

# Modifiable Risk Factors Implicated in Prostate Cancer Mortality and Morbidity among Nigerian and Cameroonian Men

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## ABSTRACT

Prostate cancer is a significant public health problem affecting men globally. In 2018, it was the second most commonly diagnosed cancer among men world-wide and disproportionately impact men of African ancestry. Some of the modifiable risk factors for prostate cancer include knowledge and attitudes about the disease, the belief system of individuals and their diet. Moreover, physical activity, alcohol and tobacco consumption have also been suggested as behavioral factors that contribute to prostate cancer disparities. This study compares modifiable risk factors implicated in prostate cancer among men living in Africa and African immigrants living in the United States to identifying behavioral factors that can be targeted for intervention. A cross-sectional study design was employed among Black men in Nigeria, Cameroon and African immigrants in United States using the Global Prostate Cancer Measure for Black men. Findings indicate that Nigerian and Cameroonian men residing in the United States expressed a more positive attitude towards screening than their counterparts in Africa. Knowledge levels about prostate cancer was higher among African Immigrants in the United States compared to those living in Africa. Additionally, fatalism, attitude and knowledge of prostate cancer signs and symptoms were statistically significant in the prediction of prostate cancer screening. Cancer control and prevention efforts in Nigerian and Cameroon should focus on educating men about the signs and symptoms of this disease to increase knowledge levels and ensure awareness of screening methods. Prostate cancer survivors should be part of health promotion campaigns to reduce fatalistic beliefs.

**KEYWORDS:** Risk factors, prostate cancer, health disparity, African ancestry, behavioral factors,

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## INTRODUCTION

Prostate cancer (CaP) is a significant public health problem affecting men globally. According to the international agency for research in cancer, it was the second most commonly diagnosed cancer among men worldwide in 2018 (Bray, 2018) and disproportionately impact men of African ancestry (American Cancer Society, 2018). It accounted for 359,000 associated deaths globally in 2018, with an increasing number of fatalities reported in sub-Saharan Africa (Bray et al 2018). Established risk factors for this disease include older age; family history; and African ancestry (Centers for Disease Control and Prevention, 2018). While these factors are non-modifiable, there are other contributing factors to CaP disparities that are modifiable. They include knowledge and attitudes about the disease, beliefs, and lifestyle factors, such as diet, physical inactivity, alcohol and tobacco consumption. These behavioral factors exacerbate disparities in CaP outcomes among Black men. Current literature indicates that low knowledge and awareness about the disease, socio-economic status, lack of access to quality care, diagnostic centers and treatment play significant roles in late stage presentation and mortality (Akpuaka et al., 2013; Baade, Youlden, & Krnjacki, 2009; Cobran et al., 2014; McFall, Hamm, & Volk, 2006).

In the United States (US), CaP is the most common cancer diagnosed among men and the second ranked cause of cancer mortality, with about 1 man in 7 likely to be impacted by this disease during their life time (ACS, 2018). It is estimated that in 2018 about 164,690 men were diagnosed with this disease in the US with about 29,430 deaths (ACS, 2018). Ethnic/racial and geographic disparities characterize the burden of CaP among sub populations and regions within the US. For

example, in 2015, Black men in America experienced the highest incidence rate (158 per 100,000 persons) compared to all races (99 per 100,000 persons). Similarly, death rates for the same year showed Black men were more likely to die of CaP than any other racial or ethnic group in America (CDC, 2018). According to the United States Cancer Statistics Working Group (U.S. Cancer Statistics Working Group, 2017), between 1999 and 2012, the Northeast region had the highest incidence of 115.4 per 100,000 people followed by the Midwest with 105.3 per 100,000 people and the South with 104.3 per 100,000 people. In terms of death rates, the Midwest and South regions had the highest at 19.8 per 100,000 people followed by the West region at 19.5 per 100,000 and the Northeast at 18.8 per 100,000 people (U.S. Cancer Statistics Working Group, 2017). Reasons for these unequal distribution in health outcomes are complex and include social determinants of health such as lack of access to medical care, low socio-economic status, and the structural determinants and conditions of daily life (Marmot, Friel, Bell, Houweling, & Taylor, 2008; Schroeder, 2007).

