Original Article

Burden of cervical cancer in Northern Nigeria

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ABSTRACT

Background: Data regarding burden of illness borne by women affected with cancer of the cervix (CaCvx) has been largely anecdotal. This study aimed to evaluate disability and cost burden of the illness in northern Nigeria.

Materials and Methods: Cost of illness was determined using the bottom-up approach and involved estimating costs of managing various stages of the illness while disability adjusted life year (DALY) was estimated sing CaCvx survival data from northern Nigeria.

Results: Overall cost of illness ranged from ₦191,338 ($524) to ₦1,001,298 ($2,743) for local to metastatic diseases, respectively. Of these, direct medical costs accounted for up to 75.4% while indirect costs accounted for up to 48% in different stages of the disease. Productivity losses ranged from 18.3% to 43.1%, while surgical, medical, and radiotherapies accounted for losses between 37.2% and 46%. Estimated DALY was 269 years/100,000 women with cost/DALY saved on treatment estimated at between $19 and $1,443 for different stages. At the discounted rate, it was estimated that it would be 16 to 902 times cheaper to screen for the disease than to treat ($P < 0.0001$).

Conclusion: Though burden of illness borne by women with CaCvx in northern Nigeria is similar to that borne by women in other developing countries, it is still too high; and the only panacea to this is institution of early screening programs and immunization. In addition, concerted effort is needed to ensure extension of health insurance coverage for cancer therapy and increase in availability of radiotherapy service as a means of reducing waiting times for treatment.

Key words: Cervical cancer; cost of illness; disability adjusted life year; productivity.

Introduction

In Nigeria, cervical cancer is associated with age-standardized incidence and mortality rates of 36 per 100,000 and 17.5 per 100,000, respectively, and younger mean age of occurrence (4th decade) among Nigerian women.[1-3] However, these data do not reflect the social and economic burden of the disease.

As a means of capturing the real cost of diseases, the Global Burden of Diseases (GBD) study introduced the concept of disability adjusted life year (DALY).[4] This sums up years of life lost due to disability (YLD) with years of life lost (YLL) due to premature death. The value of healthy life lost for different diseases (DALY saved/$) can then be compared and used as a guide for prioritizing health resource allocation.[5]

Thus, the aim of this study is to evaluate the burden of cervical cancer in Kano, northern Nigeria by computing DALY as well as the cost of illness for cervical cancer.

Access this article online	
Website: www.tjogonline.com	Quick Response Code
DOI: 10.4103/TJOG.TJOG_74_17	

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How to cite this article: Akinfenwa AT, Monsur TA. Burden of cervical cancer in Northern Nigeria. Trop J Obstet Gynaecol 2018;35:25-9.

Materials and Methods

In estimating the cost of illness for cervical cancer, the bottom-up approach was adopted and all values were rendered in Naira (and US dollar equivalent at average 2016 rate of ₦365: 1 Dollar). Direct medical costs were based on costs of requisite investigations, drugs, consultation, and other services in a teaching hospital in northwestern Nigeria, being the hospital serving the largest population in the north. Direct medical costs included cost of obtaining a hospital card, consultation, microbiological, hematological, biochemical, histopathological, and radiological investigations, as well as medical and surgical procedures, examination under anesthesia, blood transfusion, and radiotherapy.

These costs were computed for worst case scenarios of Localized disease (1a1, 1a2, 1b1, 1b2, and 2a), regional disease (2b, 3a and 3b), and metastatic disease (4a and 4b). Salvage dialysis was computed as three sessions per week before nephrostomy.

Costs of transportation to and from the hospital (N1, 000; $2.7) was based on 2016 average cost from the furthest part of the state to the hospital. This also included the cost of transportation to a radiotherapy reference facility also in northern Nigeria.

Productivity losses were calculated at N102 ($0.3) per hour based on the minimum monthly wage of N18, 000 ($49.3) for 8-hour work days and 22 days a month. Due to the usual long waiting periods, productivity loss was estimated to be a full work day. Productivity loss of an accompanying relative was also calculated but only for the days on admission. Productivity losses were also only calculated for a year and did not include potential losses due to premature mortality.

