

Relationship Between Transabdominal Measurements of Prostate Volume and Anthropometric Measurements among Male Residents in Ondo State

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ABSTRACT

Introduction: The prostate gland is a major site of diseases like prostatitis, benign prostatic hyperplasia and carcinoma of the prostate. Growth and enlargement of prostate can be predicted by prostate volume in the future. The prostate gland volume are influenced by a number of factors which includes age, body mass index (BMI), waist circumference (WC) and ethnicity. **Aim:** To study the relationship between anthropometric measurements and transabdominal measurements of prostate volume among male Residents in Ondo State. **Method:** A cross-sectional descriptive study was carried out at Ultrasound Department, University of Medical Sciences Teaching Hospital, Ondo, Ondo state with 200 healthy adults categorized into 4 age groups 1,2,3 and 4 i.e 20-50 years, 51-60 years, 61-70years, >71 years. Three categories of BMI was formed which are Healthy (18 to 25 kg/m²), Overweight (>25 to 29 kg/m²), Obese (≥30 kg/m²). Data analysis was done using SPSS version 20. Post hoc- LSD Fishers test was applied to make comparison between means of different groups. Univariate analysis was used to test the linear association among the variables. . P-value < 0.05 was considered significant.

Results: Mean age of the subject in this study was 46.3 ± 17.0 years (Table 1). Age group was divided into group 1, 2, 3 and 4 i.e 20-50 years, 51-60 years, 61-70 years, >71 years with 125, 29, 24 and 22 subjects respectively (Table 2). The BMI was classified into three groups which includes normal weight, over weight and obese with 100, 65 and 35 subjects respectively. The mean BMI in the study was 25.8 ± 4.61 . Significant positive correlation was seen between prostrate volume and Age and positively with BMI. The correlation coefficients were ($r=0.017$) and ($r=0.062$) respectively. **Conclusion:** Age plays a significant role in the determination of prostate volume. The prostate volume increases as the age increases. Also BMI has a contributing factor to change in prostate volume as the Obese people have an increase prostate volume

Key Words: Prostate, Volume, Prostatic Cancer, Benign Prostatic Hypertrophy, Age, Obesity.

INTRODUCTION

The Prostate can be referred to as a compound tubulo-alveolar exocrine gland found in the male reproductive system, which has a milky appearance. It is the organ that surrounds the proximal urethra at the bladder neck. It is anterior to the rectum. It secretes a slightly acidic substance and the seminal vesicle open into it from where semen is discharged into the urethra. [1].

Many diseases are known to be associated with the prostate gland. These include Prostatitis, Benign hyperplasia and Carcinoma [2]. Prostate cancer is one of the most common cancers in men [3].

The growth and enlargement of prostate can be predicted by prostate volume in the future [4]. Prostate volume varies with age as well as the presence of prostatic diseases [5]. A normal prostate volume is about 0.250ml and 10ml at birth and puberty respectively and can be as high as 40ml at the age of 80yrs [6].

The most easily observed feature of the prostatic gland, which is very often causally related to prostatic disease is the prostatic volume. The assessment of the significance of the volume is often complicated by the age and BMI. While carcinoma may be associated with increased prostatic size, it may be seen in a normal-sized prostate.. Prostatic volume is assessed as part of diagnostic measure along with PSA values [7] and monitoring management progress in carcinoma, hyperplasia cases [8, 9, 10, 11,12].

Prostatic volume can be measured with CT, MRI and ultrasound. The cheapest, and most readily available method without the risk of ionising radiation is ultrasound. With Ultrasound, prostate volume can be measured via Transperineal (TPUS), Transrectal (TRUS), and Transabdominal (TAUS). However, according to American Institute of Ultrasound & Medicine guidelines Transabdominal ultrasonography is preferred [13].