Significant challenges exist in quantifying the burden of CaP in sub-Saharan Africa (SSA) (Adeloye et al., 2016). Few countries in this region have established population-based cancer registries, and existing registries lack adequate resources (Morhason-Bello et al., 2013; Odedina et al., 2009). The African Organization for Research and Training in Cancer (AORTIC) estimates that while 80% of the United States population is covered by cancer registries, only about 1% of African population are presently covered (Morhason-Bello et al., 2013). Data from the International Agency for Research on Cancer (GLOBOCAN 2012) show that in 2012, the most

common cancer among men in SSA was prostate which accounted for 16.4% of new cancer cases (Parkin, Bray, Ferlay, & Jemal, 2014). In SSA, the risk of developing CaP before age 75 was estimated at 3.4% in 2012 affecting almost 1 in 30 men (Parkin et al., 2014). Published data reveals wide geographic variations in reported incidence and mortality from CaP in Africa. In 2012, CaP death rates were higher in Southern Africa (age-standardized rate 24.4 per 100,000 population per year), Middle Africa (age-standardized rate of 24.2 per 100,000 population per year), and Western Africa (age-standardized rate of 21.2 per 100,000 population per year) compared to North Africa (age-standardized rate of 7.0 per 100,000) which is 7 times lower than the rates of the other three regions (Ferlay et al., 2015). These figures may not reflect the actual burden of this disease in Africa as several studies have noted underreporting of cancer cases (Angwafo, 1998; Chu et al., 2011; Jemal, 2012; Klassen & Platz, 2006; Morhason-Bello et al., 2013; Odedina et al., 2009) due to lack of population-based cancer registries. Moreover, the population of Africa between 2010 and 2030 is projected to increase by 60% overall (from 1.03 billion to 1.65 billion) and by 90% for individuals 60 years and older (from 55 million to 103 million), the age at which cancer frequently occurs (United Nations Department of Economic and Social Affairs Population Division, 2017).

Among men in Nigeria, CaP is the most common malignancy with an incidence rate of 30 per 100,000 cases and mortality rate of 26 per 100,000 cases (Ferlay et al., 2013). A hospital-based study showed incidence of 127/100,000 cases with a national population risk of 2% (Osegbe, 1997). This was compared to the low incidence in previous years owing to gross underestimation of the disease. Alabi and colleagues (Alabi, Sowunmi,

Alabi A.S., & Fatiregun, 2016) reported an incidence of 12.1% in Lagos Nigeria, which was comparable to other studies from Kano, Zaria, Benin, and Maiduguri with incidence of 16.5%, 9.2%, 7.13% and 6.15% of all male cancers respectively (Akinremi, Ogo, & Olutunde, 2011). These results are contrary to previous perception on the rarity of the disease in Africa.

In Cameroon, CaP is the leading cause of death from cancer among men (Orock, Ndom, & Doh, 2012). In 2012, the population-based age standardized incidence for CaP among men was 23.0 per 100,000 persons and mortality rate was 18.6 per 100,000 persons (Ferlay et al., 2015). This number might not reflect the true burden of the disease as there is no active national surveillance system, and some cancer deaths are neither reported nor recorded (Angwafo et al., 2003; Doh, 2006).

Behavioral factors have been shown to offer the single greatest opportunity to bring about reduction in cancer incidence, improvement in health outcomes and reduction in the global burden of cancers (Klein et al., 2014; Schroeder, 2007; Stein & Colditz, 2004). A study by Mokdad and colleagues (Mokdad, Marks, Stroup, & Gerberding, 2004; Stein & Colditz, 2004) showed that behavioral factors account for nearly 40% of all deaths in the United States. Behavioral factors provide an opportunity to understand the etiology of cancer and effectively address potential areas for cancer control and prevention intervention. This study aimed to identify the behavioral factors associated with CaP among men with common ancestral background, living in three countries: United States, Nigeria, and Cameroon. We examined the similarities and differences in modifiable risk factors such as diet, health literacy,

physical activity, cigarette smoking, attitudes, fatalism and knowledge about the signs and symptoms of this disease. Results of this study indicate that Nigerian and Cameroonian men residing in the United States expressed a more positive attitude towards screening than their counterparts in Africa. Knowledge levels about prostate cancer was higher among African Immigrants in the United States compared to those living in Africa. Additionally, fatalism, attitude and knowledge of prostate cancer signs and symptoms were statistically significant in the prediction of prostate cancer screening. One public health application of this result entail tailored interventions in Nigeria and Cameroon that seek to improve attitudes and knowledge about this disease and address fatalistic beliefs.

