Detection rate of prostate cancer following 12-core extended biopsy in a Semi-urban Nigerian Tertiary Hospital

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\textbf{Abstract}

\textbf{Background:} Transrectal prostate biopsy using the extended protocol has become the standard mode of obtaining tissue for histological diagnosis with cancer detection rate varying with race and geographical regions. This study is aimed at evaluating the cancer detection rate following a 12-core extended transrectal biopsy of the prostate in a semi-urban Nigerian tertiary hospital.

\textbf{Materials and Methods:} This was a hospital-based prospective study. Patients who had one or combination of elevated prostate-specific antigen (PSA) levels, abnormal digital rectal examination (DRE), and suspicious ultrasound findings were recruited into this study. Each had 12-core extended biopsy done. Their clinical and histological information were recorded in a pro forma. Data analysis was performed using the statistical programming for social sciences (SPSS) version 21. For all statistical tests, $P < 0.05$ was regarded as significant.

\textbf{Results:} Of the 120 patients, 78 (65\%) had prostate cancer. The cancer detection rate in participants aged 50–59, 60–69, 70–79, 80–89, 90–100 were 75\%, 46.7\%, 72.3\%, 85.7\%, and 100\%, respectively. Overall, the cancer detection rate at PSA levels 4.0–10.0 was 25\%, 10.1–20.0 was 54.7\%, 20.1–50.0 was 67.4\%, 50.1–100.0 was 100\%, and >100.0 was 100\%. The cancer detection rate for men with suspicious DRE and prostatic ultrasound findings were comparatively higher than those with normal DRE and prostatic ultrasound findings at similar PSA levels.

\textbf{Conclusion:} This study showed a higher cancer detection rate with a 12-core biopsy protocol when compared to similar studies from the Western world, the Middle East, and urban centers in Nigeria due to poor awareness and late presentation in our environment.

\textbf{Keywords:} Biopsy protocols, detection rate, prostate biopsy, prostate cancer

\textbf{INTRODUCTION}

Worldwide, prostate cancer is the second-leading cause of cancer-related mortality after lung cancer.\textsuperscript{1,2} The incidence varies with race and higher among the Africans.\textsuperscript{3} Adeloye et al.\textsuperscript{4} reported an incidence of 22.0/100,000 population in Africans. Ikuerowo et al.\textsuperscript{5} found a prevalence rate of 1046/100,000 men of age $\geq$ 40 in a Nigerian community, while hospital prevalence of 182.5/100,000 has been...
reported by some scholars, Obiora and Nwosu in Port Harcourt, Nigeria, reported a hospital incidence of 37.4%.

The diagnosis of prostate cancer relies on a tripod of digital rectal examination (DRE), prostate-specific antigen (PSA), and transrectal biopsy of the prostate. Prostate biopsy is the established mode of obtaining tissue for histological diagnosis in patients with suspected prostate cancer. Hodge et al. in 1989, based on the observation by McNeal that approximately 80% of prostate cancer originated in the peripheral zone, introduced a systematic sextant prostate biopsy. They established a 9% improvement over the lesion-directed biopsies. However, researchers have demonstrated an increase in cancer detection if an extended biopsy protocol (ranging from 8 to 26 cores) is employed. The extended 12-core biopsy template increases the detection rate of prostate cancer and decreases the probability of repeat biopsy when compared to the sextant protocol. Jia et al. in a study done among the Han people of China, reported prostate cancer detection rate of 42.8% following a 10-core (plus an additional core in each suspicious area) biopsy protocol. Furthermore, Ojewola in South-western Nigeria, reported an overall cancer detection by the extended technique as 48.8%. Beyond the extended 12-core biopsy template, the diagnostic output becomes relatively insignificant.

Adenocarcinoma is the most predominant form of prostate cancer with other variants being uncommon. Obiora and Nwosu in a recent study in Port Harcourt observed 100% adenocarcinoma in the 198 specimens studied. The Gleason grading system is the most commonly used for prostate cancer grading. It is reproducible and predicts disease progression and patient survival. The scoring system, on a needle core biopsy, is based on the sum of the most predominant glandular pattern and highest grade. Majority of patients in sub-Saharan Africa have a high Gleason score (≥7) which is a reflection of poor prognosis, increased risk of cancer progression, and high mortality from the disease.

