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Social determinants of health associated with the clinicopathological presentation of patients with prostate cancer in Kenya

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Introduction: In Kenya prostate cancer (Ca) is the leading cause of cancer related mortality among men. There is lack of data on the social determinants of health and their impact on the stage at diagnosis.

Purpose: The purpose of this study was to determine prostate cancer stage at diagnosis, and social determinants associated with advanced disease in a Kenyan population.

Methods: We analyzed data from 170 prostate cancer patients recruited from Kenyatta National Hospital (KNH) and MP Shah Hospital, Nairobi (2022–2024) on patients prospectively recruited in the International Registry for Men with Advanced Prostate Cancer (IRONMAN) and African Cancer Genome Registry (ACGR) registries. Patients included in the study had a histological diagnosis of prostate cancer. All participants completed standardized questionnaires assessing sociodemographic factors, health knowledge, and healthcare access. Clinical and pathological staging data was also collected and multivariable logistic regression used to determine factors associated with metastatic disease at diagnosis.

Results: The mean age for the participants was 70 years. Most of the participants presented with advanced disease 84.7% ($n = 144$). Half of the participants (50%, $n = 84$) had a Gleason score of 9 and 10 or an ISUP (International Society of Urological Pathology) Grade 5, 36% ($n = 60$) had grades 3 and 4 the remaining 14% ($n = 24$) had grade 1 and 2. The median PSA was 81 ng/ml (IQR: 26.5–262) and the mean was 402.22 ng/ml (SD:1128.17) with most of the patients 60.5% ($n = 92$) having a PSA over 50 ng/ml. The odds of advanced disease were significantly lower among patients with tertiary education compared to primary or no formal education (OR = 0.0.13 95% CI: 0.03–0.56). Patients who were very spiritual had higher odds of advanced disease (OR = 4.51 95% CI: 1.33–15.22).

Conclusion: Kenyan men in this cohort present predominantly with advanced prostate cancer, influenced by educational status, spirituality and region of residence. There is need for community-based awareness and screening programs for men with low education.

KEYWORDS

advanced prostate cancer, social determinants of health, clinicopathological characteristics, PSA at diagnosis, Kenya

1 Introduction

Prostate cancer (PCa) is the second most frequently diagnosed cancer and the fifth leading cause of cancer-related deaths among men worldwide with an estimated 1.4 million new cases and 375,000 deaths in 2020. The burden of prostate cancer is projected to escalate, reaching nearly 2.3 million new cases and 740,000 deaths by 2040, primarily due to population growth and aging (1).

In the USA, a study on prostate cancer incidence by age and stage, found that 80% of the patients had localized disease (2). In Europe more than 80% of the disease is diagnosed at an early stage. In Sub Saharan Africa, middle East and Asia majority of patients present with advanced and metastatic disease with high mean PSA, and Gleason score >7 (3–9). PCa is the most common cancer in Kenya and the second leading cause of cancer mortality in males annually, with 3,582 new cases (21.9%) and 2,029 deaths (6.9%), respectively, in 2022 (10, 11). An estimated 88% of PCa patients in Kenya present with advanced disease, resulting in a high case-fatality rate. A local study reported that 87.5% of PCa patients presented with advanced disease in stage III/IV (12).

Histopathological staging is done with Gleason Score and is combined with clinical staging for prognosis and treatment.

PCa development and progression have multifactorial causes, including social determinants of health. The social determinants of health for PCa encompass various factors that influence an individual's risk, access to healthcare and overall wellbeing. These determinants can significantly impact the incidence, diagnosis and outcomes associated with PCa. These include socioeconomic factors such as education and income, neighborhood characteristics, social support, and the structure of social networks (13, 14). Socioeconomic status independently predicted the stage of prostate cancer at diagnosis. Cases from the highest socioeconomic status block group were more likely to present with localized disease compared to those from the lowest socioeconomic status group. Additionally, race also independently influenced the stage at which prostate cancer was diagnosed (15).