## METHODS

### Study Design and Sites

This was a cross-sectional study design implemented by the Prostate Cancer Transatlantic Consortium (CaPTC) investigators in three countries (United States, Nigeria and Cameroon). The study sites included: Federal University of Agriculture Abeokuta, Covenant University Otta, Lagos State University Teaching Hospital, Lagos University Teaching Hospital, ACE Medicare Clinic Lagos, Ekiti State Teaching Hospital, Obafemi Awolowo University Teaching Hospital Complex Ile-Ife, University of Ilorin, National Hospital Abuja, University of Maiduguri, Ahmadu Bello University Zaria, and the University of Calabar. In Cameroon, the University Hospital Center of the University of Yaounde 1 participated, and in the United States, the University of Florida.

### Participants

Participation in this study was limited to Nigerian and Cameroonian men between the age of 35 and 70 years residing in Nigeria, Cameroon, or the United States regardless of any cancer diagnosis. The inclusion criteria were men with a first-degree male relative living in one of the three countries. Exclusion criteria were men below age 35 or older than 70 years.

### Study variables and Measures

The *Global Prostate Cancer Measure for Black men* developed by CaPTC and the African Caribbean Cancer Consortium (AC3) investigators was used for data collection. This multi-item standardized instrument has been validated for use in other studies conducted in Black men (Odedina et al., **in Press**; Blackman et al., 2018; Cobran et al., 2014; Kaninjing et al., 2017; Kumar et al., 2009; Odedina et al., 2011a; Ogunsanya et al., 2016a). The study variables and measures are presented next:

*Demographic variables* included participants' age, educational level, religion, marital status, and employment. *Age* was categorized into four strata (35-44); (45-54); (55-64); and 65 plus. *Marital status* was categorized into single or married. *Religion* was stratified into three categories: Christian, Muslim, and Other. *Employment status* was divided into three groups: employed, not employed, and refused to provide information. *Education* included four levels: less than high school, high school, university and refused to provide information.

*Outcome variables* for this study was having had a *prostate specific antigen test (PSA)* and or *digital rectal examination (DRE)*. Both were measured by asking participants "How long has it been since you had your last PSA test?" and "How long has it been since you had your last DRE exam?"

Response options were: A) Within the past year; B) Within the past 2 years; C) Within the past 3 years; D) Within the past 5 years; E) 5 or more years ago; and F) Never. Both variables were dichotomized into 1 (if participant had received a PSA test- options A-E) or 0 (if participant had not received a PSA test- option F).

*Independent variables* were smoking status, fatalism, attitude, health literacy, knowledge, meat diet, poultry diet, fish diet, physical activity, and alcohol consumption. With regards to *smoking status*, participants were asked “What are your smoking habits?” with the following response options: A) I smoke daily; B) I smoke daily but I have cut down; C) I smoke every once in a while; D) I used to smoke, but quit less than 6 months ago; E) I used to smoke, but quit more than 6 months ago; F) I have never smoked; G) I used to smoke, quit time unknown; H) Don’t know/Not sure G) Refused. This variable was categorized as current smoker if response was either A, B, or C.; past smoker if response was either D, or E; and never if response was F or G. Participants were also asked, “Have you smoked at least 100 cigarettes in your entire life?”. The equivalent of 100 cigarettes is 5 packs. Participant choices were A) Yes, B) No, C) Don’t know/not sure and D) Refused. Four items were used to measure *cancer fatalism* among study participants with response captured on a Likert-type scale (Strongly Agree; Agree; Neutral; Disagree; Strongly Disagree). The items were: A) I believe if someone has prostate cancer, it is already too late to do something about it; B) Getting prostate cancer means the end of the world; C) If someone is told “You have prostate cancer”, there is nothing to be hopeful for; and D) The first thing that comes to my mind when I hear “prostate cancer” is death. The score range for this variable was 4 – 20. Higher scores

indicate higher fatalism or the sense that things are beyond the control of the individual.

