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POPULATION-BASED CANCER STATISTICS FOR THE LAHORE DISTRICT, PAKISTAN

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ABSTRACT

Objectives

To estimate the population-level cancer estimates for the Lahore district, which is part of the Punjab Cancer Registry (PCR), Pakistan. The population of Lahore was estimated at 9.5 million in 2010.

Design

A cross-sectional study.

Setting

The Registry has nineteen collaborating centers in Lahore that report their data to the Central Office located within a tertiary care cancer treatment facility in Lahore, Pakistan.

Participants

Patients belonging to Lahore, of any age-group, and diagnosed with cancer in 2010, were included in the study. Patients were followed-up between July and October 2015 to determine their vital status.

Outcome measures

Summaries were generated for gender, diagnoses, deaths, and the basis of diagnosis. Five-year age categories were created from 0-4 till 70-74, followed by 75+ years. The Age-Standardized Incidence Rates (ASIR) were computed per 100,000 population. Death counts were reported by site.

Results

In 2010, in Lahore, a total of 5,302 new cancers were diagnosed-43% male and 57% female; 88·6% microscopically confirmed and 11·4% non-microscopically. The ASIR amongst males was 70·9 and amongst females 107·6. ASIRs of leading cancers, amongst men, were: prostate 6·2, urinary bladder 5·2, and Non-Hodgkin Lymphoma (NHL) 5·1, and amongst women: breast 49·9, ovary 4·6, and corpus uteri and NHL 3·5, each. A total of 1,656 deaths were recorded.

Conclusions

In Lahore, the ASIR was higher in women than in men. Amongst men, prostate cancer and in women breast cancer was the leading cancer types. These estimates can also be used for health promotion and policy making in the region.

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ARTICLE SUMMARY

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This is the first time that the age-standardized incidence rates have been presented for the Lahore district.
- A comparison has been made with the incidence rates reported by other registries around the world.
- There are follow-up issues related to determining the vital status of the patients, once they are registered as new cancer patients. Therefore, the limitation of the study is that the vital status of the vast majority of patients could not be determined.

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PAPER

POPULATION-BASED CANCER STATISTICS FOR THE LAHORE DISTRICT, PAKISTAN

INTRODUCTION

In the area of public health research, conducting high-quality, population-level studies, is hailed as the gold standard, as the outcomes truly represent the disease status of the community on whom the studies are being conducted. This includes the practice of population-based cancer registration, which not only assists in providing statistics and trends on incidence, mortality, and survival, it can also provide information on putative risk factors associated with various diseases within a defined population, living in a geographically demarcated area, over a specified period of time. However, cancer registration can only be undertaken if there is appropriate infrastructure to enable it, and suitable, well-trained staff to perform the tasks associated with it. Understandably, there is a cost associated with conducting this type of epidemiologic work, and in a resource-constrained country like Pakistan, governments are less likely to focus on the area of cancer registration than other areas deemed more immediately critical. Further, there is no legislation in the country that requires health-care practitioners to report diagnoses of cancer.

The question whether cancer registration is a necessity or a luxury in developing countries has been debated extensively over the years. A paper published in 2008 stated that in low-income countries, cancer registration is urgently needed so as to gauge the cancer burden in the region[1]. Given that Pakistan is categorized as a 'lower-middle income country' by the World Bank, with its population estimated to be 185·0 million in the year 2014, and the life expectancy at birth being 66 years (65 years for males and 67 years for females), it seems unlikely that registration of all cancer diagnoses will be accurate and complete at the national level in the near future[2]. However, there is no denying the fact that knowing the cancer burden in the region helps in projecting estimates, establishing the required numbers of health-care facilities to cater to the needs of the patients, training sufficient numbers of health-care practitioners to manage the conditions, addressing health education, and assisting in developing prevention, early detection, and cancer control programs in the region. Figure 1 is a map of Pakistan showing the provinces of Pakistan and countries adjacent to Pakistan[3].

Population-level statistics cannot be computed without the availability of figures for the population under review, or the catchment population. In Pakistan, publications describing the population structure are available for the census that was conducted in 1998[4]. However, the most recent population census, initiated a year ago, has not yet been completed[5]; therefore, accurate figures describing the Pakistani population are not available. As a result, for this study, population estimates are based on population figures determined by using the average annual growth rates provided by the Government of Pakistan[4].

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Even though accurate population figures are not available, enthusiastic professionals have, over the years, endeavored to determine cancer estimates for Pakistan. In the past, the regional registry of the Karachi South district, in the province of Sindh, was established and managed for several years by a dedicated pathologist, Dr. Yasmin Bhurgri[6]. This registry was widely recognized at an international level for its data quality[6]. However, due to the sudden death of Dr. Bhurgri in January 2012, this registry is no longer active. Another registry in Pakistan is the Punjab Cancer Registry (PCR), which was founded collaboratively by a group of health-professionals in 2005, pioneered by the administrators of a complete cancer treatment facility in Lahore called the Shaukat Khanum Memorial Cancer Hospital and Research Center (SKMCH & RC)[7-10]. The Punjab Cancer Registry, herein, referred to as the Registry, is registered with, and regulated under, the Societies Registration Act, 1860, of Pakistan[11]. It is also a member of the International Association of Cancer Registries, France[12]. The purpose of establishing the Registry was to determine the cancer estimates in the province of Punjab. Punjab is the most populous province of Pakistan, with a population estimated at 100M, and 36 administrative districts, of which Lahore is the most populous, with a population of some 9M[4,13]. For about a decade, data have been captured in a systematic and pre-defined manner, in accordance with the minimum data items required for cancer registries as well as some additional optional data items[7,10,14]. The quality of data collected for the Lahore district and the level of completeness have improved with the passage of time, with the number of cases reported to the Registry going up from 2,006 in the year 2005 to 5,123 in the year 2015 (Figure 2). Data are collected using both the active and passive methods of data collection from nineteen collaborating centers within the Lahore district, both in the government and private sectors (Appendix A). Information collected on paper-based forms is subsequently entered into the database developed within the computerized Hospital Information System, after checking for duplication. Some of the fields are automatically populated by linkages with the pathology records of the SKMCH & RC pathology department. Cancers are coded using the International Classification of Diseases, Clinical Modification, 10th revision[15]. Over recent years, six other districts have been included for the purpose of data collection, with the idea being to include 1-2 contiguous district(s) of Punjab every year in order to expand cancer registration. This approach has been adopted because the sponsor, SKMCH & RC, is a charitable organization, and it is logistically not possible to initiate data collection from 36 districts of Punjab simultaneously.

