COMMON CANCERS AND ASSOCIATED RISK FACTORS IN ARUA DISTRICT UGANDA

BY

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Adm No. H153/P/2530/21

A Thesis Submitted to the Post Graduate School in Partial Fulfillment of the Requirements for the Award of the Degree of Master of Epidemiology and Biostatistics of Jaramogi Oginga Odinga University of Science and Technology

March 2024

DECLARATION

I declare that this thesis has not been submitted for any other degree in any university before. All the work is original unless otherwise acknowledged.

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DEDICATION

I dedicate this thesis to my dear family my parents; Mr. Anthony Amandua and Mrs. Grace Bako, my siblings; Eugene, Patience, Elly and Desire, my husband; Felix Ayiga and my children Emmanuella and Godwin who I left back home in Uganda and travelled to Kenya especially my son who was one year old at that time and still breastfeeding. My family has supported me so much and kept me going through their encouragement. I also dedicate this to my workmates at the Uganda Cancer Institute for their help throughout this Master's program

ACKNOWLEDGEMENT

I am grateful to God for enabling me successfully carry out this research. Thanks also goes to my supervisors; Dr. Daniel Onguru, Dr. Annet Nakaganda and Dr. Charles Angira as well as lecturers for the guidance offered in accomplishing this. I am grateful to the research team including Joan Ahikiriza, Linda Adong, Ashraf Nkangi for data collection. The records assistants of the different facilities for availing the data source documents. I am also grateful to the Uganda Cancer Institute, Arua Regional Referral Hospital, Kuluva Hospital, Omugo HCIV and Rhino Camp HCIV for permission to carry out this research. Thanks goes to the funders of this research; European and Developing Countries Clinical Trials Partnership Program (EDCTP), and the Horizon 2020 European Union Funding for Research & Innovation through the Capacity Development for Applied Epidemiologists (CDAE). To my family for the patience, prayers and guidance during the entire course of the study. Also my classmates in Bondo for their contribution throughout the stages of this thesis.

ABSTRACT

Cancer is the second leading cause of mortality worldwide, with over 19 million cases and 10 million deaths worldwide. Approximately, 50% of all new cancer cases and 70% of all deaths occur in low-and middle-income countries. In Uganda, 34,008 new cancer cases were registered and 22,992 deaths occurred in 2020. Arua district was purposively selected for this study because no active cancer surveillance is done in the district and the findings of this research will help strengthen and evaluate cancer control interventions in Arua. The goal of the study was to determine the common cancers and risk factors for the common lifestyle cancers amongst adult men and women in Arua. A retrospective cohort study, using medical records was used to determine the commonest cancers in Arua District for the period of 2017 to 2021. In addition, a nested case-control study was employed to investigate the cancer risk factors associated with the identified commonest cancers. Cases were identified from 5 health facilities in Arua and 1 in Kampala. Data was collected using a Data Abstraction Form and analyzed using Stata 17. The findings showed 1,118 new cancer cases were registered by this study, liver cancer was the commonest cancer in Arua accounting for 13.7%, followed by Cancer of the Cervix (11.8%), Breast (10.7%), Esophagus (10.5%) and Burkitt's lymphoma (6.4%). Men with a history of tobacco use were 3.2 times more likely to suffer from cancer of the esophagus than those with no history of tobacco use at 95% CI (1.7-5.9). Having more children was a protective factor against breast cancer in women, OR, CI (0.8, 0.7-0.9). The risk of getting breast cancer was 2.1 times higher in pre-menopausal women than post-menopausal women OR, CI (2.1, 1.2-3.7). A positive history of Contraceptive use increased the risk of breast cancer by 2.2 times, OR, CI (2.2, 1.0-4.7) in the bivariate analysis. In conclusion, this study suggested that cancer of the liver, cervix, breast, esophagus and burkitt lymphoma were the five top cancers in Arua and that reproductive risk factors came out strong for breast cancer while lifestyle risk factors came out strongly for cancer of the esophagus hence the need for targeted cancer control interventions against these cancers in Arua district.

Definition of Terms

Cancer	A disease caused when cells divide uncontrollably in a body part
Common Cancers	Refer to the frequency of occurrence of some cancers more than the others
Newly diagnosed	Incident cases
Cancer Registration	Process of collection, storage and management of data on persons with cancer
Population Based Cancer Registry	Collects data on every person with cancer in a well-defined population, usually comprising people resident in a well-defined geographical region
Hospital Based Cancer Registry	Collects data on every person with cancer in a hospital
Secondary Malignancy	A new cancer that occurs in an individual usually as a result of previous cancer treatment or other reasons
Lifestyle Cancers	Cancers driven by one's choice of living behavior
Cancer Risk factors	Something that increases a person's chance of getting a cancer
Globocan	A project of the International Agency for Research on Cancer that provides estimates by cancer site and sex using the best available data in each country and several methods of estimation.

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ABBREVIATIONS

AML	Acute Myeloid Leukemia
APHRC	African Population and Health Research Center
BC	Breast Cancer
BMI	Body Mass Index
BPS	Board of Postgraduate Studies
BRCA	Breast Cancer Gene
CDAE	Capacity Development of Applied Epidemiologists in Eastern Africa Region
CHWs	Community Health Workers
CI	Confidence Interval
CME	Continuing Medical Education
CORU	Cancer Occurrence in Uganda
COVID19	Corona Virus 19
DAF	Data Abstraction Form
DCO	Death Certificate Only
DM	Diabetes Mellitus
EBV	Epstein-Barr Virus
EDCTP	European and Developing Countries Clinical Trials Partnership
ENT	Ear Nose and Throat
GCR	Gulu Cancer Registry
GLOBOCAN	Global Cancer Observatory
HAART	Highly Active Antiretroviral Therapy
HBV	Hepatitis B Virus
HCC	Hepatocellular Carcinoma
HCV	Hepatitis C Virus
HHV8	Human Herpes Virus 8
HIV	Human Immune Virus
HPV	Human Papilloma Virus
HTLV-1	Human T-Lymphotropic Virus 1
IARC	International Agency for Research on Cancer
IRB	Institutional Review Board
IQR	Interquartile Range
JOOUST	Jaramogi Oginga Odinga University of Science and Technology
KCR	Kampala Cancer Registry
KS	Kaposi Sarcoma
MakSPH	Makerere University School of Public Health
MESH	Medical Subject Headings
MUAC	Mid Upper Arm Circumference
NCDs	Non Communicable Diseases
NHL	Non Hodgkin Lymphoma
NOS	Not otherwise Specified
OR	Odds Ratio
PBCR	Population Based Cancer Registry

PCU	Palliative Care Unit
PFP	Private for Profit
PMT	Protection Motivation Theory
PNFP	Private Not for Profit
REC	Research Ethics Committee
REDCap	Research Electronic Data Capture
RRH	Regional Referral Hospital
TCMP	Traditional and Complementary Medicine Practitioners
UBOS	Uganda Bureau of Statistics
UCI	Uganda Cancer Institute
UNCST	Uganda National Council of Science and Technology
VHT	Village Health Team
WHO	World Health Organization

CHAPTER ONE: INTRODUCTION

1.1 Introduction

Cancer is the second leading cause of mortality worldwide with over 19 million cases worldwide and 10 million deaths (Globocan, 2020b). Approximately, 50% of all new cancer cases and 70% of all deaths occur in low- and middle-income countries. In Africa, over 1.1 million new cases and 711,429 deaths due to cancer occurred in 2020. Also, this ever present disease has coexisted in Africa with more recently discovered communicable diseases such as Malaria, Ebola, AIDS and COVID19 (Halperin, 2020). Even though cancer death rates have surpassed those of AIDS, tuberculosis, and malaria combined, there remains a lack of commitment to fighting cancer in Africa (Gutman *et al.*, 2020). Indeed, most attention goes to investigating communicable diseases while disregarding the challenges posed by several non-communicable diseases such as cancer (Rebbeck, 2020). With the cancer burden rising in sub-Saharan Africa, countries in the region need surveillance systems to measure the magnitude of the problem and monitor progress in cancer control planning (Bray *et al*., 2022). In Uganda, 34,008 new cancer cases were registered and 22,992 deaths occurred in 2020. The five common cancers in Uganda were Cervix, Kaposi Sarcoma (KS), Breast, prostate, and non-Hodgkin's Lymphoma (NHL) and the risk of developing cancer in Uganda before the age of 75years was estimated to be 16%. These cancer estimates for Uganda come mainly from one cancer registry that is based in Kampala capital city and little is known from other parts of the country (Globocan, 2020c).

There are observed differences in the burden and distribution of cancer types worldwide (Isabel dos Santos, n.d.). This is due to differences in both aging and growth of the population as well as changes in the prevalence and distribution of the main risk factors for cancer, most of which are associated with socioeconomic development (Vineis & Wild, 2014). Effective national cancer control plans rely on robust and solid data on cancer patterns and the different risk factors associated with the cancer in different communities.

Uganda is divided into four regions: Northern, Central, Eastern and Western. Arua is one of the districts in the Northern region lying mainly to the west of River Nile in North West Uganda. According to the Uganda Bureau of Statistics (UBOS) population projections, the population of Arua district was projected at 938,900 people in 2021 suggesting an increase from 782,077 people

in 2014 (Census, 2014) of which about 15% are refugees. Because of this, there is an expected rise in burden of disease due to increased prevalence of risk factors associated with economic and demographic transition (including smoking, alcohol, obesity, physical inactivity, and reproductive behaviors). (Sung *et al.*, 2021).The life expectancy of Uganda has also greatly improved from 47 years in the late 90^{s} to 64 years currently(*UBOS, 2020,*.) . With this improvement in life expectancy, there is an expected increase in burden of cancers associated with old age (Pedersen *et al.*, 2016).

The available data on cancer incidence in Uganda is from two Population Based Cancer Registries and none of these covers Arua district and yet cancer incidence is driven by genetics but also by environment and culture of a population. Therefore this study sought to describe what cancers were common in Arua using data that was specific to the district but also what risk factors were prevalent in this population.

1.2 Problem Statement

There are observed differences in the burden and distribution of cancer types worldwide. (Bray *et al.*, 2022). However, Uganda lacks data on the distribution of cancer in other parts of the country other than Kampala capital city. As a result, most cancer control interventions are not based on local research evidence and are implemented based on general assumptions and opinions of the significant leaders.(Jatho *et al*., 2020) Various factors affect the distribution of cancers among the population including: environmental variations in the prevalence of cancer risk factors, age of the population and type of medical care/diagnosis as determined by the socioeconomic status of residents. (Isabel dos Santos, n.d.)These factors may affect the distribution of cancers in Uganda too, since regions and populations in Uganda are heterogeneous in many ways including: ethnicity, social systems, culture, diet patterns, economically, lifestyle, and natural/geographical environment. (Nakaganda, Mbarusha, *et al.*, 2023) Because of these differences, there is need to determine the burden of cancer and risk factors across different geographical regions to inform the planning and implementation of targeted cancer control strategies in Uganda. And also because the World Health Organization (WHO) recommends that countries come up with specific national cancer control policies, plans and programs that are harmonized to include cancer surveillance strategies in the entire country (Bezwoda, 2012).

1.3 Objectives of the study

Main objective

To describe the common cancers and risk factors associated with these cancers in Arua District, Uganda

Specific objectives

1. To determine the commonest cancers in Arua District from 2017 to 2021
2. To determine the risk factors associated with the commonest lifestyle cancer amongst men from Arua district 2017 to 2021
3. To examine the risk factors associated with the commonest lifestyle cancer amongst women from Arua district 2017 to 2021

1.4 Research Questions

1. What are the commonest cancers in Arua district from 2017 to 2021?
2. What cancer risk factors are associated with the commonest lifestyle cancer in men of 20 years and above from Arua from 2017 to 2021?
3. What cancer risk factors are associated with the commonest lifestyle cancer amongst women of 20 years and above in Arua from 2017 to 2021?

1.5 Justification

The exact burden of disease in Arua is not known, since no active surveillance of cancer patterns and associated risk factors of the disease is done in Arua district. Also, Arua district has the highest population amongst all the districts in West Nile (the proposed Arua Cancer Registry catchment population) and it has the Arua regional referral hospital. In addition, there is a faith-based hospital (Kuluva Hospital) that attempted to establish a cancer registry in the 1960s however, inadequate logistics led to the fall of this cancer registry which needs to be revitalized that is why the survey method which has proved to be feasible is being used to collect information to supplement the Arua Cancer Registry data. The study therefore intended to leverage this experience and structure.

1.6 Significance

Surveillance for cancer and associated risk factors is an important component of cancer control and planning. Since a regional cancer center has been set up in Arua district to cover the west Nile

sub region, it's important to determine the baseline cancer burden and prevalence of cancer risk factors in the district. This data will be used for planning, implementation and evaluation of cancer control interventions in this region.

1.7 Scope of the study

The study was carried out on newly diagnosed cancer patients from Arua district. These patients were found at the UCI, Arua Regional Referral Hospital (Arua RRH), Arua Palliative Care Unit (Arua PCU), Kuluva Hospital, Rhino Camp HCIV, and Omugo HCIV in Arua district. This district is located in the Northern Region of Uganda and lies about 480 km from Kampala Capital City. The study was carried out with funding from the Capacity Development of Applied Epidemiologists in Eastern Africa Region (CDAE) and European and Developing Countries Clinical Trials Partnership (EDCTP) with support from the African Population and Health Research Center (APHRC).

1.8 Strengths of the study

Ability and willingness of health facilities to provide required information. All the six health facilities visited for data collection willingly gave the required information for this study.

The 'Catchment population approach' used correctly described the cancer patterns. This method, also known as the "CORU method" was adopted from a feasibility study done in Uganda to establish the feasibility of estimating cancer incidence in resource limited settings where PBCRs are absent. Using the CORU approach for this study therefore described the cancer patterns in Arua hence helping the study achieve its objective one

The methodology used which was adapted from the International Agency for Research on Cancer, to identify cancer risk factors in resource limited settings using routinely collected data correctly determined the breast and esophageal cancer risk factors, hence helping the study achieve objectives two and three.

Most of the study findings were consistent with what other studies have reported. And hence this signified that the study methodology used ably answered the study objectives in correspondence with other studies.

1.9 Limitations of the study

Since the study was based on routine data, both exposure and outcome of interest had already occurred, it was limited by missing and inadequate data which could have biased our estimates.

External validity was affected because risk factors amongst males may not be generalizable to the females and the same applies for risk factors amongst females.

Poor record keeping. Some of the health facilities visited had their records already destroyed by termites and this affected data collection since the patient charts were already torn.

Archiving methods of old records. Some facilities had no facilities for archiving their old records. Because of this, very few records were retrieved for 2017 since these facilities had destroyed some of these records.

Matching of cases and controls could not be done due to the limited number of cases and controls with information on the different cancer risk factors.

