An-Najah National University
Faculty of Graduate Studies

A Survey Study of Cancer Types in Northern West Bank, Palestine

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This Thesis was defended successfully on 5/8/2010 and approved by:

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Dedication

To

My Father, Mother and Brothers for their patience and encouragement,

with love and respect

Acknowledgement

I would like to express my special thanks and gratitude to my supervisor , Dr. Jihad Abdallah for his encouragement, guidance and help through this study.

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الإقــرار

أنا الموقعة أدناه مقدمة الرسالة التي تحمل العنوان:

A Survey Study of Cancer Types in Northern West Bank , Palestine

دراسة مسحية لأنواع السرطان في شمال الضفة الغربية فلسطين

أقر بأن ما اشتملت عليه هذه الرسالة إنما هي نتاج جهدي الخاص، باستثناء مـــا تمـــت الإشارة إليه حيثما ورد، وأن هذه الرسالة ككل، أو أي جزء منها لم يقدم من قبل لنيل أية درجة علمية أو بحث علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis unless otherwise referenced is the researcher's own work and has not been submitted elsewhere for any other degree or qualification.

Student's name: **اسم الطالبة:**

Signature: **التوقيع:**

Date: **التاريخ:**

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Abstract

This study was carried out to investigate incidence rates and risk factors of non- hematology cancer types in the northern governorates of the West Bank (Nablus, Jenin, Tulkarm, Tubas, Qalqiliya, and Salfit). Risk factors may vary among different geographical locations. The main aim of this study was to investigate the differences in incidence rates among geographical locations and the relationship between geographical locations and cancer types with variation of risk factors. This is a retrospective study which covered cancer patients diagnosed between 2005 and 2008. The data were obtained from three governmental hospitals which had cancer therapy centers in the Northern West Bank (Al-Watani hospital in Nablus, Thabet-Thabet hospital in Tulkarm, and Jenin hospital in the city of Jenin). Medical and personal data were obtained from the registry files of patients, while lifestyle information and other data were obtained via interviews with patients or their close relatives in case of death.

There were 1037 new cancer cases diagnosed between 2005 and 2008 in the six governorates of the north of the West Bank. The age-adjusted incidence rate over the period from 2005-2008 was 103.2 per 100,000 (95%CI: 96.9, 109.4) with a yearly rate of 25.7 cases per 100 000 people. The crude incidence rate was 112.3 per100 000 (95%CI: 105.4,

119.1). Significant differences in incidence rates were found among governorates and types of location (rural, urban, and refugee camps). The lowest incidence rate was found in Jenin (age adjusted rate of 45.0 per 100 000 over the whole period) and the highest rate was found in Nablus (148.1 per 100 00). Refugee camps had higher incidence rate than urban and rural areas (age adjusted rate of 169.0 for refugee camps, 103.2 for urban areas, and 79.3 for rural areas). Breast, colorectal, uterus, and ovary cancers were the most frequent among women, while colorectal, bladder, lung, prostate, and stomach cancers were the most common among males.

All governorates had high percentages of patients exposed to electromagnetic sources. Tulkarm and Qalqilia had high percentages of patients exposed to open sewage streams, Salfit and Qalqilia had high percentages of patients living close to garbage dumps, while Tubas and Jenin had high percentages of patients living close to stone factories. Tulkarm also had high percentage of patients living close to chemical factories compared to the other governorates.

Risk of cancer increased with age (people in age groups of 40 years and older had much higher risk of cancer compared to the age group of less than 40 years). There was a strong relationship between family history (percentage of patients having relatives with cancer) and each of breast, cervical, uterus, ovary, colorectal, thyroid, testicular and neck cancers. A strong relationship was found between cancer type and smoking status.

Cancers of the respiratory systems (lung, nasopharynx, and larynx), testicular cancer, and cancers of the bladder, prostate and stomach had high percentage of smoking patients (>75%). A strong relationship was also found between occupation and cancer types. Farmers made up the biggest working slice among cancer patients (13% of all patients) with males comprising the majority of this group (93 %) followed by teachers (7.8% of all cases), builders (6.1% of all cases) and factory workers (4.1% of all cases, all males). More than three fourths of cancer patients suffered from stress before being diagnosed with cancer: 54.3% suffered social stress, 28.8% suffered economical stress, 15.4% suffered political stress, and 6.6% suffered psychological stress.

No differences were found among cancer types in the level of consumption for each of sweets, carbohydrates, salts, vegetables and fruits, but differences were found for fat consumption. Esophageal and testicular cancers were associated with high consumption of fat. Patients with colorectal, lung, bladder and head-brain cancers also consumed high levels of fat. Cancer patients had rare sport activity before being diagnosed (85% did not have any sport activity and only 2% of patients practiced sports daily).

The results of this study stress the urgent need for measures to reduce the effects of environmental pollution and health educational programs should be implemented to target groups at higher risk of cancer like farmers and families with strong cancer history.

Chapter One

Introduction an literature review

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Cancer is a term used when abnormal cells divide without control and are able to invade other tissues [109]. Normal body cells grow, divide, and die in an orderly fashion. In normal differentiated cells, there are cellular mechanisms which control cell division. When these mechanisms do not function properly, cells may multiply excessively forming a tumor. Tumor is an abnormal mass of cells. There are two types of tumors malignant and benign tumors : malignant tumor is an abnormal mass of tissue capable of spreading into neighboring tissue and often to other parts of the body. Malignant tumors are composed of cancer cells. Cancer cells are very similar to cells of the organism from which they originated and have similar DNA and RNA. Cancer cells form from cells dividing out of control caused by alteration (damage) of DNA, and these changes can occur at many levels. Changes in many genes are required to transform a normal cell into cancer cells.

Typically, genetic abnormalities in cancer cells affect two general classes of genes. Cancer promoting genes (Oncogenes) activated in cancer cells, giving it new proprieties such as hyperactive growth and division. Tumor suppressor genes are then inactivated in cancer cells causing loss of normal functions of these cells such as control over the cell cycle. Genetic abnormalities can be inherited or can be caused by the environment [110].

Metastasis is a process of travel or spread of cancer cell to other parts of the body. Cancer cells often spread via three main ways:

1- Local spread: cancer cells grow directly into nearby body tissues.

2- Through the blood circulation: cancer cells break way from the primary tumor and then slip through the walls of blood vessels into the blood stream until they get stuck somewhere. Most cancer cells spreading via blood circulation are killed by white cells in the immune system, but some of them stick to platelets to form clumps and give themselves protection, these cells will survive and form metastasis.

3- Through the lymphatic system: cancer cells travel in lymph fluid until they get stuck in small channels inside the lymph node and grow into secondary cancer (metastasis) [111,112]. Secondary cancer doesn't take the characteristics of the cells in the new location, but continues to resemble the primary cancer. A majority of cancers start at a single site in the body and spread to other parts [113].

Cancer cells are grouped into four categories: carcinomas, sarcomas, leukemia and lymphomas. Carcinomas are cancers that originate in the covering of the body, such as skin or the linings of the intestinal tract or respiratory tract. Sarcomas arise in tissues that support the body, such as bone. Leukemia and lymphomas are cancers of blood forming tissue, such as bone marrow, spleen and lymph nodes. Cancers are named according to the type of organ or tissue in which they appear.

Cancer is classified into four stages depending on the extent of growth and spread through the body (stages correspond with severity). Stage 1 is when the tumor is relatively small and contained within the

organ where it started. Stage 2 means that cancer hasn't started to spread into surrounding tissue, but it is larger than in stage 1. Stage 3 corresponds to the stage where cancer cells have spread into nearby lymph nodes. Stage 4 is the most severe; the cancer has spread into other parts of the body and this stage is called secondary or metastasis cancer. Another classification system is the TNM system; a three dimensional rating of cancer. The T stands for tumor size, N for lymph nodes involvement, and M stands for metastasis. Larger scores on each of the three scales indicate more advanced cancer. For example, a large tumor which hasn't spread to other body parts is rated T3, N0, M0 [60].

1. 1 Common Types of cancer

1.1. 1 Bladder cancer

Cancer that forms in the organ which stores urine (bladder). Bladder cancer is one of the most common cancers worldwide, with the highest incidence in developed countries. Two main histological types of bladder cancer are identified. The transitional cell carcinoma (TCC) is related to smoking and is the most prevalent in western and industrialized countries. The Squamous Cell Carcinoma (SCC) is more frequently seen in some Middle Eastern and African countries. The two types develop in the inner lining of the bladder and cause chronic irritation and inflammation [90].

Smoking is a risk factor for bladder cancer in males and females. Schistosomiasis parasitic disease is related to bladder cancer; it is common

in Northeast Africa, Southwest Asia, and Madagascar. Certain organic chemicals, age and sex are additional risk factors. People over the age of 70 years develop the disease 2 to 3 times higher, especially in males [89]. Diet rich in fresh fruit and vegetables is correlated with reduced bladder cancer risk while calcium and sodium are related to bladder cancer risk [105]. Increasing urination frequency and drinking water could reduce the risk of bladder cancer by reducing the time that carcinogenic agents stay in the bladder, such as those from tobacco, so getting up at night at least twice to pass urine reduced risk by 10-59% [6].

1.1.2 Brain cancer

May be benign or malignant. Brain cancer has two types: one type that starts in the brain is called primary brain tumor. Another type called metastatic brain cancer that starts some where else in the body and moves to the brain. Brain cancer is also called Glioma and Meningioma. It arises from the glial cells that surround and support neurons. Little information is known a bout the etiology of brain and other CNS (Central Nervous System) cancers. Brain cancer increased in developed countries, particularly among the elderly. Incidence is associated with environmental risk factors (ionizing radiation), and with socioeconomic status [54, 95]. Brain and other CNS cancers accounted for 4.8% of all cancers in Jordanians, 3.4% in Israel Arabs and 3.1% in Egyptians and the incidence of the disease was higher in males than females in Arab countries [54, 95]. There is a significant risk of brain tumors from cell phone use [76].

1.1.3 Breast cancer

Cancer cells start in the breast, in the inner lining of the milk ducts or lobules. There are different types of breast cancer. Breast cancer in females is about 100 times more frequent than men. Breast cancer is the second most common type of cancer after lung cancer. In 2004, breast cancer caused 519,000 deaths world wide [126]. Breast cancer is common in women in developed countries. Mortality rate due to breast cancer is stable despite the increasing incidence. Lifestyle is the leading cause of 15% of breast cancer cases, and it can be attributed to hereditary and hormonal exposure [14]. Breast cancer has high incidence in Israel compared with low rate in the Arab population [89].

High-fat diet intake, drinking more alcohol, and eating less fish, produce more estrogen and more insulin-like growth factors (IGF-1). These compounds are known to be strong factors associated with increased risk of breast cancer [49]. Ultraviolet-B radiation is a type of sunlight that produces vitamin D. Increasing exposure to UV-B reduced the mortality from breast cancer [49]. Progesterone regulates 162 genes, a number of these genes make small proteins ‘‘chemokines ‘‘which control the process of inflammation [27]. Microphages (type of white blood cells) move to the breast during inflammation, and clear the way for nutrient delivery but also clear the way for tumor cells to move into the breast, so macrophages may promote the development of cancer tumors [27].

One of the protective behaviors against breast cancer is breast feeding. For example, in India where breast feeding is very common, the incidence of breast cancer was low compared with high income countries where breast feeding is not common [46]. Another study [47] indicated that stressful life events are risk factors for the development of breast cancer. Results reported by Green [27] indicated that dietary factors played a role in developing cancer and showed that the mortality rate of breast cancer was doubled in 1980. Breast cancer is the most common cancer [38] among women in Arab countries with a young age of around 50 years (13-35% of all female cancer). The disease remains very common in Egypt, Tunisia, Saudi Arabia, Syria, Palestine and other countries.

1.1.4 Bone cancer

Abnormalities in the cells which make the bone. It is more frequent in children and adolescents than in adults. There are many different types: Osteosarcoma, Ewing's sarcoma, Choudrosarcoma, Malignant fibrous histiocytoma, Fibro sarcoma, and Chordoma. Generally, bone cancer in older adults results from metastatic spread of another tumor [131].

1.1.5 Cervical cancer

Cancer cells which develop in the cervix. Cervix is the part of the female reproductive system, connects the uterus to the vagina. Cervical cancer is the second most common form of cancer among women worldwide (394,000 new cases, 274,000 deaths in 2002). Cervical cancer

accounted for 15% of all female cancers in developing countries and 3.6% in developed countries [88] Infection with HPV, smoking, low socioeconomic status and multiple sexual partners are risk factors for cervical and corpus cancers. The highest rate was found in the age group 60-69 years [56]

1.1.6 Childhood cancers

The most common childhood cancers are leukemia, lymphoma, and brain cancer. Risk factors for childhood cancers are different from risk factors in adults. It is generally a rare disease among children. In developed countries, the incidence is only 0.5% of all cancers in children under 5 years. Twelve types of childhood tumors have been classified according to the international classification of childhood cancer. Chromosomal abnormalities, DNA repair disorders, congenital anomalies and hereditary immune deficiency states are risk factors associated with childhood cancer. Childhood cancers are histologicaly variable and embryonic tumors are the most common, while the majority of adult cancers are carcinomas [87, 103].

1.1.7 Colorectal cancer

The cancer cells grow in the colon and rectum. The colon is the part of the digestive system, where the waste material is stored. The rectum is the end of the colon adjacent to the anus; together they form a long, muscular tube called the large intestine. Colorectal cancer (CRC) is the

third leading of cancer death in males and the fourth leading of cancer death in females, with 655 000 deaths world wide per year [42]. Incidence of CRC was 20.1 per 100, 000 in males and 14.6 per 100,000 in females. The CRC is one of the most common cancers in the following countries with 13% of all cancers (Israel 14.8%, Jordan 9%, and Egypt 14.4%), [45]. Colon cancer is more common than rectal cancer (65% of all CRC in the world).

Dietary factors, smoking, alcohol consumption and genetics are known risk factors for the disease [15, 48]. Physical activity was associated with reduced risk of colorectal cancer [99]. Sedentary lifestyle, meat intake, overweight and decreased ingestion of vegetables, fruits and fish are correlated with colorectal cancer incidence and mortality, so certain changes in diet and lifestyle should be implement to decrease the incidence and mortality of colorectal cancer (the minimal time span needed for implementation is 10-15 years) [15].

Another epidemiological study observed that western pattern of diet which is characterized by high intake of meat, fat, refined grains, and sugars was correlated with higher risk for developing colorectal cancer [100]. An observational study indicated that long term aspirin use is associated with lower risk for colorectal cancer [23]. An American study [21] identified a number of life style factors which affect risk of colon cancer, such as diet, obesity and use of certain medications. The study concluded an inter-relationship of aspirin, and other non_steroid anti-

inflammatory medication (NSAID), BMI and hormone replacement therapy (HRT) in altering the risk of colon cancer. Other researchers [23] showed that the age at diagnosis may interact with other factors to alter risk of colon cancer [15].

1.1.8 Esophageal cancer

Cancer that starts in the esophagus or gullet, and there are two main types: Squamous carcinomas " the upper end of the gullet " and adenocarcinoma " around the junction between the gullet and the stomach of the lower end". Smoking and alcohol are risk factors for esophageal cancer. Diet that is low in fruit and vegetables increases the risk for certain inherited conditions which is linked with this cancer. The incidence of esophageal cancer is high in Israel compared with the Arab world [78]. The incidence of the disease increases with age. The rate was 2 to 3 times higher in males than females [78]. Eight in 20 cases occur in people aged 60 or over, 400 000 people are diagnosed worldwide. Younger patients of esophageal cancer had better survival rates than older patients [78]. Studies found strong links between an increase in body mass index (BMI) and risk in men for esophageal, thyroid, colon, and renal cancers. In women the strongest association was with endometrial, bladder, esophageal, and renal cancers [139]. Helicobacter Pylori " *H. Pyloris* " seropositivity is associated with reduced risk for esophageal Adeno carcinoma; therefore, Pylori infection might be protective against esophageal cancer [12].

1.1.9 Kidney cancer

Cancer cells which develop in the kidney. Kidneys are part of the urinary tract. Kidney cancer may spread to the lungs, bones or liver, and it may spread from one kidney to the other.

1.1.10 Laryngeal cancer

Cancer that can develop in any part of the larynx . Most of the cancers of the larynx begin in cells that line the inner walls of the larynx (called Squamous cell carcinoma). Cancer may develop in the central part of the larynx that includes the vocal cord (glottis), and in the area above the glottis (supra glottis) or more rarely in the area of connection of the larynx to the trachea (sub glottis). It is much more common in males than females, especially those older than 60 years. Poor eating habits, smoking and alcohol consumption are risk factors for laryngeal cancer [89].

1.1.11 Liver cancer

There are several different types of liver cancer. Hemangiomas (start in blood vessels) are the most common of liver cancers. Hepatic adenoma is uncommon and found mainly in women using estrogen or in case of steroid abuse. Focal nodular hyperplasia is the second most common liver cancer and results of congenital arteriovenous malformation hepatocyte response [132]. Infection with HBV, dietary factors, alcohol consumption, smoking, and use of oral contraceptives are risk factors for liver cancer [26]. It’s important not to confuse cancers that start in the liver with

cancers that spread to the liver after starting elsewhere in the body. Liver damage (cirrhosis) increases the chance of developing liver cancer and also people with diabetes have a higher risk of developing liver cancer [89]. One study [65] has found that coffee consumption lowers risk for liver cancer but drinking low to moderate amounts of alcohol increases risk for liver cancer. A major goal of Hepatitis B (HBV) immunization programs is to reduce the risk for liver cancer, because chronic infection of Hepatitis B causes the body own immune system to attack the liver cells and aid the development of hepatite cellular carcinoma [25].

1.1.12 Lung cancer

About 90-95% of lung cancers arise from the epithelial or lining cells of bronchi and bronchioles. Mesotheliomas cancer arises from the thin layer of tissue that surrounds the lung "pleura". Lung cancer is the most commonly diagnosed cancer and causes more deaths than any other cancer (it is the leading cause of cancer deaths in most countries). The incidence of lung cancer is higher among men than women. Smoking is the most important risk factor in the development of lung cancer [33].

Smoking causes around nine out of ten cases of lung cancer, and the risk increases as the period of smoking increases [33]. Female smokers are more likely to develop lung cancer but less likely to die from it than male smokers [57]. Asbestos workers who smoke have a very high lung cancer risk (50-90 times greater than that of people in general), [135]. Also both smokers and non-smokers who are exposed to asbestos have a greater risk

for Mesotheliomas (a type of cancer that starts in the lining surrounding the lung), [135]. The risk is increased in persons who have relatives with lung cancer [20]. Radon, asbestos, and arsenic are carcinogens correlated with lung cancer. Radon is the second leading cause of lung cancer. It's a colorless gas trapped in houses and buildings. Radon causes lung cancer among smokers and non-smokers, but the risk is higher in smokers than nonsmokers [5].

1.1.13 Oral cavity cancer

It is a part of a group of cancers called head and neck cancers. Most of oral cancers begin in the tongue and in the floor of the mouth. Squamous cell carcinoma is a cancer that begins in the flat cells that cover the surface of the mouth, tongue and lips. A decrease has been noticed in the number of cases of oral cavity cancers and deaths in the last 20 years [136]. Smoking and consumption of alcohol are the major risk factors of the head and neck tumors [125, 54]. These two risk factors account for 75% of all oral cavity cancers. Geographical factors and sexual differences also play an important role for developing this type of cancer (men are twice more susceptible to oral cancers than women), [82].

1.1.14 Ovarian cancer

The ovary is a part of the female reproductive system and produces estrogen and progesterone. The etiology of ovarian cancer is poorly understood (90% of ovarian cancers occur sporadically but 10% of ovarian cancers occur in women with inherited genetic changes), [103]. Women

who have family members with breast, uterus or colorectal cancer have an increased risk of ovarian cancer but the risk is higher for women with family history of ovarian cancer [43]. Old age (over 55 years), reproductive history and hormonal therapy are additional risk factors for ovarian cancer [128]. A recent study showed that the risk of ovarian cancer increased in women who had used hormonal therapy [32]. A women with no affected relatives had a 1.4 % lower lifetime risk of ovarian cancer, but a woman with one affected (first relative: mother, sister or daughter) had a 5% higher lifetime risk of ovarian cancer [134].

The incidence of ovarian cancer is higher in industrial countries, such as (Israel, Australia, Cypriots, etc) while the lowest incidence rates were observed in countries such like Jordan and Egypt and in Arabs living in Israel [86].

1.1.15 Pancreatic cancer

It is a malignant tumor of the pancreas. It has one of the highest fatality rates of all cancers; the five year survival rate is 4% and only 10-15% of patients survive more than five years [140]. It’s a silent killer, because symptoms do not appear in early stages. Age, gender, smoking, diet, DM (Diabetes Mellitus), and family history are risk factors for pancreatic cancer. It is more common in males (men are almost twice likely to develop pancreatic cancer than women). Pancreatic cancer is the fourth highest cancer killer, it is responsible for 6% of cancer deaths each year [59, 86].

A research in the Lowa community investigated the relation between the Nitrate and nitrite levels in drinking water and dietary sources with pancreatic cancer. The study indicated that long-term exposure to drinking water with low levels of nitrate (about 10 mg/L) was not associated with pancreatic cancer, while the consumption of dietary nitrate from animal products may increase the risk [29]. Smoking is a major risk factor for developing pancreatic cancer (20% of pancreatic cancer cases explained by smoking) [52]. Onions, garlic, beans, carrots, yellow vegetables, dark leafy vegetables, and cruciferous vegetables showed the strongest inverse association with pancreatic cancer and other cancers [24]. Depression (mental disorders) was associated with pancreatic cancer: patients with depression were more likely to develop pancreatic cancer than other gastrointestinal malignancies or all other cancers [22].

1.1.16 Prostate cancer

Cancer cells develop in the prostate gland in the male reproductive system. Men who develop prostate cancer don't show symptoms in early stage, and most likely die of other causes. Prostate cancer is one of the most prevalent types of cancer in men and is most common in men over the age of fifty. Age, genetics, diet, lifestyle, and medications are risk factors for prostate cancer. For example in USA there were 230 000 new cases and 30 000 deaths in 2005 [137]. The incidence of prostate cancer in the Arab population is the lowest in the world [63,137]. A retrospective study [9] of the prevalence of prostate cancer in the West Bank, found that there were

statistically significant correlations between stage of cancer and city, stage and smoking, stage and place, and stage and number of children. Collie et al. [28] studied the relationship of mortality rate due to prostate cancer with dietary practices and found strong positive correlations with the consumption of meat, added fat and oils, ice cream, salad and margarine, and that shortage of vegetable consumption is a suspected risk factor for prostate cancer. A cohort study concluded that aging and gonadal androgenic hormones were the most important risk factors for development of prostate cancer [75].

1.1.17 Skin cancer

Is a malignant growth on the skin, and the most common cases are basal cell cancer, squamous cell cancer, and melanoma. Basal and squamous cell carcinoma are together called non melanoma skin cancer. Generally, most skin cancers are detected in the early stages because the cancer develops in the outer layer of skin "epidermis ". Smoking, over-exposure to UV-radiation, chronic non-healing wounds, viruses and genetics are risk factors for skin cancer [142]. Over one million new cases occur annually in USA [140].

