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Original Research Article

Association between fingerprint patterns and prostate cancer grade among blacks: a cross-sectional review

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ABSTRACT

Background: Prostate cancer is a major global health concern, with higher incidence and aggressiveness among Black men. Owing to its genetic basis, numerous biomarkers have been explored for early detection and prognosis. Simple, low-cost, and less invasive tools are particularly valuable for African populations. Fingerprints, which are genetically determined and unique to individuals, have been investigated as a potential marker for prostate cancer risk. Objective of the study was to examine fingerprint pattern prevalence among Nigerian men with prostate cancer and assess associations with histological grades.
Methods: A descriptive cross-sectional study was conducted from January 2012 to July 2023 among 52 newly diagnosed patients. Fingerprints were captured using a digital reader, standardized, analyzed, and classified. Statistical analysis (Chi-square test) was performed using statistical package for social science (SPSS) v19.0, with significance set at $p<0.05$.
Results: Loop and composite patterns each accounted for 34.6%, while whorl and arch patterns represented 23.1% and 7.7%, respectively. Among loop patterns, 55.5% were high-grade (ISUP 4 or 5). Composite patterns showed majority (33.3%) ISUP 4, with the highest proportion (83.3%) in loop + arch composites. Whorl patterns were more frequent in low-grade (ISUP 1) disease (41.7%). No statistically significant association was found between fingerprint patterns and ISUP grades ($\chi^2=13.868$, $p=0.309$).
Conclusion: Loop patterns were most frequent, particularly in high-grade disease, but lacked statistical significance as a predictor. Larger, multicenter studies are needed to clarify potential links between dermatoglyphics and prostate cancer.

Keywords: Prostate cancer, African blacks, Dermatoglyphics, Tumor genetics

INTRODUCTION

Prostate cancer (CaP) is a malignant condition affecting the prostate gland and is most commonly seen in men over the age of fifty. Globally, it ranks as the second most frequently diagnosed cancer and the fifth leading cause of cancer-related deaths among men.[1-3] The global burden of prostate cancer—both in incidence and mortality—is rising rapidly, partly due to population growth and aging.[1,2] CaP shows a higher incidence and more aggressive progression in Black men, and it is considered a significant public health concern in this population.[4,5] In Africa and Nigeria in particular, the true incidence and burden of CaP remain unclear, largely due to inadequate

health data and poor record-keeping. This disease exhibits variable biological behavior, ranging from small slow growing tumors to large, aggressive, and life-threatening forms, thus preventable and curable if diagnosed early.[6] Several risk factors have been associated with both the onset and severity of the disease, including age, family history, and race.[1,7] While some tumors including CaP have a genetic basis, prediction and identification of individual or group at risk of CaP and its histological characteristics especially among African blacks are still not well understood.

Finger prints also termed finger dermatoglyphics is a division of dactylography that describes the production of patterns of parallel friction ridges on the palm surfaces of distal phalanx of fingers.[8-13] This was first studied by Francis Galton and Edward Henry in 1892.[9] Finger prints are developed intrauterine on the fetus between the second and fifth month and remains unaltered after delivery and persists throughout life except for permanent finger scarring.[9,12-15] Finger prints help in firm grip of objects, identification of individuals and a non-invasive tool for medical diagnosis.[9,5,10,12,15-18] Various classification types with modifications have been described based on shape, height and orientation of the patterns. Overall, three major types of finger print patterns have been described and they include loops (radial, ulnar), whorls (spiral, concentric), arches (plain, tented).[9,13,19,20] A mixture of these major patterns has also described and are termed mixed or composite type (central pocket loop, twin loop, accidental).[9,19-21] Figure 1 illustrates the types of finger prints patterns. The common natural population frequency distribution of these fingerprint patterns is loop pattern being the most common, followed by whorl, arch and composite patterns.[12,22-24] Finger prints are peculiar to individuals and are controlled by the individual's genetic makeup.[12,15,25] Studies have suggested its usefulness in study and diagnosis of conditions with suspected genetic, hereditary or syndromic disorders.[5,9,18,26,27] Several works have noted variable findings on finger print associations with certain cancers.[5,28-33] Studies have also affirmed that data on dermatoglyphics may be used to device model for prediction of cancers and for early diagnosis of patients with genetic tendency to particular malignant diseases.[9,26,27,34,35] Few works have described association of CaP and finger prints.[5,36] To the best of my knowledge, no study has addressed the association of fingerprint patterns with histological grade of CaP. In resource poor countries like Nigeria, with no national policy on CaP screening, determination of finger print patterns and its association with prostate cancer grade among CaP patients may aid in prediction and identification of those at risk of the disease, early diagnosis, prompt and effective treatment of these patients, thus can form a framework for establishment and modification of CaP screening protocols in this peculiar study population.[5] Search for available, quick and cost effective method with a genetic link as CaP in this study may obviate challenging need for an elaborate and costly genetic testing among this study group with limited resources and risk of aggressive disease. This is a preliminary study to investigate the prevalence of finger print patterns among CaP patients and association between finger print patterns and prostate cancer grade among Nigerian men.