The absence of recent data on the stage at presentation, PSA, histology and their determinants among PCa patients in Kenya raises concerns about the status of the disease. Obtaining up-to-date information is crucial for informed decision-making in healthcare policy and practice. By determining the stages of PCa and clinicopathological factors and their social determinants, the study contributes to the clinical understanding of the disease. This can help health professionals with early diagnosis, effective treatment planning, and improve overall patient outcomes. It will also be leveraged in defining methods to improve social determinants of advanced PCa. The purpose of this study is to determine clinicopathological features, and social determinants associated with advanced disease in a Kenyan population.

2 Materials and methods

2.1 Study population

This was a cross-sectional study, involving data collected from prostate cancer patients enrolled in Nairobi, Kenya as part of

the IRONMAN and the ACGR registries. Collectively, patients were enrolled over 2 years from September 2022 and September 2024 from KNH, a public national referral hospital and MP Shah Hospital, a private hospital. The sample size of 162 was determined using Cochran's formula, assuming a 95% confidence level ($Z = 1.96$), a 5% margin of error, and an estimated proportion of the population, 0.88 (percentage of late disease in Kenya) (12). There were 140 patients enrolled from the IRONMAN and ACGR registries. To achieve the sample size, additional patients meeting the eligibility criteria were enrolled from a private urology clinic run within MP Shah Hospital ending up with a total number of 170 recruits in the study. Ethical approvals for this study were obtained from the KNH/UON Ethical and Research Committee. A research permit was also obtained from the National Commission for Science Technology and Innovation.

Eligible patients were 40 years or older with a histologically confirmed diagnosis of prostate cancer from laboratory reports. Those with incomplete data were excluded from the study and analysis. This age was selected because prostate cancer is much less common among younger age groups.

2.2 Data collection

Data were collected from all the patients using a standardized questionnaire developed for administration to Black men in Sub-Saharan Africa (16). The variables included in this study were age, socioeconomic factors such as education, occupation, house ownership, number of rooms in the house, living arrangements, spirituality (an open-ended question), health access, health insurance, family history of cancer, region of residence, and marital status. In this study, spirituality refers to participants' personal beliefs and sense of meaning or connection, which may influence how they cope with illness, make health decisions, and seek care. It includes varying levels of self-reported spiritual engagement, from very spiritual to not at all spiritual. More than two rooms was a proxy for wealth and defined as >2 rooms=High SES.

Clinical variables were systematically abstracted from medical records by trained research personnel and included serum PSA levels at diagnosis, Gleason score, grade group, and clinical disease stage classification according to the American Joint Committee on Cancer (AJCC) based on Tumor size, lymph node involvement and distant metastasis (TNM) staging systems.

2.3 Data Analysis

Statistical analyses were performed using STATA version 16.0 (StataCorp. LLC). Descriptive statistics were generated and presented in the form of tables and graphs for the following attributes: frequencies, proportions, and measures of central tendency (mean, range, and standard deviations). Variables included in the multivariable analysis were age, family history of prostate cancer, residence, spirituality, home ownership, education level, PCa symptom knowledge, employment, number of rooms in a house, and marital status. First, chi-square tests were performed to test univariate associations of categorical variables with advanced

TABLE 1 Demographic characteristics of participants.

Demographic characteristic	Frequency (N = 170)	Percentage (%)
Age in years		
49–60	17	9.9
61–70	64	37.4
71–80	72	42.1
81+	18	10.5
County of residence		
Nairobi	39	23.0
Others	130	77.0
Marital status		
Married	147	86.
Not Married	18	10.5
Unknown	2	1.1
Education level		
No formal education	7	4.1
Primary	60	35.1
Secondary	60	35.1
Tertiary and above	44	25.7
Annual household income		
Less than 1.3 M	22	12.9
1.3M–2.6 M	2	1.2
2.6M–3.9 M	1	0.5
Don't know	145	85.3
Current occupation		
Employed	44	25.9
Retired	63	37.1
Unemployed/unable to work	63	37.1
Health insurance cover		
Yes	164	96.5
No	6	3.5
House ownership		
Own	140	82.4
Rent	30	17.6
Living arrangements		
Live alone	16	9.4
With family members	80	47.1
With spouse or partner	74	43.5
Number of rooms		
1–2	36	21.2
3–5	125	73.5
6–8	9	5.3

