Time Series Analysis of Breast Cancer in Yola, Adamawa State, Nigeria

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Abstract
This study investigated the trend pattern of reported cases of breast cancer in Yola, Adamawa State. A quantitative secondary data between 2008 and 2017 was obtained from Statistics Unit Federal Medical Centre Yola, regarding the number of breast cancer incidence, survivals, and mortality as a result of the disease over the study period. The study used least square method of time series to determine the level of trend patterns and future occurrence of the breast cancer incidence, survivals and mortality in the study area. Based on the study, the results revealed that the trend model of breast cancer incidence predicted a continuously declining in the incidence of breast cancer up to the period of 2025. In contrast to the breast cancer incidence, the model of breast cancer mortality indicates an alarming rate up to the year 2025, while the model of breast cancer survivals predicts a decline in the survival rate. The results from this research will serve as a spring board for policy formulation and implementation of breast cancer control Programme in Adamawa State Nigeria.

Keywords: Breast Cancer; Time Series; Incidence; Survivals; Mortality; Chemotherapy; Trend Pattern.

Introduction

Breast cancer is a cancer originating from the tissue most commonly from the inner lining of the milk ducts or the lobules that supply the ducts with milk. The size, stage, rate of growth and other characteristics of the tumor determine the series of treatment of breast cancer. The treatments may include surgery, immunotherapy, chromosomal therapy, radiotherapy and chemotherapy. Several chemotherapy regimens are commonly use in addition to surgery. Most forms of thermotherapy kills the cells that are dividing rapidly anywhere in the breast that were missed during surgery and radiation exposure to the heart may cause heart failure in the future. Some breast cancers are sensitive to hormones such as estrogen and progesterone which makes it possible to treat them blocking the effects of these hormones (Wafar, 2019). Early diagnosis of breast cancer is known to be vital not just in the treatment of the disease but also in determining prognosis (El Saghir *et al.*, 2011). In developing or low income countries, breast cancer is often characterized by late clinical presentations or advanced stages of the disease, when only chemotherapy and palliative care can be offered, with resulting high mortality (Adeniji, 1999; Anyanwu, 2000; Parkin *et al.*, 2008). Breast in general begins forming during the prenatal period and undergoes substantial changes during adolescence and adulthood. Breast cancer arises when abnormal cellular growth occurs in certain structures within the cells of breast. Because autopsies were rare, cancer of the internal organ were essentially invisible to ancient medicine, breast cancer however could be felt through the skin and in its advanced state often developed into fumigating lesion, ulcerate through the skin and weeping fetid dark fluid. Although breast cancer is often spoken of as if it is a single disease, evolving techniques of analysis of the molecular characteristic of tumors are pointing to a variety of types of potentially offering origins. Gaining a better understanding of the nature of heterogeneity of breast cancer will be useful in helping researchers to improve design and interpretation of studies of possible risk factors and it may influence approaches to prevention (Wafar, 2019).

Globally, mammography method of screening has played a key role in reducing breast cancer mortality. By identifying a subset of cancers diagnosed before they reach clinical presentation, intervention is more likely to result in long-term survival. Despite this benefit, mammography screening has drawn criticism for excessive false-positive results, limited sensitivity, and the potential of over diagnosis of clinically insignificant lesions. Incremental improvements in mammography have been realized through development of full-field digital imaging and recently, through the addition of the 3-dimensional technique of tomosynthesis, (Sarah *et al.*, 2014). The oldest description of cancer was discovered in Egypt, dates back to approximately 3000BC. Edwin Smith Papyrus described eight cases of tumors or ulcers of the breast that

were treated by cauterization with a tool called the fire drill. About one-third of all people in the US will develop cancer during their lifetimes. Today, millions of people are living with cancer or have had cancer, (American Cancer Society medical information, 2018). Worldwide, breast cancer is the second most common cause of cancer death in women after lung cancer. Breast cancer affects women of all races without exception even though severity and survival rate are often diverse (American Cancer Society medical information, 2018). Also, the most prominent cause of cancer death among women in low-and middle-income countries is breast cancer, accounting for 269,000 deaths (12.7% of all cancer deaths) in 2008 (Ferlay *et al.*, 2008; Lancet, 2011). The breast cancer burden differs between countries and regions showing variations in incidence, mortality and survival rates (Coughlin and Ekwueme, 2009; World Health Organization, 2009).