In the past, PCR data have been reported to the International Agency for Research on Cancer (IARC) in response to a call for data by the Agency. The data have been used, along with data from Dr. Yasmin Bhurgri's paper, and the Federal Bureau of Statistics, Pakistan, to provide cancer estimates for Pakistan in the Globocan 2012 report[16]. Between July and October 2015, an attempt was made to obtain follow-up data, by making phone calls to patients in order to determine their vital status; these data were again reported to IARC. We were able to contact only 60% of patients in this way.

This manuscript provides population-level cancer estimates for the Lahore district, based on cases diagnosed in 2010 and reported to the Registry. This is the first time that the Lahore district population-level data have been computed and are being reported.

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METHODS

The population denominator

The population of the Lahore district was estimated at 9,503,871 in the year 2010, determined using an average annual growth rate of 3·46%[4,13]. The total area of the Lahore district is 1,772 square kilometers, its population density being calculated as 5,363 persons, per square kilometer, in the year under study[4]. Figure 3 is a population pyramid showing the population distribution of the Lahore district by age-group and gender, for the year 2010. These population estimates were used as the population-at-risk denominator, for calculating the incidence rates for this study.

Data collection

The Punjab Cancer Registry data were reviewed retrospectively to retrieve information on cancer patients belonging to the Lahore district and having been diagnosed in the year 2010. Information was collected on new cancer diagnoses (by histology and gender), the most valid basis of diagnosis as microscopically versus non-microscopically confirmed, and deaths recorded. Five-year age categories were created beginning from 0-4 years and ending on 70-74 years, with all those above 75 included as 75+. Cases were stratified by age-group and histology/site.

Data analysis

Counts were determined and ASIRs computed according to 5-year age-group, weighted by the Segi World Standard population[17]. ASIRs were expressed per 100,000 population, separately for male and female patients. For mortality data, counts were stratified by site. Overall survival interval was computed between the dates of diagnosis and last contact and analyzed using the Kaplan-Meier method. Of a total of 5,302 cases recorded in the year 2010, survival intervals could not be computed for 2,530 cases (47·7%). This is because, of these 2,530 cases, attendants of 128 patients could only communicate that the patients had died but could not recall their dates of death; in 21 cases, patients died on the day of cancer diagnoses and their intervals were set at naught; and in 2,381 cases, no contact could be established on the phone numbers provided. Accordingly, the survival intervals of these 2,530 patients could not be confirmed and these patients were not included in the survival analysis. Although extensive survival analysis was subsequently done on the fifty percent of cases on whom the duration of survival was available, the survival estimates generated were not considered valid. Therefore, survival results are not being presented in this manuscript.

Data were analyzed using the Microsoft Excel, version 2010, and SPSS, version 19. The local Institutional Review Board (IRB) granted exemption from full IRB evaluation.

RESULTS

The population of the Lahore district was estimated to stand at 9,503,871 in the year 2010, with males accounting for 52·7% and females 47·3% of the population. Further, of a total of 5,302 cancer patients

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belonging to the district of Lahore and registered in the PCR database against the same year, 3,000 (56·6%) were female and 2,302 (43·4%) were male patients. Of all the cancers diagnosed, about 88·6% were microscopically and 11·4% were non-microscopically confirmed (Table 1). Skin cancer had the highest figure in the microscopically confirmed group (98·7%), whereas, liver and intrahepatic bile duct(s) had the highest figure in the non-microscopically confirmed category (76·1%). The ASIR for all sites combined amongst male patients was 70·9 per 100,000 men and in female patients, 107·6, per 100,000 women. Tables 2-3 show the ASIRs for all the cancers recorded in the Registry, for males and females, respectively. Amongst men, the highest ASIRs were recorded for the following sites and malignancies: prostate 6·2, bladder 5·2, NHL 5·1, trachea, bronchus, and lung 4·8, liver 4·2, and brain and CNS 4·2, whereas, amongst females, the highest ASIRs were: breast 49·9, ovary 4·6, corpus uteri 3·5, NHL 3·5, cervix uteri 3·1, and brain and CNS 2·7.

Table 1. The basis of diagnosis, categorized as being microscopically and non-microscopically confirmed (N=5,302).

	The basis of diagnosis	
Cancer site	**Microscopic (%)**	**Non-Microscopic (%)**
Lip & oral cavity	92.4	7.6
Esophagus	97.4	2.6
Stomach	97.6	2.4
Colorectal	92.6	7.4
Liver & intrahep. bile ducts	23.9	76.1
Gall bladder	75.0	25.0
Larynx	90.5	9.5
Bronchus & lung	90.1	9.9
Bone	92.6	7.4
Connective tissue	93.2	6.8
Leukemia	77.1	22.9
Breast	91.7	8.3
Cervix uteri	91.9	8.1
Corpus uteri	94.0	6.0
Testis	96.8	3.2
Prostate	94.5	5.5
NHL	89.5	10.5
Hodgkin lymphoma	93.3	6.7
Urinary bladder	94.4	5.6
Brain	95.2	4.8
Skin	98.7	1.3
Ovary	87.0	13.0

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Table 2. Age-specific and age-standardized incidence rates of cancers diagnosed in the Lahore district in 2010, amongst males.