Three items measured *participant's attitude* towards screening for prostate cancer with responses in a scale (Very Favorable; Favorable; Neutral; Unfavorable; Very Unfavorable). The items include: A) Weighing the advantages and disadvantages of prostate cancer screening to make a decision about screening for prostate cancer; B) Getting tested for prostate cancer with Digital Rectal Examination (DRE) every year; and C) Getting tested for prostate cancer using my blood sample for serum prostate specific antigen (PSA) test every year. The score range for this variable was 3 – 15. Higher scores indicate positive attitude.

*Health literacy* was measured by four items with responses in a Likert-type scale (Always; Often; Sometimes; Rarely; Never). The items were: A) I have someone help me read health materials; B) I am confident filling out health forms by myself; C) I have problems understanding written information about prostate cancer; and D) When someone discusses prostate cancer with me, I have problems understanding the information. The score range for this variable was 4 – 20. Lower scores indicating low literacy levels.

Twenty items assessed *participants' knowledge* of prostate cancer signs and symptoms. Responses were “True”; “False”; and “Don’t Know”, with “Don’t Know” and blank responses coded as wrong response.

Participants were asked about their *diet*, particularly consumption of meat, poultry, fish, animal organs and animal fats. Participants had the option to report their frequency of consumption of these items per week, or per

month. *Physical activity* was measured by a single item with a “Yes” or “No” response to the following question: “Are you involved in vigorous-intensity activity that causes large increases in your breathing or heart rate (for example carrying or lifting heaving loads, digging or construction work) for at least 10 minutes continuously?”. The internal consistency of sampling instrument was established at 0.88 Cronbach’s alpha for cancer fatalism, 0.84 for attitude and 0.47 for health literacy.

### Recruitment and Data collection

After Institutional Review Board approval from each participating institution, data collection commenced in May 2017 and is still ongoing. The data reported in this paper is the data collected between May 2017 and July 2017. The *Global Prostate Cancer Measure for Black men* was administered by trained investigators, research staff and student assistants. Prior to administration of study survey, informed consent was obtained from each participant. Recruitment took place in community settings at all participating sites. In addition, there were recruitment at clinics in Nigeria and Cameroon. The first 500 participants who participated in the study were included for this report. Participants in the United States were

provided a \$25.00 gift card for completing questionnaire while those in Nigeria and Cameroon received either a T-shirt or a small monetary incentive.

### Data Management and Statistical Methods

The Research Electronic Data Capture (REDCap) was used for data entry and management. The data was exported to SAS software for data analyses. Descriptive statistics was used to summarize the study variables. We then computed proportions for quantitative measures and compared qualitative measures using t and chi-square tests. Logistic regression was used to assess the effects of demographic and independent variables on outcome variables.

## RESULTS

A total of 500 participants completed questionnaire for this study, with 428 (85.6%) participants from Nigeria, 34 (6.8%) from Cameroon and 38 (7.6% African immigrants from the US with first-degree male relatives living in either Cameroon or Nigeria. Majority of the participants had achieved university level education, were married, identified as Christians, and were employed. Table 1 shows the demographic variables for study participants.

Table 1. Demographic characteristics of study participants (n=500).

	Countries		
Variables	Cameroon n=34 (6.8%)	Nigeria n=428 (85.6%)	United States n=38 (7.6%)
<b>Age</b>			
35-44	8 (23.53)	189 (44.25)	19 (50.00)
45-54	12 (35.29)	133 (31.15)	15 (39.47)
55-64	9 (26.47)	68 (15.93)	4 (10.53)
65+	5 (14.71)	37 (8.67)	0 (00.00)
<b>Education</b>			
< High School	8 (23.53)	79 (18.77)	0 (00.00)
High School	10 (29.41)	97 (23.04)	1 (02.63)
University	14 (41.17)	243 (57.72)	37 (97.37)