Pathology laboratories were not visited due to inadequate resources hence reducing the number of morphologically verified cases.

Death Certificate Only (DCO) cases were also not captured by this study. Therefore, further research needs to be done to identify any DCO cases in Arua as this will help boost the quality of the data and hence accurately estimate cancer incidence in the district.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Research has been done on the various patterns of cancers in the world, both in developing countries and developed countries.(DeVita & Rosenberg, 2012) The World Health Organization (WHO) through the International Agency for Research on Cancer (IARC) releases a biannual report of the global Cancer statistics (Globocan). These statistics are specific to countries, regions, continents and the world and they describe the patterns of disease, burden and projections of the disease burdens for the next 10 or more years. The global Cancer Observatory also gives a snapshot of what cancers are attributable to lifestyle and environmental risk factors worldwide. The Global Initiative for Cancer Registry Development (gicr.iarc.fr), led by International Agency for Research in Cancer (IARC), is a partnership of leading cancer prevention organizations that seeks to address data availability, ensuring the robustness of cancer incidence data by improving their quality, comparability and use (Hamdi *et al.*, 2021). Data collected in this framework is available through IARC's GLOBOCAN database. Despite the availability of cancer data from IARC, data on cancer patterns in Africa are sparse (Orem & Wabinga, 2009), but the considerable effort which has gone into fostering the development of population-based cancer registries (PBCR) cannot go unnoticed amidst various challenges such as limited human resource, poor medical infrastructure and limited access to diagnostic services, medical and vital records and population denominators (Omonisi *et al.*, 2020). Nonetheless, the information produced by the PBCRs gives a unique insight into cancer patterns in Africa, and it is the results from the PBCRs that IARC publishes biannually to describe the cancer patterns in the continent. Data on cancer patterns from Uganda is from two PBCRs; the Gulu Cancer Registry (GCR) and Kampala Cancer Registry, KCR (Wabinga *et al*., 2016). Thus, relevant to this paper is work that has previously been done on the patterns of cancer in the world, Sub-Saharan Africa and specifically Uganda. Also, this chapter seeks to review literature on cancer risk factors associated with the five common cancers seen in adult men and women in Uganda.

2.2 Common Cancers

To describe the cancer patterns of Uganda, literature was identified through use of both grey literature from conference proceedings and reports and also searching from PubMed/Medline library, Research for Life and Google scholar as well as the internet. Specific MESH (Medical subject Headings) terms were used to search for literature employing both controlled vocabulary

and keywords in the search. Incidence, patterns, common diagnosis, cancer, malignancy and neoplasms were used in the search interchangeably. Literature was searched for all years, after which studies conducted and findings published 10 years back were included but preference was for studies published after 2016 up to date since those were the recent studies. These studies were those that described incidence trends, common cancers, patterns of cancer, neoplasms and malignancy in Uganda.

Available data on cancer patterns in Uganda is through modelling of data from two Population Based Cancer Registries)(PBCRs): Kampala Cancer Registry (KCR) and Gulu Cancer Registry (GCR) which represent only about 10% of the cancer situation in Uganda hence warranting the need for establishing more cancer registries and also improving quality of data from the available cancer registries. More epidemiological studies can also be carried out to describe the patterns of disease in Uganda through collection and analysis of hospital, hospice and even histopathology laboratory data on cancer incidences and patterns (Nakaganda, Spencer, et al., 2023). Globocan estimates of cancer incidence in Uganda were also used for the 2018 and 2020 reports of cancer in Uganda.

Cancer constitutes a huge burden worldwide in both more and less developed countries alike. Africa is undergoing significant improvements in population health, shown by the declining infant mortality rates, HIV/AIDS fatality rates, and improved life expectancy (Sharma *et al*., 2022). These could be attributable to improved vaccination coverage (Wallace *et al*., 2014), malaria interventions such as bed nets (Lim *et al.*, 2011), antiretroviral therapy for HIV, and prevention of mother-to-child transmission of HIV (Maartens *et al*., 2014).

Amidst these gains, the disease landscape in Africa is also undergoing significant changes, with rising morbidity and mortality due to non-communicable diseases such as; cancer, cardiovascular disease, type 2 diabetes and falling burden of communicable diseases(Roth *et al*., 2018). Cancer is now the fifth leading cause of death in Africa (Roth *et al.*, 2018), which warrants further investigation about cancer burden in African region.

About 18.1 million new cases and 9.6 million cancer deaths were estimated to have occurred worldwide in 2018 (Bray *et al*., 2018). In Africa, 5.8% of the world's incident cancer cases and 7.3% of deaths due to cancer were registered in 2018. This was because of a difference in

distribution of cancer types and higher case fatality in Africa. The most commonly diagnosed cancers were cancers of the lung (11.6%), breast (11.6%), prostate (7.1%), colon (6.1%) and stomach at 5.7% (Bray *et al.,* 2018). The global cancer burden is expected to be 28.4 million cases in 2040, a 47% rise from 2020, with a larger increase in developing (64% to 95%) versus developed (32% to 56%) countries due to demographic changes, although this may be further exacerbated by increasing risk factors associated with globalization and a growing economy Sung et al., 2021)

In Uganda, 34,008 new cancer cases were registered and 22,992 deaths occurred in 2020. The five common cancers in Uganda according to globocan 2020 were Cervix, Kaposi Sarcoma (KS), Breast, Prostate, and Non-Hodgkin's Lymphoma (NHL). Children (14 years and below) consist about 10% of cancer patients in Uganda(Globocan, 2020c). The five causes of cancer mortality in Uganda were cancer of the cervix, KS, Esophagus, Liver, and NHL. The patterns of cancer are different even within the East African region, Kaposi Sarcoma was among the five contributors of cancer morbidity and mortality in Uganda, however in Kenya, Kaposi Sarcoma was not even among the ten commonly diagnosed cancers in the country. Differences in cancer patterns also exist within Uganda as evidenced at the Uganda Cancer Institute which is the sole comprehensive national cancer referral hospital in the country (Martin Nabwana, 2018). Even in the same country, various different patterns have been observed (Nwafor *et al,* 2018). Cancer patterns were observed to be different within Uganda for instance between Kampala and Mbarara where by stomach and penile cancer which are rare cancers in Kampala were found to be common in Mbarara (Parkin *et al.*, 2010), and cancer of the esophagus which is common in Kampala was found to be uncommon in Mbarara (*Bukirwa et al.*, 2021).

With the COVID-19 pandemic, delays in diagnosis and treatment were experienced due to health system closures, suspension of cancer screening programs and limited access to care, this then led to an observed short-lived decline in cancer incidence followed by an increase in advanced stage diagnosis and even mortality (Sung *et al.,* 2021b). Studies identified by this literature review specifically established the trends of disease in Northern Uganda as from the GCR (Okongo *et al.*, 2019) and those from the KCR which also collects data on cancer trends in the population of Kyadondo county and surrounding areas (Bukirwa *et al.*, 2021). No periodic surveys are done to ascertain the exact magnitude and burden of disease in the different populations. However, Results

of a study done in Uganda proved the feasibility of estimating cancer incidence, using a retrospective cohort design and a "catchment population approach" or better still known as the "CORU design". This approach involves active registration of newly diagnosed cancer cases, for a defined period of time, in all the health facilities serving a defined population(Nakaganda, Spencer, *et al.,* 2023)

This study therefore aimed at minimizing the gap in knowledge about the cancer burden in Arua district by using a catchment population approach and specifically a population that is not served by neither the Kampala Cancer Registry nor the Gulu Cancer Registry.

2.3 Risk factors for cancer among men and women in Uganda

2.3.0 Introduction

. It is usually not easy to tell exactly why a person develops a cancer and another does not (Goding Sauer *et al., 2019*). However, research has shown that certain risk factors may increase a person's probability of developing cancer, other factors may also lower a person's risk of developing a cancer and these are known as protective risk factors (Wu *et al.,* 2018). Cancer occurrence can be examined in relation to personal attributes of individuals using routinely collected data (Isabel dos Santos, n.d.). Studies that use routine data in cancer epidemiology are referred to as Routine data based studies. Specific to this study, known risk factors for cancers amongst men and women will be reviewed and categorized as; lifestyle factors, reproductive factors, anthropometric factors, genetic factors, infection associated factors and socio demographic factors and how they increase one's risk for the different cancers. A recent study done in Uganda projected a shift in spectrum of common cancers in Uganda from infection related to lifestyle associated cancers as a new trend emerging in low and middle income countries (Asasira *et al.,* 2022a).

2.3.1 Lifestyle-associated risk factors

Commonly known lifestyle risk factors associated with cancers include; physical inactivity (sedentary lifestyle), diet, harmful alcohol consumption, and smoking (tobacco use). However, for purposes of this study, focus was on alcohol consumption and smoking because the study did not involve direct interaction with study participants and only depended on data that had already been collected. History of alcohol consumption and tobacco use are the most commonly studied lifestyle

cancers in Uganda because data on these is collected by clinicians in health facilities(Jatho *et al.,* 2020). The risk of developing cancer due to tobacco use and alcohol consumption is dependent on the quantity and duration (intensity) of the smoking and alcohol consumption habit prior to onset of the cancer. Important to note also is the association between alcohol consumption and tobacco use. Although the tobacco control Act is effective in Uganda, there is no similar legislative Act on the control of Alcohol in Uganda (Nabirye & Kamulegeya, 2019).

Alcohol Consumption

Consumption of alcohol is one of the most important known and modifiable risk factor for human cancer (Scoccianti *et al.,* 2014). It is associated with an increased risk for cancers of many organs, such as oral cavity, pharynx, larynx, and esophagus; breast; liver (hepatocellular carcinoma); ovary; colon; rectum; stomach; and pancreas(Purohit *et al*., 2005). However, data on alcohol use is limited in most sub-Saharan countries, with Uganda inclusive. The WHO global status report on alcohol consumption put the annual consumption percapita in Uganda to be 26.0 liters which is the highest in East Africa (Hammer *et al.,* 2018). A study conducted in Uganda found out that if alcohol use was eliminated, approximately 13% of incident cases of cancer of the esophagus would be eliminated (Okello *et al.,* 2016). Another study on the joint and independent effect of smoking and alcohol consumption on oral cancer found alcohol consumption not to be independently associated with oral cancer while on the other hand joint consumption of both tobacco and alcohol was found to increase the risk of oral cancer (Ferreira Antunes *et al.,* 2013). No history of alcohol consumption was found to be associated with a decrease in the incidence of colon cancer among those with a family history of colorectal cancer (Cho *et al.,* 2012). Hepatocellular carcinoma is the most common type of liver cancer that is associated with alcohol consumption (Llovet *et al*., 2016). A recent meta-analysis on alcohol consumption and the risk of stomach cancer established a higher daily intake of alcohol to be associated with a higher risk of stomach cancer (Deng *et al.,* 2021). Among females, alcohol consumption was found to be associated with breast cancer in Uganda irrespective of the dose response (Qian *et al.,* 2014). It may also be associated with an increased risk of ovarian cancer in specific populations (Yan-Hong *et al.,* 2015).

Tobacco Use

Tobacco use is a leading cause of cancer and of death from cancer, accounting for many types of cancers among men in Uganda; esophagus, bladder, HCC, colorectal, stomach, kidney, lung and acute myeloid leukemia (AML) as well as mouth and throat cancers. WHO puts the prevalence of tobacco use in Uganda to be at 5% among adults (15 years and above) in Uganda (WHO, 2021a).Chewing tobacco is associated with an increased risk of mouth, esophagus and pancreas cancer. Important to note is that there is no safe level of tobacco use, therefore any prior history of tobacco use could increase one's risk of cancer.

A study conducted in Uganda observed that majority of lung cancer patients diagnosed were never smokers (Kibudde *et al.,* 2021). A meta-analysis conducted in a Caucasian population confirmed the association between tobacco smoking and onset risk of acute myeloid leukemia (AML). However, in Uganda no studies have been conducted to establish the association between AML and tobacco smoking (Shi *et al*., 2019). Tobacco use is also associated with cancer of the esophagus in Uganda (Ocama *et al*., 2008). The odds of getting colorectal cancer in Uganda were twice amongst past and current smokers than amongst those who had never smoked *(*Wismayer *et al.*, 2022).

Among females specifically, tobacco use (smoking) has been found to be associated with an increased risk of cervical cancer. A study carried out among Tunisia women revealed a 14 times increased risk of cervical cancer among women who were smokers (Zidi *et al*., 2020). Tobacco substances damage the DNA of cervix cells and may contribute to the development of cervical cancer(Castellsagué & Muñoz, 2003). Smoking also makes the immune system less effective in fighting HPV infections.

2.3.2 Reproductive risk factors

Most reproductive cancer risk factors are associated with prevalent cancers among women. For purposes of this study, we will explore the following risk factors; parity, age at menarche, menopausal status, and history of oral contraceptive usage. According to the 2014 census of Uganda, UBOS put the fertility rate of the country to be 5.4 births per woman. Women who have had 5 or more full-term pregnancies have an increased risk of developing cervical cancer (Bosch

& de Sanjosé, 2007). This could be due to hormonal changes during pregnancy making women more susceptible to HPV infection or cancer growth (Kurnia *et al.*, 2022). Another thought is that pregnant women might have weaker immune systems, allowing for HPV infection and cancer growth (Pimple & Mishra, 2022). Therefore, these findings could explain the role of parity in increasing the risk of cervical cancer. Multiple parity on the other hand was seen as a protective factor for breast cancer in a study carried out in Mozambique to explore the overall risk factors for breast cancer among women in Sub-Saharan Africa (Brandão *et al.,* 2021). However, these findings could be confounded by the menopausal status of the women. African women generally start child bearing at an early stage, hence increasing the risk of getting breast cancer before the age of 45years (premenopausal) and reducing their risk of breast cancer at the age of 45 years or older (post-menopausal) (Palmer *et al*., 2003).

Late age at menarche has also been seen to increase the risk of breast cancer among pre-menopausal women while it is protective for post-menopausal women (Okobia *et al.,* 2006). The interval between menarche and first sexual intercourse was also found to increase a woman's risk of cervical cancer in a case control study carried out in Thailand (Natphopsuk *et al*., 2012).

Sexual history is an important risk factor for cervical cancer. Becoming sexually active at a young age especially below 18 years. An earlier study carried out in Mexican women found onset of sexual activity after the age of 25 years to be a protective factor against cervical cancer (Lazcano-Ponce *et al*., 1995).These findings were consistent with those in another study among rural Indian women which reported increased risk of cervical cancer among women who had onset of sexual activity at 12 years and below (Biswas *et al.,* 1997). A study done in Uganda also got the same results, early onset of sexual activity was found to significantly increase risk of cervical cancer probably due to an earlier age at infection with the HPV (Parkin *et al.,* 2010). Having many sexual partners is also another factor related to sexual history that could increase a woman's risk of cervical cancer (Newton *et al*., 2007). Among HPV positive women, a large number of sexual partners was found to increase the risk of cervical cancer in a meta-analysis done between HPV positive women (cases) and HPV negative women (controls) (Castellsagué *et al.,* 2006). Having a sexual partner who is HPV infected or who has multiple sexual partners also increases a woman's risk of cervical cancer.