Male		Age-specific incidence rates																			
Site	All ages (years)	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+	Crude	%	ASIR	ICD-10
Lip	10	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.3	0.0	0.0	1.1	0.9	3.9	1.6	0.0	0.0	0.2	0.4	0.3	C00
Tongue	72	0.0	0.0	0.0	0.0	0.8	0.2	1.4	1.7	4.8	4.8	4.0	5.2	6.8	9.6	14.7	3.6	1.4	3.1	2.2	C01-C02
Mouth	83	0.0	0.2	0.2	0.0	0.2	0.2	0.9	1.4	3.6	6.4	5.7	9.5	13.7	16.0	9.2	1.8	1.7	3.6	2.7	C03-C06
Salivary gland	16	0.0	0.0	0.2	0.0	0.0	0.2	0.6	0.7	0.4	0.5	1.1	0.9	1.0	1.6	3.7	1.8	0.3	0.7	0.5	C07-C08
Tonsil	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	C09
Other oropharynx	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	1.8	0.0	0.0	0.1	0.1	C10
Nasopharynx	7	0.0	0.0	0.0	0.0	0.2	0.0	0.6	0.0	0.0	0.0	0.6	0.9	2.0	0.0	0.0	0.0	0.1	0.3	0.2	C11
Hypopharynx	10	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.0	0.0	1.1	0.9	1.0	0.0	3.7	3.6	0.2	0.4	0.3	C12-C13
Pharynx	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	C14
Esophagus	43	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.8	3.8	2.3	2.6	4.9	9.6	11.0	12.4	0.9	1.9	1.5	C15
Stomach	61	0.0	0.0	0.0	0.0	0.0	2.0	0.9	1.7	2.0	4.3	4.6	5.2	3.9	16.0	5.5	1.8	1.2	2.6	1.9	C16
Small intestine	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.5	1.1	0.9	1.0	1.6	0.0	3.6	0.2	0.4	0.3	C17
Colon	84	0.0	0.0	0.0	0.2	0.4	0.7	0.6	1.4	2.0	6.4	6.9	8.6	9.8	22.5	7.4	8.9	1.7	3.6	2.8	C18
Rectum	59	0.0	0.0	0.0	0.0	0.6	0.7	1.4	1.0	1.6	3.2	5.7	4.3	5.9	16.0	3.7	3.6	1.2	2.6	1.9	C19-C20
Anus	17	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.4	0.0	2.9	2.6	2.0	4.8	1.8	0.0	0.3	0.7	0.6	C21
Liver	117	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	1.6	4.8	12.0	13.8	16.6	35.3	20.3	17.8	2.3	5.1	4.2	C22
Gall bladder	26	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.3	0.0	0.0	2.9	3.5	2.0	9.6	3.7	7.1	0.5	1.1	0.9	C23-C24
Pancreas	17	0.0	0.0	0.0	0.0	0.2	0.0	0.3	0.0	1.6	1.6	0.0	3.5	0.0	3.2	3.7	0.0	0.3	0.7	0.5	C25
Nose, sinus	8	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.3	0.4	0.0	0.0	2.6	0.0	0.0	1.8	0.0	0.2	0.3	0.2	C30-31
Larynx	66	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.7	1.2	6.4	4.6	9.5	11.7	12.8	12.9	1.8	1.3	2.9	2.3	C32
Trachea, bronchus, lung	132	0.0	0.0	0.0	0.0	0.0	0.2	0.9	1.0	1.6	4.3	5.7	19.0	21.5	32.1	35.0	35.5	2.6	5.7	4.8	C33-C34
Other thoracic organ(s)	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	2.9	0.0	1.0	0.0	5.5	1.8	0.2	0.5	0.4	C37-C38
Bone	49	0.0	0.6	0.9	3.2	1.4	0.5	1.2	0.3	0.0	0.0	0.6	0.0	2.9	0.0	3.7	1.8	1.0	2.1	0.9	C40-C41
Melanoma of the skin	2	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	C43
Other skin	92	0.0	0.2	0.3	0.4	0.2	1.2	2.3	1.7	1.6	3.2	2.9	9.5	11.7	22.5	14.7	14.2	1.8	4.0	3.0	C44
Connective & soft tissue	55	0.3	0.3	0.2	1.4	1.0	0.7	0.9	2.1	0.4	4.8	1.1	2.6	2.9	3.2	5.5	3.6	1.1	2.4	1.4	C47,C49
Breast	19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.2	0.5	0.6	2.6	2.0	9.6	0.0	3.6	0.4	0.8	0.7	C50
Prostate	165	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	1.1	2.9	13.0	22.5	36.9	70.0	101.3	3.3	7.2	6.2	C61
Testis	31	0.2	0.0	0.0	0.9	0.6	0.7	0.6	2.1	2.0	0.5	1.1	0.0	1.0	1.6	0.0	1.8	0.6	1.3	0.7	C62
Kidney	53	0.8	0.2	0.0	0.0	0.0	0.2	0.3	0.7	2.4	3.2	2.3	7.8	6.8	8.0	3.7	7.1	1.1	2.3	1.7	C64
Bladder	142	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.3	1.6	4.8	6.3	17.3	24.4	40.1	33.1	46.2	2.8	6.2	5.2	C67
Eye	25	1.0	0.5	0.0	0.2	0.2	0.2	0.0	0.3	0.0	1.1	0.6	0.9	2.0	1.6	7.4	1.8	0.5	1.1	0.7	C69
Brain, CNS	160	0.3	1.4	0.6	0.7	1.2	3.7	5.5	3.8	5.2	7.0	14.3	14.7	10.7	9.6	5.5	3.6	3.2	7.0	4.2	C70-C72
Thyroid	23	0.0	0.0	0.0	0.4	0.2	1.0	0.6	0.0	1.2	1.1	0.6	2.6	1.0	1.6	5.5	0.0	0.5	1.0	0.6	C73
Adrenal	2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.1	0.1	C74
Hodgkin lymphoma	77	0.3	1.8	0.5	1.4	0.2	1.7	1.4	2.4	3.2	2.7	2.3	6.1	2.0	6.4	3.7	0.0	1.5	3.3	1.8	C81
NHL	179	0.5	1.1	1.4	1.3	2.2	1.0	4.0	3.1	4.8	5.9	11.4	8.6	26.4	22.5	20.3	17.8	3.6	7.8	5.1	C82-C88
Multiple myeloma	20	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.0	1.1	1.7	3.5	3.9	3.2	3.7	1.8	0.4	0.9	0.7	C90
Lymphoid leukemia	64	3.1	1.5	2.3	0.7	0.8	0.7	0.3	0.0	1.2	0.0	0.0	0.0	1.0	3.2	1.8	1.8	1.3	2.8	1.2	C91
Myeloid leukemia	27	0.3	0.5	0.2	0.4	1.0	0.5	0.6	0.7	0.4	0.5	1.1	0.9	2.0	0.0	0.0	1.8	0.5	1.2	0.6	C92-93
Leukemia unspecified	22	0.7	0.6	0.0	0.4	1.0	0.2	0.9	0.0	0.0	1.1	0.0	0.9	0.0	0.0	0.0	0.0	0.4	1.0	0.4	C95
Other & unspecified	172	0.0	0.2	0.9	0.9	0.4	2.0	2.9	4.2	4.0	6.4	12.6	10.4	20.5	17.7	31.3	40.9	3.4	7.5	5.3	Other & unspecified
Benign CNS	67	0.2	0.2	0.3	0.5	0.6	1.7	2.9	3.1	2.0	4.8	1.7	0.9	7.8	3.2	5.5	0.0	1.3	2.9	1.7	Benign CNS
All sites (total)	2302	7.7	9.1	7.9	13.3	14.7	21.6	34.2	40.9	53.8	98.2	129.2	197.1	259.9	385.2	362.8	353.7	46.2	100.0	70.9	

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Table 3. Age-specific and age-standardized incidence rates of cancers diagnosed in the Lahore district in 2010, amongst females.

