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Universal healthcare coverage, cancer screening and potential barriers to accessing cancer care in Sub-Saharan Africa: The results and implications of a Cross-sectional Community Study in Rural South-West Nigeria

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Conflicts of Interest: None to declare

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ABSTRACT

Background/Aims: Cancer burden is predicted to double by 2030 in sub-Saharan Africa. Accordingly, access to healthcare services for cancer management has been made a priority in the region. In Nigeria, the National Cancer Control Plan aims to ensure greater than 50% cancer screening of eligible populations by 2022 for all Nigerians. This study sought to describe current healthcare utilization, cancer screening activities and potential barriers to accessing cancer care within a rural community-based adult population in South-West Nigeria.

Methods: During April 2018, a cross-sectional study of community-based adults (>18 years) was conducted approximately 130 kilometers east of Ibadan, 250 km from Lagos in Osun State, South-West Nigeria. Participants completed a face-to-face survey in local dialect. A validated questionnaire was used to assess demographics, health status, income, medical expenditures, doctor visits, and cancer screening history.

Results: A total of 346 individuals were enrolled; the median age was 52 years, and 75% of participants were female. Of the entire cohort, only 4% had medical insurance,. 46% reported a major medical cost in the last year. Cancer screening activities were infrequent, with 1.5% of participants reporting having cervical cancer screening and 3.3% of participants >40 years having a mammogram. Colonoscopy screening in those >50 years was 5%. Cancer screening assessment was less frequent in those with less income and lower levels of education. Despite this, we observed that most individuals had contact with a primary health care doctor (52% in the last year), and over 70% access to radio and TV suggesting the opportunity to expand community-based screening interventions and awareness exist.

Conclusions: Despite expected increases in cancer cases**,** our data highlight a deficiency in cancer screening and lack of universal healthcare coverage within a community-based adult Nigerian population. Increasing financial risk protection, awareness, and targeted resource allocation may help expand access.

Keywords: Non-communicable disease, Sub-Saharan Africa, Cancer, Universal Healthcare, Screening

Strengths and Limitations of the study:

1) The study provided a contemporary perspective potential barriers to accessing medical and cancer care in rural South-West Nigeria. Recruitment and data collection performed by interviewers fluent in the local dialect who underwent a systematic and rigorous two-day training program.

2) Questionnaire tailored to the local population and developed in collaboration with local clinicians, epidemiologists, and nutritionists. Questionnaire items derived by adapting features from validated and/or widely implemented local or nationwide surveys.

3) Study conducted in conjunction with local community healthcare workers and the regional tertiary referral hospital to help build capacity, increase healthcare awareness, and establish a sustained relationship with these rural communities.

4) Potential for measurement error or recall bias, as we relied on individuals to retrospectively describe their own health and socioeconomic status as well as their interactions with healthcare services.

5) Survey conducted at a single time (mid-week, during the day), which may have affected sample composition (e.g., more females than males).

INTRODUCTION

The burden of non-communicable disease (NCD), in particular cancer, in sub-Saharan Africa is well documented.[1-3] According to recent International Agency for Research on Cancer GLOBOCAN estimates, by 2030, 75% of new cancer cases will be within low and middle-income countries.[4 5] In sub-Saharan Africa, despite the fact that cancer burden is predicted to double by 2030, the entire region accounts for <1% of worldwide medical cancer expenditures.[6-8] Central to addressing the growing burden of cancer in sub-Saharan Africa is the need to improve access to cancer care services for screening, prevention, and treatment.[9]

NCDs, including cancer, threaten to overwhelm fragile health systems in sub-Saharan Africa and lead to dramatic rises in health and social care costs in the near-term.[7 10] In the region, out-of-pocket health expenditures are a major contributor to poverty [11-13], and a lack of adequate social protection has the potential to drive families and individuals further into poverty. In Nigeria, universal healthcare coverage in the form of the National Health Insurance Scheme (NHIS) was implemented in 2005, with an overarching goal of universal health coverage for all Nigerians.[14] However, uptake has been limited and restricted,[15] and as a result, the large majority of Nigerians still face significant financial burden when healthcare needs arise.[15 16]

In Nigeria cancer incidence and mortality is increasing and women have a higher cancer incidence than men.[17] The most common forms of cancer in Nigeria are breast and cervical, with these accounting for over 50 percent of cancer deaths.[17-19] Regionally, the need to improve access to cancer services for early detection has been recognised, with a focus on these cancers. In 2018, Nigeria launched the "National

Cancer Control Plan 2018-2022," with the goal to make screening services available for all Nigerians, and at least "greater than 50% screening of all eligible populations by 2022."[20] Despite this, the current state of cancer screening and barriers to care in this region (esp. rural areas) are not well-defined. This gap limits our ability to define actionable steps towards improving access and achieving the established screening goal. In addition, with 50 percent of Nigeria's population living in rural areas[21] we hypothesize that unique challenges may exist for individuals in these communities, where nationwide initiatives may have limited reach.

This study aimed to describe potential barriers to accessing cancer care within a rural community-based adult population in South-West Nigeria. This study was performed as part of a broader community-based capacity building project in South-West Nigeria[22] investigating potentially modifiable cancer risk factors in the setting of rising rates of cancer in the region.[6 19 20 23] Herein, we report health insurance coverage and socioeconomic status in relation to health conditions, health expenditures, cancer screening assessment and provide a snapshot of the health needs and burden faced by individuals in the region.

METHODS

During April 2018, a cross-sectional study of community-based adults was conducted in Osun State, South-West Nigeria. Two rural towns Ijebu-Jesa and Ere-Jesa, (approximately 130 kilometers east of Ibadan, 250 km from Lagos, on latitude 7.45 degrees north within the rain forest belt), were selected at random. These towns were in proximity to Obafemi Awolowo University Teaching Hospital Complex, Ile-Ife, the

main tertiary referral center in the region. The study was approved by the Obafemi Awolowo University institutional ethics review committee.

Patient and Public Involvement

Prior to the study, local community leaders in the towns were contacted, and the goals of the research were explained. In the time leading up to the study, healthcare workers and community leaders notified and mobilized potential participants in the two communities. They were also involved in the design of the study and in disseminating the results to all participants. Adult participants were consecutively enrolled upon arrival at pre-designated locations (main town hall) in the two towns. Based on the resource capacity of each town hall and the size of each community, enrolment was to be capped at a maximum of 300 participants at Ijebu-Jesa and 100 at Ere-Jesa. All study participants received blood pressure checks, and health promotion talks were held for those waiting to be surveyed. Study participants were given a small stipend to cover their transportation costs to the study venue on the study day (300 Naira, ~80 US cents). This amount was determined by local healthcare workers.

After obtaining informed consent, the study participants underwent a 50-60 minute one-on-one, face-to-face survey conducted in the local Yoruba dialect by a trained research assistant. All research assistants underwent a two-day training program that involved education in the research aims, methodology, and ethics as well as interview techniques and the use of electronic tablets for recording data. The survey consisted of a questionnaire to gather quantitative data on demographics, health status, income, medical expenditures, dietary habits, physical activity, family history, screening history, medical history, reproductive history, primary healthcare visits, medication

use, and environmental exposures. Cancer screening activities in screen-eligible individuals included history of cervical examination and screening test in women >21 years, mammogram in women >40 years, and colonoscopy in all individuals >50 years. Because cervical cancer screening intervention was self-reported, screening could be by pap smear or visual inspection with acetic acid or Lugo's iodine (VIA/VILI). This could be conducted in a primary healthcare setting. Manual breast examination by a health care worker was not captured and therefore the assessed intervention evaluated management at local secondary and tertiary health care facilities. All of the assessed interventions were screening activities specified as part of the Nigerian National Cancer Control Plan 2018-2022. Medical expenses were defined as any 'major medical costs' as perceived by the study participant on direct questioning. This was clarified by recording the amount spent in Naira, and the medical reason for the expenditure was also documented. The questionnaire, developed in collaboration with local clinicians, epidemiologists, and nutritionists, was derived by adapting features from validated and/or widely implemented local or nationwide surveys. This included the Nigeria Demographic and Health Survey,[24] Nigeria General Household Survey,[25] World Health Organization-endorsed Global Physical Activity Questionnaire,[26] and the Nurses' Health Study questionnaire.[27-30] Demographic and socioeconomic data collected from our study population were compared to data from the Nigerian Demographic and Health Survey and the Oxford Poverty Health Indicator [31] [32] to assess external validity.

Statistical analysis

Data were summarized in the form of proportions and frequency tables for categorical variables. Continuous variables were summarized using mean, median, and standard deviation. Comparisons of discrete variables were computed using Fisher's exact test and multiple logistic regression. All analyses were conducted using SAS software version 9.4 (SAS Institute Inc., Cary, NC)

RESULTS

A total of 346 individuals were consecutively enrolled in the study and interviewed. Enrolment was capped at this number to ensure complete surveys could be conducted for all individuals. The demographic features of the group are presented in **Table 1**. The majority of participants were Yoruba speaking (n=332, 96%) and married (n=213, 62%) with a median age of 52 years. Females accounted for 75% of the cohort (n=261). Most individuals had some form of education, with 166 participants (48%) reporting more than primary school education. In addition, 30 participants (9%) reported being unemployed. Of female participants, 70% had ≥4 live births.

Table 1: Demographic characteristics of the study group (n=346)

(n=268 Ijebu-Jesa, n=68 Ere-Jesa)

Variable	n (%)
Median Age, years (range)	52 (18-100)
Sex	
Male	85 (24.6)
Female	261 (75.4)
Marital Status	
Single	27 (7.8)
Married	213 (61.6)
Other (Divorced/cohabiting)	106 (30.6)
Tribe	
Yoruba	332 (96.0)
Ibo	5 (1.4)

Religion	Other	9 (2.6)
	Christian	326 (94.2)
	Muslim	19 (5.5)
	Other	1 (0.3)
Education		
	No formal education	88 (25.4)
	Primary	92 (26.6)
	Secondary	92 (26.6)
	Vocational/Technical	45 (13.0)
	Higher	29 (8.4)
Occupation		
	Unemployed	30 (8.7)
	Civil servant	30 (8.7)
	Trader	123 (35.5)
	Farmer	35 (10.1)
	Self-employed	80 (23.1)
	Other	48 (13.9)
Number of Live Births (Females, n=242)		
	0	6 (2.5)
	1	15 (6.2)
	2	23 (9.5)
	3	28 (11.6)
	4	54 (22.3)
	5 or more	116 (47.9)

Overall, 155 participants (45%) had a personal monthly income of <10,000 Naira (~1 USD per day), and 134 individuals (76%) had a family monthly income of <50,000 Naira (140 USD per month) (**Table 2a**). In addition, 198 participants (57%) lived in a family home or owned an apartment. The majority of participants (92%) reported having access to electricity, and over 70% reported access to television (76%) or radio (73%).

To assess the comparability of our results to the general Nigerian population, we compared the data from our study population to that recorded in the Nigerian Demographic and Health Survey (**Table 2b**).[31] Both groups had similar degrees of

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education at the primary level for males and females, but overall there were fewer uneducated males and females within our surveyed population when compared to national averages. Our surveyed group also had better access to electricity, radio, and television compared to the national survey group (rural). When compared to equivalent parameters for Nigeria from the multi-dimensional poverty index (MPI) developed by the Oxford Poverty and Human Development Initiative,[32] our study population had similar levels of deprivation for years of schooling (defined as <6 years of school) and electricity (defined as no household electricity).

Table 2a: Income and household conditions

Variable	n (%)
Personal income (per month, in Naira)	
<10,000	155 (44.8)
10,000-49,999	139 (40.2)
50,000-99,999	26 (7.5)
100,000-249,999	16 (4.6)
250,000-499,999	9 (2.6)
≥500,000	1 (0.3)
Family income (per month, in Naira)	
<10,000	117 (33.8)
10,000-49,999	147 (42.5)
50,000-99,999	38 (11.0)
100,000-249,999	28 (8.1)
250,000-499,999	11 (3.2)
≥500,000	5 (1.4)
Type of dwelling	
Own apartment	131 (37.9)
Rent apartment	146 (42.2)
Family house	67 (19.4)
Other	2 (0.6)
Type of toilet	
Water system	151 (43.6)
Pit latrine	164 (47.4)
Bush	23 (6.6)
Bucket	7 (2.0)
Other	1 (0.3)
Water source	
Pipe borne/boreholes	185 (53.5)

Well	146 (42.2)
River	15 (4.3)
Appliances	
Electricity	318 (91.9)
Television	262 (75.7)
Radio	251 (72.5)
Refrigerator	154 (44.5)
Air conditioner	8 (2.3)
Generating set	99 (28.6)
Personal computer	38 (11.0)
None	18 (5.2)

Table 2b: Comparison between study sample characteristics and 2013 Nigerian National Demographic and Health Survey (NDHS)

	NDHS Urban (%)	NDHS Rural (%)	NDHS Total (%)	Current study (%)
Cooking Fuel				
Electricity	0.7	0.2	0.4	10.7
Liquefied petroleum gas/natural Gas/biogas	4.6	0.5	2.3	21.1
Kerosene	47.6	8.7	25.5	31.8
Charcoal	5.3	1.6	3.2	2.3
Wood	37.9	83.3	63.7	34.1
Electricity				
Yes	83.6	34.4	55.6	91.9
No	16.3	65.4	44.2	8.1
Missing	0.1	0.2	0.2	0
Household Appliances				
Radio	77.7	61.3	68.3	72.5
Television	73.2	28.2	47.6	75.7
Refrigerator	32.5	7.5	18.3	44.5
Means of Transportation				
Bicycle	12.7	18.3	18.3	0.9
Motorcycle/scooter	27.0	31.2	31.2	15.0
Car/truck	14.4	8.7	8.7	12.1
Education	NDHS Female (%)	NDHS Male (%)	Current study Female (%)	Current study Male (%)
No formal education	37.8	21.2	28.7	15.3
Primary	17.3	16.7	26.8	25.9
Secondary	35.8	47.7	28.0	22.4
More than secondary	9.1	14.3	16.5	36.5

Within the group surveyed, cancer screening/assessment activities were limited: 2% (4/267) of female participants had a previous cervical smear/assessment, and 3%

(6/182) of females >40 years had ever had a mammogram (**Table 3**). The prevalence of colonoscopy screening in those >50 years was 5% (9/200). In terms of healthcare access, 180 individuals (52%) had seen a primary healthcare doctor in the last year and were less likely to see a traditional healer during this period. Of all participants, 110 reported being diagnosed with hypertension (32%), but most individuals were not on daily hypertensive medication (n=324, 94%). The use of other medications for primary prevention of NCDs, such as aspirin and anti-cholesterol medications, was also infrequent.

Table 3: Screening activities, access to medical services, and health conditions

Variable	n (%)
Cancer screening	
Cervical Cancer assessment (if female > 21, n = 261)	4 (1.5)
Previous mammogram (if female >40, n = 183)	6 (3.3)
Previous colonoscopy (if >50 years, n = 190)	9 (4.5)
Last primary health care physician visit	
<1 year ago	180 (52.0)
1-4 years ago	93 (26.9)
5-10 years ago	32 (9.2)
>10 years ago	41 (11.8)
Last time seen traditional healer	
Never	254 (73.4)
<2 years ago	66 (19.1)
≥2 years ago	26 (7.5)
Hypertension	110 (31.8)
Diabetes	16 (4.6)
High cholesterol	24 (6.9)
Stroke	18 (5.2)
Alcohol use[+]	
No	227 (65.6)
Yes, drank in past, but quit	65 (18.8)
Yes, currently drink alcohol	54 (15.6)
Smoking status*	
Never	303 (87.6)
Ever	43 (12.4)
Medication use	

Reported anti-hypertensive use	78 (22.5)
Reported aspirin use	89 (25.7)
Reported anti-cholesterol use	7 (2.0)
Reported herbal supplement use	233 (67.3)
Oral contraceptive use	
Never	175 (67.0)
Past use	64 (24.5)
Current use	22 (8.4)

+ Participants were asked "Have you had 10 or more drinks of alcohol in your life?"
* Participants were asked "Have you smoked 5 packs of cigarettes (100) or more in your lifetime?"

Only 15 individuals out of 346 (4%) had medical insurance (**Table 4**). For the remaining uninsured participants, 66% reported that they were unaware that health insurance existed. A further 73 participants (22%) stated that insurance was too difficult to access. Despite this, nearly half of those surveyed (n=160, 46%) reported a major medical cost in the last year, with the majority from unforeseen events, such as acute illness, trauma, or surgery (58%). The costs incurred ranged from 5000-1,500,000 Naira, with a median of 10,000 Naira, an amount that is more than the monthly income for ~45% of individuals in this study. In addition, 52 participants (33%) reported that their major medical costs were for chronic conditions. Overall individuals, with incomes in the lowest brackets (<50,000 Naira), accounted for most of those that incurred major medical costs in the last two years (74.4%), had more visits to their primary care doctor in the year (75.6%), and higher levels of hypertension (80.4%).

Table 4: Insurance coverage and medical costs

Variable	n (%)
Insurance	
No	331 (95.7)
Yes	15 (4.3)
Last time used insurance	

In the last 2 years	6 (40.0)
>2 years ago	9 (60.0)
How many family members covered by insurance	
None	331 (95.7)
1-2	8 (2.3)
3-4	3 (0.9)
5 or more	4 (1.2)
Reasons for not having insurance (n=331)	
Expense	32 (9.7)
Lack of coverage	13 (3.9)
Too difficult to access	73 (22.1)
Other	217 (65.6)
Major medical costs in the last 2 years	
No	186 (53.8)
Yes	160 (46.2)
Estimated amount	
<10,000 Naira	73 (45.6)
10,000-49,000 Naira	38 (23.8)
50,000-99,999 Naira	16 (10.0)
>100,000 Naira	22 (13.8)
Unknown	11 (6.9)
Reasons for major medical costs (n=158)	
Surgery	17 (10.8)
Chronic conditions	52 (32.9)
Acute illness/trauma	74 (46.8)
Other/multiple reasons	15 (9.5)
Amount spent (continuous)	
Overall median (range)	10,000 (50-1,500,000)
Median amount spent by reason (range)	
Surgery	60,000 (7,000-150,000)
Chronic conditions	18,000 (500-150,000)
Acute illness/trauma	5,000 (50-400,000)
Other/multiple reasons	70,000 (800-500,000)

Within eligible populations, we performed analysis to look for the association between cancer screening activity and income, insurance status and education **Table 5**. Individuals with lower levels of income were less likely to have had cancer screening assessments. Cancer screening activity was more frequent in those with higher levels

of education. No significant relationship was observed by insurance status or other factors that were assessed. In a multivariate logistic regression model including personal income, insurance status and education, the only statistically significant odds ratio for association with cancer screening activity was observed for personal income (personal income OR 2.7 95%CI 1.3-5.7 p<0.01, education level OR 1.7 95%CI 0.98-2.7 p=0.06, insurance status OR 4.3 95%CI 0.8-23.1 p=0.09.

Table 5: Association between Cancer Screening Activity and Income, Insurance and Education N =310[+]

Variable	Cancer Screening (N=17)	No Cancer Screening (N=293)	P value*
Personal income (per month, in Naira)			
<10,000	2/138 (1.5)	140/138 (98.5)	
10,000-49,999	9/122 (7.4)	115/122 (92.6)	<0.01
>50,000	6/43 (14.0)	38/43 (86.0)	
Family income (per month, in Naira)			
<10,000	1/108 (0.9)	107/108 (99.1)	
10,000-49,999	8/129(6.2)	121/129(93.8)	<0.01
>50,000	8/66 (12.1)	58/66 (87.9)	
Insurance Status			
No	15/290 (5.2)	275/290 (94.8)	0.12
Yes	2/13 (15.4)	11/13 (84.6)	
Education			
No formal education	1/86 (1.2)	85/86 (98.8)	
Primary	3/83 (3.6)	80/83 (96.4)	0.04
Secondary	8/78 (10.3)	70/78 (89.7)	
Higher	5/56 (8.9)	51/56 (91.1)	

No association by Gender, Marital Status, Religion

[+] Adjusted for eligible population, whereby cancer screening activities defined as history of cervical assessment in women >21 years, mammogram in women >40 years, and colonoscopy in all individuals >50 years
* Fisher's exact test for association

DISCUSSION

We performed a cross-sectional community-based study in Osun state, Nigeria to provide a snapshot of the challenges faced in the management of NCDs in the region. This study was conducted with an emphasis on cancer within broader research aims of identifying risk factors (lifestyle, diet, biological) associated with the rising cancer incidence in the region. We observed that screening assessment for breast, cervical, and colon cancer (the major contributors to cancer morbidity in the region), [6] [19] [33] were extremely low. This observation was despite a median age of 52 years and a high representation of females. In addition, <5% of the surveyed population possessed universal health care in the form of health insurance. We also found low incomes, high fertility rates, and evidence of poorly controlled chronic diseases, such as hypertension, in our cohort. The rates are comparable to national averages (suggesting our sample sits between the urban/rural divide)[31] and likely represent broad health and development deficiencies present in the community.