Long term use of oral contraceptives also increases the risk of cervical cancer. A systematic review found out that the risk of cervical cancer increased with duration of contraceptive use in women with HPV infection (Gierisch *et al*., 2013). A case control study carried out among black women in South Africa also found an increased risk of cervical cancer among women with a history of long term oral contraceptive use (longer than 5 years) while adjusting for potential confounders (age, calendar year of diagnosis, education, smoking, alcohol, parity/age at first birth, and number of sexual partners) (Urban *et al.*, 2012). A Danish cohort study reported a 20% increased risk of breast cancer among current and recent hormonal contraception users (Zidi *et al*., 2020) and these findings were consistent with those from previous studies.

African women generally start child bearing at an early stage, hence increasing the risk of getting breast cancer before the age of 45years (premenopausal) and reducing their risk of breast cancer at the post-menopausal age of 45 years or older (Palmer *et al*., 2003). An earlier systematic review found that older age at first birth was associated with an increased risk of breast and brain cancers but decreased risk of cervical and endometrial cancers (Merrill *et al.*, 2005).

2.3.3 Genetic Factors

Most or even all cancers are associated with exposure to certain genetic factors. Cancer genes maybe inherited from parents or exposure to certain carcinogens or even ageing. Having a family history of cancer doesn't necessarily result into one acquiring a cancer later on in their lives though it has been seen to increase one's risk of getting cancer. Recent studies have reported differences in prostate cancer patterns mainly due to variations in early detection, accessibility to treatment and genetic factors (Gandaglia *et al.,* 2021).

Rates of prostate cancer were observed to be highest amongst men of African descent in the United States and the Caribbean which was an indicator of ethnic and genetic risk associated with acquiring the disease (Bray *et al*., 2018). Having a father or brother with prostate cancer more than doubles a man's risk of developing this disease, (the risk is more for a man with a brother with the disease than for a father). The risk is much higher for men with several affected relatives, particularly if their relatives were young when the cancer was found. Genetically, BRCA1 and

BRCA2 mutations have been identified to increase a man's risk of developing prostate cancer (Gallagher *et al.,* 2010).

Genetic factors increase the risk of breast cancer through a high prevalence of mutations of the genes of BRCA1 and BRCA2 as well as a positive family history of breast or cancer of the Ovary. Genetic factors are known to account for 5% to 10% of breast cancer cases (Bray *et al*., 2018). Family history of cancer should be present in a first degree relative like a parent or a sibling (brother or sister). Results of a meta-analysis found that Women with a first-degree family history of endometrial cancer or colorectal cancer have a higher risk of developing endometrial cancer than those without a family history (Win et *al.,* 2015). Esophageal cancer is also associated with a positive family history of cancer as evidenced in a study carried out in high risk China which reported that participants with positive family history of esophageal cancer had significantly higher risk of esophageal cancer precancerous lesions. This risk increased with the number of esophageal cancer positive first degree relatives (Zhou *et al.,* 2022). A positive family history of hematological malignancies has also been seen to be associated with an increased risk of Non Hodgkin Lymphoma (Thandra *et al*., 2021).

2.3.4 Infection Associated Risk Factors

Infectious agents were responsible for 33 per 100,000 cancer cases in Sub-Saharan Africa in 2018 (Rositch, 2020). Hence accounting for an estimated 15% of all new cancer cases annually worldwide, of which two-thirds occur in less developed countries (Sung *et al.*, 2021). According to WHO (de Martel *et al*., 2020), Cancers for which there is well-established evidence of a causal link with infectious agents include; carcinoma of the oral cavity, oropharynx including tonsil and base of tongue, larynx, anus squamous cell carcinoma, cervix, vulva, vagina, and penis which are associated with (HPV infection). Adult T-cell leukaemia and lymphoma which are associated with HTLV-1 Infection; Kaposi sarcoma associated with HHV-8 Infection; Hodgkin lymphoma, Burkitt lymphoma, and nasopharyngeal carcinoma associated with EBV Infection; non-cardia and cardia gastric carcinoma (Stomach cancer), and gastric non-Hodgkin lymphoma associated with H. pylori; Hepatocellular carcinoma associated with HBV Infection; hepatocellular carcinoma and other non-Hodgkin lymphomas associated with HCV; Cholangiocarcinoma associated with *Opisthorchis viverrini* and *Clonorchis sinensis*; and bladder carcinoma associated with

Schistosoma haematobium. However in Uganda the common Infection related cancers include KS, Burkitt's lymphoma, liver cancer (Hepatocellular Carcinoma), cervical cancer and gastric malignancies. HHV-8, human papillomavirus (HPV) and Epstein Barr virus are common cancer related infections in the population as well as HIV Infection (Orem, 2012).

2.3.5 Anthropometric Factors

The Centers for Disease Control (CDC) defines Anthropometric measurements as noninvasive quantitative measurements of the body. Common anthropometric measurements include; Height or length, Weight, Mid-upper arm circumference (MUAC), Demi-span or arm span, Knee height, Sitting height, Skin fold thickness and Head circumference. However, for purposes of this study, the anthropometric risk factors for adult cancers identified in literature are weight and height which affect Body Mass Index (BMI) which is a derived indicator of adiposity hence leading to obesity which increases one's risk of certain cancers. A meta-analysis of prospective studies found an increased risk of endometrial cancer among women with a high BMI and also women with increasing height (Aune *et al.,* 2015). For premenopausal women, breast cancer risk increases with increasing height, but decreases with higher weight or body mass index, and no association with increased central adiposity exists. For postmenopausal women, an increased risk of breast cancer is found with increasing levels of all the anthropometric variables including height, weight, body mass index, waist-hip ratio, waist circumference and weight gain. Weight loss appears to decrease risk, particularly if it occurs later in life (Friedenreich, 2001). On the other hand, anthropometric measures were unrelated to overall ovarian cancer (Baumeister *et al*., 2021). Obesity is known to modulate the endocrine system, hence increasing the risk of prostate cancer. A study among lowa men estimated an increased risk of prostate cancer among white men with a BMI of greater than or equal to 24 (Putnam *et al.,* 2000).

2.3.6 Other Comorbidities

Diabetes mellitus (DM), one of the most common life-threatening illnesses worldwide, is a group of metabolic diseases, characterized by sustained hyperglycemia. It is suggested there is a strong association between diabetes mellitus (especially type 2 diabetes mellitus) and carcinogenesis (Wojciechowska *et al.*, 2016). Endometrial, ovarian, and breast cancers are associated with diabetes mellitus (Vrachnis *et al.*, 2016). The risk of hepatocellular carcinoma and pancreatic

cancer is also said to increase due to having diabetes mellitus as a comorbidity (Yang *et al.*, 2016). Other cancers with an increased risk due to DM include; colorectal cancer, lung, breast and oral cancer *(Lin et al.*, 2015). Obesity, Hepatitis B and C, HIV/AIDs, and other infections discussed above have been explained by various studies as comorbidities that could increase a person's risk of different cancers. Diabetes mellitus is also associated with an increased risk of HCC however, this association could be confounded by liver cirrhosis (Yang *et al.*, 2016). Insulin resistance and consequent production of reactive oxygen species that trigger hepatic inflammation are thought to have a role in hepatocarcinogenesis (El-Serag *et al*., 2006).

2.3.7 Socio demographic factors

The main examples of socio demographic factors in health include; age, sex, education, migration background and ethnicity (tribe), religious affiliation, marital status, employment, and income status, as well as the marital status. However, for purposes of this study, focus will be on age and sex as potential confounding variables to increasing the risk of cancers. Rates of both incidence and mortality were 2 to 3 times higher among men than among women for liver cancer in most regions in 2020 (Sung et al., 2021). In Uganda, esophageal cancer is common in both males and females. However, the cancer is more prevalent in males than females and the risk increases with increasing age (Short *et al.*, 2017). KS has also been reported to be more prevalent in males than in females (Chaabna *et al.*, 2013). NHL is more common among men, those aged 65 years and above, and those with autoimmune disease (HIV, Hepatitis C, H. pylori) or a family history of hematological malignancies (Thandra *et al*., 2021). Therefore, despite of the various risk factors to the different cancers, they could be confounded by the different socio demographic factors.

2.4 Theoretical framework

This study was based on the Protection Motivation Theory (PMT). PMT is one model that explains why people engage in unhealthy practices which could expose them to disease and offers suggestions for changing those behaviors through primary and secondary prevention. Therefore this study used PMT which is an influential theory that promotes self-efficacy on lifestyle modification for healthy behaviors. The PMT demonstrates the relationship between maladaptive responses to health threats and the intention to perform adaptive behavior. Maladaptive responses are unhealthy behaviors that place an individual at risk of developing health problems. Therefore,

smoking and alcohol consumption (lifestyle factors) and the risk of Cancer in adults. The conceptual framework therefore was developed based on the PMT with the independent variables being the cancer risk factors (life style, reproductive, genetic, infection related, anthropometric and comorbidities) with the dependent variable being cancer

Source: (Zhu, H,2022.)

2.5 Conceptual framework

The conceptual framework was designed by myself with the dependent variables as Cancers and the independent variables as known cancer risk factors. The lifestyle factors included smoking history and alcohol consumption history, the reproductive factors included parity, contraceptive use, menopausal status, the genetic factors included the family history of cancer, infection related included HIV and H pylori, the anthropometric factors included BMI while the comorbidities were Hepatitis B and C, Hypertension, and Diabetes.

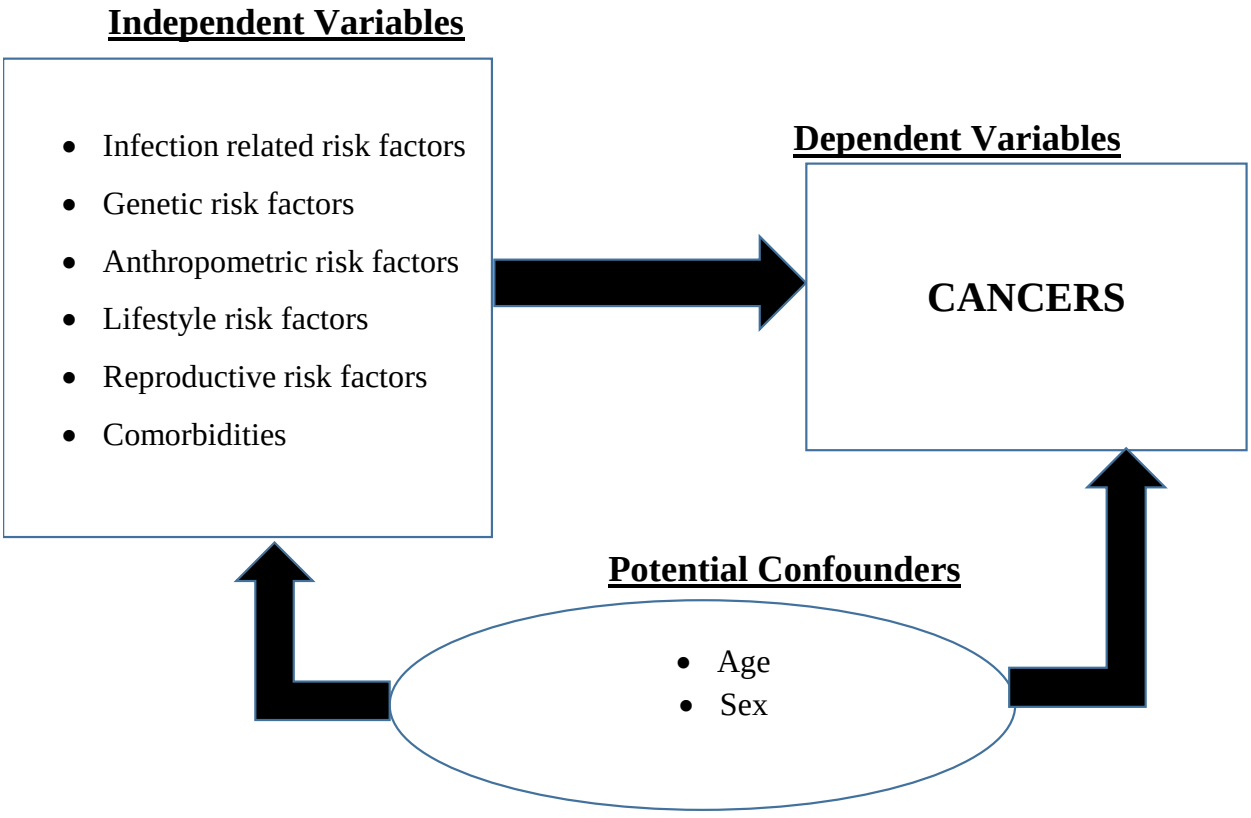

Figure 2.1 Conceptual framework (source; self)

CHAPTER THREE: METHODOLOGY

3.1 Study setting

This study was conducted in Arua district in West Nile sub-region of Northern Uganda. Uganda is divided into four regions and ten sub regions; West Nile sub region is one of the three sub regions in Northern Uganda lying mainly to the west of River Nile. Arua is one of the 12 districts in West Nile Sub region. Data was collected from multiple sites in form of hospitals, the palliative care unit and Health Centre IVs (HCIVs) in Arua and the Uganda Cancer Institute (UCI) in Kampala. Uganda has a decentralized health care system with Universal Health Coverage, comprised of the national referral hospitals, regional hospitals, district hospitals, health center IV, III, II and community health workers (CHWs), and also referred to as the Village Health Teams (VHTs). Services in all the public facilities are free of charge. The Private health sector comprises Private Not for Profits (PNFP), Private for Profit (PFP), and Traditional and Complementary Medicine Practitioners (TCMP)(Barugahara *et al.*, 2016).

The VHTs cannot diagnose a cancer but can advise patients to seek health care when consulted. However early detection and diagnostic services are lacking at the Health center I, II and IIIs of Uganda, but health education is provided at these facilities. Health Centre IV has a laboratory and is managed by a senior medical doctor, therefore they can clinically diagnose cancer or detect early. District hospitals have the capacity to detect early, diagnose a cancer and then refer and follow up the patients. Regional hospitals have consultants including a Histopathologist where confirmation of cancer is made. Cancer patients will at one point seek care at any of the higher health facilities in Uganda because of the aggressive and painful nature of the disease and it is at these facilities that the cancer may be diagnosed. However, most of the patients in Uganda are by self-referral after onset of symptoms. It has also been found that patients with cancer residing around the regional hospital will more likely seek treatment from this health facility than those residing far from it (Nakaganda *et al.*, 2021).End of life care is one of the elements of the cancer control continuum. Palliative care services in Uganda are offered to patients with terminal illnesses and its greatest need is generally among patients with advanced stage cancer and this constitutes about 80% of the patients registered at cancer treatment centers in Uganda.(Amandua Jacinto, 2013). Therefore, cancer patients in Arua are expected to visit the palliative care center in the district.