(Continued)

TABLE 1 (Continued)

Demographic characteristic	Frequency (N = 170)	Percentage (%)
Level of spirituality		
Slightly or not spiritual	12	7.1
Fairly	82	48.2
Very	76	44.7
Source of information		
Doctor only	121	71.2
Doctor/pharmacist	16	9.4
Others	47	19.4
Knowledge of prostate cancer symptoms		
No	129	75.9
Yes	41	24.1
Unable to see a doctor in the last 12 months due to financial issues		
Yes	81	47.7
No	88	51.8
Don't know/not sure	1	0.6
Family history of prostate cancer disease		
Yes	34	20
No	120	70.6
Don't know	16	9.4

M, Million, currency in Kenya shilling.

disease. Binary multivariable regression models (adjusted and unadjusted) were performed to identify the factors associated with advanced and metastatic disease. Statistical significance was set at an alpha level of 0.05.

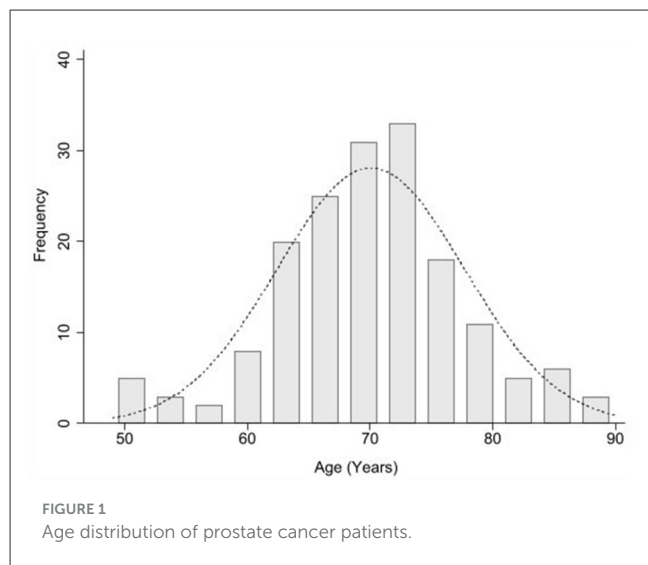
3 Results

3.1 Sociodemographic characteristics

This report presents findings from a cohort of 170 male patients diagnosed and living with prostate cancer. The mean age of the study participants was 70 years, with a minimum age of 49 years and a maximum of 90 years, with a standard deviation of 7.6 years. Most patients were in the 61–80-year age group (Table 1 and Figure 1).

There was a significant number of patients (77%, $n = 130$) who resided outside the Nairobi region where the study was carried out, while 23% were residing in Nairobi. The odds of being diagnosed with advanced disease were lower for patients who resided outside Nairobi (OR: 0.13, 95% CI: 0.02–0.81) which were statistically significant.

The majority (71%, $n = 104$) had at least secondary education, with 25.9% ($n = 44$) having attained tertiary education, while 4.1% ($n = 7$) had no formal education. Patients with tertiary or higher education had significantly lower odds of being diagnosed at a