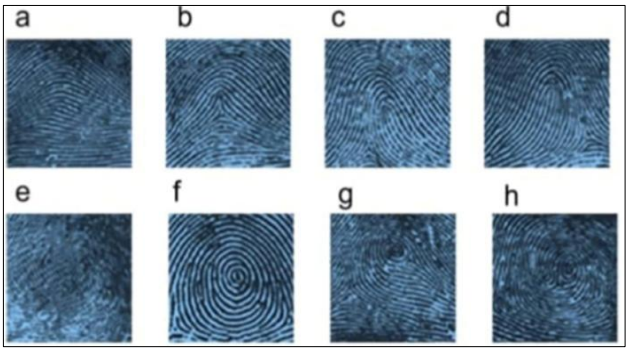

Figure 1: Types of finger print patterns: (a) plain arch, (b) tented arch, (c) ulnar loop, (d) radial loop, (e) double loop whorl, (f) plain whorl, (g) central pocket loop whorl, and (h) accidental loop whorl.[9]

METHODS

This study was conducted at Urology Clinic of St. Charles Borromeo Specialist Mission Hospital, Onitsha in Anambra state, Nigeria between January 2021 and July 2023. Ethical approval with reference number SCBSHO/2021/005 was obtained from the institution and the study complied with Helsinki declaration.

It was a descriptive cross-sectional hospital-based study. We selected patients by purposive criterion sampling method. Fifty-two newly histological diagnosed prostate cancer patients seen in urology clinic who gave consent for the study and had intact index finger tip on the non-dominant hand were included in the study. Patients with damaged, absent or scarred index finger tip of non-dominant hand or refused consent were excluded.

All prostate biopsy specimens were processed according to standard pathological procedures. Fresh tissue sections were made from formalin fixed and paraffin embedded (FFPE) tissue blocks using microtome set at 4 µm. The tissue ribbons from microtome are floated in warm water part, and then onto a clearly labeled glass slide. The tissue sections were de-paraffinised by passing it through xylene, rehydrated in decreasing alcohol concentrations and then rinsed in water. These tissue sections were then stained with haematoxylin and eosin staining protocols, and then mounted. The prepared slides were then viewed using diagnostic compound binocular microscope (Carl Zeiss Axioscope 40) for diagnosis and classification based on the five tier grading system of prostatic carcinoma by the International Society of Urological Pathology (ISUP) consensus conference of 2014 as adopted by the World Health Organization (WHO) classification of tumors of the urinary system and male genital organs in 2016.[37,38] Gleason's grade, Gleason's score and ISUP classification were assigned accordingly.

Finger print capture was done with finger print reader Digital Persona, Inc, made in China with serial number AY00T014401 and part number 50013-S11-103 (Figure 2). The finger print reader was configured to a personal computer with provision for patients' data entry which included: age at diagnosis of prostate cancer, weight and height of patient, histological type of prostate cancer, Gleason's grade and score, ISUP class, and finger print pattern. Finger print capture was from index finger of non-dominant hand in all the patients after thorough cleaning. Non-dominant hand is considered to be exposed to less friction that may make the finger prints difficult to capture and interpreted. We focused on the index finger for uniformity. Four serial captures of same finger were obtained and the device automatically saves the best picture captured. The finger print pictures were viewed, interpreted and classified based on Henry's classification into loop, whorl, arch and composite (mixed) types.[19] This was done independently by a panel of four urologists and a forensic pathologist, and findings reconciled before assigning finger print pattern to each subject. The reconciled finger print pattern and the computer stored patients' variables were entered into a proforma. Statistical analysis was done with statistical package for the social sciences (SPSS) program (version 19.0, Chicago Illinois, USA). Quantitative and qualitative variables were analyzed using Chi square tests and expressed as mean and standard deviation or numbers and percentages where appropriate. A p value of <0.05 was considered statistically significant.