1.1.18 Stomach cancer

Cancer that develops in any part of the stomach, it causes about 800,000 deaths worldwide per year [130]. It comes second to lung cancer worldwide, and it is still the most common cancer in developing countries. About 7,900 new cases are diagnosed each year in the European Union

[147]. Nutritional factors (high intake of salt and meat, inadequate intake of fruit and vegetables) are the major risk factors for stomach cancer. Smoking increases risk. Helicobacter pylori infection is an important risk factor for stomach cancer. Stomach cancer in the Arab world is low, especially in Egypt, Jordan, and Iraq compared with Israel and Turkey. Stomach cancer in males is twice that in females and increases for people aged above 50 years. Thirty-eight percent of the world's stomach cases occur in China [66, 89]. High levels of nitrate intake were linked with stomach cancer and other types of cancer (non-Hodgkin's lymphoma cancer, bladder and pancreatic cancer). In stomach Nitrites can react with food proteins to form N-nitroso compounds. These compounds have been found to be carcinogenic [1]. Smoking is the most important behavioral risk factor for stomach cancer [94]. Frequent consumption of fruits, vegetables and whole grains has been associated with reduced risk of stomach cancer [69]. A Study investigated the effect of nutrition on stomach cancer in high and low-risk areas for the disease in the Federal Republic of Germany [17], showed that vegetables were consumed most in the low-risk areas, whereas mashed potatoes and cabbage were consumed most in the highest-risk areas.

1.1.19 Thyroid cancer1

Cancer cells which develop in the thyroid gland. Papillary, follicular medullary or a plastic are kinds of malignant tumors. Papillary and follicular tumors are the most common, and they grow slowly and they are

highly treatable and are usually curable. Thyroid cancer isn’t fatal in patients under 45 years of age [128]. It accounts for about 35% of all cancers in USA. It is the second common type of female cancers in Kuwait and several other countries in the Gulf region [73]. Thyroid cancer is less common among males in most populations. The major risk factors for the disease are dietary factors (low intake OF iodine), female hormones and reproductive history, and radiation exposure. Some studies in Europe and Asia suggested that smoking is associated with reduced risk of thyroid cancer [14, 74].

1.1.20 Uterus cancer

Cancer cells start in the cells that make up the lining of the uterus (endometrial). It is the fourth most common cancer affecting women after breast cancer, lung cancer, and colorectal cancer. Most of the uterus cancer cases (75%) occur in women aged 60 to 69 years because of the changes in hormone levels that happen during the menopause. Obesity is a real risk factor for uterus cancer. There are two main types of endometrial cancers. The first type is a slow growing cancer linked to estrogen and accounts for 80% of cases [129, 130]. Type two is fast-growing and doesn't have connection with hormones.

1.2 Risk factors for cancer

There are several risk factors for cancer. These include external factors (tobacco, chemicals, radiation and infection by organisms), internal

factors (genetics and hormones), nutritional factors, lack of physical activities and alcohol consumption.

1.2.1 Smoking

Cigarettes contain over 4000 chemicals, with over 40 of them being known carcinogens. Tobacco smoking damages important genes that control the growth of cells, causing them to grow abnormally [114]. Annually, smoking alone is directly responsible for approximately 30% of all cancer deaths in USA, and 87% of lung cancer deaths. Smoking is also responsible for most cancer cases of the Larynx, Oral cavity, Pharynx, Esophagus, and Bladder. In addition it is a cause of Kidney, Pancreas, Cervix, and Stomach cancers. The risk is not limited to smokers, but also increases the risk for people exposed to secondhand smoking (or environmental tobacco smoking). The risk increases with total life time exposure to cigarette smoking including the number of cigarettes smoked per day, the age at which smoking began, the number of years a person has smoked, and the smoker's exposure to secondhand smoking [113, 115, 101]. Active and passive smokers have an increased risk of breast cancer compared with women who have never been either actively or passively exposed. However, exposure to environmental tobacco, smoking during childhood or before the first pregnancy didn’t appear to increase risk of breast cancer [35]. Another study observed that the risk for lung cancer increased for both current and former smokers compared with those who

never smoked but for former smokers it decreased with increasing duration of abstinence [20].

Smoking is associated with colorectal cancer incidence and mortality It is also associated with cancers of the organs where there is direct contact with tobacco–related carcinogens such as lung, and organs where exposure to tobacco degradation products is indirect such as colon and kidney [48]. Benzo [a] Pyrene (BaP), a compound found in cigarettes and detected in the cervical mucus, is a major carcinogen [4]. It interacts and plays as a cofactor with human papillomavirus (HPV) to increase the risk of cervical cancer progression [4]. The P53 mutations (Mutations in the p53 gene which is a tumor suppressor gene, and activity of this gene stops the formation of tumor) are frequent in tobacco-related cancers and the mutation's load (frequency) is higher in smokers than nonsmokers [92].

1.2.2 Chemicals

The human body is exposed to thousands of chemicals. Many chemicals are essential while others can be harmful and affect our life. There are many ways in which the body can be exposed to chemicals: through the air, food and beverages and through direct contact with skin. Chemicals can be stored in the body for a long time [115]. Some chemicals first need to be activated by enzymes in the body to become carcinogens such as Benzene which has been shown to be a carcinogenic agent causing Leukemia, Lymphomas, and other hematological cancers [143]. Chlorinated hydrocarbons in asbestosis and Hexavalent chromium have

been shown to be carcinogenic [143]. Some pesticides and chemicals used in agriculture and pest control are also carcinogenic [116]. Higher rates of lip, skin, stomach, brain and prostate cancers were found in male farm workers with high exposure to pesticides, solvents, fuel exhaust and toxin from mold. Lip and skin cancers are also due to exposure to UV radiation from the sun [39]. Cancer risk among people drinking chlorinated water is 93% higher than that of those not drinking chlorinated water. Use of Chlorine in drinking water causes chemical reactions that may produce carcinogenic compounds like chloroforms and tri-halomethans. Chlorinated water is associated with bladder cancer, esophagus cancer, rectum cancer, breast cancer, and larynx cancer [140].

1.2.3 Radiation

It is the emission of energy from any source. Radiation can generally be defined as being ionizing or non- ionizing. Ionizing radiation consists of high energy waves that are able to penetrate cells and cause ionization in different parts of the cells. The most sensitive part in cells is the DNA and can lead to damages which contribute to cancer. The amount of damage is related to the dose of radiation received by the cells. Ionizing radiation is relatively weak carcinogen compared to many chemical agents. The thyroid gland and bone marrow are the most sensitive to radiation, while the kidney, bladder, and ovary seem to be the least affected. Types of ionizing radiation include X- ray, gamma rays, cosmic rays, and particles given off by radioactive material such as alpha particles, beta rays and protons and

they have different energy levels. Non-ionizing radiation such as Ultraviolet rays, visible light, electro magnetic field, microwaves and radio waves are cancer-causing agents, but they don’t have enough energy to cause ionization in tissues [116]. Wing et al [107] compared ratios of radiation exposure between sectors with cancer incidence. His results indicated that higher fallout was correlated with higher cancer incidence, and increases in cancer incidence were correlated with the number of people hit by high doses of ionizing radiation.

1.2.4 Infectious organisms

Infections are linked to about 15% to 20 % of cancer worldwide. Certain viruses, bacteria and parasites are risk factors for several cancers such as Human Papilloma Virus (HPV) the main cause of cervical cancer, which is one the most common cancers among women world wide[118]. The risk is increased when combined with the risk from smoking. Epstein–Barr Virus (EBV) infects and stays in certain white blood cells in the body (B cells), and is linked to some cases of stomach cancer in Africa and parts of Southeast Asia. About 30 % of liver cancers in the USA are related to hepatitis B and C infection. Human Immunodeficiency Virus (HIV) doesn't cause cancer, but HIV infects and destroys white blood cells (T cells) which weakness the body's immune system and increases the risk for cancer [117,134]. HIV infection has been linked to higher risk of invasive Oral cancer, Lung cancer, Cancer of the mouth and throat, cancer of testicles, and skin cancer. Human Herpes Virus 8 (HHV-8) has been found

in nearby all tumors in patients with Kaposisacoma (KS). The KS is a rare slow-growing cancer. Human T-Lymphotrophic Virus-1 (HTLV-1) has been linked with a type of lymphatic leukemia and non-Hodgkin lymphoma. Infection with Helicobacter Pylori (*H. pylori*) for a long time may lead to stomach cancer. Chlamydia Trachoma doesn't cause cancer by itself but it may work with HPV virus to promote cancer. Infection with Schist soma haematobium parasite has been linked to Bladder cancer. *Opisthorchis vivervini* and *clonorchis sinensisare* live flukes have been linked to increased risk of cancer of the bile duct [133,134]

1.2.5 Genetic factors

Cancer can develop due to inactivation of certain genes such as tumor suppressor genes (P53, Two-hit hypothesis), Oncogenes and DNA repair gene. Inheriting a cancer gene usually means that a person has a significantly increased risk of developing cancer compared to other persons not inheriting the gene [59, 67].

BRCA1 and BRCA2 genes appear to be similar in function, but they are located on different chromosomes. Mutations in the BRCA1gene increase risk for breast, ovarian, prostate and, possibly, colon cancer. Mutations in the BRCA2 gene increase the risk for breast (males and females), ovarian, prostate, and pancreatic cancers [43]. Ten percent of ovarian cancers are caused by an inherited faulty gene [134]. Non-polyp sis colorectal cancer (HNPCC) is a hereditary syndrome which increases the risk for colorectal cancer [62].

1.2.6 Hormones

Hormones don’t cause cancer at normal levels, but deficiency in hormones can retard cancer by straying it, with depleting everything else in the body [58]. Thyroid gland enlarges (Goiter), nodules appear in the thyroid gland and over a period of time cancer may appear in thyroid nodules. Also missed diagnosis and treatment of hormone deficiency increases risk of Breast cancer [37, 58].

1.2.7 Dietary factors

Dietary factors account for at least 30% of all cancer in developed countries and up to 20 % in developing countries [120]. One third of all cancer deaths are related to diet and activity factors [121]. Being overweight or obese increases the risk of several cancer types including cancers of the Breast, Colon, Endometrial, Esophagus, and Kidney. Increased fat tissue raises circulating estrogen levels, which increase the risk of breast cancer. Obese men have higher rate of prostate cancer [121]. Fast food which is rich in fats and calories raises cancer risk [122]. Physical inactivity causes obesity and increases the risk for cancer while regular physical activity has shown effect in reducing the risk of cancer [122]. Higher intakes of animal fat, cholesterol, lactose, meat, eggs and whole milk increased ovarian cancer while higher intakes of vitamin A, fruits and vegetables reduced the risk [73]. Pectin, the fiber in apple skin, is fermented in the intestine producing short-chain fatty acids that prevent the growth of harmful bacteria. They also nourish the cells of the intestinal

lining, making them more resistant to becoming cancerous [119]. Antioxidants, such as vitamin C and E and beta carotene, seem to have a synergitic effect when taken together, so eating lots of fruits and vegetables in a salad together produces a grater anticancer effect than eating each one individually [119].

1.3 Distribution and statistics of cancer

1.3.1 Distribution of cancer worldwide

Cancer has increased in the last years, and is becoming a major public health problem worldwide. Ten million cases were diagnosed in 1996 and the number of diagnosed cases in 2020 is estimated at 20 million [96]. In 2007, there were more than 12 million new cases worldwide; 5.4 million cases occurred in developed countries and 6.7 million in developing countries. Currently, cancer accounts for one-tenth of all deaths in developing countries [96] an. In developed countries, cancer is the second leading cause of death, after heart diseases (one in eight deaths worldwide is due to cancer; 20,000 cancer deaths a day), while in developing countries it’s the third leading cause of death. Cancer will become the leading cause of death worldwide – exceeding AIDS, tuberculosis, and malaria combined [124]. For example, in USA it accounts for nearly one of every four deaths. Cancers of prostate, lung, and colorectal accounted for about 50% of all newly diagnosed cases among men (prostate cancer alone, accounted for about 25% of cases), while breast, lung, and colorectal cancers accounted for 50% of new cases in women (breast cancer accounted for 26% of all

new cases among women), [79]. The age-adjusted incidence rate of cancer in USA is 162.7 among males and 110.4 among females while in the UK the rates are 173.7 and 121.3 among males and females, respectively [89].

In 2002, a study of cancer types in 20 large areas of the world found that geographic variation and variation in lifestyle and environment played an important role in the distribution of cancer types. The most commonly diagnosed cancer types were lung cancer (1.35miilion), breast cancer (1.15 million cases), and colorectal cancer (1 million cases). The most common causes of cancer death were lung (700,000 deaths) and liver cancer (598,000 deaths). The study also showed that breast cancer was the most prevalent cancer among females (4.4 million) and patients survived up to 5 years following diagnosis [90].

1.3.2 Distribution of cancer in the Arab world

Cancer incidence is increasing in Arab countries due to several factors such as westernization of social and dietary habits. Cancer is the fourth most killer with about half a million new cases a year in the Arab World. Lung, liver, and bladder cancers are the most common among men and breast cancer among women [69, 84]. Prostate, breast, and colorectal cancers appear to be increasing in the Arab world [133]. Lung cancer is the most common type of cancer among Arab men (26.1%). Among several Arab countries (Egypt, Saudi Arabia, Kuwait, Oman and Jordan) the highest frequency of lung cancer was observed in Egypt [31]. Stomach

cancer is the second type of cancer among men (16.8%) and colorectal cancer is the third type in both males (11.8%) and females (13.8%), [145].

A study compared the distribution of cancer between Gaza and Egypt and showed that the distribution of cancer was different between the two countries. Lymphoma, bladder cancer and cancer of the oral cavity and pharynx were the most common kinds of cancer in Egyptian men. In contrast, lung, Leukemia and lymphoma were the most frequent among men in Gaza. Breast cancer had the highest frequency in both countries [84]. A survey study of cancer types in Oman for the period (1993-1997), showed that stomach cancer was the most common type in men while cancer of the colon was the least type (2.8%). On the other hand, breast cancer was the most common type of cancers in Omani women (13.7%) while cancer of the connective tissue was the least (2.2%) [7]. Another study in Saudi Arabia [31] found that leukemia was higher among men compared to women (close to 10% of all cancers in men and 6-7% among women) due to higher exposure to some chemicals, radiation or drugs.

1.3.3 Distribution of cancer in Palestine

Figure 1.1 shows the leading causes of death in the occupied Palestinian territories in 2005.

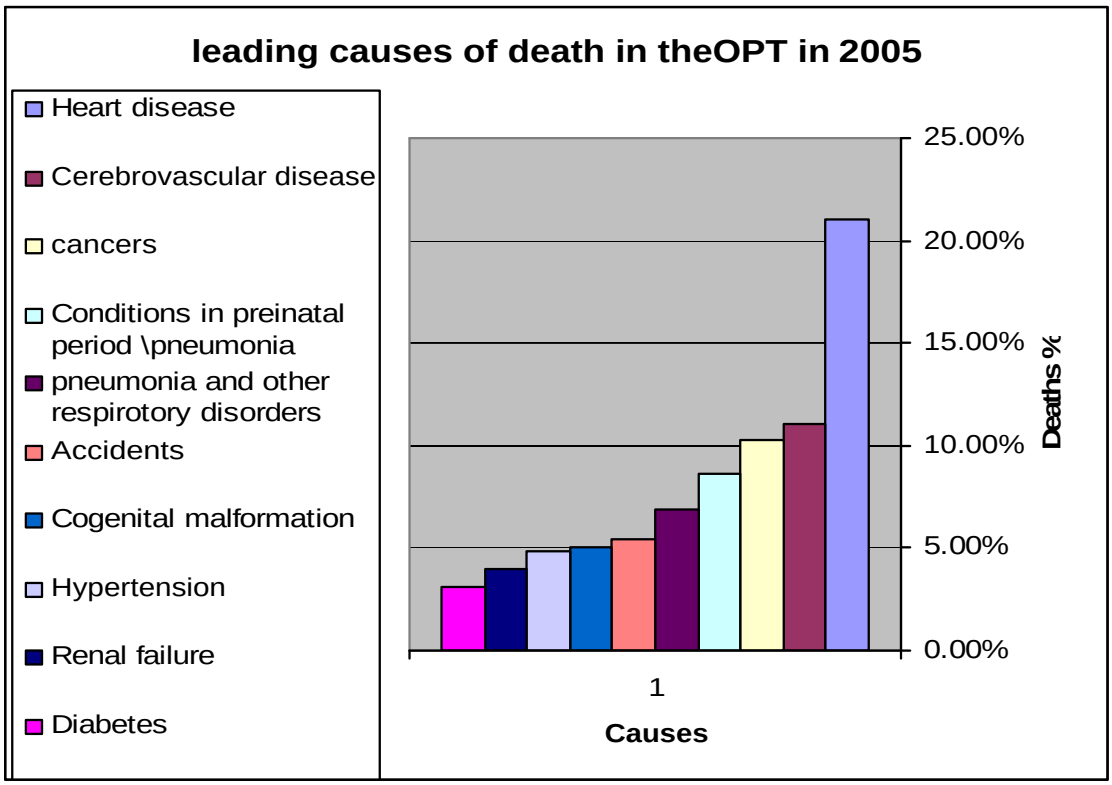

Figure (1.1): **Leading causes of death in the Occupied Palestinian Territories in 2005 [61]**

Incidence of cancer in 2005 was 43.1 per 100,000 (49.2 per 100,000 in the West Bank and 32.7 per 100,000 in Gaza strip). The mortality rate due to cancer was 27.8 per 100,000, which did not differ much from that in the year 2000. Forty five percent of all cases were in men and 55% in women. Breast cancer had an incidence rate of 60 per 100,000 which made it the most prevalent type in the total population (16.4%), and among females (31%). Lung cancer is the most common type in Palestinian men. It is the leading cause of death of all cancers in men (7.1 deaths per 100,000 in 2005 and 22.8% of all cancer deaths). Prostate cancer is the second most common type in Palestinian men. After lung cancer, the four types of cancer resulting in similar mortality rates are prostate (9.5%), nervous system (9.5%), colorectal (9.3%), and liver (9.1%), [41, 61, 97].

The mortality rate from all types of cancer was 26.8 per 100,000 in recent years [36], (See Table 1).

According to Hamad [50] the geographical distribution of cancer in the North of the West Bank for the period from 1999-2002 was as follows: Nablus had 395 new cases (38 per 100,000 per year), Jenin had 281 new cases (29 per 100,000 population), Tulkurm had 135 new cases (25 per 100,000 population), Qualqilia had 69 new cases (24 per 100,000), and Salfit had 52 new cases (27 per 100,000). Hamad [50] showed that gastrointestinal cancers were more frequent among older people (55-75 years) in the North of the West Bank, liver and stomach cancers were more frequent in males and pancreas, colorectal and oral cavity cancers were more spread in refugee camps than villages and cities. He also found that liver cancer was more frequent among employees and stomach and oral cavity cancers were more frequent among workers, while pancreas and colorectal cancers were more frequent among house wives. A retrospective study [9] of the prevalence of prostate cancer in the West Bank revealed that the incidence rate of prostate cancer was highest in Bethlehem, followed by Nablus then Jericho, but was lowest in Jerusalem [9]. Another study of prostate cancer [96] that covered the period 1998-2006 showed that the incidence rate was 10.4 per 100,000, and the majority of patients (64.1%) were diagnosed in Nablus and the lowest (6.4%) in Tulkurm city. The prevalence of prostate cancer in Palestine is low compared to western countries despite the high intake of calories.

Table (1.1): Age-adjusted cancer incidence and site-specific proportions of all cancers in the occupied Palestinian and in neighboring countries [41, 97]

	West Bank	Israel Arabs	Israel Jews	Jordanians	Lebanese
Women					
Years	1998-2001	1996-2001	1996-2001	1996-2001	1998
Age-adjusted incidence (per 100,000 population)	88.5	128.7	272.1	112.2	134.8
Total cancer cases					
Year	2005	2000	2002	2002	1998
Breast	31.4%	27.7%	31.5%	32.5%	46.7%
Colon and rectum	9.2%	9.6%	14.1%	9.0%	11.5%
Thyroid	5.5%	7.0%	3.6%	5.4%	
Corpus uteri	4.4%	5.05	4.1%	2.4%	6.5%
Ovary	3.8%	3.2%	2.7%	4.1%	5.9%
Cervix uteri	1.0%	2.0%	1.7%	2.2%	2.3%
Lung and bronchus	3.0%	3.5%	4.6%	2.3%	4.5%
Men					
Years	1998-2001	1996-2001	1996-2001	1996-2001	1998
Age adjusted incidence (per100,000 population0	108.0	175.7	282.6	115.2	154.2
Total cancer cases					
Year	2005	2000	2002	2002	1998
Lung	13.8%	19.0%	9.8%	12.2%	14.1%
Prostate	11.3%	8.4%	17.5%	7.5%	14.2%
Colon and rectal	9.6%	9.9%	14.1%	9.1%	12.3%
Non-Hodgkin lymphoma	5.0%	7.7%	5.7%	7.1%	4.2%
Stomach	4.7%	3.4%	4.3%	4.7%	7.9%

1.4 Significance of the study

Cancer is becoming a major public health concern, especially in developing countries, including Palestine, due to adopting western life style behavior such as smoking, higher consumption of saturated fat and calories, and reduced physical activity [40]. The West Bank is undergoing a transition characterized by rapid urbanization and changing lifestyle, and epidemiologic transition characterized by a persisting burden of infections diseases, and a rise in chronic diseases including cancer [2]. In the West Bank, severe restriction on the movement of Palestinian people and goods, and difficult access to health services negatively affected living conditions and health status [2]. Cancer mortality rate in the West Bank accounted for (10%) of total mortality from 1999 through 2003 and the crude cancer incidence in the west bank in 1999 was 6.6 per 100,000 [2].

Despite the rising importance of this disease, there is a lack of studies which characterize the incidence of different types of cancer in Palestine. Medical research is rare in Palestine, especially in a country under occupation where the field of research remains of low interest, and resources are very limited. Existing studies are not recent and/or mostly focused on a single type of cancer or on the total rate of incidence. Our study will address the geographical distribution of all solid cancer types in the North of the West Bank in the period from 2005 to 2008.

1.5 Objectives of the study

The main objectives of this study were:

1- To compare the incidence rates of cancer among the Northern governorates of the West Bank (Tulkurm, Nablus, Qualqilia, Jenin, Tubas and Salfit) and link these rates to some risk factors.

2- Compare incidence rates between types of localities (urban, rural, and refugee camps)

3- Identify occupations at high risk of development of various types of cancer.

4- Investigate the relationships of various risk factors (genetic, dietary, stress, etc) with cancer types.

5- To construct an incidence map of cancer in the North of the West Bank.

Chapter Two

Methodology

Chapter Two
Methodology

2.1 Study population

The study targeted cancer patients in the North of the West Bank (the governorates of Nablus, Tulkarm, Qualqilia, Jenin, Tubas, and Salfit) diagnosed in the period from 2005 to 2008. Three hospitals have cancer therapy centers in the north of the West Bank. These are: Al-Watani hospital in Nablus which is the main oncology center and keeps the registry files of most cancer patients of this region, Thabet-Thabet hospital in Tulkarm, and Jenin hospital in the city of Jenin. All three are governmental hospitals

2.1.1 Inclusion criteria

A patient was included if he/she met the following criteria:

1. Lived in the North of the West Bank at time of diagnosis.
2. Diagnosed with any type of solid cancers "oncology " in 2005 through 2008).

