IBOM MEDICAL JOURNAL
Vol.19 No.3 | July - September 2026 | Pages 669-676
www.ibommedicaljournal.org

Vitamin D status in patients treated for prostate diseases in a tertiary hospital, in Calabar, south-south, Nigeria

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Abstract

Context: Vitamin D deficiency is a global problem often undiagnosed among patients, and routine monitoring is not practiced in Nigeria.
Objective: We assessed the vitamin D status of patients undergoing treatment for prostate diseases in Calabar.
Methods: A descriptive cross-sectional study of 102 men aged 40 years and above, with prostate diseases, devoid of prostate-related surgeries, recruited from urology clinic, in the University of Calabar Teaching Hospital, from October 2023 to April, 2024. Data was collected using an interviewer-administered questionnaire after consent. Blood samples were analyzed for vitamin D and prostate-specific antigens.
Results: Most participants, 43 (42.2%) were 61-70 years, and over half 55 (53.9%) had a tertiary education. Majority, 52 (50.9%), had benign prostatic hyperplasia, 40 (39.2%) had prostate cancer, and 10 (9.8%) had prostatitis. Overall, 71(69.61%) had sufficient vitamin D levels (50–100 nMol/L), and 10(9.8%) had deficiency. Higher proportion of deficiency was found in the 1-5 years treatment category. Elevated prostate-specific antigen (>10 ng/mL), occurred in 52 (50.98%) of participants, predominantly below six months of treatment. There was no statistically significant association between sociodemographic characteristics of respondents, treatment categories, and PSA with vitamin D levels ($p > 0.05$).
Conclusion: Majority of patients had sufficient vitamin D levels. However, vitamin D deficiency was higher in the prostate cancer group and the1-5 years treatment category. Further studies are suggested to understand vitamin D's long-term role in prostate disease management.

Keywords: Prostate diseases, vitamin D deficiency, prostate-specific antigen

Introduction

In contemporary times, global attention has shifted to vitamin D following the realization that its deficiency affects various populations in different countries worldwide[1]. Globally, about a billion people have been postulated to suffer from vitamin D deficiency, and half of the world's population is said to have vitamin D insufficiency[2]. In African populations, vitamin D status is poorly characterized[3]. Vitamin D is recognized to have a vast physiologic influence on most tissues and organs, including the prostate, and plays a role in the

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DOI: 10.61386/imj.v19i3.1198

regulation of prostate-specific antigen and androgen receptor modulation[4]. It is also responsible for immune modulation mechanisms, suppressing chronic inflammation, and regulating cellular proliferation, growth, and development[4]. Deficiency of vitamin D has been incriminated in the pathogenesis of most communicable and non-communicable diseases[2,3]. It has also been associated with the pathogenesis of prostate diseases[5,6]. Additionally, progression of prostate diseases, potential for metastasis, and incidence have been widely speculated to have an association with low states of vitamin D; however, there is little or no evidence to show this claim among black African populations[7]. Causes of Vitamin D deficiency and insufficiency, among many other things, have been attributed to inadequate exposure to sunlight, use of sunscreens, and drugs[1]. Patients with prostate diseases are treated with a wide range of drugs, including androgen deprivation therapy, 5-alpha reductase inhibitors, alpha receptor blockers, and prolonged antibiotic use[8]. All these are known to cause vitamin D deficiency on long-term exposure. Vitamin D deficiency worsens prostate diseases and complicates osteoporosis, pathological fractures, osteomalacia, and sarcopenia[9]. There is poor characterization of vitamin D deficiency among black African populations[3], inconsistencies in the findings of previous studies[10], and regional variability has been widely speculated globally[2,11]. Despite the knowledge and awareness of the role of drugs used in the treatment of prostate diseases on vitamin D deficiency, there is a paucity of data on the prevalence of vitamin D deficiency among patients being treated for prostate diseases in the study area. These underscore the need to assess vitamin D status in patients being managed for prostate diseases in Cross River State, Nigeria.