Previous studies conducted in the region [34-42] have demonstrated that poor access to cancer services is associated with late presentation and high incidence/mortality ratio.[5] [43] This highlights a need to develop sound health infrastructure, whereby individuals can be screened for asymptomatic disease and also adequately access services in a timely fashion when symptomatic. Our study identifies that screening activities may be lacking and that the potential cost implications of accessing treatment when symptoms arise, in the absence of adequate health insurance, can be high. The experience from other sub-Saharan African nations suggests that individuals seeking cancer services face significant barriers to access.[35] [36] [44-47] The Nigerian "National Cancer Control Plan 2018-2022," specifically details goals to make screening services

and early detection of cancer available for all Nigerians, and to improve access to quality, cost-effective, and equitable diagnostic and treatment services for cancer care. This is centered around investment in eight public comprehensive cancer centers covering all geo-political zones, as well as the implementation of various screening strategies throughout different sectors of the healthsystem.[20]. Our results suggest that considerable work is required to reach the goal of "greater than 50% screening of 'eligible populations' by 2022."[20] We assessed cancer screening using measures that are recommended in this national plan. The methods we assessed are accessed at different levels of the healthcare system – cervical cancer assessment predominantly at a primary health care level, breast cancer at secondary/tertiary level through mammography, and colon cancer at tertiary level through colonoscopy. Our analysis provides some idea of how individuals have navigated health system and their degree of engagement different levels.

It is important to acknowledge that cancer screening in low and middle income countries requires measures tailored to local capacity and disease prevalence. For breast cancer, although mammography remains the gold standard for early detection of breast cancer, the Breast Health Global Initiative (BHGI) resource-stratified guidelines recommend clinical breast examination as a practical and necessary alternative for early detection in low-resource settings.[19 45 48] This has been recommended in local policy and was not assessed in the current study.[20] Despite this, with over 50 percent of individuals in this study visiting a primary health care doctor in the last year, our findings strongly support the need to concentrate cancer screening efforts at primary healthcare where possible through the use of similar interventions. Colon cancer screening by colonoscopy for those over the age of fifty

as recommended in high income countries does not exist in sufficient capacity for this to be recommended in an LMIC setting.[49] Efforts to intervene at primary healthcare level through the use of stool testing and symptom stratification are ongoing.[50] [51] Overall, education, training and adequately resourcing community healthcare workers and physicians at primary healthcare level for cancer screening assessment is essential.

We demonstrated that both income and medical expenditure relative to this level of income, compounded by the lack of universal health care coverage, must be factored into strategies laid out to address cancer control. The costs of the screening interventions assessed in this study relative to income, are prohibitive for the majority of individuals without government subsidy; approx. $50 US ~ $18000 Naira (for mammography), $15 US ~ $3000 Naira (cervical smear). This is compounded by the finding of only 4% of our cohort having health insurance coverage. In addition, major medical costs were incurred by over half of those interviewed, and a significant proportion of these costs were for chronic diseases (33%). Those individuals with the lowest income were more likely to report visits to the doctor, chronic disease, and significant "out of pocket" medical expenditures. The Nigerian national health insurance scheme (NHIS) has been in place since 2005. When it was introduced, state governments were instructed to adopt the program for their employees in the formal sector. After insuring government employees, state governments were instructed to expand coverage across all individuals with the goal of universal health coverage.[14] [15] Recent reports confirm that this expansion has been limited in Nigeria. In line with previous studies, our data indicate that the NHIS is severely underutilized in the community population.[15] [16] The state health insurance scheme has been instituted in

only 2 out of 36 states of the federation at community level and this has not been the case in Osun state where the study took place. [15]

We found wide range of "major" medical expenditure in our study group, with a median expenditure exceeding the monthly salary of ~45% of the group. It is important to note that we did not obtain information on total household expenditures to allow a relative assessment of the amount spent on medical costs, and, in turn, determine "catastrophic" costs.[16] However, based on income and demographic comparisons with other groups studied in the region, it is likely that catastrophic spending is high.[52] Further research into how the money to cover medical expenditure is generated (i.e., personal savings, family savings, loans, etc.) is required. Taken together with prior work in the region [53] [54], it is evident that risk pooling and financial risk protection are required for the provision of preventative and therapeutic NCD health services.

Whilst we did not directly assess awareness of cancer screening, we did demonstrate an association between cancer screening activity and education level. Levels of education have been associated with awareness and accessing cancer services in previous studies.[35] [42] [44] [55] In addition to this, we also found that ~75% of participants had access to radio and/or television within family and social networks, suggesting that mass communication channels to promote health awareness exist. In fact, these facilitated the current study when combined with strategies using mobile phone technologies. More broadly, these channels represent promising avenues to promote health and prevention of disease in the region.[56] In addition, "demand-side" approaches to resource allocation, such as the stipend we provided for travel in the

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study or e-vouchers,[57] [58] are likely to be well received by the community and may promote uptake of health-screening activities.

A strength of this study is that it was performed within the community and involved trained research staff fluent in the local dialect and used a validated questionnaire. The study was performed in conjunction with local community healthcare workers and the tertiary referral hospital, which was intended to help residents develop an awareness of how and where healthcare can be accessed in the area and to establish a sustained relationship with this community. Limitations of this work include the potential for misclassification and recall bias, as we relied on individuals to retrospectively describe their own health and socioeconomic status as well as their interactions with healthcare services. In addition, while the study sample was chosen at random and consecutive individuals were enrolled, the survey was conducted at a single time that was mid-week, during the day; this timing may have affected our sample composition (e.g., resulted in more females than males). Nevertheless, overall consistency with national demographic indicators (e.g., income, education, and living conditions) indicates that our sample is likely reflective of rural community-dwelling individuals in the wider region.[31] [32]

In summary, our results highlight infrequent cancer screening activities in a Nigerian community population and identifies areas that can be targeted to address this, including the use of measures focused at primary healthcare level, financial risk protection, awareness, and strategic resource allocation.

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REFERENCES

1. Niessen LW, Mohan D, Akuoku JK, et al. Tackling socioeconomic inequalities and non-communicable diseases in low-income and middle-income countries under the Sustainable Development agenda. *Lancet* 2018;391(10134):2036-46. doi: 10.1016/s0140-6736(18)30482-3 [published Online First: 2018/04/09]

2. Ezzati M, Pearson-Stuttard J, Bennett JE, et al. Acting on non-communicable diseases in low- and middle-income tropical countries. *Nature* 2018;559(7715):507-16. doi: 10.1038/s41586-018-0306-9 [published Online First: 2018/07/27]

3. NCD Countdown 2030: worldwide trends in non-communicable disease mortality and progress towards Sustainable Development Goal target 3.4. *Lancet* 2018;392(10152):1072-88. doi: 10.1016/s0140-6736(18)31992-5 [published Online First: 2018/09/29]

4. GLOBOCAN 2018: counting the toll of cancer. *Lancet* 2018;392(10152):985. doi: 10.1016/s0140-6736(18)32252-9 [published Online First: 2018/09/29]

5. Bray F, Ferlay J, Soerjomataram I, et al. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: A Cancer Journal for Clinicians* 2018;68(6):394-424. doi: 10.3322/caac.21492

6. Olaleye O, Ekrikpo U. Epidemiology of Cancers in Sub-Saharan Africa. In: Adedeji OA, ed. Cancer in Sub-Saharan Africa: Current Practice and Future. Cham: Springer International Publishing 2017:3-19.

7. Mostert S, Njuguna F, Olbara G, et al. Corruption in health-care systems and its effect on cancer care in Africa. *Lancet Oncol* 2015;16(8):e394-404. doi: 10.1016/s1470-2045(15)00163-1 [published Online First: 2015/08/08]

8. Harford JB. Barriers to overcome for effective cancer control in Africa. *Lancet Oncol* 2015;16(8):e385-93. doi: 10.1016/s1470-2045(15)00160-6 [published Online First: 2015/08/08]

9. Transforming our world : the 2030 Agenda for Sustainable Development: UN General Assembly; 21 October 2015 [Available from: https://www.undp.org/content/undp/en/home/sustainable-development-goals.html accessed 23 August 2019.

10. Douthit NT, Alemu HK. Social determinants of health: poverty, national infrastructure and investment. *BMJ Case Reports* 2016;2016:bcr2016215670. doi: 10.1136/bcr-2016-215670

11. Attia-Konan AR, Oga ASS, Touré A, et al. Distribution of out of pocket health expenditures in a sub-Saharan Africa country: evidence from the national survey of household standard of living, Côte d'Ivoire. *BMC Res Notes* 2019;12(1):25. doi: 10.1186/s13104-019-4048-z [published Online First: 2019/01/17]

12. Leive A, Xu K. Coping with out-of-pocket health payments: empirical evidence from 15 African countries. *Bull World Health Organ* 2008;86(11):849-56. doi: 10.2471/blt.07.049403 [published Online First: 2008/11/26]

13. Xu K, Evans DB, Kawabata K, et al. Household catastrophic health expenditure: a multicountry analysis. *Lancet* 2003;362(9378):111-7. doi: 10.1016/s0140-6736(03)13861-5 [published Online First: 2003/07/18]

14. Onoka CA, Onwujekwe OE, Uzochukwu BS, et al. Promoting universal financial protection: constraints and enabling factors in scaling-up coverage with social health insurance in Nigeria. *Health Res Policy Syst* 2013;11:20. doi: 10.1186/1478-4505-11-20 [published Online First: 2013/06/15]

15. Uzochukwu BS, Ughasoro MD, Etiaba E, et al. Health care financing in Nigeria: Implications for achieving universal health coverage. *Niger J Clin Pract* 2015;18(4):437-44. doi: 10.4103/1119-3077.154196 [published Online First: 2015/05/15]

16. Aregbeshola BS, Khan SM. Out-of-Pocket Payments, Catastrophic Health Expenditure and Poverty Among Households in Nigeria 2010. *Int J Health Policy Manag* 2018;7(9):798-806. doi: 10.15171/ijhpm.2018.19 [published Online First: 2018/10/15]

17. Jedy-Agba E, Curado MP, Ogunbiyi O, et al. Cancer incidence in Nigeria: a report from population-based cancer registries. *Cancer Epidemiol* 2012;36(5):e271-8. doi: 10.1016/j.canep.2012.04.007 [published Online First: 2012/05/25]

18. Awodele O, Adeyomoye AA, Awodele DF, et al. Cancer distribution pattern in south-western Nigeria. *Tanzan J Health Res* 2011;13(2):125-31. doi: 10.4314/thrb.v13i2.55226 [published Online First: 2011/04/01]

19. Ishola F, Omole O. A vision for improved cancer screening in Nigeria. *Lancet Glob Health* 2016;4(6):e359-60. doi: 10.1016/s2214-109x(16)30062-6 [published Online First: 2016/05/21]

20. Nigeria National Cancer Control Plan 2018 – 2022. Abuja: Federal Ministry of Health, Nigeria 2018.

21. World Bank staff estimates based on the United Nations Population Division's World Urbanization Prospects: 2018 Revision: The World Bank Group; [Available from: https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS accessed November 2019.

22. Kingham TP, Alatise OI. Establishing Translational and Clinical Cancer Research Collaborations Between High- and Low-Income Countries. *Annals of Surgical Oncology* 2015;22(3):741-46. doi: 10.1245/s10434-014-4342-x

23. Irabor DO. Emergence of Colorectal Cancer in West Africa: Accepting the Inevitable. *Niger Med J* 2017;58(3):87-91. doi: 10.4103/0300-1652.234076 [published Online First: 2017/05/01]

24. National Population Commission (NPC) [Nigeria] and ICF International. 2014. Nigeria Demographic and Health Survey 2013. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF International. https://dhsprogram.com/pubs/pdf/fr293/fr293.pdf (Accessed February 14, 2018).

25. National Bureau of Statistics (NBS) - Federal Government of Nigeria. Nigeria - General Household Survey, Panel 2015-2016, Wave 3. http://microdata.worldbank.org/index.php/catalog/2734/study-description (Accessed February 15, 2018).

26. Cleland CL, Hunter RF, Kee F, et al. Validity of the global physical activity questionnaire (GPAQ) in assessing levels and change in moderate-vigorous physical activity and sedentary behaviour. *BMC Public Health* 2014;14:1255. doi: 10.1186/1471-2458-14-1255 [published Online First: 2014/12/11]

27. Colditz GA, Manson JE, Hankinson SE. The Nurses' Health Study: 20-year contribution to the understanding of health among women. *J Womens Health* 1997;6(1):49-62.

28. Hu FB, Satija A, Rimm EB, et al. Diet Assessment Methods in the Nurses' Health Studies and Contribution to Evidence-Based Nutritional Policies and Guidelines. *American*

journal of public health 2016;106(9):1567-72. doi: 10.2105/AJPH.2016.303348 [published Online First: 2016/07/28]

29. Willett WC, Sampson L, Stampfer MJ, et al. REPRODUCIBILITY AND VALIDITY OF A SEMIQUANTITATIVE FOOD FREQUENCY QUESTIONNAIRE. *American Journal of Epidemiology* 1985;122(1):51-65. doi: 10.1093/oxfordjournals.aje.a114086

30. Wolf AM, Hunter DJ, Colditz GA, et al. Reproducibility and Validity of a Self-Administered Physical Activity Questionnaire. *International Journal of Epidemiology* 1994;23(5):991-99. doi: 10.1093/ije/23.5.991

31. Nigeria Demographic and Health Survey. Abuja, Nigeria: National Population Commission, Federal Republic of Nigeria, June 2014.

32. "Nigeria Country Briefing", Multidimensional Poverty Index Data Bank: Oxford Poverty and Human Development Initiative, University of Oxford.; 2017 [Available from: www.ophi.org.uk/multidimensional-poverty-index/mpi-country-briefings/. accessed August 2019 2019.

33. Morhason-Bello IO, Odedina F, Rebbeck TR, et al. Challenges and opportunities in cancer control in Africa: a perspective from the African Organisation for Research and Training in Cancer. *Lancet Oncol* 2013;14(4):e142-51. doi: 10.1016/s1470-2045(12)70482-5 [published Online First: 2013/04/09]

34. Olasehinde O, Alatise OI, Arowolo OA, et al. Barriers to mammography screening in Nigeria: A survey of two communities with different access to screening facilities. *Eur J Cancer Care (Engl)* 2019;28(2):e12986. doi: 10.1111/ecc.12986 [published Online First: 2019/01/08]

35. McKenzie F, Zietsman A, Galukande M, et al. Breast cancer awareness in the sub-Saharan African ABC-DO cohort: African Breast Cancer—Disparities in Outcomes study. *Cancer Causes & Control* 2018;29(8):721-30. doi: 10.1007/s10552-018-1047-7

36. Makau-Barasa LK, Greene SB, Othieno-Abinya NA, et al. Improving Access to Cancer Testing and Treatment in Kenya. *Journal of Global Oncology* 2018(4):1-8. doi: 10.1200/jgo.2017.010124

37. Ugwumba FO, Ekwueme OE, Okoh AD. Testicular Cancer and Testicular Self-Examination; Knowledge, Attitudes and Practice in Final Year Medical Students in Nigeria. *Asian Pac J Cancer Prev* 2016;17(11):4999-5003. doi: 10.22034/apjcp.2016.17.11.4999 [published Online First: 2016/12/30]

38. Mbamara SU, Ikpeze OC, Okonkwo JE, et al. Knowledge, attitude and practice of cervical cancer screening among women attending gynecology clinics in a tertiary level medical care center in southeastern Nigeria. *J Reprod Med* 2011;56(11-12):491-6. [published Online First: 2011/12/27]

39. Wright KO, Kuyinu YA, Faduyile FA. Community education on cervical cancer amongst market women in an urban area of Lagos, Nigeria. *Asian Pac J Cancer Prev* 2010;11(1):137-40. [published Online First: 2010/07/03]

40. Aniebue PN, Aniebue UU. Awareness and practice of cervical cancer screening among female undergraduate students in a Nigerian university. *J Cancer Educ* 2010;25(1):106-8. doi: 10.1007/s13187-009-0023-z [published Online First: 2010/01/19]

41. Ajape AA, Babata A, Abiola OO. Knowledge of prostate cancer screening among native African urban population in Nigeria. *Nig Q J Hosp Med* 2010;20(2):94-6. [published Online First: 2011/01/20]

42. Obiechina NJ, Mbamara SU. Knowledge attitude and practice of cervical cancer screening among sexually active women in Onitsha, southeast Nigeria. *Niger J Med* 2009;18(4):384-7. [published Online First: 2010/02/03]

43. Kontis V, Mathers CD, Bonita R, et al. Regional contributions of six preventable risk factors to achieving the 25 x 25 non-communicable disease mortality reduction target: a modelling study. *Lancet Glob Health* 2015;3(12):e746-57. doi: 10.1016/s2214-109x(15)00179-5 [published Online First: 2015/10/27]

44. Tiruneh FN, Chuang KY, Ntenda PAM, et al. Individual-level and community-level determinants of cervical cancer screening among Kenyan women: a multilevel analysis of a Nationwide survey. *BMC Womens Health* 2017;17(1):109. doi: 10.1186/s12905-017-0469-9 [published Online First: 2017/11/17]

45. Masalu N, Serra P, Amadori D, et al. Setting up a community-based cervical screening service in a low-income country: a pilot study from north-western Tanzania. *International Journal of Public Health* 2017;62(7):755-62. doi: 10.1007/s00038-017-0971-8

46. Kangmennaang J, Mkandawire P, Luginaah I. Breast cancer screening among women in Namibia: explaining the effect of health insurance coverage and access to information on screening behaviours. *Glob Health Promot* 2017:1757975917727017. doi: 10.1177/1757975917727017 [published Online First: 2017/09/26]

47. Stulac S, Binagwaho A, Tapela NM, et al. Capacity building for oncology programmes in sub-Saharan Africa: the Rwanda experience. *Lancet Oncol* 2015;16(8):e405-13. doi: 10.1016/s1470-2045(15)00161-8 [published Online First: 2015/08/08]

48. Anderson BO, Yip CH, Smith RA, et al. Guideline implementation for breast healthcare in low-income and middle-income countries: overview of the Breast Health Global Initiative Global Summit 2007. *Cancer* 2008;113(8 Suppl):2221-43. doi: 10.1002/cncr.23844 [published Online First: 2008/09/26]

49. Knapp GC, Alatise OI, Olasehinde OO, et al. Is Colorectal Cancer Screening Appropriate in Nigeria? *J Glob Oncol* 2019;5:1-10. doi: 10.1200/jgo.19.00035 [published Online First: 2019/06/07]

50. Alatise OI, Ayandipo OO, Adeyeye A, et al. A symptom-based model to predict colorectal cancer in low-resource countries: Results from a prospective study of patients at high risk for colorectal cancer. *Cancer* 2018;124(13):2766-73. doi: 10.1002/cncr.31399 [published Online First: 2018/04/13]

51. Knapp GC, Sharma A, Olopade B, et al. An Exploratory Analysis of Fecal Immunochemical Test Performance for Colorectal Cancer Screening in Nigeria. *World J Surg* 2019;43(11):2674-80. doi: 10.1007/s00268-019-05100-0 [published Online First: 2019/08/14]

52. Olugbenga-Bello A, Adebimpe W. Knowledge and attitude of civil servants in Osun state, Southwestern Nigeria towards the national health insurance. *Nigerian Journal of Clinical Practice* 2010;13(4):421-26.

53. Dieleman JL, Sadat N, Chang AY, et al. Trends in future health financing and coverage: future health spending and universal health coverage in 188 countries, 2016–40. *The Lancet* 2018;391(10132):1783-98. doi: https://doi.org/10.1016/S0140-6736(18)30697-4

54. Dieleman J, Campbell M, Chapin A, et al. Evolution and patterns of global health financing 1995–2014: development assistance for health, and government, prepaid private, and

out-of-pocket health spending in 184 countries. *The Lancet* 2017;389(10083):1981-2004. doi: https://doi.org/10.1016/S0140-6736(17)30874-7

55. Alatise OI, Fischer SE, Ayandipo OO, et al. Health-Seeking Behavior and Barriers to Care in Patients With Rectal Bleeding in Nigeria. *Journal of global oncology* 2017;3(6):749-56. doi: 10.1200/JGO.2016.006601 [published Online First: 2017/02/01]

56. Yang Q, Van Stee SK. The Comparative Effectiveness of Mobile Phone Interventions in Improving Health Outcomes: Meta-Analytic Review. *JMIR Mhealth Uhealth* 2019;7(4):e11244. doi: 10.2196/11244 [published Online First: 2019/04/04]

57. Erwin E, Aronson KJ, Day A, et al. SMS behaviour change communication and eVoucher interventions to increase uptake of cervical cancer screening in the Kilimanjaro and Arusha regions of Tanzania: a randomised, double-blind, controlled trial of effectiveness. *BMJ Innovations* 2019:bmjinnov-2018-000276. doi: 10.1136/bmjinnov-2018-000276

58. Hurst TE, Semrau K, Patna M, et al. Demand-side interventions for maternal care: evidence of more use, not better outcomes. *BMC Pregnancy Childbirth* 2015;15:297. doi: 10.1186/s12884-015-0727-5 [published Online First: 2015/11/17]

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Healthcare utilization, cancer screening and potential barriers to accessing cancer care in Rural South-West Nigeria: A cross-sectional study.

