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## Epidemiology and cost of drug treatment of cancer in Northern Cyprus

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**Background/aim:** To determine the epidemiology, the sociodemographic features, the incidence and prevalence rate of cancer, and the cost of drug treatment in Northern Cyprus.

**Materials and methods:** All of the oncology prescriptions, cancer pathology reports, and cancer referrals to overseas for 2011 were collected from the state hospitals, the only private university hospital that provides oncology services, and the Ministry of Health to prepare an epidemiological database. The total cost of drug treatment at the state hospitals and cost of the most frequent five cancer types were also calculated using the therapy protocols and the expense of the drugs.

**Results:** The total incidence rate for all cancer cases in 2011 was 201 per 100,000 and the prevalence rate was 460 per 100,000. The five most common cancer types were breast (19.8%), prostate (12.6%), colorectal (9.7%), thyroid (6.4%), and lung (5.6%). The cost of drug treatment for cancer at the state hospitals comprises 25% of the total medical budget of the Directorate of Pharmaceuticals. Almost 1/3 of this amount was spent on drug treatment of breast cancer.

**Conclusion:** Breast cancer is the most frequent and the most costly cancer type in Northern Cyprus. Of all the districts, the Güzelyurt-Lefke District has the highest cancer rate.

**Key words:** Northern Cyprus, cancer, epidemiology, treatment, cost

### 1. Introduction

Cyprus is the third biggest island in the Mediterranean, with an area of 9251 km<sup>2</sup>, and Northern Cyprus has an area of about 3242 km<sup>2</sup>, with a population of 294,396 (National Planning Bureau, 2011).

Cancer is an important cause of death worldwide and a major public health issue in the European Union (EU) (1,2). According to GLOBACAN 2012, an estimated 14.1 million new cancer cases and 8.2 million cancer related deaths occurred in 2012. The most commonly diagnosed cancers worldwide were those of the lung (1.8 million, 13% of the total), breast (1.7 million, 11.9%), and colorectum (1.4 million, 9.7%). There are differences with regard to decreases and increases in the incidence and mortality of cancer types between the sexes and among countries (1,2). In some cancer types, mortality is decreased in spite of an increase in their incidence. For instance, improvement of early detection programs for breast cancer plays a leading role in reducing mortality and improving the patient's prognosis (1). While more than half of the cancer cases (56.8%) and cancer deaths (64.9%) occurred in less developed regions of the world, cancer mortality has been reduced in developed countries, which could be attributed

to several factors such as advances in early detection, improved diagnostic approaches and cancer treatment methodology, lifestyle changes, and the development of preventive vaccines for some cancer types (2).

Scientific progress in oncology has led to new diagnostic tools and the development of new targeted therapies. The cost of cancer care is expected to rise with increased incidence in the ageing population, along with advances in diagnostic technology and novel targeted treatments (3). The average cost of treatment for the most common cancers has increased as well. Recent studies indicate that cancer drugs account for approximately 10% of the total cancer cost (4), whereas both the number of cancer survivors and cancer expenditures are likely to increase in the future.

The increased incidence is explained by ageing and growth of the global population along with other nonmodifiable factors like genetic susceptibility (4). Lifestyle factors such as the increase in prevalence of female smokers, and lower rates of reproduction also contribute to an increase in the incidence of cancers (4). In addition to the aforementioned causes, environmental factors such as pollutants present in the air, soil, water, and

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other media; indoor pollution from cooking and heating; residential exposure to asbestos and radon; second-hand tobacco smoke; diesel engine emissions; and arsenic contamination of drinking water are common causes of cancer (5,6).

Although the main economic activities are tourism, university education, and agriculture in Northern Cyprus, it is well known that in the past copper mining was an important activity, especially around the western town of Lefke. In terms of environmental factors, this is considered an important issue. The aim of this paper was to provide the figures for the basic epidemiological indicators, which are incidence and prevalence, to determine the major cancer types and the distribution of cancer cases in different districts in Northern Cyprus and also to determine the cost of drug therapy.