more advanced stage compared to those with primary or no formal education (OR = 0.13, 95% CI: 0.03–0.56). However, there were no statistically significant differences in stage at diagnosis between patients with no formal or primary education and those with secondary education (OR = 0.60, 95% CI: 0.16–2.29). Knowledge of prostate cancer symptoms was lacking in 75% of the participants. No significant association was observed between prostate cancer symptom knowledge and the likelihood of being diagnosed at an advanced stage (OR = 1.31, 95% CI: 0.32–5.33). Most participants were married at 88% ($n = 147$), and marital status was not significantly associated with being diagnosed with advanced disease (OR = 1.11, CI: 0.24–4.96). In terms of employment, 37.1% ($n = 63$) were unemployed or unable to work, 37.1% ($n = 63$) were retired, and 25.9% ($n = 44$) were employed. Although 96.5% ($n = 164$) had some form of health insurance, over half (51.8%, $n = 88$) had been unable to seek medical treatment in the past year due to cost. A significant number (85.3%, $n = 145$) were unaware of their household income, and 12.9% earned less than Ksh 1.3 million per year. The Majority (82.4%, $n = 140$) owned homes, while 17.6% ($n = 30$) rented homes. In terms of household sizes, 73.5% ($n = 125$) were living in houses with 3–5 rooms, 21.2% ($n = 36$) in 1–2 rooms, and 5.3% ($n = 9$) in 5–8 rooms. Interestingly, living in a house with more than two rooms was associated with lower odds of advanced disease at diagnosis (OR = 0.45, 95% CI: 0.08–2.42) but this relationship was not statistically significant. Living arrangements were also reported, with 47.1% ($n = 80$) living with family members, 43.5% living with spouse or partner and the remaining 9.4% ($n = 16$) living alone. The level of spirituality differed among the patients, with the majority describing themselves as either fairly (48.2%, $n = 82$) or very spiritual (44.7%, $n = 76$); only 7.1% ($n = 12$) were slightly or not spiritual at all. Patients who were very spiritual were more than 4 times likely to present with advanced disease (OR = 4.51 CI: 1.33–15.22), this relationship was statistically significant with low precision. Family history of prostate cancer was found in only 20% ($n = 34$) of the participants with higher odds of late-stage

disease (CI: OR = 1.46 (0.39–5.46) but this relationship was not statistically significant (Table 2).

3.2 Clinicopathological characteristics

PSA levels varied significantly among the patients, with the majority having levels exceeding more than 50 ng/ml at 60.5% ($n = 92$). The distribution of PSA levels was as follows: <10 ng/ml: 5.9% ($n = 9$), 11–20 ng/ml: 17.1% ($n = 26$), 21–50 ng/ml: 16.5% ($n = 25$). Due to the skewed distribution the PSA levels at diagnosis were summarized using median and interquartile range. The median PSA was 81 ng/ml (IQR: 26.5–262) while the mean was 402.22 ng/ml (SD:1128.17). Most of the participants presented with advanced disease 84.7%, ($n = 144$) whereas 15.3% ($n = 26$) presented with early disease. The majority (84.7%, $n = 129$) had undergone PSA testing due to symptoms rather than routine screening, and 75.9% ($n = 129$) had no knowledge of prostate cancer symptoms. Most preferred to obtain medical information only from doctors (71.2%, $n = 121$), followed by doctor/pharmacist (9.4%, $n = 16$) and other sources (19.4%, $n = 47$) (Table 1). PSA diagnosis was positively associated with advanced disease ($p = 0.01$).

Most patients exhibited high Gleason scores, which indicate aggressive disease. The distribution was as follows: Group 1: 3.57% ($n = 6$), Group 2: 10.71% ($n = 18$), Group 3: 20.24% ($n = 34$), Group 4: 15.48% ($n = 26$), and Group 5: 50% ($n = 84$). Notably, fifty percent of patients in Gleason grade group 5 suggest a diagnosis of highly aggressive disease (Table 3).

4 Discussion

This study reveals striking patterns of late-stage disease presentation and identifies critical social determinants influencing diagnosis timing.

Our findings provide essential baseline data for developing targeted interventions to address the prostate cancer burden in Kenya and could potentially inform efforts in other sub-Saharan African countries.

The predominance of advanced disease at diagnosis in our cohort represents a public health crisis requiring immediate attention. This finding aligns closely with a previous study, which reported 87.5% advanced presentation, suggesting minimal progress in early detection over nearly two decades (12). This contrasts with Western populations, where over 80% of patients present with early-stage disease due to screening, highlighting the urgent need for systematic screening programs in Kenya (2).

Generally, PCa is prevalent among elderly males (10, 11, 16). After the age of 40, African Americans men and those with a positive family history, face an increased risk of prostate cancer. In contrast white men experience a heightened risk after age 50, particularly if they have a family history (17). In this study 20% of the participants had a family history of prostate cancer which is comparable to what has been reported in other studies (18, 19). One study reported that the risk of developing PCa depends on the age of the patient and the number of family members affected resulting in different strata of disease (20).