3.2 Study Design

The study employed a retrospective cohort chart review to determine the commonest cancers and a nested case control study to investigate the risk factors associated with common lifestyle cancers among adult men and women. Use of a retrospective cohort chart review design has been proved feasible to estimate the burden of cancer in populations where cancer registries do not exist (Nakaganda, Spencer, et al., 2023).

3.3 Study Population

The target population were newly diagnosed cancer patients from Arua district between 2017 and 2021. The period 2017 to 2021 was chosen because at the time of conceptualization, this was the most recent five year period that could be used to estimate cancer incidence in the district with minimal missing data. Arua district demarcation according to the 2014 UBOS census was used for this study. According to the Uganda Bureau of Statistics (UBOS) population projections, the population of Arua district was projected at 938,900 people in 2021 (*UBOS 2020*, n.d.)

3.4 Sample size

Cancer registration for cancers diagnosed in Arua district from 2017 to 2021 was done to answer objective one. In the nested case control, sample size was 116 cases of women with the commonest lifestyle cancer and 395 controls of women with other cancers. Selection was done without matching. For men, the sample size was 94 cases of men with the commonest lifestyle cancer and 301 controls of men with other cancers without matching. The sample size for men yielded a power of 99% at α=0.05 while that of women yielded a power of 95%

The power calculations were based on the formula;

$$Power = \Phi \frac{\sqrt{(n_1 * \Delta^2)} - z_{1-\alpha/2}\sqrt{(1+1/\kappa) * p * q}}{\sqrt{(p_1 * q_1) + (p_2 * q_2 / \kappa)}}$$

Where;

Δ = difference of proportions of exposure between case and control= $| p_2 - p_1 |$

κ = ratio of sample size: controls / cases

p_1= percent (proportion) of exposure among cases

p_2= percent (proportion) of exposure among controls; $p = (p_1*n_1 + p_2*n_2) / (n_1+n_2)$

q= 1-p;

n_1 = available sample size among cases

The above sample size involved all female patients with breast cancer as the cases while women with other cancers as controls while the male case where men with cancer of the esophagus as cases while the men with other cancers were the controls

3.5 Sampling Technique

Arua district was of interest for this study and purposively sampled because the district has the highest population amongst all the districts in West Nile (the proposed Arua Cancer Registry catchment population) and it has the Arua regional referral hospital. In addition, there is a faith-based hospital (Kuluva Hospital) that attempted to establish a cancer registry in the 1960s (Walusansa *et al.*, 2012). There are 5 hospitals, 3 HCIVs, and 1 Palliative care centre in Arua spread across four counties. However, 2 hospitals (Kuluva Hospital and Arua RRH), 2 HCIVs and 1 Palliative care centre as well as the Uganda Cancer Institute were visited for data collection because of resource constraints. (Refer to Appendix VIII)

3.6 Inclusion and Exclusion criteria

3.6.1 Inclusion

All newly diagnosed cancer patients from Arua district from 2017 to 2021

3.6.2 Exclusion

i. Those diagnosed outside the study period
ii. Cancer patients from outside the study geographical area
iii. Non cancer patients

3.7 Data Collection

3.7.1 Objective 1

Primary data was collected through patient chart reviews following a Data Abstraction Form (DAF) for variables of interest, (refer to Appendix I). Quality of the data abstraction process was ensured by training of study staff in quality control measures; real-time review and audit of abstracted forms; data entry checks and generation of weekly data queries; holding weekly data cleaning and error correction meetings; and final data cleaning and consistence checks by the

investigator before data analysis. Real time review and audit of abstracted forms was done by a trained clinician in cancer registration. In order to know the commonest cancers, all cancers had to be registered to ascertain what the commonest cancers were. A cancer case was defined as that diagnosed by: clinical, histology of primary tissue, cytology/hematology, specific tumor makers, clinical investigation, and histology of metastases. The variables of interest for this objective included: sex, age at incidence, incident date, basis of diagnosis, primary site, histological type, treatment received, status at last contact

3.7.2 Objective 2 and 3

The DAF was still used for these two objectives and the variables of interest were the known risk factors for the different common cancers in men and women. These risk factors were divided into; socio-demographic factors, reproductive factor, infection related factors, life style related factors, anthropometric factors, genetic factors, and other comorbidities. This data was collected by 2 trained research assistants in cancer registration. The completed DAFs were then entered in REDcap. Missing data was dealt with at the data collection stage by visiting several sites for data collection. In this we anticipated that if patient information on a certain variable was missing at a specific facility then it could be recovered at another facility since cancer patients go to several facilities in their quest for better health outcomes. However, those with missing information on residence and the cancer diagnosis were excluded at the collection stage.

3.8.1 Validity

Validity was ensured by using a standardized Data Abstraction Form (DAF).This Data Abstraction Form was adopted from the International Agency for Research on Cancer and it is what is used for cancer registration in resource limited setting. (Refer to Appendix I)

3.8.2 Reliability

Reliability on the other hand was ensured by piloting the Data collection tool on 20 charts of patients from Arua randomly selected at the Uganda cancer institute. A cronbach Alpha was computed and was 0.84 which suggested that the DAF was 84% reliable and could therefore be used to answer the study objectives.

3.8.3 Pilot Study

A pilot study was carried out prior to the main data collection and this was done at the Uganda Cancer Institute due to proximity. Twenty charts of patients from Arua were randomly selected and data abstraction done by the researcher, these 20 charts were also included in the main study and the cronbach Alpha measure of reliability was computed from these 20 charts.

3.9 Data Analysis Plan

The study used both descriptive (highlighting the summary statistics from the study) and inferential statistics to answer its objectives. Stata version 17 was used for data analysis and the detailed analysis per objective is described below;

3.9.1 Objective 1

For this objective, common cancers were computed as frequencies and percentages and interest was in finding out the five common cancers among adults (both males and females), adult males, adult females and also the common childhood malignancies in Arua district. Proportions of the cancers were obtained and these described the common cancers. For the common cancers, estimates (imputing) was done for missing age and sex depending on the cancer.

3.9.2 Objective 2 and 3

For objectives two and three, inferential data analysis was done. Cases were those with the commonest cancer and controls were those without that specific cancer. Occurrence of cancer Risk factors for the commonest cancers among the adult men and women was tabulated. Restriction was done to control for confounding by age and sex between cases and controls. A binary logistic regression was then carried out and odds ratios computed to determine the odds of getting a specific cancer due to specific risk factor as opposed to other cancers among the study participants with the same age and or sex. Missing data was dealt with at the analysis stage by excluding patients without information on the risk factors of interest. Chi square tests were run to investigate whether the missing data was associated with the study outcome. This was done to identify and hence minimize any missing data bias.

3.10 Ethical Considerations

The study obtained ethical approval from the JOOUST (Jaramogi Oginga Odinga University of Science and Technology) Board of Postgraduate studies and the Makerere University School of Public Health Research and Ethics Committee. Approval was also got from the Uganda National Council of Science and Technology (UNCST). Administrative clearances were got from Arua district Local Government, Arua City, Terego District Local Government and Madi Okollo district Local Government for permission to carry out the research in the district. Permission was also got from Arua RRH, Rhino Camp HCIV, Kuluva Hospital, Arua PCU and Omugo HCIV. The study also obtained a waiver of consent for the participants since the study did not involve direct interaction with the subjects. Confidentiality was ensured by keeping all study documents under lock and key, also the extracted DAFs were entered and securely kept in a password protected computer. Research assistants used were only those with training in Human Subject Protection (HSP) and who had obtained training in cancer registration. The participants of the research did not obtain any direct benefits and the harm of participating in this research was very minimal since no invasive procedures were used. Dissemination of this study findings was done at national and international conferences but also at the Uganda Cancer Institute during the weekly Research in Progress meetings. A copy of this thesis report book will be kept at the Arua District Health Office Archives. But also the study findings will be shared at the Arua Regional Referral bi-weekly Continuing Medical Education (CME) meetings

CHAPTER FOUR: RESULTS

Findings showed that 1,271 cancer cases were collected, however, 153 of these were duplicates and were therefore dropped leaving 1,118 cases in the analysis of the common cancers in Arua district (Figure 4.1).

Figure 4.1: A schema of the cancer cases collected

4.0 Characteristics of the data sources

Table 4.1 is a description of the 6 sources of data collection for this study, describing their location and what cancer services are offered at these health facilities.

Table 4.1: Characteristics of the data sources

Health facility	Facility level	Ownership	Location	Cancer services offered at facility
Arua Regional Referral Hospital	Regional Referral Hospital	Government	Arua City	prevention, early detection, diagnosis, treatment, palliative care, research and surveillance
Arua Palliative Care Unit	Hospice	Government	Arua City	palliative care and surveillance
Uganda Cancer Institute	National Cancer Referral Hospital	Government	Kampala	prevention, early detection, diagnosis, treatment, palliative care, research, training and surveillance
Kuluva Hospital	Hospital	Faith based	Arua District	prevention, early detection, diagnosis, treatment, palliative care and surveillance
Omugo HCIV	Health Center IV	Government	Terego District	prevention, early detection, diagnosis, palliative care and surveillance
Rhinocamp HCIV	Health Center IV	Government	Madi Okollo District	prevention, early detection, diagnosis, palliative care and surveillance

4.1 Demographic characteristics of the cancer cases

During the five-year study period, a total of 1118 new cancer cases were registered in Arua district from 2017 to 2021, with 52.1% females. The median age was 45 years, ranging from 30 to 60 years in the lower and upper quartiles respectively. The median age was computed instead of mean because the age wasn't normally distributed. The most dominant tribe were the Lugbara (85.2%) who are the largest population in this area. By nationality, Ugandans were most represented since the study was carried out in Uganda. However, non-nationals accounted for 5.5% of the cancer cases in Arua. Table 4.2 shows the socio demographic characteristics of the cancer cases.

Table 4.2 Socio demographic characteristics of the cancer cases (n=1118)

Variable		Frequency	Percentage
Sex	Female	583	52.1
	Male	535	47.9
Age category	Adults	947	84.7
	Children	138	12.34
	Adolescents	33	2.95
Residence	Arua	718	64.2
	Terego	236	21.1
	Madiokollo	164	14.7
Tribe	Lugbara	953	85.2
	Madi	55	4.9
	Kakwa	41	3.7
	Alur	25	2.2
	Other	44	3.9
Nationality	Ugandan	1,057	94.5
	South Sudanese	58	5.2
	Congolese	2	0.2
	Ethiopian	1	0.1
Religion	Christian	908	81.2
	Muslim	162	14.5
	Unknown	48	4.3
Marital status	Married	314	28.1
	Single	212	19.0
	Widow/Widower	62	5.6
	Divorced/Separated	50	4.5
	Unknown	480	42.9
Employment status	Unemployed	357	31.9
	Informal employment	245	21.9
	Formal employment	74	6.6
	Unknown	442	39.5

4.2 Clinical characteristics of the cancer cases in Arua District

Most of the identified cancer cases were diagnosed clinically (57.2% of the cases). 76% of the cancers were not staged and 88% were alive in their charts at the time of data collection. About 15% of the cases were got from Arua Regional Referral Hospital. Table 4.3 represents the clinical characteristics of the cancer cases in Arua district.

Table 4.3: Clinical characteristics of the cancer cases (n=1118)

Variable		Number	Percentage
Basis of diagnosis	Clinical only	639	57.2
	Histology of primary	259	23.2
	Clinical investigations	199	17.8
	Cytology / Hematology	15	1.3
	History of metastasis	5	0.5
	Specific tumor markers	1	0.1
Stage	Un staged	851	76.1
	IV	181	16.2
	III	50	4.5
	II	29	2.6
	I	7	0.6
Status at last contact	Alive	987	88.3
	Dead	131	11.7
Cause of death	This Cancer	70	53.4
	Other cause	51	38.9
	Unknown	10	7.63
Place of death	Hospital	81	61.8
	Home	34	25.9
	Unknown	16	12.2
Secondary malignancy	No	1,109	99.2
	Yes	9	0.8
Institution	Arua Regional Referral Hospital	514	43.5
	Arua Palliative Care Unit	268	22.7
	Uganda Cancer Institute	186	15.7
	Kuluva Hospital	196	16.6
	Omugo HCIV	10	0.8
	Rhinocamp HCIV	8	0.7

Note: Stage IV, III, II and I refer to cancer stages Four, three, two and one respectively.

4.3 Distribution of the Cancers

The year 2017 had the least number of cancer cases (141 cases) in the five years.. This was followed by an increase in cases in 2018 and 2019 respectively, however there was a significant decline in 2020 which could be explained by the COVID-19pandemic which was characterized by

lockdowns making it difficult for people to access both cancer screening and diagnostic services. The year 2021 had an increase in the number of cases seen in Arua due to the ease in lockdown in several parts of Uganda.