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Healthcare utilization, cancer screening and potential barriers to accessing cancer care in Rural South-West Nigeria: A cross-sectional study.

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Conflicts of Interest: None to declare

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ABSTRACT

Background/Aims: Cancer burden is predicted to double by 2030 in sub-Saharan Africa. Accordingly, access to healthcare services for cancer management has been made a priority in the region. In Nigeria, the National Cancer Control Plan aims to ensure greater than 50% cancer screening of eligible populations by 2022 for all Nigerians. This study sought to describe current healthcare utilization, cancer screening activities and potential barriers to accessing cancer care within a rural community-based adult population in South-West Nigeria.

Methods: During April 2018, a cross-sectional study of community-based adults (>18 years) was conducted approximately 130 kilometers east of Ibadan, 250 km from Lagos in Osun State, South-West Nigeria. Participants completed a face-to-face survey in local dialect. A questionnaire was used to assess demographics, health status, income, medical expenditures, doctor visits, and cancer screening history.

Results: A total of 346 individuals were enrolled; the median age was 52 years, and 75% of participants were female. Of the entire cohort, only 4% had medical insurance,. 46% reported a major medical cost in the last year. Cancer screening activities were infrequent, with 1.5% of participants reporting having cervical cancer screening and 3.3% of participants >40 years having a mammogram. Colonoscopy screening in those >50 years was 5%. Cancer screening assessment was less frequent in those with less income and lower levels of education. Despite this, we observed that most individuals had contact with a primary health care doctor (52% in the last year), and over 70% access to radio and TV suggesting the opportunity to expand community-based screening interventions and awareness exist.

Conclusions: Despite expected increases in cancer cases, our data highlight a deficiency in cancer screening and lack of universal healthcare coverage within a

community-based adult Nigerian population. Increasing financial risk protection, awareness, and targeted resource allocation may help expand access.

Strengths and Limitations of the study:

1) The study provided a contemporary perspective potential barriers to accessing medical and cancer care in rural South-West Nigeria. Recruitment and data collection performed by interviewers fluent in the local dialect who underwent a systematic and rigorous two-day training program.

2) Questionnaire tailored to the local population and developed in collaboration with local clinicians, epidemiologists, and nutritionists. Questionnaire items derived by adapting features from validated and/or widely implemented local or nationwide surveys.

3) Study conducted in conjunction with local community healthcare workers and the regional tertiary referral hospital to help build capacity, increase healthcare awareness, and establish a sustained relationship with these rural communities.

4) Potential for measurement error or recall bias, as we relied on individuals to retrospectively describe their own health and socioeconomic status as well as their interactions with healthcare services.

5) Survey conducted at a single time (mid-week, during the day) in two geographic locations, which may have affected sample composition (e.g., more females than males).

INTRODUCTION

The burden of non-communicable disease (NCD), in particular cancer, in sub-Saharan Africa is well documented.[1-3] According to recent International Agency for Research on Cancer GLOBOCAN estimates, by 2030, 75% of new cancer cases will be within low and middle-income countries.[4 5] In sub-Saharan Africa, despite the fact that cancer burden is predicted to double by 2030, the entire region accounts for <1% of worldwide medical cancer expenditures.[6-8] Central to addressing the growing burden of cancer in sub-Saharan Africa is the need to improve access to cancer care services for screening, prevention, and treatment.[9]

NCDs, including cancer, threaten to overwhelm fragile health systems in sub-Saharan Africa and lead to dramatic rises in health and social care costs in the near-term.[7 10] In the region, out-of-pocket health expenditures are a major contributor to poverty [11-13], and a lack of adequate social protection has the potential to drive families and individuals further into poverty. In Nigeria, universal healthcare coverage in the form of the National Health Insurance Scheme (NHIS) was implemented in 2005, with an overarching goal of universal health coverage for all Nigerians.[14] However, uptake has been limited and restricted,[15] and as a result, the large majority of Nigerians still face significant financial burden when healthcare needs arise.[15 16]

In Nigeria cancer incidence and mortality is increasing and women have a higher cancer incidence than men.[17] The most common forms of cancer in Nigeria are breast and cervical, with these accounting for over 50 percent of cancer deaths.[17-19] Regionally, the need to improve access to cancer services for early detection has been recognised, with a focus on these cancers. In 2018, Nigeria launched the "National

Cancer Control Plan 2018-2022," with the goal to make screening services available for all Nigerians, and at least "greater than 50% screening of all eligible populations by 2022."[20] Despite this, the current state of cancer screening activities and barriers to care in this region (esp. rural areas) are not well-defined or documented. This gap limits our ability to define actionable steps towards improving access and achieving the established screening goal. National programmes for screening breast and cervical cancer are lacking. Typically, screening interactions occur at primary health care facilities or community health clinics – often for women when they are being seen during pregnancy or for other related health issues such as immunisations. Screening services for cervical and breast cancer have been implemented sporadically by both government and non-government organisations but predominantly in urban areas. The overwhelming majority of individuals in the region are symptomatic when they present with disease. With 50 percent of Nigeria's population living in rural areas[21] we hypothesize that unique challenges may exist for individuals in these communities, where nationwide initiatives may have limited reach.

This study aimed to describe potential barriers to accessing cancer care within a rural community-based adult population in South-West Nigeria. This study was performed as part of a broader community-based capacity building project in South-West Nigeria[22] investigating potentially modifiable cancer risk factors in the setting of rising rates of cancer in the region.[6 19 20 23] Herein, we report health insurance coverage and socioeconomic status in relation to health conditions, health expenditures, cancer screening assessment and provide a snapshot of the health needs and burden faced by individuals in the region.

METHODS

Study Design/Setting

During April 2018, a cross-sectional study of community-based adults was conducted in Osun State, South-West Nigeria. Two rural towns Ijebu-Jesa and Ere-Jesa, (approximately 130 kilometers east of Ibadan, 250 km from Lagos, on latitude 7.45 degrees north within the rain forest belt), were selected at random. These towns were in proximity to Obafemi Awolowo University Teaching Hospital Complex, Ile-Ife, the main tertiary referral center in the region. This study was part of a broader capacity building project in the region to improve cancer care. It was a baseline study to assess access to cancer services but also explore unique risk factors for cancer – such as diet, exercise, microbial and environmental exposures. The study was approved by the Obafemi Awolowo University institutional ethics review committee.

Patient and Public Involvement

Prior to the study, local community leaders in the towns were contacted, and the goals of the research were explained. In the time leading up to the study, healthcare workers and community leaders notified and mobilized all potential participants in the two communities. They were also involved in the design of the study and in disseminating the results to all participants. Participants were notified of the study through discussion at the weekly local community meetings in the month leading up to the study, advertisements on local radio-stations and through community workers visiting regional sites.

Participants

Adults >18 years in the two towns were invited to participate. Adult participants were consecutively enrolled upon arrival at pre-designated locations (main town hall) in the two towns. Based on the resource capacity of each town hall and the size of each community, enrolment was to be capped at a maximum of 300 participants at Ijebu-Jesa and 100 at Ere-Jesa. All study participants received blood pressure checks, and health promotion talks were held for those waiting to be surveyed. Study participants were given a small stipend to cover their transportation costs to the study venue on the study day (300 Naira, ~80 US cents). This amount was determined by local healthcare workers.

Questionnaire

The survey consisted of a questionnaire to gather quantitative data on demographics, health status, income, medical expenditures, dietary habits, physical activity, family history, screening history, medical history, reproductive history, primary healthcare visits, medication use, and environmental exposures. The questionnaire used was developed in collaboration with local clinicians, epidemiologists, and nutritionists, and was derived by adapting features from validated and/or widely implemented local or nationwide surveys. This included the Nigeria Demographic and Health Survey,[24] Nigeria General Household Survey,[25] World Health Organization-endorsed Global Physical Activity Questionnaire,[26] and the Nurses' Health Study questionnaire.[27-30]

Data collection

After obtaining informed consent, the study participants underwent a 50-60 minute one-on-one, face-to-face survey conducted in the local Yoruba dialect by a trained

research assistant. All research assistants underwent a two-day training program that involved education into the research aims, methodology, and ethics as well as interview techniques through role paying exercies, pilot testing of the questionnaire and the use of electronic tablets for recording data.

Outcome measures

Cancer screening activities in screen-eligible individuals included history of cervical examination and screening test in women >21 years, mammogram in women >40 years, and colonoscopy in all individuals >50 years. Because cervical cancer screening intervention was self-reported, screening could be by pap smear or visual inspection with acetic acid or Lugo's iodine (VIA/VILI). This could be conducted in a primary healthcare setting. Manual breast examination by a health care worker was not captured and therefore the assessed intervention evaluated management at local secondary and tertiary health care facilities. All of the assessed interventions were screening activities specified as part of the Nigerian National Cancer Control Plan 2018-2022. Medical expenses were defined as any 'major medical costs' as perceived by the study participant on direct questioning. This was clarified by recording the amount spent in Naira, and the medical reason for the expenditure was also documented. Demographic and socioeconomic data collected from our study population were compared to data from the Nigerian Demographic and Health Survey and the Oxford Poverty Health Indicator [31] [32] to assess external validity.

Statistical analysis

Data were summarized in the form of proportions and frequency tables for categorical variables. Continuous variables were summarized using mean, median, and standard

deviation. Comparisons of discrete variables were computed using Fisher's exact test and multiple logistic regression. Missing data were not possible for completed questionnaires as only complete responses to questions could be processed in order to advance the survey on the electronic tablets. All analyses were conducted using SAS software version 9.4 (SAS Institute Inc., Cary, NC)

RESULTS

A total of 346 individuals were consecutively enrolled in the study and interviewed. Enrolment was capped at this number to ensure complete surveys could be conducted for all individuals. All individuals that were interviewed provided data for analysis. The demographic features of the group are presented in **Table 1**. The majority of participants were Yoruba speaking (n=332, 96%) and married (n=213, 62%) with a median age of 52 years. Females accounted for 75% of the cohort (n=261). Most individuals had some form of education, with 166 participants (48%) reporting more than primary school education. In addition, 30 participants (9%) reported being unemployed. Of female participants, 70% had ≥4 live births.

Table 1: Demographic characteristics of the study group (n=346)

(n=268 Ijebu-Jesa, n=68 Ere-Jesa)

Variable	n (%)
Median Age, years (range)	52 (18-100)
Sex	
Male	85 (24.6)
Female	261 (75.4)
Marital Status	
Single	27 (7.8)
Married	213 (61.6)
Other (Divorced/cohabiting)	106 (30.6)
Tribe	

	Yoruba	332 (96.0)
	Ibo	5 (1.4)
	Other	9 (2.6)
Religion		
	Christian	326 (94.2)
	Muslim	19 (5.5)
	Other	1 (0.3)
Education		
	No formal education	88 (25.4)
	Primary	92 (26.6)
	Secondary	92 (26.6)
	Vocational/Technical	45 (13.0)
	Higher	29 (8.4)
Occupation		
	Unemployed	30 (8.7)
	Civil servant	30 (8.7)
	Trader	123 (35.5)
	Farmer	35 (10.1)
	Self-employed	80 (23.1)
	Other	48 (13.9)
Number of Live Births (Females, n=242)		
	0	6 (2.5)
	1	15 (6.2)
	2	23 (9.5)
	3	28 (11.6)
	4	54 (22.3)
	5 or more	116 (47.9)

Overall, 155 participants (45%) had a personal monthly income of <10,000 Naira (~1 USD per day), and 134 individuals (76%) had a family monthly income of <50,000 Naira (140 USD per month) (**Table 2a**). In addition, 198 participants (57%) lived in a family home or owned an apartment. The majority of participants (92%) reported having access to electricity, and over 70% reported access to television (76%) or radio (73%).

To assess the comparability of our results to the general Nigerian population, we compared the data from our study population to that recorded in the Nigerian

Demographic and Health Survey (**Table 2b**).[31] Both groups had similar degrees of education at the primary level for males and females, but overall there were fewer uneducated males and females within our surveyed population when compared to national averages. Our surveyed group also had better access to electricity, radio, and television compared to the national survey group (rural). When compared to equivalent parameters for Nigeria from the multi-dimensional poverty index (MPI) developed by the Oxford Poverty and Human Development Initiative,[32] our study population had similar levels of deprivation for years of schooling (defined as <6 years of school) and electricity (defined as no household electricity).

Table 2a: Income and household conditions

Variable	n (%)
Personal income (per month, in Naira)	
<10,000	155 (44.8)
10,000-49,999	139 (40.2)
50,000-99,999	26 (7.5)
100,000-249,999	16 (4.6)
250,000-499,999	9 (2.6)
≥500,000	1 (0.3)
Family income (per month, in Naira)	
<10,000	117 (33.8)
10,000-49,999	147 (42.5)
50,000-99,999	38 (11.0)
100,000-249,999	28 (8.1)
250,000-499,999	11 (3.2)
≥500,000	5 (1.4)
Type of dwelling	
Own apartment	131 (37.9)
Rent apartment	146 (42.2)
Family house	67 (19.4)
Other	2 (0.6)
Type of toilet	
Water system	151 (43.6)
Pit latrine	164 (47.4)
Bush	23 (6.6)
Bucket	7 (2.0)
Other	1 (0.3)

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Water source

Pipe borne/boreholes	185 (53.5)
Well	146 (42.2)
River	15 (4.3)

Appliances

Electricity	318 (91.9)
Television	262 (75.7)
Radio	251 (72.5)
Refrigerator	154 (44.5)
Air conditioner	8 (2.3)
Generating set	99 (28.6)
Personal computer	38 (11.0)
None	18 (5.2)

Table 2b: Comparison between study sample characteristics and 2013 Nigerian National Demographic and Health Survey (NDHS)

	NDHS Urban (%)	NDHS Rural (%)	NDHS Total (%)	Current study (%)
Cooking Fuel				
Electricity	0.7	0.2	0.4	10.7
Liquefied petroleum gas/natural Gas/biogas	4.6	0.5	2.3	21.1
Kerosene	47.6	8.7	25.5	31.8
Charcoal	5.3	1.6	3.2	2.3
Wood	37.9	83.3	63.7	34.1
Electricity				
Yes	83.6	34.4	55.6	91.9
No	16.3	65.4	44.2	8.1
Missing	0.1	0.2	0.2	0
Household Appliances				
Radio	77.7	61.3	68.3	72.5
Television	73.2	28.2	47.6	75.7
Refrigerator	32.5	7.5	18.3	44.5
Means of Transportation				
Bicycle	12.7	18.3	18.3	0.9
Motorcycle/scooter	27.0	31.2	31.2	15.0
Car/truck	14.4	8.7	8.7	12.1

Education	NDHS Female (%)	NDHS Male (%)	Current study Female (%)	Current study Male (%)
No formal education	37.8	21.2	28.7	15.3
Primary	17.3	16.7	26.8	25.9
Secondary	35.8	47.7	28.0	22.4
More than secondary	9.1	14.3	16.5	36.5

Within the group surveyed, cancer screening/assessment activities were limited: 2% (4/267) of female participants had a previous cervical smear/assessment, and 3% (6/182) of females >40 years had ever had a mammogram (**Table 3**). The prevalence of colonoscopy screening in those >50 years was 5% (9/200). In terms of healthcare access, 180 individuals (52%) had seen a primary healthcare doctor in the last year and were less likely to see a traditional healer during this period. Of all participants, 110 reported being diagnosed with hypertension (32%), but most individuals were not on daily hypertensive medication (n=324, 94%). The use of other medications for primary prevention of NCDs, such as aspirin and anti-cholesterol medications, was also infrequent.

Table 3: Screening activities, access to medical services, and health conditions

Variable	n (%)
Cancer screening	
Cervical Cancer assessment (if female > 21, n = 261)	4 (1.5)
Previous mammogram (if female >40, n = 183)	6 (3.3)
Previous colonoscopy (if >50 years, n = 190)	9 (4.5)
Last primary health care physician visit	
<1 year ago	180 (52.0)
1-4 years ago	93 (26.9)
5-10 years ago	32 (9.2)
>10 years ago	41 (11.8)
Last time seen traditional healer	
Never	254 (73.4)
<2 years ago	66 (19.1)
≥2 years ago	26 (7.5)
Hypertension	110 (31.8)
Diabetes	16 (4.6)
High cholesterol	24 (6.9)
Stroke	18 (5.2)
Alcohol use[+]	
No	227 (65.6)
Yes, drank in past, but quit	65 (18.8)
Yes, currently drink alcohol	54 (15.6)

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Smoking status*

Never	303 (87.6)
Ever	43 (12.4)

Medication use

Reported anti-hypertensive use	78 (22.5)
Reported aspirin use	89 (25.7)
Reported anti-cholesterol use	7 (2.0)
Reported herbal supplement use	233 (67.3)
Oral contraceptive use	
Never	175 (67.0)
Past use	64 (24.5)
Current use	22 (8.4)

⁺ Participants were asked "Have you had 10 or more drinks of alcohol in your life?"
* Participants were asked "Have you smoked 5 packs of cigarettes (100) or more in your lifetime?"

Only 15 individuals out of 346 (4%) had medical insurance (**Table 4**). For the remaining uninsured participants, 66% reported that they were unaware that health insurance existed. A further 73 participants (22%) stated that insurance was too difficult to access. Despite this, nearly half of those surveyed (n=160, 46%) reported a major medical cost in the last year, with the majority from unforeseen events, such as acute illness, trauma, or surgery (58%). The costs incurred ranged from 5000-1,500,000 Naira, with a median of 10,000 Naira, an amount that is more than the monthly income for ~45% of individuals in this study. In addition, 52 participants (33%) reported that their major medical costs were for chronic conditions. Overall individuals, with incomes in the lowest brackets (<50,000 Naira), accounted for most of those that incurred major medical costs in the last two years (74.4%), had more visits to their primary care doctor in the year (75.6%), and higher levels of hypertension (80.4%).

Table 4: Insurance coverage and medical costs

Variable	n (%)

Insurance	
No	331 (95.7)
Yes	15 (4.3)
Last time used insurance	
In the last 2 years	6 (40.0)
>2 years ago	9 (60.0)
How many family members covered by insurance	
None	331 (95.7)
1-2	8 (2.3)
3-4	3 (0.9)
5 or more	4 (1.2)
Reasons for not having insurance (n=331)	
Expense	32 (9.7)
Lack of coverage	13 (3.9)
Too difficult to access	73 (22.1)
Other	217 (65.6)
Major medical costs in the last 2 years	
No	186 (53.8)
Yes	160 (46.2)
Estimated amount	
<10,000 Naira	73 (45.6)
10,000-49,000 Naira	38 (23.8)
50,000-99,999 Naira	16 (10.0)
>100,000 Naira	22 (13.8)
Unknown	11 (6.9)
Reasons for major medical costs (n=158)	
Surgery	17 (10.8)
Chronic conditions	52 (32.9)
Acute illness/trauma	74 (46.8)
Other/multiple reasons	15 (9.5)
Amount spent (continuous)	
Overall median (range)	10,000 (50-1,500,000)
Median amount spent by reason (range)	
Surgery	60,000 (7,000-150,000)
Chronic conditions	18,000 (500-150,000)
Acute illness/trauma	5,000 (50-400,000)
Other/multiple reasons	70,000 (800-500,000)

Within eligible populations, we performed analysis to look for the association between cancer screening activity and income, insurance status and education **Table 5**.

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Individuals with lower levels of income were less likely to have had cancer screening assessments. Cancer screening activity was more frequent in those with higher levels of education. No significant relationship was observed by insurance status or other factors that were assessed (gender, marital Status, religion). In a multivariate logistic regression model including personal income, insurance status and education, the only statistically significant odds ratio for association with cancer screening activity was observed for personal income (personal income OR 2.7 95%CI 1.3-5.7 p<0.01, education level OR 1.7 95%CI 0.98-2.7 p=0.06, insurance status OR 4.3 95%CI 0.8-23.1 p=0.09.