Materials and methods:

Study location

The study was conducted at the Urology Clinics of the University of Calabar Teaching Hospital, a tertiary Hospital located in the capital city of Calabar, Cross River State, within the South-South geopolitical zone of Nigeria. The Hospital is a 790-bed space center that serves patient population of the state, and four other neighbouring states that include – Akwa Ibom, Abia, Benue, and Ebonyi, as well as two neighbouring countries (Cameroun and Equatorial Guinea). The Urology Department has four busy clinics with a steady patient inflow, and attend to various urologic conditions including prostate disease patients who usually constitute the largest patient population in these clinics.

Study design

It was a cross-sectional descriptive study performed over six months, from October 2023 to April 2024.

Study population

A total of 102 ambulant men, 40 years and above, receiving treatment for prostate diseases were recruited, with the exclusion of patients who had undergone prostate-related surgeries, treatment naïve patients, and those receiving vitamin D supplementation or treatment for other cancers and co-morbidities.

Study instrument

A pretested semi-structured, interviewer-administered questionnaire was used for data collection. The questionnaire comprised of section A (sociodemographic), section B (anthropometric measurements), section C (Medical history, and levels of vitamin D and PSA), and section D (complications).

Sample size determination

The sample size was determined using Araoye formula for sample size determination when sample population is less than 10000[12], with the formula:

$$nf = n/(1+(n)/(N))$$

Where nf = desired sample size when population is less than 10,000

n = desired sample size when the population is greater than 10,000 = 126

N = the estimate of the population size = 500

nf = 127/(1+(127)/(500))

= 126/1.25

= 101.2

Rounded up to 102

Sampling Technique

A non-probability sampling technique was employed through consecutive recruitment of the participants as they presented to the clinics and satisfied the inclusion criteria, until the calculated sample size was obtained.

Study procedure

Five (5) mL of blood samples were collected from each patient while seated, into serum separator vacutainer tubes. The samples were then centrifuged at 3000g for 5 minutes before separation, and were stored in 2 mL cryotubes at -80°C until analyses for Vitamin D, and prostate-specific antigen. The ELISA method was used to determine vitamin D and PSA using BIOS Microwell Diagnostic Systems immunoassay test kits with LOT numbers 32310100 and 323103101 for 25(OH) vitamin D and PSA, respectively. They were read off on the Mindray 96A microplate reader.

Data management

Data were entered into the IBM statistical package for the Social Sciences (SPSS), version 25, for cleaning and analysis. Descriptive statistics were performed using frequencies and percentages for categorical data and mean +/- standard deviation for quantitative data that were normally distributed. Inferential statistics were carried out using ordinal logistic regression and chi-square test. A 5% level of significance was regarded as statistically significant.

Ethical issues:

Ethical approval was obtained from the University of Calabar Teaching Hospital Health Research Ethics Committee, and the HREC protocol assigned number is UCTH/HREC/33/vol.III/124. All participants signed a written informed consent form before enrollment. The research was conducted following the principles of the Helsinki Declaration.

Results

Socio-Demographic Characteristics of Participants

Table 1 presents the socio-demographic characteristics of the Participants. Most participants were within the age range of 61–70 years 43 (42.1%), while those aged 40–50 years were the least represented 4 (3.9%). In terms of educational qualification, the majority had tertiary education 55 (53.9%), and 95 (93.1%) of the participants were married. About 27 (26.4%) of the participants reported engaging in physical activities. The participants' family size, tribe/state of origin, and occupation were also represented in Table 1.