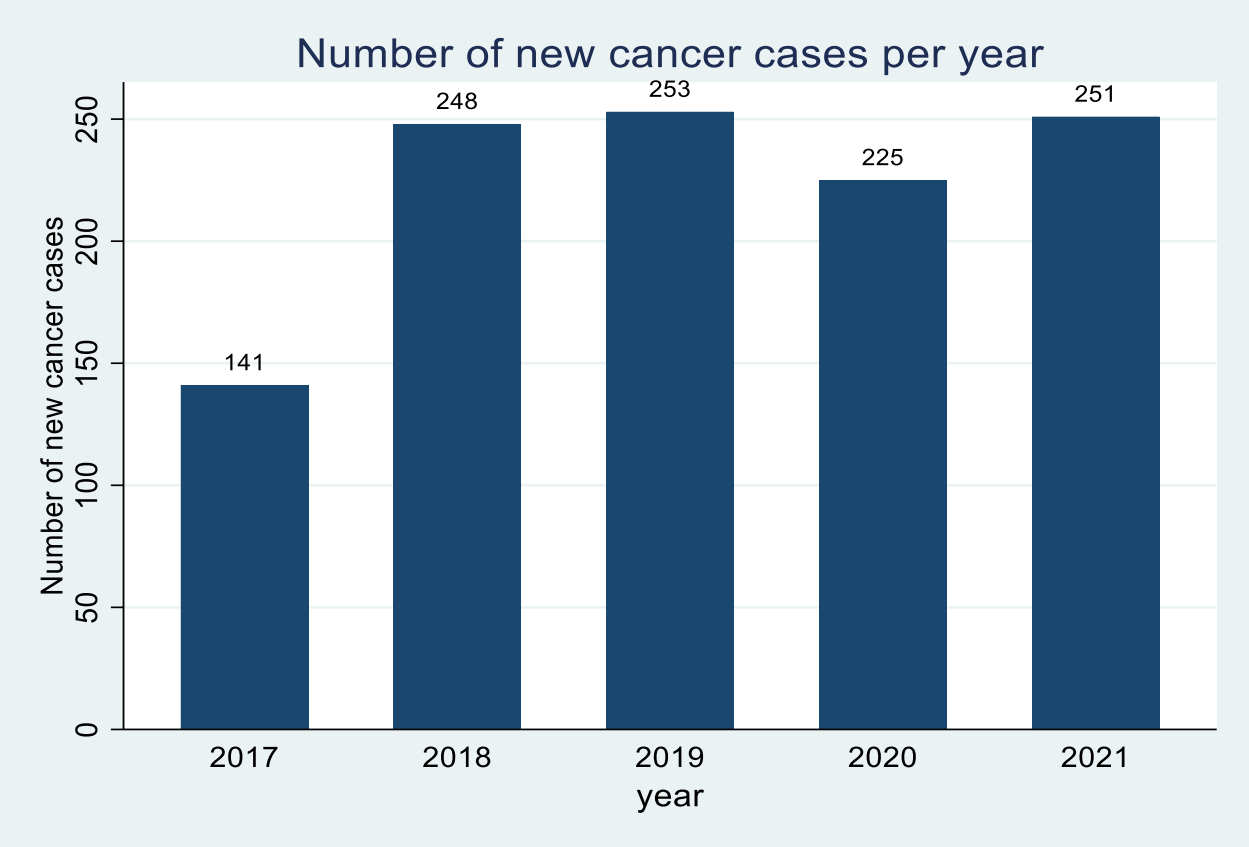

Figure 4.2 Distribution of cancer cases

4.4 Common Cancers in Arua District

The commonest cancer seen in Arua district in the five year period was cancer of the liver also known as Hepatocellular Carcinoma (HCC), 13.7%, this was overall, irrespective of the sex and ages. This was followed by Cancer of the cervix (11.8%), Breast cancer (10.7%), Cancer of the Esophagus (10.5%) and Burkitt's lymphoma (6.4%) Table 4.4 shows a description of the different cancers in hierarchy of the commonest to the least common in Arua district.

Table 4.4: New cases by cancer site, both sexes, all ages

Cancer(n=1118)	Frequency	Percentage
Liver	153	13.69
Cervix	132	11.81
Breast	120	10.73
Esophagus	117	10.47
Burkitt Lymphoma	72	6.44
Lymphoma	70	6.26
Kaposi Sarcoma	56	5.01
Prostate	47	4.2
Osteosarcoma	44	3.94
Leukemia	32	2.86
Stomach	24	2.15
Colorectal	24	2.15
ovary	18	1.61
Abdominal Malignancy	17	1.52
Nasopharyngeal Carcinoma	16	1.43
Malignant Melanoma	16	1.43
Endometrial cancer	14	1.25
Lung	13	1.16
Tongue	11	0.98
Rhabdomyosarcoma	11	0.98
Larynx	11	0.98
ENT Cancers	10	0.89
Bladder	9	0.81
Eye	9	0.81
Penis	8	0.72
Nephroblastoma	5	0.45
Neuroblastoma	3	0.27
Other and unspecified cancers	56	5.01

Note; ENT refers to Ear Nose and Throat cancers and this table describes the new cancers by site.

The cancer cases were categorized by age, those aged 20 years and above were categorized as adults while those below 20 years were children and adolescents. Cancer patterns and the common cancers amongst adults and children by sex were then described. About 85% of the cases were adults

4.5 Common Cancers amongst children

In this study, 12% (n=138) of the study participants were aged 14 years and below and hence categorized as children. The five common cancers amongst children from Arua district irrespective of sex were Burkitt's lymphoma (49%), other lymphomas (13%), leukemia (12%), Wilms Tumor (4%), and Retinoblastoma (4%). The table 4.5 shows the common cancers amongst children from Arua, both sexes.

Table 4.5: Common cancers amongst children (age 0-14 years), both sexes, (n=138)

Diagnosis	Frequency	Percentage
Burkitt lymphoma	68	49.28
Other lymphomas	18	13.04
Leukemia	16	11.59
Wilms Tumor	5	3.62
Retinoblastoma	5	3.62
Osteosarcoma	4	2.9
Kaposi sarcoma	3	2.17
Neuroblastoma	3	2.17
Malignant Melanoma	2	1.45
Rhabdomyosarcoma	1	0.72
Other unspecified pediatric cancers	13	9.42

Note; this table describes the cancer patterns in children of both sexes

4.5.1 Five common cancers amongst children

Males accounted for 61.4% of the Children with cancer in Arua over the five year period. Across gender, Burkitt's lymphoma was still the commonest cancer amongst both male and female children in Arua. Amongst the Female children as shown in Figure 4.4, the commonest cancer was BL (54%), Leukemia (24%), other lymphomas (14%), Osteosarcoma (4%) and Retinoblastoma (4%). Amongst male children, the five common cancers were; BL (58%), Leukemia (17%), other lymphomas (10%), Osteosarcoma (9%) and Wilm's tumor (6%)

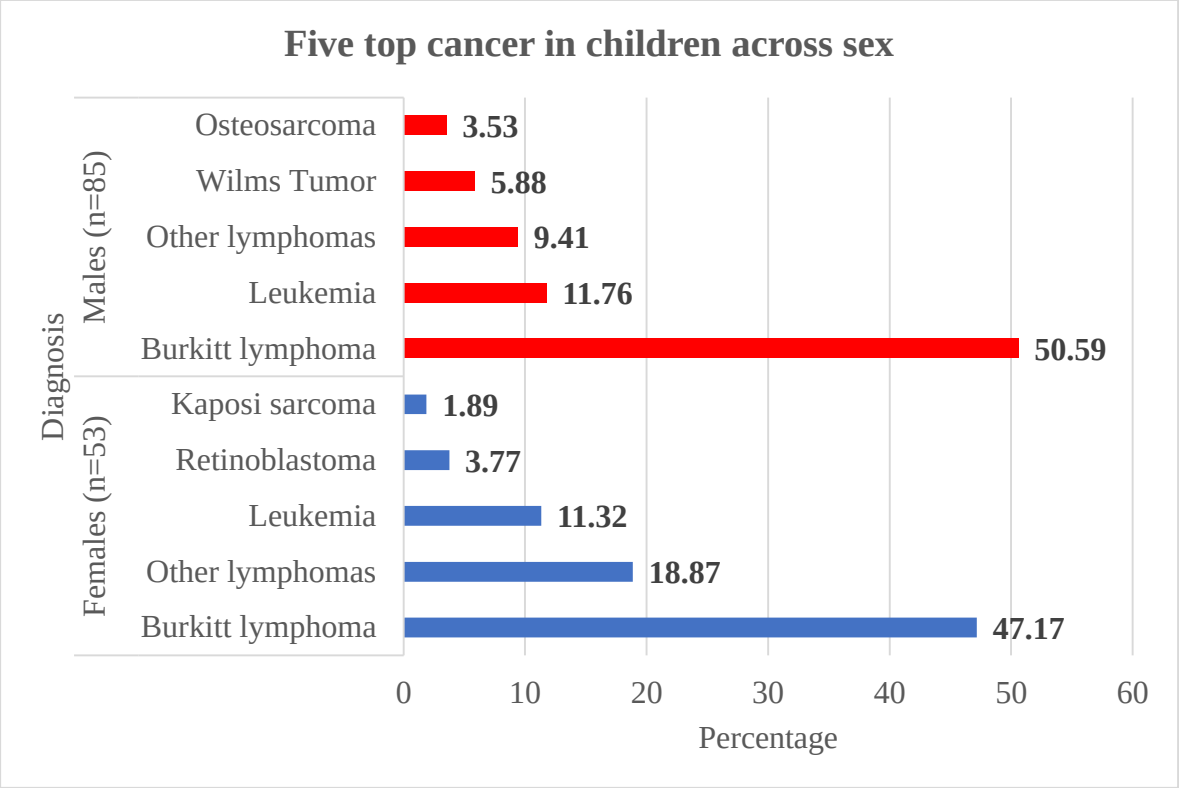

Figure 4.4: Top five Cancers amongst children (age 0-14 years), both sex, (n=138)

4.5.2 Common Cancers among adolescents (15-19 years)

About 3% of the study participants were adolescents (aged between 15 and 19 years). The patterns of disease in this age group were characterized by Lymphomas mostly accounting for 24%, Osteosarcoma 18%, Leukemia 15%, BL 12% and Kaposi sarcoma 9%. These results are displayed in table 4.6

Table 4.6: Cancer patterns amongst adolescents (15-19 years) n=33

Diagnosis	Frequency	Percentage
Lymphoma	8	24.24
Osteosarcoma	6	18.18
Leukemia	5	15.15
Burkitt lymphoma	4	12.12
Kaposi sarcoma	3	9.09
Rhabdomyosarcoma	1	3.03
Malignant Melanoma	1	3.03
ENT	1	3.03
Other unspecified adolescent cancers	4	12.5

4.6 Common Cancers amongst adults

Adults in this study were those aged 19 years and above and these were 947 cases. The five common cancers amongst adults in Arua district for both sexes were HCC (16%), Cervix (14%), Breast (13%), Esophagus (12%) and Kaposi Sarcoma (5%). Table 4.7 below shows the cancer patterns amongst adults in Arua district.

Table 4.7: Cancer patterns amongst Adults (age>19 years) both sexes, (n=947)

Cancer(n=1118)	Freq	%age
Liver cancer	153	13.69
Cervix	132	11.81
Breast	120	10.73
Esophagus	117	10.47
Burkitt Lymphoma	72	6.44
Lymphoma	70	6.26
Kaposi Sarcoma	56	5.01
Prostate	47	4.2
Osteosarcoma	44	3.94
Leukemia	32	2.86
Stomach	24	2.15
Colorectal	24	2.15
Ovary	18	1.61
Abdominal Malignancy	17	1.52
Nasopharyngeal Carcinoma	16	1.43
Malignant Melanoma	16	1.43
Endometrial cancer	14	1.25
Lung	13	1.16
Tongue	11	0.98
Rhabdomyosarcoma	11	0.98
Larynx	11	0.98
Ear Nose and Throat Cancers	10	0.89
Bladder	9	0.81
Eye	9	0.81
Penis	8	0.72
Nephroblastoma	5	0.45
Neuroblastoma	3	0.27
Other and unspecified cancers	56	5.01

Note; Liver cancer accounted for about 14%, cervix 12%, breast 11%, esophagus 10% and burkitt lymphoma 6% of the cancers in Arua district.

4.6.1 Common Cancers among Adult Females (n=519)

Amongst the females, the top five cancers were Cervix (25%), Breast (22%), Liver cancer (13%), Lymphomas (4%) and Esophagus (4%)

4.6.2 Common Cancers among Adult Males (n=428)

Amongst the males, the top five cancers were Esophagus (94 cases), Liver cancer (82 cases), Prostate cancer (47 cases), Kaposi sarcoma (32 cases), and Lymphomas (23 case). Figure 4.5 shows the top five cancers amongst adult men and women in Arua district from 2017 to 2021.

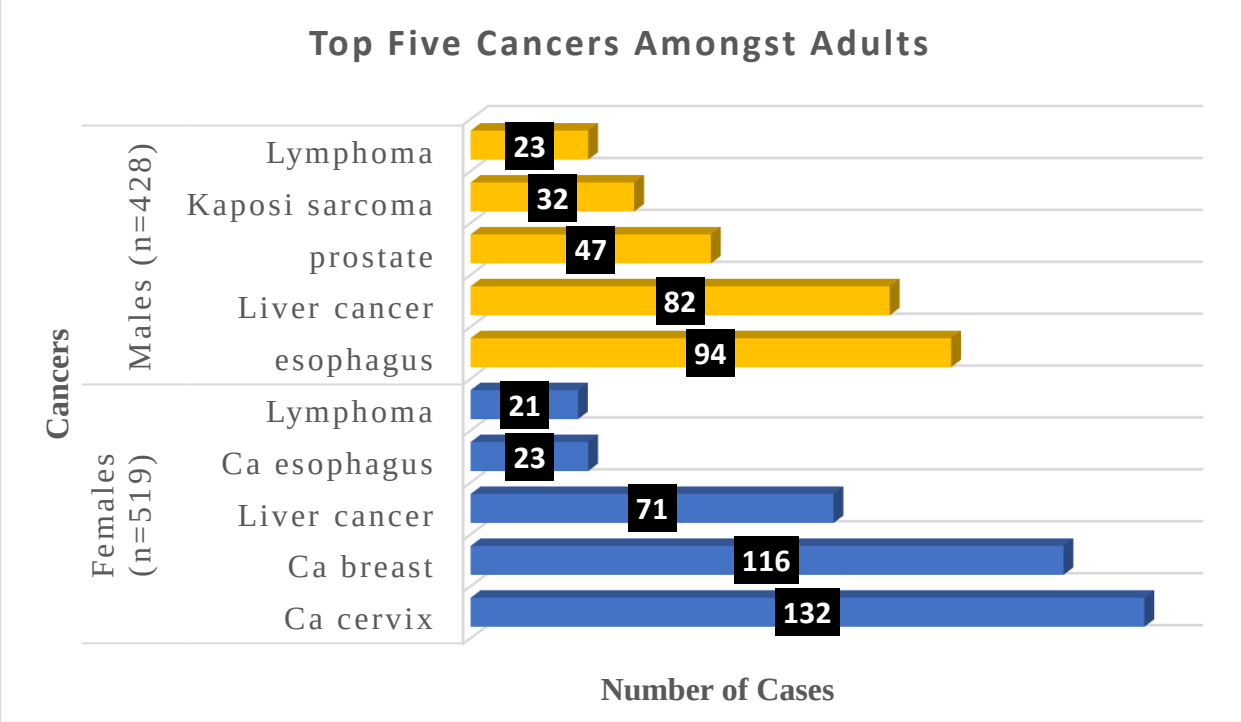

***Figure 4.5: T*op five cancers amongst adult females and males in Arua district**

4.7 Risk factors for the commonest lifestyle cancer in men

From our analysis of common cancers amongst men in Arua, we found out that cancer of the esophagus was the commonest cancer amongst men and this cancer is also a lifestyle associated malignancy.

4.7.1 Prevalence of cancer risk factors amongst men in Arua

Results from table 4.8 show the prevalence of known cancer of the esophagus risk factors amongst cases (men who were 30 years and above with cancer of the esophagus which was the commonest lifestyle cancer amongst adult men in Arua district) and controls (men who were 30 years and above with other cancers). The age for men with cancer of the esophagus in this study ranged between 30 and 86 years. Therefore, the selection of cases and controls was restricted to only men in that age group with cancer of the esophagus as cases and men within the same age group but with other cancers as controls.