2.1.2 Exclusion criteria

A patient was excluded if he/she:

1. Was diagnosed in 2009 because the collection of data was completed before the end of 2009.

2. Was diagnosed in the specified period for a solid cancer but did not live in the North of the West Bank.

3. Was diagnosed with a hematology cancer.

No sampling was performed as all available files of cancer patients diagnosed in the specified period (2005-2008) were initially consulted (a total of 1075 files: 919 files from Al-Watani hospital, 96 files from Thabet-Thabet hospital, and 60 files fom Jenin hospital). These included 20 duplicate files and 18 files (discarded) for patients from outside the study region. For duplicate files, only the older file was considered. Thus the study covered a total of 1037 patients diagnosed with non _hematology cancers from the three hospitals (Table 2.1).

Table (2.1): Distribution of cancer patients in the North of the West Bank by hospital

Hospital	Females	Males	Total
Al_Watani	454	429	883
Jenin	31	29	60
Tulkurm	51	43	93
Total	536	501	1037

2.3 Study design

This is a retrospective study and covered the northern governorates of the West Bank (Nablus, Tulkarm, Qualqilia, Jenin, Tubas and Salfit). The study relied on data obtained from the registry files of patients (medical and some personal data) as well as complementary information (habitat, lifestyle and risk factors) obtained via direct or phone interviews. A questionnaire of four parts was designed to collect the data. The first part

included personal information (age, gender, address, occupation, etc); the second part included lifestyle information (dietary habits, sport activity, etc); the third part included information on patient's habitat and place of work (types and sources of pollution); and the last part included medical information (type of cancer, hormonal imbalance, stress factors, etc). The main information obtained from the registry files included date of diagnosis, date of birth, gender, address of residence, telephone number, and type of diagnosed cancer and other diseases. Complementary data to those in the registry files were obtained via direct (face to face) or phone interviews. Direct interviews with patients were made during their medical visits to the hospital. In case where the patient was not alive, the interview was made with close family members. Only patients of Al-Watani hospital were interviewed (883 patients) because files of patients in the other two hospitals lacked address of residence and phone numbers.

The questionnaire was first tested on a small random sample of 10 patients. Slight modifications were made on the questionnaire based on the results from the random sample. The questionnaire was also approved by a panel of experts in the subject. A statement was included in the questionnaire (and also verbally drawn to the attention of respondents) concerning the ethical issues of this study and the confidentiality of the information provided by the patients. This statement was approved by a specialized jury from the department of Public Health at the Faculty of Graduate Studies of An-najah National University, Nablus.

In this study, a patient's residence was classified according to 1) the governorate (Nablus, Tulkarm, Qualqilia, Jenin, Tubas or Salfit), and 2) the type of locality (urban, rural, or refugee camp). The latter classification is important in social and epidemiological studies in Palestine as differences may exist among locations, particularly in economic status and access to education and medical services. Type of locality was assigned according to the classification published by the Palestinian Central Bureau of Statistics (PCBS) which was based on the following criteria [**85**] :

Urban: Any locality whose population amounts to 10 000 persons or more. Besides, it refers to all localities whose populations vary from 4000 to 9999 persons provided they have, at least, four of the following elements: public electricity network, public water network, post office, health center with a full-time physician and a school offering a general secondary education certificate.

Rural: Any locality whose population is less than 4000 persons or whose population varies from 4000 to 9999 persons but lacking four of the aforementioned elements.

Camp: It refers to any locality referred to as a refugee camp and administered by the United Nations Refugees and Work Agency in the Near East (U.N.R.W.A.).

2.4 Age-adjusted incidence rates

These were calculated by the direct adjustment method using the 2007 population census [85] as a base reference. Adjustment weights were

calculated as the ratio of the population size in the particular age group to the total population size in the West Bank. Age groups according to the PCBS are as follows: less than one year, 1-4 yr, 5-9, 10-14, ..., 90-94, and 95+ years.

2.5 Study hypotheses

General hypothesis: There are differences among geographical regions, types of locality, and cancer types in incidence rates due to differences in atmosphere, habitat, life style, family history and different types of pollution.

Specific hypotheses: The following specific alternative hypotheses were tested at significance level ($\alpha = 0.05$)

1. There is a relationship between cancer type and governorate.
2. There is a relationship between cancer type and type of locality.
3. There is a relationship between cancer type and occupation.
4. There is a relationship between cancer type and gender.
5. There is a relationship between cancer type and year of diagnosis.
6. There are differences among governorates in mean age at diagnosis.
7. There are differences among types of locality in mean age at diagnosis.

8. There is a difference between males and females in mean age at diagnosis.

9. There are differences among cancer types in mean age at diagnosis.

10. There are differences among governorates in mean survival time after diagnosis.

11. There are differences among types of locality in mean survival time after diagnosis.

12. There is a difference between males and females in mean survival time after diagnosis.

13. There are differences among cancer types in mean survival time after diagnosis.

14. There is a relationship between cancer type and consumption of high-fat food (yes, no).

15. There is a relationship between cancer type and consumption of high-sugar food (yes, no).

16. There is a relationship between cancer type and consumption of carbohydrate-rich food (yes, no)

17. There is a relationship between cancer type and consumption of salty food (yes, no)

18. There is a relationship between cancer type and rate of vegetable consumption (low, moderate, high)

19. There is a relationship between cancer type and rate of fruit consumption (low, moderate, high)

20. There is a relationship between district and number of different sources of pollution nearby residence

21. There is a relationship between type of locality and number of different sources of pollution nearby residence.

22. There is a relationship between cancer type and presence of chemical factories nearby residence (yes, no).

23. There is a relationship between cancer type and presence of stone factories nearby residence (yes, no).

24. There is a relationship between cancer type and presence of open sewage streams nearby residence (yes, no).

25. There is a relationship between cancer type and presence of garbage dumps nearby residence.

26. There is a relationship between cancer type and presence of electromagnetic sources nearby residence (yes, no).

27. There is a relationship between cancer type and family history (first and/or second degree relatives having the same or different cancer type).

28. There is a relationship between cancer type and smoking *habit (*nonsmoker, smokes cigarettes only, smokes *Argeeleh* only, smokes both cigarettes and *Argeeleh*).

29. There is a relationship between cancer type and number of smoked cigarettes per day.

30. There is a relationship between gender and smoking habit .

31. There is a relationship between governorate and smoking habit.

32. There is a relationship between type of locality and smoking habit.

33. There is a relationship between cancer type and alcohol consumption

34. There is a relationship between gender and alcohol consumption

35. There is a relationship between governorate and alcohol consumption

36. There is a relationship between type of locality and alcohol consumption

37. There is a relationship between cancer type and social stress (stress, no stress).

38. There is a relationship between cancer type and economic stress (stress, no stress)

39. There is a relationship between cancer type and psychological stress (stress, no stress).

40. There is a relationship between cancer type and political stress (stress, no stress).

41. There is a relationship between cancer type and number of different kinds of stress suffered by the patient (0, 1, 2, 3 or more types)

2.6 Statistical methods

The study employed both descriptive (graphs, frequencies, means, standard deviations, etc) and inferential statistical procedures (tests of hypothesis). The 95% confidence intervals for incidence rates were calculated based on Poisson approximation as outlined in [30]. Incidence (number of new cases) of overall and each cancer type and levels of risk factors were classified in (**r x c**) contingency tables across pairs of variables of interest (governorate, type of locality, gender, occupation, etc). Fisher's exact test was performed to test for dependency (presence of relationship) between row and column classifications. Fisher's exact test is more appropriate than the asymptotic chi-square when the table contains cells with expected counts less than 5. The Kolmogorov-Smirnov test of normality was employed to age at diagnosis, survival time, number of smoked cigarettes, number of sources of pollution and number of kinds of stress to decide upon the appropriate analysis (parametric or non parametric). The test showed that all five variables deviated from normality ($P < 0.05$) and thus Kruskal-Wallis test was used instead of ANOVA to test differences in these variables among multilevel classifications. These

analyses were carried out using SPSS (Statistical Package for the Social Sciences) V16 (SPSS Inc., Chicago, IL, USA).

A negative binomial regression analysis was performed to estimate incidence rate ratios (IRR) of cancer and compare these ratios among the levels of factors in the model. The model included the following factors as class variables: age group (five groups: <40, 40-49, 50-59, 60-69, and more than 70 years), gender, year of diagnosis, governorate and type of locality with population size used as an offset variable. Population size was from the 2007 census of the Palestinian population [85]. The estimated IRR for one level of a given factor is thus adjusted for the levels of the other factors in the model. The negative binomial regression was adopted rather than Poisson regression because it accounts better for overdispersion in the data by inclusion of a dispersion parameter (the negative binomial resulted in a better fit of the data: ratio of deviance to degrees of freedom of 0.998 for the negative binomial analysis compared to 1.144 for the Poisson regression; values closer to 1.0 indicate better fit). This analysis was carried out using SAS/STAT software V9.0 for Windows (SAS Institute Inc., Cary, NC, USA).

Chapter Three

Results

Chapter Three
Results

3.1 Overall incidence rates of cancer

In this study there were 1037 new cancer cases diagnosed between 2005 and 2008 in the six governorates of the northern West Bank (Figure 3.1). The data showed an increase in the number of new cancer cases from 2005 to 2008 (200 cases in 2005, 229 cases in 2006, 293 cases in 2007 and 315 cases in 2008). The increase was mainly in urban and rural areas but the trend was not consistent among governorates (Table 3.1). In refugee camps, the incidence was nearly stable. Over the whole period, about 50% of the subjects (519 cases) were diagnosed in Nablus, and the lowest number of cases was observed in Tubas (27 cases, 2.6%). About 63% of diagnosed patients lived in urban areas, 27% lived in rural areas and 10% lived in refugee camps. There were no differences ($P > 0.05$) among governorates and types of locality in the distribution of number of caner cases by gender.

Crude and age-adjusted incidence rates are in Tables 3.2, 3.3, and 3.4. Crude rate increased from 21.7 (adjusted rate of 20) cases per 100 000 in 2005 to 34.1 (age-adjusted rate of 31.3) cases per 100 000 people in 2008 with an average of 28.1 (age-adjusted rate of 25.7) cases per 100 000 people per year (Table 3.2). The crude rate over the whole period was 112.3 cases per 100 000 and the age-adjusted rate was 103.2 cases per 100 000. Average yearly crude rate by governorate ranged from 11.8 (adjusted rate of 12.4) cases per 100 000 for Jenin to 41.1 (adjusted rate of

37.0) cases per 100 000 for Nablus (Table 3.3). Refugee camps had higher incidence rates (average crude rate of 42.2; average age-adjusted rate of 42.1 cases per 100 000) than urban areas (average crude rate of 27.9; average age-adjusted rate of 28.6 cases per 100 000) and rural areas (average crude rate of 27.1; average age-adjusted rate of 24.3 cases per 100 000), Table 3.4.

Estimates of IRR (incidence rate ratios) and 95% CI from the negative binomial regression are in Table 3.5. As expected, people in age groups of 40 years and older had much higher risk of cancer ($P < 0.0001$) compared to the age group of less than 40 years (IRR of 9.66 for age group 40-49 yr, 21.78 for age group 50-59 yr, 36.69 for age group 60-69 yr, and 45.98 for age group $\geq$ 70 yr). The IRR for year of diagnosis showed an increase of risk in 2007 (IRR of 1.43, $P < 0.001$) and 2008 (IRR of 1.58, $P < 0.0001$) compared to the reference year 2005 but the increase was not significant for 2006 (IRR of 1.13, $P > 0.05$). All governorates had higher incidence rates of cancer than Jenin ($P < 0.0001$) except for Tubas (IRR = 1.13, $P > 0.05$). Nablus had the highest rate ratio (IRR = 3.30), followed by Qualqilia (IRR = 2.59), then Salfit (IRR = 2.46) and Tulkarm (IRR = 2.34). Urban and rural localities had significantly less incidence rates than refugee camps (IRR = 0.74, $P < 0.01$ for urban; IRR= 0.51, $P < 0.0001$ for rural areas). No difference was found in overall cancer incidence rates between males and females (IRR = 1.01 for males relative to females, $P > 0.05$).

3.2 Incidence rates of cancer types

Number of new cases and crude incidence rates for the cancer types are in Table 3.6. Table 3.7 shows the number of diagnosed cases of each cancer type by governorate. Breast, colorectal, uterine, and ovarian cancers were the most frequent among women (38.1%, 14.6%, 6.0%, and 5.4%, respectively) while colorectal, bladder, lung, prostate, and stomach cancers were the most common among males (15.6%, 13.2, 13.0%, 11.6%, 6%, respectively). Fisher's exact test showed a significant relationship between governorate and cancer type ($P < 0.01$). For example, Nablus had 61% of all lung cases (10 % of cases in the governorate) and 52% of all breast cases (20.6% of cases in the governorate). No significant relationship was found between cancer type and type of locality ($P > 0.05$).

Table 3.8 shows the crude incidence rates (for both genders combined) by governorate . Number of new cases and crude rates by type of locality are in Table 3.9 and Table 3.10. Age-adjusted estimates based on small numbers of cases (less than 25 cases) exhibit large amount of random variation [30], therefore, these were not calculated for individual cancers.

3.3 Age at diagnosis

All cancer types developed, on average, at older age ($\geq$ 40 years) except bone, nasopharyngeal and testicular cancers in which the average age at diagnosis was less than 40 years (Figure 3.2). Mean age at diagnosis for all patients was 55.73 years (SD = 17.52 years). Kruskal-Wallis test

showed significant differences in age at diagnosis among cancer types ($P < 0.001$), between males and females ($P < 0.001$), among governorates ($P < 0.05$) and occupations ($P = 0.000$) but no significant differences ($P > 0.05$) were found among types of locality (55.95, 55.18, 55.86 years for urban areas, rural areas and refugee camps, respectively). Males were diagnosed at older age than females (57.72 years for males and 53.88 years for females). Patients living in Tubas had, on average, younger age at diagnosis (46.6 years) than patients in the other governorates (56.4 for Nablus, 56.25 for Tulkarm, 56.03 for Salfit, 55.23 years Jenin and 54.26 years for Qalqilia). Figure 3.3 shows the mean of age at diagnosis by occupation. Students had the youngest age at diagnosis (average of 14.74 years) and farmers had the oldest age at diagnosis (average of 67.64 years).

3.4 Survival Time

The average survival time for all cancer patients was 1.24 years (SD = 1.36) and the maximum survival time was 10 years. Average survival times after diagnosis for cancer types ranged from 0.43 year for patients with Esophageal cancer to 5.0 years for patients with neck cancer (Figure 3.4), but the differences among cancer types were not significant ($P = 0.15$). Similarly, no significant differences were found among governorates ($P = 0.29$) and types of locality ($P = 0.15$). Average survival times by governorate were 1.16, 1.24, 1.21, 1.50, 0.40, and 1.29 years for patients living in Jenin, Nablus, Qalqilia, Selfit, Tubas and Tulkarm, respectively. Average survival time was 1.27 years for patients living in urban areas,

1.25 years for patients living in rural areas and 1.03 years for refugees. Females had higher average survival time than males (1.33 years for females and 1.16 years for males) but the difference was not statistically significant (P = 0.15). Business owners and office workers survived longer (2.5 and 1.90 years, respectively) than patients of other occupations (Figure 3.5). It should be noted that survival data are censored because not all patients have died by the time the data were collected.

3.5 Distribution of cancer types according to Occupation

The distribution of cancer cases by cancer type and occupation are in Table 3.11. About 43 % of patients had no occupation (97.3% of these were housewives). Farmers made up the biggest slice in the working group (13% of all patients) with males comprising the majority of this group (93 %) followed by teachers (7.8% of all cases), builders (6.1% of all cases) and factory workers (4.1% of all cases, all males). Fisher's exact test showed a strong relationship (P = 0.000) between occupation and cancer type. This indicates that some occupations have higher risk of developing certain cancer types than others. Lung, colorectal, bladder, prostate and stomach cancers were the most frequent among farmers. Breast and colorectal were the most frequent cancers among teachers while bladder, lung, prostate and colorectal had high frequencies compared to other types of cancer among builders and factory workers. It should be noted that incidence rates could not be calculated due to lack of population census by occupation (at least not for the classification of categories described here)

3.6 Dietary Factors

Most patients of all cancer types in the study consumed high levels of fat, sweets, carbohydrates, and salts (Figure 3.6). No relationship was found (Fisher's exact test, $P > 0.05$) between cancer type and level of consumption for each of sweets, carbohydrates, and salts, but a slight relationship was found for fat consumption ($P = 0.05$). Esophageal and testicular cancers were associated with high consumption of fat. Patients with colorectal, lung, bladder and head-brain cancers also consumed fat in high levels

Of all interviewed patients (883 patients), 36 % consumed low levels of vegetables, about 51% consumed moderate levels of vegetables and 13% consumed high levels. Figure 3.7 shows levels of vegetable consumption by cancer type. Results of Fisher's exact test showed that the proportions of patients within levels of vegetable consumption were not different across cancer types (i.e., there is no relationship between cancer type and level of vegetable consumption, $P > 0.05$).

Levels of fruit consumption by cancer type are in Figure 3.8. Half of patients consumed low levels of fruits, about 38% consumed moderate levels and about 12 % consumed high levels. The results of Fisher's exact test for fruit consumption were similar to those for vegetable consumption (no relationship between cancer type and level of fruit consumption, $P > 0.05$)

No differences were found (P > 0.05) among governorates and types of locality in dietary habits (consumption of fat, sweets, etc)

3.7 Sources of pollution

Figure 3.9 shows the percentage of cancer patients in each governorate exposed to different sources of pollution. All governorates had high percentages of patients exposed to electromagnetic sources (67.6% in Qalqilia, 63% in Nablus and Jenin, 62.3% in Salfit, 56.3% in Jenin, and 53% in Tulkarm). There were highly significant differences (P = 0.000) among governorates in the percentages of patients exposed to chemical factories, open sewage streams, garbage dumps, and stone factories. Tulkarm had high percentage of patients living close to chemical factories (50.5%) compared to the other governorates (20.7% in Qalqilia, 9.8% in Salfit, 4% in Nablus, 3.7% in Tubas, and 2.5% in Jenin). Qalqilia and Tulkarm had high percentages of patients exposed to open sewage streams (48.6 and 46%, respectively), Qalqilia and Salfit had high percentages of patients living close to garbage dumps (48.6%, and 47.5%, respectively), while Tubas and Jenin had high percentages of patients living close to stone factories (48.1%, and 33.6%, respectively).

The pollution patterns by type of locality are in Figure 3.10. Significant differences were found among types of locality in the percentages of patients exposed to chemical factories (P = 0.003), open sewage streams (P = 0.000), garbage dumps (P = 0.001), and stone factories (P = 0.003) but not electromagnetic sources (P = 0.055). The

majority of patients living in refugee camps are exposed to open sewage streams (76.9%). Higher percentage of patients in rural areas lived near garbage dumps (37.4%) and stone factories (27.3%) compared to patients in urban (25.3%, and 19.8%) and refugee camps (28.7%, 13%). Percentages of patients exposed to pollution from chemical factories were 17.8% in urban areas, 12% in refugee camps and 9.4% in rural areas. Significant differences were also found among types of locality (P = 0.000) in the percentage of patients exposed to number of sources pollution (zero, one, two, three or more sources): 57.7% of patient in urban areas were exposed to two ore more sources of pollution, 59.8% in rural areas and 72.3% in refugee camps.

Figure 3.11 shows the percentage of patients in each cancer type exposed to different sources of pollution. Some variation can be noticed among cancer types, but the variation was not statistically significant for any type of pollution (P > 0.05). Many patients were exposed to more than one type of pollution (Figure 3.12).

3.8 Family History

Table 3.12 shows the relationship between cancer types and family history of cancer. First degree relatives included fathers, mothers, brothers, sisters, sons and daughters while second degree relatives included any other relatives. The table shows high variation among cancer types in the percentage of patients with family history. A strong family history was particularly evident for colorectal, breast, cervical, testicular, uterus, and

prostate cancers (Fisher's exact test showed strong relationship ($P < 0.001$) between cancer type and presence of at least one first relative with any cancer type, between cancer type and presence of at least one relative with the same cancer type, between cancer type and presence of at least one relative with any cancer type. Of all interviewed subjects (883), 22.5% had at least one first relative with cancer (same or different cancer), and 12.3% had at least one first relative with the same cancer type, while 22.1% of patients had at least one relative (first and/or second degree) with the same cancer type. About 2% of patients had two or more first degree relatives with the same cancer type.

There were no differences among governorates and types of locality in family history (Fisher's exact test, $P > 0.05$).

3.9 Smoking and alcohol intake

Figure 3.13 shows the relationship between cancer types and smoking status. A strong relationship was found (Fisher's exact test, $P = 0.000$) between cancer type and smoking status. Cancers of the respiratory systems (lung, nasopharynx, and larynx), testicular cancer, and cancers of the bladder, prostate and stomach had more than 75% of their patients in the smoking categories. These cancers were much more frequent among smokers than non smokers (13% vs. 3% for lung cancer, 1.5% vs. 0.2% for nasopharyngeal cancer, 1.7% vs. 0.2% for laryngeal cancer, 1.5% vs. 0.2% for testicular cancer, 10.9% vs. 3.2% for bladder cancer, 9.4% vs. 1.7% for prostate cancer, and 5.6% vs. 2.2% for stomach cancer). In addition,

patients of these cancers smoked more cigarettes, on average, than patients of other cancer types (Figure 3.14; P = 0.000). However, smoking status had a strong relationship with gender (Fisher's exact test, P = 0.000). 84.6% of male patients were smokers compared to only 25.3% of females. As shown in Figure 3.15, a higher percentage of male patients smoked cigarettes (28%) or both cigarettes and *Argeeleh* (46.6%) compared to female patients (2.6% and 4.8% of female patients, respectively), but a higher percentage of females smoked *Argeeleh* only (17.8%) compared to males (10%). The relationship between cancer types and smoking status was thus investigated for males and females, separately (Figure 3.16 and Figure 3.17). The results of Fisher exact test showed a significant relationship for males (P = 0.000) but not for females (P > 0.05). This should not be interpreted as if smoking is not associated with cancer in females but it means that in females, smoking status is not different across cancer types.

Of all interviewed cancer patients, 8% declared having consumed alcohol. Figure 3.18 shows the relationship between cancer types and alcohol consumption. Strong differences were found among cancer types in the distribution of alcohol-consuming and non-alcohol patients (P = 0. 000). Patients with testicular, stomach, and pancreas cancers had higher percentages of alcohol consumers than the other types (25%, 22.2%, and 17.4%, for the three cancer types, respectively).

No differences were detected among types of locality in smoking status (P = 0.071) and alcohol consumption (P = 0.84) but significant

differences were found among governorates for both smoking status (P = 0.000) and alcohol consumption (P = 0.006). The percentages of smoking patients (cigarettes, *Argeeleh*, or both) by governorate were 62.5% in Tubas, 61.8% in Nablus, 53.2% in Jenin, 41% in Salfit, 40.9% in Qalqiliya, and 36.4% in Tulkarm. The percentages of interviewed patients who declared consuming alcohol were 16.7% in Tubas, 9.7% in Jenin, 9.6% in Nablus, 7.3% in Qalqilia, 3.3% in Salfit, and only 0.9% in Tulkarm.