## 2. Materials and methods

There are five district state hospitals, a private university hospital, and other private hospitals and clinics in Northern Cyprus. However, oncology services are only provided at the Lefkoşa State Hospital and at the private university hospital (Near East University (NEU)). Since cancer is the responsibility of the Ministry of Health, all citizens of Northern Cyprus are eligible for treatment free of charge. If the required treatment is available at the oncology department of the state hospital, patients receive their treatment there. If not, they are referred to the private university hospital (NEU) in Northern Cyprus or to eligible hospitals in Turkey by the Ministry of Health. However, there are also patients who choose to receive treatment in South Cyprus or overseas without local government subsidization. These patients are not always reported, which makes it very difficult to come up with an exact number of cancer patients in Northern Cyprus.

In this study, all the cancer patients who receive treatment at the state hospitals and at NEU, as well as those referred to outside organizations were recorded. Since there is no cancer registry in the country, data from the state hospital was collected from the pathology reports, the radiation oncology department, and from the prescriptions of cancer patients for 2011. All the cancer referral information was obtained from the Ministry of Health, and all the data from NEU was obtained from the pathology, medical oncology, and radiation oncology departments for the same year. Data from the mentioned sources were combined and a final list was prepared on a Microsoft Excel spreadsheet including sex, age, address, type of cancer, and date of diagnosis. Only cases of primary cancer were considered. Missing data regarding sociodemographic information were obtained from the Ministry of the Interior. All the data regarding prescriptions, reports, referrals, and sociodemographic

information were collected with written permission from the Ministry of Health and were treated as confidential.

This is a descriptive, cross-sectional study and all the data are shown with descriptive statistics. For each subgroup of categorical variables, frequency and percentage of cancer types were calculated. For the continuous data, mean and standard deviation were calculated. All the calculations and data management processes were carried out with SPSS Version 15.0 (SPSS Inc., Chicago, IL, USA). Incidence and prevalence were calculated by standardized rate per 100,000 inhabitants, using the population of Northern Cyprus, which was obtained from the National Planning Bureau.

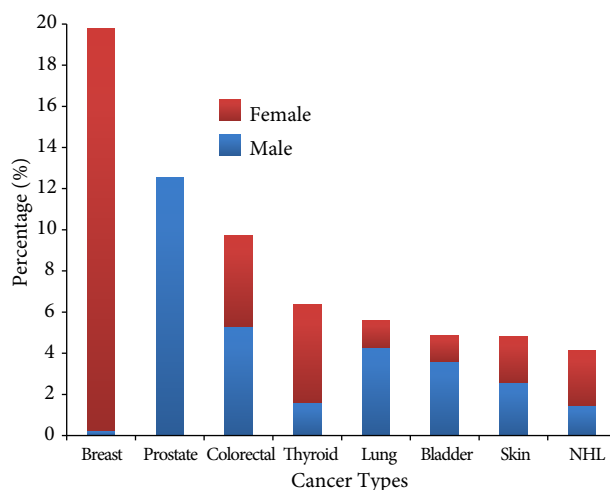
With regard to the cost of medical treatment at the hospitals, all the expenditure was calculated using the Directorate of Pharmaceuticals records with written permission from the Ministry of Health. The Directorate of Pharmaceuticals is the body responsible for purchasing and supplying the medicines to be used at the state hospitals. Total expenditure on cancer drugs was calculated to find the medical cost of cancer treatment. This was then calculated as a percentage within the total medical cost of the Directorate of Pharmaceuticals to find the economic burden of the disease. Within this cost, percentages of expenses for each of the most common five cancer types were also calculated separately. In order to determine the cost of drug treatment for the five most common cancer types, therapy protocols were taken into consideration. According to protocols, cost of drugs was calculated per patient annually. Therefore, the total cost of the most frequent five cancer types in Northern Cyprus was also determined.

## 3. Results

The results of this study show that there were 592 new cancer cases in 2011. The total number of patients including the new patients and the patients who were diagnosed prior to 2011 and were still receiving treatment was 1354. While 52.8% (715) of the patients were female, 47% (639) were male.

The most frequent cancer type among men was prostate (26.6%), followed by colorectal (11.3%), lung (9.1%), bladder (7.7%), and nonmelanoma type of skin cancer (5.5%). Among women, breast cancer was the most frequent cancer (37.1%), followed by thyroid (9%), colorectal (8.4%), non-Hodgkin lymphoma (5%), and nonmelanoma type of skin cancer (4.2%). Figure 1 shows the distribution of the most frequent cancer types by sex and in the total population.

The predominant age group affected was 51–70 years old including both sexes. This group made up almost half of the cases (43.9%) for all cancers. Other age groups affected were >71 years old (32.1%), 31–50 years old (18.6%), 19–



**Figure 1.** Distribution of most frequent cancer types by sex and in the total population (female 639 (53%), male 715 (47%).)

