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# Mapping Cancer Prevalence in Elgeyo Marakwet County, Kenya, Using Geographical Information System

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# Abstract:

Cancer is also a disease associated with space and time therefore analysis can be done on cancer data to determine its spread, patterns and trends to come up with ways to halt its spread. Events that occur anywhere are associated with location and time thus spatial and temporal components of these events can be used to demonstrate aspects related to when and where these events occurred. In Kenya, Cancer is reported to be an important health issue as it ranks third cause of country's death. During the determination of cancer, geo-environmental factors and cancer distribution relationship examination is significant. To determine the spatial and temporal prevalence of cancer. A GIS cancer database will be developed using cancer data from the Elgeyo Marakwet County. A cross sectional study will be used. The GIS software will include the use of ArcGIS by ESRI. Secondary data on cancer cases will be obtained from the cancer Registers and cancer treatment card from January 2003 to December 2013 held at the Moi Teaching and Referral hospital (MTRH). The data will be recorded from the year 2003 to 2013 by the Eldoret Cancer Registry and contained specific data for gender and status (alive or deceased). To determine the cancer occurrence trends, the cancer incidence rates and locations will be obtained from Moi Teaching and Referral hospital (MTRH), and then a cancer density map will be produced. The ArcGIS 10 software will then be used to come up with choropleth maps which show information by coloring each component area, providing an indication of the magnitude of the variable of interest. GIS provides an efficient means of analyzing and visualizing cancer data thus depicting trends and patterns of the spread of cancer in space and time. Different maps and graphs will be produced as a means to visualize and evaluate the extent at which cancer has spread in Elgeyo Marakwet County.

# 1. Introduction

It has been reported in the last 35 years, the global world burden of cancer has increased more than doubled and is believed that it will continue to increase each year (Boyle & Levin, 2008). Today, the greatest of the global burden is in the low- and medium-resource countries (Thom, 2008). According to the 2008 World Cancer Report (Boyle & Levin, 2008), cancer mortalities doubled between 1975 and 2000 and is expected to triple again by 2030, leading to about 27 million cases of cancer and 17 million yearly cancer related mortalities by 2030. The initial cancer maps were produced in the year 1875(Howe G. M. (1989).The current disease atlas started with Howe's National Atlas of Disease Mortality in the United Kingdom (Howe, 1963). According to Mason *et al.* (1975), the initial cancer atlases in the America, mapped thirty four (34) variants of cancer in the small area level. The second version of cancer disease atlases included findings of model-based procedures, for instance time trends of map based on a projected straight forward Poisson model (Pickle *et al.* 1984) p.31. In the USA Cancer is reported as the second highest cause of death in the state of Georgia. Cancer is a very serious health issue that must be tackled in different ways including the prevention and treatment, specifically in cancer death rates at seventy one percent greater than the white women (Singh *et al.* 2005). Again, African Americans could have lower cancer participation in clinical trial than whites (Corbie-Smith *et al.*, 2004 p.31). It should be ensured that all clinical trial patients reflect the population and the cancer trial clinical results are generalizable (Etling *et al.*, 2006).

In Turkey, cancer is reported as the second highest killer disease causing many deaths. In this country, 100-150 thousand cases are observed, and the prevalence of this disease is increasing at 6% rate per year (Tuncer, 2005). Turkey must take decisive measures to tackle cancer, otherwise, a projected five million people will get cancer twenty years from now and further 3.5 million will have died (Source?).

Cancer has many possible causes, with many factors outside (environmental factors), and also inside the body, being major contributors to the cancer development in people (Delpomme *et al.* 2007; Irigaray *et al.*, 2007). According to findings by the U.S. Department of Health and Human Services (HHS, 2003) about two thirds of all reported cancer cases that occur in the U.S. are

thought to be related with exposure to great variety of man-made and naturally occurring substances in the environment. The environmental factors are divided into two groups (HHS, 2003; Irigaray *et al.*, 2007; Wang & Chen, 2001):lifestyle choices: excessive alcohol consumption, smoking, lack of exercise, poor diet, and excessive exposure to sunlight); External factors: exposure to certain medical drugs, radiation, viruses, bacteria and chemicals present in the air, water, food and workplace.

In other cases highly specific environmental exposures could be linked to a specific type of cancer, e.g. asbestos is linked primarily to lung cancer. In other reported cases different factors could be associated to various kinds of cancer, an example of such is smoking and can be linked to up to thirteen kinds of cancer (HHS, 2003). The chance an individual could develop cancer because of a certain environmental agent greatly depends on many factors such as length of exposure, frequency of exposure, exposure to other agents, genetic factors, diet, lifestyle, overall health, age and gender (HHS, 2003). The complex interplay all of these factors make it difficult to predict if a specific environmental exposure could cause a particular person to get cancer. However, some known certain environmental factors e.g. tobacco, alcohol, ultraviolet radiation, pesticides, dioxins, metals and solvents could increase these risk (Delpomme *et al.*, 2007; HHS, 2003; Irigaray *et al.*, 2007).

By mapping cancer type cases, certain patterns of occurrence could occur with regard to interplay between the cancer cases and the environmental factors sighted (Boyle &Smans, 2008). Currently Geographical Information System (GIS) is used to present cancer incidence on maps, an example is the cancer scenery for South Africa could be obtained (Frenzel-Beyme *et al.*, 1979). This could enable researchers to focus and investigate spatial patterns that emerge and quantify the most occurring relationship between cancer and other health, socioeconomic and environmental variables (Brewer, 2006). Brewer proposed that once detailed datasets of cancer incidence in South Africa have been obtained, further analysis could be done to geo statistically look at the relationship between cancer incidences and certain land-uses and environmental factors. GIS can thus serve as an additional tool in the exploration, analysis and communication of cancer and cancer related data.