TABLE 2 Univariate and multivariable regression analysis.

Variable	Unadjusted odds ratio (95% CI)	Adjusted odds ratio (95%CI)
Age	0.99 (0.93–1.04)	1.01 (0.94–1.09)
Family history of PCa		
No	Ref	Ref
Yes	1.32 (0.42–4.21)	1.46 (0.39–5.46)
Residence		
Nairobi	Ref	Ref
Other	0.25 (0.06–1.12)	0.13 (0.02–0.81)*
Very spiritual		
No	Ref	Ref
Yes	2.50 (0.99–6.30)	4.51 (1.33–15.22)*
Education		
Primary or no formal	Ref	Ref
Secondary	0.87 (0.28–2.63)	0.60 (0.16–2.29)
Tertiary+	0.31 (0.11–0.87)*	0.13 (0.03–0.56)*
PCa symptom Knowledge		
No	Ref	Ref
Yes	0.90 (0.24–3.30)	1.31 (0.32–5.33)
Employment		
Employed	Ref	Ref
Retired	0.80 (0.29–2.24)	2.94 (0.70–12.25)
Unemployed	1.51 (0.49–4.67)	2.31 (0.58–9.17)
Rooms in Home		
1–2	Ref	Ref
>2	0.44 (0.12–1.55)	0.45 (0.08–2.42)
Married		
No	Ref	Ref
Yes	0.90 (0.24–3.30)	1.11 (0.24–4.96)

*P-value < 0.05. * bold: Statistically significant association with advanced disease.

In West Africa there is an increased incidence of prostate cancer in the age range of 30–100 years, with a mean of 67.7 years (3). In our study the lowest age was 49 years and oldest was 90 years with a mean of 70 years indicating that patients were generally slightly older at diagnosis than what is reported elsewhere, which may reflect late presentation and delayed diagnosis (21). This finding emphasizes the need for early prostate cancer screening.

Forty-two percent of the participants in this study were diagnosed in the 8th decade (71–80 years). The US Preventive Services Task Force (USPTF) recommends against prostate cancer screening for men over 70 years (22). With the findings of this study further research is needed in sub-Saharan Africa and other lower-middle-income countries on the diagnosis and management of older men with prostate cancer, elucidating whether overdiagnosis and overtreatment are issues in this group of patients (3, 23).

TABLE 3 The stages of presentation and clinicopathological characteristics.

	Frequency (N = 170)	Percentage (%)
Gleason score		
Group 1 (≥)	6	3.6
Group 2 (3 + 4 = 7)	18	10.7
Group 3 (4 + 3 = 7)	34	20.2
Group 4 (8)	26	15.5
Group 5 (9 and 10)	84	50
Unknown	2	0.0
PSA at diagnosis-ng/ml		
0–10	9	5.3
11–20	26	15.3
21–50	25	54.1
>50	92	60.5
Unknown	18	10.6
TNM		
Early stage	26	15.3
Advanced stage	144	84.7
Reason for PSA test		
Because of a problem	124	72.9
Part of routine exam	26	15.3
Unknown	20	11.8

Clinicopathological characteristics investigated (Gleason score and PSA) varied widely. The majority of patients had high PSA levels at diagnosis, which were significantly associated with advanced disease. A review of 13 studies in sub-Saharan Africa reported substantial variation in mean PSA levels, with Senegal recording the highest mean of $1,447 \pm 812$ ng/ml and a range of 5.88 to 21,660 ng/ml (3). In contrast the median PSA at diagnosis in the USA was 6.2 ng/ml in 2010 and rose to 7.1 ng/ml in 2018 due to reduced screening rates (24). This study found very high levels of PSA in some patients with advanced disease highlighting the need for routine PSA screening and public awareness efforts to promote early detection (21).

More than half of the patients had a high Gleason Score (9 and 10) or ISUP Grade Group 5, indicative of aggressive disease. This aligns with other studies that found African populations have a higher incidence of high-grade tumors compared to other ethnic groups (25). Additionally, a few patients had ISUP Grade Group 1 and 2, emphasizing that prostate cancer in African settings is frequently diagnosed at an aggressive stage (26). In the USA patients are primarily diagnosed with Gleason grade groups 1 and 2 (24).