3.10 Types of Stress

Only 22% of questioned cancer patients declared not having suffered from any kind of stress before being diagnosed with cancer, 54.3% suffered social stress, 28.8% suffered economical stress, 15.4% suffered political stress, and 6.6% suffered psychological stress. Figure 3.19 describes the distribution of different kinds of stress in different cancer types. Social stress ranked first in almost all cancer types, followed by economic stress, then political stress and finally, psychological stress. Significant differences were found among cancer types in the percentages of patients suffering from social stress ($P < 0.05$), economical stress ($P < 0.01$) and psychological stress ($P < 0.05$) but no significant differences were found for political stress ($P > 0.05$) Figure 3.20 shows the distribution of the number of different kinds of stress by cancer type. The distribution of the number of stresses suffered by a patient differed among cancer types (P = 0.022). Laryngeal, thyroid, cervical and stomach cancers had high percentages of patients suffering two or more kinds of stress. No

differences were found among governorates (P = 0.98) and Types of locality (P = 0.89).

3.11 Chronic diseases

The results showed that 46.3% of cancer patients had one chronic disease or more: 22.4% of patients had diabetes and 34.1% had hypertension (11.6% had both diabetes and hypertension). A significant association was found between cancer type and each of diabetes (P = 0.001) and hypertension (P = 0.002). The highest percentages of patients with diabetes were observed among patients of prostate cancer (46.2%), cervical cancer (36.4%), liver cancer (31%), skin cancer (30.4%), and colorectal cancer (28.6%). For hypertension, the highest percentages were found among patients with pancreas cancer (56.5%), bladder cancer (53.8%), liver cancer (44.8%), ovary (44.4%), prostate cancer (42.3%), stomach (41.7%), colorectal cancer (41.3%), cervical cancer (36.4%), and kidney cancer (35.7%), Figure 3.21.

No differences were found among governorates in the percentage of cancer patients with hypertension (P = 0.09) but significant differences (P = 0.005) were found for diabetes (31.1% in Salfit, 25% in Nablus, 21.8% in Qalqilia, 15% in Tulkarm, 12.9% in Jenin, and 4.2% in Tubas). There were no differences among types of locality in percentage of patients with diabetes but differences were found (P = 0.04) in percentages of cancer patients with hypertension (45.3% of patients in refugee camps, 33.6% of patients in urban areas, and 30.9% of patients in rural areas)

3.12: Sport Activity

Frequency of sporting activity among cancer patients was low. It was found that 85% of patients who responded to the complementary questionnaire didn't practice sport. Only 2% of patients practiced sport daily, 5% practiced twice per week and 4% of them practiced sports once a week.

3.13 List of Tables

Table (3. 1): Number of new cancer cases in Northern West Bank by governorate and type of locality for the period of 2005-2008.

Type Of Locality													
	Camp				**Rural**				**Urban**				**Total**
Governorate	**2005**	**2006**	**2007**	**2008**	**2005**	**2006**	**2007**	**2008**	**2005**	**2006**	**2007**	**2008**	
Males													
Jenin	0	0	0	2	2	5	4	9	4	4	15	15	60
Nablus	11	13	7	10	14	25	18	18	30	32	45	46	269
Qalqiliya	N.A	N.A	N.A	N.A	5	1	5	3	9	5	12	9	49
Selfit	N.A	N.A	N.A	N.A	5	7	3	5	2	1	0	2	25
Tubas	0	0	1	0	0	0	1	0	1	0	5	5	13
Tulkarm	5	2	1	2	1	3	7	7	10	10	18	19	85
All governorates	**16**	**15**	**9**	**14**	**27**	**41**	**38**	**42**	**56**	**52**	**95**	**96**	**501**
Females													
Jenin	0	0	1	1	0	3	7	3	6	13	7	18	59
Nablus	8	13	7	10	8	12	24	14	28	37	45	44	250
Qalqiliya	N.A	N.A	N.A	N.A	4	0	4	4	15	11	10	14	62
Selfit	N.A	N.A	N.A	N.A	4	4	10	6	4	4	1	3	36
Tubas	0	0	0	0	0	0	0	0	7	2	3	2	14
Tulkarm	5	2	1	6	2	7	5	9	10	13	26	29	115
All governorates	**13**	**15**	**9**	**17**	**18**	**26**	**50**	**36**	**70**	**80**	**92**	**110**	**536**
Total	**29**	**30**	**18**	**31**	**45**	**67**	**88**	**78**	**126**	**132**	**187**	**206**	**1037**

Table (3.2): Crude and age-adjusted incidence rates of cancer in Northern West Bank for the years 2005-2008.

Year	Crude incidence rate per 100 000 (95% CI)			Age-adjusted incidence rate per 100 000 (95% CI)		
	Males	Females	Both	Males	Females	Both
2005	21.1 (16.9, 25.2)	22.3 (17.9, 26.6)	21.7 (18.7, 24.7)	21.1 (16.9, 25.3)	22.28 (18.3, 26.2)	20.0 (17.3, 22.8)
2006	23.0 (18.6, 27.3)	26.7 (21.9, 31.4)	24.8 (21.6, 28.0)	23.3 (18.9, 27.7)	23.3 (19.2, 27.5)	22.7 (19.7, 25.6)
2007	30.2 (25.2, 35.2)	33.3 (28.0, 38.6)	31.7 (28.1, 35.4)	30.7 (25.6, 35.8)	28.8 (24.2, 33.5)	29.1 (25.8, 32.5)
2008	32.3 (27.2, 37.5)	36 (30.4, 41.5)	34.1 (30.3, 37.9)	32.5 (27.3, 37.7)	31.7 (26.8, 36.5)	31.3 (27.8, 34.8)
All years	106.5 (97.2, 115.9)	118.2 (108.2, 128.2)	112.7 (105.8,119.6)	107.6 (98.2, 117.1)	104.0 (95.1, 112.8)	104.4 (98.0, 110.7)
Average over years	26.6	29.57	28.1	26.9	26.52	26.7

Table (3.3): Crude and age-adjusted incidence rates of cancer in Northern governorates of the West Bank for the years 2005-2008.

Governorate	Year				Average
	2005	2006	2007	2008	
	Crude incidence rates per 100 000 (95% CI)				
JEN	4.76 (2.1,7.5)	9.92 (6.0, 13.8)	13.5 (9.0,18.0)	19.0 (13.7,24.4)	11.8
NAB	31.3 (25.2,37.5)	41.8 (34.7, 48.9)	46.2 (38.7,53.7)	44.9 (37.6,52.3)	41.1
QAL	35.6 (23.4,47.7)	18.3 (9.6, 27.0)	33.4 (21.7,45.2)	32.3 (20.8,43.9)	29.9
SAL	27.5 (12.7,38.8)	27.5 (14.0, 41.0)	24.1 (11.5,36.7)	27.5 (14.0,41.0)	26.7
TUB	16.6 (5.1,28.1)	4.2 (-1.6, 9.9)	20.8 (7.9,33.6)	14.5 (3.8,25.3)	14.0
TUL	20 (13.4,27.5)	24 (16.0, 31.3)	37 (27.5,46.6)	46 (35.4,56.6)	31.8
	Age adjusted incidence rates per 100 000 (95% CI)				
JEN	9.1 (5.4,12.7)	9.4 (5.7,13.1)	12.8 (8.5,17.1)	18.2 (13.0,23.3)	12.4
NAB	28.5 (22.9,34.1)	37.5 (31.1,44.0)	41.6 (34.8,48.3)	40.5 (33.8,47.1)	37.0
QAL	36.6 (23.9,49.3)	18.4 (9.4,27.5)	33.5 (21.5,45.6)	32.6 (20.7,44.6)	30.3
SAL	24.7 (12.1,37.2)	25.9 (13.2,38.7)	22 (10.4,33.6)	25.9 (13.1,38.7)	24.6
TUB	17 (5.1,28.2)	4 (1.7,10.2)	21 (7.7,33.3)	14 (3.7,25.2)	14.0
TUL	18 (11.8,24.4)	21 (14.0,27.3)	32 (24.0,40.7)	40 (30.5,48.9)	27.8

Table (3.4): Crude and age-adjusted incidence rates of cancer in Northern West Bank by year and type of locality.

Governorate	Year				Average
	2005	2006	2007	2008	
	Crude incidence rate per 100 000 (95% CI)				
Rural	13.8 (9.8 , 17.9)	20.6 (15.7 , 25.5)	27.0 (21.4 , 32.7)	47 (23.9 , 69.9)	27.1
Urban	23.6 (19.4,27.7)	24.7 (20.5 , 28.9)	35.0 (29.9 , 40.0)	46 (32.7 , 58.4)	27.9
Refugee camps	45.8 (29.1,62.5)	47.4 (30.4 , 64.4)	28.4 (15.3 , 41.6)	47 (14.5 , 79.7)	42.2
	Age adjusted incidence rate per 100 000 (95% CI)				
Rural	13.0 (9.2 , 16.9)	18.7 (14.2 , 23.2)	25.5 (20.1 , 30.8)	40 (28.1 , 50.4)	24.3
Urban	21.4 (17.7 , 25.1)	22.4 (18.5 , 26.2)	31.6 (27.1 , 36.1)	39 (20.5 , 60.2)	28.6
Refugee camps	44.7 (28.3 , 61.1)	46.3 (29.6 , 63.0)	28.3 (15.2 , 41.5)	49 (14.7 , 82.4)	42.1

Table (3.5): Cancer incidence rate ratios (IRR) from the negative binomial regression analysis

	IRR(Wald 95%CI)	Wald's $\chi 2$	P value
Age Group			
<40	Ref		
40-49	9.66 (7.6 , 12.27)	343.04	< 0.0001
50- 59	21.78 (17.3 , 27.4)	689.38	< 0.0001
60-69	36.69 (29.13 , 46.21)	937.12	< 0.0001
>70	45.98 (36.65 , 57.69)	1094.64	< 0.0001
Gender			
Females	Ref		
Males	1.01 (0.87 , 1.16)	0.01	0.92
Year			
2005	Ref		
2006	1.13 (0.91 , 1.46)	1.17	0.2791
2007	1.43 (1.17 , 1.76)	11.7	0.0006
2008	1.58 (1.28 , 1.93)	19.07	< 0.0001
Governorate			
Jenin	Ref		
Nablus	3.3 (2.64 , 4.13)	109.8	< 0.0001
Qalqiliyia	2.59 (1.95 , 3.43)	43.65	< 0.0001
Selfit	2.46 (1.77 , 3.42)	28.93	< 0.0001
Tubas	1.13 (0.73 , 1.74)	0.29	0.5903
Tulkarm	2.34 (1.82 , 3.01)	44.51	< 0.0001
Type of locality			
Camp	Ref		
Urban	0.74 (0.59 , 0.92)	7	0.0082
Rural	0.51 (0.4 , 0.66)	27.77	< 0.0001

Table (3.6): Number of new diagnosed cases and crude incidence rates of cancer types in Northern West Bank for the period 2005-2008.

Cancer Type	New cases(Percentage)			Crude Incidence rate		
	Males	Females	All	Males	Females	All
Bladder	66 (13.2%)	16(3%)	82(7.9%)	14.0	3.5	8.9
Bone	4 (0.8%)	4(0.75%)	8(0.77)	0.9	0.9	0.9
Breast	2 (0.4%)	204(38.1%)	206(19.9%)	0.4	45	22.4
Cervical	0 (0)	13(2.4%)	13(1.3%)	0	2.9	1.4
Colorectal	78 (15.6%)	78(14.6%)	156(15%)	16.6	17.2	17
Esophagus	4 (0.8%)	11(2.1%)	15(1.4%)	0.9	2.4	1.6
Head-Brain	49 (9.8)	23(4.3%)	72(6.9%)	10.4	5.1	7.8
Kidney	7 (1.4%)	8(1.5%)	15(1.4%)	1.5	1.8	1.6
Larynx	15 (3%)	0(0)	15(1.4%)	3.2	0	1.6
Liver	15 (3%)	16(3%)	31(3%)	3.2	3.5	3.4
Lung	65 (13%)	20(3.7%)	85(8.2%)	13.8	4.4	9.2
Nasopharynx	8 (1.6%)	0(0)	8(0.77%)	1.7	0	0.9
Neck	6 (1.2%)	5(0.93%)	11(1.2%)	1.3	1.1	1.2
Ovary	0 (0)	29(5.4%)	29(2.8%)	0	6.4	3.2
Pancreas	15 (3%)	13(2.4%)	28(2.7%)	3.2	2.9	3.0
Prostate	58 (11.6%)	0(0)	58(5.6%)	12.3	0	6.3
Skin	21 (4.2%)	5(0.93%)	26(2.5%)	4.5	1.1	2.8
Stomach	30 (6%)	17(3.2%)	47(4.5%)	6.4	3.8	5.1
Testicular	9 (1.8%)	0(0)	9(0.9%)	1.9	0	0.98
Thyroid	13 (2.6%)	14(2.6%)	27(2.6%)	2.8	3.1	2.9
Uterus	0 (0)	32(6%)	32(3.1%)	0	7.1	3.5
Other types	36 (7.2%)	28(5.2%)	64(6.2%)	7.7	6.2	7.0

Table (3.7): Number of new cancer cases in Northern West Bank for the period 2005-2008 by cancer type, governorate and gender

Cancer Type	Jenin		Nablus		Qalqiliyia		Salfit		Tubas		Tulkarm	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Bladder	6(10%)	3(5.1%)	33(12.3%)	7(2.8%)	9(18.6%)	2(3.2%)	4(16%)	2(5.6%)	0(0)	0(0)	14(16.5%)	2(1.7%)
Bone	0(0)	0(0)	2(0.7%)	3(1.2%)	2(4.1%)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(0.9%)
Breast	0(0)	15(25.4%)	1(0.4%)	106(42.4%)	1(2%)	16(25.8%)	0(0)	17(47.2%)	0(0)	7(50%)	0(0)	43(37.4%)
Cervical	0(0)	2(3.4%)	0(0)	9(3.6%)	0(0)	0(0)	0(0)	1(2.7%)	0(0)	0(0)	0(0)	1(0.9%)
Colorectal	9(15%)	7(15.3%)	40(14.9%)	37(14.8%)	10(20%)	10(16.1%)	6(24%)	4(11.1%)	2(15.4%)	0(0)	11(12.%)	20(17.4%)
Esophagus	1(1.7%)	3(5.1%)	3(1.1%)	7(2.8%)	0(0)	0(0)	0(0)	0(0)	0(0)	1(7.1%)	0(0)	0(0)
Head-Brain	4(6.7%)	2(3.4%)	25(9.3%)	7(2.8%)	4(8.2%)	7(11.3%)	1(4%)	1(2.7%)	1(7.7%)	0(0)	14(16.5%)	6(5.2%)
Kidney	0(0)	2(3.4%)	3(1.1%)	3(1.2%)	2(4.1%)	1(1.6%)	0(0)	0(0)	1(7.7%)	1(7.1%)	1(1.2%)	1(0.9%)
Larynx	3(5%)	0(0)	6(2.2%)	0(0)	1(2%)	0(0)	0(0)	0(0)	0(0)	0(0)	5(5.9%)	0(0)
Liver	5(8.3%)	2(3.4%)	7(2.6%)	8(3.2%)	1(2%)	3(4.8%)	0(0)	1(2.7%)	1(7.7%)	0(0)	1(1.2%)	2(1.7%)
Lung	7(11.7%)	2(3.4%)	42(15.6%)	10(4%)	6(12%)	2(3.2%)	2(8%)	1(2.7%)	1(7.7%)	0(0)	7(8.2%)	5(4.3%)
Nasopharynx	0(0)	0(0)	7(2.6%)	0(0)	0(0)	0(0)	1(4%)	0(0)	0(0)	0(0)	0(0)	0(0)
Neck	0(0)	0(0)	4(1.5%)	3(1.2%)	0(0)	0(0)	0(0)	1(2.7%)	0(0)	0(0)	2(2.4%)	1(0.9%)
Ovary	0(0)	5(8.5%)	0(0)	12(4.8%)	0(0)	5(8.1%)	0(0)	0(0)	0(0)	0(0)	0(0)	7(6.1%)
Pancreas	1(1.7%)	5(8.5%)	8(3%)	6(2.4%)	3(6.1%)	0(0)	2(8%)	0(0)	0(0)	0(0)	1(1.2%)	2(1.7%)
Prostate	7(11.7%)	0(0)	38(14%)	0(0)	1(2%)	0(0)	2(8%)	0(0)	2(15.4%)	0(0)	8(9.4%)	0(0)
Skin	3(5%)	0(0)	12(4.5%)	2(0.8%)	2(4.1%)	1(1.6%)	2(8%)	1(2.7%)	0(0)	0(0)	2(2.4%)	1(0.9%)
Stomach	6(10%)	3(5.1%)	13(4.8%)	6(2.4%)	1(2%)	3(4.8%)	3(12%)	1(2.7%)	2(15.4%)	0(0)	5(5.9%)	4(3.5%)
Testicular	2(3.3%)	0(0)	5(1.9%)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	2(2.4%)	0(0)
Thyroid	1(1.7%)	0(0)	5(1.9%)	5(2%)	2(4.1%)	4(6.5%)	0(0)	0(0)	1(7.7%)	1(7.1%)	4(4.7%)	4(3.5%)
Uterus	0(0)	7(15.3%)	0(0)	5(2%)	0(0)	5(8.1%)	0(0)	3(8.3%)	0(0)	1(7.1%)	0(0)	11(9.6%)
Other types	5(8.3%)	1(1.7%)	15(5.6%)	14(5.6%)	4(8.2%)	3(4.8%)	2(8%)	3(8.3%)	2(15.4%)	3(21.4%)	8(22.2%)	4(3.5%)

Table (3.8): Crude incidence rates (and 95% CI) of cancer types by governorate

	Governorate						
	Jenin	**Nablus**	**Qalqiliya**	**Selfit**	**Tubas**	**Tulkarm**	**Total**
Bladder	3.57(1.2,5.9)	12.66(8.7,16.6)	11.86(4.9,18.9)	10.31(2.1,18.6)	0.00	10.23(5.2,15.2)	8.88(7.0,10.8)
Bone	0.00	1.58(0.2,3.0)	2.16(-0.8,5.1)	0.00	0.00	0.64(-0.6,1.9)	0.87(0.3,1.5)
Breast	5.95(2.9,9.0)	33.87(27.4,40.3)	18.33(9.6,27.0)	29.21(15.3,43.1)	14.53(3.4,25.3)	27.48(19.3,35.7)	22.3(19.3,25.3)
Cervical	0.79(-0.3,1.9)	2.85(1.0,4.7)	0.00	1.72(-1.6,5.1)	0.00	0.64(-0.6,1.9)	1.41(0.6,2.2)
Colorectal	6.35(3.2,9.5)	24.37(18.9,29.8)	21.56(12.1,31.0)	17.18(6.5,27.8)	4.15(-1.6,9.9)	19.81(12.8,26.8)	16.89(14.2,19.5)
Esophagus	1.59(0.0,3.1)	3.16(1.2,5.1)	0.00	0.00	2.08(-2.0,6.1)	0.00	1.62(0.8,2.4)
Head-Brain	2.38(0.5,4.3)	10.13(6.6,13.6)	11.86(4.9,18.9)	3.44(-1.3,8.2)	2.08(-2.0,6.1)	12.78(7.2,18.4)	7.80(6.0,9.6)
Kidney	0.79(-0.3,-0.2)	1.90(0.4,3.4)	3.23(-0.4,6.9)	0.00	4.15(-1.6,9.9)	1.28(-0.5,3.0)	1.62(0.8,2.4)
Larynx	1.19(-0.2,2.5)	1.90(0.4,3.4)	1.08(-1.0,3.2)	0.00	0.00	3.20(0.4,6.0)	1.62(0.8,2.4)
Liver	2.78(0.7,4.8)	4.75(2.3,7.2)	4.31(0.1,8.5	1.72(-1.6,5.1)	2.08(-2.0,6.1)	1.92(-0.3,4.1)	3.36(2.2,4.5)
Lung	3.57(1.2,5.9)	16.46 (12.0,20.9)	8.63(2.6,14.6)	5.15	2.08(-2.0,6.1)	7.67(3.3,12.0)	9.20(7.2,11.2)
Nasopharynx	0.00	2.22(0.6,3.9)	0.00	1.72(-1.6,5.1)	0.00	0.00	0.87(0.3,1.5)
Neck	0.00	2.22(0.6,3.9)	0.00	1.72(-1.6,5.1)	0.00	1.92(-0.3,4.1)	1.19(0.5,1.9)
Ovary	1.98(0.2,3.7)	3.80(1.6,5.9)	5.39(0.7,10.1)	0.00	0.00	4.47(1.2,7.8)	3.14(2.0,4.3)
Pancreas	2.38(0.5,4.3)	4.43(2.1,6.8)	3.23(-0.4,6.9)	3.44(-1.3,8.2)	0.00	1.92(-0.3,4.1)	3.03(1.9,4.2)
Prostate	2.78(0.7,4.8)	12.03(8.2,15.9)	1.08(-1.0,3.2)	3.44(-1.3,8.2)	4.15(-1.6,9.9)	5.11(1.6,8.7)	6.28(4.7,7.9)
Skin	1.19(-0.2,2.5	4.43(2.1,6.8)	3.23(-0.4,6.9)	5.15(-0.7,11.0)	0.00	1.92(-0.3,4.1)	2.81(1.7,3.9)
Stomach	3.57(1.2,5.9)	6.01(3.3,8.7)	4.31(0.1,8.5)	6.87(0.1,13.6)	4.15(-1.6,9.9)	5.75(2.0,9.5)	5.09(3.6,6.5)
Testicular	0.79(-0.3,1.9)	1.58(0.2,3.0)	0.00	0.00	0.00	1.28(-0.5,3.0)	0.97(0.3,1.6)
Thyroid	0.40(-0.4,1.2)	3.16(1.2,5.1)	6.47(1.3,11.6)	0.00	4.15(-1.6,9.9)	5.11(1.6,8.7)	2.92(1.8,4.0)
Uterus	2.78(0.7,4.8)	1.58(0.2,3.0)	5.39(0.7,10.1)	5.15(-0.7,11.0)	2.08(-2.0,6.1)	7.03(2.9,11.2)	3.46(2.3,4.7)
Other types	2.38(0.5,4.3	9.18(5.8,12.5)	7.55(2.0,13.1)	8.59(1.1,16.1)	10.38(1.3,19.5)	7.67(3.3,12.0)	6.93(5.2,8.6)

Table (3.9.): Number of new cases in Northern West Bank by cancer type, type of locality and gender.