In calculating disability adjusted life years (DALY), the formula:

DALY = Years of life lost due to disability (YLD) + Years of live lost (YLL) prematurely was used;[6] where:

YLD (at 3% discount rate) $=0.6\ (-0.03)^{-1}$ (e ^ (−0.03t); and t = 2 years. The 2 years adopted in the calculation was based on the study by Musa *et al.*[7] in northern Nigeria who reported mean duration of 23.7 months survival among women with cervical cancer.

YLL (at 3% discount rate) was calculated using the formula: e ^ (−0.03*t) (1 – e ^ (−0.03L); where L = age at death).

Age discounting was calculated using the formula; 0.1658(*X*e ^ 0.04*X*) where *X* is age.

Based on the study by Yakassai *et al.*,[8] with age range of 35–74 years, the ages computed were 35, 45, 55, and 75 years. Life expectancy for these ages were derived from life expectancy tables.[9] Disability weights assigned to cervical cancer with and without treatment were 0.540 and 0.569, respectively, as described in the GBD, 2013.[10]

Results

As shown in Table 1, the cost of treatment for localized to metastatic carcinoma of the cervix ranged from ₦191,338 ($524) to ₦1,001,298 ($2,743), respectively. Estimated direct medical costs accounted for the bulk of calculated expenditure with medical and surgical procedures as well as medications accounting for between 37.2% and 46.0% of costs. Cost of consultations and health records accounted for the least fraction (0.4–1.5%) of estimated expenditure. Productivity losses accounted for the bulk of estimated costs for regional and metastatic diseases at 43.1% and 42.4% of costs, respectively. There was statistically significant difference in estimates of direct versus indirect costs for the three stratified stages with direct medical costs being the highest for early-stage tumors (Chi-square stat 14.08; $P = 0.0008$).

The years of life lived with disability (YLD) was uniform across the selected ages and was 1.1 years out of the 2 years actually

Table 1: Breakdown of costs of different stages of cervical cancer

Item estimated	Localized tumor 1a, b and 2a (₦, %)		Regional tumor 2b, 3a and 3b (₦, %)		Metastatic tumor 4a and b (₦, %)	
Direct costs						
Consultation + Records	2,900	1.5	3,700	0.4	6,400	0.6
Laboratory	35,350	18.5	88,850	9.0	99,050	9.9
Radiology	18,000	9.4	48,000	4.9	51,000	5.1
Procedures + Medications	88,000	46.0	372,000	37.7	372,000	37.2
Indirect costs						
Transportation costs	12,000	6.3	48,000	4.9	48,000	4.8
Productivity loss	35,088	18.3	424,848	43.1	424,848	42.4
Total (₦)	191,338 ($524)	100	985,398 ($2,700)	100	1,001,298 ($2,743)	100

lived. Based on the remnant unlived life expectancy, years of life lost (YLL) due to premature death fell progressively from 19.0 years for a woman who was diagnosed at 35 years and died at 37 years to 4.8 years for a woman diagnosed at the age of 75 who survived for 2 years after diagnosis [Table 2]. Age and time discounted DALY also fell progressively from 28.0 years for a woman diagnosed at 35 years to 1.9 years for a woman diagnosed at 75 years.

Average YLL was estimated at 13.1 and age standardized rate of 229.3 years per 100,000 women aged 35 to 75 years. Age standardized YLD and DALY were estimated to be 39.6 years and 269 years per 100,000 women, respectively. Cost per DALY saved ranged from ₦6,834 ($19) to ₦100,704 ($276) for the treatment of localized tumor to ₦35,761 ($98) and ₦526,999 ($1,443) for the treatment of metastatic tumor. There was also statistically significant difference in DALY relative to cost per DALY saved for early to metastatic stages of the disease (Chi-square 247.7; $P < 0.0001$).