Life style risk factors collected were history of alcohol consumption and tobacco use without dose response. Prevalence amongst cases for these risk factors was about 44% and 59% respectively. A cross tabulation was done to find out if there was association between these risk factors and cancer of the esophagus. The p value corresponding to the chi-square for history of tobacco use ($p<0.01$) was statistically significant at $\alpha=0.05$. Hence denoting an association between history of tobacco use and incidence of cancer of the esophagus amongst men from Arua district.

Data on genetic risk factors was presented by Family history of cancer which was constrained by missing data. However, prevalence was 2.1% amongst cases and 1.9% amongst controls Anthropometric factors collected were weight and height, from which the Body Mass Index (BMI) was computed. The BMI was categorized as underweight (0 to 18.49), healthy (18.5 to 24.9), Overweight (25 to 29.9) and the Obese (30 to 54). This risk factor was categorized by 88% missing data which was a limitation to our findings.

Table 4.8: Prevalence of cancer risk factors amongst males with cancer of the esophagus (age>=30 years) cases and controls

Risk factor	Variable		cases n=94		controls n=301		
			Freq	%	Freq	%	*p*
Lifestyle	Alcohol consumption history	Yes	131	43.5	53	56.4	
		No	64	21.3	16	17.0	
		Unknown	106	35.2	25	26.6	0.091
	Tobacco use history	Yes	55	58.5	99	32.9	
		No	16	17.0	91	30.2	
		Unknown	23	24.5	111	36.9	**<0.01**
Genetic	Family history of cancer	Yes	2	2.1	6	1.9	
		No	8	8.5	51	16.9	
		Unknown	84	89.4	244	81.1	0.135
Anthropometric	BMI	underweight	6	75	9	23.7	
		Healthy	2	25	25	65.8	
		0verweight	0	0	3	7.9	
		obese	0	0	1	2.6	**0.045**
Infection related	HIV Status	Positive	4	4.3	36	11.9	
		Negative	31	33	102	33.9	
		Unknown	59	62.8	163	54.1	0.08
	H. pylori	Yes	9	9.6	8	2.3	
		No	85	90.4	293	97.3	**0.004**
Comorbidity	TB	Yes	9	9.6	16	5.3	
		No	85	90.4	285	94.7	0.139
	Diabetes Mellitus	Yes	2	2.1	11	3.6	
		No	92	97.9	290	96.3	0.469
	Hypertension	Yes	4	4.3	22	7.3	
		No	90	95.7	279	92.7	0.297
	History of comorbidity	Yes	38	40.4	108	35.9	
		No	56	59.6	193	64.1	0.425

Note: This table describes the prevalence of the cancer of the esophagus risk factors amongst men above 30 years cases and controls. TB refers to Tuberculosis, HIV is Human Immune Virus and BMI is Body Mass Index

4.8 Cancer risk factors amongst men in Arua

A bivariate logistic regression was done to estimate the risk through odds ratios and 95% confidence intervals (CI) of getting cancer of the esophagus by men in the Arua among those exposed and unexposed to the different cancer risk factors. Men with a history of tobacco use were 3.2 times more likely to suffer from cancer of the esophagus than those with no history of tobacco use. This finding was significant at 95% CI (1.7-5.9). Tobacco use was one of the lifestyle associated risk factors for cancer of the esophagus collected in this study. The other lifestyle associated risk factor collected was history of alcohol consumption which however did not show any statistical significance in this analysis. Genetic risk factors in this study were represented by family history of cancer. However, there was scanty information in the charts about family history of cancer, this could therefore have led to biased estimated. Family history of cancer was not a significant predictor of cancer of the esophagus amongst men from Arua. BMI was collected as an anthropometric risk factor for cancer of the esophagus in this study. However, there was scanty data on this risk factor, stratification was done; "underweight" were those with a BMI between 0 and18.49, "Healthy" were those with a BMI between 18.5 and 24.99, "Overweight" those with a BMI between 25 and 29.9 while "Obese" were those with a BMI between 30 and 54. The overweight and obese were dropped in this study since there was no data for these BMI categories amongst the cases. Being healthy was a protective factor against cancer of the esophagus amongst men from Arua. The odds ratio of 0.12 implied that healthy men were 0.12 times less likely to have cancer of the esophagus than those who were underweight CI (0.02-0.7). Amongst the infection related risk factors, history of infection with H pylori, increased the risk of cancer of the esophagus by 3.9 times compared with those who did not have a history of infection with the Hpylori with a CI (1.5-10.4). HIV infection was not a significant predictor of cancer of the esophagus in this population. OR, 0.4 with a CI (0.12-1.11) for those HIV positive. None of the comorbidities was a significant predictor of cancer of the esophagus (Table 4.9).

Table 4.9: Risk factors among males with cancer of the esophagus cases and controls (age ≥ 30 years)

Risk factor			Bivariate analysis		
			OR	**95% CI**	***P***
Life style associated	Tobacco use history	No	1		
		Yes	3.2	1.7-5.9	**<0.01**
	Alcohol use history	No	1		
		Yes	1.6	0.9-3.1	0.137
Genetic		No	1		
	Family history of cancer	Yes	2.1	0.4-12.4	0.403
Anthropometric		Underweight	1		
	BMI	Healthy	0.12	0.02-0.7	**0.019**
Infection related		No	1		
	H pylori	Yes	3.9	1.5-10.4	**<0.01**
	HIV	Negative	1		
		Positive	0.4	0.12-1.11	0.07
Comorbidities	Diabetes Mellitus	No	1		
		Yes	0.6	0.12-2.63	0.47
	Hypertension	No	1		
		Yes	0.6	0.19-1.68	0.3
	TB	No	1		
		Yes	1.9	0.80-4.42	0.144
	No comorbidity	No	1		
		Yes	1.2	0.75-1.95	0.426

Note; TB refers to Tuberculosis, HIV is Human Immune Virus and BMI is Body Mass Index.

4.9 Risk factors for the commonest lifestyle cancer in Women

From our analysis of common cancers amongst women in Arua, we found out that Breast Cancer (BC) was the commonest lifestyle cancer amongst women.

4.9.1 Prevalence of cancer risk factors amongst Women

From table 4.10, prevalence of a history of alcohol consumption was higher amongst the cases at 24% with a chi square measure of association between history of alcohol consumption and incidence of breast cancer that was statistically significant (p value <0.01). Tobacco history had a higher prevalence amongst the controls of almost 9%, the chi square was also significant for this risk factor with (p value <0.01). And this showed that the two life style risk factors studied had an association with BC incidence. Both a positive family history and no family history of cancer were higher amongst the cases 8.6 and 25.9% with a corresponding chi square value that was significant (p value <0.01). This revealed that genetic risk factors had an association with BC. Prevalence of HIV was higher in controls than the cases at 12.5%. The above results showed an association between HIV status and incidence of breast cancer (p value = 0.014). The reproductive risk factors studied included; history of contraceptive use, menopausal status, parity and age at menarche. Amongst the cases, median parity was 4 children with an interquartile range (IQR) of 1 to 5 children. While amongst the controls, median parity was 6 children with an IQR of 3 to 8 children. Age at menarche had a median of 15 years amongst the cases while in controls median age at menarche was 14 years. This signified that women with BC had fewer children but also started their menses later than the women without BC. History of contraceptive use had a statistically significant association with BC incidence (p value <0.01). Prevalence of contraceptive use was higher amongst cases at 16.4% than the controls. Most of the cases with BC were premenopausal women at 55.2% and there was an association between menopausal status and BC (p value = 0.017).

Table 4.10: Prevalence of cancer risk factors amongst females with breast cancer cases and controls (age ≥ 23 years)

Risk factor	Variable		Cases n=116		Controls n=395		
			Number	%age	Number	%age	P value
Life style associated	Alcohol consumption history	Yes	28	24.14	78	19.75	<**0.01**
		No	50	43.1	124	31.39	
		Unknown	38	32.76	193	48.86	
	Tobacco use history	Yes	9	7.76	35	8.86	<**0.01**
		No	70	60.34	165	41.77	
		Unknown	37	31.9	195	49.37	
Reproductive	History of contraceptive use	Yes	19	16.38	17	4.3	<**0.01**
		No	34	29.31	66	16.71	
		Unknown	63	54.31	312	78.99	
	Menopausal status	Premenopausal	64	55.17	168	42.53	**0.017**
		Peri-menopausal	15	12.93	42	10.63	
		Postmenopausal	37	31.9	185	46.84	
Genetic	Family history of cancer	Yes	10	8.62	8	2.03	<**0.01**
		No	30	25.86	46	11.65	
		Unknown	76	65.52	341	86.33	
Anthropometric	BMI_Categories	Underweight (0-18.49)	5	10.64	12	27.27	0.13
		Healthy (18.5-24.9)	23	48.94	22	50	
		0verweight (25-29.9)	14	29.79	7	15.91	
		Obese (30-54)	5	10.64	3	6.82	
Infection related	HIV Status	Positive	8	6.9	49	12.5	**0.014**
		Negative	55	47.41	131	33.42	
		Unknown	53	45.69	214	54.08	
Comorbidity	TB	Yes	5	4.31	13	3.29	0.601
		No	111	95.69	382	96.71	
	H pylori	Yes	0		12	3.04	0.057
		No	116	100	383	96.96	
	Diabetes Mellitus	Yes	6	5.17	13	3.29	0.346
		No	110	94.83	382	96.71	
	Hypertension	Yes	10	8.62	30	7.59	0.718
		No	106	91.38	365	92.41	
	No other commorbidity	Yes	58	50	135	34.18	<0.01
		No	58	50	260	65.82	

Note: TB refers to Tuberculosis, HIV is Human Immune Virus and BMI is Body Mass Index

4.10 Cancer risk factors amongst Women in Arua

Of the 120 cases of breast cancer, 97% were females. The median age for these was 45 years with an IQR (35 to 59 years). The minimum age for those with BC was 23 years and the maximum age was 84 years. Restriction was therefore done to control for confounding to ensure that sex and age which were the main confounders in this study according to literature but also according to study findings were controlled for. Only women who were 23 years and above were selected as controls to the cases in this study. Therefore, the men were dropped in the analysis of risk factors for cancer of the breast amongst women from Arua district. To minimize bias in selection of controls, they were selected from the same population as the cases and these were women suffering from other cancers and not cancer of the breast in Arua.

None (0) of the life style associated risk factors collected in this study was a statistically significant risk factor for cancer of the breast. History of tobacco use had an OR, CI (0.6, 0.3-1.3) in the bivariate analysis. History of alcohol consumption also had an OR, CI (0.9, 0.5-1.5) in the bivariate analysis, these findings would have suggested that a history of both life style risk factors were protective against breast cancer in women. Parity, Menopausal status and history of contraceptive use were statistically significant reproductive risk factor for breast cancer amongst women in Arua at α=0.05. Findings showed that having more children was a protective factor against breast cancer in women from Arua. This had an OR, CI (0.8, 0.7-0.9) in the bivariate analysis, for each additional child had by a woman, the risk of getting breast cancer was 0.8 times lower. The risk of getting breast cancer was 2.1 times higher in pre-menopausal women than post-menopausal women from Arua, this had an OR, CI (2.1, 1.2-3.7) in the bivariate analysis. History of contraceptive use was collected in this study and this was irrespective of the type of contraception (hormonal versus non hormonal). A positive history of Contraceptive use was increased the risk of breast cancer by 2.2 times and this was shown by an OR, CI (2.2, 1.0-4.7) in the bivariate analysis. Anthropometric risk factors were height and weight, from which the body mass index (BMI) was computed as a known risk factor for breast cancer. For each increasing unit in the BMI of a woman, the risk of developing breast cancer was 1.1 times more with an OR, CI (1.1, 1.0-1.2) in the bivariate analysis. HIV status which was an infection related risk factor was also a significant predictor of breast cancer with the risk 2.6 times higher amongst those who were HIV negative than those who were positive. This had an OR, CI (2.6, 1.1-5.8) in the bivariate analysis. A history of no comorbidity also increased the risk of breast cancer by 1.9 times compared to a history of any comorbidity with

an OR, CI (1.9, 1.3-2.9) in the bivariate analysis. Genetics through family history of cancer were not a significant predictor of breast cancer (Table 4.11).

Table 4.11: Risk factors for breast cancer among female cases and controls (age ≥23 years)

Risk factor			Bivariate analysis		
			OR	**95% CI**	**P-Value**
Life style associated	Tobacco use history	No	1		
		Yes	0.6	0.3-1.3	0.211
	Alcohol use history	No	1		
		Yes	0.9	0.5-1.5	0.674
Reproductive	Parity		0.81	0.7-0.9	**<0.01**
	Menopause status	Post menopause	1		
		Premenopausal	2.1	1.2-3.7	**0.013**
		Peri menopause	1.4	0.6-3.2	0.46
	Age at menarche		0.7	0.5-1.2	0.19
	History of contraceptive use	No	1		
		Yes	2.2	1-4.7	**0.049**
Genetic	Family history of cancer	Yes	1		
		No	0.5	0.2-1.5	0.219
Anthropometric	BMI		1.1	1.01-1.22	**0.029**
		underweight	1		
		Healthy	2.5	0.8-8.3	0.132
		0verweight	4.8	1.2-19.1	**0.026**
	BMI Categories	obese	4	0.7-23.5	0.125
Infection related	HIV	Positive	1		
		Negative	2.6	1.1-5.8	**0.022**
Comorbidities	History of No comorbidity	Yes	1		
		No	1.9	1.3-2.9	**0.002**

Note; this table shows the output of logistic regression done to estimate the risk of breast cancer incidence in women who were 23 years and above. TB refers to Tuberculosis, HIV is Human Immune Virus and BMI is Body Mass Index

CHAPTER FIVE: DISCUSSION

5.1 Discussion

The goal of this study was to describe the common cancers in Arua district over a five year period, and also determining whether some of the known risk factors for Breast Cancer (BC) and Cancer of the Esophagus worldwide actually applied to Arua district. Achieving this goal was dependent on the ability of health facilities in Arua to make a cancer diagnosis(Ferlay *et al., 2021*), clinically or histologically. Anecdotal data suggests that this was the first study to use routinely collected data to study risk factors for common lifestyle cancers in the population of Arua district. The findings of this study revealed that the cancer patterns in Arua are a bit different from those observed in Kampala and Gulu.