Refused	2 (05.88)	2 (00.48)	0 (00.00)
<b>Marital Status</b>			
Single	4 (11.76)	28 (6.55)	5 (13.89)
Married	30 (88.24)	399 (93.44)	31 (86.11)
<b>Religion</b>			
Christian	31 (96.88)	288 (68.74)	35 (94.59)
Muslim	0 (00.00)	128 (30.55)	1 (02.70)
Other	1 (03.13)	3 (00.72)	1 (02.70)
<b>Employment Status</b>			
Employed	23 (67.65)	372 (88.15)	32 (86.44)
Not Employed	11 (23.53)	50 (11.86)	5 (12.95)
Refused	3 (08.82)	0 (00.00)	1 (00.61)

Table 2 provides a comparison of the study variables across the three study sites. The variables that were statistically significant ( $p < .05$ ) across the three study populations were cancer fatalism, attitude, knowledge, diet of poultry, intensive physical activity, PSA test and DRE. Nigerian and Cameroonian men residing in the US had a lower mean score for cancer fatalism (6.6666) compared to participants in Cameroon (8.9642) and those from Nigeria (8.7839). This means that participants in the US felt they had the power to influence their behavior and health outcome, as opposed to participants from the other sites who considered the events around their health as inevitable and controlled by fate. Regarding attitude and Knowledge, Nigerian and Cameroonian men residing in the US expressed more positive attitude (13.2500) compared to those from Nigeria (11.2052) and from Cameroon (11.5357). Knowledge

level about CaP was higher among Nigerian and Cameroon men residing in the US than those in Cameroon and Nigeria. Concerning diet, participants from Cameroon and Nigeria consumed less poultry than those living in the US. Higher physical activity was reported among participants from Nigeria (2.1392) followed by participants from the US (2.0833) and those from Cameroon reported the lowest physical activity (1.0000). Reported PSA test was more common among participants from Cameroon (0.8928) followed by participants from the US (0.6666) and least common among participants from Nigeria (0.2919). History of DRE was more commonly reported by participants from the US (0.7500) followed by participants from Cameroon (0.6071) and least reported among participants from Nigeria (0.2267).

**Table 2. Descriptive Statistics of behavioral factors across study sites.**

Variable	Cameroon (N=30)	Nigeria (N=355)	US (N=36)	Pvalue
Smoking Status (%)	3.57%	4.94%	2.94%	0.8123
Current smoker	25.00%	16.36%	17.65%	
Past smoker	71.43%	78.70%	79.41%	
Never				
Fatalism	8.96	8.78	6.66	0.0048
Attitude	11.53	11.20	13.25	<.0001
Health Literacy	12.78	13.38	14.66	0.1500

Knowledge	6.75	6.79	9.66	0.0002
Diet (meat)	1.74	1.65	1.53	0.6258
Diet (poultry)	1.33	1.42	2.08	0.0009
Diet (fish)	2.45	2.11	1.68	0.0621
Diet (organ)	1.08	1.32	0.94	0.1353
Diet (fats)	2.09	2.13	2.05	0.2832
Physical Activity	1.00	2.13	2.08	<.0001
Alcohol consumption	2.43	1.67	1.91	0.2709
PSA (1=yes; 0=no)	0.89	0.29	0.66	0.0001
DRE (1=yes; 0=no)	0.60	0.22	0.75	0.0006

Regarding DRE, participants from Nigeria had an 81% lower odds of getting a DRE compared to participants in the US, whereas no difference was found between participants in Cameroon and those in the US (Table 3). When examining the effect of diet, individuals consuming meat on average had a 52% lower odds of having a DRE relative to those who did not consume meat (OR = 0.48; 95% CI: 0.29 – 0.80); furthermore, the odds of having a DRE was 2.15 times higher for study participants who consumed fish (OR= 2.15; 95% CI:1.46 – 3.16), compared to those who did not. In terms of PSA, a meat-based diet was found to be a significant predictor whereby meat-consuming participants, with an OR of 0.56 (95% CI 0.37 – 0.85) had a 44% lower odds of having a PSA test compared to those who did not consume meat. Conversely, participants

who reported a fish-based diet OR of 1.77 (95% CI: 1.28 – 2.44) on average had a 77% higher odds of getting a PSA test than participants whose diet did not contain fish. These findings indicate that participants who were more likely to exhibit CaP preventative behavior were also more likely to participate in CaP screening. For all other variables no difference was found in the odds of having a DRE.