At the moment, there is a relative paucity of literature on the detection rate of prostate cancer using the extended core biopsy protocol in sub-Saharan Africa where the majority of patients present late due to poor awareness and out-of-pocket health-care financing. In this study, we aim to evaluate the detection rate of carcinoma of the prostate following a 12-core extended transrectal biopsy of the prostate.

MATERIALS AND METHODS

This is a prospective study carried out on 120 men who were investigated for suspected prostate cancer in our hospital between June 2016 and November 2017. Informed consent from the patients and approval from the ethics and research committee of the institution were obtained. Patients who fulfilled the selection criteria were enrolled in the study. The objectives of the study were explained to each patient at the time of enrolment.

All patients had a DRE, serum PSA assay, and trans-abdominal prostate ultrasound scan (as transrectal ultrasound scan, is not readily available in our practice) followed by transrectal needle biopsy of the prostate. Indications for prostate biopsy included the presence of one or a combination of elevated PSA, abnormal DRE, and suspicious findings on prostate ultrasound scan. Under digital guidance, 12-core biopsy was obtained in all patients from the apex, mid-portion, and base of each lateral lobe using a size 18 spring-loaded semi-automated Tru-Cut biopsy after rectal lubrication with 5–10 ml of 2% lidocaine jelly and a preliminary DRE. All patients also had oral ciprofloxacin and metronidazole commenced 2 h before the procedure and continued for 3–7 days according to the unit’s protocol. No form of bowel preparation was done, though patients were instructed to empty their bowel in the morning of the day of the biopsy.

All patients were allowed to go home after observation for about an hour following the procedure. The prostate specimens were analyzed by pathologists in our institution. Tumor grade was assessed according to the Gleason grading system.

A structured pro forma was used to record relevant patients’ information including the demographic data, indication(s) for biopsy, preoperative serum PSA concentration, prostate volume, DRE findings, and histological results. Cancer detection rates of the 12-core extended biopsy protocols were determined and compared at various age range, serum PSA levels, and different DRE and ultrasound findings.

Statistical analysis

The data obtained were analyzed with the Statistical Package for the Social Sciences (SPSS) for Windows program (version 21.0, SPSS Inc., Chicago, Illinois, USA.). Frequency distribution for the variables was presented in tables. The level of significance of the variables was determined using Pearson’s Chi-square test. For all statistical tests, $P < 0.05$ was regarded as significant.

RESULTS

A total of 120 patients participated in this study. The mean age of the 120 patients was 69.8 ± 9.1 years (range: 51–100). The mean serum PSA level was 36.6 ± 25.2 ng/
ml (range: 5.7–310.2), while the mean prostate volume was 101.4 ± 91.4 ml (range: 10–635). Figure 1 shows the frequency distribution of the histological subgroups by age. The peak age for men with prostate cancer was in the eighth decade of life while those with nodular hyperplasia was in the seventh decade. Patients with carcinoma of the prostate were significantly older than those with nodular hyperplasia \( P = 0.006 \) and also had a significantly higher mean serum PSA level and mean prostate volume [Table 1]. Furthermore, a significant correlation \( P = 0.017 \) was observed when participants’ age was cross tabulated with histological diagnosis of prostate cancer.

Regarding the modes of presentation, 118 (98.3%) had lower urinary tract symptoms, 41 (34.2%) had hematuria, 28 (23.3%) had both bone pain and weight loss, while 13 (10.8%) had either acute or chronic urinary retention. There were no asymptomatic patients.

Elevated serum PSA level was the most reported reason for biopsy (100%). This was followed by abnormal DRE (61.7%) and abnormal prostate ultrasound scan (29.1%) with only one patient (0.83%) having biopsy done on account of metastatic bone deposit and elevated PSA.

Of the 120 patients, 78 (65%) had a histological diagnosis of prostate cancer, while 42 (35%) were nodular hyperplasia. All cases of prostate cancer were adenocarcinoma. As the age of participants increased, the detection rate of prostate cancer increased with 100% detection rate in patients >90 years [Table 2].