Table 5: Association between Cancer Screening Activity and Income, Insurance and Education N =310[+]

Variable	Cancer Screening (N=17)	No Cancer Screening (N=293)	P value*
Personal income (per month, in Naira)			
<10,000	2/138 (1.5)	140/138 (98.5)	
10,000-49,999	9/122 (7.4)	115/122 (92.6)	<0.01
>50,000	6/43 (14.0)	38/43 (86.0)	
Family income (per month, in Naira)			
<10,000	1/108 (0.9)	107/108 (99.1)	
10,000-49,999	8/129(6.2)	121/129(93.8)	<0.01
>50,000	8/66 (12.1)	58/66 (87.9)	
Insurance Status			
No	15/290 (5.2)	275/290 (94.8)	0.12
Yes	2/13 (15.4)	11/13 (84.6)	
Education			
No formal education	1/86 (1.2)	85/86 (98.8)	
Primary	3/83 (3.6)	80/83 (96.4)	0.04
Secondary	8/78 (10.3)	70/78 (89.7)	
Higher	5/56 (8.9)	51/56 (91.1)	

No association by Gender, Marital Status, Religion

[+] Adjusted for eligible population, whereby cancer screening activities defined as history of cervical assessment in women >21 years, mammogram in women >40 years, and colonoscopy in all individuals >50 years
* Fisher's exact test for association

DISCUSSION

We performed a cross-sectional community-based study in Osun state, Nigeria to provide a snapshot of the challenges faced in the management of NCDs in the region. This study was conducted with an emphasis on cancer within broader research aims of identifying risk factors (lifestyle, diet, biological) associated with the rising cancer incidence in the region. We observed that screening assessment for breast, cervical, and colon cancer (the major contributors to cancer morbidity in the region), [6 19 33] were extremely low. This observation was despite a median age of 52 years and a high representation of females. In addition, <5% of the surveyed population possessed universal health care in the form of health insurance. We also found low incomes, high fertility rates, and evidence of poorly controlled chronic diseases, such as hypertension, in our cohort. The rates are comparable to national averages (suggesting our sample sits between the urban/rural divide)[31] and likely represent broad health and development deficiencies present in the community.

Previous studies conducted in the region [34-42] have demonstrated that poor access to cancer services is associated with late presentation and high incidence/mortality ratio.[5 43] This highlights a need to develop sound healthcare infrastructure, whereby individuals can be screened for asymptomatic disease and also adequately access services in a timely fashion when symptomatic. Our study identifies that screening activities may be lacking through either delivery and/or uptake, and that the potential cost implications of accessing treatment when symptoms arise, in the absence of adequate health insurance, can be high. The experience from other sub-Saharan African nations suggests that individuals seeking cancer services face significant barriers to access.[35 36 44-47] The Nigerian "National Cancer Control Plan 2018-2022,"

specifically details goals to make screening services and early detection of cancer available for all Nigerians, and to improve access to quality, cost-effective, and equitable diagnostic and treatment services for cancer care. This is centered around investment in eight public comprehensive cancer centers covering all geo-political zones, as well as the implementation of various screening strategies throughout different sectors of the healthsystem.[20]. Our results suggest that considerable work is required to reach the goal of "greater than 50% screening of 'eligible populations' by 2022."[20] We assessed cancer screening using measures that are recommended in this national plan. The methods we assessed are accessed at different levels of the healthcare system – cervical cancer assessment predominantly at a primary health care level, breast cancer at secondary/tertiary level through mammography, and colon cancer at tertiary level through colonoscopy. Whilst our analysis provides some idea of how individuals may have navigated the health system further detailed study is required to look at specific engagement at these different levels to inform appropriate resource allocation.

It is important to acknowledge that cancer screening in low and middle income countries requires measures tailored to local capacity and disease prevalence. For breast cancer, although mammography remains the gold standard for early detection of breast cancer, the Breast Health Global Initiative (BHGI) resource-stratified guidelines recommend clinical breast examination as a practical and necessary alternative for early detection in low-resource settings.[19 45 48] This has been recommended in local policy and was not assessed in the current study.[20] Despite this, with over 50 percent of individuals in this study visiting a primary health care doctor in the last year, our findings strongly support the need to concentrate cancer

screening efforts at primary healthcare where possible through the use of similar interventions. Colon cancer screening by colonoscopy for those over the age of fifty as recommended in high income countries does not exist in sufficient capacity for this to be recommended in an LMIC setting.[49] Efforts to intervene at primary healthcare level through the use of stool testing and symptom stratification are ongoing.[50] [51] Overall, education, training and adequately resourcing community healthcare workers and physicians at primary healthcare level for cancer screening assessment is essential.

We demonstrated that both income and medical expenditure relative to this level of income, compounded by the lack of universal health care coverage, must be factored into strategies laid out to address cancer control. The costs of the screening interventions assessed in this study relative to income, are prohibitive for the majority of individuals without government subsidy; approx. $50 US ~ $18000 Naira (for mammography), $15 US ~ $3000 Naira (cervical smear). This is compounded by the finding of only 4% of our cohort having health insurance coverage. In addition, major medical costs were incurred by over half of those interviewed, and a significant proportion of these costs were for chronic diseases (33%). Those individuals with the lowest income were more likely to report visits to the doctor, chronic disease, and significant "out of pocket" medical expenditures. The Nigerian national health insurance scheme (NHIS) has been in place since 2005. When it was introduced, state governments were instructed to adopt the program for their employees in the formal sector. After insuring government employees, state governments were instructed to expand coverage across all individuals with the goal of universal health coverage.[14] [15] Recent reports confirm that this expansion has been limited in Nigeria. In line with

previous studies, our data indicate that the NHIS is severely underutilized in the community population.[15][16] The state health insurance scheme has been instituted in only 2 out of 36 states of the federation at community level and this has not been the case in Osun state where the study took place. [15]

We found wide range of "major" medical expenditure in our study group, with a median expenditure exceeding the monthly salary of ~45% of the group. It is important to note that we did not obtain information on total household expenditures to allow a relative assessment of the amount spent on medical costs, and, in turn, determine "catastrophic" costs.[16] However, based on income and demographic comparisons with other groups studied in the region, it is likely that catastrophic spending is high.[52] Further research into how the money to cover medical expenditure is generated (i.e., personal savings, family savings, loans, etc.) is required. Taken together with prior work in the region [53][54], it is evident that risk pooling and financial risk protection are required for the provision of preventative and therapeutic NCD health services.

Whilst we did not directly assess awareness of cancer screening, we did demonstrate an association between cancer screening activity and education level. Levels of education have been associated with awareness and accessing cancer services in previous studies.[35][42][44][55] In addition to this, we also found that ~75% of participants had access to radio and/or television within family and social networks, suggesting that mass communication channels to promote health awareness exist. In fact, these facilitated the current study when combined with strategies using mobile phone technologies. More broadly, these channels represent promising avenues to promote health and prevention of disease in the region.[56] In addition, "demand-side"

approaches to resource allocation, such as the stipend we provided for travel in the study or e-vouchers,[57][58] are likely to be well received by the community and may promote uptake of health-screening activities.

A strength of this study is that it was performed within the community and involved trained research staff fluent in the local dialect and used a validated questionnaire. The study was performed in conjunction with local community healthcare workers and the tertiary referral hospital, which was intended to help residents develop an awareness of how and where healthcare can be accessed in the area and to establish a sustained relationship with this community. Limitations of this work include the potential for misclassification and recall bias, as we relied on individuals to retrospectively describe their own health and socioeconomic status as well as their interactions with healthcare services. Whilst we have documented low levels of screening activities and associations with income and education, we did not directly require individuals to state specifically their personal reasons for not being screened to delineate availability, awareness or finances. In addition, while the study sample was chosen at random and consecutive individuals were enrolled, the survey was conducted at a single time that was mid-week, during the day; this timing may have affected our sample composition (e.g., resulted in more females than males). Nevertheless, overall consistency with national demographic indicators (e.g., income, education, and living conditions) indicates that our sample is likely reflective of rural community-dwelling individuals in the wider region.[31][32]

In summary, our results highlight infrequent cancer screening activities in a Nigerian community population and identifies areas that can be targeted to address this,

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including the use of measures focused at primary healthcare level, financial risk protection, awareness, and strategic resource allocation.

Ethical Approval Statement

The study was approved by the Obafemi Awolowo University institutional ethics review committee. Further details available directly from: Obafemi Awolowo University Teaching Hospitals Complex, ILE-IFE, NIGERIA. Ethics and Research Committee

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REFERENCES

1. Niessen LW, Mohan D, Akuoku JK, et al. Tackling socioeconomic inequalities and non-communicable diseases in low-income and middle-income countries under the Sustainable Development agenda. *Lancet* 2018;391(10134):2036-46. doi: 10.1016/s0140-6736(18)30482-3 [published Online First: 2018/04/09]

2. Ezzati M, Pearson-Stuttard J, Bennett JE, et al. Acting on non-communicable diseases in low- and middle-income tropical countries. *Nature* 2018;559(7715):507-16. doi: 10.1038/s41586-018-0306-9 [published Online First: 2018/07/27]

3. NCD Countdown 2030: worldwide trends in non-communicable disease mortality and progress towards Sustainable Development Goal target 3.4. *Lancet* 2018;392(10152):1072-88. doi: 10.1016/s0140-6736(18)31992-5 [published Online First: 2018/09/29]

4. GLOBOCAN 2018: counting the toll of cancer. *Lancet* 2018;392(10152):985. doi: 10.1016/s0140-6736(18)32252-9 [published Online First: 2018/09/29]

5. Bray F, Ferlay J, Soerjomataram I, et al. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: A Cancer Journal for Clinicians* 2018;68(6):394-424. doi: 10.3322/caac.21492

6. Olaleye O, Ekrikpo U. Epidemiology of Cancers in Sub-Saharan Africa. In: Adedeji OA, ed. Cancer in Sub-Saharan Africa: Current Practice and Future. Cham: Springer International Publishing 2017:3-19.

7. Mostert S, Njuguna F, Olbara G, et al. Corruption in health-care systems and its effect on cancer care in Africa. *Lancet Oncol* 2015;16(8):e394-404. doi: 10.1016/s1470-2045(15)00163-1 [published Online First: 2015/08/08]

8. Harford JB. Barriers to overcome for effective cancer control in Africa. *Lancet Oncol* 2015;16(8):e385-93. doi: 10.1016/s1470-2045(15)00160-6 [published Online First: 2015/08/08]

9. Transforming our world : the 2030 Agenda for Sustainable Development: UN General Assembly; 21 October 2015 [Available from: https://www.undp.org/content/undp/en/home/sustainable-development-goals.html accessed 23 August 2019.

10. Douthit NT, Alemu HK. Social determinants of health: poverty, national infrastructure and investment. *BMJ Case Reports* 2016;2016:bcr2016215670. doi: 10.1136/bcr-2016-215670

11. Attia-Konan AR, Oga ASS, Touré A, et al. Distribution of out of pocket health expenditures in a sub-Saharan Africa country: evidence from the national survey of household standard of living, Côte d'Ivoire. *BMC Res Notes* 2019;12(1):25. doi: 10.1186/s13104-019-4048-z [published Online First: 2019/01/17]

12. Leive A, Xu K. Coping with out-of-pocket health payments: empirical evidence from 15 African countries. *Bull World Health Organ* 2008;86(11):849-56. doi: 10.2471/blt.07.049403 [published Online First: 2008/11/26]

13. Xu K, Evans DB, Kawabata K, et al. Household catastrophic health expenditure: a multicountry analysis. *Lancet* 2003;362(9378):111-7. doi: 10.1016/s0140-6736(03)13861-5 [published Online First: 2003/07/18]

14. Onoka CA, Onwujekwe OE, Uzochukwu BS, et al. Promoting universal financial protection: constraints and enabling factors in scaling-up coverage with social health insurance in Nigeria. *Health Res Policy Syst* 2013;11:20. doi: 10.1186/1478-4505-11-20 [published Online First: 2013/06/15]

15. Uzochukwu BS, Ughasoro MD, Etiaba E, et al. Health care financing in Nigeria: Implications for achieving universal health coverage. *Niger J Clin Pract* 2015;18(4):437-44. doi: 10.4103/1119-3077.154196 [published Online First: 2015/05/15]

16. Aregbeshola BS, Khan SM. Out-of-Pocket Payments, Catastrophic Health Expenditure and Poverty Among Households in Nigeria 2010. *Int J Health Policy Manag* 2018;7(9):798-806. doi: 10.15171/ijhpm.2018.19 [published Online First: 2018/10/15]

17. Jedy-Agba E, Curado MP, Ogunbiyi O, et al. Cancer incidence in Nigeria: a report from population-based cancer registries. *Cancer Epidemiol* 2012;36(5):e271-8. doi: 10.1016/j.canep.2012.04.007 [published Online First: 2012/05/25]

18. Awodele O, Adeyomoye AA, Awodele DF, et al. Cancer distribution pattern in south-western Nigeria. *Tanzan J Health Res* 2011;13(2):125-31. doi: 10.4314/thrb.v13i2.55226 [published Online First: 2011/04/01]

19. Ishola F, Omole O. A vision for improved cancer screening in Nigeria. *Lancet Glob Health* 2016;4(6):e359-60. doi: 10.1016/s2214-109x(16)30062-6 [published Online First: 2016/05/21]

20. Nigeria National Cancer Control Plan 2018 – 2022. Abuja: Federal Ministry of Health, Nigeria 2018.

21. World Bank staff estimates based on the United Nations Population Division's World Urbanization Prospects: 2018 Revision: The World Bank Group; [Available from: https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS accessed November 2019.

22. Kingham TP, Alatise OI. Establishing Translational and Clinical Cancer Research Collaborations Between High- and Low-Income Countries. *Annals of Surgical Oncology* 2015;22(3):741-46. doi: 10.1245/s10434-014-4342-x

23. Irabor DO. Emergence of Colorectal Cancer in West Africa: Accepting the Inevitable. *Niger Med J* 2017;58(3):87-91. doi: 10.4103/0300-1652.234076 [published Online First: 2017/05/01]

24. National Population Commission (NPC) [Nigeria] and ICF International. 2014. Nigeria Demographic and Health Survey 2013. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF International. https://dhsprogram.com/pubs/pdf/fr293/fr293.pdf (Accessed February 14, 2018).

25. National Bureau of Statistics (NBS) - Federal Government of Nigeria. Nigeria - General Household Survey, Panel 2015-2016, Wave 3. http://microdata.worldbank.org/index.php/catalog/2734/study-description (Accessed February 15, 2018).

26. Cleland CL, Hunter RF, Kee F, et al. Validity of the global physical activity questionnaire (GPAQ) in assessing levels and change in moderate-vigorous physical activity and sedentary behaviour. *BMC Public Health* 2014;14:1255. doi: 10.1186/1471-2458-14-1255 [published Online First: 2014/12/11]

27. Colditz GA, Manson JE, Hankinson SE. The Nurses' Health Study: 20-year contribution to the understanding of health among women. *J Womens Health* 1997;6(1):49-62.

28. Hu FB, Satija A, Rimm EB, et al. Diet Assessment Methods in the Nurses' Health Studies and Contribution to Evidence-Based Nutritional Policies and Guidelines. *American*

journal of public health 2016;106(9):1567-72. doi: 10.2105/AJPH.2016.303348 [published Online First: 2016/07/28]

29. Willett WC, Sampson L, Stampfer MJ, et al. REPRODUCIBILITY AND VALIDITY OF A SEMIQUANTITATIVE FOOD FREQUENCY QUESTIONNAIRE. *American Journal of Epidemiology* 1985;122(1):51-65. doi: 10.1093/oxfordjournals.aje.a114086

30. Wolf AM, Hunter DJ, Colditz GA, et al. Reproducibility and Validity of a Self-Administered Physical Activity Questionnaire. *International Journal of Epidemiology* 1994;23(5):991-99. doi: 10.1093/ije/23.5.991

31. Nigeria Demographic and Health Survey. Abuja, Nigeria: National Population Commission, Federal Republic of Nigeria, June 2014.

32. "Nigeria Country Briefing", Multidimensional Poverty Index Data Bank: Oxford Poverty and Human Development Initiative, University of Oxford.; 2017 [Available from: www.ophi.org.uk/multidimensional-poverty-index/mpi-country-briefings/. accessed August 2019 2019.

33. Morhason-Bello IO, Odedina F, Rebbeck TR, et al. Challenges and opportunities in cancer control in Africa: a perspective from the African Organisation for Research and Training in Cancer. *Lancet Oncol* 2013;14(4):e142-51. doi: 10.1016/s1470-2045(12)70482-5 [published Online First: 2013/04/09]

34. Olasehinde O, Alatise OI, Arowolo OA, et al. Barriers to mammography screening in Nigeria: A survey of two communities with different access to screening facilities. *Eur J Cancer Care (Engl)* 2019;28(2):e12986. doi: 10.1111/ecc.12986 [published Online First: 2019/01/08]

35. McKenzie F, Zietsman A, Galukande M, et al. Breast cancer awareness in the sub-Saharan African ABC-DO cohort: African Breast Cancer—Disparities in Outcomes study. *Cancer Causes & Control* 2018;29(8):721-30. doi: 10.1007/s10552-018-1047-7

36. Makau-Barasa LK, Greene SB, Othieno-Abinya NA, et al. Improving Access to Cancer Testing and Treatment in Kenya. *Journal of Global Oncology* 2018(4):1-8. doi: 10.1200/jgo.2017.010124

37. Ugwumba FO, Ekwueme OE, Okoh AD. Testicular Cancer and Testicular Self-Examination; Knowledge, Attitudes and Practice in Final Year Medical Students in Nigeria. *Asian Pac J Cancer Prev* 2016;17(11):4999-5003. doi: 10.22034/apjcp.2016.17.11.4999 [published Online First: 2016/12/30]

38. Mbamara SU, Ikpeze OC, Okonkwo JE, et al. Knowledge, attitude and practice of cervical cancer screening among women attending gynecology clinics in a tertiary level medical care center in southeastern Nigeria. *J Reprod Med* 2011;56(11-12):491-6. [published Online First: 2011/12/27]

39. Wright KO, Kuyinu YA, Faduyile FA. Community education on cervical cancer amongst market women in an urban area of Lagos, Nigeria. *Asian Pac J Cancer Prev* 2010;11(1):137-40. [published Online First: 2010/07/03]

40. Aniebue PN, Aniebue UU. Awareness and practice of cervical cancer screening among female undergraduate students in a Nigerian university. *J Cancer Educ* 2010;25(1):106-8. doi: 10.1007/s13187-009-0023-z [published Online First: 2010/01/19]

41. Ajape AA, Babata A, Abiola OO. Knowledge of prostate cancer screening among native African urban population in Nigeria. *Nig Q J Hosp Med* 2010;20(2):94-6. [published Online First: 2011/01/20]

42. Obiechina NJ, Mbamara SU. Knowledge attitude and practice of cervical cancer screening among sexually active women in Onitsha, southeast Nigeria. *Niger J Med* 2009;18(4):384-7. [published Online First: 2010/02/03]

43. Kontis V, Mathers CD, Bonita R, et al. Regional contributions of six preventable risk factors to achieving the 25 x 25 non-communicable disease mortality reduction target: a modelling study. *Lancet Glob Health* 2015;3(12):e746-57. doi: 10.1016/s2214-109x(15)00179-5 [published Online First: 2015/10/27]

44. Tiruneh FN, Chuang KY, Ntenda PAM, et al. Individual-level and community-level determinants of cervical cancer screening among Kenyan women: a multilevel analysis of a Nationwide survey. *BMC Womens Health* 2017;17(1):109. doi: 10.1186/s12905-017-0469-9 [published Online First: 2017/11/17]

45. Masalu N, Serra P, Amadori D, et al. Setting up a community-based cervical screening service in a low-income country: a pilot study from north-western Tanzania. *International Journal of Public Health* 2017;62(7):755-62. doi: 10.1007/s00038-017-0971-8

46. Kangmennaang J, Mkandawire P, Luginaah I. Breast cancer screening among women in Namibia: explaining the effect of health insurance coverage and access to information on screening behaviours. *Glob Health Promot* 2017:1757975917727017. doi: 10.1177/1757975917727017 [published Online First: 2017/09/26]

47. Stulac S, Binagwaho A, Tapela NM, et al. Capacity building for oncology programmes in sub-Saharan Africa: the Rwanda experience. *Lancet Oncol* 2015;16(8):e405-13. doi: 10.1016/s1470-2045(15)00161-8 [published Online First: 2015/08/08]

48. Anderson BO, Yip CH, Smith RA, et al. Guideline implementation for breast healthcare in low-income and middle-income countries: overview of the Breast Health Global Initiative Global Summit 2007. *Cancer* 2008;113(8 Suppl):2221-43. doi: 10.1002/cncr.23844 [published Online First: 2008/09/26]

49. Knapp GC, Alatise OI, Olasehinde OO, et al. Is Colorectal Cancer Screening Appropriate in Nigeria? *J Glob Oncol* 2019;5:1-10. doi: 10.1200/jgo.19.00035 [published Online First: 2019/06/07]

50. Alatise OI, Ayandipo OO, Adeyeye A, et al. A symptom-based model to predict colorectal cancer in low-resource countries: Results from a prospective study of patients at high risk for colorectal cancer. *Cancer* 2018;124(13):2766-73. doi: 10.1002/cncr.31399 [published Online First: 2018/04/13]

51. Knapp GC, Sharma A, Olopade B, et al. An Exploratory Analysis of Fecal Immunochemical Test Performance for Colorectal Cancer Screening in Nigeria. *World J Surg* 2019;43(11):2674-80. doi: 10.1007/s00268-019-05100-0 [published Online First: 2019/08/14]

52. Olugbenga-Bello A, Adebimpe W. Knowledge and attitude of civil servants in Osun state, Southwestern Nigeria towards the national health insurance. *Nigerian Journal of Clinical Practice* 2010;13(4):421-26.