A 3-5MHz transducer directed caudally through a fully filled urinary bladder is used in Transabdominal ultrasound to send ultrasound beam under the pubic arch and anthropometric measurements of prostate volume is done [7]. The organs are viewed through the abdominal walls by ultrasound waves action mainly transmission and reflection. Transabdominal method is time-effective and can be performed non-invasively [14].

Studies have shown that prostate volume among men varies not only with age but also with Body Mass Index (BMI) [10]. A recent study from United state shows that Body Mass Index has a positive relationship in men younger than 63 years of age [11]. A Positive relationship between age and prostate volume was demonstrated [12]. Rohrmann et al. [14] in their study showed a positive relationship between lower urinary tract symptoms (LUTS) and increase in BMI after age 25

An important association between anthropometric measures and benign prostate hyperplasia was first documented by the Massachusetts Male Aging Study Group [16]. According to a study by Tsukamoto et al. [11], obesity is said to have an influence on the enlargement of prostate. Also, centrally obese men have higher estrogen and lower testosterone levels which may influence prostate volume [17]. Prostate cancer is known to cause increase in cancer related deaths among Nigeria men [18, 19]; the prevalence in 1997 in Lagos Nigeria study is 127 per 100,000 [20]. Also a recent research reported a prevalence of 182.5 per 100,000 male in Southwestern Nigeria [21]. However, the prevalence of Prostate cancer in Nigerian community specifically Ondo state is not truly known. So this study is based on measurement of prostate volume using transabdominal ultrasound and determine its relationship with prostate specific antigen and anthropometric measurements of male residents in Ondo state.

STUDY METHOD

Study Population

This is cross-sectional descriptive study amount ultrasound patients at the Radiology department of University of Medical Sciences Teaching Hospital, Ondo, Ondo state. The data of consented adults age of 20 and above were used in this study. Excluded from the study were subjects with history of abnormal prostate condition like pelvic or prostatic surgery, recurrent urinary tract infection or bladder stones, acute or chronic urinary retention, acute or chronic prostatitis within previous 3 months and known cases of prostatic carcinoma, diabetes mellitus and hypertension were excluded from our study. Also Patients on medications such as 5-alpha reductase inhibitors and anti-androgens that has effects on prostate growth and those on antipsychotic and anti parkinson medications were excluded from the study.

Besides ultrasound, the consenting patients also had their respective height, weight and BMI recorded. The height and weight were measured using normal standard anthropometric techniques while the BMI was calculated by the division of the weight of subject by the square of their heights.

Prostate Ultrasonographic Scanning Protocols

Ultrasonographic scanning was conducted by using Mindray Diagnostic machine Model DC-N2, Manufactured in 2015 and a Curvilinear probe 3.5MHz. It was set to a 3D mode and 3.5 Megahertz transducer was used in the measurement of prostate volume. The patient lies in a supine position with the gel poured on the anterior part of the pubic region and the transducer placed inferiorly under pubis symphysis. Transverse sections were obtained at about an angle of 15°. The length, anteroposterior height and transverse diameters of the prostate were measured on frozen images [22].

Subjects should have a partial or fully filled bladder by consuming about 500ml of water 30 minutes before the scan thereby enabling a well-imaged and observation of the anatomy of the prostate.

According to Sanders et al [23, 24], ellipsoid model is used as the basis for the calculation of prostate volume. Anteroposterior height, Craniocaudal length and Transverse width were measured and multiplied by a correction factor 0.524 ($H \times W \times L \times \pi / 6$)

Prostate ellipsoid formula:

(Anteroposterior Length x Transverse Length x Craniocaudal Length x 0.524).

ANALYSIS

The data of the study subjects were divided into 4 groups based on age (<50 years, 51-60 years, 61-70 years, >71 years in groups 1, 2, 3 and 4 respectively). The Subjects were also divided into 3 BMI groups [Healthy (>18 to 25 kg/m²), Overweight (>25 to 29 kg/m²), Obese (≥ 30 kg/m²)] in accordance with WHO classification.