The distribution of cancers in Arua represents the population level cancer incidence with Cancer of the Liver, Cervix, Breast, Esophagus and Burkitt's lymphoma (BL). The higher incidence of Liver cancer in Arua district could be attributed to the high prevalence of Hepatitis B (HBV) in Uganda of 8.45% as reported by a meta-analysis done in East Africa (Kafeero *et al.*, 2021).The highest rates are in Northern Uganda (4.6%)where Arua district is located (Chiesa *et al*., 2020) compared to 0.8% in Western Uganda and 2.7% in Eastern Uganda HBV is endemic in Arua district and yet studies have reported HBV to be the most common risk factor of Liver cancer in Sub Saharan Africa (Kedar Mukthinuthalapati *et al.*, 2021). However, co-infection with HIV, altered liver function and liver cirrhosis also increase the risk of developing Liver cancer. (Nsibirwa *et al.*, 2023). The Cancer patterns in Uganda, have never depicted Liver cancer to be among the five commonly diagnosed cancers in Uganda. However, liver cancer was the fourth commonest cancer amongst men in Uganda in 2020. (Globocan, 2020b). This could therefore imply the need for a multidisciplinary approach in liver cancer control from prevention through HBV control but also not ignoring the role of liver cirrhosis and excessive alcohol consumption in liver cancer. This calls for further research.

Overall, Cervical cancer was the second commonest malignancy in Arua compared to the national cancer patterns where Cervical cancer is the commonest cancer in Uganda contributing to 20.5% of all cancers diagnosed in Uganda (Globocan, 2020). The results of this study showed that cervical cancer accounted for 11.8% of the cancers seen in Arua district. Cervical cancer was also the commonest cancer amongst females in Arua and these findings were consistent with the known cancer trends in Uganda (Okongo *et al.*, 2019).

Burkitt Lymphoma (BL) was the commonest cancer amongst children accounting for 49% of all the cancers in children. But it was also amongst the top five cancers in Arua district. The over representation of BL among the five top cancers in Uganda could be attributed to the fact that there was a BL diagnosis and treatment center in Arua district at Kuluva Hospital, hence the availability of data on BL in the district. The high incidence of BL in this area has been documented by previous studies carried out at Kuluva Hospital in the 1980s(Orem & Wabinga, 2009). The cancer patterns in Uganda have always shown BL to be the most common form of malignancy amongst children, and specifically the endemic BL which is also common in SSA and attributed to Epstein Barr virus (EBV) and Plasmodium falciparum malaria. (Manolov & Manolova, 1972). Malaria prevalence in Uganda is high at 19% according to the World Malaria Report of 2022(WHO, 2021) and this is the highest in East and Southern Africa. Malaria is highly endemic in 96% of Uganda. (WHO, 2021b) And the Northern Region (where Arua is located) has the highest transmission intensity with malaria incidence above 450 cases/1000 population (Marie *et al*., 2023) Infection with Plasmodium falciparum malaria is a known risk factor for BL in children. (Peprah *et al.*, 2020). Therefore the high incidence of BL in Arua could be attributed to the endemicity of malaria in Arua. And like all infection related cancers, controlling malaria (through strengthening the use of Insecticide Treated Mosquito Nets, adopting the use of the malaria vaccine, indoor residual Sprays among others) in this area and in the whole of Uganda could significantly reduce malaria cases and subsequently the incidence of BL in this region and hence cancer control.

Prostate cancer was the third commonest cancer amongst men in Arua at 11%. Worldwide, prostate cancer presents the second common solid tumor amongst men, accounting for 14.1% of cancers amongst men (Gandaglia *et al*., 2021), next to lung cancer (WHO, 2020) In Uganda, prostate cancer was the commonest cancer among males accounting for 16.3% of the cancers in the country (Globocan, 2020c). Although incidence of prostate cancer worldwide has been reported to be on the rise, studies have shown it to stabilize especially in developed countries due to better usage of the Prostate Specific Antigen (PSA) screening methods (Seraphin *et al*., 2021). Therefore, Uganda should strengthen the use of the PSA screening methods for prostate cancer and also train more laboratory personnel on screening using PSA in order to achieve results as those in the developed world.

Kaposi sarcoma (KS) was the fourth common cancer amongst men in Arua. These findings were different from what the previous trends in cancer incidence have shown in Uganda. (Bukirwa et al., 2021). In 2020, KS was reported as the commonest cancer amongst men in Uganda (Globocan, 2020a). However, the under representation of KS amongst men in Arua could be due to the improvement in survival from HIV and the better adherence to ART amongst men in Uganda hence reduction in progressive HIV (Parkin et al., 2010). Epidemic KS was reported as the most common type of KS in Uganda and SSA. Therefore, there is need to maintain the interventions towards the fight against HIV new infections in Uganda and also improve health education on the need for adherence to ART to prevent progression to stage IV HIV at which stage the risk of developing KS is high.

The cancer patterns of Arua depicted few numbers in 2017 (141) which could be due to the many missing records in the year 2017. Some of the facilities visited had poor methods of archiving and some of the records for that year had already been destroyed by termites and dampness in the archives hence reducing on the number of retrieved patient charts in 2017. There was a peak in cancer incidence in 2019 (253) and a drop in 2020 (225), the drop in 2020 could be attributed to the lockdown following the Covid19 pandemic in 2020. During the pandemic, the government of Uganda instituted measures to control the spread of the disease including restrictions to movement and a national lockdown from March 2020 to July 2021.(Pheic, 2020). The lockdown was characterized by a ban on public transport but also cancer screening in health facilities hence making it difficult for people to travel to the hospitals for diagnosis. (Abila *et al*., 2020). This could also be attributed to the fact that most of the cancer control strategies during the pandemic were centered on cancer treatment services ignoring surveillance, and prevention (Nakaganda,, *et al.*, 2023). However, cancer incidence increased in the year 2021 (251 cases) and this could be attributed to the ease in lockdown.

Cancer of the esophagus was the commonest cancer amongst men in Arua district and also the commonest life style cancer in men and these findings are different from the national cancer pattern (Globocan, 2020c). This implies that Arua district has more of life style associated cancers compared to the whole Uganda (Asasira *et al.,* 2022b).

In regards to the cancer risk factors, the risk of cancer of the esophagus was 3.2 times higher amongst cases than controls for men with a history of tobacco use without dose response. Current

use of tobacco in Uganda has consistently reduced from 11% in 2012/13 to 5% in 2016/17 and to 3% in 2019/20 (Uganda Bureau of Statistics (UBOS), 2020). However, this prevalence has been decreasing over time for both sexes from 25.2% and 3.3% in 2000 to 10.1% and 0.8% in 2016 for males and females respectively(Nakaganda, *et al*., 2023).

The Westnile sub region where Arua is located was reported to have the highest percentage of smoke tobacco use in the country at 10% by the recent UBOS household survey (Uganda Bureau of Statistics (UBOS), 2020). Arua district is a tobacco growing district with a high prevalence of tobacco use, a study done by a student from Makerere University showed that prevalence of tobacco use among motorcyclists alone in Arua stood at 57% (Apolot, n.d.). Yet, tobacco use and smoking is a known and yet modifiable risk factor for cancer of the esophagus. In Uganda, cancer of the esophagus is on the rise hence the high incidence amongst men in Arua (Bukirwa *et al*., 2021). Therefore emphasis should be in eliminating tobacco use in the country since even previous studies have shown an increased risk of cancer of the esophagus due to tobacco use; a meta-analysis on esophageal cancer risk factors in Africa showed a 3.15 times increased risk of esophageal cancer among those with a history of tobacco use than those without. Adopting the tobacco control act of 2015 would go a long way in controlling tobacco use in the country and subsequently cancer of the esophagus incidence due to tobacco use (Asombang *et al.*, 2019).

The risk of cancer of the esophagus due to a history of alcohol consumption did not show any statistical significance in this analysis. These findings were inconsistent with what some studies have reported (Middleton *et al.*, 2022). Alcohol consumption is a known and yet modifiable risk factor for cancer of the esophagus and further studies can be done to ascertain the role of alcohol in cancer of the esophagus in Arua district while adjusting for potential confounders.

Amongst the infection related risk factors, history of infection with H pylori, increased the risk of cancer of the esophagus by 3.9 times compared with those who did not have a history of infection with the H pylori with a CI (1.5-10.4). These findings were in agreement with a study done in Thailand which reported a 2.76 times higher risk of cancer of Esophagus amongst those with H pylori co infection than those without (Poosari *et al.*, 2023).

Breast cancer, was the commonest lifestyle cancer amongst women in Arua and accounted for 10.7%, this was consistent with the national estimates of breast cancer in Uganda (Moodley *et al*., 2020). The reproductive factors investigated in this study included; parity, menopausal status,

history of contraceptive use, and age at menarche. Findings showed a negative inverse relationship between BC and parity. With every child had by a woman, the risk of BC was seen to be 0.8 times lower or an 80% reduced risk of breast cancer for every additional child had by a woman in Arua Having more children was therefore a protective factor against BC. These findings were consistent with a meta-analysis on the role of parity in BC incidence that also revealed the protective effect of multiple parity on BC(Azubuike, 2023). Menopausal status was a significant predictor of BC incidence in this study. Risk was 2.1 times higher among premenopausal women than the postmenopausal women. These findings were not consistent with those from the developed world which is characterized by a higher incidence of BC among post-menopausal women (Momenimovahed & Salehiniya, 2019). Having a history of contraceptive use increased the risk of BC by 2.1 times in this study and this was irrespective of the type of contraception. Studies both in the western world and in developing countries have shown the role of contraceptive use on BC incidence. Statistically significant associations have been established between hormonal contraceptive use and BC. A Danish cohort study reported a 20% increased risk of breast cancer among current and recent hormonal contraception users (Zidi *et al.*, 2020).

Each increasing unit in the BMI increased the risk of a woman getting BC by 1.1 times in this study findings. These findings were consistent with what has been reported worldwide on the part played by height and weight on BC (Friedenreich, 2001) and yet BMI is a modifiable risk factor for BC. These findings were consistent with a systematic review done in Uganda that showed that being overweight was a major risk factor for cancers in women (Nakaganda, Mbarusha, *et al.*, 2023).

HIV status was the only infection whose data was collected in this study and findings showed a 2.6 times increased risk of BC amongst those who were HIV negative than those who were HIV negative. These findings verified what other studies have suggested that is; a lower risk of breast cancer in women with HIV versus those without HIV.(Coburn *et al.*, 2021). Also an earlier systematic review showed that BC incidence is either same or less in HIV-infected patients compared to the general population. However, the patients with HIV infection present with more advanced stage. And, the impact of HAART on breast cancer incidence in HIV-infected patients is still unclear.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The study findings showed Liver cancer, cancer of the cervix, Breast cancer, cancer of the Esophagus and Burkitt's lymphoma as the commonest cancers overall, irrespective of the sex and ages. History of tobacco use led to a 3.2 times increased risk of cancer of the esophagus amongst the men. Reproductive factors on the other hand came out as strong risk factors for breast cancer in this study. Therefore, based on these study findings, cancer occurrence in the population can be studied in resource limited settings where population based cancer registries are absent. But also risk factors for cancers can be studied using routinely collected data if there is a systematic way of risk factor assessment in the health facilities of Uganda.

6.2 Recommendations

1. There is need by Ministry of Health to encourage vaccination against HBV in Arua in order to strengthen primary prevention against Liver cancer but also strengthen cancer surveillance in the district through hospital based and even a population based cancer registry surveillance. Further research needs to be done to ascertain the high incidence of Liver cancer in the district. A government aided pathology laboratory would also go a long way in easing diagnosis and hence increase on the number of morphologically verified cases in the district. Early detection of BL can help improve treatment outcomes

2. Cancer control strategies for Breast cancer should be geared towards the reproductive factors. But also the role of HIV in breast cancer should be studied at large since the study findings showed being HIV positive to be protective against BC in Arua. The people of Arua should be encouraged to screen for breast cancer and cancer of the cervix and also efforts should be made to make the screening services accessible to the people. More research also needs to be done through genetic epidemiology to examine the role of genetics in cancer occurrence. Standardizing cancer risk factor assessment at all health facilities in Uganda would help strengthen cancer risk surveillance and training health workers on the importance of cancer risk assessment would help reduce on missing data on cancer risk factors.

3. The tobacco control act in Arua needs to be reinforced by the district leadership in order to curb the diseases associated with the use of tobacco but especially cancer of the esophagus.

Also health promotion needs to be done in Arua by Ministry of Health on the dangers of tobacco use and the risk it imposes on the health of men in Arua. Endoscopy services could also be set up in the district by the government to ease screening and even early detection of cancer of the esophagus.

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APPENDICES

APPENDIX I: DATA ABSTRACTION FORM

DATA ABSTRACTION FORM

Hospital ID: ..... Study ID: .....

A. PATIENT SOCIODEMOGRAPHIC INFORMATION

1. Surname: .....
2. Given name(s): .....
3. Age at incidence: .....
4. Sex: Male ☐ Female ☐ Not known ☐
5. Residence address:

District: ..... County: .....
Parish: ..... Village: .....

6. Telephone number: .....
7. Tribe: .....
8. Nationality: .....
9. Religion

Christian ☐ Muslim ☐ Other ☐ Unknown ☐

10. Marital Status

Single ☐ Married ☐ Divorced/Separated ☐ Widow/Widower ☐ Unknown ☐

11. Employment Status

Formal employment ☐ Informal employment ☐ Unemployed ☐ Unknown ☐

B. TUMOR INFORMATION

12. Date of incidence (dd/mm/yyyy): .....
13. Basis of diagnosis:

Death certificate only ☐ clinical only ☐ clinical investigations (x ray, etc.) ☐

Cytology / Hematology ☐ Histology of primary ☐ Specific tumor markers ☐

History of metastasis ☐ Unknown ☐

14. Primary tumor site (Topography): .....
15. Morphology (histological type): .....
16. Laterality:

Right ☐ Left ☐ Bilateral ☐ Unknown ☐ N/A ☐

17. Stage: .....

C. TREATMENT INFORMATION

18. Check all that apply

Surgery ☐ Radiotherapy ☐ Chemotherapy/Hormonal therapy ☐ Palliation ☐
Supportive therapy ☐ None ☐ Unknown ☐ Other (Specify) .....

19. Date of last contact (dd/mm/yyyy): .....

20. Status at last contact: Alive ☐ Dead ☐ Unknown ☐
21. If dead, cause of death; This Cancer ☐ Other cause ☐ Unknown ☐
22. Place of death:.....

D. RISK FACTOR INFORMATION

i. Life style associated risk factors:

23. History of alcohol consumption: Yes ☐ No ☐ Unknown ☐
24. History of tobacco use: Yes ☐ No ☐ Unknown ☐

ii. Reproductive risk factors

25. Parity: .....
26. Age at menarche: .....
27. History of oral contraceptive use: Yes ☐ No ☐ Unknown ☐
28. Menopausal status: Premenopausal ☐ Peri-menopausal ☐ Postmenopausal ☐

iii. Genetic risk factors

29. Family history of cancer: Yes ☐ No ☐ Unknown ☐
30. If yes, what cancer: .....
31. Relative with a positive family history of cancer (check all that apply):
Father ☐ Mother ☐ Brother ☐ Sister ☐ Other ☐

iv. Anthropometric factors

32. Height (cm): .....
33. Weight (Kg): .....
34. BMI: ..... (To be system generated)

v. Infection associated risk factors and comorbidities

35. HIV Status: Positive ☐ Negative ☐ Unknown ☐
36. Patient history of relevant prior infections and comorbidities:

Hepatitis B ☐ Hepatitis C ☐ H Pylori ☐ Diabetes Mellitus ☐

Hypertension ☐ Tuberculosis (TB) ☐ None ☐ Unknown ☐

Other (Specify) .....