Figure 2: Finger print capturing device.

RESULTS

Adenocarcinoma of prostate was recorded in all the cohorts. Table 1 shows that peak age of CaP occurrence was in the seventh and eighth decades, with a mean and modal ages of 68.1±8.52 and 71 years respectively.

Prostate carcinoma increases steadily with age from the fifth decade of life, reaching its peak in the seventh and eighth decades, and thereafter declines.

The higher grades (ISUP classes 4 and 5) of prostate carcinomas were observed to be more common, together accounting for 50% (26.9% and 23.1% respectively) of the cases (Tables 2 and 3). There is no significant relationship between age and grade of prostate carcinoma (X^2=10.418, p value=0.844).

Table 1: Demographic statistics of prostate cancer.

Demographic statistics	Values in years	
Mean	68.096	
Median	69.000	
Mode	71.0	
Standard deviation	8.5159	
Age range (in year)	43-87	
Age ranges (years)	**Frequency**	**Percent**
41-50	2	3.8
51-60	6	11.5
61-70	21	40.4
71-80	21	40.4
>80	2	3.8
Total	52	100.0

Table 2: Age distribution of the various ISUP classes of prostate carcinoma.

Age range (years)	ISUP class				
	1	**2**	**3**	**4**	**5**
41–50	0	1	0	0	1
51–60	1	0	1	2	2
61–70	3	4	3	5	6
71–80	6	3	4	6	2
>80	0	0	0	1	1
Total (n=52)	10	8	8	14	12

Table 3: Gleason's pattern of distribution in the various ISUP classes of prostate carcinoma.

ISUP class	Gleason grade									
	3+3	**3+4**	**3+5**	**4+3**	**4+4**	**4+5**	**5+3**	**5+4**	**5+5**	**Total**
1	10	-	-	-	-	-	-	-	-	10
2	-	8	-	-	-	-	-	-	-	8
3	-	-	-	8	-	-	-	-	-	8
4	-	-	2	-	10	-	2	-	-	14
5	-	-	-	-	-	4	-	6	2	12
Total	10	8	2	8	10	4	2	6	2	52

Tables 4 and 5 show that loop and composite fingerprint patterns are more common among the cohort with equal distribution of 34.6%, followed by whorl (23.1%) and arch (7.7%). Among the cohort with loop pattern of finger print, more than half (55.5%) had high grade CaP (ISUP 4 and 5; with equal distribution). Patients with composite finger print pattern had majority (33.3%, n=6) with ISUP 4 CaP, among which 83.3% had combination of loop and arch pattern. Low grade CaP (ISUP 1) was mostly noted among cohorts with whorl pattern of finger print (41.7%). However, there is no statistical significant association between the patterns finger print and the ISUP grades of prostate carcinoma (CaP) with chi-square and p-values of 13.868 and 0.309.

Table 4: Relationship between the finger print patterns and the grades (ISUP) of CaP.

ISUP class	Finger print				Total
	Arch	Loop	Whorl	Comp-osite	
1	1	2	5	2	10
2	2	4	1	1	8
3	0	2	2	4	8
4	0	5	3	6	14
5	1	5	1	5	12
Total	4	18	12	18	52

Table 5: Relationship between the sub-classified finger print patterns and the grades of CaP.

ISUP class	Finger print patterns					
	Arch	Who-rl	Loop	Composite		Tot-al
				W+A	L+A	
1	1	5	2	0	2	10
2	2	1	4	0	1	8
3	0	2	2	2	2	8
4	0	3	5	1	5	14
5	1	1	5	2	3	12
Total	4	12	18	5	13	52