Female		Age-specific incidence rates																			
	All ages (years)	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+	Crude	%	ASIR	ICD-10
Lip	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	4.9	0.0	0.1	0.1	0.2	C00
Tongue	43	0.0	0.0	0.0	0.0	0.2	0.0	0.3	1.2	1.0	3.7	6.9	5.4	7.2	9.9	9.8	0.0	1.0	1.4	1.7	C01-C02
Mouth	34	0.0	0.0	0.0	0.4	0.2	0.6	0.0	0.4	1.9	0.6	4.1	4.4	6.0	2.0	12.3	4.5	0.8	1.1	1.3	C03-C06
Salivary gland	14	0.0	0.0	0.2	0.0	0.0	0.6	0.3	1.2	0.0	0.0	2.1	2.2	0.0	4.0	0.0	0.0	0.3	0.5	0.5	C07-C08
Tonsil	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	C09
Nasopharynx	6	0.0	0.0	0.0	0.2	0.0	0.0	0.3	0.0	1.0	0.0	0.0	1.1	0.0	0.0	2.5	0.0	0.1	0.2	0.2	C11
Hypopharynx	12	0.0	0.0	0.0	0.0	0.4	0.0	0.3	0.8	0.0	0.6	0.7	1.1	1.2	0.0	4.9	2.3	0.3	0.4	0.4	C12-C13
Esophagus	33	0.0	0.0	0.0	0.0	0.0	0.3	0.0	1.2	2.4	4.3	2.8	0.0	7.2	6.0	7.4	2.3	0.7	1.1	1.3	C15
Stomach	24	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.4	1.0	3.1	2.1	2.2	6.0	6.0	0.0	2.3	0.5	0.8	1.0	C16
Small intestine	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	1.1	0.0	0.0	7.4	2.3	0.1	0.2	0.3	C17
Colon	64	0.0	0.0	0.2	0.6	0.4	1.1	1.7	2.5	1.4	2.5	6.9	7.6	4.8	19.8	7.4	4.5	1.4	2.1	2.4	C18
Rectum	42	0.0	0.0	0.2	0.2	0.9	1.7	1.3	0.8	2.9	0.0	2.8	4.4	4.8	6.0	4.9	2.3	0.9	1.4	1.4	C19-C20
Anus	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.1	0.1	0.1	C21
Liver	59	0.0	0.0	0.0	0.0	0.2	0.3	0.3	0.0	0.5	7.4	6.9	15.2	8.4	15.9	7.4	2.3	1.3	2.0	2.5	C22
Gall bladder	46	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.8	2.4	3.1	4.1	6.5	12.1	4.0	4.9	13.5	1.0	1.5	1.9	C23-C24
Pancreas	13	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.4	0.5	0.6	0.7	2.2	0.0	9.9	2.5	0.0	0.3	0.4	0.6	C25
Nose, sinus	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.6	0.7	0.0	4.8	2.0	2.5	0.0	0.2	0.3	0.4	C30-31
Larynx	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.4	1.1	1.2	0.0	0.0	4.5	0.2	0.3	0.3	C32
Trachea, bronchus, lung	30	0.0	0.0	0.2	0.4	0.0	0.3	0.7	0.4	1.4	2.5	1.4	3.3	4.8	4.0	7.4	4.5	0.7	1.0	1.1	C33-C34
Other thoracic organ(s)	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	1.2	0.0	1.1	0.0	0.0	0.0	0.0	0.1	0.2	0.2	C37-C38
Bone	32	0.2	0.2	1.2	1.7	1.3	0.3	0.3	1.7	0.5	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.7	1.1	0.6	C40-C41
Melanoma of the skin	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	2.0	0.0	2.3	0.1	0.1	0.1	C43
Other skin	59	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.8	2.9	5.0	3.5	3.3	10.8	21.8	19.6	13.5	1.3	2.0	2.6	C44
Connective & soft tissue	40	0.3	0.2	0.3	0.2	0.9	1.7	1.0	1.7	1.0	0.6	3.5	1.1	2.4	4.0	2.5	6.8	0.9	1.3	1.2	C47,C49
Breast	1390	0.0	0.0	0.0	0.2	3.1	14.2	35.8	60.3	93.3	131.8	145.9	167.6	149.5	148.8	135.0	103.5	30.9	46.3	49.9	C50
Vulva	3	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	2.3	0.1	0.1	0.1	C51
Vagina	5	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.4	0.0	0.6	0.0	0.0	1.2	0.0	0.0	2.3	0.1	0.2	0.2	C52
Cervix uteri	86	0.0	0.0	0.0	0.0	0.4	0.3	1.3	5.0	5.3	11.8	6.2	12.0	13.3	2.0	4.9	6.8	1.9	2.9	3.1	C53
Corpus uteri	83	0.0	0.0	0.0	0.0	0.0	0.3	0.7	2.9	1.4	6.2	9.0	13.1	20.5	17.9	14.7	6.8	1.8	2.8	3.5	C54
Uterus, unspecified	34	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	2.9	5.0	3.5	3.3	7.2	4.0	4.9	0.0	0.8	1.1	1.3	C55
Ovary	138	0.0	0.2	0.5	0.4	1.8	2.3	2.7	5.8	9.6	10.5	13.1	14.2	16.9	13.9	9.8	0.0	3.1	4.6	4.6	C56
Other female gen. organ(s)	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.7	0.0	2.4	0.0	2.5	0.0	0.1	0.2	0.2	C57
Placenta	3	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	C58
Kidney	35	0.5	0.2	0.0	0.0	0.4	0.0	0.0	0.8	2.4	2.5	3.5	7.6	2.4	2.0	2.5	4.5	0.8	1.2	1.2	C64
Bladder	35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.4	1.9	2.1	4.4	6.0	7.9	12.3	13.5	0.8	1.2	1.5	C67
Eye	8	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	1.2	2.0	0.0	2.3	0.2	0.3	0.3	C69
Brain, CNS	84	0.2	0.8	0.7	0.6	0.9	1.4	1.3	2.1	5.3	6.2	8.3	8.7	6.0	9.9	2.5	2.3	1.9	2.8	2.7	C70-C72
Thyroid	71	0.0	0.2	0.2	0.4	1.8	1.4	1.7	3.7	5.3	4.3	5.5	1.1	10.8	2.0	4.9	2.3	1.6	2.4	2.2	C73
Hodgkin lymphoma	27	0.3	0.3	0.2	0.4	1.1	1.4	0.0	1.7	1.0	1.2	0.0	1.1	0.0	0.0	2.5	0.0	0.6	0.9	0.6	C81
NHL	96	0.2	0.5	0.0	1.0	0.7	0.3	1.3	2.9	4.8	7.4	7.6	6.5	10.8	9.9	19.6	24.8	2.1	3.2	3.5	C82-C88
Multiple myeloma	13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.2	0.0	1.1	2.4	7.9	4.9	0.0	0.3	0.4	0.6	C90
Lymphoid leukemia	30	1.2	1.4	1.3	0.0	0.2	0.0	0.3	0.0	0.5	0.0	0.0	2.2	1.2	0.0	0.0	0.0	0.7	1.0	0.6	C91
Myeloid leukemia	15	0.0	0.2	0.0	0.2	0.2	0.3	0.0	0.8	0.5	0.6	2.1	3.3	0.0	0.0	2.5	0.0	0.3	0.5	0.5	C92-93
Leukemia unspecified	8	0.2	0.2	0.3	0.0	0.2	0.3	0.3	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.2	C95
Other & unspecified	166	0.2	0.0	0.2	0.4	0.7	1.7	2.7	5.8	7.2	9.9	15.9	20.7	19.3	33.7	34.4	24.8	3.7	5.5	6.4	Other & unspecified
Benign CNS	73	0.3	0.2	0.5	1.1	0.4	2.3	2.0	5.4	3.8	3.7	3.5	4.4	4.8	4.0	4.9	2.3	1.6	2.4	2.1	Benign CNS
All sites (total)	3000	3.9	4.7	6.1	8.2	17.0	34.1	58.5	114.9	169.2	242.6	278.0	339.6	358.0	383.0	375.6	265.6	66.7	100.0	107.6	

