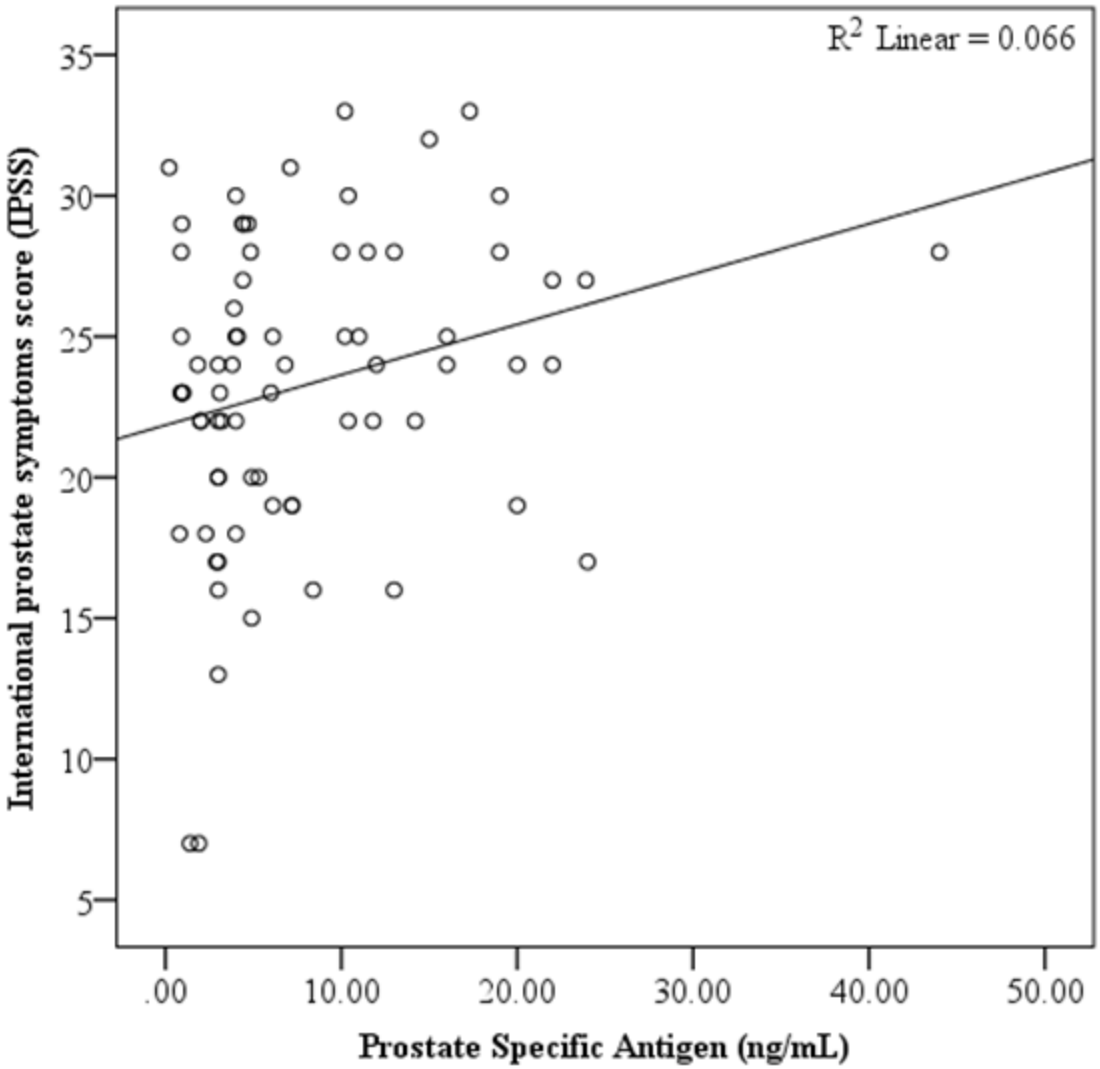


Figure 6

Scatter plot showing correlation between PSA and IPSS score

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- APPENDIXIV.docx