Cancer Type	Urban			Rural			Camp		
	Male	Female	Both	Male	Female	Both	Male	Female	Both
Bladder	39	9	**48**	18	6	**24**	9	1	**10**
Bone	2	0	**2**	1	3	**4**	1	1	**2**
Breast	2	129	**131**	0	54	**54**	0	21	**21**
Cervical	0	9	**9**	0	3	**3**	0	1	**1**
Colon-rectal	46	50	**96**	21	18	**39**	11	10	**21**
Esophagus	2	11	**13**	2	0	**2**	0	0	**0**
Head-Brain	32	14	**46**	11	6	**17**	6	3	**9**
Kidney	6	4	**10**	1	4	**5**	0	0	**0**
Larynx	6	0	**6**	7	0	**7**	2	0	**2**
Liver	9	13	**22**	4	2	**6**	2	1	**3**
Lung	37	12	**49**	22	6	**28**	6	2	**8**
Nasopharynx	3	0	**3**	3	0	**3**	2	0	**2**
Neck	4	5	**9**	2	0	**2**	0	0	**0**
Ovary	0	19	**19**	0	7	**7**	0	3	**3**
Pancreas	8	9	**17**	5	2	**7**	2	2	**4**
Prostate	38	0	**38**	13	0	**13**	7	0	**7**
Skin	11	2	**13**	10	1	**11**	0	2	**2**
Stomach	18	12	**30**	9	4	**13**	3	1	**4**
Testicular	6	0	**6**	3	0	**3**	0	0	**0**
Thyroid	7	11	**18**	6	3	**9**	0	0	**0**
Uterus	0	26	**26**	0	3	**3**	0	3	**3**
Other types	23	17	**40**	10	8	**18**	3	3	**6**

Table (3.10): Crude incidence rates(and 95% CI) of cancer types by type of locality for the period 2005-2008.

Type of locality			
	Urban	**Rural**	**Camp**
Bladder	8.97(6.4,11.5)	7.37(4.4,10.3)	15.80(6.0,25.6)
Bone	0.37(-0.1,0.9)	1.23(0.0,2.4)	3.16(-1.2,7.5)
Breast	24.49(20.3,28.7)	16.59(12.2,21.0)	33.18(19.0,47.4)
Cervical	1.68(0.6,2,2.8)	0.92(-0.1,1.0)	1.58(-1.5,4.7)
Colorectal	17.95(14.4,21.5)	11.98(8.2,15.7)	33.18(19.0,47.4)
Esophagus	2.43(1.1,3.8)	0.61(-0.2,1.5)	0
Head-Brain	8.60(6.1,11.1)	5.22(2.7,7.7)	14.22(4.9,23.5)
Kidney	1.87(0.7,3.0)	1.54(0.2,2.9)	0
Larynx	1.12(0.2,2.0)	2.15(0.6,3.7)	3.16(-1.2,7.5)
Liver	4.11(2.4,5.8)	1.84(0.4,3.3)	4.74(-0.6,10.1)
Lung	9.16(6.6,11.7)	8.60(5.4,11.8)	12.64(3.9,21.4)
Nasopharynx	0.56(-0.1,1.2)	0.92(-0.1,2.0)	3.16(-1.2,7.5)
Neck	1.68(0.6,2.8)	0.61(-0.2,1.5)	0
Ovary	3.55(2.0,5.1)	2.15(0.6,3.7)	4.74(-0.6,10.1)
Pancreas	3.18(1.7,4.7)	2.15(0.6,3.7)	6.32(0.1,12.5)
Prostate	7.10(4.8,9.4)	3.99(1.8,6.2)	11.06(2.9,19.3)
Skin	2.43(1.1,3.8)	3.38(1.4,5.4)	3.16(-1.2,7.5)
Stomach	5.61(3.6,7.6)	3.99(1.8,6.2)	6.32(0.1,12.5)
Testicular	1.12(0.2,2.0)	0.92(-0.1,2.0)	0
Thyroid	3.37(1.8,4.9)	2.77(1.0,4.6)	0
Uterus	4.86(3.0,6.7)	0.92(-0.1,2.0)	4.74(-0.6,10.1)
Other types	7.48(5.2,9.8)	5.53(3.0,8.1)	9.48(1.9,17.1)

Table (3.11): Number of new cancer cases in Northern West Bank by cancer type and occupation

Cancer Type	Occupation													
	Teacher	Student	Painting	Other	Office Work	None	Crafter	Baking and Resturation	Farmer	Factory Worker	Engineer	Driver	Business owner	Builder
Bladder	6	0	3	6	5	13	3	2	16	7	3	5	2	11
Bone	0	5	0	0	0	2	0	0	1	0	0	0	0	0
Breast	19	0	0	2	5	164	10	1	2	0	2	0	0	1
Cervical	2	0	0	0	0	11	0	0	0	0	0	0	0	0
Colon-rectal	17	0	1	5	5	67	6	2	20	7	6	6	4	10
Esophagus	2	0	0	2	1	7	0	2	1	0	0	0	0	0
Head-Brain	3	6	1	7	3	23	2	3	11	2	4	2	1	4
Kidney	1	0	1	1	0	7	0	0	2	2	0	0	1	0
Larynx	0	0	1	1	0	0	1	0	6	1	0	0	1	4
Liver	5	0	0	1	1	15	0	1	3	2	0	0	1	2
Lung	7	0	1	9	4	18	1	3	21	5	0	3	2	11
Nasopharynx	1	1	2	2	1	0	0	0	1	0	0	0	0	0
Neck	0	0	0	0	2	6	1	0	0	0	0	2	0	0
Ovary	2	0	0	0	2	22	0	0	2	0	1	0	0	0
Pancreas	0	0	0	5	0	12	1	0	4	1	1	3	0	1
Prostate	4	0	2	3	3	0	0	6	16	5	1	2	6	10
Skin	1	0	0	1	4	5	1	0	7	2	0	3	1	1
Stomach	3	0	2	4	2	13	3	1	10	0	1	4	0	4
Testicular	0	2	0	1	2	0	1	0	1	0	0	1	0	1
Thyroid	0	1	0	2	1	11	1	0	2	5	2	0	0	2
Uterus	4	0	0	1	0	25	1	0	0	0	1	0	0	0
Other types	4	8	1	2	1	27	3	1	9	3	1	3	0	1
Total	81	23	15	55	42	448	35	22	135	42	23	34	19	63

Table (3.12): Relationship of cancer types with family history

Cancer type	% of patients in each cancer type			
	First degree relatives with		First and/or second degree relatives with	
	Same cancer type	Same or different cancer type	Same cancer type	Same or different cancer type
Bladder	7.7	12.3	18.5	29.2
Bone	16.7	16.7	25	37.5
Breast	14.9	27.6	27.6	50.3
Cervical	27.3	36.4	27.3	45.5
Colorectal	21.3	35.4	40.2	59.1
Esophagus	0.0	15.4	15.4	46.2
Head-Brain	14.8	20.6	17.6	39.7
Kidney	8.2	21.4	7.1	42.9
Larynx	11.1	22.2	11.1	33.3
Liver	6.9	13.8	6.9	24.1
Lung	9.5	24.3	17.6	43.2
Nasopharynx	0.0	0.0	0.0	37.5
Neck	22.2	22.2	22.2	22.2
Ovary	11.1	25.9	11.1	40.7
Pancreas	8.7	26.1	13.0	39.1
Prostate	9.6	17.3	21.2	38.5
Skin	8.7	13.0	8.7	30.4
Stomach	13.9	22.2	16.7	30.6
Testicular	0.0	12.5	37.5	62.5
Thyroid	16.0	20.0	28.0	44
Uterus	10.5	26.3	26.3	52.6
Other types	1.8	3.6	7.3	25.5

3.14 List of figures

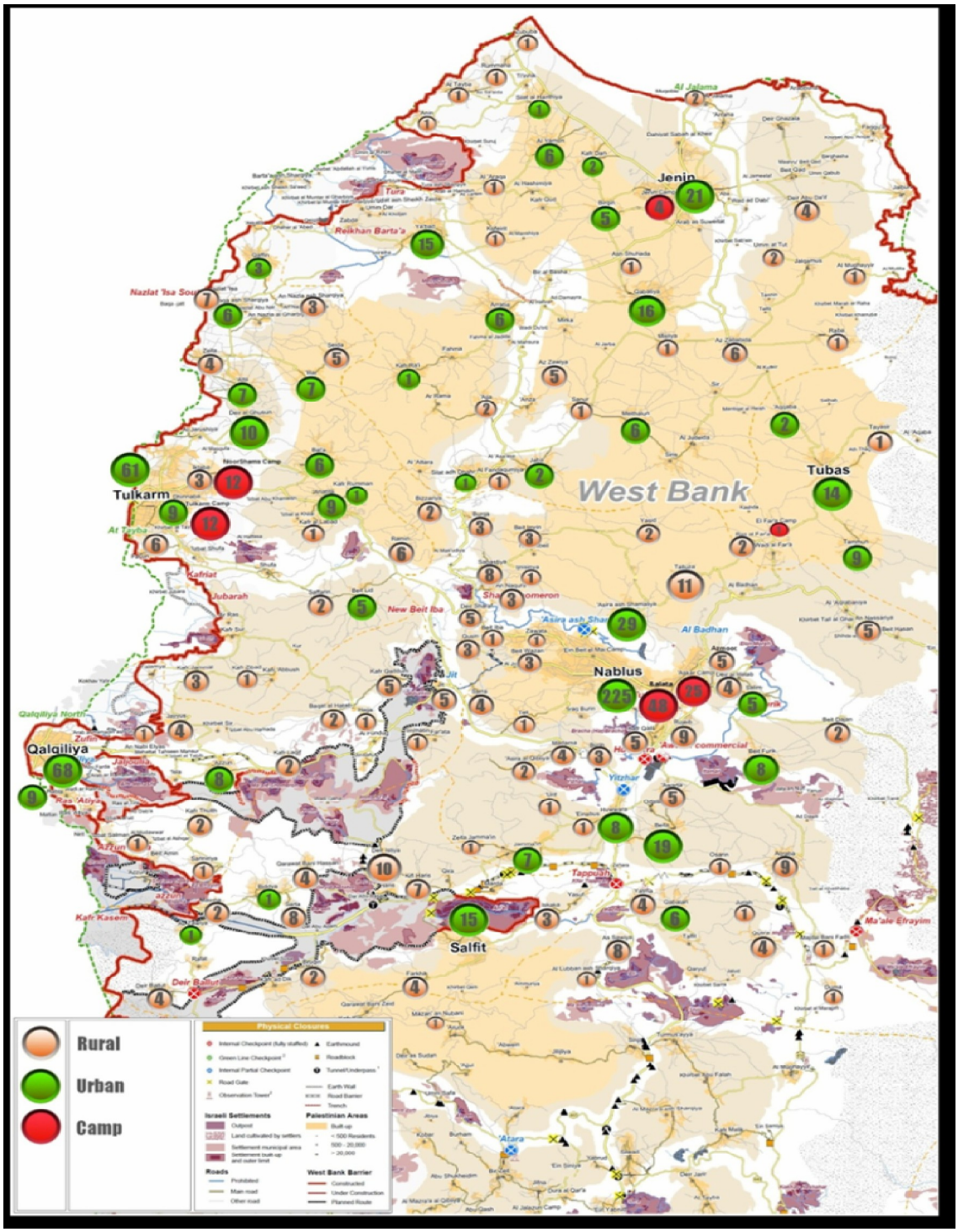

Figure (3.1): Distribution of new cancer cases in Northern West Bank

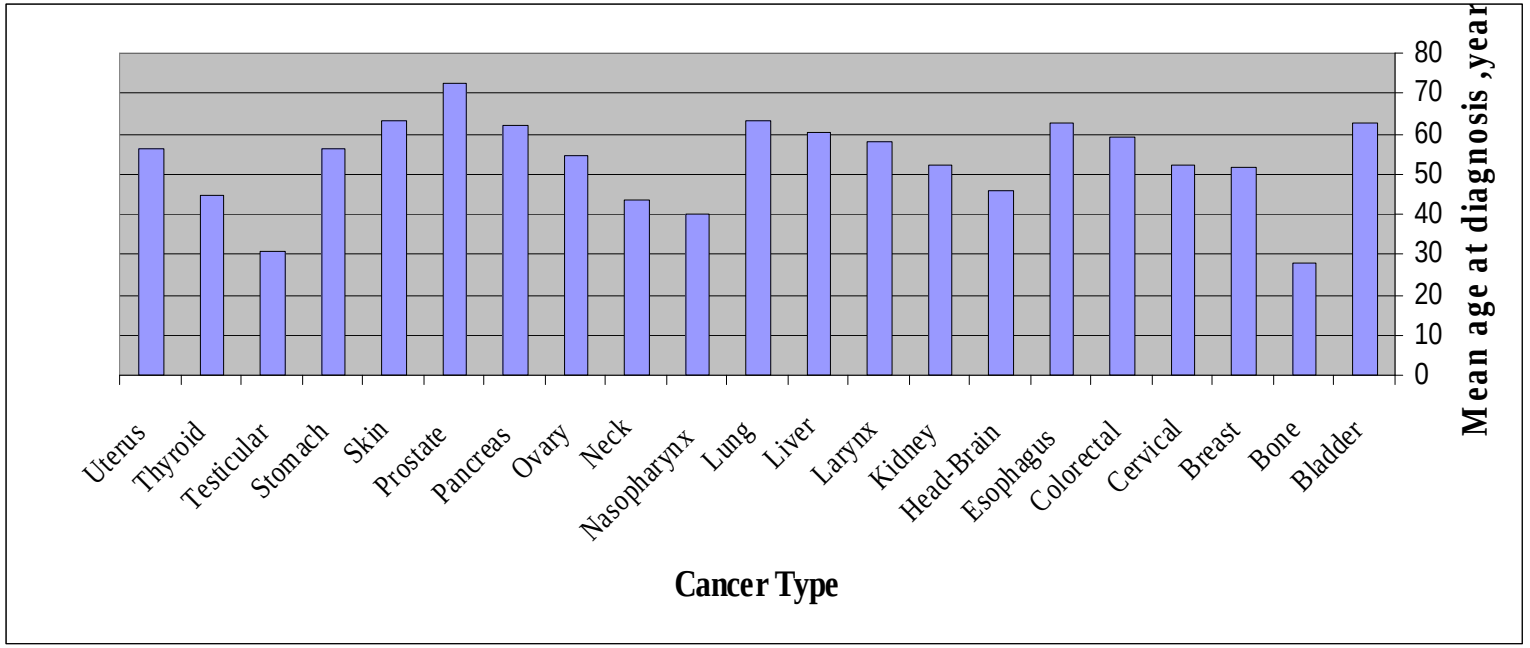

Figure (3.2): Mean age at diagnosis of cancer patients in Northern of West Bank by cancer type

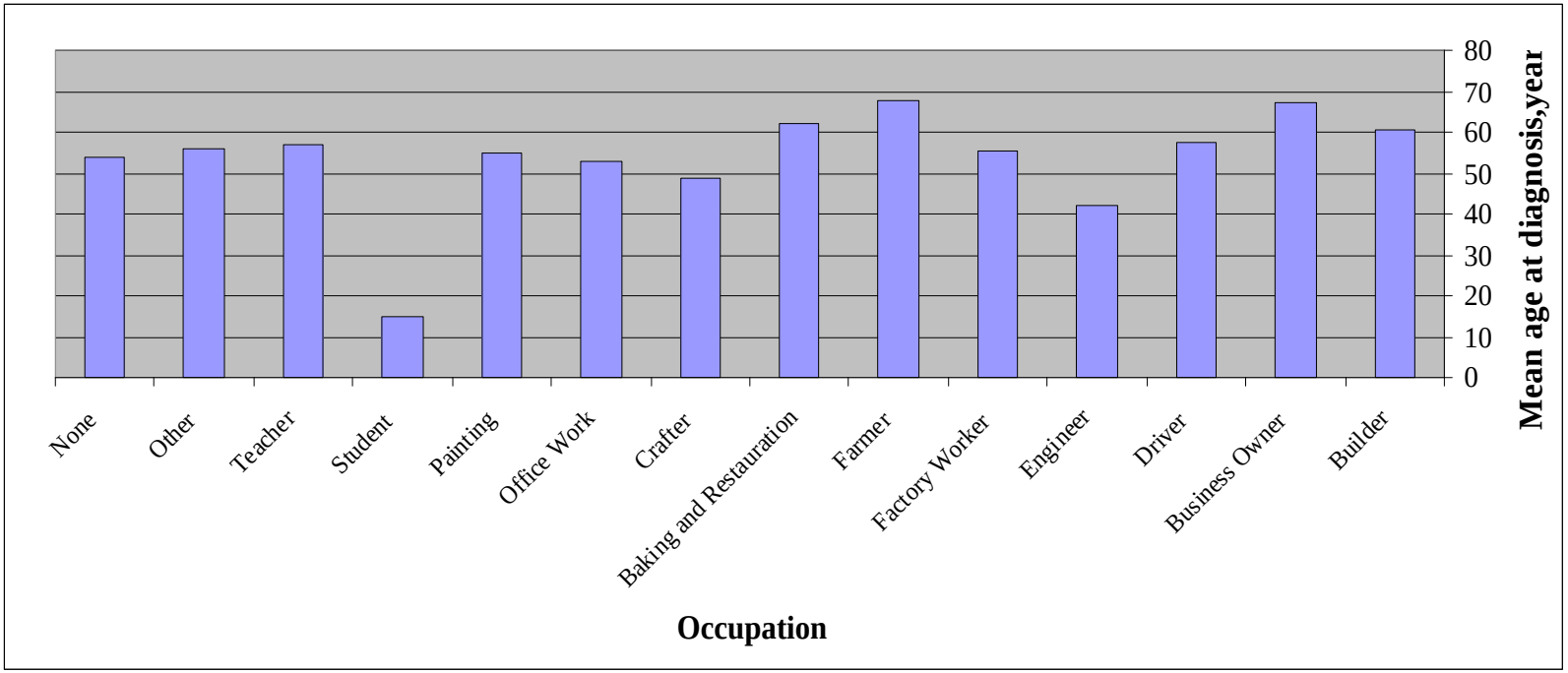

Figure (3.3): Mean age at diagnosis of cancer patients in Northern of West Bank according to occupation

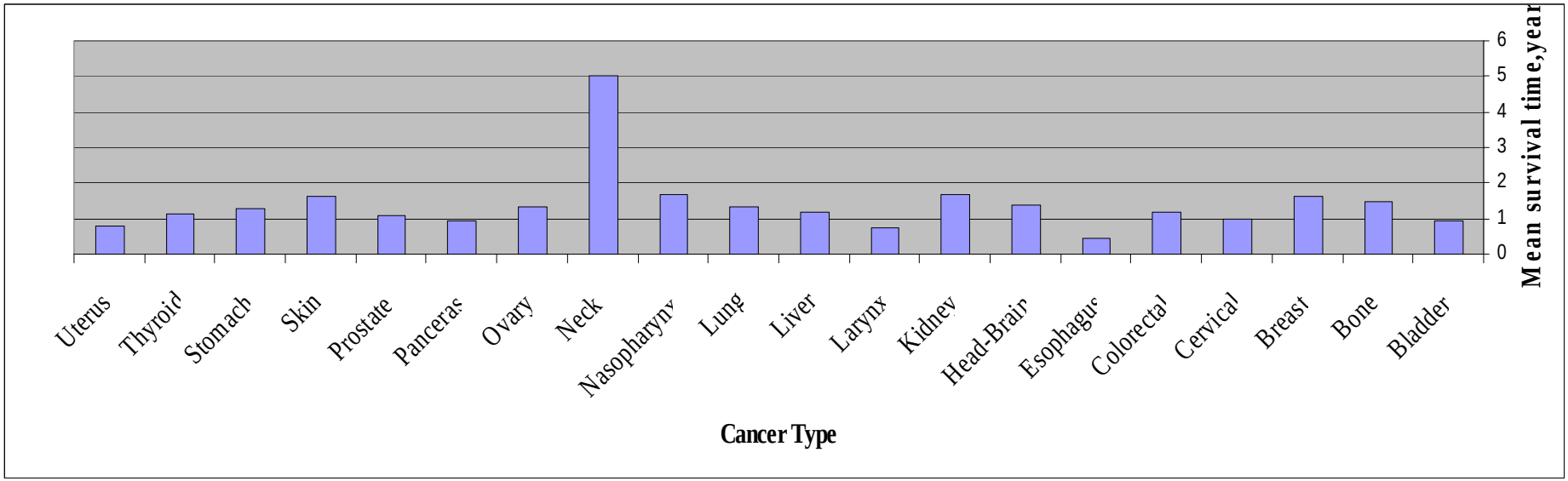

Figure (3.4): Mean survival time of cancer patients in Northern of West Bank by cancer type

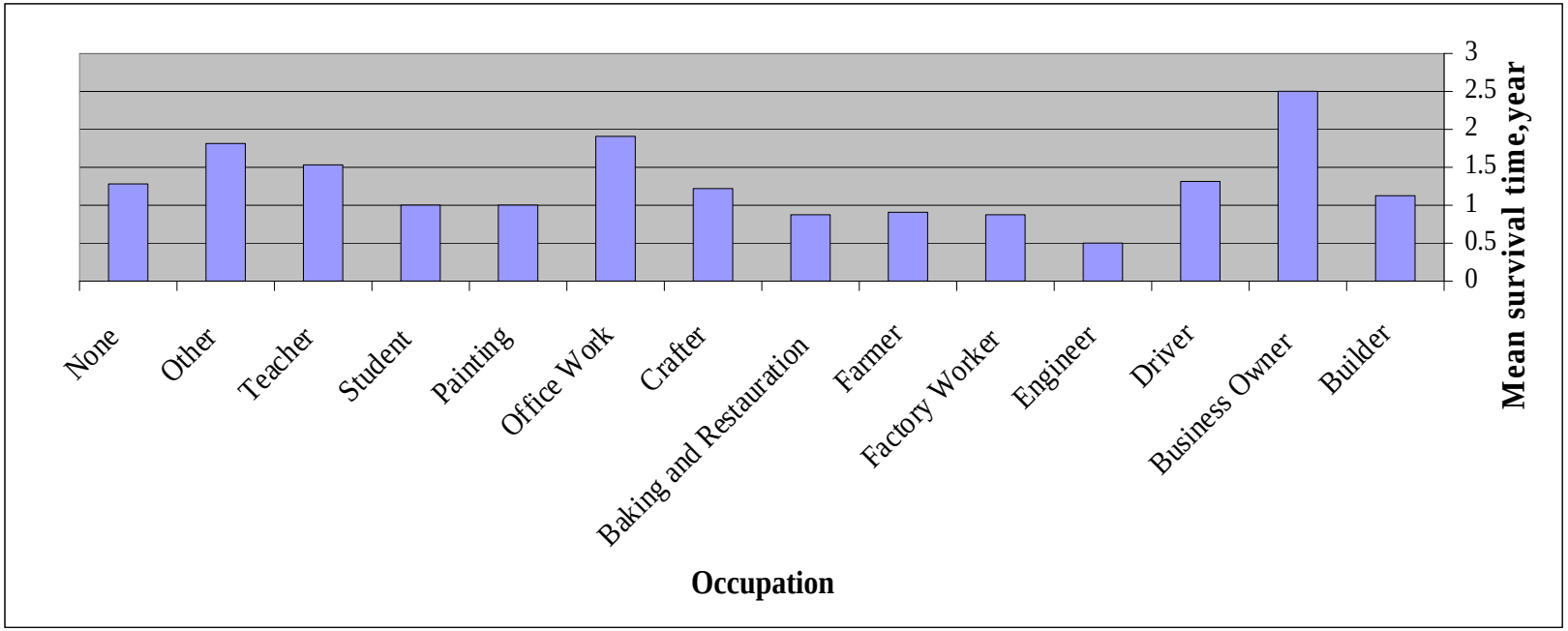

Figure (3.5): Mean survival time of cancer patients in Northern of West Bank according to occupation