53. Dieleman JL, Sadat N, Chang AY, et al. Trends in future health financing and coverage: future health spending and universal health coverage in 188 countries, 2016–40. *The Lancet* 2018;391(10132):1783-98. doi: https://doi.org/10.1016/S0140-6736(18)30697-4

54. Dieleman J, Campbell M, Chapin A, et al. Evolution and patterns of global health financing 1995–2014: development assistance for health, and government, prepaid private, and

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out-of-pocket health spending in 184 countries. *The Lancet* 2017;389(10083):1981-2004. doi: https://doi.org/10.1016/S0140-6736(17)30874-7

55. Alatise OI, Fischer SE, Ayandipo OO, et al. Health-Seeking Behavior and Barriers to Care in Patients With Rectal Bleeding in Nigeria. *Journal of global oncology* 2017;3(6):749-56. doi: 10.1200/JGO.2016.006601 [published Online First: 2017/02/01]

56. Yang Q, Van Stee SK. The Comparative Effectiveness of Mobile Phone Interventions in Improving Health Outcomes: Meta-Analytic Review. *JMIR Mhealth Uhealth* 2019;7(4):e11244. doi: 10.2196/11244 [published Online First: 2019/04/04]

57. Erwin E, Aronson KJ, Day A, et al. SMS behaviour change communication and eVoucher interventions to increase uptake of cervical cancer screening in the Kilimanjaro and Arusha regions of Tanzania: a randomised, double-blind, controlled trial of effectiveness. *BMJ Innovations* 2019:bmjinnov-2018-000276. doi: 10.1136/bmjinnov-2018-000276

58. Hurst TE, Semrau K, Patna M, et al. Demand-side interventions for maternal care: evidence of more use, not better outcomes. *BMC Pregnancy Childbirth* 2015;15:297. doi: 10.1186/s12884-015-0727-5 [published Online First: 2015/11/17]

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	4
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	8,9
Objectives	3	State specific objectives, including any prespecified hypotheses	9
Methods			
Study design	4	Present key elements of study design early in the paper	10,11
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	10
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	10
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	11
Bias	9	Describe any efforts to address potential sources of bias	10,11
Study size	10	Explain how the study size was arrived at	10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	12,13
		(*b*) Describe any methods used to examine subgroups and interactions	12,13
		(*c*) Explain how missing data were addressed	13
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	13
		(b) Give reasons for non-participation at each stage	13
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	13,14
		(b) Indicate number of participants with missing data for each variable of interest	n/a
Outcome data	15*	Report numbers of outcome events or summary measures	14,15,16

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15,16
		(*b*) Report category boundaries when continuous variables were categorized	n/a
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	21
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	21-25
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	21-25
Generalisability	21	Discuss the generalisability (external validity) of the study results	21-25
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	1

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Healthcare utilization, cancer screening and potential barriers to accessing cancer care in Rural South-West Nigeria: A cross-sectional study.

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2020-040352.R2
Article Type:	Original research
Date Submitted by the Author:	28-Jun-2021
Complete List of Authors:	Sharma, Avinash; Memorial Sloan Kettering Cancer Center, Surgery Alatise, Olusegun; Obafemi Awolowo University Teaching Hospital Complex O'Connell, Kelli; Memorial Sloan Kettering Cancer Center, Epidemiology and Biostatistics Gbenga, Ogunleye; Obafemi Awolowo University Teaching Hospital Complex, Surgery Aderounmu, Adewale; Obafemi Awolowo University Teaching Hospital Complex, Surgery Samson, Marquerite; Memorial Sloan Kettering Cancer Center, Epidemiology and Biostatistics Wuraola, Funmilola; Obafemi Awolowo University Teaching Hospital Complex Olasehinde, Olalekan; Obafemi Awolowo University Teaching Hospital Complex Kingham, T; Memorial Sloan Kettering Cancer Center, Surgery Du, Mengmeng; Memorial Sloan Kettering Cancer Center, Epidemiology and Biostatistics
Primary Subject Heading:	Global health
Secondary Subject Heading:	Oncology, Health services research, Public health
Keywords:	PUBLIC HEALTH, PREVENTIVE MEDICINE, Epidemiology < ONCOLOGY, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Organisation of health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, Health economics < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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Healthcare utilization, cancer screening and potential barriers to accessing cancer care in Rural South-West Nigeria: A cross-sectional study.

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ABSTRACT

Background/Aims: Cancer burden is predicted to double by 2030 in sub-Saharan Africa; access to healthcare services for cancer management is a priority in the region. In Nigeria, National Cancer Control Plan aims to ensure >50% cancer screening of eligible populations by 2022 for all Nigerians. We describe healthcare utilization, cancer screening activities and potential barriers to accessing cancer care within an understudied rural community-based adult population in South-West Nigeria.

Methods: In April 2018, we conducted a cross-sectional study of community-based adults (>18 years) ~130 kilometres east of Ibadan, 250 km from Lagos in Osun State, South-West Nigeria. Participants completed a face-to-face survey in local dialect. We used a questionnaire to assess demographics, health status, income, medical expenditures, doctor visits, and cancer screening history.

Results: We enrolled 346 individuals; with median age of 52 years, and 75% female. Of the entire cohort, 4% had medical insurance. 46% reported a major medical cost in the last year. Cancer screening activities were infrequent in eligible participants: 1.5% reported having had cervical cancer screening, 3.3% mammogram, and 5% colonoscopy screening. Cancer screening assessment was less frequent in those with less income and lower education levels. Using a multivariable logistic regression model including personal income, insurance status, and education, higher personal income was associated with more cancer screening activity (OR 2.7 95%CI 1.3-5.7 p<0.01). Despite this, most individuals had contact with a primary health care doctor (52% in the last year), and over 70% access to radio and TV suggesting the opportunity to expand community-based screening interventions and awareness exists.

Conclusions: Despite national increases in cancer cases**,** we highlight a deficiency in cancer screening and universal healthcare coverage within a community-based adult Nigerian population. Subject to availability of governmental resources, increasing financial risk protection, awareness, and targeted resource allocation may help expand access in Nigeria.

Keywords: Non-communicable disease, Sub-Saharan Africa, Cancer, Universal Healthcare, Screening

Strengths and Limitations of the study:

1) Rigorously trained interviewers fluent in the local dialect collected contemporary perspectives of potential barriers to accessing medical and cancer care in a crucially understudied population in rural South-West Nigeria.

2) Questionnaire items derived by adapting features from validated and/or widely implemented local or nationwide surveys and tailored to the local population in collaboration with local clinicians, epidemiologists, and nutritionists.

3) Study conducted in conjunction with local community healthcare workers and the regional tertiary referral hospital to help build capacity, increase healthcare awareness, and establish a sustained relationship with these rural communities.

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4) Potential for measurement error or recall bias, as we relied on individuals to retrospectively describe their own health and socioeconomic status as well as their interactions with healthcare services.

5) Survey conducted at a single time (mid-week, during the day) in two geographic locations, which may have affected sample composition (e.g., more females than males).

INTRODUCTION

The burden of non-communicable disease (NCD), in particular cancer, in sub-Saharan Africa is well documented.[1-3] According to recent International Agency for Research on Cancer GLOBOCAN estimates, by 2030, 75% of new cancer cases will be within low and middle-income countries.[4 5] In sub-Saharan Africa, despite the fact that cancer burden is predicted to double by 2030, the entire region accounts for <1% of worldwide medical cancer expenditures.[6-8] Central to addressing the growing burden of cancer in sub-Saharan Africa is the need to improve access to cancer care services for screening, prevention, and treatment.[9]

NCDs, including cancer, threaten to overwhelm fragile health systems in sub-Saharan Africa and lead to dramatic rises in health and social care costs in the near-term.[7 10] In the region, out-of-pocket health expenditures are a major contributor to poverty [11-13], and a lack of adequate social protection has the potential to drive families and individuals further into poverty. In Nigeria, universal healthcare coverage in the form of the National Health Insurance Scheme (NHIS) was implemented in 2005, with an overarching goal of universal health coverage for all Nigerians.[14] However, uptake has been limited and restricted,[15] and as a result, the large majority of Nigerians still face significant financial burden when healthcare needs arise.[15 16]

In Nigeria cancer incidence and mortality is increasing and women have a higher cancer incidence than men.[17] The most common forms of cancer in Nigeria are breast and cervical, with these accounting for over 50 percent of cancer deaths.[17-19] Regionally, the need to improve access to cancer services for early detection has been recognised, with a focus on these cancers. In 2018, Nigeria launched the "National

Cancer Control Plan 2018-2022," with the goal to make screening services available for all Nigerians, and at least "greater than 50% screening of all eligible populations by 2022."[20] Despite this, the current state of cancer screening activities and barriers to care in this region (esp. rural areas) are not well-defined or documented. This gap limits our ability to define actionable steps towards improving access and achieving the established screening goal. National programmes for screening breast and cervical cancer are lacking. Typically, screening interactions occur at primary health care facilities or community health clinics – often for women when they are being seen during pregnancy or for other related health issues such as immunisations. Screening services for cervical and breast cancer have been implemented sporadically by both government and non-government organisations but predominantly in urban areas. The overwhelming majority of individuals in the region are symptomatic when they present with disease. With 50 percent of Nigeria's population living in rural areas[21] we hypothesize that unique challenges may exist for individuals in these communities, where nationwide initiatives may have limited reach.

This study aimed to describe potential barriers to accessing cancer care within a rural community-based adult population in South-West Nigeria. This study was performed as part of a broader community-based capacity building project in South-West Nigeria[22] investigating potentially modifiable cancer risk factors in the setting of rising rates of cancer in the region.[6 19 20 23] Herein, we report health insurance coverage and socioeconomic status in relation to health conditions, health expenditures, cancer screening assessment and provide a snapshot of the health needs and burden faced by individuals in the region.

METHODS

During April 2018, a cross-sectional study of community-based adults was conducted in Osun State, South-West Nigeria. Two rural towns Ijebu-Jesa and Ere-Jesa, (approximately 130 kilometers east of Ibadan, 250 km from Lagos, on latitude 7.45 degrees north within the rain forest belt), were selected at random. These towns were in proximity to Obafemi Awolowo University Teaching Hospital Complex, Ile-Ife, the main tertiary referral center in the region. This study was part of a broader capacity building project in the region to improve cancer care and prevention in this understudied population. It served as a baseline study to assess access to cancer services as well as a pilot study to explore endemic risk factors for cancer – such as unique dietary, exercise and environmental exposures.

Patient and Public Involvement

Prior to the study, local community leaders in the towns were contacted, and the goals of the research were explained. In the time leading up to the study, healthcare workers and community leaders notified and mobilized all potential participants in the two communities. They were also involved in the design of the study and in disseminating the results to all participants. Participants were notified of the study through discussion at the weekly local community meetings in the month leading up to the study, advertisements on local radio-stations and through community workers visiting regional sites.

Participants

Adults >18 years in the two towns were invited to participate. Adult participants were consecutively enrolled upon arrival at pre-designated locations (main town hall) in the two towns. Sample size for this study was therefore based on resource capacity of each town hall, available number of interviewers to administer the questionnaire, and the size of each rural community in which we recruited; enrolment was capped at a maximum of 300 participants at Ijebu-Jesa and 100 at Ere-Jesa over the recruitment period. All study participants received blood pressure checks, and health promotion talks were held for those waiting to be surveyed. Study participants were given a small stipend to cover their transportation costs to the study venue on the study day (300 Naira, ~80 US cents). This amount was determined by local healthcare workers.

Questionnaire

The survey consisted of a questionnaire to gather quantitative data on demographics, health status, income, medical expenditures, dietary habits, physical activity, family history, screening history, medical history, reproductive history, primary healthcare visits, medication use, and environmental exposures. (See supplementary file). The questionnaire used was developed in collaboration with local clinicians, epidemiologists, and nutritionists, and was derived by adapting features from validated and/or widely implemented local or nationwide surveys. This included the Nigeria Demographic and Health Survey,[24] Nigeria General Household Survey,[25] World Health Organization-endorsed Global Physical Activity Questionnaire,[26] and the Nurses' Health Study questionnaire.[27-30] We therefore did not additionally test for reliability and our study was intended to capture a cross-sectional snapshot of our rural communities. However, we expect low social mobility in our two rural Nigerian towns

and therefore limited changes over time for the sociodemographic features collected in our questionnaire.

Data collection

After obtaining informed consent, the study participants underwent a 50-60 minute one-on-one, face-to-face survey conducted in the local Yoruba dialect by a trained research assistant. All research assistants underwent a two-day training program that involved education into the research aims, methodology, and ethics as well as interview techniques through role paying exercises, pilot testing of the questionnaire and the use of electronic tablets for recording data.

Outcome measures

Cancer screening activities in screen-eligible individuals included history of cervical examination and screening test in women >21 years, mammogram in women >40 years, and colonoscopy in all individuals >50 years. Because cervical cancer screening intervention was self-reported, screening could be by pap smear or visual inspection with acetic acid or Lugo's iodine (VIA/VILI). This could be conducted in a primary healthcare setting. Manual breast examination by a health care worker was not captured and therefore the assessed intervention evaluated management at local secondary and tertiary health care facilities. All of the assessed interventions were screening activities specified as part of the Nigerian National Cancer Control Plan 2018-2022. Medical expenses were defined as any 'major medical costs' as perceived by the study participant on direct questioning. This was clarified by recording the amount spent in Naira, and the medical reason for the expenditure was also documented. Demographic and socioeconomic data collected from our study

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population were compared to data from the Nigerian Demographic and Health Survey

and the Oxford Poverty Health Indicator [31] [32] to assess external validity.

Statistical analysis

Data were summarized in the form of proportions and frequency tables for categorical

variables. Continuous variables were summarized using mean, median, and standard

deviation. Comparisons of discrete variables were computed using Fisher's exact test

and multiple logistic regression. Missing data were not possible for completed

questionnaires as only complete responses to questions could be processed in order

to advance the survey on the electronic tablets. All analyses were conducted using

SAS software version 9.4 (SAS Institute Inc., Cary, NC)

RESULTS

A total of 346 individuals were consecutively enrolled in the study and interviewed

during the recruitment period. All individuals that were interviewed provided data for

analysis. The demographic features of the group are presented in **Table 1**. The

majority of participants were Yoruba speaking (n=332, 96%) and married (n=213,

62%) with a median age of 52 years. Females accounted for 75% of the cohort

(n=261). Most individuals had some form of education, with 166 participants (48%)

reporting more than primary school education. In addition, 30 participants (9%)

reported being unemployed. Of female participants, 70% had ≥4 live births.

Table 1: Demographic characteristics of the study group (n=346)

(n=268 Ijebu-Jesa, n=68 Ere-Jesa)

Variable	n (%)
Median Age, years (range)	52 (18-100)
Sex	
Male	85 (24.6)
Female	261 (75.4)
Marital Status	
Single	27 (7.8)
Married	213 (61.6)
Other (Divorced/cohabiting)	106 (30.6)
Tribe	
Yoruba	332 (96.0)
Ibo	5 (1.4)
Other	9 (2.6)
Religion	
Christian	326 (94.2)
Muslim	19 (5.5)
Other	1 (0.3)
Education	
No formal education	88 (25.4)
Primary	92 (26.6)
Secondary	92 (26.6)
Vocational/Technical	45 (13.0)
Higher	29 (8.4)
Occupation	
Unemployed	30 (8.7)
Civil servant	30 (8.7)
Trader	123 (35.5)
Farmer	35 (10.1)
Self-employed	80 (23.1)
Other	48 (13.9)
Number of Live Births (Females, n=242)	
0	6 (2.5)
1	15 (6.2)
2	23 (9.5)
3	28 (11.6)
4	54 (22.3)
5 or more	116 (47.9)

Overall, 155 participants (45%) had a personal monthly income of <10,000 Naira (~1 USD per day), and 134 individuals (76%) had a family monthly income of <50,000 Naira (140 USD per month) (**Table 2a**). In addition, 198 participants (57%) lived in a

family home or owned an apartment. The majority of participants (92%) reported

having access to electricity, and over 70% reported access to television (76%) or radio

(73%).

To assess the comparability of our results to the general Nigerian population, we

compared the data from our study population to that recorded in the Nigerian

Demographic and Health Survey (**Table 2b**).[31] Both groups had similar degrees of

education at the primary level for males and females, but overall there were fewer

uneducated males and females within our surveyed population when compared to

national averages. Our surveyed group also had better access to electricity, radio, and

television compared to the national survey group (rural). When compared to equivalent

parameters for Nigeria from the multi-dimensional poverty index (MPI) developed by

the Oxford Poverty and Human Development Initiative,[32] our study population had

similar levels of deprivation for years of schooling (defined as <6 years of school) and

electricity (defined as no household electricity).

Table 2a: Income and household conditions

Variable	n (%)
Personal income (per month, in Naira)	
<10,000	155 (44.8)
10,000-49,999	139 (40.2)
50,000-99,999	26 (7.5)
100,000-249,999	16 (4.6)
250,000-499,999	9 (2.6)
≥500,000	1 (0.3)
Family income (per month, in Naira)	
<10,000	117 (33.8)
10,000-49,999	147 (42.5)
50,000-99,999	38 (11.0)
100,000-249,999	28 (8.1)
250,000-499,999	11 (3.2)
≥500,000	5 (1.4)

Type of dwelling

Own apartment	131 (37.9)
Rent apartment	146 (42.2)
Family house	67 (19.4)
Other	2 (0.6)

Type of toilet

Water system	151 (43.6)
Pit latrine	164 (47.4)
Bush	23 (6.6)
Bucket	7 (2.0)
Other	1 (0.3)

Water source

Pipe borne/boreholes	185 (53.5)
Well	146 (42.2)
River	15 (4.3)

Appliances

Electricity	318 (91.9)
Television	262 (75.7)
Radio	251 (72.5)
Refrigerator	154 (44.5)
Air conditioner	8 (2.3)
Generating set	99 (28.6)
Personal computer	38 (11.0)
None	18 (5.2)

Table 2b: Comparison between study sample characteristics and 2013 Nigerian National Demographic and Health Survey (NDHS)

	NDHS Urban (%)	NDHS Rural (%)	NDHS Total (%)	Current study (%)
Cooking Fuel				
Electricity	0.7	0.2	0.4	10.7
Liquefied petroleum gas/natural Gas/biogas	4.6	0.5	2.3	21.1
Kerosene	47.6	8.7	25.5	31.8
Charcoal	5.3	1.6	3.2	2.3
Wood	37.9	83.3	63.7	34.1
Electricity				
Yes	83.6	34.4	55.6	91.9
No	16.3	65.4	44.2	8.1
Missing	0.1	0.2	0.2	0
Household Appliances				
Radio	77.7	61.3	68.3	72.5
Television	73.2	28.2	47.6	75.7
Refrigerator	32.5	7.5	18.3	44.5
Means of Transportation				
Bicycle	12.7	18.3	18.3	0.9
Motorcycle/scooter	27.0	31.2	31.2	15.0
Car/truck	14.4	8.7	8.7	12.1

Education	NDHS Female (%)	NDHS Male (%)	Current study Female (%)	Current study Male (%)
No formal education	37.8	21.2	28.7	15.3
Primary	17.3	16.7	26.8	25.9
Secondary	35.8	47.7	28.0	22.4
More than secondary	9.1	14.3	16.5	36.5

Within the group surveyed, cancer screening/assessment activities were limited: 2% (4/267) of female participants had a previous cervical smear/assessment, and 3% (6/182) of females >40 years had ever had a mammogram (**Table 3**). The prevalence of colonoscopy screening in those >50 years was 5% (9/200). In terms of healthcare access, 180 individuals (52%) had seen a primary healthcare doctor in the last year and were less likely to see a traditional healer during this period. Of all participants, 110 reported being diagnosed with hypertension (32%), but most individuals were not on daily hypertensive medication (n=324, 94%). The use of other medications for primary prevention of NCDs, such as aspirin and anti-cholesterol medications, was also infrequent.