Attitude in this analysis was found to be a significant predictor of CaP screening, with an OR of 1.21 (95% CI: 1.05 – 1.39) meaning that for each unit increase in the score for attitude, the odds of having a PSA on average increased by 21% (Table 3). All other remaining variables assessed for an association with the PSA were not found to be significant.

**Table 3. Odds Ratio Estimates of the Association between Behavioral Factors and Having a DRE or a PSA.**

	PSA	DRE
S2Q1: Cameroon vs US	2.17 (0.52 - 9.02)	0.68 (0.14 - 3.28)
S2Q1: Nigeria vs US	0.57 (9.02 - 1.51)	<b>0.19 (0.06 - 0.58)</b>
Fatalism	1.02 (0.94 - 1.12)	1.02 (0.92 - 1.14)
Attitude	<b>1.21 (1.05 - 1.39)</b>	1.06 (0.90 - 1.24)
Health Literacy	1.01 (0.92 - 1.10)	1.03 (0.93 - 1.15)
Knowledge	1.04 (0.97 - 1.11)	1.02 (0.94 - 1.11)
Diet (meat)	<b>0.56 (0.37 - 0.85)</b>	<b>0.48 (0.29 - 0.80)</b>
Diet (poultry)	1.30 (0.90 - 1.88)	1.08 (0.72 - 1.62)
Diet (fish)	<b>1.77 (1.28 - 2.44)</b>	<b>2.15 (1.46 - 3.16)</b>
Diet (organ)	0.99 (0.75 - 1.29)	1.10 (0.80 - 1.51)



Diet (fats)	0.80 (0.57 - 1.11)	0.83 (0.56 - 1.23)
Physical Activity	1.11 (0.82 - 1.49)	1.03 (0.71 - 1.48)
Alcohol Duration	1.14 (0.96 - 1.36)	1.14 (0.92 - 1.41)
Smoking status: Current smoker vs Past smoker	1.38 (0.31 - 6.19)	0.67 (0.10- 4.66)
Smoking status: Never vs Past smoker	0.78 (0.35 - 1.73)	0.67 (0.26 - 1.71)

## DISCUSSION

Since human behavior is a significant contributor to the etiology and management of cancer outcomes (Klein et al., 2014; Mokdad et al., 2004), effective cancer prevention and control efforts can benefit from behavioral intervention strategies. This study uniquely focuses on exploring modifiable behavioral factors for CaP among Nigerian and Cameroonian men residing in Nigeria, Cameroon and the United States. The important findings with implications for health promotion and CaP awareness among this population are summarized next.

### Cancer fatalism and prostate cancer detection

While participants in the US felt they had the power to influence their behavior and health outcome, participants from Nigeria and Cameroon considered the events around their health as inevitable and dependent on fate. This perception has been described as cancer fatalism- a belief that death is inevitable following a diagnosis of cancer, and it is a major barrier to cancer detection and control (West, 1993). Other studies from Nigeria and Cameroon have reported strong perception of fatalism about this disease as conversations about cancer in these countries are often shrouded in fear and strongly held superstitious beliefs (Aderounmu et al., 2006; Kaninjing et al., 2018; Ojewola et al., 2017). Similarly, a 2011 study among ethnically diverse Black men in Florida (Odedina et al., 2011) noted that US-born Black men and Caribbean-born US citizens reported less cancer fatalism compared to African-born Black men. Another study among men in a rural Kenyan

community reported relatively high fatalistic beliefs of prostate cancer screening (Mutua, Pertet, & Otieno, 2017). This feeling of powerlessness or the fear of "getting to know" one's status is detrimental to early detection of CaP and management of the disease. Therefore, cancer prevention and control efforts should focus on educating men in Nigeria and Cameroon on measures and behaviors that are within their reach in maintaining their health. Education about signs and symptoms for this disease, screening and diagnostic tests and treatment options can increase perception of control over one's overall health. In addition, it is important to involve CaP survivors in education and awareness campaigns. If men in Nigeria and Cameroon are exposed to men who have survived the disease and living a productive life as survivors, this may diminish cancer fatalism.