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Of the 5,302 patients, death was recorded in 1,656 (31·2%) cases by the cut-off date for this study; this included 791 male and 865 female patients. One-thousand, two-hundred and sixty-five patients were still alive (23·9%) at the time of review, whereas, the vital status of 2,381 patients (44·9%) could not be determined. Death certificates were available for only 8% of patients (127/1,656), representing just one collaborating center. Table 4 displays death counts and proportion by cancer sites.

Table 4. Distribution of deaths recorded (1,656 (791 male and 865 female patients)), of the patients diagnosed with cancer in the Lahore district in 2010, according to gender and cancer type (top 10 cancers only).

Males	Count	%	Female	Count	%
Brain	74	9	Breast	330	38
Lip & oral cavity	58	7	Ovary	47	5
Liver & intrahep. bile ducts	56	7	Colorectal	42	5
Colorectal	53	7	Brain	41	5
Bronchus & lung	51	6	NHL	33	4
NHL	51	6	Liver & intrahep. bile ducts	28	3
Prostate	49	6	Lip & oral cavity	25	3
Urinary bladder	46	6	Leukemia	20	2
Leukemia	45	6	Cervix	19	2
Larynx	22	3	Corpus uteri	17	2

Of the deaths recorded, in male patients, 9% were in those who had brain tumor, 7% each in those with lip & oral cavity, liver & intrahepatic bile ducts, and colorectal tumors, 6% each in cancers of the bronchus & lung, NHL, prostate, urinary bladder, and leukemia, and 3% in laryngeal carcinoma. Amongst females, 38% deaths were recorded in those who had breast cancer, 5% each in those who had ovarian, colorectal, and brain tumors, 4% in NHL, 3% each in those who had liver & intrahepatic bile ducts and lip & oral cavity tumors, and 2% each in those who had leukemia and cancer of the cervix and corpus uteri.

DISCUSSION

The results reported for the population of the Lahore district show that over 5,000 cancer cases were reported in 2010. The ASIR for all-cancers combined was higher amongst females (107·6) than in males (70·9). These results also included the ASIRs for benign CNS tumors and other/unspecified sites. The ASIRs reported by the Surveillance, Epidemiology, and End Results (SEER) Program of the United States of America (USA), are very high (359·4 for females and 282·6 for males)[18,19]. These figures represent SEER 18 registries compiling data from all cases diagnosed since 2000 and covering approximately 30% of the US population[18,19]. The ASIRs published in the CI5-X report for Delhi in India and Riyadh in Saudi Arabia, are close to the Lahore district figures as opposed to the SEER rates; in fact, the ASIRs for females in these three regions are quite similar to one another. It is important to point out that Delhi,

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located in India, to the east of Lahore, is closer to Lahore than is Karachi located in Southern Pakistan. As far as the South Karachi Registry is concerned, based on the last report (1998-2002) released in CI5-IX, it can be seen that the ASIRs for Karachi were relatively high (192·0 for females and 166·6 for males) as compared to those for the Lahore district. Further, in the region of Golestan in Iran (2005-2007), and for Israel, again the ASIRs were high compared to those reported for the Lahore district[19]. For the SEER Program, Delhi, Iran, and Saudi Arabia, data were reported for the 2003-2007 time period. Table 5 shows a comparison of the ASIRs according to cancer sites, though not all sites, in the aforementioned regions of the world. In women belonging to the Lahore district, the ASIR of breast cancer ranked the highest (49·9) of all the cancers, and was higher than that for Delhi (31·6), but relatively low compared to that reported for the Israeli Jews (89·4). Amongst men in the Lahore district, the ASIR of prostate cancer was the highest (6·2) of all the cancers, but was lower than that reported for Delhi (10·1) and Riyadh (7·9). The ASIR of cervical cancer in Lahore was 3·1 but in Delhi it was much higher, at 17·7; this is despite the fact that the screening levels are low in the general population of India[20]. Other than this, of the factors implicated in the etiology of cervical cancer in the Indian population (early age at marriage, having multiple sexual partners and pregnancies, poor genital hygiene, malnourishment, use of oral contraceptives, low level of awareness, and prevalence of specific oncogenic types of Human Papilloma Viruses (HPV) 16 and 18 that can be easily spread through direct sexual contact), some are also found in the Pakistani population. Although, not many population-level studies have been conducted to determine the HPV prevalence in Pakistan, one study reports HPV positivity to be nearly 2·8% in the general population (25/899) and about 92% in patients with invasive cervical cancer (83/91)[21]. These figures demonstrate that extensive population-level studies are needed to decipher the role of HPV in causing cervical cancer in Pakistan. However, in India, it has been reported that HPV prevalence varies from 7·5% to 16·9% in women without cervical cancer as opposed to 87·8% to 96·7% amongst cervical cancer patients[20].

As far as the mortality data are concerned, since the vital status of all the patients could not be recorded, our results have to be interpreted with caution. The highest mortality was recorded in patients diagnosed with breast cancer amongst females, and amongst those with brain tumors in males. Due to the non-availability of the vital status of nearly half of the patients, the survival statistics could not be reported either. The establishment of a death registry in the region could help in collecting the mortality data and determining the cause-specific mortality, along with the survival estimates for the study population.

The fact that nearly 13% were non-microscopically confirmed cancers as opposed to nearly 87% that were microscopically confirmed, is a quality index for the data.

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Table 5. ASIRs, per 100,000 population, for selected cancer sites, in Pakistan, India, Iran, Israel, and USA.