Table 1: Basic features of patients

| Variables          | Prostate cancer | Benign prostatic hyperplasia | \( \chi^2 \) |
|--------------------|-----------------|------------------------------|--------------|
| Number of patients | 78              | 42                           |              |
| Age (years)        |                 |                              |              |
| Mean               | 71.6±9.6        | 66.4±6.8                     | 0.006        |
| Range              | 51.0-100.0      | 52.0-82.0                    |              |
| Prostate volume (ml)|                |                              |              |
| Mean               | 107.9±99.3      | 89.3±74.1                    | 0.009        |
| Range              | 10.0-635.0      | 26.2-421.8                   |              |
| PSA                |                 |                              |              |
| Mean               | 45.2±33.8       | 20.5±9.0                     | 0.002        |
| Range              | 5.7-310.2       | 8.5-46.3                     |              |

PSA: Prostate specific antigen

The serum PSA levels were classified into five subgroups: 4.0–10.0, 10.1–20.0, 20.1–50.0, 50.1–100.0, and >100.0 ng/ml. The cancer detection rates at the various PSA levels are shown in Table 4. The detection rate increased proportionately with rising serum PSA levels with a rate of 100% in men with serum PSA of >50 ng/ml [Table 4].

In addition, the DRE findings were matched with the different groups of PSA levels. For patients with normal DRE, the cancer detection rates for PSA levels 4.0–10.0 ng/ml was 0%, 10.1–20.0 ng/ml was 34.6%, 20.1–50.0 ng/ml was 0%, 50.1–100.0 ng/ml was 100%, and >100.0 ng/ml was 100%. For those with abnormal DRE, the cancer detection rate for serum PSA levels 4.0–10.0 ng/ml was 33.3%, 10.1–20.0 ng/ml was 74.1%, 20.1–50.0 ng/ml was 88.6%, 50.1–100.0 ng/ml was 100%, and >100.0 ng/ml was 100%.

Prostate ultrasound findings at different PSA levels were also subdivided into five groups: With normal prostatic ultrasound findings, the cancer detection rates were 0% for 4.0–10.0 ng/ml, 40% for 10.1–20.0 ng/ml, 54.8% for 20.1–50.0 ng/ml, 100% for
50.1–100.0, and >100 ng/ml. In the men with suspicious ultrasound findings, the detection rates were 50% for 4.0–10.0 ng/ml, 100% for 10.1–20.0 ng/ml, 93.3% for 20.1–50.0 ng/ml, 100% for 50.1–100.0 and >100 ng/ml.

Table 5 depicts the overall cancer detection rate for DRE and prostate ultrasound findings. The detection rate was significantly higher in men with suspicious DRE ($P = 0.000$) and suspicious prostate ultrasound findings ($P = 0.000$). In addition, a detection rate of 96.7% was noted when both suspicious DRE and prostate ultrasound findings were considered together.

The mean Gleason score of 78 patients with prostate adenocarcinoma was 7.0 (±1.5). Thirty-one (39.7%) of the men had a Gleason score $>7$. Twenty-nine (37.2%) had a Gleason score of $<7$ while 18 (23.1%) had a score of 7. This data showed that a considerable percentage of high risk and poorly differentiated prostate cancers (Gleason scores $>7$) in this study tended to be common in the men at the time of diagnosis.

**DISCUSSION**

The prostate cancer detection rate varies from one geographical location to the other and amongst various races.\[4,15\] Jia et al.\[15\] reported an overall prostate cancer detection rate of 42.8% among the Chinese population when 10-core biopsy plus biopsy of the suspicious lesion was done. Ng et al.\[20\] reported a detection rate of 52% in Australia. Our prostate cancer detection rate (65%) was outstandingly more than the rates in the above studies. The probable reason may be due to the ethnic difference in the detection rates of prostate cancer and the fact that most of our patients present with advanced disease. The detection rate of 65% in this study is more than the 48.8% reported by Ojewola et al.\[9\] in the city of Lagos, Nigeria but similar to the 60.1% reported by Irekpita et al.\[21\] in a work done in the same locality. The difference in the detection rate may be due to increased awareness and early presentation among urban dwellers and the fact that this study took into account only patients with elevated PSA.