Discussion

Estimated cost of illness for cervical cancer in our study ranges from ₦191,338 (524 US$) to ₦1,001,298 ($2,743) for local to metastatic disease. Our estimated cost of treating localized tumor is lower than the range of $2,014 in India to $6,496 estimated for South Africa, but similar to the $2,683 in Kenya and $2,933 in India for treatment of advanced disease. It is, however, lower than the $3,680 in South Africa[11] [Table 3]. At our estimated rate, based on extrapolated annual growth rate of 2.6% from 2006 census figures,[12,13] 788 of 2,187,628 women (35–74 years of age) in Kano state would require an average of about $1,567,332 for a year of treatment. This is higher than the total estimated cost of $1,429,673 required to treat 550 patients documented in a study from Morocco.[14] Nevertheless, these costs, similar to ours, show the significant economic burden borne by women with the disease, especially against the backdrop of a national per capital GDP of $2,178 (2016).[15]

In this analysis, direct medical costs accounted for up to 75.4% while indirect costs accounted for up to 48%. Our estimated fractions are comparable to those reported from Ethiopia (74%: 26%; medical to non-medical) but less than the 90%: 10% described in the US study.[16,17] While radiotherapy (including brachytherapy) accounted for 80% of costs in the Moroccan study, these only accounted for 4% of our estimated costs. The higher value may be due to non-inclusion of indirect costs in the Moroccan study. In contrast, productivity losses accounted for the bulk of costs in our study with values of up to 43.1%.

Table 2: DALY calculation and cost/DALY saved

Age years	Life expectancy (years)	YLD	YLL	DALY§	Cost/DALY saved on treatment; ₦	($)
35	30.9	1.1	19.0	28.0	6,834-35,761	(19-98)
45	24.1	1.1	16.1	20.7	9,243-48,372	(25-133)
55	17.1	1.1	12.6	13.7	13,966-73,087	(38-200)
75	5.5	1.1	4.8	1.9	100,704-526,999	(276-1,443)

YLL, Years of life lost; YLD, years lost due to disability; DALY, Disability adjusted life years; §, Age and year-weighted

Table 3: Comparative cost of illness for cervical cancer with other countries

	Index study	South Africa[11]	Kenya[11]	India[11]
Demography				
CaCvx ASIR/100,000	36	175	200	187
Average hourly rate (2016 $)	0.28	13.8	2.7	0.67
Cost of staging and treatment				
Local disease	524	6,496	2,164	2,014
Regional disease	2,700	4,243	2,683	2,933
Metastatic disease	2,743	3,680	2,683	2,933

CaCvx, Cancer of the cervix

Table 4: Comparison of DALY in other regions and countries of the world

Country/Region	YLD/100,000	YLL/100,000	DALY/100,000
Index study	40	229	269
Cuba	9	215	224
India	38	428	466
Bangladesh	34	520	554
North America	19	55	74

YLL, Years of life lost; YLD, years lost due to disability; DALY, Disability adjusted life years

The Economist Intelligence Unit[18] derived a global economic cost of US$286 billion for new cancer cases in 2009, 24% of which resulted from productivity losses. Pearce *et al*.[19] in their study have projected that in Europe, over a period of 19 years (2011–2030), productivity losses attributable to cervical cancer will amount to about €155,000 per death. Similarly, a woman in Nigeria, diagnosed and died of cervical cancer in 2016 at the age of 35 years, based on retirement age of 65 years, at 1% annual salary increment, 15% inflation rate, and exchange rate of ₦310.4:1€, stands a life time earning loss of approximately €67,470.

Such productivity loss, at the barest minimum wage utilized in this computation, may best be conceptualized in terms of household income loss, bringing to focus a part of the illness burden borne by the patient's family. Household expenditure, as reported by Oguntayo and colleagues[20] in Zaria, northern Nigeria was estimated to be between $700 and $2,050, with family and relatives footing the bill in as much as 57% of cases.