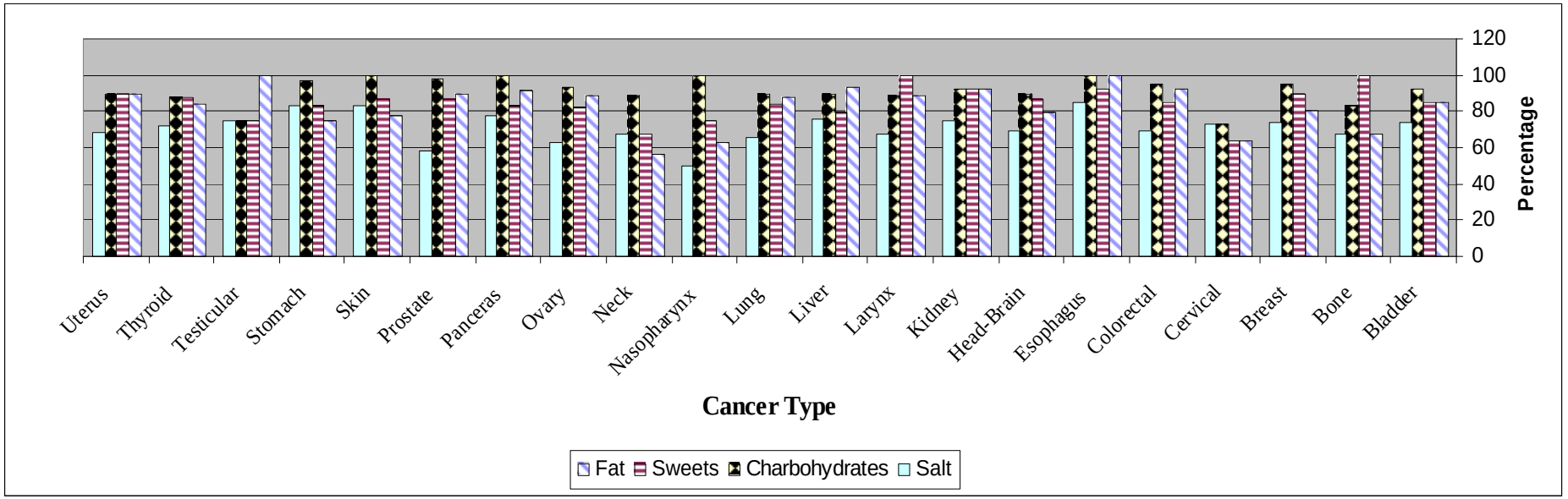

Figure (3.6): Percentage of cancer patients in each cancer type with high consumption of fat, sweets, carbohydrates and salt

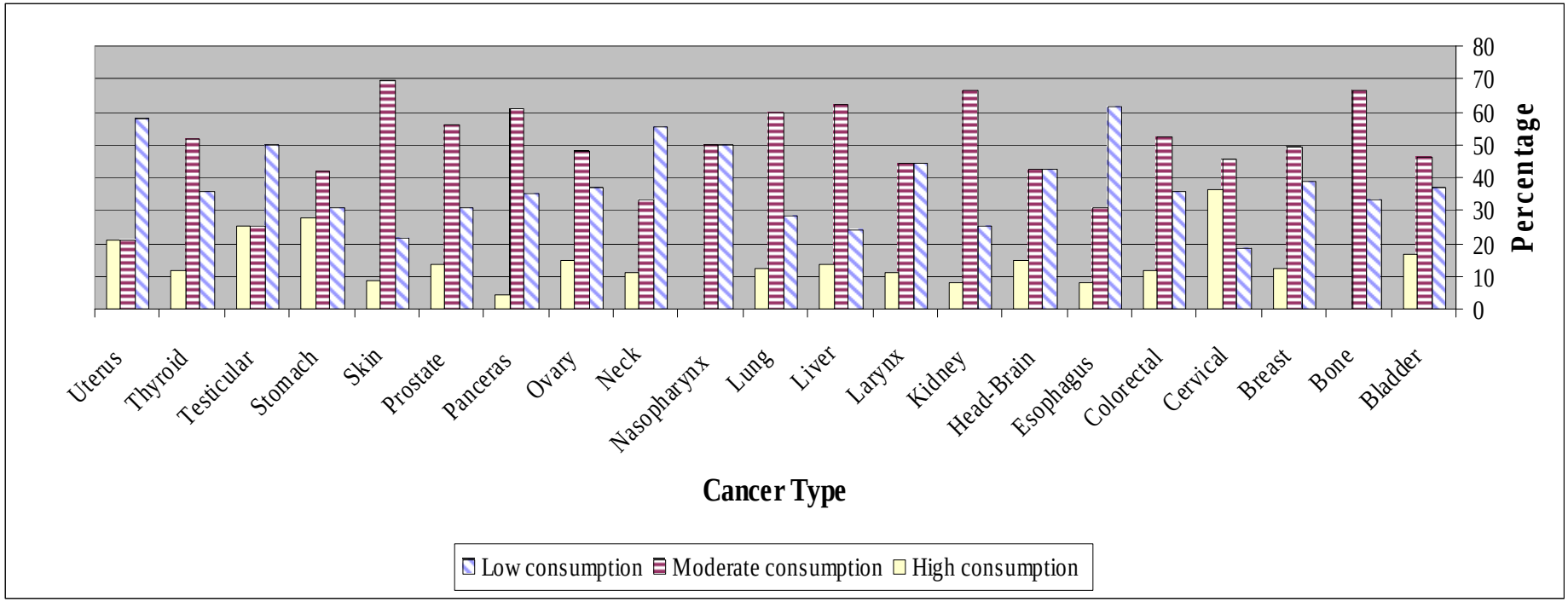

Figure (3.7): Percentage of cancer patients in each cancer type with low, moderate or high consumption of vegetables

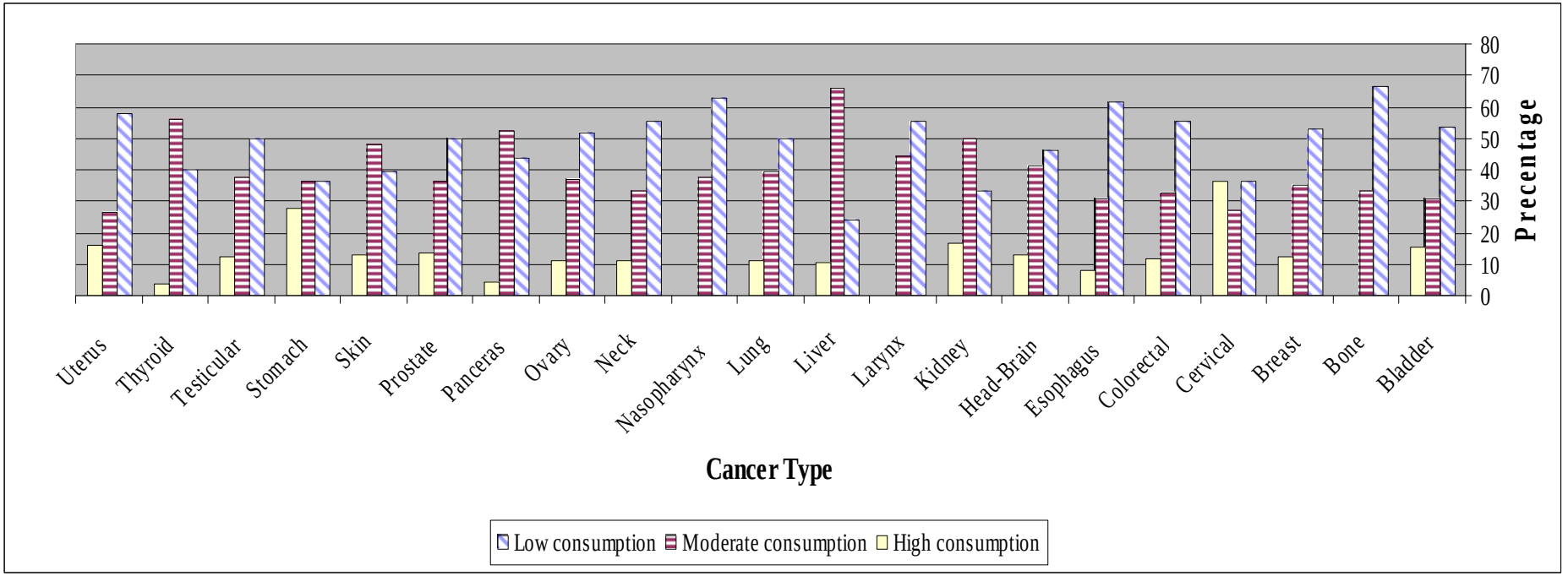

Figure (3.8): Percentage of cancer patients in each cancer type with low, moderate or high consumption of fruits

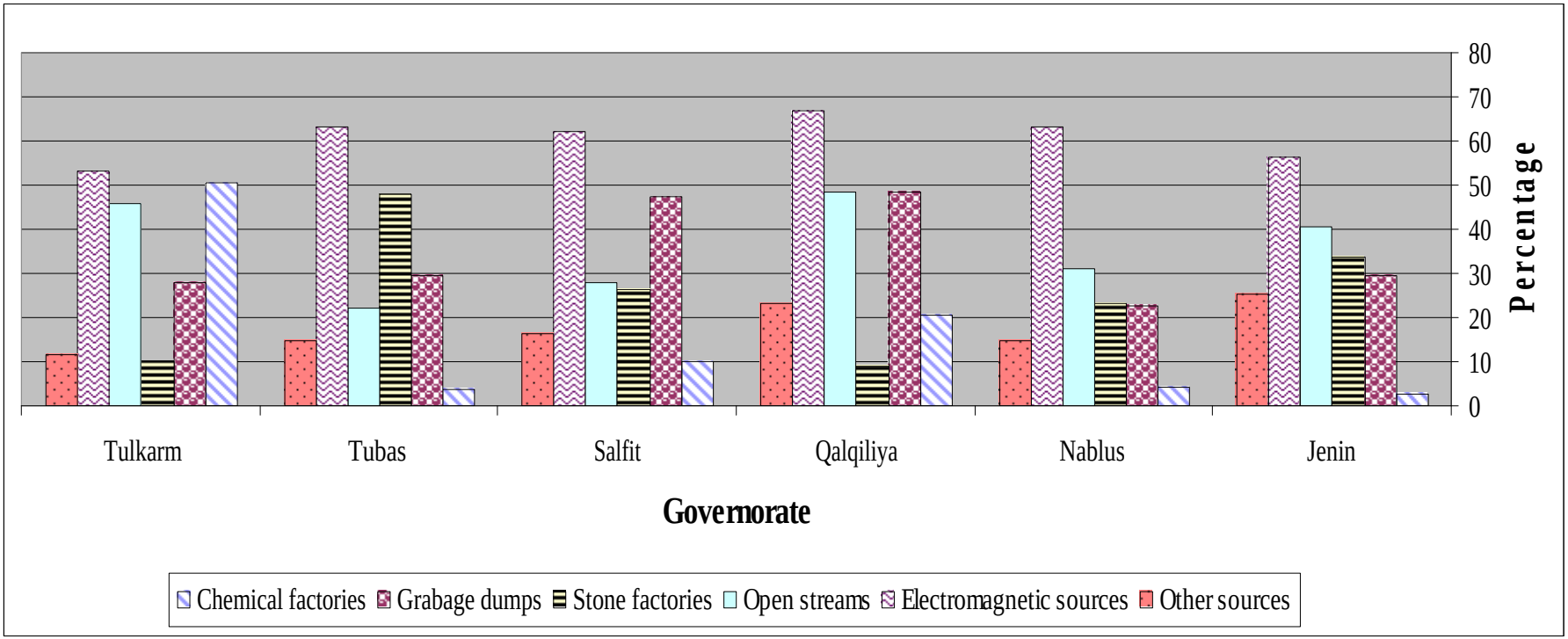

Figure (3.9): Distribution of sources of pollution by governorate

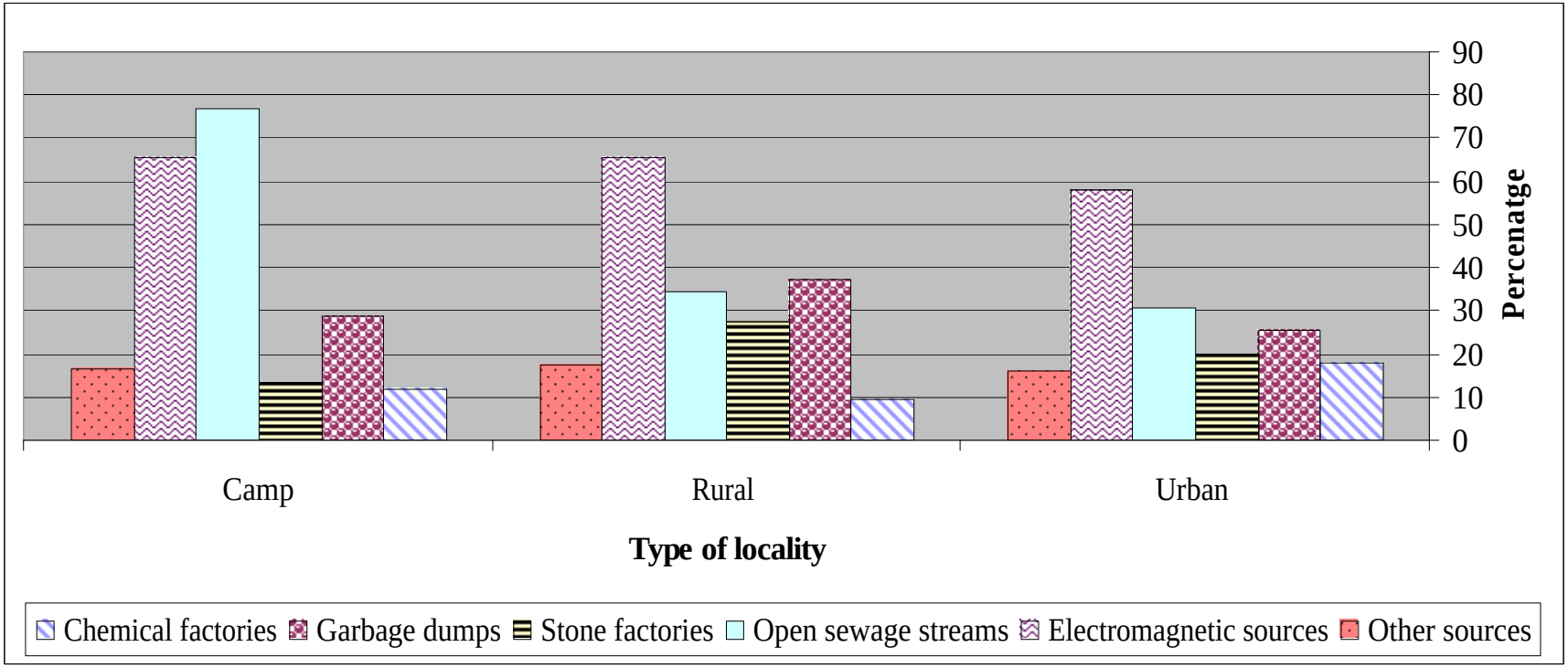

Figure (3.10): Distribution of sources of pollution by type of locality

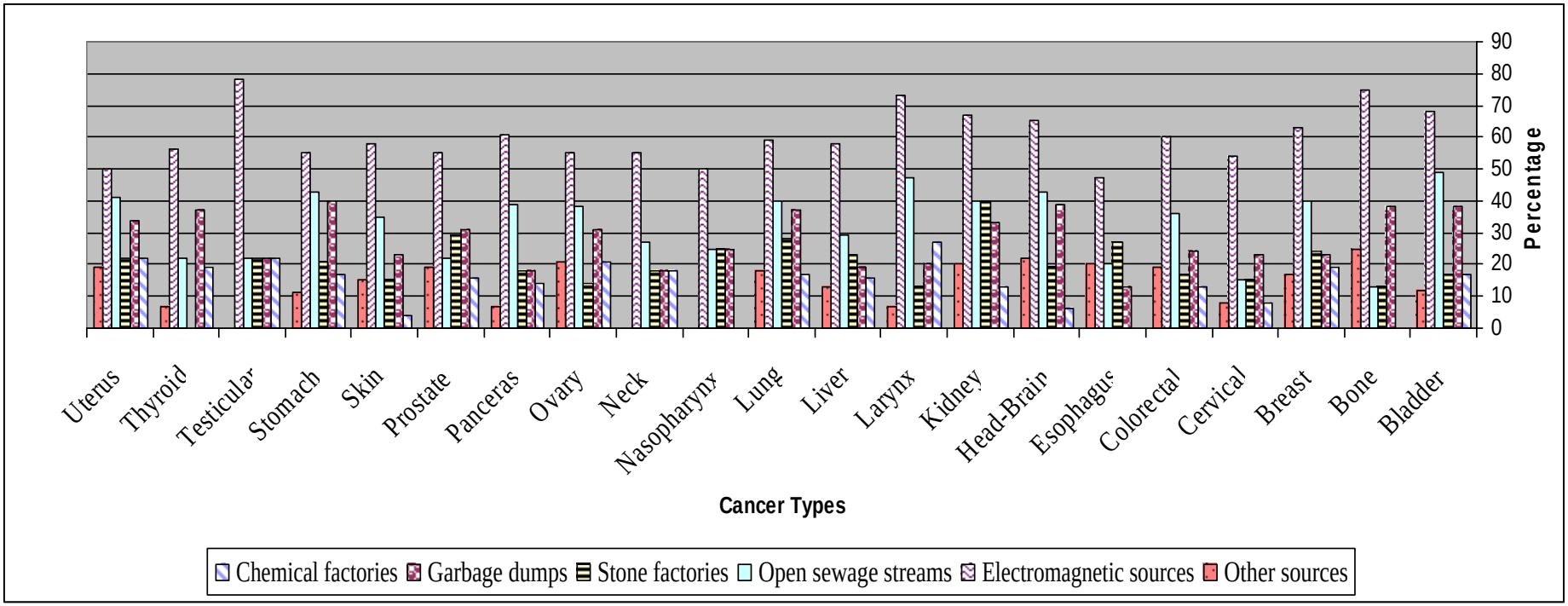

Figure (3.11); Percentage of patients in each cancer type by source of pollution in living area

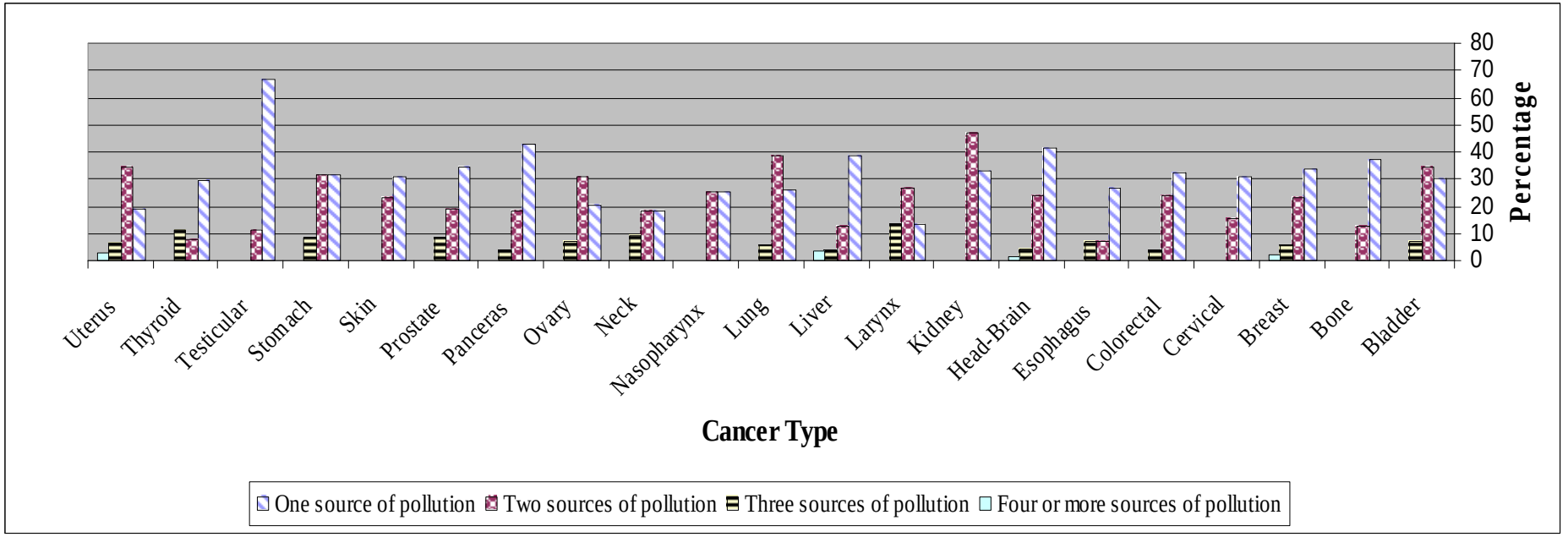

Figure (3.12): Distribution of number of sources of pollution by cancer type.