Table 1: Socio-demographic characteristics of participants

Variable	Frequency (n 102)	Percentage (%)
Age grade		
40-50 years	4	3.92
51-60 years	32	31.37
61-70 years	43	42.16
71 years and above	23	22.55
Educational qualification		
No formal education	5	4.90
Primary	8	7.84
Secondary	34	33.33
Tertiary	55	53.92
Marital Status		
Single	5	4.90
Married	95	93.14
Widower	2	1.96
Family size		
Less than 6	19	18.63
6-10 size	24	23.53
11 and above	2	1.96
No response	57	55.88
Tribe/State of Origin		
Cross River	63	61.76
Akwa Ibom	18	17.65
Igbo	18	17.65
Others	3	2.94
Occupation		
Civil Servant	20	19.61
Farmer	29	28.43
Trader	16	15.69
Self-employed	13	12.75
Retired	24	23.53
Physical/sporting activities*		
Yes	27	26.47
No	75	73.53

*Brisk walking, gardening, washing of clothes, and dancing,

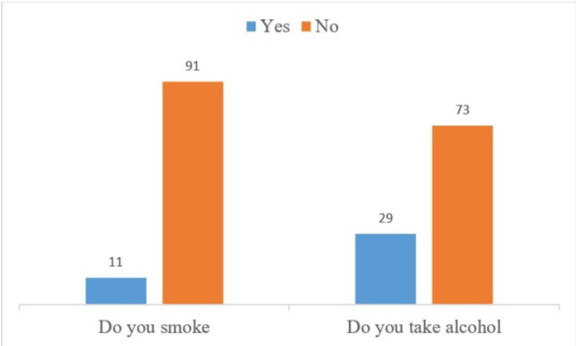

Figure 1: Tobacco and alcohol consumption

Figure 1 represents the cigarette smoking and drinking habits of the participants. A total of 11 (10.7%) participants reported that they smoke, while 91(89.2%) do not. Similarly, 29 (28.4 %) participants indicated that they take alcohol, whereas 73 (71.5%) do not.

Anthropometric Characteristics of Participants

Table 2 presents the anthropometric characteristics of the participants. The Body Mass Index (BMI) distribution shows that more than half of the participants 54 (52.9%) had a normal weight, 27 (26.4%) were overweight and 15 (14.7%) were obese. Only 6 (5.8%) were underweight.

Regarding systolic blood pressure, the majority 79 (77.4%) had normal readings (<139 mmHg), while 23 (22.5%) were hypertensive (≥140 mmHg). Similarly, for diastolic blood pressure, 83 (81.3%) had normal levels (<89 mmHg), whereas 19 (18.6%) were hypertensive (≥90 mmHg)

Table 2: Anthropometric characteristics and Blood Pressure of participants

Variable	Frequency (n)	Percentage (%)
Body Mass Index (Kg/m²)		
Underweight (<18.5)	6	5.88
Normal weight (18.5-24.9)	54	52.94
Overweight (25.0-29.9)	27	26.47
Obesity (> 30.0)	15	14.71
Systolic Blood Pressure (mmHg)		
Normal (<139)	79	77.45
Hypertensive ≥ 140	23	22.55
Diastolic Blood Pressure (mmHg)		
Normal < 89	83	81.37
Hypertensive ≥ 90	19	18.63

Medical History and Biochemical profile of Participants

Table 3 presents key findings on the medical history and biochemical profile of the participants.

Most participants, 52 (50.9 %), were diagnosed with benign prostatic hyperplasia (BPH), followed by those with prostate cancer, 40 (39.2 %), and prostatitis, 10 (9.8%). In terms of treatment duration, the majority, 42 (41.1 %), had been receiving treatment for less than 6 months, while 36 (35.2 %) had been on treatment between 1 and 5 years now.

For Vitamin D levels, most participants 71(69.6 %) had sufficient levels (50–100 nMol/L), while a smaller proportion 15 (14.7 %) had insufficient levels and 10 (9.8%) were deficient.

PSA results revealed that a large proportion, 52 (50.9 %), had significant PSA levels (above 10 ng/ml), while 31(30.3 %) had indeterminate levels, and only 19 (18.6 %) were within the normal cut-off value.