The prostate cancer detection rates at PSA levels 4.0–10.0 was 25%, 10.1–20.0 was 54.7%, 20.1–50.0 was 67.4%, 50.1–100.0 was 100%, and >100.0 was 100%. The cancer detection rate in this study increases with increase in the PSA levels [Table 2]. This finding is in tandem with the findings of Jia et al.\[15\] in China and Narayanaswamy\[22\] et al. in the Middle East. The cancer detection rate of 25.0% at PSA range of 4.0–10.0 ng/ml in this study, was consistent with other studies from the Western world and the Eastern hemisphere as well as similar studies from our locality.\[15,17,20,21\] This result, however, is much higher than the prostate cancer detection rate of 13.3% obtained by Ezenwa et al.\[23\] in Lagos, southwestern Nigeria. This difference may be due to the six core biopsy protocol used in that study which has been noted to give a lower detection rate compared to the extended 12 core biopsy regimen.\[11,12,14,16\] In men with PSA levels $>10$ ng/ml, the detection rate of 66.4% is higher than the 40% reported in the Kuwaiti men\[22\] and the 59.5% rate reported in Korean men\[24\] but comparable with the 67% detection rate reported among the Americans.\[25\] This comparable high rate may be explained by the proposition of some scholars that there exists an endemic hereditary predisposition connecting the American blacks and the Africans\[20\] and further buttresses the existence of some natural elements in our surroundings that may be amplifying the inheritable factors thought to be responsible for prostate cancer.\[12,27\]

Age remains the strongest risk factor for carcinoma of the prostate.\[3\] The peak age range in this study was 70–79 years. The peak age range was similar to what has been reported in other published series.\[7,15\] However, some scholars in the Middle East and Europe have reported a peak age range of 60–69 years. This difference may be because patients usually

| Number with prostate cancer | Detection rate (%) |
|-----------------------------|--------------------|
| ACS                          | 50                 |
| CDC                          | 50                 |
| MDC                          | 50                 |
| UMC                          | 50                 |

**Table 4: Relationship between serum prostate specific antigen and prostate cancer detection rate**

| PSA range (ng/ml) | Total number of patients | Number with prostate cancer | Detection rate (%) |
|-------------------|--------------------------|----------------------------|--------------------|
| 4.0–10.0          | 4                        | 1                          | 25                |
| 10.1–20.0         | 53                       | 29                         | 54.7              |
| 20.1–50.0         | 46                       | 31                         | 67.4              |
| 50.1–100.0        | 8                        | 8                          | 100               |
| >100              | 9                        | 9                          | 100               |

PSA: Prostate specific antigen

| Variable                | Total number of patients | Number with prostate cancer | Detection rate (%) | $\chi^2$ |
|-------------------------|--------------------------|-----------------------------|--------------------|---------|
| DRE                     | Normal                   | 46                          | 17                 | 37.0    | 0.000  |
|                         | Suspicious               | 74                          | 61                 | 82.4    |        |
| Prostate scan           | Normal                   | 84                          | 44                 | 52.4    | 0.000  |
|                         | Suspicious               | 36                          | 34                 | 94.4    |        |
| Suspicious DRE/prostate | Normal                   | 30                          | 29                 | 96.7    |        |

DRE: Digital rectal examination, USS: Ultrasound scan
present late in our environment.\cite{6} When age was taken into consideration, it was noted that the detection rate rose with the increase in the age of the study participants [Table 2]. This is because prostate cancer is a disease of the elderly.

Furthermore, the mean prostate volume of men with carcinoma of the prostate was significantly higher than those with benign prostatic hyperplasia (BPH) \( (P = 0.009) \). A similar work done in China reported a similar finding.\cite{22}

The prostate cancer detection rate increased proportionately with increase in prostate volume [Table 3]. This observation is at variance with that of Narayanaswamy et al.\cite{22} who reported a decreased detection rate with increasing prostate volume with the majority of the cancer patients having the prostate volume of \(<50.0 \text{ g}\).

The combination of more than one diagnostic tool has been variously reported to increase the detection rate of prostate cancer.\cite{5,15,19,21} The most productive clinical method of increasing the prostate cancer detection rate is to combine the findings of DRE and the level of serum PSA. The subjective bias associated with DRE was reduced in this study by ensuring that the same urologists perform the DRE before the prostate biopsy procedure. The cancer detection rate of patients with suspicious DRE of 82.4\% in this study was higher than those with normal DRE of 37.0\% with a \( P = 0.000 \) [Table 4]. This finding is in line with other studies which showed that the detection rate of prostate cancer with suspicious DRE findings was obviously higher than that with normal DRE findings.\cite{20,21,24}