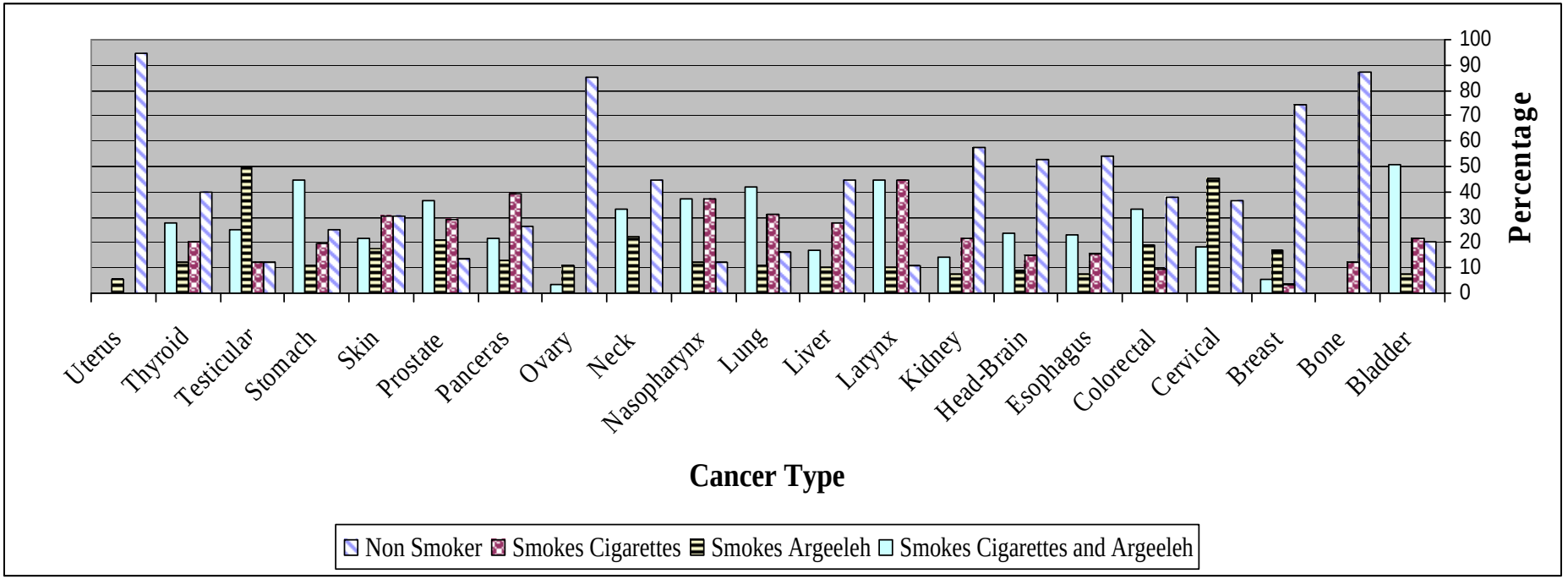

Figure (3.13): Smoking status by cancer type

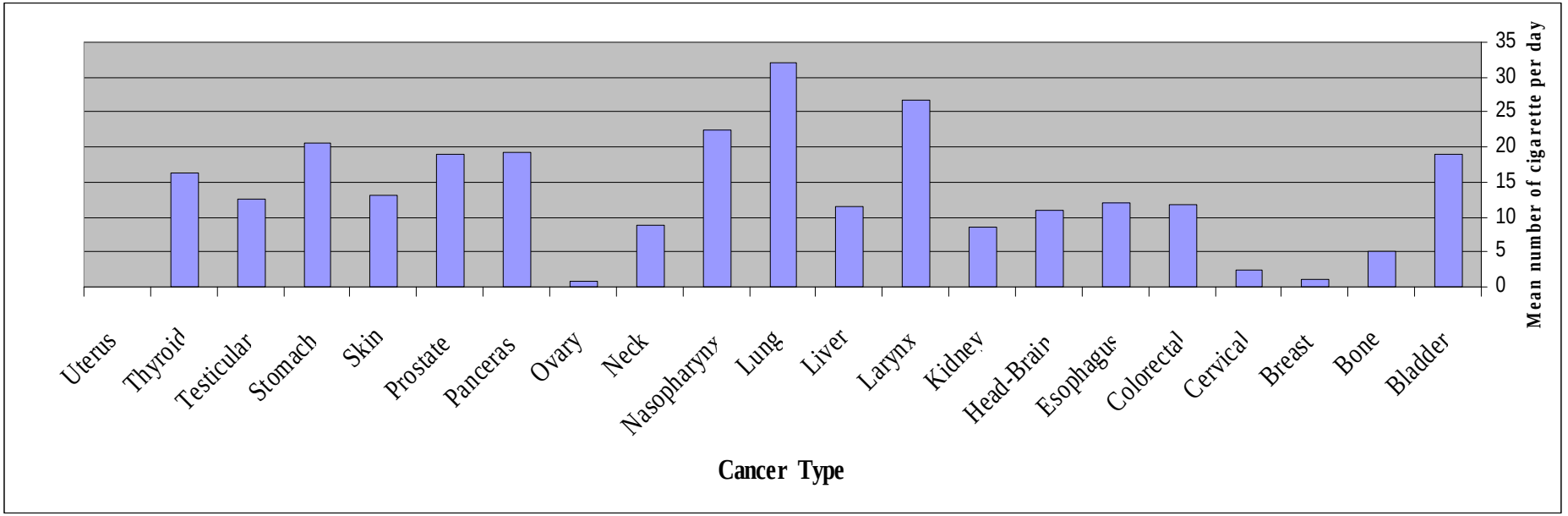

Figure (3.14):. Relationship between cancer type and average number of smoked cigarettes.

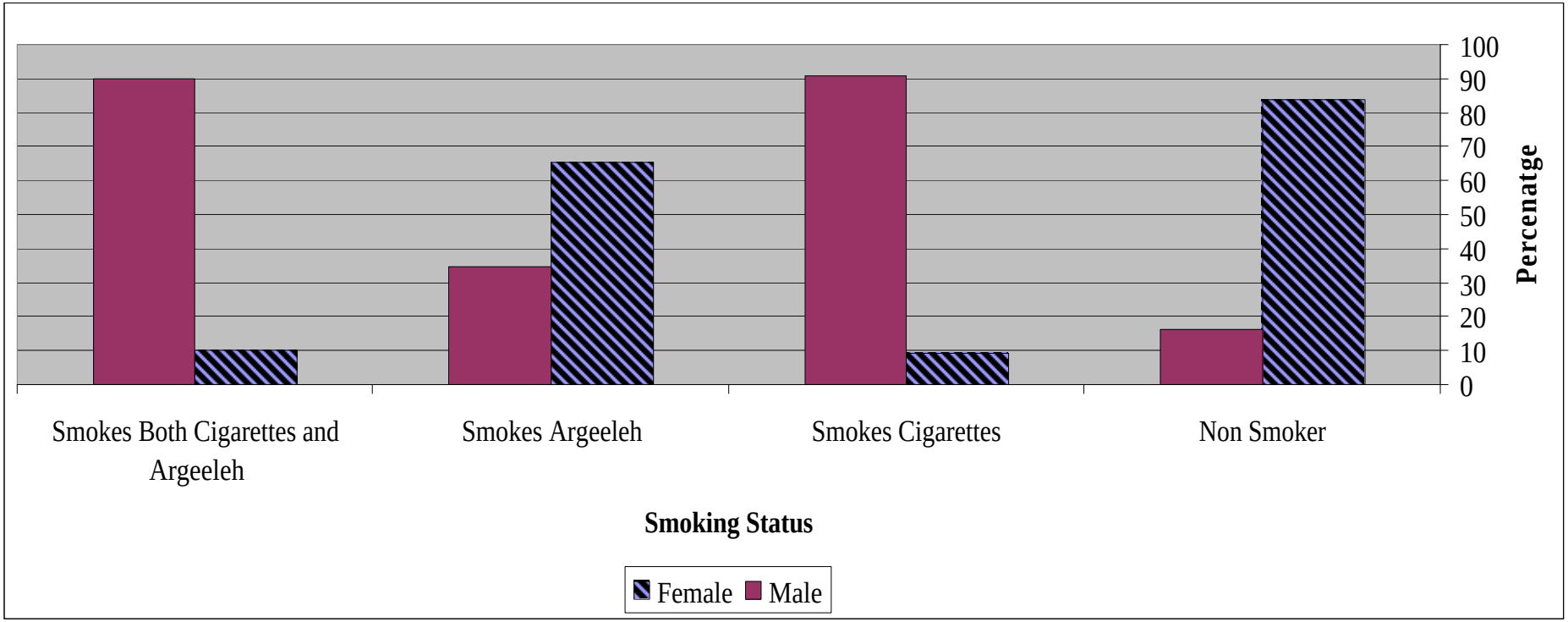

Figure (3.15): Smoking status by gender

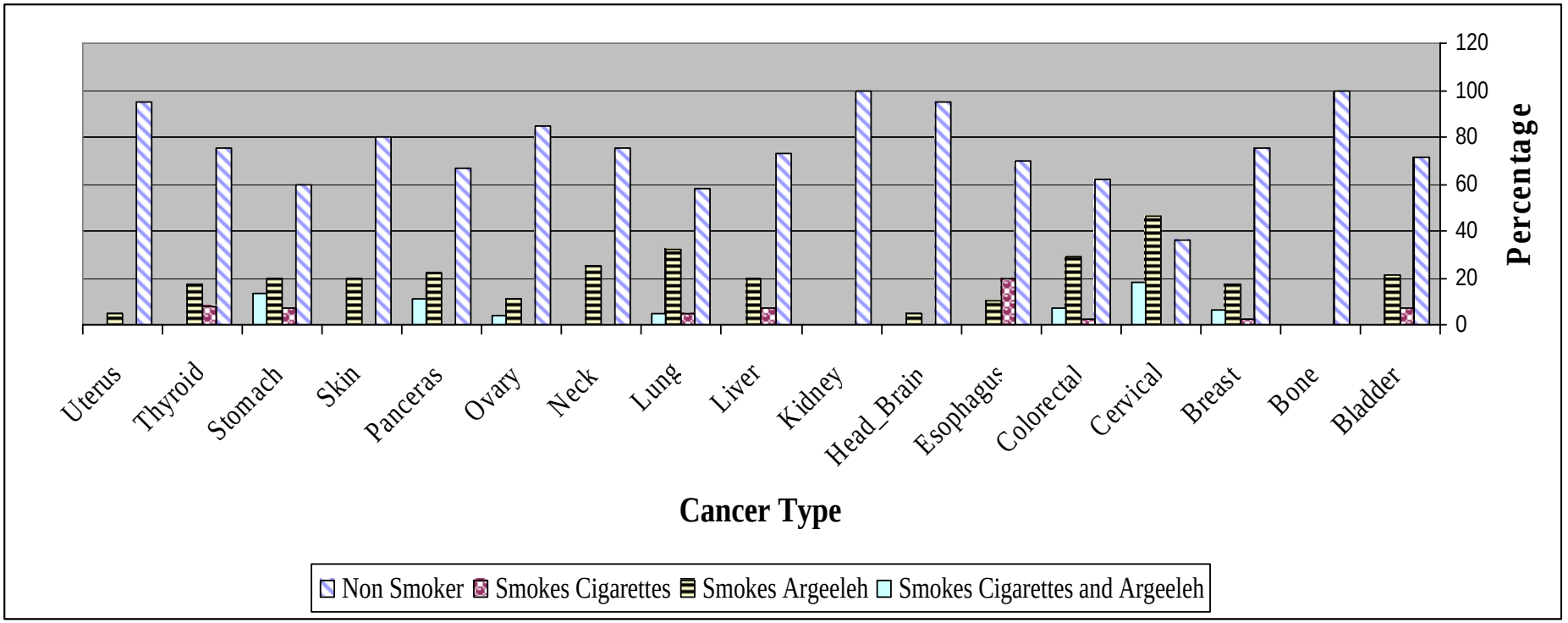

Figure (3.16): Smoking status by cancer type in Females

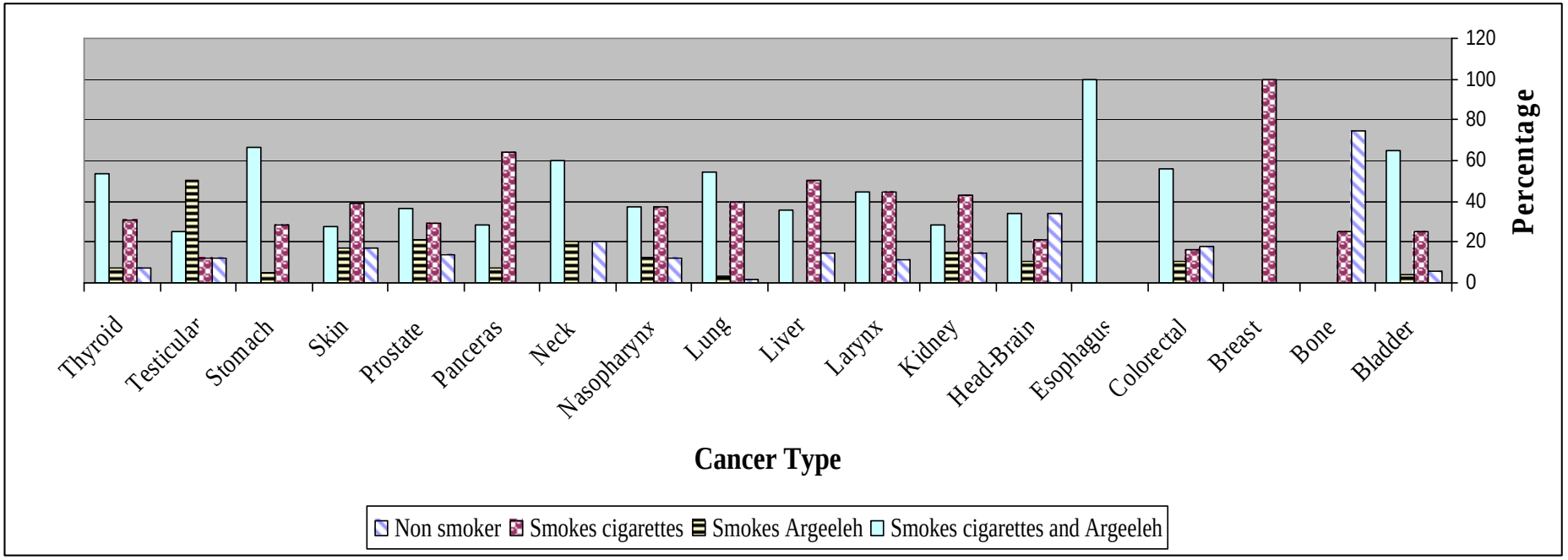

Figure (3.17): Smoking status by cancer type in Males

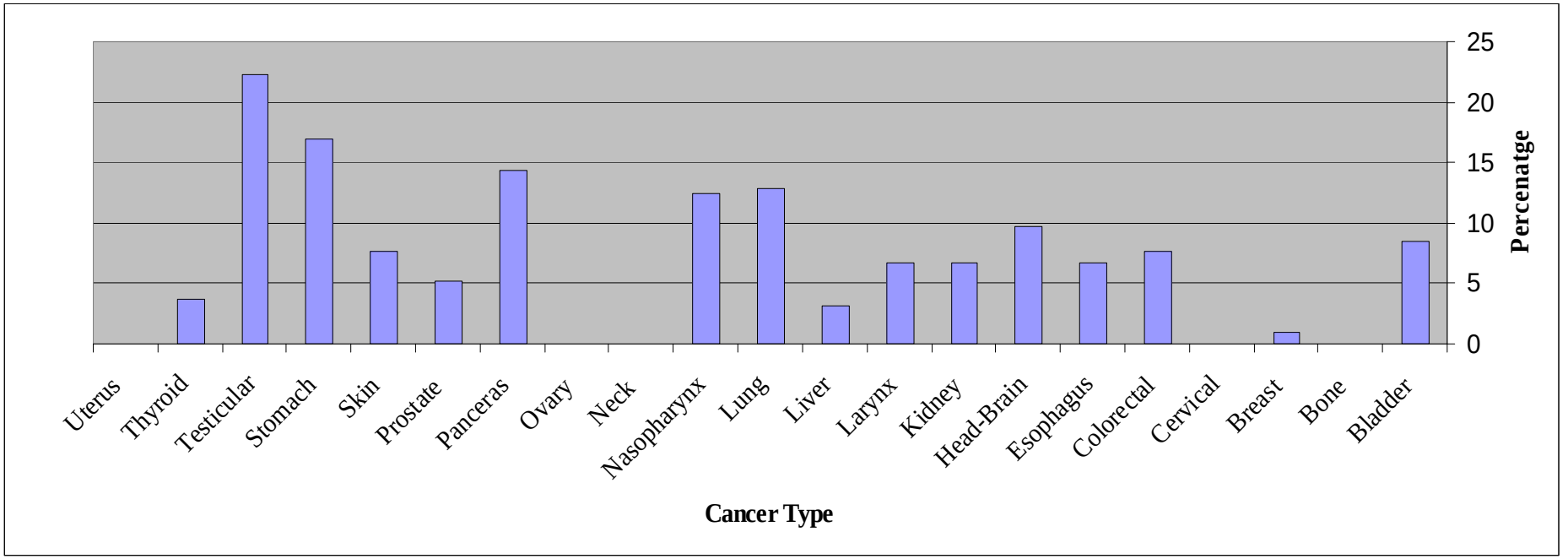

Figure (3.18): Percentage of patients with alcohol consumption within each cancer type

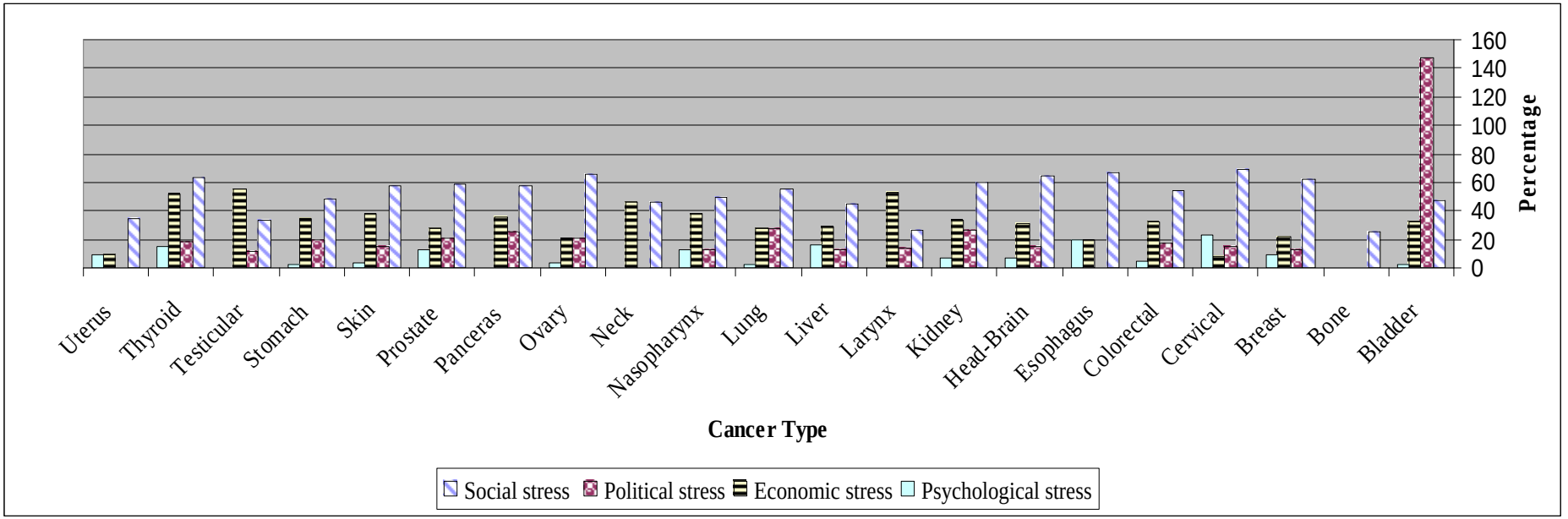

Figure (3.19): Distribution of kinds of stress by cancer type

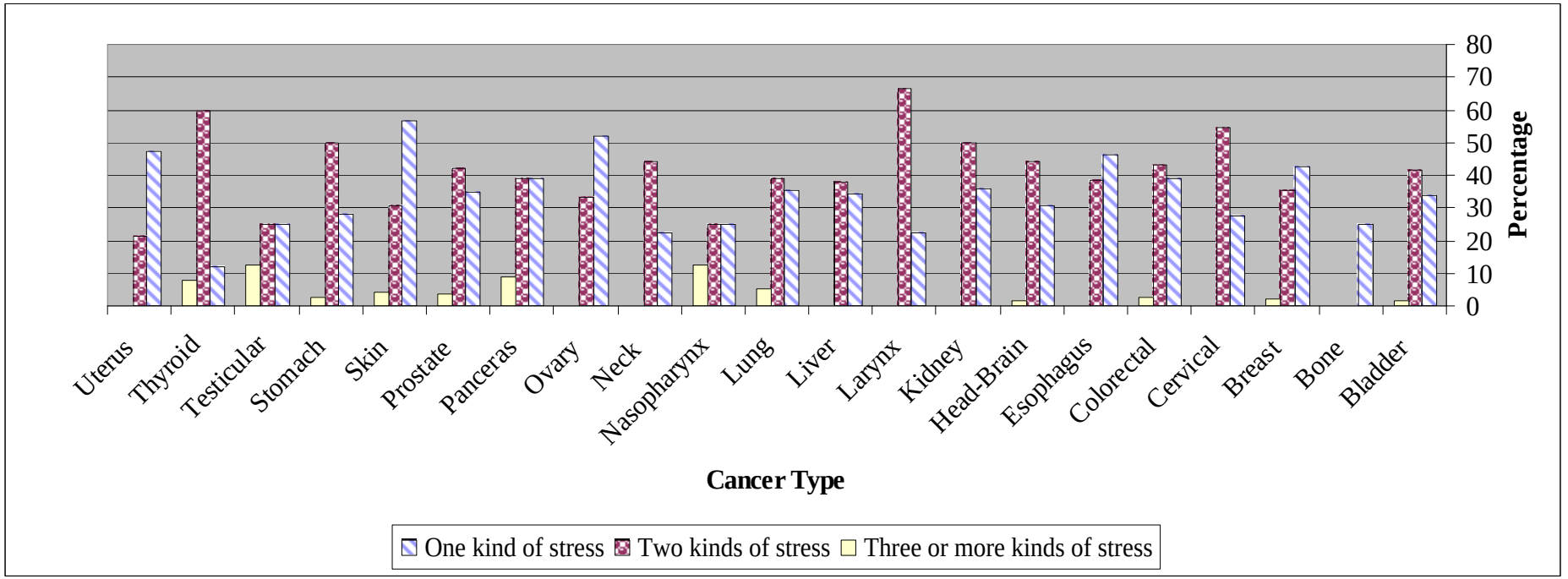

Figure (3.20): Distribution of number of different kinds of stress by cancer type

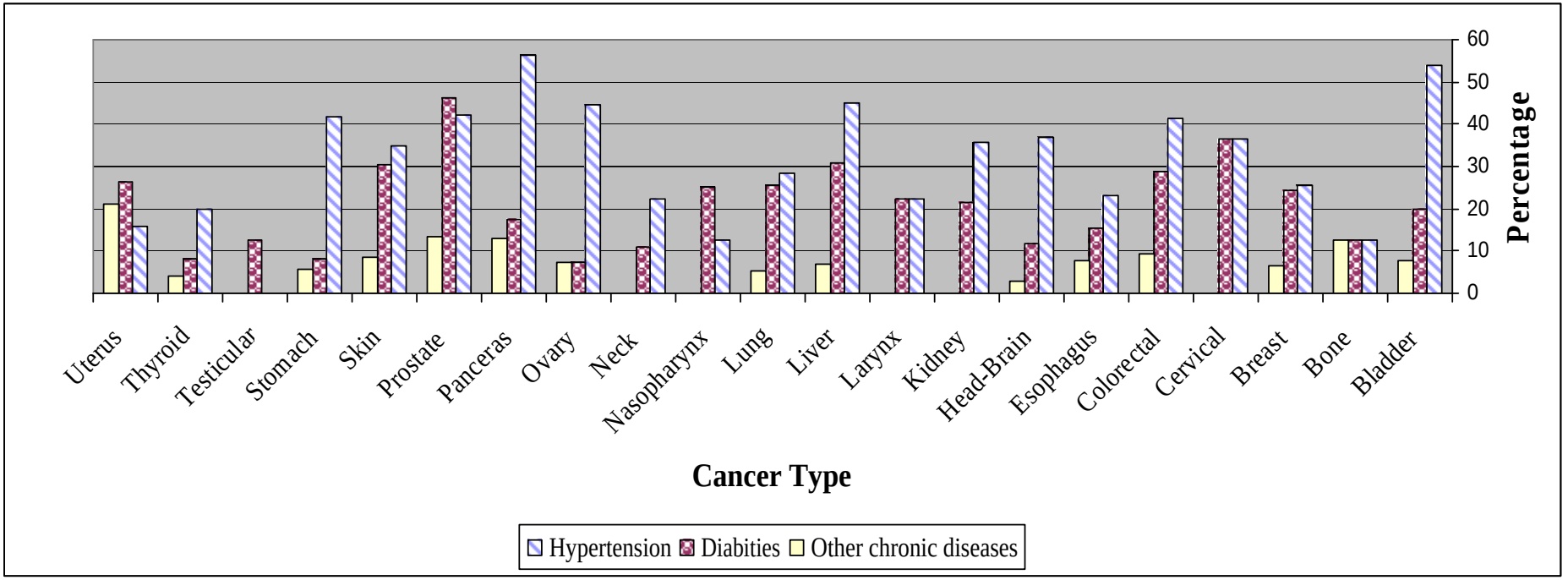

Figure (3.21): Percentage of patients in each cancer type with chronic diseases

Chapter Four

Discussion, Conclusions and Recommendations

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4.1 Discussion

This study aimed at investigating incidence rates of cancer in the northern governorates of the West Bank. The yearly age-adjusted incidence rate in the northern governorates was 25.7 cases per 100,000 (crude rate of 28.1). The rate over the 4-year period was 103.2 cases per 100 000 (crude rate of 112.3). Hamad [50] found a crude incidence rate of 33 cases per 100 000 people per year for the period from 1999 to 2002 (total of 1000 new cases). However, his study included also non-solid cancers (3.1%). Comparison of results from the two studies indicate that overall incidence rate of cancer is stable in the northern West Bank and the increase in the number of newly diagnosed cases of solid cancer (1037 vs. 869) is due to the natural growth of the population. However, this study showed an increase in incidence rates in 2007 and 2008 compared to the first two years of the study (2005-2006). One reason for this could be that a high number of cases were diagnosed in later years as the population in the northern West Bank enjoyed more free movement and reached screening centers more easily due to relaxation of restrictions of movement imposed by the Israelis compared to the earlier years (probably a fewer number of patients sought diagnosis exams abroad in the last two years compared to earlier years).