	Pakistan	Pakistan	India	Iran	Saudi Arabia	Israel	USA
	Lahore	Karachi	New Delhi	Golestan	Riyadh	Jews	SEER
	2010	1998-2002	2003-2007	2005-2007	2003-2007	2003-2007	2003-2007
Oral cavity & salivary gland-C00-C08							
Male	5.7	22.5	14.0	1.7	1.6	3.3	6.9
Female	3.7	20.4	4.7	1.3	1.4	2.3	3.1
Pharynx-C09-C14							
Male	0.7	8.2	6.6	1.0	2.4	1.5	4.4
Female	0.7	3.4	1.5	0.7	1.3	0.5	1.1
Oesophagus-C15							
Male	1.5	6.7	4.9	23.2	1.6	1.8	5.1
Female	1.3	8.6	2.9	18.8	1.3	0.9	1.2
Stomach-C16							
Male	1.9	6.0	3.2	30.4	4.4	10.0	6.6
Female	1.0	3.6	1.5	12.6	2.3	5.4	3.3
Small intestine-C17							
Male	0.3	0.2	0.2	1.4	0.5	1.0	1.5
Female	0.3	0.4	0.1	0.9	0.3	0.7	1.1
Colo-rectum-C18-C21							
Male	5.3	7.1	5.5	13.6	12.5	42.8	35.3
Female	3.9	5.2	3.7	10.4	10.6	32.6	26.5
Liver-C22							
Male	4.2	5.4	2.6	3.6	3.0	3.1	7.6
Female	2.5	3.7	1.5	2.0	6.0	1.4	2.4
Gall bladder-C23-C24							
Male	0.9	1.3	4.0	1.2	1.2	1.7	1.7
Female	1.9	4.9	8.0	1.6	2.5	1.4	1.7
Pancreas-C25							
Male	0.5	0.9	1.9	2.8	3.2	8.6	8.2
Female	0.6	0.5	1.1	1.0	1.9	6.4	6.2
Nose & sinus-C30-C31							
Male	0.2	0.7	0.3	0.0	0.2	0.4	0.6
Female	0.4	0.4	0.2	0.2	0.2	0.3	0.4
Larynx-C32							
Male	2.3	10.7	8.0	4.1	1.7	4.1	4.3
Female	0.3	1.8	1.1	1.4	0.1	0.6	0.9
Trachea, bronchus, & lung-C33-C34							
Male	4.8	25.2	13.7	17.5	6.3	29.8	48.3
Female	1.1	3.6	3.6	5.6	2.2	13.4	33.8
Bone-C40-C41							
Male	0.9	1.3	2.0	1.3	0.8	1.3	1.0
Female	0.6	1.5	1.2	1.5	0.5	1.0	0.8
Melanoma of the skin-C43							
Male	0.0	0.5	0.2	0.9	0.3	13.7	16.8
Female	0.1	0.3	0.2	0.7	0.4	11.2	12.0
Skin-C44							
Male	3.0	4.3	1.3	11.0	3.8	2.8	1.3
Female	2.6	4.1	1.0	7.7	3.2	1.9	1.0
Connective & soft tissue-C47-C49							
Male	1.4	2.4	1.5	2.1	1.3	3.2	3.0
Female	1.2	2.3	1.2	2.1	0.9	2.2	2.1
Breast-C50							
Male	0.7	1.0	1.3	0.1	0.5	1.3	0.7

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Female	49.9	69.0	31.6	28.0	21.1	89.4	86.6
Cervix-C53							
Female	3.1	7.5	17.7	5.4	2.0	5.5	6.4
Uterus-C54							
Female	3.5	6.7	4.5	1.7	4.4	14.4	16.7
Ovary-C56-C57.0-4							
Female	4.8	8.8	8.6	6.1	3.3	9.2	9.6
Other female genital organ(s)-C51-C52, C55, C58							
Female	1.7	1.0	1.6	1.4	0.9	1.8	2.5
Penis-C60							
Male	-	0.1	1.0	0.0	0.1	0.3	0.7
Prostate-C61							
Male	6.2	10.1	10.1	10.6	7.9	68.3	106.8
Testis-C62							
Male	0.7	1.2	0.6	2.3	0.6	4.7	4.9
Kidney, etc.-C64, C66, C68							
Male	1.7	1.9	2.7	2.2	3.8	13.9	137.0
Female	1.2	0.8	1.2	1.2	2.5	6.5	7.1
Bladder-C67							
Male	5.2	9.3	6.5	8.5	5.6	25.5	20.8
Female	1.5	2.6	1.5	2.8	1.3	4.8	5.3
Eye-C69							
Male	0.7	0.6	0.3	0.4	0.4	0.6	0.8
Female	0.3	0.3	0.2	0.2	0.2	0.4	0.6
Brain, CNS-C70-C72							
Male	4.2	3.3	3.8	7.8	3.5	6.7	6.4
Female	2.7	2.7	2.4	5.3	2.1	5.0	4.6
Thyroid-C73							
Male	0.6	0.7	1.1	1.2	2.5	4.8	3.9
Female	2.2	2.9	**2.5**	3.0	10.2	14.7	12.3
Adrenal & other endocrine-C74-C75							
Male	0.1	0.2	0.2	0.7	0.3	0.6	0.5
Female	-	0.3	0.2	0.4	0.2	0.5	0.4
Hodgkin lymphoma-C81							
Male	1.8	2.0	1.6	1.8	2.2	3.6	2.7
Female	0.6	1.0	0.7	1.1	2.0	3.4	2.2
NHL-C82-C86, C96							
Male	5.1	7.6	5.6	7.2	8.6	17.9	15.5
Female	3.5	5.1	3.0	3.3	7.1	14.4	10.8
Multiple myeloma-C88, C90							
Male	0.7	1.8	2.0	2.4	1.8	4.8	4.7
Female	0.6	1.3	1.2	2.2	1.0	3.0	3.1
Leukemia-C91-C95							
Male	2.2	4.8	5.6	10.8	5.7	10.6	11.1
Female	1.2	4.1	3.6	7.7	4.3	6.9	7.1
All sites-C00-C96							
Male	70.9	166.6	119.7	165.3	104.1	273.1	359.4
Female	107.6	192.0	118.4	142.0	103.9	308.5	282.6

CONCLUSION

This is the first time that an attempt has been made to determine and report the population-based cancer statistics for the Lahore district. This collaborative study highlights cancer registration and follow-

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up issues in a developing country like Pakistan, along with the non-availability of recent, accurate population estimates required as denominators in computation of the incidence rates. Over 5,300 new cancer cases were reported in the Lahore district, in the year 2010 (Figure 2). Although it is likely that all the cases have not been reported for the year 2010, it is not possible to gauge the extent of under-reporting at this stage. The cancer statistics reported in this manuscript can be used as baseline figures for comparison with studies to be undertaken in the future. These statistics can also assist in highlighting the putative risk factors associated with cancers commonly diagnosed in the region, as part of a health promotion and education program. Finally, this report can play an important role in developing prevention, early detection, and cancer control strategies in the region.