Similarly, the prostate cancer detection rate in men with suspicious prostatic ultrasound findings was higher in this study when compared to those with normal prostatic ultrasound findings [Table 4]. In addition, a higher overall detection rate of 96.7\% and a rise across the PSA groups was noted when suspicious DRE was combined with suspicious prostatic ultrasound findings. Similar studies in Kuwait and China reported similar findings though with lower detection rates.\cite{15,22} The likely reason for this marked difference may be the absence of comprehensive population-based prostate cancer screening program in sub-Saharan Africa due to limited resources.\cite{5,6} As a result of this, many prostate cancer patients in our environment present late with features of local invasion or distant metastasis.\cite{4,6}

The predominance of prostate cancer (65\% carcinoma of the prostate and 35\% BPH) in this study demonstrates a paradigm shift from BPH to prostate cancer being the most common prostate disease among the elderly in our environment and gives credence to the earlier observed rising incidence of prostate cancer among the blacks, particularly in sub-Saharan Africa. This finding is at variance with that earlier reported by many Nigerian scholars.\cite{6,7,16,23} This study also shows that all of the prostate cancers were adenocarcinomas. This correlates favorably well with most reports among the blacks.\cite{5,6,7,28}

The majority of the patients (62.8\%) had high Gleason score of \( \geq 7 \) with a peak score of seven. This compares well with the findings in other centers in Nigeria and China.\cite{7,15,16} The probable reason for the high Gleason score and by inference, poor prognosis at presentation may be the absence of screening program in sub-Saharan Africa and the fact that the majority of our patients presents when they develop complications or in the advanced stage of the disease.\cite{6} Also as noted by some researchers\cite{7,29} paucity of knowledge of the disease could be responsible for the high prevalence of the high Gleason score with poor prognosis.

**CONCLUSION AND RECOMMENDATION**

Detection rates in patients with prostate cancer vary across geographical regions and races.

This study showed that there is a high prostate cancer detection rate when a 12-core biopsy protocol is used. Higher PSA, prostate volume, and abnormal DRE and prostatic ultrasound findings were linked to higher prostate cancer detection rates in this study. These rates are comparatively higher than other similar studies from the developed society and most cities in Nigeria. This difference may be due to increased awareness and early presentation in these places. There is a need for a targeted prostate cancer awareness campaign in sub-Saharan Africa to enhance the early detection of prostate cancer.

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**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**

1. Ferlay J, Soerjomataram I, Dikshit R, Eser S, Mathers C, Rebelo M, et al. Cancer incidence and mortality worldwide: Sources, methods and major patterns in GLOBOCAN 2012. Int J Cancer 2015;136:E359-86.
2. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2018. CA Cancer J Clin 2018;68:7-30.
3. Yeboah ED. The prostate gland. In: Badoe EA, Archampong EQ, da Rocha-Afodu JT, editors. Principles and Practice of Surgery Including Pathology in the Tropics. 4\textsuperscript{th} ed. Accra: Ghana Publishing Co-Operation; 2009. p. 917-52.
4. Adeloye D, David RA, Ademori AV, Is celorun kanami A, Oyedokun A, Iweala EE, et al. An estimate of the incidence of prostate cancer in Africa: A systematic review and meta-analysis. PLoS One 2016;11:e0153496.
5. Ikueworo SO, Omisanjo OA, Biolu MJ, Ajala MO, Mordi VP, Esu JO. Prevalence and characteristics of prostate cancer among participants of a community-based screening in Nigeria using serum prostate specific antigen and digital rectal examination. Pan Afr Med J 2013;15:129.

6. Badmus TA, Adesunkanmi AR, Yusuf BM, Oseni GO, Ezizi AK, Bakare TI, et al. Burden of prostate cancer in southwestern Nigeria. Urology 2010;76:412-6.

7. Obiorah CC, Nwosu SO. A histopathological study of carcinoma of the prostate in Port Harcourt, Nigeria. Niger J Clin Pract 2011;14:363-7.

8. Heidenreich A, Bastian PJ, Bellmunt J, Bolla M, Joniau S, van der Kwast T, et al. EAU guidelines on prostate cancer. Part 1: Screening, diagnosis, and local treatment with curative intent-update 2013. Eur Urol 2014;65:124-37.

9. Ojewola RW, Tijani KH, Jeje EA, Anunobi CC, Ogunjimi MA, Ezenwa EV, et al. Detection of prostate cancer: Comparison of cancer detection rates of sextant and extended ten-core biopsy protocols. Niger Postgrad Med J 2012;19:137-42.