Table 5: Discounted Cost and cost/DALY estimates for different screening modalities

Screening Test	Transport cost	Productivity loss	Direct cost	Total ₦	Cost per DALY averted ($)
VIA (1 visit; see and treat)	1,000	816	1,000	2,816	0.94
Pap smear (2 visits)	2,000	1,632	1,200	4,832	1.6
HPV DNA testing (2 visits)	2,000	1,632	20,000	23,632	44.5

For screening commenced at the age of 20, 5-yearly ×3; life expectancy 44.1 years

The estimates in this study are also more likely to be out of pocket expenditures, reflecting deficiencies of the national health insurance scheme (NHIS). At present, the scheme covers for only 15 cumulative days of admissions per year.[21] These may not sufficiently cater for patients, especially those with advanced disease, who may have longer spells of admission. In addition to this, not only are antineoplastic and immunosuppressive therapeutic agents on the national essential medicines list rudimentary, they are not covered by NHIS and thus not prescribed.[22,23]

Radiotherapy, the mainstay of treatment for advanced cervical cancer, is virtually non-existent in the country, especially when time spent waiting for commencement of this service is considered an indicator of quality of care and patient outcome.[24] Adewuyi and colleagues[25] reported that the population served by each of the 5 megavoltage machines in the country ranges from 20 to 40 million people per machine. This results in long waiting times with attendant poor outcome as well as significant productivity losses. While Nascimento and Silva[26] in Brazil report a median of 41 days to commencement of radiotherapy, Anakwenze *et al*.[27] in Ibadan report a median waiting time of 12.2 months (range: 1–44.7 months). As with chemotherapy, this service is also not covered by the NHIS, further worsening the cost burden borne by patients.

The enormous burden of cervical cancer borne by affected women is further exemplified by the high estimated DALY of 269 years per 100,000 women in our study; though comparable to that for Cuba, and lower than those for Bangladesh and India [Table 4], these figures reflect not only high rate of cervical cancer but also a poorer outcome when compared with DALY of 74 years per 100,000 women in north America afflicted with cervical cancer.[28,29]

The estimated 1.1 YLD reflects findings by Musa *et al*.[7] in northern Nigeria that mean time to death for advanced disease was 6.9 ± 7.0 months versus 23.7 ± 12.7 months for early disease. Thus, out of a possible 2 years, 1.1 of these are lived with the burden of the disease. These disability burden have been described by the WHO to include departures from good or ideal health in any of the important domains of health. These include mobility, self-care, participation in usual activities, pain and discomfort, anxiety and depression, and cognitive impairment.[30] However, the more alarming statistic is the high estimated 229 years/100,000 value of YLL in our study. Our data, though echoes those from other low-income countries [Table 4], is in stark contrast to the 55 years/100,000 women reported for north America. This further highlights the mortality burden associated with the disease in our region of the world.

The index study shows that the cost per potential DALY averted ranges from ₦6,834 to ₦526,999 ($19 to $1,443) per woman between the ages of 35 and 75 years. The WHO has estimated that in 10 years (2014–2024) there is potential of saving $896 per DALY averted using HPV vaccination and $413 for a one-time visual inspection with acetic acid (VIA) screening in low-to-middle income countries like Nigeria.[31] This is supported by our estimates which show that the overall cost of screening, using VIA, Papaniculaou smear, and HPV DNA testing would be $7.7, $13.2, and $64.7, respectively. For a female in northern Nigeria who commences Pap smear screening from the age of 20 (in 2016) and screens 5-yearly on three occasions, the cost per DALY averted would range from $0.94 to $44.5 [Table 5]; ₦ inflation rate of 15% and $ rate of 3%. This is 16 to 902 times cheaper than cost/DALY saved on treatment of established disease, thus making it cheaper to screen than treat (P value <0.00001).

This study concludes that, though burden of illness borne by women with cervical cancer in northern Nigeria is similar to that borne by women in other developing countries, it is still too high, and the only panacea to this is institution of early screening programs and immunization. In addition, concerted effort is needed to ensure extension of health insurance coverage for cancer therapy and increase in availability of radiotherapy service for reducing waiting times of treatment.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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