This study maps cancer distribution cases in Elgeiyo Marakwet County. In Kenya, hospitals collect patients' information about diseases and maintain registries. Cancer diagnosis is done at MTRH and all the data stored using a system protected by laws governing privacy and confidentiality. This data has the cancer patient residential address. In this way, the trends of cancer incidence and deaths in populations can spatially be perceived and also examineall the relationships of mortality, incidence as well as environmental risk factors.

The availability of geographic information system (GIS)due to the development in computer hardware, has led to boundless mapping of academic cartographers. The logical step of this study is to address the cancer burden so as to effectively use geo-referenced data in a broad long-range goal. MTRH, the county as well as all health agencies in this study shall be the primary users as they plan to reduce cancer mortality and morbidity in their implementation and evaluation of plans and initiatives. The main beneficiaries from this research shall be epidemiologists and other health researchers. The aim of this research is to map the Geographic distribution of cancer cases in Elgeyo Marakwet County over a ten-year period 2003 to 2013.

#### 2. Research Methodology

Cancer cases according to their address information were matched to an administration unit code. Thus, cancer data sets were linked to base map in foundation geo data base via GIS. For each cancer case, an administration unit code was recorded to cancer registry dataset for geocoding.

In order to be able to perform some statistical analysis and comparisons, some calculation of cancer incidence values for each administrative unit were done.

# 3. Findings

# 3.1. Geographical Distribution Cancer Type

The distribution of cancer types in Elgeyo Marakwet were derived from information on Secondary data. Kamariny had the highest occurrence of Cancer related diseases for the period from 2003 to 2009 with a record of 76 while Embobut/Embolot, Kapyego and Sambirir recorded the lowest rate of cancer related diseases.

# 3.2. County Cancer Distribution



Figure 1: Total cancer occurrence per ward in Elgeyo Marakwet County in the period 2003-2009

The rate of cancer in the three wards with more than 30 instances is situated on high population areas and on centers. The possible reason for this numbers could mostly be due to high rates of exposure to processed foods due to advanced technology in the areas and visitors, however more research needs to be done to confirm. The other reason is enlightenment of the general public translating to more instances of cancer screening and visit medical centres thus their records are available. The zones were there were less than 10 cases were reported could be due to inadequate health facilities thus the low level of incidences.



Figure 2: Level of cancer incidences versus death rates between 2003 and 2009 in EMC

# 3.4. Distribution per Sub County Units

The distribution of the disease per Sub County was plotted to give an in-depth view of distribution based on local lifestyles and climatic changes. It was observed that Keiyo South Location was leading with more than half of the cases reported in the sub county. Marakwet East Location was the lowest though it had a very high risk of occurrence as per the kernel distribution figure below. Marakwet East has a high tendency of newer infections than other Sub-counties, this could be attributed to sedentary lifestyle and its Proximity to Kapsowar which had the highest occurrence by 29%.

# 3.5. Cancer Distribution by Types

The distribution of cancer by type within the county showed that the most common cancer type is Skin cancer affecting 11% of the patients. Oesophogus, Lymphnode and uncategorized types followed at 9%, 8% and 8%, respectively.



Figure 3: Distribution of cancer by type

The probable reason why the leading type of cancer is skin cancer could be due to the tropics effect. The county lies slightly on  $0^{\circ}10'0'$  North of the equator indicating that there is high insolation rate in the area and is a risk factor according to America National cancer institute.

#### 3.6. Spatial and Temporal Patterns of Cancer Cases

The spatial distribution of cancer in the county was plotted using Arcmap and it was observed that there were zones that had low rates of infection while others had high rate of infection. The distribution could be observed from Fig. 4.10 below showing zones with occurrences of 5-9 to be higher than those of 48-76 persons.

#### 3.7. Cancer Cluster Cases per Locations

A kernel distribution density was conducted to show the spatial relationship of the cancer distribution in the county and the location. The distribution showed that most of the areas had low counts of possible cancer cases while a small area had a higher risk of the occurrences in Marakwet East.



*Figure 4: Spatial relations of cancer occurrence to health facilities in EMC between 2003 and 2009* The spatial distribution of health facilities shows that Marakwet has the highest number of health facilities concentrated mainly on the East. This has seen a rise in the occurrences recording in this particular area.

#### 3.8. Trend of Cancer Occurrence between 2003 and 2009

The trend of cancer occurrences in the county was plotted and it was observed that there is anupward trend in cancer occurrences from 2003 to 2005. From 2005 to 2006 the highest cases of cancer was recorded at 85 while in 2009 the lowest occurrences was recorded. The increasing cancer trend in the county needs to be further investigated studied to identify the reasons across the county. This medical facilities offer patient's free early screening of cancer and therefore immediate treatment commences reducing the death rates and preventing more occurrences. Availability of information on carcinogenic foods might also have played a key role in the new occurrences of the diseases. .However this needs to be confirmed by a full study.



Figure 5: Cancer occurrence Trend from 2003-2009 in EMC.

#### 3.9. Trend by Sub County

Despite the dropping trend in the county in general, the sub counties of Kapsowar, Moiben, Arror, Sengwer, Sambirir and Soy North showed an increasing trend from 2007 to 2009 (Fig. 4.15). The analysis below compares the trends in high, medium and low occurrences areas based on the reported cases

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