Data analysis was done using SPSS version 20. Frequencies and percentages were taken out for categorical variables. Mean and standard deviation was taken out of the numerical variables for prostate gland volume. Post hoc- LSD Fisher's test was applied to make comparison between means of different groups. Univariate analysis was used to test the linear association among the variables. P-value < 0.05 was considered significant.

RESULTS

Characteristics of Subjects

Mean age of the subject in this study was 46.3 ± 17.0 years (Table 1). Age group was divided into group 1, 2, 3 and 4 i.e. <50 years, 51-60 years, 61-70 years, >71 years with 125, 29, 24 and 22 subjects respectively (Table 2).

Fig 1 shows a bar chart representation of the age of the subjects with the largest number of patients under the age of 50 years (125).

Post hoc comparison using the Fisher LSD test (Table 3) showed the significant mean difference of prostate volume with different age groups but there was no significant difference of PV between subjects of <50 and 51-60, 61-70 and >71 years age group.

The BMI was classified into three groups which includes Normal weight, Over weight and Obese with 100, 65 and 35 subjects respectively. The mean BMI in the study was 25.8 ± 4.61 . There was no significant difference among the BMI groups.

The mean prostate volume in the study was 32.42 ± 34.11 cm³. PV was the largest in obese groups. There was no significant difference among the BMI groups ($p = 0.107$).

Association between PV with Age and BMI

The relationship between Age, BMI and Weight with Prostate volume was done graphically. Significant positive correlation was seen between prostate volume and Age and positively with BMI. The correlation coefficients were ($r = 0.017$) and ($r = 0.062$) respectively.

Table 1. Descriptive stats for total participants

Variables	Total participants N 200 Mean $\pm$ S.D
AGE	46.3 $\pm$ 17.0
SUBJECT WEIGHT (kg)	74.4 $\pm$ 14.9
SUBJECT HEIGHT(cm)	1.70 $\pm$ 0.09
BMI	25.8 $\pm$ 4.61
LENGTH	3.76 $\pm$ 1.19
HEIGHT PH	3.31 $\pm$ 1.02
WIDTH	4.02 $\pm$ 0.95
VOLUME	32.4 $\pm$ 34.1

Table 2: Prostate volume in different age groups

Age group (Years)		1(<50)	2(51-60)	3(61-70)	4(>71)	Total	P-value
		N=125	N=29	N=24	N=22	N=200	
Prostrate (mls)	Volume	21.1 $\pm$ 20.9	31.2 $\pm$ 19.5	64.7 $\pm$ 48.9	68.4 $\pm$ 48.8	32.5 $\pm$ 34.2	0.000