E. SOURCE OF INFORMATION

37. Institution/ward: .....

Form filled by: .....

Sign: .....

Date (ddmmyyyy): .....

APPENDIX II: CONSENT WAIVER

02/Nov/2022

The Chairperson
MakSPH Research and Ethics Committee (SPHREC)

Dear Sir,

RE: REQUEST FOR WAIVER OF CONSENT

Study title: Common Cancers and Associated Risk Factors in Arua District Uganda 2017 to 2021 Version 1.0 dated 01/November/2022

This is to request a waiver of consent for the above mentioned study. This study does not involve direct interaction with human participants as it aims at reviewing routinely collected data from patient medical records (files and pathology reports).

Yours sincerely,

Angucia Bridget Sharon
Principal Investigator

APPENDIX III: Uganda National Council of Science and Technology APPROVAL

Uganda National Council for Science and Technology

(Established by Act of Parliament of the Republic of Uganda)

Our Ref: HS2539ES **3 January 2023**

BRIDGET SHARON ANGUCIA
UGANDA CANCER INSTITUTE
Kampala

Re: Research Approval: **COMMON CANCERS AND ASSOCIATED RISK FACTORS IN ARUA DISTRICT UGANDA 2017 TO 2021**

I am pleased to inform you that on **03/01/2023**, the Uganda National Council for Science and Technology (UNCST) approved the above referenced research project. The Approval of the research project is for the period of **03/01/2023** to **03/01/2024**.

Your research registration number with the UNCST is **HS2539ES**. Please, cite this number in all your future correspondences with UNCST in respect of the above research project. As the Principal Investigator of the research project, you are responsible for fulfilling the following requirements of approval:

1. Keeping all co-investigators informed of the status of the research.
2. Submitting all changes, amendments, and addenda to the research protocol or the consent form (where applicable) to the designated Research Ethics Committee (REC) or Lead Agency for re-review and approval **prior** to the activation of the changes. UNCST must be notified of the approved changes within five working days.
3. For clinical trials, all serious adverse events must be reported promptly to the designated local REC for review with copies to the National Drug Authority and a notification to the UNCST.
4. Unanticipated problems involving risks to research participants or other must be reported promptly to the UNCST. New information that becomes available which could change the risk/benefit ratio must be submitted promptly for UNCST notification after review by the REC.
5. Only approved study procedures are to be implemented. The UNCST may conduct impromptu audits of all study records.
6. An annual progress report and approval letter of continuation from the REC must be submitted electronically to UNCST. Failure to do so may result in termination of the research project.

Please note that this approval includes all study related tools submitted as part of the application as shown below:

No.	Document Title	Language	Version Number	Version Date
1	Consent	English	01	07 December 2022
2	Data collection tool	English	01	01 November 2022
3	Project Proposal	English	1.0	
4	Approval Letter	English		
5	Administrative Clearance	English		

Yours sincerely,

Hellen Opolot
For: Executive Secretary
UGANDA NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

LOCATION/CORRESPONDENCE

Plot 6 Kimera Road, Ntinda
P.O. Box 6884
KAMPALA, UGANDA

COMMUNICATION

TEL: (256) 414 705500
FAX: (256) 414-234579
EMAIL: info@uncst.go.ug
WEBSITE: http://www.uncst.go.ug

APPENDIX IV: Makerere School of Public Health REC (SPHREC) APPROVAL

MAKERERE UNIVERSITY
P.O. Box 7072
Kampala UGANDA
Email: hdrecadmin@musph.ac.ug
Tel: +256 -414-543 872/ 031-2-263158
Fax: +256-414-531807
Website: www.sph.mak.ac.ug

COLLEGE OF HEALTH SCIENCES
SCHOOL OF PUBLIC HEALTH
Research and Ethics Committee

07/12/2022

To: BRIDGET SHARON ANGUCIA

JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY, KENYA
0705828368

Type: Initial Review

Re: SPH-2022-349: COMMON CANCERS AND ASSOCIATED RISK FACTORS IN ARUA DISTRICT UGANDA 2017 TO 2021, 01, 2022-11-02

I am pleased to inform you that the MAK School of Public Health REC (SPHREC), through expedited review held on **07/12/2022** approved the above referenced study.
Approval of the research is for the period of **07/12/2022** to **07/12/2023.**

As Principal Investigator of the research, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the research.
2. Changes, amendments, and addenda to the protocol or the consent form must be submitted to the REC for re-review and approval **prior** to the activation of the changes.
3. Reports of unanticipated problems involving risks to participants or any new information which could change the risk benefit: ratio must be submitted to the REC.
4. Only approved consent forms are to be used in the enrollment of participants. All consent forms signed by participants and/or witnesses should be retained on file. The REC may conduct audits of all study records, and consent documentation may be part of such audits.
5. Continuing review application must be submitted to the REC **eight weeks** prior to the expiration date of **07/12/2023** in order to continue the study beyond the approved period. Failure to submit a continuing review application in a timely fashion may result in suspension or termination of the study.
6. The REC application number assigned to the research should be cited in any correspondence with the REC of record.
7. You are required to register the research protocol with the Uganda National Council for Science and Technology (UNCST) for final clearance to undertake the study in Uganda.

The following is the list of all documents approved in this application by MAK School of Public Health REC (SPHREC):

No.	Document Title	Language	Version Number	Version Date
1	Protocol	English	01	2022-11-02
2	Informed Consent Waiver	English	01	2022-11-02
3	Data collection tools	English	01	2022-11-01

Yours Sincerely

Joseph Kagaayi
For: MAK School of Public Health REC (SPHREC)

APPENDIX V: JOOUST BPS REC APPROVAL

JARAMOGI OGINGA ODINGA
UNIVERSITY OF SCIENCE AND TECHNOLOGY

DIVISION OF RESEARCH, INNOVATION AND OUTREACH
JOOUST-ETHICS REVIEW OFFICE

Tel. 057-2501804
Email: erc@jooust.ac.ke
Website: www.jooust.ac.ke

P.O. BOX 210 - 40601
BONDO

OUR REF: JOOUST/DVC-RIO/ERC/E4

10th February, 2023

Bridget Sharon Angucia
SHS
JOOUST

Dear Ms. Angucia,

RE: APPROVAL TO CONDUCT RESEARCH TITLED "COMMON CANCERS AND ASSOCIATED RISK FACTORS IN ARUA DISTRICT UGANDA 2017 TO 2021"

This is to inform you that JOOUST ERC has reviewed and approved your above research proposal. Your application approval number is **ERC 36/02/23-9/04.** The approval period is from 10th January, 2023– 09th January, 2024.

This approval is subject to compliance with the following requirements:

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations and violations) are submitted for review and approval by JOOUST IERC.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to NACOSTI IERC within 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks of affected safety or welfare of study participants and others or affect the integrity of the research must be reported to NACOSTI IERC within 72 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to JOOUST IERC.

Prior to commencing your study, you will be expected to obtain a research permit from National Commission for Science, Technology and Innovation (NACOSTI) https:oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

Prof. Francis Anga'wa
Chairman, JOOUST ERC

Copy to: Deputy Vice-Chancellor, RIO Director, BPS DEAN, SHS

/dm

APPENDIX VI: ARUA DISTRICT ADMINISTRATIVE CLEARANCE

ARUA CITY
Mighty City of Opportunities

OFFICE OF THE CITY CLERK

Plot 47 – 55, Arua Avenue
www.aruacity.go.ug
+256 772 611985
P. O. Box 27, Arua
info@aruacity.go.ug
+256 782 288464

OUR REF: CR/220/1

27th December 2022

Ms. Angucia Bridget Sharon
Jaramogi Oginga Odinga University of Science & Technology
KENYA

PERMISSION TO COLLECT DATA

Reference is made to your letter dated 19TH December 2022 requesting for permission to collect Data in Arua City on the topic ***"Common Cancers and associated risk factors in Arua City Uganda 2017 to 2021"***.

Permission is granted on the following conditions

1. You observe COVID – 19 SOPs while undertaking the research.
2. The data collected is strictly used for academic purposes.
3. You are expected to report to the City Medical Officer, Arua City for further information on the data collection.

I therefore request the people concerned to assist you in giving information and you are requested to deposit a copy of your findings to the Registry of Arua City

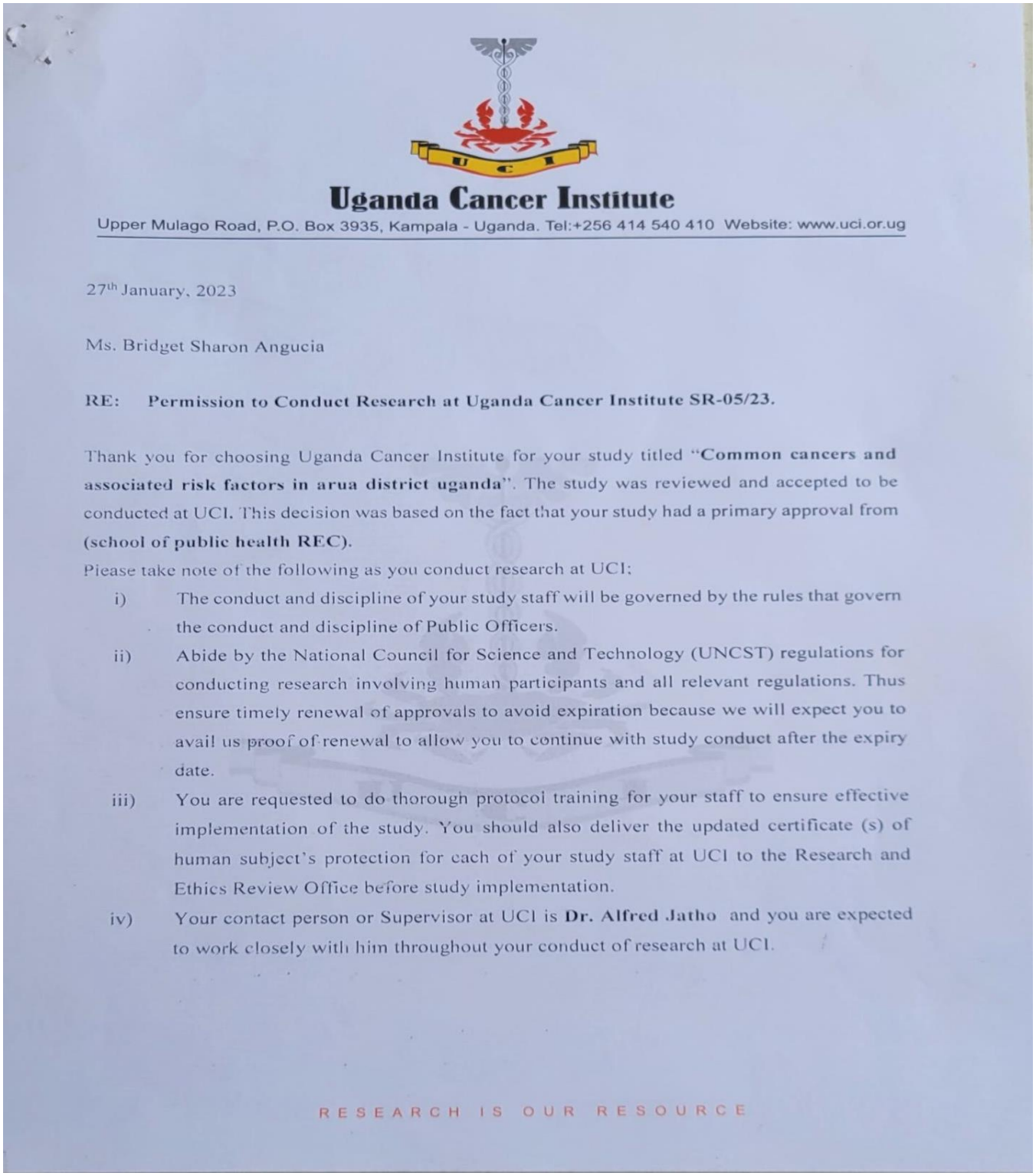
Yours faithfully,

For: CITY TOWN CLERK
ARUA CITY
P.O. BOX 27, ARUA CITY
Sign:.....

Jobile Cornelius
For: AG. CITY TOWN CLERK

Cc Director Board of Postgraduate Studies/
Jaramogi Oginga Odinga University of Science & Technology, Kenya
Cc City Medical Officer/Arua City

APPENDIX VII: UGANDA CANCER INSTITUTE ADMINISTRATIVE CLEARANCE



Uganda Cancer Institute

Upper Mulago Road, P.O. Box 3935, Kampala - Uganda. Tel:+256 414 540 410 Website: www.uci.or.ug

27th January, 2023

Ms. Bridget Sharon Angucia

RE: Permission to Conduct Research at Uganda Cancer Institute SR-05/23.

Thank you for choosing Uganda Cancer Institute for your study titled "**Common cancers and associated risk factors in arua district uganda**". The study was reviewed and accepted to be conducted at UCI. This decision was based on the fact that your study had a primary approval from **(school of public health REC).**

Please take note of the following as you conduct research at UCI:

i) The conduct and discipline of your study staff will be governed by the rules that govern the conduct and discipline of Public Officers.

ii) Abide by the National Council for Science and Technology (UNCST) regulations for conducting research involving human participants and all relevant regulations. Thus ensure timely renewal of approvals to avoid expiration because we will expect you to avail us proof of renewal to allow you to continue with study conduct after the expiry date.

iii) You are requested to do thorough protocol training for your staff to ensure effective implementation of the study. You should also deliver the updated certificate (s) of human subject's protection for each of your study staff at UCI to the Research and Ethics Review Office before study implementation.

iv) Your contact person or Supervisor at UCI is **Dr. Alfred Jatho** and you are expected to work closely with him throughout your conduct of research at UCI.

RESEARCH IS OUR RESOURCE

v) Schedule a date with the coordinator of research in progress meeting(s) to orient UCI staff about this study before implementation. This helps to solicit for cooperation of staff once the study begins.

This offer can however be terminated in case your behavior or study staff is contrary to the Institute's values and principles.

By copy of this letter, the UCI Clinical head is informed about your study and strongly urged to take action in case of any malpractices observed as you conduct research at UCI.

Sincerely,

pp Dr. Nixon Niyonzima
Director Research and Training UCI

C.C. Executive Director, UCI

" The Senior Hospital Administrator, U.C.I.

" UCI Clinical Head, UCI

" **Dr. Alfred Jatho (UCI Supervisor)**

APPENDIX VIII: SAMPLING FRAME