30 (3.1%) years old, and 0–12 years old (1.4%). The 13–18 years old (0.9%) age group was the least affected. Patients were between 0 and 100 years old; the mean age was 60.83 with a standard deviation of 17.01. Figure 2 shows the distribution of the most frequent cancer types by age.

The total incidence rate for all cancer cases in 2011 was 201 per 100,000, and the prevalence rate was 460 per 100,000. Incidence and prevalence were calculated by standardized rate per 100,000 inhabitants using the population of Northern Cyprus, which was obtained from the National Planning Bureau.

The five most common cancer types among all patients were breast (19.8%), prostate (12.6%), colorectal (9.7%), thyroid (6.4%), and lung (5.6%).

When we compared overall cancer prevalence in different districts in Northern Cyprus, Güzelyurt-Lefke had the highest prevalence (601.5 per 100,000), followed by İskele (454.6 per 100,000), Lefkoşa (425.5 per

100,000), Mağusa (403.8 per 100,000), and Girne (398.2 per 100,000). Figure 3 shows the distribution of the most frequent cancer types by district.

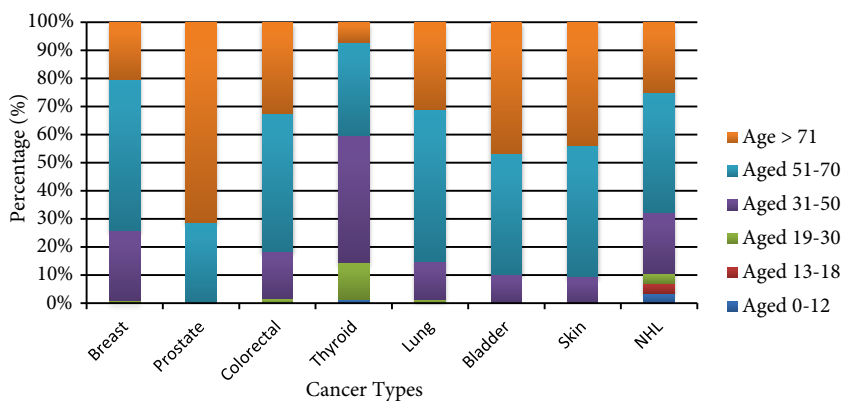
Out of 1354 patients, 836 of them received their treatment at the state hospitals and the cost of their drug treatment was 11,050,532.867 Turkish Lira (TL), which is 25% of the total medical budget of the Directorate of Pharmaceuticals.

Total cost of the five most frequent cancer types in Northern Cyprus was also determined. The results of this study show that breast cancer treatment is the most costly one (35%), followed by colorectal (6%), lung (2%), and prostate cancer (2%) (Figure 4).

#### 4. Discussion

The current study is a comprehensive scientific study with regard to cancer in Northern Cyprus. The incidence and prevalence rate of cancer, epidemiology, sociodemographic features, and cost of drug treatment for cancer were all determined for this study. All the data used here are of a unique official nature, being obtained from the both public and private hospitals and from the Ministry of Health; therefore, they are the most complete available. However, patients who seek private care abroad or in South Cyprus are not included in the data. The results of this study showed that there was a sex difference in cancer types and most people involved were between 51 and 70 years old. The five most common cancer types among all patients were as follows: breast, prostate, colorectal, thyroid, and lung.

In 2010, the Ministry of Health carried out a survey consisting of five districts with a total of 7827 people. Adults aged 18 or over who were North Cyprus citizens and resident in private households in Northern Cyprus were the target population in this survey. The target population was selected to represent all the districts of Northern Cyprus, and a multistage sample procedure was used in