In a report by Siegel *et al.* (2014), it was indicated that deaths as a result of breast cancer in Nigeria has reached 13,264 or 0.70% and the age adjusted Death Rate is 28.11 per 100,000 population, ranking Nigeria 4th in the world. Adebamowo and Ajayi (1999) also stated that breast cancer is the most common cancer in Nigeria. Government of Nigeria established a 5-Year Nigeria Cancer Control Plan (2008 - 2013) but the impact of advocacy, awareness creation, cancer prevention, early detection through regular screening and cancer management are not felt. At state level, there are various comprehensive health policies aimed at coping with health care delivery services and breast cancer awareness campaigns. There is currently no National policy on cancer control in Nigeria; however, control of reproductive cancers is included in the "National Policy on Reproductive Health and Strategic Framework" (FMOH, 2004). The aim of this systematic review is to compare all existing evidence on the awareness of breast cancer, attitude and screening practices among women in the six geopolitical zones of Nigeria. It is interesting to know that as debilitating as breast cancer disease is, majority of Nigerian women have little or no knowledge of the disease and even in situations where they are aware of the disease, their attitudes towards seeking healthcare is negative causing their untimely or preventable death. It has been observed that certain socio-cultural, religious, genetic and economic factors are responsible for this negative attitude. Adamawa State like other states in Nigeria had suffered great pain from this deadly disease even before the establishment of Federal Medical Centre, Yola in 2000 by the Federal Government of Nigeria and was commissioned by the former governor of the state, his Excellency, Mr. Boni Haruna and opened its door to patients.

Objective of the Study

The objective of this study is to determine the seasonal trend pattern of breast cancer over the study period and forecast future occurrence of the disease in the study area.

Literature Reviews

Globally, breast cancer is the most prevalent cancer and the second most common cause of cancer related mortality in women (Parkin et al., 2005). Studies have shown that breast cancer accounts for 23% (1.38 million) of the total new cancer cases and 14% (458,400) of the total cancer deaths in 2008 (Ferlay *et al.*, 2010). In 2004, about 1.15 million new breast cancer cases, with over 500,000 deaths were recorded around the world and more than half of all cases occurred in industrialized countries (Wafar, 2019). Breast cancer incidence rates vary from 19.3 per 100,000 women in Eastern Africa to 89.7 per 100,000 women in Western Europe. The disease is normally high in developed regions of the world except Japan and low in most of the developing regions. Due to more favorable survival of breast cancer women in developed regions, the range of mortality rates is very much less, approximately 6-19 per 100,000. Notwithstanding, it is still the most frequent cause of cancer death in women in both developing and developed regions, (Ferlay *et al.*, 2010). Breast cancer is killing Black women at astronomical rates. This is not a sensationalized fact. Even though white women are diagnosed with breast cancer at higher rates, Black women's death rates from breast cancer are higher. In fact, Black women are 40% more likely to die of breast cancer than white women. One in eight Black women will be diagnosed with breast cancer in her lifetime, so the odds aren't in their favour. On top of terrible odds, Black women have to deal with systemic racism's chokehold on the economy. Not all Black women live in poverty, but poverty disproportionately

affects Black people, (Danielle, 2019). Breast cancer can develop as a result of abnormality "a mistake" in the genetic material. However, only 5-10% of cancers are due to an abnormality inherited from the mother or father. About 85-90% of breast cancers are due to genetic abnormalities that happen as a result of the aging process and the "wear and tear" of life in general, (Ebigbo *et al.,* 2019). In India, young women who are relatively at the premenopausal stage are very much stricken to the effect of breast cancer, (Sandhu, Karwasra and Marwah, 2010). At the same time, Asian Indian women specifically who immigrate to the United States have higher breast cancer rates when compared to their corresponding place in India, (Smyer and Stenvig, 2007). Moreover, as an effect of lifestyle factors, the incidence of breast cancer is higher among women in urban areas than among who lives in rural regions, (Bao and Davidson, 2007).

Breast cancer has been growing in a rapid manner with nearly one million new cases each year. One of the recent studies stated that, more than half (52.9%) of 1.67 million new breast cancer cases were diagnosed particularly in developing countries and as an evidence, nearly 62% of deaths occurred in developing countries due to the effect with breast cancer in 2012 (Joannie *et al.*, 2013). It must be noted that mortality rate of breast cancer is comparatively less in high-income countries than low- and middle-income countries (Ferlay *et al.*, 2010). There is variation of breast cancer incidence worldwide in which Africa is not excluded (Ojewusi and Arulogun, 2016). Incidence of breast cancer varies from 27% of cancers in North African countries (Algeria and Egypt) to 15% in sub-Saharan Africa (Parkin *et al.*, 2005). The actual incidence of breast cancer is generally not known however; an increasing incidence of the disease in many parts of Africa was indicated by several publications (Onwere *et al.*, 2009; Anyanwu et al., 2011). Women in any age range are at risk of breast cancer and the risks increases with advanced age (Omotara *et al.*, 2012). Breast cancer, the most common non-skin cancer, is now ranked as the first among all cancers diagnosed in women worldwide. In Iran, women diagnosed with breast cancer comprised 24.4% of all malignancies with a crude incidence rate of 17.4 per 100, 000, (Kolahdoozan, Sadjadi, Radmard and Khademi, 2010). African women; in comparison with their low incidence of cancer disproportionately bears a high cancer mortality rate. It has been estimated that by the year 2020, approximately 70% of new cancer cases will occur among individuals in developing countries and population groups that have previously enjoyed low incidence, with a substantial fraction likely to be breast malignancies, (Azubuike and Okwuokei 2013). In Nigeria, about two thirds of women with breast cancer are diagnosed at an advanced stage, with the possibility of metastatic spread (Akaro-Anthony *et al.*, 2010). Regular Breast Self-Examination has been suggested as part of an overall health promotion concept (Plesnicar et al., 2004). Studies conducted in Nigeria also revealed that; only 38.7% of female secondary school students were aware of Breast Self-Examination as a method for detection of breast cancer (Omotara *et al.*, 2012). In Yola Adamwa State, the rate of breast cancer incidence is gradually decreasing with time (Wafar, 2019).