Table 3: Screening activities, access to medical services, and health conditions

Variable	n (%)
Cancer screening	
Cervical Cancer assessment (if female > 21, n = 261)	4 (1.5)
Previous mammogram (if female >40, n = 183)	6 (3.3)
Previous colonoscopy (if >50 years, n = 190)	9 (4.5)
Last primary health care physician visit	
<1 year ago	180 (52.0)
1-4 years ago	93 (26.9)
5-10 years ago	32 (9.2)
>10 years ago	41 (11.8)
Last time seen traditional healer	

Never	254 (73.4)	
<2 years ago	66 (19.1)	
≥2 years ago	26 (7.5)	
Hypertension	110 (31.8)	
Diabetes	16 (4.6)	
High cholesterol	24 (6.9)	
Stroke	18 (5.2)	
Alcohol use⁺		
No	227 (65.6)	
Yes, drank in past, but quit	65 (18.8)	
Yes, currently drink alcohol	54 (15.6)	
Smoking status*		
Never	303 (87.6)	
Ever	43 (12.4)	
Medication use		
Reported anti-hypertensive use	78 (22.5)	
Reported aspirin use	89 (25.7)	
Reported anti-cholesterol use	7 (2.0)	
Reported herbal supplement use	233 (67.3)	
Oral contraceptive use		
Never	175 (67.0)	
Past use	64 (24.5)	
Current use	22 (8.4)	

⁺ Participants were asked "Have you had 10 or more drinks of alcohol in your life?"

* Participants were asked "Have you smoked 5 packs of cigarettes (100) or more in your lifetime?"

Only 15 individuals out of 346 (4%) had medical insurance (**Table 4**). For the remaining uninsured participants, 66% reported that they were unaware that health insurance existed. A further 73 participants (22%) stated that insurance was too difficult to access. Despite this, nearly half of those surveyed (n=160, 46%) reported a major medical cost in the last year, with the majority from unforeseen events, such as acute illness, trauma, or surgery (58%). The costs incurred ranged from 5000-1,500,000 Naira, with a median of 10,000 Naira, an amount that is more than the monthly income for ~45% of individuals in this study. In addition, 52 participants (33%) reported that their major medical costs were for chronic conditions. Overall individuals,

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with incomes in the lowest brackets (<50,000 Naira), accounted for most of those that incurred major medical costs in the last two years (74.4%), had more visits to their primary care doctor in the year (75.6%), and higher levels of hypertension (80.4%).

Table 4: Insurance coverage and medical costs

Variable	n (%)
Insurance	
No	331 (95.7)
Yes	15 (4.3)
Last time used insurance	
In the last 2 years	6 (40.0)
>2 years ago	9 (60.0)
How many family members covered by insurance	
None	331 (95.7)
1-2	8 (2.3)
3-4	3 (0.9)
5 or more	4 (1.2)
Reasons for not having insurance (n=331)	
Expense	32 (9.7)
Lack of coverage	13 (3.9)
Too difficult to access	73 (22.1)
Other	217 (65.6)
Major medical costs in the last 2 years	
No	186 (53.8)
Yes	160 (46.2)
Estimated amount	
<10,000 Naira	73 (45.6)
10,000-49,000 Naira	38 (23.8)
50,000-99,999 Naira	16 (10.0)
>100,000 Naira	22 (13.8)
Unknown	11 (6.9)
Reasons for major medical costs (n=158)	
Surgery	17 (10.8)
Chronic conditions	52 (32.9)
Acute illness/trauma	74 (46.8)
Other/multiple reasons	15 (9.5)
Amount spent (continuous)	
Overall median (range)	10,000 (50-1,500,000)
Median amount spent by reason (range)	
Surgery	60,000 (7,000-150,000)
Chronic conditions	18,000 (500-150,000)

Acute illness/trauma	5,000 (50-400,000)
Other/multiple reasons	70,000 (800-500,000)

Within eligible populations, we performed analysis to look for the association between cancer screening activity and income, insurance status and education **Table 5**. Individuals with lower levels of income were less likely to have had cancer screening assessments. Cancer screening activity was more frequent in those with higher levels of education. No significant relationship was observed by insurance status or other factors that were assessed. In a multivariable logistic regression model including personal income, insurance status and education, the only statistically significant odds ratio for association with cancer screening activity was observed for personal income (personal income OR 2.7 95%CI 1.3-5.7 p<0.01, education level OR 1.7 95%CI 0.98-2.7 p=0.06, insurance status OR 4.3 95%CI 0.8-23.1 p=0.09.

Table 5: Association between Cancer Screening Activity and Income, Insurance and Education N =310[+]

Variable	Cancer Screening (N=17)	No Cancer Screening (N=293)	P value*
Personal income (per month, in Naira)			
<10,000	2/138 (1.5)	140/138 (98.5)	
10,000-49,999	9/122 (7.4)	115/122 (92.6)	<0.01
>50,000	6/43 (14.0)	38/43 (86.0)	
Family income (per month, in Naira)			
<10,000	1/108 (0.9)	107/108 (99.1)	
10,000-49,999	8/129(6.2)	121/129(93.8)	<0.01
>50,000	8/66 (12.1)	58/66 (87.9)	
Insurance Status			
No	15/290 (5.2)	275/290 (94.8)	0.12
Yes	2/13 (15.4)	11/13 (84.6)	
Education			
No formal education	1/86 (1.2)	85/86 (98.8)	
Primary	3/83 (3.6)	80/83 (96.4)	0.04
Secondary	8/78 (10.3)	70/78 (89.7)	

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Higher	5/56 (8.9)	51/56 (91.1)

No association by Gender, Marital Status, Religion

[+] Adjusted for eligible population, whereby cancer screening activities defined as history of cervical assessment in women >21 years, mammogram in women >40 years, and colonoscopy in all individuals >50 years
[*] Fisher's exact test for association

DISCUSSION

We performed a cross-sectional community-based study in Osun state, Nigeria to provide a snapshot of the challenges faced in the management of NCDs in the region. This study was conducted with an emphasis on cancer within broader research aims of identifying risk factors (lifestyle, diet, biological) associated with the rising cancer incidence in the region. We observed that screening assessment for breast, cervical, and colon cancer (the major contributors to cancer morbidity in the region), [6 19 33] were extremely low. This observation was despite a median age of 52 years and a high representation of females. In addition, <5% of the surveyed population possessed universal health care in the form of health insurance. We also found low incomes, high fertility rates, and evidence of poorly controlled chronic diseases, such as hypertension, in our cohort. The rates are comparable to national averages (suggesting our sample sits between the urban/rural divide)[31] and likely represent broad health and development deficiencies present in the community. For example, the high prevalence of hypertension in this population is remarkably similar to that reported in a systematic review and meta-analysis conducted in the region.[34 35] The high burden of hypertension in the region has also been recently acknowledged by the World Health Organization in its efforts to control hypertension in Nigeria.[36]

Previous studies conducted in the region [37-45] have demonstrated that poor access to cancer services is associated with late presentation and high incidence/mortality ratio.[5 46] This highlights a need to develop sound healthcare infrastructure, whereby individuals can be screened for asymptomatic disease and also adequately access services in a timely fashion when symptomatic. Our study identifies that screening activities may be lacking through either delivery and/or uptake, and that the potential

cost implications of accessing treatment when symptoms arise, in the absence of adequate health insurance, can be high. The experience from other sub-Saharan African nations suggests that individuals seeking cancer services face significant barriers to access.[38][39][47-50] The Nigerian "National Cancer Control Plan 2018-2022," specifically details goals to make screening services and early detection of cancer available for all Nigerians, and to improve access to quality, cost-effective, and equitable diagnostic and treatment services for cancer care. This is centered around investment in eight public comprehensive cancer centers covering all geo-political zones, as well as the implementation of various screening strategies throughout different sectors of the healthsystem.[20]. Our results suggest that considerable work is required to reach the goal of "greater than 50% screening of 'eligible populations' by 2022."[20] We assessed cancer screening using measures that are recommended in this national plan. The methods we assessed are accessed at different levels of the healthcare system – cervical cancer assessment predominantly at a primary health care level, breast cancer at secondary/tertiary level through mammography, and colon cancer at tertiary level through colonoscopy. Whilst our analysis provides some idea of how individuals may have navigated the health system further detailed study is required to look at specific engagement at these different levels to inform appropriate resource allocation.

It is important to acknowledge that cancer screening in low and middle income countries requires measures tailored to local capacity and disease prevalence. For breast cancer, although mammography remains the gold standard for early detection of breast cancer, the Breast Health Global Initiative (BHGI) resource-stratified guidelines recommend clinical breast examination as a practical and necessary

alternative for early detection in low-resource settings.[19] [48] [51] This has been recommended in local policy and was not assessed in the current study.[20] Despite this, with over 50 percent of individuals in this study visiting a primary health care doctor in the last year, our findings strongly support the need to concentrate cancer screening efforts at primary healthcare where possible through the use of similar interventions. Colon cancer screening by colonoscopy for those over the age of fifty as recommended in high income countries does not exist in sufficient capacity for this to be recommended in an LMIC setting.[52] Efforts to intervene at primary healthcare level through the use of stool testing and symptom stratification are ongoing.[53] [54] Overall, education, training and adequately resourcing community healthcare workers and physicians at primary healthcare level for cancer screening assessment is essential.

We demonstrated that both income and medical expenditure relative to this level of income, compounded by the lack of universal health care coverage, must be factored into strategies laid out to address cancer control. The costs of the screening interventions assessed in this study relative to income, are prohibitive for the majority of individuals without government subsidy; approx. $50 US ~ $18000 Naira (for mammography), $15 US ~ $3000 Naira (cervical smear). This is compounded by the finding of only 4% of our cohort having health insurance coverage. In addition, major medical costs were incurred by over half of those interviewed, and a significant proportion of these costs were for chronic diseases (33%). Those individuals with the lowest income were more likely to report visits to the doctor, chronic disease, and significant "out of pocket" medical expenditures. The Nigerian national health insurance scheme (NHIS) has been in place since 2005. When it was introduced, state

governments were instructed to adopt the program for their employees in the formal sector. After insuring government employees, state governments were instructed to expand coverage across all individuals with the goal of universal health coverage.[14] [15] Recent reports confirm that this expansion has been limited in Nigeria. In line with previous studies, our data indicate that the NHIS is severely underutilized in the community population.[15] [16] The state health insurance scheme has been instituted in only 2 out of 36 states of the federation at community level and this has not been the case in Osun state where the study took place. [15]

We found wide range of "major" medical expenditure in our study group, with a median expenditure exceeding the monthly salary of ~45% of the group. It is important to note that we did not obtain information on total household expenditures to allow a relative assessment of the amount spent on medical costs, and, in turn, determine "catastrophic" costs.[16] However, based on income and demographic comparisons with other groups studied in the region, it is likely that catastrophic spending is high.[55] Further research into how the money to cover medical expenditure is generated (i.e., personal savings, family savings, loans, etc.) is required. Taken together with prior work in the region [56] [57], it is evident that risk pooling and financial risk protection are required for the provision of preventative and therapeutic NCD health services.

Whilst we did not directly assess awareness of cancer screening, we did demonstrate an association between cancer screening activity and education level. Levels of education have been associated with awareness and accessing cancer services in previous studies.[38] [45] [47] [58] In addition to this, we also found that ~75% of participants had access to radio and/or television within family and social networks, suggesting

that mass communication channels to promote health awareness exist. In fact, these facilitated the current study when combined with strategies using mobile phone technologies. More broadly, these channels represent promising avenues to promote health and prevention of disease in the region.[59] In addition, "demand-side" approaches to resource allocation, such as the stipend we provided for travel in the study or e-vouchers,[60 61] are likely to be well received by the community and may promote uptake of health-screening activities.

A strength of this study is that it was performed within the community and involved trained research staff fluent in the local dialect and used a validated questionnaire. The study was performed in conjunction with local community healthcare workers and the tertiary referral hospital, which was intended to help residents develop an awareness of how and where healthcare can be accessed in the area and to establish a sustained relationship with this community. Limitations of this work include the potential for misclassification and recall bias, as we relied on individuals to retrospectively describe their own health and socioeconomic status as well as their interactions with healthcare services. Whilst we have documented low levels of screening activities and associations with income and education, we did not directly require individuals to state specifically their personal reasons for not being screened; we were therefore unable to delineate specific barriers to cancer screening, such as emotional barriers (e.g., concern about cancer diagnosis, limited awareness) and barriers to access (e.g., screening locations, availability of transportation, limited finances, etc.). Detailed qualitative analysis of these barriers would be worthwhile and is the subject of our future work in the region. In addition, while the study sample was chosen at random and consecutive individuals were enrolled, the survey was

conducted at a single time that was mid-week, during the day; this timing may have affected our sample composition. For instance, 75% of participants in our study were female, which may potentially limit the generalizability of our findings. However, it is reassuring we observed overall consistency with national demographic indicators (e.g., income, education, and living conditions), which indicates that our sample is likely reflective of rural community-dwelling individuals in the wider region.[31] [32]

In summary, our results highlight infrequent cancer screening activities in a Nigerian community population and identifies areas that can be targeted to address this, including the use of measures focused at primary healthcare level, financial risk protection, awareness, and strategic resource allocation.

Ethical Approval Statement

The study was approved by the Obafemi Awolowo University institutional ethics review committee.

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2. **O.I. Alatise**

   Author contribution: Initial conception, study and questionnaire design, manuscript revision

3. **K. O'Connell**

   Author contributions: Data and statistical analysis, questionnaire design, manuscript revision

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7. **F. Wuraola**

   Author contributions: study design, questionnaire design, manuscript revision

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   Author contributions: study design, data collection, manuscript revision

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Competing Interests: None to declare

Data sharing: No additional data available

REFERENCES

1. Niessen LW, Mohan D, Akuoku JK, et al. Tackling socioeconomic inequalities and non-communicable diseases in low-income and middle-income countries under the Sustainable Development agenda. *Lancet* 2018;391(10134):2036-46. doi: 10.1016/s0140-6736(18)30482-3 [published Online First: 2018/04/09]

2. Ezzati M, Pearson-Stuttard J, Bennett JE, et al. Acting on non-communicable diseases in low- and middle-income tropical countries. *Nature* 2018;559(7715):507-16. doi: 10.1038/s41586-018-0306-9 [published Online First: 2018/07/27]

3. NCD Countdown 2030: worldwide trends in non-communicable disease mortality and progress towards Sustainable Development Goal target 3.4. *Lancet* 2018;392(10152):1072-88. doi: 10.1016/s0140-6736(18)31992-5 [published Online First: 2018/09/29]

4. GLOBOCAN 2018: counting the toll of cancer. *Lancet* 2018;392(10152):985. doi: 10.1016/s0140-6736(18)32252-9 [published Online First: 2018/09/29]

5. Bray F, Ferlay J, Soerjomataram I, et al. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: A Cancer Journal for Clinicians* 2018;68(6):394-424. doi: 10.3322/caac.21492

6. Olaleye O, Ekrikpo U. Epidemiology of Cancers in Sub-Saharan Africa. In: Adedeji OA, ed. Cancer in Sub-Saharan Africa: Current Practice and Future. Cham: Springer International Publishing 2017:3-19.

7. Mostert S, Njuguna F, Olbara G, et al. Corruption in health-care systems and its effect on cancer care in Africa. *Lancet Oncol* 2015;16(8):e394-404. doi: 10.1016/s1470-2045(15)00163-1 [published Online First: 2015/08/08]

8. Harford JB. Barriers to overcome for effective cancer control in Africa. *Lancet Oncol* 2015;16(8):e385-93. doi: 10.1016/s1470-2045(15)00160-6 [published Online First: 2015/08/08]

9. Transforming our world : the 2030 Agenda for Sustainable Development: UN General Assembly; 21 October 2015 [Available from: https://www.undp.org/content/undp/en/home/sustainable-development-goals.html accessed 23 August 2019.

10. Douthit NT, Alemu HK. Social determinants of health: poverty, national infrastructure and investment. *BMJ Case Reports* 2016;2016:bcr2016215670. doi: 10.1136/bcr-2016-215670

11. Attia-Konan AR, Oga ASS, Touré A, et al. Distribution of out of pocket health expenditures in a sub-Saharan Africa country: evidence from the national survey of household standard of living, Côte d'Ivoire. *BMC Res Notes* 2019;12(1):25. doi: 10.1186/s13104-019-4048-z [published Online First: 2019/01/17]

12. Leive A, Xu K. Coping with out-of-pocket health payments: empirical evidence from 15 African countries. *Bull World Health Organ* 2008;86(11):849-56. doi: 10.2471/blt.07.049403 [published Online First: 2008/11/26]

13. Xu K, Evans DB, Kawabata K, et al. Household catastrophic health expenditure: a multicountry analysis. *Lancet* 2003;362(9378):111-7. doi: 10.1016/s0140-6736(03)13861-5 [published Online First: 2003/07/18]

14. Onoka CA, Onwujekwe OE, Uzochukwu BS, et al. Promoting universal financial protection: constraints and enabling factors in scaling-up coverage with social health insurance in Nigeria. *Health Res Policy Syst* 2013;11:20. doi: 10.1186/1478-4505-11-20 [published Online First: 2013/06/15]

15. Uzochukwu BS, Ughasoro MD, Etiaba E, et al. Health care financing in Nigeria: Implications for achieving universal health coverage. *Niger J Clin Pract* 2015;18(4):437-44. doi: 10.4103/1119-3077.154196 [published Online First: 2015/05/15]

16. Aregbeshola BS, Khan SM. Out-of-Pocket Payments, Catastrophic Health Expenditure and Poverty Among Households in Nigeria 2010. *Int J Health Policy Manag* 2018;7(9):798-806. doi: 10.15171/ijhpm.2018.19 [published Online First: 2018/10/15]

17. Jedy-Agba E, Curado MP, Ogunbiyi O, et al. Cancer incidence in Nigeria: a report from population-based cancer registries. *Cancer Epidemiol* 2012;36(5):e271-8. doi: 10.1016/j.canep.2012.04.007 [published Online First: 2012/05/25]

18. Awodele O, Adeyomoye AA, Awodele DF, et al. Cancer distribution pattern in south-western Nigeria. *Tanzan J Health Res* 2011;13(2):125-31. doi: 10.4314/thrb.v13i2.55226 [published Online First: 2011/04/01]

19. Ishola F, Omole O. A vision for improved cancer screening in Nigeria. *Lancet Glob Health* 2016;4(6):e359-60. doi: 10.1016/s2214-109x(16)30062-6 [published Online First: 2016/05/21]

20. Nigeria National Cancer Control Plan 2018 – 2022. Abuja: Federal Ministry of Health, Nigeria 2018.

21. World Bank staff estimates based on the United Nations Population Division's World Urbanization Prospects: 2018 Revision: The World Bank Group; [Available from: https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS accessed November 2019.

22. Kingham TP, Alatise OI. Establishing Translational and Clinical Cancer Research Collaborations Between High- and Low-Income Countries. *Annals of Surgical Oncology* 2015;22(3):741-46. doi: 10.1245/s10434-014-4342-x

23. Irabor DO. Emergence of Colorectal Cancer in West Africa: Accepting the Inevitable. *Niger Med J* 2017;58(3):87-91. doi: 10.4103/0300-1652.234076 [published Online First: 2017/05/01]

24. National Population Commission (NPC) [Nigeria] and ICF International. 2014. Nigeria Demographic and Health Survey 2013. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF International. https://dhsprogram.com/pubs/pdf/fr293/fr293.pdf (Accessed February 14, 2018).

25. National Bureau of Statistics (NBS) - Federal Government of Nigeria. Nigeria - General Household Survey, Panel 2015-2016, Wave 3. http://microdata.worldbank.org/index.php/catalog/2734/study-description (Accessed February 15, 2018).

26. Cleland CL, Hunter RF, Kee F, et al. Validity of the global physical activity questionnaire (GPAQ) in assessing levels and change in moderate-vigorous physical activity and sedentary behaviour. *BMC Public Health* 2014;14:1255. doi: 10.1186/1471-2458-14-1255 [published Online First: 2014/12/11]

27. Colditz GA, Manson JE, Hankinson SE. The Nurses' Health Study: 20-year contribution to the understanding of health among women. *J Womens Health* 1997;6(1):49-62.