FOOTNOTES

Contributors

FB conceived the idea of the study, designed it, supervised the statistical analysis, did literature search, interpreted the results, and drafted the manuscript. FB further did the survival analysis for this study. SMa did the case-finding, coding, and indexing of cases from SKMCH & RC and computed the incidence rates and created figures and tables; RF and AY validated the data, checked for duplication, and followed-up on the patients; and AQ and KLA worked on the comparison of the incidence rates with other regions. MAY reviewed the paper critically. MM was responsible for reporting the cancers recorded at the Institute of Nuclear Medicine and Oncology, Lahore; GRS from Ittefaq Hospital, Lahore; TM from Fatima Jinnah Medical University, Lahore; ORC from Chughtais Lahore Lab., Lahore; NC from Sheikh Zayed Hospital, Lahore; SR from Fatima Memorial Hospital, Lahore; TA from Allama Iqbal Medical College, Lahore; GH from the Children's Hospital & the Institute of Child Health, Lahore; RB from the Services Institute of Medical Sciences, Lahore; BAS from Nawaz Shairf Social Security Hospital, Lahore; and ZA and MAK from Jinnah Hospital, Lahore. NS contributed intellectually to the study. MTM, SMu, and AL did the pathologic confirmation of cases at SKMCH & RC, Lahore. SMa supervised, FB managed, and MAY and FS established and directed the Punjab Cancer Registry.

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None for this study.

Competing interests

We declare no competing interests.

Data sharing statement

No additional data available.

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We thank the professionals representing various centers in the region for reporting their data to the Punjab Cancer Registry. We also thank the staff of the unit Cancer Registry and Clinical Data Management, SKMCH & RC, on making additional efforts to complete cancer registration, following international guidelines, thus, enabling us to complete the study.

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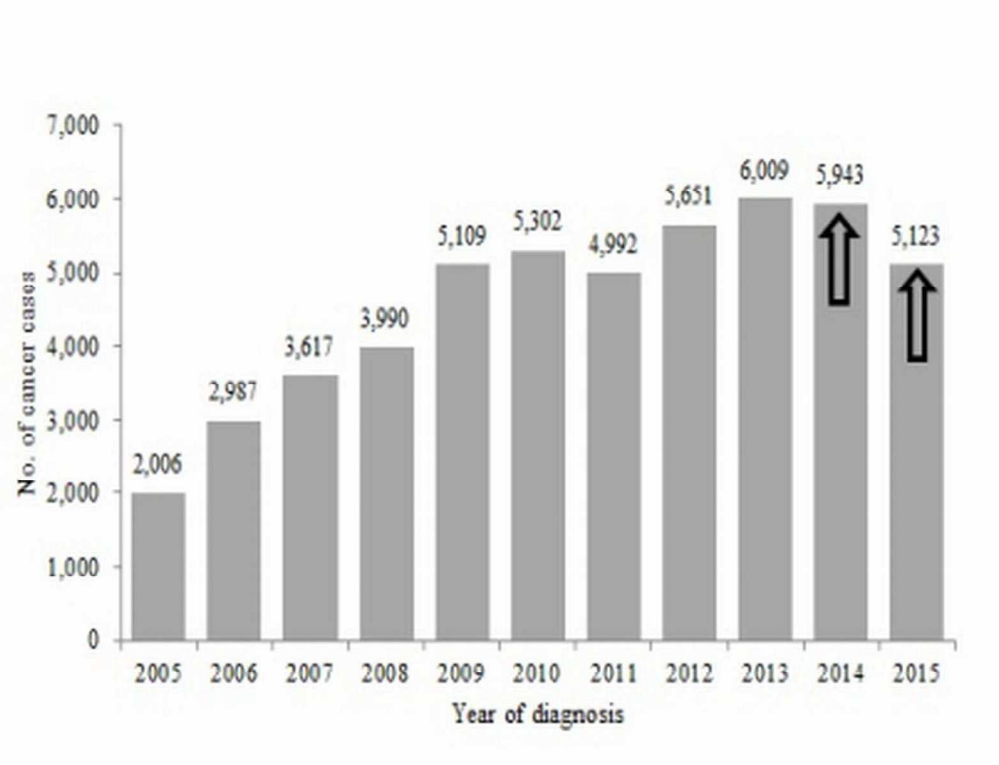

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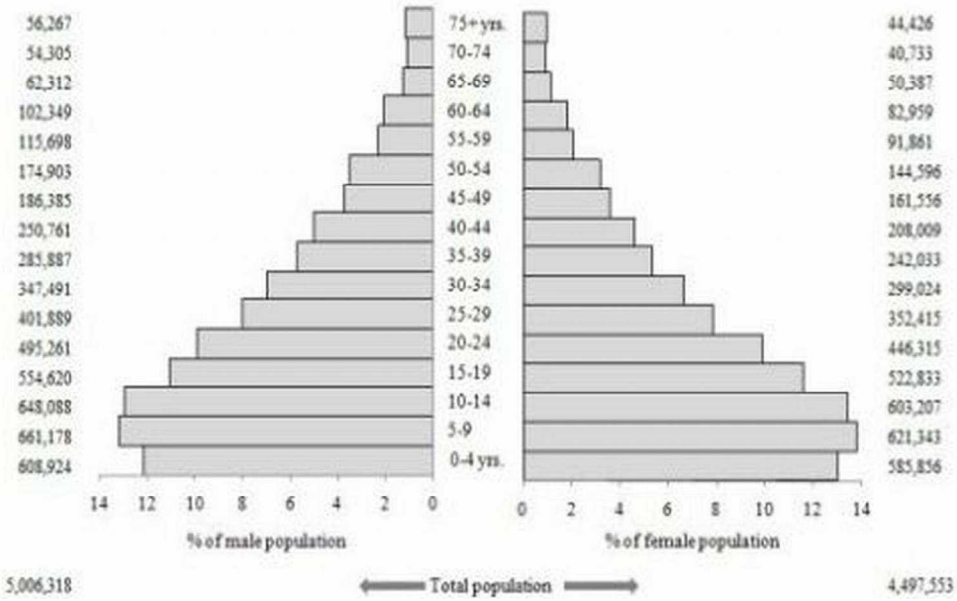

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Appendix A-List of collaborating centers: Centers 1-13 contributed data in 2010 and are listed in descending order of the number of cases reported, to the Punjab Cancer Registry.