Materials and Methods

Ex post facto design with quantitative approach was used involving the use of secondary data obtained from the record and statistics unit of the Federal Medical Center Yola, regarding the number of breast cancer incidence, survivals and mortality as the result of the disease over the study period from 2008-2017 as shown in Table 1.

Table1: Number of Breast Cancer Incidence, Survivals and Mortality

Period	Age Distribution of Incidence			Total Incidence	Survivals	Mortality
	12 – 32	35 – 69	70 – 85			
2008	23	101	4	128	90	38
2009	27	105	5	137	100	37
2010	25	90	6	121	101	20
2011	22	123	8	153	120	33
2012	28	129	4	161	80	81
2013	25	114	5	144	70	74

2014	24	105	6	135	80	55
2015	24	110	5	139	75	64
2016	30	108	5	143	105	38
2017	34	60	5	99	60	39
Total	**262**	**1045**	**53**	**1360**	**881**	**479**

Source: Federal Medical Center, Yola

The method used to determine the level of trend pattern/fluctuation of the breast cancer incidence, survivals and mortality in the study area is least square method of time series. In fact, time series is the most widely used method of finding the trend. The equation of the linear least square is given as:

$$y_t = \alpha + \beta t \quad (1)$$

where:
$y_t -$ is the estimated trend value for the given period
$\alpha -$ is the trend line value when $t = 0$, (intercept)
$\beta -$ is the slope of the trend line, that is the change in y_t per unit change in time
$t -$ is the time unit
The two parameters α *and* β are given as:

$$\alpha = \frac{\sum y}{n} \quad (2)$$

$$\beta = \frac{\sum ty}{\sum t^2} \quad (3)$$

Data Analysis

As stated above, the statistical technique used to analyze the obtained data is the Least Square Method of Time Series.

Table 2: Computation of Trend for Breast Cancer Incidence by Least Square of Method Time Series

Period	t	y	yt	t^2	$\hat{y}$
2008	-5	128	-640	25	141.45
2009	-4	137	-548	16	140.36
2010	-3	121	-363	9	139.27
2011	-2	153	-306	4	138.18
2012	-1	161	-161	1	137.09
2013	1	144	144	1	134.91
2014	2	135	270	4	133.82
2015	3	139	417	9	132.73
2016	4	143	572	16	131.64
2017	5	99	495	25	130.55
Total	**0**	**1360**	**-120**	110	**1360**

Source: Researcher's Results (2019)

$\alpha = \frac{\sum y}{n} = \frac{1360}{10} = 136, \beta = \frac{\sum ty}{\sum t^2} = \frac{-120}{110} = -1.09$

Therefore the linear trend equation is given as: $\hat{y}_t = 136 - 1.09t$ (4)

Based on equation (4), the rate of decrease in breast cancer incidence among women in the study area, is 1.09 persons every year.

Table 3: Computation of Trend for Breast Cancer Survivals by Least Square Method of Time Series

Period	t	y	yt	t^2	$\hat{y}$
2008	-5	90	-450	25	101.65
2009	-4	100	-400	16	98.94

2010	-3	101	-303	9	96.23
2011	-2	120	-240	4	93.52
2012	-1	80	-80	1	90.81
2013	1	70	70	1	85.39
2014	2	80	160	4	82.68
2015	3	75	225	9	79.97
2016	4	105	420	16	77.26
2017	5	60	300	25	74.55
Total	**0**	**881**	**-298**	**110**	**881**

Source: Researcher's Results (2019)

$\alpha = \frac{\sum y}{n} = \frac{881}{10} = 88.1, \beta = \frac{\sum ty}{\sum t^2} = \frac{-298}{110} = -2.71$

Therefore the linear trend equation is given as: $\hat{y}_t = 88.1 - 2.71t$ (5)

Based on equation (5), there is a decrease in survivals of breast cancer with 2.71 women every year.