Socioeconomic factors such as lack of education, poverty, and income inequality are among the most important social determinants of health (27). Education emerged as a critical factor influencing stage at diagnosis. Higher education emerged as the

strongest protective factor against advanced disease presentation. This finding reflects the critical role of health literacy in promoting early detection through improved understanding of symptoms, reduced healthcare navigation barriers, and proactive health-seeking behavior. The equal distribution of patients across primary (35.1%) and secondary (35.1%) education levels, with only 25% having tertiary education, indicates a substantial population at risk due to limited health literacy. Men with at least some college education were 53% more likely to be diagnosed with prostate cancer compared to those with a high school diploma or less (28). Limited education hampers the ability to interpret health information, as shown in studies where men with lower education levels had poor knowledge and uptake of prostate cancer screening (7, 29). Expanding educational initiatives tailored to less-educated populations is critical for improving health literacy and promoting early detection. Annual household income's influence on the stage of prostate cancer was not evaluated in this study as many patients were unaware of or refused to disclose their income. Previous studies suggest that neighborhoods with poor socioeconomic conditions are linked to high-grade prostate cancer (30), independent of individual-level exposures (13). Married men were not found to have lower odds of being diagnosed with advanced stage disease. Contrary to expectations, this study suggests that marriage does not automatically confer a protective effect. These findings suggest that marriage, while often linked to better health outcomes (31), can have complex influences that warrant further qualitative exploration. A study from Canada revealed that single men had an increased risk of high-grade prostate cancer at diagnosis compared to men currently married or with a partner (32). These findings suggest complex social dynamics in health-seeking behavior and potential barriers to timely care. The inverse association between social support and advanced stage at prostate cancer diagnosis may be explained by several factors (30). Men may be influenced by their spouse, other relatives (30), or friends within their social network to undergo prostate cancer screening. In addition, marital status is positively associated with health insurance and household income. Men who are married may have greater access to health care associated with prostate cancer screening. In an analysis of SEER cancer registry data, the relationship between marital status and prostate cancer survival was investigated. Married patients were less likely to present with metastatic disease and less likely to die as a result of prostate cancer than unmarried patients (33). Single men had an increased risk of high-grade prostate cancer at diagnosis compared to men currently married or with a partner.

Despite the controversy surrounding PSA screening, individuals with higher health literacy may exhibit greater proactive engagement in their urologic healthcare (34). In our study, more than 75% of the participants did not know or could not identify prostate cancer symptoms. Similarly, knowledge of prostate cancer symptoms was associated with lower odds of late-stage diagnosis. Cultural norms, stigma, caregiving responsibilities, or dependence on spousal prompting may delay timely health-seeking; this is supported by the large number of participants lacking symptom awareness, suggesting cultural barriers to health literacy.

This study shows that despite the majority of the participants being covered by the government-subsidized insurance they

still presented with advanced disease in 85% of the cases. Expanding the Social Hospital Insurance Fund (SHIF) to include free or low-cost prostate cancer screening could significantly improve access instead of insuring patients for treatment purposes after diagnosis.

In terms of residence, there was a trend toward earlier detection in rural areas outside Nairobi. This unexpected trend could reflect greater health system delays or navigation challenges in urban settings, suggesting a need for targeted interventions in metropolitan areas. It may also indicate that patients traveling from areas outside Nairobi were financially advantaged and had relatives living in Nairobi who had access to pathways and navigation systems. Further research in this area should be considered. A study looking at differences in rural vs. urban patients in diagnosis and treatment in a population-based cohort in Carolina found that patients with prostate cancer who live in rural vs. urban areas experience several differences in care that are likely clinically meaningful, including fewer cores in the diagnostic biopsy, less utilization of multidisciplinary consultation, less use of active surveillance or observation for low-risk disease (35). A study investigated the determinants of cancer care pathways at Wajir County in Kenya using a mixed-method approach to understand the patient's perspective of cancer care. They found a high burden of late-stage cancer disease, low screening rates and treatment services, limited access to pathways and navigation systems (36).