10. McNeal JE. Origin and development of carcinoma in the prostate. Cancer 1969;23:24-34.

11. Damiano R, Autorino R, Perdonà S, De Sio M, Oliva A, Esposito C, et al. Are extended biopsies really necessary to improve prostate cancer detection? Prostate Cancer Prostatic Dis 2003;6:250-5.

12. Durkan GC, Sheikh N, Johnson P, Hildreth AJ, Greene DR. Improving prostate cancer detection with an extended-core transrectal ultrasonography-guided prostate biopsy protocol. BJU Int 2002;89:33-9.

13. Stamey TA. Making the most out of six systematic sextant biopsies. Urology 1995;45:2-12.

14. Naughton CK, Miller DC, Mager DE, Ornstein DK, Catalona WJ. A prospective randomized trial comparing 6 versus 12 prostate biopsy cores: Impact on cancer detection. J Urol 2000;164:388-92.

15. Jia Y, Zhu LY, Xian YX, Sun XQ, Gao JG, Zhang XH, et al. Detection rate of prostate cancer following biopsy among the northern Han Chinese population: A single-center retrospective study of 1022 cases. World J Surg Oncol 2017;15:165.

16. Irekpita E, Owobu C, Aigbe E, Obasikene G, Igbe A, Ezenwa EV, et al. The value of percentage free prostate specific antigen (PSA) in the detection of prostate cancer among patients with intermediate levels of total PSA (4.0-10.0 ng/mL) in Nigeria. Arab J Urol 2012;10:394-400.

17. Ezenwa EV, Tijani KH, Jeje EA, Sorisyan OO, Ogunjimi MA, Ojewola RW, et al. The value of percentage free prostate specific antigen (PSA) in the detection of prostate cancer among patients with intermediate levels of total PSA (4.0-10.0 ng/mL) in Nigeria. Arab J Urol 2012;10:394-400.

18. Epstein JI, Allsbrook WC Jr, Amin MB, Egevad LL. ISUP Grading Committee. The 2005 International Society of Urological Pathology (ISUP) Consensus Conference on Gleason Grading of Prostatic Carcinoma. Am J Surg Pathol 2005;29:1228-42.

19. Baade PD, Youlden DR, Cramb SM, Dunn J, Gardiner RA. Epidemiology of prostate cancer in the Asia-Pacific region. Prostate Int 2013;1:47-58.

20. Ng TK, Vasilareas D, Mitterdorfer AJ, Maher PO, Lalak A. Prostate cancer detection with digital rectal examination, prostate-specific antigen, transrectal ultrasonography and biopsy in clinical urological practice. BJU Int 2005;95:545-8.

21. Irekpita E, Owoyemi B, Aigbe E, Ogunjimi MA, Ezenwa EV, et al. Assessment of DRE and PSA as diagnostic and screening tools for carcinoma of the prostate in rural Nigeria. East Cent Afr J Surg 2014;19:53-7.

22. Narayanaswamy A, Abul F, Mathew TC. Detection rate and clinical pattern of prostate cancer in Kuwait: A single-center experience. Med Princ Pract 2011;20:34-8.

23. Hegde V, Hegde R, Hegde S, Hegde S. Detection rate of prostate cancer following biopsy among the northern Han Chinese population: A single-center retrospective study of 1022 cases. World J Surg Oncol 2017;15:165.

24. Yang WJ, Lee DH, Chung BH, Cho JS, Choi YD, Kim SJ, et al. Detection rate of prostate cancer on biopsy according to serum prostate-specific antigen in Korean men: A multicenter study. Urology 2006;67:333-6.

25. Greiner MB, Partin AW. PSA levels and the detection rate of prostate cancer on biopsy. Eur Urol 2002;1:21-7.

26. Osogbe DN. Prostate cancer in Nigerians, facts and non facts. J Urol 1997;157:1340-3.

27. Ogunnlewe JO. Androgen concentration in blacks with benign and malignant prostatic disease. J Urol 1988;140:160-4.

28. Elem B, Patil PS. Pattern of urological malignancy in Zambia. A hospital-based histopathological study. Br J Urol 1991;67:37-9.

29. Ajae AA, Babata A, Abiola OO. Knowledge of prostate cancer screening among native African urban population in Nigeria. Nig Q J Hosp Med 2010;20:94-6.