28. Hu FB, Satija A, Rimm EB, et al. Diet Assessment Methods in the Nurses' Health Studies and Contribution to Evidence-Based Nutritional Policies and Guidelines. *American*

journal of public health 2016;106(9):1567-72. doi: 10.2105/AJPH.2016.303348 [published Online First: 2016/07/28]

29. Willett WC, Sampson L, Stampfer MJ, et al. Reproducibility and Validity of a Semiquantitative Food Frequency Questionnaire. *American Journal of Epidemiology* 1985;122(1):51-65. doi: 10.1093/oxfordjournals.aje.a114086

30. Wolf AM, Hunter DJ, Colditz GA, et al. Reproducibility and Validity of a Self-Administered Physical Activity Questionnaire. *International Journal of Epidemiology* 1994;23(5):991-99. doi: 10.1093/ije/23.5.991

31. Nigeria Demographic and Health Survey. Abuja, Nigeria: National Population Commission, Federal Republic of Nigeria, June 2014.

32. "Nigeria Country Briefing", Multidimensional Poverty Index Data Bank: Oxford Poverty and Human Development Initiative, University of Oxford.; 2017 [Available from: www.ophi.org.uk/multidimensional-poverty-index/mpi-country-briefings/. accessed August 2019 2019.

33. Morhason-Bello IO, Odedina F, Rebbeck TR, et al. Challenges and opportunities in cancer control in Africa: a perspective from the African Organisation for Research and Training in Cancer. *Lancet Oncol* 2013;14(4):e142-51. doi: 10.1016/s1470-2045(12)70482-5 [published Online First: 2013/04/09]

34. Adeloye D, Basquill C, Aderemi AV, et al. An estimate of the prevalence of hypertension in Nigeria: a systematic review and meta-analysis. *J Hypertens* 2015;33(2):230-42. doi: 10.1097/hjh.0000000000000413 [published Online First: 2014/11/08]

35. Idris IO, Oguntade AS, Mensah EA, et al. Prevalence of non-communicable diseases and its risk factors among Ijegun-Isheri Osun residents in Lagos State, Nigeria: a community based cross-sectional study. *BMC Public Health* 2020;20(1):1258. doi: 10.1186/s12889-020-09349-2

36. Nigeria collaborates with WHO to curb hypertension, introduces control initiative Abeokuta, Nigeria: World Health Organisation; December 2020 [Available from: https://www.afro.who.int/news/nigeria-collaborates-who-curb-hypertension-introduces-control-initiative#:~:text=The%20review%20estimated%20that%20prevalence,29.5%25%2C%20women%2031.1%25). accessed 15 April 2021 2021.

37. Olasehinde O, Alatise OI, Arowolo OA, et al. Barriers to mammography screening in Nigeria: A survey of two communities with different access to screening facilities. *Eur J Cancer Care (Engl)* 2019;28(2):e12986. doi: 10.1111/ecc.12986 [published Online First: 2019/01/08]

38. McKenzie F, Zietsman A, Galukande M, et al. Breast cancer awareness in the sub-Saharan African ABC-DO cohort: African Breast Cancer—Disparities in Outcomes study. *Cancer Causes & Control* 2018;29(8):721-30. doi: 10.1007/s10552-018-1047-7

39. Makau-Barasa LK, Greene SB, Othieno-Abinya NA, et al. Improving Access to Cancer Testing and Treatment in Kenya. *Journal of Global Oncology* 2018(4):1-8. doi: 10.1200/jgo.2017.010124

40. Ugwumba FO, Ekwueme OE, Okoh AD. Testicular Cancer and Testicular Self-Examination; Knowledge, Attitudes and Practice in Final Year Medical Students in Nigeria. *Asian Pac J Cancer Prev* 2016;17(11):4999-5003. doi: 10.22034/apjcp.2016.17.11.4999 [published Online First: 2016/12/30]

41. Mbamara SU, Ikpeze OC, Okonkwo JE, et al. Knowledge, attitude and practice of cervical cancer screening among women attending gynecology clinics in a tertiary level

medical care center in southeastern Nigeria. *J Reprod Med* 2011;56(11-12):491-6. [published Online First: 2011/12/27]

42. Wright KO, Kuyinu YA, Faduyile FA. Community education on cervical cancer amongst market women in an urban area of Lagos, Nigeria. *Asian Pac J Cancer Prev* 2010;11(1):137-40. [published Online First: 2010/07/03]

43. Aniebue PN, Aniebue UU. Awareness and practice of cervical cancer screening among female undergraduate students in a Nigerian university. *J Cancer Educ* 2010;25(1):106-8. doi: 10.1007/s13187-009-0023-z [published Online First: 2010/01/19]

44. Ajape AA, Babata A, Abiola OO. Knowledge of prostate cancer screening among native African urban population in Nigeria. *Nig Q J Hosp Med* 2010;20(2):94-6. [published Online First: 2011/01/20]

45. Obiechina NJ, Mbamara SU. Knowledge attitude and practice of cervical cancer screening among sexually active women in Onitsha, southeast Nigeria. *Niger J Med* 2009;18(4):384-7. [published Online First: 2010/02/03]

46. Kontis V, Mathers CD, Bonita R, et al. Regional contributions of six preventable risk factors to achieving the 25 x 25 non-communicable disease mortality reduction target: a modelling study. *Lancet Glob Health* 2015;3(12):e746-57. doi: 10.1016/s2214-109x(15)00179-5 [published Online First: 2015/10/27]

47. Tiruneh FN, Chuang KY, Ntenda PAM, et al. Individual-level and community-level determinants of cervical cancer screening among Kenyan women: a multilevel analysis of a Nationwide survey. *BMC Womens Health* 2017;17(1):109. doi: 10.1186/s12905-017-0469-9 [published Online First: 2017/11/17]

48. Masalu N, Serra P, Amadori D, et al. Setting up a community-based cervical screening service in a low-income country: a pilot study from north-western Tanzania. *International Journal of Public Health* 2017;62(7):755-62. doi: 10.1007/s00038-017-0971-8

49. Kangmennaang J, Mkandawire P, Luginaah I. Breast cancer screening among women in Namibia: explaining the effect of health insurance coverage and access to information on screening behaviours. *Glob Health Promot* 2017:1757975917727017. doi: 10.1177/1757975917727017 [published Online First: 2017/09/26]

50. Stulac S, Binagwaho A, Tapela NM, et al. Capacity building for oncology programmes in sub-Saharan Africa: the Rwanda experience. *Lancet Oncol* 2015;16(8):e405-13. doi: 10.1016/s1470-2045(15)00161-8 [published Online First: 2015/08/08]

51. Anderson BO, Yip CH, Smith RA, et al. Guideline implementation for breast healthcare in low-income and middle-income countries: overview of the Breast Health Global Initiative Global Summit 2007. *Cancer* 2008;113(8 Suppl):2221-43. doi: 10.1002/cncr.23844 [published Online First: 2008/09/26]

52. Knapp GC, Alatise OI, Olasehinde OO, et al. Is Colorectal Cancer Screening Appropriate in Nigeria? *J Glob Oncol* 2019;5:1-10. doi: 10.1200/jgo.19.00035 [published Online First: 2019/06/07]

53. Alatise OI, Ayandipo OO, Adeyeye A, et al. A symptom-based model to predict colorectal cancer in low-resource countries: Results from a prospective study of patients at high risk for colorectal cancer. *Cancer* 2018;124(13):2766-73. doi: 10.1002/cncr.31399 [published Online First: 2018/04/13]

54. Knapp GC, Sharma A, Olopade B, et al. An Exploratory Analysis of Fecal Immunochemical Test Performance for Colorectal Cancer Screening in Nigeria. *World J Surg*

2019;43(11):2674-80. doi: 10.1007/s00268-019-05100-0 [published Online First: 2019/08/14]

55. Olugbenga-Bello A, Adebimpe W. Knowledge and attitude of civil servants in Osun state, Southwestern Nigeria towards the national health insurance. *Nigerian Journal of Clinical Practice* 2010;13(4):421-26.

56. Dieleman JL, Sadat N, Chang AY, et al. Trends in future health financing and coverage: future health spending and universal health coverage in 188 countries, 2016–40. *The Lancet* 2018;391(10132):1783-98. doi: https://doi.org/10.1016/S0140-6736(18)30697-4

57. Dieleman J, Campbell M, Chapin A, et al. Evolution and patterns of global health financing 1995–2014: development assistance for health, and government, prepaid private, and out-of-pocket health spending in 184 countries. *The Lancet* 2017;389(10083):1981-2004. doi: https://doi.org/10.1016/S0140-6736(17)30874-7

58. Alatise OI, Fischer SE, Ayandipo OO, et al. Health-Seeking Behavior and Barriers to Care in Patients With Rectal Bleeding in Nigeria. *Journal of global oncology* 2017;3(6):749-56. doi: 10.1200/JGO.2016.006601 [published Online First: 2017/02/01]

59. Yang Q, Van Stee SK. The Comparative Effectiveness of Mobile Phone Interventions in Improving Health Outcomes: Meta-Analytic Review. *JMIR Mhealth Uhealth* 2019;7(4):e11244. doi: 10.2196/11244 [published Online First: 2019/04/04]

60. Erwin E, Aronson KJ, Day A, et al. SMS behaviour change communication and eVoucher interventions to increase uptake of cervical cancer screening in the Kilimanjaro and Arusha regions of Tanzania: a randomised, double-blind, controlled trial of effectiveness. *BMJ Innovations* 2019:bmjinnov-2018-000276. doi: 10.1136/bmjinnov-2018-000276

61. Hurst TE, Semrau K, Patna M, et al. Demand-side interventions for maternal care: evidence of more use, not better outcomes. *BMC Pregnancy Childbirth* 2015;15:297. doi: 10.1186/s12884-015-0727-5 [published Online First: 2015/11/17]

Participant ID: _____　　COLORECTAL CASE / BREAST CASE / CONTROL (CIRCLE ONE)

Recruitment site: _____　　MALE / FEMALE (CIRCLE ONE)

Interviewer ID: _____　　　　Date questionnaire administered: _____

Phone Number_____　Hospital Number _____

Patient Surname: _____　　Patient First Name: _____

All INFORMATION IS STRICTLY CONFIDENTIAL AND IS TO BE USED FOR RESEARCH PURPOSES ONLY.

PLEASE NOTE IN COVER SHEET REASON FOR NON-RESPONSE TO ANY QUESTIONS.

PLEASE ENTER ALL WRITTEN TEXT USING ONLY CAPITAL LETTERS.

PLEASE ENTER ALL NUMBERS AS VALUES ONLY WITH NO SYMBOLS OR PUNCTUATION.

Demographic History

1. What is your date of birth (DAY/MONTH/YEAR)? _____/_____/_____

2. (*FOR CASES ONLY*) When did you last feel well (i.e., mostly unaffected by pain/discomfort)? _____ (months ago)

3. (*FOR CASES ADD:* When you were well) what is/was your weight? (*Measure to nearest kg)* _____ (kg)

4. Has your weight changed (+/- 5 kg) in the past 2 years? ☐ No　　☐ Increased 5 kg　　☐ Decreased 5 kg

5. Which diagram best depicts your <u>outline</u> at each age?
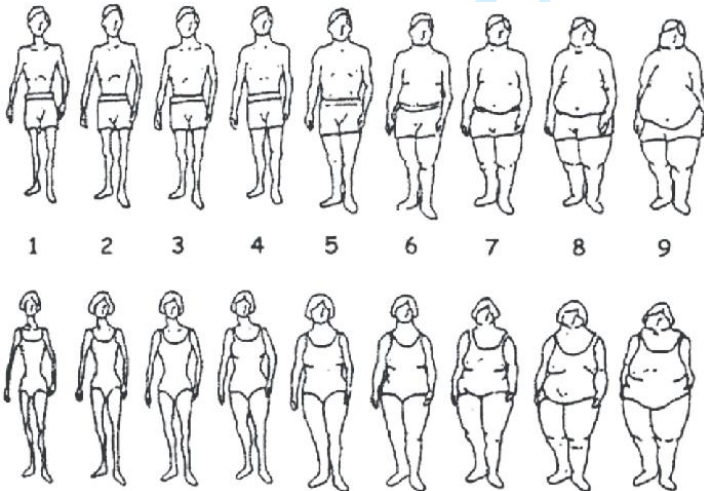
	Indicate diagram (1 to 9)
Age 10 years	
Age 20 years	
Age 30 years (*if applicable*)	
Age 40 years (*if applicable*)	
Age 50 years (*if applicable*)	
Current	

6. What is your height? (*Measure to nearest cm)* _____ (cm)

7. What is your current marital status? ☐ Single　　☐ Widowed　　☐ Married　　☐ Divorced

8. Has anyone in your immediate family (e.g., parents, siblings, children) completed secondary school or above? ☐ Yes　　☐ No

9. What is the highest educational level you have completed?

☐ No formal education ☐ Primary ☐ Secondary ☐ Vocational/technical ☐ University ☐ Graduate school

10. What is/was your occupation at the following 2 time periods?

	Unemployed	Pensioner	Civil Servant	Trader	Farmer	Driver	Self Employed	Retired	Student	Other _____
Current										
Less than 2 years ago										
More than 2 years ago										

11. What is your current religion? ☐ Christian　　☐ Muslim　　☐ Traditional　　☐ Other_____ (specify)

12. What is your current address? Latitude _____ Longitude _____ House Number _____ Street/Suburb Name _____ Town _____

LGA/District _____ Landmark _____ Village Name _____

13. What tribe do you belong to? ☐ Yoruba ☐ Ibo ☐ Hausa ☐ Other_____ (specify)

14. Including yourself, how many people live in your household? _____

15. Including you, what was your <u>household's</u> AVERAGE MONTHLY combined income (including all sources) over the last year?

_____(Naira) ☐ Refused/Don't Know

↓ If refused/don't know

15a. Was your <u>household's</u> AVERAGE MONTHLY combined income last year less than 21000 Naira? ☐ Yes ☐ No

15b. Was your <u>household's</u> AVERAGE MONTHLY combined income last year less than 34000 Naira? ☐ Yes ☐ No

16. What was your <u>personal</u> AVERAGE MONTHLY income (including all sources) over the last year?

_____(Naira) ☐ Refused/Don't Know

↓ If refused/don't know

16a. Was your <u>personal</u> AVERAGE MONTHLY income last year less than 21000 Naira? ☐ Yes ☐ No

16b. Was your <u>personal</u> AVERAGE MONTHLY income last year less than 34000 Naira? ☐ Yes ☐ No

17. What type of toilet do you have at home? ☐ Water system (flushable) ☐ Pit latrine with vent pipe ☐ Unventilated pit latrine
☐ Bush ☐ Bucket ☐ Composting toilet ☐ Other_____

18. Is your toilet shared with another household? ☐ Yes ☐ No

19. What is the source of your water supply? ☐ Pipe borne ☐ Public tap ☐ Borehole or pump ☐ Dug well
☐ River/spring ☐ Rain harvested water ☐ Other_____

20. Is your source of water located within your compound?
☐ Yes ☐ No

↓ If no

20a. Is your water source more than 30 minutes away by foot (*to and from*)? ☐ Yes ☐ No

21. Does the construction of your source of water protect the water from outside contamination? ☐ Yes ☐ No ☐ Don't Know

22. What type of floor do you have in your home?
☐ Cement ☐ Tile ☐ Wood ☐ Dirt/clay/earth ☐ Sand ☐ Dung ☐ Other_____

23. Which of these do you have in your home? (Select as many as may apply.)
☐ Electricity (Connected to the community power grid) ☐ Television ☐ Radio ☐ Refrigerator ☐ Telephone
☐ Air conditioner ☐ Generating set ☐ Personal computer ☐ Electric fan ☐ Cable (DSTV, etc.)

24. What is your <u>primary</u> cooking source? (Select only one.) ☐ Electric cooker ☐ Gas cooker ☐ Kerosene stove
☐ Charcoal or coal ☐ Wood ☐ Dung ☐ Other_____

25. Do you own any of the following? (Select as many as may apply.)
☐ Personal car or truck ☐ Bicycle ☐ Motorcycle ☐ Other automobiles_____

26. Do you have National Health Insurance (NHIS)?
☐ Yes ☐ No (go to question 27)
↓ If yes
26a. When did you last use this insurance? ☐ In the last 2 years ☐ More than 2 years ago
26b. Including yourself, how many members of your household are covered by insurance? _____

27. If no insurance, what are your reasons for not having insurance? (Select as many as may apply.)
☐ Too Expensive ☐ Doesn't cover my medical needs/costs ☐ Too difficult to access
☐ Unaware of the NHIS ☐ Other _____

28. Did you have any major medical costs in the last 2 years (regardless of insurance status)?
☐ Yes ☐ No
↓ If yes
28a. Please specify what for _____and estimated cost _____(Naira)

Past Medical History

29. Have you ever been <u>TOLD BY A DOCTOR/HEALER</u> you have any of the following conditions?

	Yes	No	If Yes →	Year of diagnosis (If <u>newly</u> diagnosed multiple times, select all that apply)			Currently being treated?	
				More than 10 years ago	**5 to 10 years ago**	**Less than 5 years ago**	**Yes**	**No**
Tuberculosis (TB)	☐	☐					☐	☐
Malaria	☐	☐					☐	☐
HIV	☐	☐					☐	☐
Hepatitis B (HBV)	☐	☐					☐	☐
Hepatitis C (HCV)	☐	☐					☐	☐
Amoebic infection	☐	☐					☐	☐
Schistosomiasis	☐	☐					☐	☐
Giardia	☐	☐					☐	☐
Other parasitic infection _____(specify)	☐	☐					☐	☐
Chronic Obstructive Pulmonary Disease (COPD)	☐	☐					☐	☐
Sickle Cell Disease (SCD)	☐	☐					☐	☐
Peptic Ulcer Disease	☐	☐					☐	☐
Diabetes	☐	☐					☐	☐
Hypertension (high blood pressure)	☐	☐					☐	☐
Myocardial infarction (heart attack)	☐	☐					☐	☐
High cholesterol	☐	☐					☐	☐
Stroke or mini-stroke	☐	☐					☐	☐
Asthma	☐	☐					☐	☐
Epilepsy	☐	☐					☐	☐
Cancer _____(specify)	☐	☐					☐	☐

30. (*FOR CASES ADD:* Prior to your visit/s for your cancer diagnosis) when was the last time you received care in a hospital?
☐ Less than 1 year ago   ☐ 1-4 years ago   ☐ 5-10 years ago   ☐ More than 10 years ago

31. Have you ever seen a traditional healer?
☐ Yes   ☐ No (go to question 32)
↓ If yes
☐ Saw <2 YEARS AGO
☐ Saw 2+ YEARS AGO
↓
31a. Did you receive any treatment?   ☐ Yes_____(specify)   ☐ No

32. Do you use traditional remedies at home?

☐ Yes _____(specify)   ☐ No (go to question 33)
↓ If yes
☐ Used <2 YEARS AGO
☐ Used 2+ YEARS AGO

Screening History

33. Have you ever had colorectal cancer screening?   ☐ Yes ☐ No (go to question 34) ☐ Never heard of this (go to question 34)
(e.g., Colonoscopy/sigmoidoscopy, stool test)   ↓ If yes (Select all that apply.)
*Colonoscopy/sigmoidoscopy: internal view of   ☐ Colonoscopy/sigmoidoscopy <10 YEARS AGO
intestines/colon via inserted camera*   ☐ Colonoscopy/sigmoidoscopy 10+ YEARS AGO
☐ Stool test <2 YEARS AGO
☐ Stool test 2+ YEARS AGO
↓
33a. Did you receive any treatment?
☐ Yes _____(specify)   ☐ No

34. (*FOR WOMEN ONLY*)
Have you ever had cervical cancer screening?   ☐ Yes ☐ No (go to question 35) ☐ Never heard of this (go to question 35)
(e.g. Pap smear, HPV testing)   ↓ If yes
collecting cells from cervix to test for cancer   ☐ cervical cancer screening <3 YEARS AGO
☐ cervical cancer screening 3+ YEARS AGO
↓
34a. Did you receive any treatment?
☐ Yes _____(specify)   ☐ No

35. (*FOR WOMEN ONLY*)
Have you ever had breast cancer screening?   ☐ Yes ☐ No (go to question 36) ☐ Never heard of this (go to question 36)
(e.g. Mammogram)   ↓ If yes
x-ray of breasts   ☐ Mammogram <2 YEARS AGO
☐ Mammogram 2+ YEARS AGO
↓
35a. Did you receive any treatment?
☐ Yes _____(specify)   ☐ No

Family History

36. Have any of these relatives had the following cancers? (Select as many as may apply.)
☐ No family history of cancer (go to question 37)

	Mother	Father	Brother	Sister
Lung				
Breast				
Colon or rectal				
Prostate				
Cervical				
Uterine (endometrial)				
Ovarian				
Pancreas				
Other/unknown_____ (specify)				

37. Have any of these relatives had the following conditions? (Select as many as may apply.)
☐ No family history of the below conditions (go to question 38)

	Mother	Father	Brother	Sister
Diabetes				
Hypertension (high blood pressure)				
Myocardial infarction (heart attack)				
High cholesterol				
Stroke or mini-stroke				