Spirituality emerged as a significant factor driving late-stage disease. This result should be interpreted considering the likelihood of older and more spiritual men delaying care. More spiritual men would prioritize faith over early screening and do not consider themselves at risk due to their faith.

Although our current study did not investigate cultural beliefs and societal attitudes toward health, cancer and masculinity may influence whether individuals seek medical help or participate in PCa screenings. Overcoming cultural barriers is essential for promoting awareness and early detection (21). In South Africa, local clinics are women-dominated, and men shy away from them. Moreover, within many African cultures, it is often considered shameful for African men to discuss their sexual or reproductive health issues with women. This is perceived as a sign of weakness and contradicts traditional notions of masculinity. As a result, men frequently present at local clinics with advanced-stage diseases. Policymakers could take steps to improve advocacy for men's health culture in order to address this issue (37).

This study is not without limitations that should be considered when interpreting this data. The study primarily recruited patients from KNH and MP Shah Hospital; thus, these data may not be representative of the wider Kenyan population or other urban and rural settings where access to healthcare differ significantly. Rural populations in Kenya face substantial barriers, including limited health infrastructure, fewer trained health personnel, longer travel distances to specialized centers, and lower literacy levels. These factors may result in even later presentations and poorer outcomes than those observed in this cohort. This limits the extent to which the results can be generalized beyond the study population. Small subgroup sizes

for categorical variables may have reduced the statistical power of the study; therefore, longitudinal designs are warranted to explore qualitative factors leading to late-stage diagnosis. A larger sample across multiple regions in Kenya would provide a more comprehensive understanding of disease patterns. Variations in PSA testing methods, quality assurance, and thresholds across healthcare facilities may have influenced the reported PSA levels at diagnosis. The findings of this study provide important information on the presentation of prostate cancer at diagnosis in Kenya and highlight the need for improved screening and diagnostic programs.

The high burden of advanced prostate cancer at diagnosis could be mitigated by prioritizing community-based PSA screening camps in rural areas and training male health workers to address masculinity-related barriers. There is a need for research exploring the social determinants of health leading to late presentation and delayed diagnosis, including socioeconomic barriers, healthcare access, and genetic predispositions, to inform tailored intervention policies.

5 Conclusion

The late-stage presentation of prostate cancer in Kenya remains a significant challenge, highlighting delays in early detection. This study provides critical insights into the clinicopathological characteristics of prostate cancer patients and their determinants, revealing a high burden of aggressive and advanced-stage disease at diagnosis.

The findings underscore the urgent need for early detection programs, integrating free PSA testing into Kenya's SHIF-covered annual health checks for men over 50 years. With 85% of patients presenting with metastatic disease and half exhibiting highly aggressive tumors (Gleason grade 9–10), community-based screening must prioritize high-risk groups (e.g., men with a family history). In addition, public awareness campaigns to promote earlier diagnosis and better patient outcomes are necessary. Partnering with local leaders to destigmatize men's health screening could address cultural barriers identified in this study. Immediate funding for longitudinal research is critical for studies to explore why Kenyan men, despite insurance coverage (96.5%), still present late—whether due to systemic delays, cultural stigma, or genetic susceptibility. Unexpected links between marital status, spirituality, and late diagnosis warrant qualitative research to uncover the hidden sociocultural dynamics.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by KNH/UON Ethics and Research Committee. The studies were conducted

in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. The animal study was approved by KNH/UON Ethics and Research Committee. The study was conducted in accordance with the local legislation and institutional requirements.

Author contributions

CW: Project administration, Writing – original draft, Methodology, Formal analysis, Funding acquisition, Data curation, Resources, Conceptualization, Writing – review & editing, Investigation. ST: Supervision, Writing – review & editing. DO: Supervision, Writing – review & editing. CR: Funding acquisition, Formal analysis, Data curation, Writing – review & editing, Supervision. CZ-J: Supervision, Writing – review & editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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