p-value <0.05 considered significant

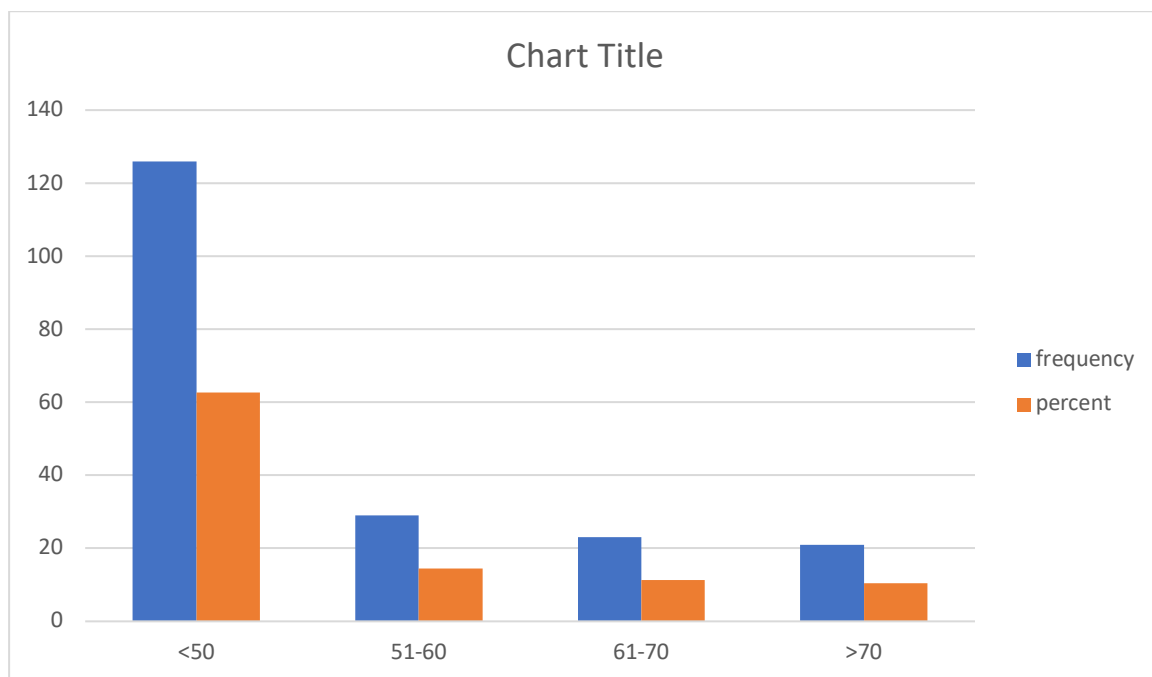


Figure 1: Age groups of study participants

Table 3: Correlation of prostate volume within different age groups

Multiple Comparison						
Dependent Variable						
					95% Confidence Interval	
(I) Age group	(J) Age group	Mean Difference (I-J)	Std. Error	Significant	Lower bound	Upper bound
<50	51-60	-10.15	5.986	0.092	-21.95	1.66
	61-70	-43.62	6.715	0.000	-56.86	-30.38
	>70	-47.32	6.849	0.000	-60.83	-33.82
51-60	<50	10.15	5.986	0.092	-1.66	21.95
	61-70	-33.47	8.211	0.000	-49.67	-17.28
	<70	-37.18	8.322	0.000	-53.59	-20.76
61 – 70	<50	43.62	6.715	0.000	30.38	56.86
	51 – 60	33.47	8.211	0.000	17.28	49.67
	<70	-3.71	8.860	0.676	-21.18	13.77
<70	<50	47.32	6.849	0.000	33.82	60.83
	51-60	37.18	8.322	0.000	20.76	53.59
	61-70	3.71	8.860	0.676	-13.77	21.18

Table 4. Prostrate Volume in BMI Groups

BMI Groups	Normal Weight	Over weight	Obese	Total	P-value
Total	N=100	N=65	N=35	N=200	
Prostrate Volume (mls)	29.96±34.36	39.57±39.66	26.19±15.61	32.42±34.11	0.107

Table 5: Correlation of prostate volume within different BMI Groups

Multiple Comparisons						
Dependent Variable Prostate Volume						
					95% Confidence Interval	
(I) BMI Group	(J) BMI Group	Mean Difference (I-J)	Std. Error	Significant	Lower bound	Upper bound
Normal Weight	Over weight	-9.60	5.425	0.078	-20.30	1.10
	Obese	3.78	6.728	0.575	-9.49	17.05
Over weight	Normal weight	9.60	5.425	0.078	-1.10	20.30
	Obese	13.38	7.192	0.064	-0.80	27.57
Obese	Normal weight	-3.78	6.728	0.575	-17.05	9.49
	Over weight	-13.38	7.192	0.064	-27.57	0.80

Table 6: Univariate analysis of prostate volume with anthropometric measurements.