Smoking & Alcohol History

38. Have you smoked 5 packs of cigarettes (100) or more in your lifetime?

☐ Yes, smoked in past, but quit　　　　☐ Yes, currently smoke　　　　☐ No (go to question 39)

↓ If smoked in past　　　　　　　　　　　If currently smoke

☐ Quit <2 YEARS AGO

☐ Quit 2+ YEARS AGO

↓

38a. At each age: Average number of cigarettes per day	None	1-4	5-14	15-24	25-35	36-44	45+
Current							
<2 years ago							
Age < 15 years							
Age 15-19 years							
Age 20-29 years (*if applicable*)							
Age 30-39 years (*if applicable*)							
Age 40-49 years (*if applicable*)							
Age 50-59 years (*if applicable*)							
Age 60 to the present (*if applicable*)							

39. Have you ever smoked any substance other than cigarettes? ☐ Yes_____(specify)　　　☐ No

40. Have you had 10 or more drinks of alcohol in your lifetime?

A drink = bottle/can of beer or, glass of wine or, shot of liquor

☐ Yes, drank in past, but quit　　　　☐ Yes, currently drink alcohol　　　　☐ No (go to question 41)

↓ If drank in past　　　　　　　　　　　If currently drink

☐ Quit <2 YEARS AGO

☐ Quit 2+ YEARS AGO

↓

40a. At each time period: Usual number of drinks (e.g., total number of bottles/cans of beer, glasses of wine, shots of liquor)	None or less than 1 per month	1-3 per month	1 per week	2-4 per week	5-6 per week	7-13 per week	14+ per week
Current							
<2 years ago							
2+ years ago							

Medication History

*FOR CASES: replace *"in the last 2 years"* with *"when you were well"* for **all questions** in medication history section*

41. Have you taken any of the following medications?

	Ever taken	IF yes →	Taken in the past 2 years*	IF Yes →	Frequency *in the last 2 years* (*FOR CASES USE*: when you were well)					
					1 day a month or less	2-3 days a month	One day a week	2-3 days a week	4-5 days a week	6+ days a week
Acetaminophen (e.g., Panadol, Paracetamol, Tylenol)	☐ Yes ☐ No		☐ Yes ☐ No							
Aspirin (e.g., Anacin, Bufferin, Alka-Seltzer)	☐ Yes ☐ No		☐ Yes ☐ No							
Other anti-inflammatory (e.g., Ibuprofen, Diclofenac, Indocin, Naprosyn, Advil)	☐ Yes ☐ No		☐ Yes ☐ No							
Anti-high blood pressure	☐ Yes ☐ No		☐ Yes ☐ No							
Anti-diabetic (e.g., Metformin)	☐ Yes ☐ No		☐ Yes ☐ No							
Anti-high cholesterol	☐ Yes ☐ No		☐ Yes ☐ No							
Multivitamin	☐ Yes ☐ No		☐ Yes ☐ No							
Folate only/vitamin B9 supplement	☐ Yes ☐ No		☐ Yes ☐ No							
Calcium only supplement	☐ Yes ☐ No		☐ Yes ☐ No							
Vitamin D only supplement	☐ Yes ☐ No		☐ Yes ☐ No							
Steroid	☐ Yes ☐ No		☐ Yes ☐ No							
Herbal supplements	☐ Yes ☐ No		☐ Yes ☐ No							

42. Have you EVER taken an antibiotic?
☐ Yes   ☐ No (go to question 44)
↓ If yes
42a. Select as many as may apply:
☐ Cipro tab (ciprofloxacin)   ☐ Flagyl (metronidazole)   ☐ Erythromycin   ☐ Ampiclox (ampicillin cloxacillin)
☐ Amoxil (amoxicillin)   ☐ Other antibiotic_____(specify)

42b. Have you taken **any** antibiotic *in the last 2 years* (*FOR CASES USE: When you were well*)?
☐ Yes, taken in past, but stopped   ☐ Yes, currently taking   ☐ No
↓ If taken in past
☐ Most recently stopped <6 WEEKS AGO
☐ Most recently stopped 6+ WEEKS AGO

43. At each period of your life: Indicate the TOTAL amount of time you used **any** antibiotics:

	None	Less than 7 days	8-15 days	16 days to 2 months	>2-4 months	>4 months to 2 years	>2-4 years	4+ years
During the past 2 years								
Age < 19 years								
Age 20-39 years (*if applicable*)								
Age 40-59 years (*if applicable*)								
Age 60 to the present (*if applicable*)								

44. Have you EVER taken an antiparasitic/anthelmintic medication?

☐ Yes ☐ No (go to question 46)

↓ If yes

44a. Select as many as may apply:

☐ Zentel (albendazole) ☐ Ivermectin ☐ Combantrin (mebendazole) ☐ Kentrax

☐ Other antiparasitic/anthelmintic _____(specify)

44b. Have you taken **any** antiparasitic/anthelmintic *in the last 2 years* (***FOR CASES USE**: When you were well*)?

☐ Yes, taken in past, but stopped   ☐ Yes, currently taking   ☐ No

↓ If taken in past

☐ Most recently stopped <6 WEEKS AGO

☐ Most recently stopped 6+ WEEKS AGO

45. At each period of your life: Indicate the TOTAL amount of time you used **any** antiparasitic/anthelmintics:

	None	Less than 7 days	8-15 days	16 days to 2 months	>2-4 months	>4 months to 2 years	>2-4 years	4+ years
During the past 2 years								
Age < 19 years								
Age 20-39 years (*if applicable*)								
Age 40-59 years (*if applicable*)								
Age 60 to the present (*if applicable*)								

46. Have you EVER taken an antimalarial medication?

☐ Yes ☐ No (go to question 48)

↓ If yes

46a. Select as many as may apply: ☐ Artemether/lumefantrine (e.g., Coartem, Lonart, Artefan) ☐ Arteether (e.g., E Mal)

☐ Artesunate/mefloquine (e.g., Artequin) ☐ Pyrimethamine/sulfadoxine (e.g., Fansidar) ☐ Amodiaquine (Camoquin)

☐ Chloroquine (e.g., Aralen)   ☐ Atovaquone/proguanil (e.g., Malanil, Malarone) ☐ Quinine

☐ Other antimalarial _____(specify)

46b. Have you taken **any** antimalarial *in the last 2 years* (***FOR CASES USE**: When you were well*)?

☐ Yes, taken in past, but stopped   ☐ Yes, currently taking   ☐ No

↓ If taken in past

☐ Most recently stopped <6 WEEKS AGO

☐ Most recently stopped 6+ WEEKS AGO

47. At each period of your life: Indicate the TOTAL amount of time you used **any** antimalarial:

	None	Less than 7 days	8-15 days	16 days to 2 months	>2-4 months	>4 months to 2 years	>2-4 years	4+ years
During the past 2 years								
Age < 19 years								
Age 20-39 years (*if applicable*)								
Age 40-59 years (*if applicable*)								
Age 60 to the present (*if applicable*)								

| Reproductive History (*THE FOLLOWING SECTION IS FOR WOMEN PARTICIPANTS ONLY; FOR MEN GO TO QUESTION 54*) |

48. Age (years) your menstrual periods began?_____ (years)*   *If Refused/Don't Know, enter 999

49. Have your menstrual periods stopped permanently?

☐ Yes   ☐ No   ☐ Not sure   ☐ Refused/Don't Know

↓ If yes

49a. Age period stopped _____ (years)*   *If Refused/Don't Know, enter 999

50. Have you ever been pregnant? (Do not include current pregnancy or those ending after January 1, 2017.)

☐ Yes   ☐ No   ☐ Not sure   ☐ Refused/Don't Know

↓ If yes

50a. Age at first pregnancy _____ (years)*   *If Refused/Don't Know, enter 999*

50b. Age at birth of first child _____ (years)*   *If Refused/Don't Know, enter 999*

50c. Age at birth of last child _____ (years)*   *If Refused/Don't Know, enter 999*

50d. Number of live births _____ *   *If Refused/Don't Know, enter 999*

50e. Number of incomplete pregnancies _____* *If Refused/Don't Know, enter 999*

50f. Average breastfeeding duration (months) ☐ 0 ☐ 1-6 ☐ 7-12 ☐ 13-18 ☐ 19-24 ☐ 24-36 ☐ 36+

50g. Average time between births (years) ☐ <1 ☐ 1-2 ☐ 3-4 ☐ 4-7 ☐ 8+ years

50h. In what way/ways was your child/children delivered? (Select all that apply.) ☐ Vaginal birth ☐ C-section

51. Have you EVER used replacement sex hormones (e.g., estrogen, progesterone)?
☐ Yes, used in past, but stopped ☐ Yes, currently use ☐ No (go to question 52) ☐ Refused/Don't Know (go to question 52)
↓ if used in past   │ If currently use
☐ Stopped <2 YEARS AGO
☐ Stopped 2+ YEARS AGO
↓

51a. For how long did you use these hormones (years)? ☐ <1 ☐ 1 ☐ 2 ☐ 3-4 ☐ 5-7 ☐ 8+
51b. Type of hormone used most recently? ☐ Oral ☐ Patch ☐ Vaginal ☐ Other_____
51c. Hormone use pattern ☐ Continuous ☐ <2 weeks/month

52. Have you EVER used oral contraceptives (OC's) for any reason (contraception, acne, menstrual irregularity, etc.)?
☐ Yes, used in past, but stopped ☐ Yes, currently use ☐ No (go to question 54) ☐ Refused/Don't Know (go to question 54)
↓
☐ Stopped <2 YEARS AGO
☐ Stopped 2+ YEARS AGO

53. *(FOR CASES ADD:* When you were well*)* What forms of contraception have you used? (Select as many as may apply.)
☐ None ☐ Oral contraceptive ☐ Sponge ☐ Diaphragm/cervical cap ☐ Tubal ligation (tubes tied) ☐ Foam or jelly
☐ Intrauterine device ☐ Condom ☐ Vasectomy ☐ Implant ☐ Injection ☐ Other_____ ☐ Refused/Don't Know

Nutrition History

54. *(FOR CASES ADD:* When you were well) How often did/do you eat meals at a restaurant and/or buka *in the last year*?
☐ Never ☐ less than once a month ☐ 1-3 times a month ☐ 1 time a week
☐ 2-4 times a week ☐ 5-6 times a week ☐ 1 time a day ☐ 2 or more times a day

55. *(FOR CASES ADD:* When you were well) Kindly recall your food habits *during the last year* when filling this portion. (Select as many as may apply.) **See photographic guide for specific foods and medium portion size. *S=Small, M=Medium, L=Large***

Beverages and Other Drinks (Page 2 of photographic guide)

	Medium serving	Serving S	M	L	Never	Less than once a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 time a day	2 or more times a day
Soft drinks e.g coca cola	35cl											
Natural fruit juice	35cl											
Juice blends e.g 5 alive	35cl											
Milk and milk products e.g yoghurt	½ litre											
Kunu, sobo	½ litre											
Coffee	35cl											
Tea	35cl											
Water	50 cl											
Other _____	_____											

Meats, Fish, Chicken, and Eggs (Pages 1 and 3 of photographic guide)

	Medium serving	Serving			Never	Less than once a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 time a day	2 or more times a day
		S	M	L								
Fried beef/veal/pork/lamb/goat	1 cut											
Fried fish	1 cut											
Fried chicken	1 cut											
Fried egg	1 egg											
Boiled beef/veal/ pork/lamb/goat	1 cut											
Boiled fish/chicken/egg	1 cut/ 1 egg											
Smoked beef/veal/pork/lamb/goat	1 cut											
Smoked fish	1 cut											
Grilled/roasted beef/veal/pork/ lamb/goat e.g. suya, asun, kilishi, ponmo	1 cut or 3 sticks											
Grilled/roasted fish	1 cut											
Offal e.g. abodi, shaki, ifun	1 cut											
Bushmeat/wildmeat	1 cut											
Snails	1 snail											
Other _____	_____											

Snacks (Pages 1 and 4 of photographic guide)

	Medium serving	Serving			Never	Less than once a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 time a day	2 or more times a day
		S	M	L								
Fried snacks e.g. puff puff, chin chin, donut, buns, plantain chip	½ cup											
Baked Snacks e.g pie, biscuit, cake	1 medium package											
Roasted /popped Snacks e.g. popcorn, corn	½ cup											
Nuts e.g. kola nut, gancina kola, walnut, cashew nut, tiger nut	½ cup											
Other_____	_____											

Grains, Cereals, and Products (Pages 1 and 5 of photographic guide)

	Medium serving	Serving			Never	Less than once a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 time a day	2 or more times a day
		S	M	L								
Fermented milled cereals e.g. pap, eko	1 cup or 1 wrap (eko)											
Boiled cereals e.g maize, rice	1 cup cooked											
Whole meal product e.g wheat, maize, rice	1 cup or 1 wrap											
Baked cereal products e.g bread	1 loaf (N100)											
Idomine, spaghetti, pasta, noodles	1 cup cooked											
Other _____	_____											

Legumes and Products (Pages 1, 6, and 10 of photographic guide)

	Medium serving	Serving			Never	Less than once a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 time a day	2 or more times a day
		S	M	L								
Boiled beans e.g ewa riro, moin moin, groundnut	1 cup cooked or 1 wrap											
Fried legume product e.g akara	5 balls											
Soy product e.g cheese, milk	1 cup											
Other _____	_____											

Roots/Tubers and Products (Page 7 of photographic guide)

	Medium serving	Serving			Never	Less than once a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 time a day	2 or more times a day
		S	M	L								
Boiled tubers e.g. yam, cocoyam, potatoes	1 cup or 1 wrap											
Cassava products e.g garri. eba, fufu	1 wrap											
Fried product e.g fried yam, potatoes, cocoyam	5 slices											
Other _____	_____											

Fruits/ Vegetables and Products (Pages 1, 8, and 10 of photographic guide)

	Medium serving	Serving			Never	Less than once a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 time a day	2 or more times a day
		S	M	L								
Whole fruit e.g orange, mango, banana, agbalumo, breadfruit	1 fruit (medium)											
Processed fruit	1 cup											
Fried plantain	1 fruit (medium)											
Grilled/roasted plantain e.g. Boli	1 fruit (medium)											
Leafy vegetables e.g pumpkin, amaranth, worowo, ewuro, spinach	½ plate											
Other vegetables e.g okra, onion, tomato, garden egg, cucumber, carrot, pepper	½ cup											
Other _____	_____											

Mushrooms and Products (Page 1 of photographic guide)

	Medium serving	Serving			Never	Less than once a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 time a day	2 or more times a day
		S	M	L								
Store bought mushrooms	1 cup											
Wild mushrooms	1 cup											
Other _____	_____											

Seasoning and Sweeteners (Pages 1 and 9 of photographic guide)

	Medium serving	Serving S	Serving M	Serving L	Never	Less than once a month	1-3 times a month	1 time a week	2-4 times a week	5-6 times a week	1 time a day	2 or more times a day
Common Salt	1 teaspoon											
Fermented seasoning agent e.g Iru, ogiri	1 wrap											
Honey	1 teaspoon											
White sugar	5 cubes or 1 teaspoon											
Artificial sweeteners e.g saccharin	½ teaspoon											
Oils e.g palm oil, vegetable oil, groundnut oil	1 tablespoon											
Other seasonings e.g ground dried crayfish, stock fish, ogbonno, dried pepper	1 tablespoon											
Other _____	_____											

56. How many people in your household generally eat together from your kitchen? _____

57. What type of oil do you most often use in cooking? (Select as many as may apply.)
☐ Palm ☐ Groundnut ☐ Vegetable/canola ☐ Carotino ☐ Olive ☐ Other_____ (specify)

58. How long does it take your family to go through a 50 cl container of cooking oil? _____ (weeks)

Physical History
---

59. UNDERLINE CURRENTLY, does your health limit you in performing moderate activities (e.g., moving a table, pushing a vacuum cleaner, carrying light loads, walking briskly)? ☐ Yes, limited a little ☐ Yes, limited a lot ☐ No

NOTE: Questions 60 and 61 are strictly about activity related to your work

60. (*FOR CASES ADD:* When you were well) Does/did your WORK require any vigorous intensity activity that caused increases in breathing, heart rate, or sweating (ex. carrying or lifting heavy loads, digging or construction work, etc) for at least 10 minutes continuously? ☐ Yes ☐ No (go to question 61)
↓ If yes

60a. In a typical week, on how many days did you do these vigorous intensity activities as part of your work?
☐ 1 day ☐ 3-4 days ☐ 2-3 days ☐ 5+ days

60b. In a typical day, for how long did you do these vigorous intensity activities as part of your work?
☐ 10-29 minutes ☐ 30-59 minutes ☐ 1 hour ☐ 1.1 – 2 hours
☐ 2.1 – 3 hours ☐ 3.1 – 5 hours ☐ 5.1 – 7 hours ☐ 7+ hours

61. (*FOR CASES ADD:* When you were well) Does/did your WORK require any moderate intensity activity (ex. walking, carrying light loads, gardening, etc) for at least 10 minutes continuously?
☐ Yes ☐ No (go to question 62)
↓ If yes

61a. In a typical week, on how many days did you do these moderate intensity activities as part of your work?
☐ 1 day ☐ 3-4 days ☐ 2-3 days ☐ 5+ days

61b. In a typical day, for how long did you do these moderate intensity activities as part of your work?
☐ 10-29 minutes ☐ 30-59 minutes ☐ 1 hour ☐ 1.1 – 2 hours
☐ 2.1 – 3 hours ☐ 3.1 – 5 hours ☐ 5.1 – 7 hours ☐ 7+ hours

NOTE: Question 62 is strictly about your activities OUTSIDE of work (includes walking to and from work)

62. (*FOR CASES ADD:* When you were well) In the last year, what was your average time PER WEEK spent at each of the following activities **OUTSIDE OF WORK**? (Select as many as may apply.)

	None	Less than 10 minutes	10-29 minutes	30-59 minutes	1 hour	1.1-2 hours	2.1-3 hours	3.1-5 hours	5.1-7 hours	7 or more hours
Walking (to/from work or for exercise)										
Farming										
Collecting water										
Washing clothes (by hand)										
Cooking										
Housecleaning										
Lifting heavy objects										
Jogging (slower than 6 minutes/ km)										
Running (6 minutes/km or faster)										
Bicycling										
Football										
Swimming										
Dancing										
Other vigorous activities _____(specify)										
Other moderate activities _____(specify)										

63. (*FOR CASES ADD:* When you were well) What is/was your average time PER DAY spent sitting or reclining in the last year?
☐ 10-29 minutes ☐ 30-59 minutes ☐ 1 hour ☐ 1.1 – 2 hours
☐ 2.1 – 3 hours ☐ 3.1 – 5 hours ☐ 5.1 – 7 hours ☐ 7+ hours

Work & Home Exposures

64. (*FOR CASES ADD:* When you were well) How frequently do/did you directly handle the following substances in the last year?

	Never	1-3 days per month	1 day per week	2-4 days per week	5-6 days per week	Everyday
Burning waste (trash)						
Asbestos (from construction)						
Insecticides/pesticides						
Wastes from operating industries						

Cancer Awareness

65. Prior to today, had you ever heard of cancer?
☐ Yes ☐ No (end of questionnaire)
↓ If yes
65a. Prior to today, which cancers had you heard of? (Select as many as may apply.) ☐ Colon/rectum ☐ Breast ☐ Cervix
☐ Prostate ☐ liver ☐ lung ☐ Other_____ (specify)
65b. Do you know anyone who has had cancer? ☐ Yes ☐ No

65c. Prior to today, what things did you think affect a person's chance of developing cancer? (Select as many as may apply.)
☐ Do not know/Not sure ☐ Chance ☐ Depends on the cancer ☐ Genetics/family history ☐ Body size
☐ Lifestyle (e.g., smoking, alcohol) ☐ Diet ☐ Environment (e.g., living or working conditions) ☐ Other_____ (specify)

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	4
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	8,9
Objectives	3	State specific objectives, including any prespecified hypotheses	9
Methods			
Study design	4	Present key elements of study design early in the paper	10,11
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	10
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	10
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	11
Bias	9	Describe any efforts to address potential sources of bias	10,11
Study size	10	Explain how the study size was arrived at	10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	12,13
		(*b*) Describe any methods used to examine subgroups and interactions	12,13
		(*c*) Explain how missing data were addressed	13
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	13
		(b) Give reasons for non-participation at each stage	13
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	13,14
		(b) Indicate number of participants with missing data for each variable of interest	n/a
Outcome data	15*	Report numbers of outcome events or summary measures	14,15,16

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15,16
		(*b*) Report category boundaries when continuous variables were categorized	n/a
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a

Discussion

Key results	18	Summarise key results with reference to study objectives	21
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	21-25
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	21-25
Generalisability	21	Discuss the generalisability (external validity) of the study results	21-25

Other information

| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 1 |

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.