Estimates from the US SEER over the period from 1996 to 2001 were 318.6 per 100 000, and estimates from the MECC (Middle East

Cancer Consortium) for the same period (1996-2001) were: Israeli Jews (274.4 per 100 000), Israeli Arabs (149.8 per 100 000), Cyprus (164.2 per 100 000), Egypt (143.0 per 100 000) and Jordan (113.3 per 100 000), [45]. The Jordanian population is largely composed of Palestinians and shares somewhat similar habits and lifestyle as Palestinians living in the West Bank.

This revealed presence of geographical variation in incidence rates. Nablus had the highest crude incidence rates, followed by Tulkarm, Qalqilia, Salfit, Tubas and Jenin had the lowest incidence rates. However, the results of the negative binomial analysis showed that Tulkarm came after Qalqiliya and Salfit in Incidence rate (IRR of 3.3, 2.59, 2.46, 2.34, and 1.13, for Nablus, Qalqilia, Salfit, Tulkarm and Tubas with Jenin as a reference). The reason for this is that the IRRs are adjusted for the other factors in the model which included age group, sex, year and type of locality. Hamad [50] also found that Nablus had the highest incidence rate (yearly crude rate of 38 cases per 100 000 people). His estimates of crude incidence rates for the other governorates were: 29, 27, 25, and 24 cases per 100 000 people for Jenin, Salfit, Tulkarm, and Qalqilia, repectively. The difference between the two studies in the ranking of governorates is because at the time of his study, Tubas was administratively considered as part of Jenin, and some villages has been administratively moved from one governorate to another.

The variation in incidence rates among governorates observed in this study should be related to differences in risk factors. Nablus is the largest

industrial city in the North of West Bank. The city has been under blockade of the Israeli army before and during the period covered by the study where the population lived under continuous stress (particularly, political and economic). It has the biggest center for cancer therapy in the North of West Bank that can help in regular screening and detection of cancer. Nablus had higher than expected percentages of patients in the smoking and alcohol consuming categories (61.8% of patients in the governorate were smokers and 30.4% smoked both cigarettes and *Argeeleh*). 15.2% of cancer patients in the governorate lived in refugee camps. Based on the 2007 population census [85], 24.7% of all refugees in the West Bank (48% of refugees in the Northern West Bank) are concentrated in four camps around the city of Nablus (9.6% of the population in the governorate are refugees compared to 10.9% for Tulkarm, 11.4% for Tubas, and 4.2% for Jenin, with no refugees living in Qalqilia and Salfit). Certain villages in Nablus also had high frequency of cancer cases such as Aseera-elshamalia (384 per100 000 ovr the 4-yr period) where a site for dumping of nuclear wastes by the Israelis is believed to be near the village and Hiwwara (143.6 per 100 000) which has the biggest Israeli checkpoint. Checkpoints in the North of West Bank have high electronic technologies which emit radiation besides the continuous harassment and stress caused by Israeli soldiers.

Tulkurm and Qalqilia followed Nablus in incidence rates. These two governorates faced different environmental hazards. Hazards come from poisonous fumes of Israeli toxic wastes regularly dumped near their villages. Near the city of Tulkarm itself are ten Israeli factories. The

factories contaminate both the water and land as they continue to pump out noxious substances [116]. In addition, an Israeli industrial zone is based in the west of Tulkurm. Qalqiliya and Tulkurm have the bigest open sewage streams in the north of the West Bank. Good part of the city of Tulkarm and several villages such as Faroon, Ertah, Denabeh and Anabta are exposed to these streams. Faroon is located near a big garbage dump. High incidence (185.2 per 100 000) was found in Nourshams camp which also has a big garbage dump. Tulkarm is also known for having big agricultural activity. Qualqilia is very close to Israel's separation barrier, and surrounded by Israeli settlements. Chemical factories found in these settlements are sources of pollution for the population. Another source of pollution is waste dumped behind the separation barrier built by Israel in addition to the large open sewage streams from the Israeli settlements in the area. Significant differences (P = 0.000) were found among governorates in the number of sources of pollution to which a patient was exposed. Cancer patients in Qalqilia and Tulkarm had been exposed, on average, to a larger number of sources of pollution than the other governorates (1.95 for Qalqilia, and 1.87 for Tulkarm compared to 1.74 for Salfit, 1.67 for Tubas, 1.62 for Jenin, and 1.44 for Nablus). Salfit, Jenin and Tubas had less frequency of cancer cases. Tubas and Jenin have the highest frequency of stone factories. Some villages in Jenin had a high frequency of cancer cases than others such as Qabatia (83.3 per 100, 000) and Yabad (110 per 100, 000). Qabatia is famous for presence of stone industry and farming. Yabed is known as having coal industry. Salfit also has villages

famous in stone industry, such as Koforhares. Jenin, however, had the lowest incidence rate in the North of West Bank.

Refugee camps had highest incidence rates, followed by urban and rural areas. Health service centers are more available in urban and refugee camps than rural areas. Refugee camps have medical centers run by the UNRWA which provide free services for refugees. Availability of these centers helps the population in receiving services more easily and in continuity without worrying about financial matters. However, these centers lack units specialized in screening for cancer. Refugee camps had the highest percentage of patients exposed to open sewage streams (76.9% compared to 34.5% for rural areas and 30.6% for urban areas). Furthermore, there was a significant relationship (P = 0.000) between type of locality and the number of sources of pollution to which a patient was exposed. The percentage of patients exposed to two or more sources of pollution was higher in refugee camps (72.3%) than rural (59.8%) and urban (57.7%) areas.

Breast cancer is the most common cancer among females in the Northern West Bank (38.1% of all cancers in women). This result is similar to findings from other statistics which showed that breast cancer was the most common type among Palestinian women and women in neighboring countries where it accounted for nearly half of all cancers in women [97]. Colorectal was the second common cancer type among females (14.6% of all cancer types in women). Breast cancer was the highest deadly cancer in

women and colorectal was the second highest deadly cancer. These results are similar to results observed from a recent study [8]. In men, colorectal was the most commonly diagnosed cancer (15.6% of all cancers in men). Bladder cancer was the second most common type in men (13.2%) followed by lung (13%) and prostate (11.6%). Lung cancer was the most deadly cancer in men followed by colorectal, bladder, then prostate cancer. Lung cancer is the most deadly cancer world wide [97] and a previous study [81] showed the same result in the West Bank.

Mean age at diagnosis was higher than 40 years for most cancers. Mean age at diagnosis for males was higher than females and may be as female cancers (breast, ovary and uterus) are diagnosed at earlier age than other cancer types. Patients of most cancer types survived a short time (an average of less than two years) after being diagnosed except patients of neck cancer who survived more than five years after diagnosis. Patients of cancer types diagnosed at earlier age (female cancers, bone, nasopharyngeal and testicular) survived longer because these cancers can be treated. Bladder, colorectal, esophageal, liver, lung, skin, prostate and pancreatic cancers developed at older ages similar to the worldwide patterns [91]. Health education regarding the early detection of cancer is low, the political situation and blockade and restrictions on the movement of citizens and medical materials are possible causes for diagnosis of cancer at older age and death of patients in a short time after diagnosis.

Stress (social, economic, political, psychological) may contribute to development of cancer. Most cancer patients under study suffered one or

more types of stress, especially social and economic stresses. It is known from previous studies that stress also reduces the effectiveness of treatment [64].

Occupational exposure to cancer occurs at the workplace. Some individuals develop cancer from exposure to certain substances at an indoor workplace such as chemical factories, painting, building and farming. In this study, farmers made up the largest segment among cancer patients (13%), and this group developed colorectal, lung, bladder, prostate and stomach cancers in high frequencies. This finding is similar to results observed from previous studies [108]. Farmers have high risk because they are usually in contact with a variety of hazardous substances including fertilizers, pesticides, solvents, oils and fuels, dusts, paints, welding fumes, zoometric viruses, microbes, fungi and these substances are known or suspected to be carcinogens. Teachers were the second highest frequent group (7.8% of all patients) because they are always exposed to stress and may be using chalks in teaching. Builders, factory workers, and painters were also common groups among patients (6.1%, 4.1%, and 1.4%, respectively). Builders are continuously exposed to cement and dust from building material. Inhaled cement dust is suspected of being able to cause cancer of the lungs [93], and the stomach [72]. A case-control study on laryngeal cancer found a significant risk ratio for workers in industries classified as concrete and cement manufacture [83]. Painters are commonly exposed to chemical compounds that are used in paint products as pigments, extenders, binders, solvents and additives. Some of these

chemicals are carcinogenic, and many studies indicated that painters are at high risk for developing cancer. A study [55] showed an excess risk for bladder cancer among painters and this was also observed in the current study. Materials used in factories, some of which are carcinogenic, put workers at risk for developing cancer, such as radon, asbestos and benzene. Drivers are also at risk for developing cancer as they are exposed to diesel fumes and air pollution during working hours. Exposure to vehicle exhaust seems to play an important part in the development of bladder [31] and lung [51] cancers among drivers. Bladder cancer was the most common, lung cancer was the fourth common type among drivers in our study.

Our diets are made up of different types of food, containing thousands of nutrients and chemicals. Some of these protect against cancer, while others increase its risk. Cancer patients in this study consumed fat, salt, sweet and carbohydrates in high levels which may be the nature of the food system in our Middle Eastern country. Bread and rice are a key part of the dining table. Olives and pickles are also common in Palestinian meals which have high concentration of salt. Meat is devoid of fiber and other nutrients that have a protective effect. Meat also contains animal protein and saturated fat. In some cases, it contains carcinogenic compounds, such as heterocyclic amines (HCA) and polycyclic aromatic hydrocarbons (PAH) formed during the processing or cooking of meat [100]. The high fat content of meat and other animal products increases hormone production, thus increasing the risk of hormone-related cancers, such as breast and prostate [100]. Our study showed that high percentages

of cancer patients (all cancer types) consumed vegetables in moderate and high level. Half of patients consumed low levels of fruits, about 38% consumed moderate levels and about 12 % consumed high levels. The results of this study showed no association between cancer types and levels of consumption of vegetables and fruits. Fruit and vegetables contain a wide variety of nutrients and are high in fibers that are protective against cancer. However, some nitrogen compounds may accumulate in plant tissues [1] from using fertilizers by farmers in higher amounts than they should, either due to ignorance, or because they want to increase their production quickly when the prices of these products in the market are high. A study found that vegetables and fruits were protective against cardiovascular disease but not against cancer [24]. Case-control studies are needed to investigate the association between cancer types and consumption of vegetables and fruits in the West Bank.

A family history of cancer can increase the risk of developing cancer (there are heredity risk factors for some types of cancer). In this study more than 40% of patients with breast, cervical, uterus, ovary, colorectal, testicular, thyroid and lung cancers had at least one relative with cancer. More than 10% of patients with cervical, ovary, breast, uterus, colorectal, neck, bone, stomach, and thyroid cancers had at least one first-degree relative with the same cancer type. Women with at least one first-degree relative with breast cancer had two to four times the risk of developing breast cancer [138]. Other studies [77] showed that risk of colorectal cancer is increased among persons with one or more affected first-degree family

members. Men with a brother or father affected by prostate cancer have approximately twice the risk of developing prostate cancer themselves, and the risk increases as the number of affected family members increases. Men from families with a history of breast and/or ovarian cancers may also be at increased risk for prostate cancer[137]. Risk of bladder cancer increased with family history of cancer in first-degree relatives, and the risk increased among younger cases [77]. In people with a family history of stomach cancer (having one or more first-degree relatives) with the same cancer, the risk to develop stomach cancer was up to three times more than those with no family history [77]. In the Kuwaiti population, a study showed that a family history of benign thyroid disease (BTD) was associated with an increased risk of thyroid cancer [73]. A family history of ovarian cancer is a risk factor for lung cancer [11]. Patients with a family history of lung cancer are more likely to acquire lung cancer [80]. Having a family history of cervical cancer (first degree relatives) increased the risk two to three times for cervical cancer [42]

A noticeable high frequency of smokers was found among male patients (about 85%) compared to females (25%). Smoking is not common among Palestinian females because of customs and traditions. It is also possible that some female patients did not reveal their true smoking habit. Of smoking women, the majority (70%) smoked *Argeeleh*, 20% smoked cigarettes and *Argeeleh* and 10% smoked only cigarettes. It is well-known that smoking *Argeeleh* is common among women in Nablus. This study showed that 77% of women smoking *Argeeleh* lived in Nablus. Smoking

Argeeleh was more common among females with breast, cervical, ovary and uterus cancers than those smoking cigarettes.

Around 90% of all lung cancers are caused directly by smoking[114]. Smoking has also been linked to several other types of cancer, such as. esophagus, larynx, mouth, throat, kidney, bladder, pancreas, stomach, and cervix [33]. Former smokers had higher risks for respiratory diseases than those who had never smoked [33] and smoking cigarettes increases the risk of developing pancreatic cancer by 70 percent [3]. The results of this study showed that cancers of the respiratory systems (lung, nasopharynx, and larynx), testicular cancer, and cancers of the bladder, prostate and stomach had high percentages of smoking patients (75% for stomach cancer to 89% for larynx). These same cancers were 2.5 times to 8.5 times more frequent among smokers than non smokers. More than 40% of patients of bladder, laryngeal, lung, stomach, nasopharyngeal, and prostate cancers smoked both cigarettes and *Argeleeh*. Cancer patients with laryngeal, lung, nasophyrngeal and stomach cancers smoked, on average, more than one packet of cigarettes per day (> 20 cigarettes), and patients with bladder, prostate, pancreas and thyroid smoked more than 15 cigarettes per day. Heavy smokers were fifty times as likely as non-smokers to contract lung cancer [13].

Despite the customs and traditions of the Palestinian society, the interesting observation in this study was the finding that 8% of cancer patients drank alcohol and the response rate seemed good in relation to

questions about alcohol consumption. It is scientifically established that alcohol increases the risk of cancers of the mouth, esophagus, pharynx and larynx, colorectal cancer, liver cancer, stomach cancer and cancer of the ovaries [13]. Studies have linked chronic heavy drinking with cancers of the stomach, pancreas, and lungs [18] which is in support of our finding that testicular, stomach and pancreas had the highest frequencies of alcohol-consuming patients (25%, 22.2%, and 17.4%, for the three types, respectively). In addition, more than 10% of patients with nasophyrngeal, lung and head-brain cancers and more than 5% of patients with laryngeal, kidney, esophageal, colorectal and bladder cancers drank alcohol. These findings are in agreement with several other studies where the strongest link between alcohol and cancer involved cancers of the upper digestive tract, including the esophagus, the mouth, the pharynx, and the larynx [139].

The results showed that 46.3% of cancer patients also suffered from one ore more chronic diseases. A significant association was found between cancer type and each of diabetes and hypertension. High percentages of patients with pancreatic, bladder, liver, ovarian, prostate, stomach, colorectal, cervical, and kidney cancers suffered from hypertension. These results are in agreement with results found by other studies [34,106]. More than 30% of patients of prostate cancer, cervical cancer, liver cancer, and skin cancer were also diabetic. Diabetes and hypertension were observed as risk factors for cancer in previous studies [53,68]

Sporting was a scarce activity for patients in this study. 85% of interviewed patients had no sporting activity at all before being diagnosed and only 2% had a daily sport activity. This reflects the poor sport activity in the whole Palestinian population, particularly women and working men. Lack of sport clubs and public sport installations in addition to poor health education about the importance of sport activity in preventing diseases are reasons for this trend. Nearly all study population considered that daily business is sporting, and they don't have enough time for exercises.

The incidence rates found in this study may be underestimates of the true incidence rates. In the northern West Bank, only three oncology centers are assigned as treatment and registry centers. Such arrangements are most likely not enough to cover the area as patients may not easily reach these centers or seek treatment outside the country. For example, residents of Salfit were likely to seek medical services in Ramallah (Southern West Bank) rather than Nablus because of proximity of Salfit to Ramallah and due to the blockade imposed on Nablus during the second *Intifada*. In addition, there are other factors which may lead to underestimation of incidence rates of cancer types: factors related to the limited financial resources, as most of our patients are not insured, factors related to cancer itself as a disease which develops without pain in the first stages, and factors related to poor health education related to screening and early detection of cancer; most people don’t know any thing about the disease other than being a dangerous killer.

4.2 Conclusions

The main conclusions of this study were:

1. Incidence rates of cancer increased in 2007 and 2008 compared to 2006 and 2005 which could be related to increased access to cancer screening centers with relaxation by the Israelis of restrictions on movement of the Palestinians in later years of the study.

2. No increase in overall incidence rate of cancer was observed for the period from 2005-2008 compared to the period from 1999-2002 and the slight increase in number of cases is a result of natural growth of the population.

3. Significant variations in incidence rates were found among geographical locations (governorates) and among types of locality. These variations were linked to differences in risk factors, particularly smoking habits and environmental pollution.

4. High percentages of patients in all governorates were exposed to electromagnetic pollution.

5. Cancer types were strongly associated with occupation, family history, smoking habits, types of pollution, stress, and chronic diseases.

6. No relationship was found between cancer type and level of consumption for each of sweets, carbohydrates and salts, but a relationship was found for fat consumption.

7. Sport was a rare activity among cancer patients reflecting probably a general trend in the Palestinian population.

4.3 Recommendations

1. Urgent measures are needed to reduce the effects of environmental pollution in all the governorates of the Northern West Bank.

2. Communication towers should be constructed in the highlands away from the residence of people.

3. Cancer detection and treatment centers should be added to rural areas and to medical services provided by UNRWA in refugee camps.

4. Health education programs should be implemented (using various methods like public TV, schools, cultural centers, posters, etc) to target the general population concerning the relationship of various risk factors (particularly pollution, smoking, alcohol intake, sport activity and dietary factors) with cancer.

5. Special education programs should target farmers concerning the risk of using and being in contact with fertilizers, pesticides, and other hazardous substances used in farming.

6. Families with strong cancer history should be identified and their members should be counseled at early ages regarding the higher risk of developing cancer and early screening programs should be implemented for these families.

7. Further research using case control studies is needed to conclude the relationship of dietary factors with cancer types and to confirm the relationships found herein with the other factors.

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جامعة النجاح الوطنية
كلية الدراسات العليا

دراسة مسحية لأنواع السرطان في شمال الضفة الغربية، فلسطين

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قدمت هذه الأطروحة استكمالاً لمتطلبات الحصول على درجة الماجستير في الصحة العامة بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس، فلسطين.
2010م

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الملخص

أجريت هذه الدراسة للتعرف على الفروق في معدلات الإصابة بين المواقع الجغرافية (المحافظات) في شما الضفة الغربية والعلاقة بين المواقع الجغرافية وأنواع السرطان مع الاختلاف في العوامل المؤثرة بمرض السرطان. تضمنت هذه الدراسة 1037 حالة سرطان جديدة شخصت بين 2005 و 2008 في محافظات شمال الضفة الغربية (طولكرم نابلس قلقيلية جنين طوباس وسلفيت). تم جمع المعلومات الطبية والمعلومات الشخصية من ملفات التسجيل للمرضى في المستشفى الوطني بنابلس و مستشفى ثابت ثابت بطولكرم ومستشفى جنين وتم الحصول على المعلومات الديمغرافية ومعلومات عن نمط الحياة وغيرها من البيانات عن طريق إجراء مقابلات مع المرضى أو أقاربهم في حالة وفاة المريض. أظهرت الدراسة اختلافات كبيرة في معدلات الإصابة بين المحافظات الستة في شمال الضفة الغربية و كان أدنى معدل إصابة في جنين وأعلى معدل إصابة في نابلس. سرطان الثدي والقولون والرحم ، وسرطان المبيض كانت الأكثر شيوعا بين النساء في المحافظات الستة في شمال الضفة الغربية وسرطان القولون والمستقيم والمثانة والرئة والبروستاتا والمعدة هي الأكثر شيوعا بين الذكور. نسبة عالية من المرضى في جميع المحافظات يتعرضون لمصادر الكهرومغناطيسية. تختلف مصادر التلوث في المحافظات ففي طولكرم وقلقيلية نسبة عالية من المرضى يتعرضون لمجاري الصرف الصحي المكشوفة و في سلفيت وقلقيلية نسبة عالية من المرضى يعيشون بالقرب من مكبات القمامة ، بينما طوباس وجنين نسبة عالية من المرضى يعيشون بالقرب من مصانع الحجر .تمتاز طولكرم أيضا بان نسبة عالية من المرضى هم من الذين يعيشون بالقرب من المصانع الكيماوية مقارنة مع المحافظات الأخرى.

بينت الدراسة ان خطر الإصابة بالسرطان يزداد مع التقدم في السن و كذلك في حال وجود أقارب في عائلات المرضى مصابين بالسرطان و أظهرت الدراسة وجود علاقة قوية بين التدخين و حدوث السرطان وتبين أيضا وجود علاقة قوية بين المهنة وأنواع السرطان. شكل المزارعون اكبر شريحة عاملة بين المرضى يليها المدرسون والعاملون في البناء والعاملون في المصانع. المرضى في هذه الدراسة تعرضوا للتوتر بأنواعه 54.3 ٪ يعانون التوتر الاجتماعي، 28.8 ٪ يعانون الضغط الاقتصادي والضغط السياسي ، وبنسبة 6.6 يعانون الضغط النفسي.ولم يعثر على أي فروق معنوية بين أنواع السرطان في مستوى الاستهلاك لكل من الحلويات والنشويات والأملاح والخضر والفاكهة ، ولكن تم العثور على فروق معنوية في استهلاك الدهون. وتبين أبضا أن نسبة عالية من المرضى 85% لا يمارسون الرياضة .

تشير نتائج هذه الدراسة الى التاكيد على الحاجة الملحة لاتخاد تدابير للحد من اثار التلوث البيئي واستهداف الفئات المعرضة لخطر الاصابةبالسرطان مثل المزارعين والعائلات التي لها اقارب في عائلاتهم مصابين بالسرطانمن خلال برامج تثقفية صحية .