L+A=loop and whorl, W+A=whorl and arch

DISCUSSION

This study observed that loop and composite fingerprint patterns were the most common patterns among the CaP patients with equal distribution of 34.6%, followed by Whorl and arch patterns. This finding is similar to previous studies.[5,12,13,24] Oladipo et al in their case-control study of dermatoglyphics of prostate cancer patients in Nigeria, noted 44.1% of ulnar loop finger print pattern in CaP patients as against 55.33% in normal patients in all digits of both hands.[5] Comparing their findings on index finger with this study (also based on index finger), right index finger shows predominance of whorl pattern (50%) among CaP patients while left index finger shows predominance of loop pattern (ulnar loop 50%, radial loop 6.7%) as against control group. This compares similar to finding in index study where non-dominant index finger was captured with highest incidence of loop pattern (34.6%). The variance in percentages may be due to varied methodology and study design. Their study was retrospective, adopted ink pad as method of sample collection from all the digits and used magnifying lens to define fingerprint pattern with no evidence of control of bias in pattern interpretation. These factors may cause errors in either overestimation or underestimation of finger print patterns.

A prospective study with use of computer-generated finger print pattern limited to the index finger of non-dominant hand, and patterns interpreted by independent panel of urologist and forensic pathologist gives more credit to findings in index study. However, findings by Oladipo et al and the index study showed no statistical significance between the fingerprint patterns and its association with CaP.[5] Rastogi et al in their population based study in Eastern India also noted high frequency of loop finger print pattern (55.9%) followed by whorls (34.9%), arch (6.0%) and composite patterns (3.1%).[12] They adopted ink pad and hand lens for finger print capture and interpretation respectively, and classified fingerprint patterns with Michael Kuchen's system. Garg et al in hospital based cross-sectional study analyzed the primary finger print patterns among medical students of Banda District, Uttar Pradesh using ink pad, magnifying lens and classified fingerprint pattern into three types (loop, whorl and arch).[24] They observed that loop patterns were the most common primary fingerprint pattern followed by whorls and arches in males (49.74%, 35.93%, 14.32% respectively), and all fingers of both hands except ring finger showed the highest frequency of loop primary fingerprint pattern. A varied methodology may explain the difference in reported figures in these studies. It is difficult to also explain whether the predominance of loop fingerprint pattern in these studies is factual or coincident considering the distribution of these fingerprint patterns in normal population where loop pattern is the most common. High percentage of composite pattern reported in index study may also be attributed to high occurrence of loop pattern in the composite group. Conversely, Thakur et al in an institution based cross-sectional study among healthy subjects, adopted inking method and Galton-Henry's classification, and reported highest frequency of whorl pattern, followed by loop and arch (51.2%, 44.1%, and 4.7% respectively).[23] It is difficult to explain the predominance of whorl pattern in this study despite the subjects being healthy normal population.

This index study also observed that high grade disease was more common among CaP cases with loop finger print pattern while low grade disease is more common among CaP cases with whorl finger print pattern. This may not be the expectation considering the normal population distribution of the fingerprint patterns where whorl pattern usually ranked second. Our rigorous search for studies on association of fingerprint pattern and CaP grade yielded no result, thus there was no previous study to compare with.

However, this study noted no association between the fingerprint pattern and CaP grade. Rahman et al in their large multi-centre case-control study in United Kingdom studied the right hand pattern and risk of Prostate cancer and noted that men with index finger longer than ring finger (high 2D:4D ratio) showed a negative association, suggesting a protective effect with 33% risk reduction.[36] They implied that high 2D:4D hand pattern may be the marker of low prenatal androgen activity, thus the importance of hormone modulation in utero on prostate cancer risk. This may indirectly relate to prostate cancer grade since prostate cancer is known to be androgen dependent.

Limitations

A small sample size of a hospital cohort will limit application of findings in this study to the general population. A case-control study on a larger population carried out for an extended period may be more informative. Capture and analysis of finger prints from all the fingers of both hands may also give additional information for better scientific judgment. This study also did not get family history to aid explore familial risk factor which may affect results.

CONCLUSION

Adenocarcinoma remains the most common histological type of prostate cancer. Loop finger print pattern has the highest incidence and cancer grade among CaP patients while whorl fingerprint pattern though relatively common in incidence, are mostly associated with low grade CaP. There was no significant association between fingerprint pattern and ISUP grade of CaP in this study, thus suggesting no link between the two. The predominance of loop fingerprint pattern may be a coincidence in relation to its highest occurrence in general population. There is therefore need for multicenter, controlled, larger population study to further explore this relationship (also with finger lengths) in search of easy, cheap and less invasive method for CaP risk prediction, diagnosis and treatment among African blacks.

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