Table 4 shows the distribution of Vitamin D levels among participants with different prostate diseases. The majority of participants across all disease categories had sufficient Vitamin D levels (50–100 nMol/L). Among those diagnosed with benign prostatic hyperplasia (BPH), 38 (37.2 %) had sufficient levels, while 8 (7.8 %) had insufficient and 2 (1.9 %) had deficiency. Only 4 (3.9 %) recorded high Vitamin D levels. For respondents with prostate cancer, 24 (23.5 %) had sufficient Vitamin D levels, 7 (6.8 %) had insufficient levels, and 8 (7.8 %) were deficient, while 1(0.9 %) had high Vitamin D levels. This shows a higher occurrence of Vitamin D deficiency among prostate cancer patients compared to those with BPH. Among those with prostatitis, most 9 (8.8 %) had sufficient Vitamin D, and only 1(0.9 %) had high levels, with none showing low or insufficient levels.

Table 3: Medical History and Level of Vitamin D, and PSA

Variable	Frequency (n=102)	Percentage (%)
Patient diagnosis		
Prostate cancer	40	39.22
BPH	52	50.98
Prostatitis	10	9.8
Treatment duration		
Less than 6 months	42	41.18
Six months – 1 year	13	12.75
1–5 years	36	35.29
Five years and above	11	10.78
Vitamin D Classification		
Low (<30 nMol/L)	10	9.8
Insufficient (30-50nMol/L)	15	14.71
Sufficient (50-100nMol/L)	71	69.61
High (Above 100nMol/L)	6	5.88
PSA Cut-offs		
Normal (4ng/ml and below)	19	18.63
Indeterminate (4-10ng/ml)	31	30.39
Significant (Above 10ng/ml)	52	50.98

Table 4: Level of Vitamin D in Identified Prostate Diseases among Participants

Variable	Low (<30 nMol/L)	Insufficient (30-50nMol/L)	Sufficient (50-100nMol/L)	High (>100nMol/L)	Total
BPH	2(1.96%)	8(7.84%)	38(37.25%)	4(3.92%)	52(50.98%)
Prostate cancer	8(7.84%)	7(6.86%)	24(23.53%)	1(0.98%)	40(39.22%)
Prostatitis	0(0.00%)	0(0.00%)	9(8.82%)	1(0.98%)	10(9.80%)
Total	10(9.80%)	15(14.71%)	71(69.61%)	6(5.88%)	102(100.00%)

Table 5 presents the treatment duration and Vitamin D, and PSA levels among participants.

For Vitamin D, sufficient levels (50–100 nMol/L) were predominant across all treatment durations, especially among participants treated for less than 6 months 37 (36.2%). Only a few cases of deficiency 10 (9.80%) and insufficiency 15 (14.7 %) of Vitamin D levels were observed, with the highest proportion of deficiency found among those treated for 1–5 years. Regarding PSA levels, about half of the respondents, 52 (50.9 %), had significant PSA readings (above 10 ng/ml), with the highest counts observed among those treated for less than 6 months, 20 (19.6 %), and 1–5 years, 20 (19.61%). Indeterminate PSA levels (4–10 ng/ml) were observed in 31(30.39%), while only 19 (18.63%) had normal PSA values.

Table 5: Levels of Vitamin D, and PSA with respect to Treatment Duration

Variable	Less than 6 months	Six months–1 year	1–5 years	Five years and above	Total
Vitamin D					
Low (<30 nMol/L)	1(0.98%)	0(0.00%)	6(5.88%)	3(2.94%)	10(9.80%)
Insufficient (30–50 nMol/L)	0(0%)	1(0.98%)	13(12.75%)	1(0.98%)	15(14.71%)
Sufficient (50 100 nMol/L)	37(36.27%)	12(11.76%)	16(15.69%)	6(5.88%)	71(69.61%)
High (Above 100 nMol/L)	4(3.92%)	0(0.00%)	1(0.98%)	1(0.98%)	6(5.88%)
PSA Cut-offs					
Normal (4ng/ml and below)	10(9.80%)	2(1.96%)	3(2.94%)	4(3.92%)	19(18.63%)
Indeterminate (4-10ng/ml)*	12(11.76%)	3(2.94%)	13(12.75%)	3(2.94%)	31(30.39%)
Significant (Above 10ng/ml)	20(19.61%)	8(7.84%)	20(19.61%)	4(3.92%)	52(50.98%)