**Figure 2.** Distribution of most frequent cancer types by age.

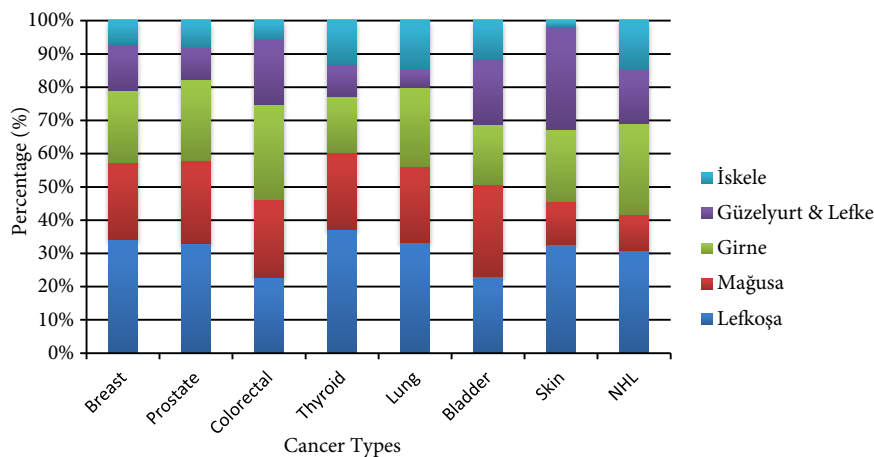


Figure 3. Distribution of most frequent cancer types by district.

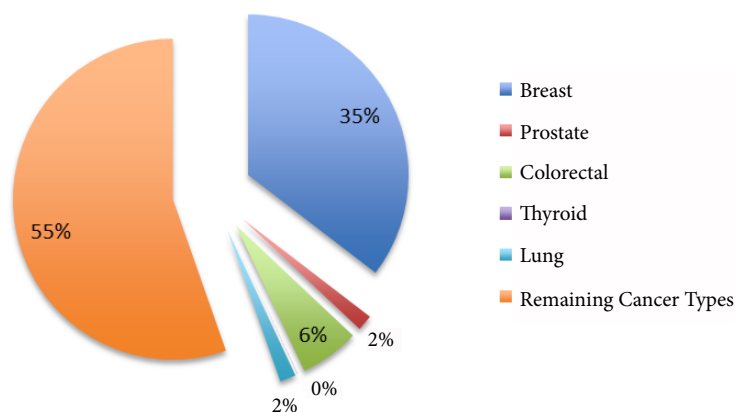


Figure 4. Distribution of the cost among different cancer types.

the design of the sample. The total number of interviews in each district was determined according to the proportion of the population aged 18 and over. The distribution of the selected population was as follows: 33.8% from Lefkoşa, 24.3% from Mağusa, 23.7% from Girne, 10.6% from Güzelyurt, and 7.7% from İskele. Each district was divided in two based on its level of urbanization. Urban and rural populations and all “regional units” were covered proportional to the number of the respective population aged 18 or above. Finally, sampling points in each region and houses on each street or village were selected randomly. Face-to-face interviews were used to collect information and participants were visited in their homes. The survey was conducted with a standard questionnaire developed by Cyprus Social and Economic Research Centre (KADEM). One member of each household was interviewed in order to obtain information about all the members of that household. In total, 2408 interviews were performed and information was collected for 7827

people. The survey was conducted between October and December 2010. The results from the survey showed that estimated crude incidence rate per 100,000 was 549.38. Compared with the Globacan findings on that date, the result had fifth place after Denmark, Germany, Italy, and Belgium (7).

According to the survey results, Mağusa had the highest incidence rate (0.695), followed by Girne (0.668), Lefkoşa (0.542), Güzelyurt (0.362), and İskele (0.145); and the five most frequent cancer types were breast (35.6%), prostate (13.3%), skin (8.9%), leukemia (8.9%), and ovarian cancer (6.7%). Colorectal cancer was in 6th place (6.6%), and lung cancer 9th place (4.4%) on the list (7). Some of the results of the current study were in accordance with this survey. The most common type of cancer was observed to be the breast followed by prostate in both studies. However, some findings are different from the current study such as the district with the highest rate of cancer. The approaches of the two studies are quite different. Considering that one of

them is a survey and thus contains a much smaller group of people from each district may be the reason for the differences in the two studies.

In another study, lung cancer had the highest incidence (24%) among males in North Cyprus (8). However, in the current study, lung cancer ranked third among males in frequency. It is well known that cigarette consumption and environmental carcinogens are associated with lung cancer. Tobacco use is a preventable cause of lung cancer. Like the rest of the world, awareness has increased in Northern Cyprus in recent years and tobacco use has declined. Furthermore, contamination from the environment, such as from the copper mines, has also declined as the mining area was cleared in 2007. These are some factors that may have contributed to a reduction in lung cancer rates in recent years.