AGE	R	0.017	P-VALUE	0.000
BMI	R	0.062	P-VALUE	0.107

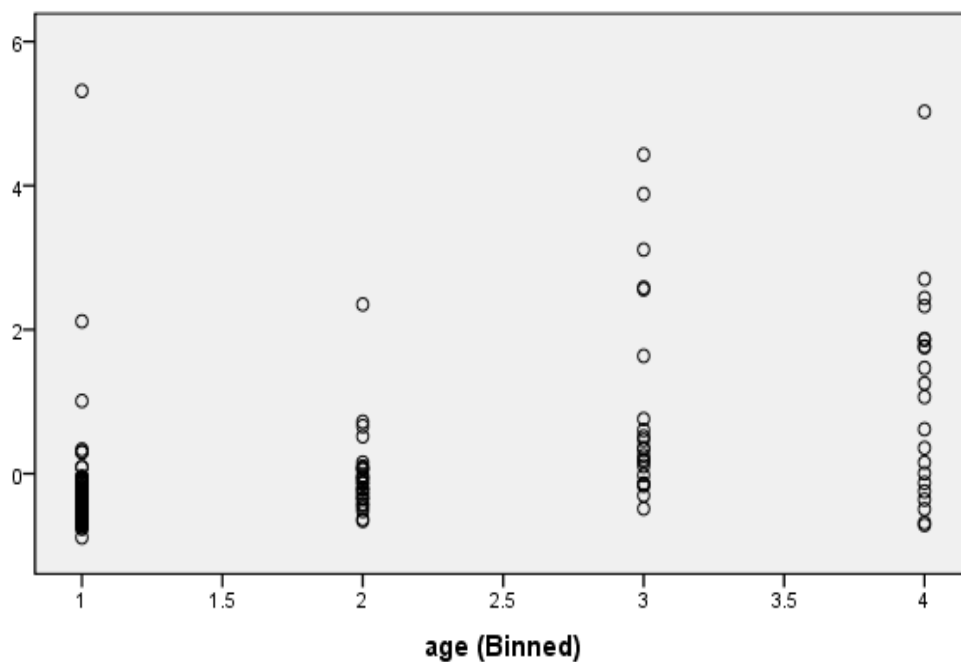


Fig 2: Plot between Prostate volume and Age

Graphically represents the significant positive correlation between age and prostate volume Plot between Prostate Volume and body mass Index (BMI)

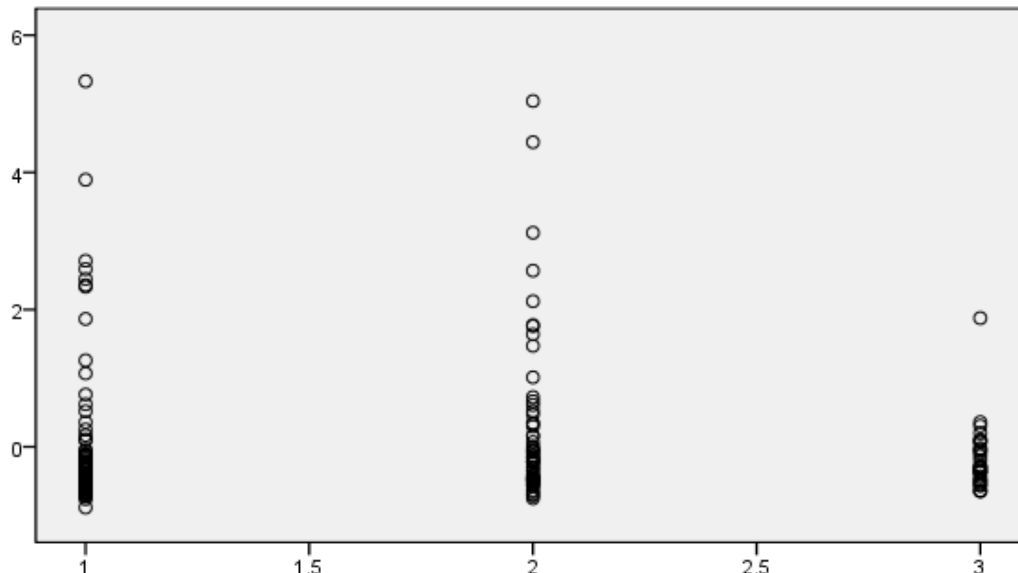


FIG 3: Graphically represents significant positive correlation between prostate volume and body mass index(BMI)