*Values within the grey zone i.e. levels that do not define presence of disease

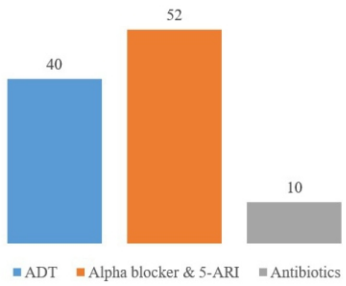

Figure 2: Types of treatment received by participants

Figure 2 presents the distribution of treatment types received by Participants.

The majority of participants, 52 (50.9%), were on combination therapy involving alpha blockers and 5-alpha-reductase inhibitors (5-ARI) such as tamsulosin + finasteride, which are commonly used to manage benign prostatic hyperplasia (BPH) by improving urine flow and reducing prostate size. A smaller proportion, 40 (39.2%), were receiving androgen deprivation therapy (ADT), including agents such as flutamide, leuprolide, and Zoladex, which are standard hormonal treatments for prostate cancer aimed at lowering testosterone levels to slow disease progression. Only 10 (9.8%) of the participants were on antibiotics, for the management of prostatitis or secondary infections associated with prostate disorders.

Table 6 examined the association between Vitamin D levels and the concentrations of PSA among participants. The Fisher's Exact test showed that no statistically significant association was found between Vitamin D and PSA levels (FET = 5.461, p = 0.473), suggesting that Vitamin D concentration may not have a direct influence on PSA levels in this population.

Also examined is the association between vitamin D and types of treatment received by Participants. The Fisher's exact test (FET = 10.028, p = 0.082) indicates no statistically significant association between Vitamin D levels and treatment type at the 0.05 significance level. This means that the distribution of Vitamin D status (low, insufficient, sufficient, and high) did not differ significantly across participants receiving androgen deprivation therapy (ADT), alpha blockers, or antibiotics.

The ordinal logistic regression in Table 7 examined the association between Vitamin D levels and occupation, as well as educational qualification. Results revealed no statistically significant relationship between occupation type and Vitamin D levels (p > 0.05 for all categories). Although self-employed respondents had higher odds of being in higher Vitamin D categories compared to retirees (B = 1.311, p = 0.125), this association was not statistically significant. Similarly, civil servants, traders, and farmers showed no statistically significant difference in Vitamin D levels relative to the reference group. This suggests that occupational type did not have a meaningful influence on Vitamin D status among participants.

The ordinal logistic regression also examined the association between vitamin D levels and educational qualification. The results indicated no statistically significant association between education and vitamin D levels (p > 0.05 for all categories of prostate diseases). Participants with no formal education (B = -0.499, p = 0.588), and those

Table 6: Association between selected variables and vitamin D levels among Participants

Variable	VitaminD(nMol/L)						
	Low (<30)	Insufficient (30 – 50)	Sufficient (50-100)	High (>100)	df	FET**	p-value
PSA (ng/mL)							
Normal (≤4.0)	2 1.96)	0(0)	16(15.68)	1(0.98)	6	5.461	0.473
Indeterminate* (4.0 10.0)	3(2.94)	6(5.88)	21(20.58)	1(0.98)			
Significant (>10.0)	5(4.90)	9(8.82)	34(33.33)	4(3.92)			
ADT***	8(7.84)	7(6.86)	24(23.52)	1(0.98)	6	10.028	0.082
Alpha-blocker	2(1.96)	8(7.84)	38(37.25)	4(3.92)			
Antibiotics	0(0)	0(0)	9(8.82)	1(0.98)			

Significance level = 0.05, FET = 5.461 and 10.028, P – value = 0.473 and 0.082 for PSA and treatment type respectively

**** Concentration of PSA at the grey zone i.e. levels that do not determine presence of disease, ** Fisher's Exact Test, *** Androgen deprivation therapy***

with primary education (B = -0.545, p = 0.464), had slightly lower odds of being in higher vitamin D categories compared to respondents with tertiary education, though these differences were not statistically significant. Similarly, those with secondary education showed no statistically significant difference (B = 0.129, p = 0.787). This suggest that vitamin D levels among participants were not influenced by their level of education.