Table 4: Computation of Trend for Breast Cancer Mortality by Least Square Method of Time Series

Period	t	y	yt	t^2	$\hat{y}$
2008	-5	38	-190	25	39.8
2009	-4	37	-148	16	41.42
2010	-3	20	-60	9	43.04
2011	-2	33	-66	4	44.66
2012	-1	81	-81	1	46.28
2013	1	74	74	1	49.52
2014	2	55	110	4	51.14
2015	3	64	192	9	52.76
2016	4	38	152	16	54.38
2017	5	39	195	25	56
Total	**0**	**479**	**178**	**110**	**479**

Source: Researcher's Results, 2019

$\alpha = \frac{\sum y}{n} = \frac{479}{10} = 47.9, \beta = \frac{\sum ty}{\sum t^2} = \frac{178}{110} = 1.62$

Therefore the linear trend equation is given as: $\hat{y}_t = 47.9 + 1.62t$ (6)

Based on equation (6), the rate of increase in breast cancer mortality is 1.62 persons every year.

Table 5: 2018-2025 Forecast of Breast Cancer Incidence, Survivals and Mortality

Period	t	$\hat{y} = 136 - 1.09t$ **(**Breast Cancer Incidence**)**	$\hat{y} = 88.1 - 2.71t$ **(**Breast Cancer Survivals**)**	$\hat{y} = 47.9 + 1.62t$ **(**Breast Cancer Mortality**)**
2018	6	129.46	71.84	57.62
2019	7	128.37	69.13	59.24
2020	8	127.28	66.42	60.86
2021	9	126.19	63.71	62.48
2022	10	125.1	61	64.1
2023	11	124.01	58.29	65.72
2024	12	122.92	55.58	67.34
2025	13	121.83	52.87	68.96

Source: Researcher's Results (2019)

From Table 5, the trend model for breast cancer incidence $\hat{y} = 136 - 1.09t$ shows that there will be a decrease in the rate of breast cancer incidence up to the year 2025. From the trend model of breast cancer survivals; $\hat{y} = 88.1 - 2.71t$, the rate of breast cancer survivals is decreasing in the study area.

As shown in table 5, the model of breast cancer mortality, $\hat{y} = 47.9 + 1.62t$ also indicates an increase in the rate of mortality up to the year 2025.

Discussion of Results

The data used for this study is a record of successful observations at a regular interval of one year from 2008 to 2017. Hence, time series is the most popular and widely accepted method of finding a trend pattern of such events collected over a successful period of time. Within the period under review, the study revealed that the total incidence of the breast cancer in Yola Adamawa State is 1,360 with 881 survivals and 479 mortalities. In a related study by Omotara *et al.* (2012), women in any age range are at risk of breast cancer and the risks increases with an advanced age. This study is in consistent with Omotara et al that the breast cancer incidence is irrespective of age and the probability of the incidence increases with age, even though the distribution of the incidence is proportional to the age and population of the women under review in the study area.

Based on the finding, the trend model for breast cancer incidence shows that there is a decrease in the rate of the incidence up to the year 2025. This finding is in agreement with (Wafar, 2019), which state that, the rate of breast cancer incidence is gradually decreasing with time in Yolaa Adamawwa State. Meanwhile the study is in contrast with Joannie *et al.* (2013), that breast cancer incidence is growing in a rapid manner with more than 1.62 million new incidences are diagnosed in developing countries. Nigeria which can be considered as a low income country, this study revealed that there is an increase in breast cancer mortality in Yola Adamawa State, which is in agreement with previous studies by Adeniji, 1999; Anyanwu, 2000; Parkin *et al.*, 2008; that in developing or low income countries, breast cancer is often characterized by late clinical presentations or advanced stages of the disease, when only chemotherapy and palliative care can be offered, with resulting high mortality.

Conclusions

Conclusively, the trend model of breast cancer incidence in table 4 predicted a continuously declining in the incidence of breast cancer up to the period of 2025. In contrast to the breast cancer incidence, the model of breast cancer mortality indicates an alarming rate up to the year 2025, while that of the model of breast cancer survivals predict a decline in the survival rate. Within the period under review, the total incidence of the breast cancer in Yola Adamawa State is 1,360 with 881 survivals and 479 mortalities.

Recommendations

Based on the findings and conclusions, the study recommends the following measures:

i. Government should establish breast cancer unit in all health centers across the nation where screening and treatment of the disease can be offered at affordable rate to the public.
ii. Government/NGOs should establish a body or programs that will create awareness and enlightenment campaign to women about the disease.
iii. Government should train more professional hands that will handle breast cancer disease.
iv. Women should be encouraged on a regular Breast-Self Examination and consult health personnel immediately in case of any abnormality, such as thickening of tissue, new lump (painful or not).

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