BODY MASS INDEX

Table 7: Multiple Linear Regression Applied To Determine Independent Predictors Of PV

Variable coefficient	Coefficient	p-value	VIF
AGE	0.523	0.000	1.0000
BMI	0.007	0.000	1.0000

DISCUSSION

This study was based on the relationship of body measurements and prostate volume among male residents in Ondo state. The mean age of the participants was 46.3 years. This was in contrast with other studies done in Nigeria by Ibinaye et al [25], Badmus et al [26] and Mohamed et al [27] with mean ages of 64.1, 64.4 and 62.5 years respectively [25,26,27]. The mean BMI in our study was 25.8% which is in agreement with studies done by Raza et al [13]. The mean prostate volume in our study was 32.5 cm³. This is in correlation with studies done in Taiwan with prostate volume of 32.2 cm³[30]. Although other studies done in Nigeria showed a higher prostate volume of 45.93 cm³, 83.5cm³ and 68.7 cm³, which could be due to the age group of the patients studied as majority of the patients in our study are below the age 50 years.

The largest mean volume of prostate in our study was in age group 4 (age 70-79 years), this means that prostate volume increases with age. This is in agreement with study by Raza et al.[13] that shows increase in prostate volume as the age increases. Also study done by Mosli et al [28] presented a positive correlation of prostate volume with age. Although the level of testosterone decreases with age, there are increasing levels of dihydrotestosterone (DHT) with age, the DHT is converted through 5 α -reductase and androgen receptors .Type 2 5 α -reductase is a serious mediator of hyperplastic prostatic growth in later age [29]

BMI is one of the major contributing factor of prostate gland volume. Positive association was shown between BMI and prostate volume in our study. This shows that prostate volume increases as the BMI increases with the largest mean prostate volume seen among the obese people. This is in contrast with study done by Badmus et al [21], with no significant association between BMI and prostate volume, also reports by Burke et al [16]. showed no positive association between BMI and prostate volume [16,27]. However study done by Raza et al shows a significant association between BMI and prostate volume [13]

Although molecular mechanism which shows increase in prostate volume as BMI increases are not fully understood, biologic mechanism seems to be insulin resistance [13]. Hyperinsulinemia has been causally associated to the growth of benign prostate hyperplasia [30]. Insulin may affect the transcription of genes involved in sex hormone metabolism which changes the androgen/estrogen ratio and circulating level of sex hormone binding globulin. Androgens are involved in development and maintenance of BPH with support of androgen receptor expression in prostate epithelium and the well-known androgen is testosterone. Such changes in the ratio of testosterone to estrogen level in prostate tissue may lead to development of benign prostate hyperplasia [31].

CONCLUSION

Majority of the subjects in our study were below 50 years which accounts for normal PV in the study. Age plays a significant role in the determination of prostate volume which shows a positive association with PV. BMI is also an important index factor used to determine prostate volume measurement in patients with obese people having a higher prostate volume.

RECOMMENDATION

The normal prostate gland volume is 25ml. Patients aged more than 50 years in our study have prostate volume greater than 25ml and since dihydrotestosterone increases with age with 5 α -reductase serves as a facilitator for hyperplastic prostate growth, we therefore recommend those above 50 years should go for ultrasound scan for prostate volume checkup should be done and regular test for prostate specific antigen at least once in a year.

Also from our study shows people with high BMI has a high prostate volume which has been linked to high ratio of testosterone to estrogen level which leads to high tendency of developing BPH, we recommend that people should regularly check their BMI once or twice a year and exercise should be done regularly.

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