Table 8 examined the relationship between Vitamin D levels and selected socio-demographic characteristics of the respondents. The chi-square test assessed the relationship between Vitamin D levels and selected socio-demographic characteristics (age grade, occupation, and educational level). For age grade (χ^2 = 7.523, df = 9, p = 0.583), there was no statistically significant association between participants' age and their Vitamin D levels. Although participants aged 61–70 years appeared to have a higher number of sufficient Vitamin D levels (32 individuals), the overall differences across age groups were not significant. For occupation (χ^2 = 10.905, df = 12, p = 0.537), there was no statistically significant association between occupation type and Vitamin D levels. Civil servants and farmers recorded relatively higher counts of sufficient Vitamin D levels compared to other groups, but these variations were not statistically meaningful. For educational level (χ^2 = 7.403, df = 9, p = 0.595), there was likewise no statistically significant relationship between education and Vitamin D levels. Respondents with a tertiary education had a higher number of sufficient Vitamin D levels (38 individuals), but overall, Vitamin D levels did not differ significantly across educational groups.

Table 7: Logistic regression between Vitamin D levels and participants' occupation

Occupation	B	S.E	Wald	p-value
Civil Servant	0.654	0.639	1.046	0.306
Farmer	0.431	0.56	0.591	0.442
Self-employment	1.311	0.855	2.349	0.125
Trader	0.577	0.677	0.726	0.394
Educational level				
No formal education	-0.499	0.921	0.294	0.588
Primary	-0.545	0.745	0.535	0.464
Secondary	0.129	0.478	0.073	0.787

Reference Occupation and Educational Qualification: Retired and Tertiary respectively

Table 8: Association between Vitamin D Levels with the socio-demographic characteristics

Variable	Low (<3nMol/L)	Insufficient (30-50nMol/L)	Sufficient (50-100nMol/L)	High (>100nMol/L)	df	χ^2 cal	p-value
Age grade							
40 50 years	1(0.98)	1(0.98)	2(1.96)	0(0)	9	7.523	0.583
51–60 years	2(1.96)	4(3.92)	25(24.50)	1(0.98)			
61–70 years	4(3.92)	5(4.90)	32(31.37)	2(1.96)			
71 years and above	3(2.94)	5(4.90)	12(11.76)	3(2.94)			
Occupation							
Civil Servant	1(0.98)	2(1.96)	15(14.70)	2(1.96)	12	10.905	0.537
Farmer	2(1.96)	6(5.88)	20(19.60)	1(0.98)			
Trader	3(2.94)	2(1.96)	11(10.78)	0(0)			
Self-employed	0(0)	2(1.96)	11(10.78)	0(0)			
Retired	4(3.92)	3(2.94)	14(13.72)	3(2.94)			
Educational Level							
No Formal Education	0(0)	2(1.96)	3(2.94)	0(0)	9	7.403	0.595
Primary	0(0)	2(1.96)	5(4.90)	1(0.98)			
Secondary	3(2.94)	3(2.94)	25(24.50)	3(2.94)			
Tertiary	7(6.86)	8(7.84)	38(37.25)	2(1.96)			