Although in the current study skin cancer was not in the top five list for all cancers, in the study mentioned above (8), it was in fifth place in frequency among both men and women. The reason for this is probably exposure to the sun. Cyprus has the warmest climate in the Mediterranean with an average annual temperature of around 24 °C (75 °F) during the day and 14 °C (57 °F) at night, whereas the temperatures on the island are more extreme, with hotter summers (Department of Meteorology, Northern Cyprus). Considering that the summer is quite long, lasting 8 months, exposure to the sun is unavoidable. However, people are more aware of the harmful effects of the sun nowadays and they are more cautious, which might be the reason for the declining number of the cases.

Breast cancer and prostate cancer have the highest frequency among all cancers in the current study. These two cancers are both glandular in nature and therefore are hormone sensitive. However, it is thought that breast cancer is mainly hereditary in Northern Cyprus, and Hinçal et al. (8) indicated that further work is required to clarify this issue by determining the inheritance of mutated tumor related genes (e.g., BRCA1/2) status of breast cancer cases in Northern Cyprus.

It is interesting that in another study (9) it was suggested that cadmium has a triggering effect on breast cancer development, while arsenic is a carcinogenic metal causing skin, bladder, liver, lung, and prostate cancers. In that study, both cadmium and arsenic were found to be a threat in Northern Cyprus due to high concentrations in the soil, which might be another reason for the high frequency of breast and prostate cancers in Northern Cyprus. Moreover, screening opportunities in both cancers have increased, which may be an important factor in the increase in the number of breast and prostate cancer patients.

In the current study, colorectal cancer ranked third among all cancers. Colorectal cancer has a strong

correlation with various factors such as poor diet, physical inactivity, excess weight, and alcohol consumption, as well as pesticides and insecticides (10,11). Although colorectal cancer was in the third place overall, it was in second place in Güzelyurt District. This is an important observation, because Güzelyurt is an important area in terms of citrus fruit cultivation, where insecticides/pesticides are widely used. It is most probable that colorectal cancer is related to insecticide/pesticide use in Güzelyurt Region of Northern Cyprus.

Thyroid cancer was the second most common among females and was in fourth place among all cancers in the current study. Although the cause of thyroid cancer is not definite, it is known that the incidence of thyroid cancer in women is higher than that in men (12) and the results of the current study support this hypothesis. Thyroid cancer cases were highest in İskele District (10.5%). Among other risk factors relevant to thyroid cancer, it is known that iodine deficiency might be a cause of this disease (13,14). Further investigation is necessary to conclusively determine the reason for the high incidence rate in the region.

Regarding the cost of drug treatment, analysis of this study showed that 25% of the total medical costs of the Directorate of Pharmaceuticals are spent on cancer drugs. Breast cancer, with its high incidence and expensive treatments, was a tremendous burden for the Department of Pharmaceuticals, accounting for as much as 35% of the total cost of cancer treatment. In the EU, the highest economic cost appears to be from lung cancer (15% of overall cancer costs), followed by breast cancer (12% of overall cancer costs) (2). Results may vary between countries due to differences in study methodology, in incidence, and in management practices as well as the characteristics of the study population, whereas costs per patient depend on cancer stage at diagnosis, survival, and choice of treatment (15). Treatment costs for different types of cancer are expected to rise due to increased number of diagnoses (due to advances in diagnostic and surgical techniques), diagnosis at earlier stages, pharmaceutical innovations, expected growth and ageing of the population, and increased survival (15–17).

In conclusion, Güzelyurt-Lefke District had the highest cancer rate in Northern Cyprus. The reasons for the high incidence of cancer in Güzelyurt-Lefke must be determined by carrying out a thorough research study in the area, especially in terms of environmental factors such as effects of mining activity and use of agrochemicals. The frequency and cost were the highest for breast cancer, which is an important issue in terms of budget planning. Overall, a comprehensive cancer control and prevention plan for Northern Cyprus is necessary. There is an urgent need to establish a cancer registry in order to provide a

system for more complete and more representative national cancer registration, which will support effective cancer control. Regarding the cost, it is obvious that introduction of the new innovative cancer drugs, development of new diagnostic technologies, and increase in the longevity of the ageing population will increase the cost of cancer treatment. Therefore, it is important to deliver affordable cancer care systems and a sufficient budget must be allocated for treatment costs. These data will encourage the related official authorities to take the necessary

precautions in cancer control, to develop comprehensive prevention plans, and to develop a sustainable health care system.

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