### Attitude and Knowledge

Participants from the US expressed a more positive attitude towards screening for CaP compared to those from Nigeria and Cameroon. Additionally, knowledge levels about CaP was higher among participants from the US than those from Cameroon and Nigeria. The knowledge gap among participants from these two sites on risk factors, signs, symptoms, and treatment options for CaP may be linked to their literacy levels. While 97% of US-based participants in this study had university education, only about 57% of the participants from Nigeria and 41% of participants from Cameroon had university education. This is consistent with the findings of Damiani et al (2015) who reported an increased level

of cancer screening in women with highest level of education. Among participants in the Florida study (Odedina et al., 2011), low CaP fatalism was associated with increase in education level. Therefore, lower level of education has the potential to negatively affect uptake of screening advice and early cancer detection (Damiani et al., 2015). However, this finding is contrary to results from a study by Magnus (2004) that found no significant difference in knowledge and nativity in participants who screened for CaP (Magnus, 2004). This may be due to the fact that participants in the Magnus study were all Americans with higher literacy level.

Other studies have shown that poor knowledge and attitudes regarding prostate cancer screening exist even among health care providers (Bourne, 2010; McNaughton-Collins & Barry, 2011). Effective cancer control efforts should include sensitization among physicians as they are a trusted source for cancer prevention and control information (Morrison BF, Aiken WD, Mayhew R, Gordon Y, 2017; Walsh-Childers, et al., 2018). Therefore, the negative attitude and lower knowledge levels exhibited by study participants from Nigerian and Cameroon indicate barriers that should be addressed to improve early cancer detection among men in these countries. Health care providers as well CaP survivors/advocates are a good source for such education.

Another important finding from this study was that a fish-based diet was a significant predictor of screening with PSA test and or DRE. One explanation of this finding could be that participants who consumed a fish-based diet were more health conscious and pro-active in their health seeking behaviors compared to those who favored a meat-based diet. While the role of diet in the etiology of prostate carcinogenesis is still unsettled, some studies

have noted the preventive role of diet, particularly vegetables, fruits, and nuts, to different classes of natural compounds, including polyphenols.

In this study, higher levels of physical activity was reported among participants from Nigeria followed by participants from the US while participants from Cameroon reported lower physical activity. According to the 2008 Physical Activity Guidelines for Americans (CDC, 2014) adults need a minimum of 2.5 hours (150 minutes) of moderate-intensity aerobic activity each week. Globally, physical inactivity is prevalent with 51% of people in the US (CDC, 2014) and 31% of people worldwide not attaining recommended physical activity levels (Hallal et al., 2012). A study by Moore and colleagues, found higher levels of physical activity were associated with an increased risk of prostate cancer (HR=1.05, CI:1.03–1.08). Although there is no conclusive evidence showing physical activity as a protective factor for prostate cancer, higher levels of physical activity has been associated with lower risk of 13 cancers including colon, breast and endometrial cancers but higher risk of malignant melanoma (Moore et al., 2016). The World Cancer Research Fund has estimated that 27–39% of the main cancers can be prevented by improving diet, physical activity and body composition (World Cancer Research Fund & American Institute for Cancer Research, 2007).

This study identified some important differences in modifiable CaP risk factors among Nigerian and Cameroonian men residing in Africa and their counterparts living in the US. It is evident that men living in Nigeria and Cameroon will benefit significantly from behavioral interventions on CaP prevention and early detection. Based on this study, the modifiable behavioral factors that can be targeted with tailored messages for CaP control and

prevention in Nigeria and Cameroon include attitudes, cancer fatalism, knowledge about CaP, and physical activity. Health care providers and CaP survivors should be integral in any behavioral intervention to address fatalistic beliefs and increase awareness about this disease.

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## Conflict of interest

The authors declare that no competing or conflict of interests exist. The funders had no role in study design, writing of the manuscript, or decision to publish.

## Authors' contributions

Design; Kaninjing, Odedina, Dagne. Introduction; Faruk, Sulaiman, Ogunlana, Atawodi, Alabi. Methods; Askins, Nggada, Kaninjing. Results; Dagne, Kaninjing, Odedina, Adegun. Discussion; Okoye, Bassey, Nkegoum, Popoola, Omonisi, Sowumni. Data Collection; Sowumni, Oladoyinbo, Fatiregun, Jibrin, Iweala, Kukoyi, Adeniji, Salako, Okpala, Okoro, Mbadiwe, Dogo, Gali

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