Discussion

The study assessed the vitamin D status of patients being managed for prostate diseases, specifically prostate cancer (Pca), benign prostatic hyperplasia (BPH), and prostatitis. Prostate-specific antigen (PSA), as a key biochemical substance that is influenced by vitamin D and which affect prostate health, was also assessed by the study. The levels and association of prostate-specific antigens with vitamin D levels of the patients were determined. Sufficient levels of vitamin D were demonstrated in a high proportion (69.6%) of the participants, even though they were not routinely given vitamin D supplementation, as was seen in the patients' treatment regimes. This finding aligns with the works of Dominguez (2021) and Kauser (2022), in which vitamin D levels without supplementation in the studied population were high[13,14]. It was concluded in their study that vitamin D deficiency is uncommon because just 10 minutes of exposure of an individual to sunlight regularly would lead to a buildup of vitamin D in the body, which implicitly applies to our study. The abundance of vitamin D in certain dietary sources, like sunlight-exposed mushrooms, fatty fish, eggs, and liver, was also theorized to be a possible factor that makes vitamin D deficiency uncommon[13,14]. It is not known whether the observation in this study may have been influenced by the abundance of sunlight and sunlight-exposed mushrooms, because these were not explored during data collection but which are factors common within the study area. The finding of our study also corroborated the study of Mohammed et al. (2021) done in Sudan, which demonstrated increased plasma levels of vitamin D in patients with PCa and BPH. However, unlike in this study, their study participants were on adjuvant treatment with radiation therapy[15]. However, the finding is at variance with earlier studies that found Vitamin D to be low in patients who received androgen deprivation therapy (ADT)[16,17], as all the patients in this study were diagnosed with PCa and were on ADT as indicated in their treatment dossier. The finding was also at variance with the study in African Americans, which suggested skin pigmentation was a probable cause of low vitamin D among the population that was studied[18] given that all the participants in the present study were all dark-skinned and highly pigmented. This study also disagrees with the assertion of AlGarni, AlAmri, et al (2023) in their study, which posited that vitamin D is the most common nutritional deficiency in all ages globally, as this is not reflected in the present study, where vitamin D was observed to be high in the studied adult population. This disparity may be a result of the peculiarity of the study area, which is not lacking in the sources of vitamin D, but which were not interrogated in the course of this study. It is speculative to say that it is a reflection of the resistance of vitamin D ligands to the vitamin D receptors (VDR) as a result of alterations of VDRs in prostate cells following treatment with antiandrogens[19]. It may also suggest the use of supplements containing vitamin D by patients who were not accounted for in this study.

Prostate-specific antigen levels were elevated in about half of the study population of the patients with prostate cancer, BPH, and prostatitis. This observation is in agreement with the view of Taha et al. 2020, in which it was posited that PSA levels are increased in inflamed and hypercellular prostate tissue, as it occurs in prostate cancer, BPH, and prostatitis, and about 10 times more in prostate cancer than in BPH[20]. The study, however, disproved the finding in some past studies that suggested an increase in prostate-specific antigen concentrations may follow a decrease in vitamin D level[20]. This is because in the present study, prostate-specific antigens remained high at normal levels of vitamin D.

The level of vitamin D in this study was not influenced positively by educational status, even though most participants with tertiary education (38) and secondary education (25) had sufficient vitamin D levels, it was not statistically significant. This is at variance with studies that demonstrated higher levels of education to have positively modified the status of vitamin D and its attendant effects. Highly educated people were likely to have good dietary habits and lifestyle practices that would improve their vitamin D status[10,21]. Although there was no statistically significant association between vitamin D levels and occupation, there is however a higher risk of developing vitamin D deficiency and insufficiency among the various occupational categories than farmers who had the greatest number of participants with sufficient vitamin D. This agrees with the study of Sowah et al, 2017, a systematic review that revealed that occupations related to sunlight exposure of workers affect vitamin D status[22]. However, neither the highest level of education nor occupation was a predictor of vitamin D levels in these groups of patients.

Conclusion

Our study showed that most participants had sufficient vitamin D levels while receiving treatment for prostate diseases. There was a high PSA level with vitamin D sufficiency across the different prostate disease categories. Deficiency and insufficiency of vitamin D were higher in the prostate cancer category and in those who had received treatment for a longer duration of up to five years. As a limitation, dietary habits and sunlight exposure-time of participants were not assessed in the course of this study. This makes it difficult to provide reasons for the findings observed, and therefore, further research would be required to fully understand the effects of prostate disease treatment on vitamin D.

Funding: We did not receive any funding.

Conflict of interest: The authors declare no conflict of interest.

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