S. No.	Center name
1	Shaukat Khanum Memorial Cancer Hospital & Research Center, Lahore.
2	Institute of Nuclear Medicine and Oncology, Lahore.
3	Ittefaq Hospital, Lahore.
4	Fatima Jinnah Medical University, Lahore.
5	Chughtais Lahore Lab., Lahore.
6	Sheikh Zayed Hospital, Lahore.
7	Fatima Memorial Hospital, Lahore.
8	The Children's Hospital & the Institute of Child Health, Lahore.
9	Allama Iqbal Medical College, Lahore.
10	Services Institute of Medical Sciences, Lahore.
11	Nawaz Sharif Social Security Hospital, Lahore.
12	Jinnah Hospital, Lahore.
13	King Edward Medical University, Lahore.
14	Shalamar Hospital, Lahore.
15	Combined Military Hospital, Lahore.
16	Akhtar Saeed Medical & Dental College, Lahore.
17	Post Graduate Medical Institute, Lahore.
18	Pride Lab., Lahore.
19	Indus Lab., Lahore.

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract-**page 7**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found- **page 7**
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported-page **9-10**
Objectives	3	State specific objectives, including any pre-specified hypotheses-**page 10**
Methods		
Study design	4	Present key elements of study design early in the paper-**page 11**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection-**page 11**
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants-**pages 9-11**
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable-**pages 11-15**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group-**pages 15-18**
Bias	9	Describe any efforts to address potential sources of bias-**page 19**
Study size	10	Explain how the study size was arrived at-**page 11**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why-**page 11**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding-**page 11**
		(*b*) Describe any methods used to examine subgroups and interactions-**page 11**
		(*c*) Explain how missing data were addressed-**page 11**
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy- **not applicable**
		(*e*) Describe any sensitivity analyses

Continued on next page

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Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed-**pages 11-15**
		(b) Give reasons for non-participation at each stage-**pages 11-15**
		(c) Consider use of a flow diagram-**none**
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders-**page 11**
		(b) Indicate number of participants with missing data for each variable of interest-**page 11**
		(c) *Cohort study*—Summarise follow-up time (e.g., average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures- **pages 11-15**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included-**pages 11-15**
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives-**pages 15-18**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias-**pages 18-19**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence-**pages 18-19**
Generalisability	21	Discuss the generalisability (external validity) of the study results- **pages 18-19**
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based-**pages 10 & 19**

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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THE EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, 2010-2012: A CROSS-SECTIONAL STUDY

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THE EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, 2010-2012: A CROSS-SECTIONAL STUDY

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THE EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, 2010-2012: A CROSS-SECTIONAL STUDY

ABSTRACT

Objectives

To estimate the population-level cancer estimates for the Lahore district, which is part of the Punjab Cancer Registry (PCR), Pakistan. The average population, per year, of Lahore was estimated at 9.8 million in 2010-2012.

Design

A cross-sectional study.

Setting

The Registry has nineteen collaborating centers in Lahore that report their data to the Central Office located within a tertiary care cancer treatment facility in Lahore, Pakistan.

Participants

Patients belonging to Lahore, of any age-group, and diagnosed with cancer in 2010-2012, were included in the study. Patients were followed-up between July and October 2015 to determine their vital status.

Outcome measures

Summaries were generated for gender, the basis of diagnosis, diagnoses, and deaths. The Age-Standardized Incidence Rates (ASIR) were computed per 100,000 population, by gender and cancer site. Five-year age categories were created from 0-4 till 70-74, followed by 75+ years. Death counts were reported by site.

Results

Between 2010 and 2012, in Lahore, a total of 15,840 new cancers were diagnosed-43% in male and 57% female patients; 93.5% microscopically confirmed and 6.5% non-microscopically. The ASIR amongst females was 105.1 and in males 66.7. ASIRs of leading cancers, amongst women, were: breast 47.6, ovary 4.9, and corpus uteri 3.6, whereas, amongst men: prostate 6.4, bladder 5.0, and, trachea, bronchus, & lung 4.6. A total of 5,134 deaths were recorded.

Conclusions

In Lahore, the ASIR was higher in women than in men. Amongst women, breast cancer, and in men, prostate cancer, were the leading cancer types. These estimates can be used for health promotion and policy making in the region.

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ARTICLE SUMMARY

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This is the first time that the age-standardized incidence rates have been presented for the Lahore district.
- A comparison has been made with the incidence rates reported by other registries around the world.
- There are follow-up issues related to determining the vital status of the patients, once they are registered as new cancer patients. Therefore, the limitation of the study is that the vital status of the vast majority of patients could not be determined.

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PAPER

THE EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, 2010-2012: A CROSS-SECTIONAL STUDY

INTRODUCTION

In the area of public health research, conducting high-quality, population-level studies, is hailed as the gold standard, as the outcomes truly represent the disease status of the community on whom the studies are being conducted. This includes the practice of population-based cancer registration, which not only assists in providing statistics and trends on incidence, mortality, and survival, it can also provide information on putative risk factors associated with various diseases within a defined population, living in a geographically demarcated area, over a specified period of time. However, cancer registration can only be undertaken if there is appropriate infrastructure to enable it, and suitable, well-trained staff to perform the tasks associated with it. Understandably, there is a cost associated with conducting this type of epidemiologic work, and in a resource-constrained country like Pakistan, governments are less likely to focus on the area of cancer registration than other areas deemed more immediately critical. Further, there is no legislation in the country that requires health-care practitioners to report diagnoses of cancer. Moreover, the health-care delivery in Pakistan is quite complex, and is as depicted in Figure 1. A large part of the population is served through a mixed system via multiple health providers[1].

The question whether cancer registration is a necessity or a luxury in developing countries has been debated extensively over the years. A paper published in 2008 stated that in low-income countries, cancer registration is urgently needed so as to gauge the cancer burden in the region[2]. Given that Pakistan is categorized as a 'lower-middle income country' by the World Bank, with its population estimated to be 185·0 million in the year 2014, and the life expectancy at birth being 66 years (65 years for males and 67 years for females), it seems unlikely that registration of all cancer diagnoses will be accurate and complete at the national level in the near future[3]. However, there is no denying the fact that knowing the cancer burden in the region helps in projecting regional cancer trends, establishing the required numbers of health-care facilities to cater to the needs of the patients, training sufficient numbers of health-care practitioners to manage the conditions, addressing health education, and assisting in developing prevention, early detection, and cancer control programs in the region. Figure 2 is a map of Pakistan showing the provinces of Pakistan and countries adjacent to Pakistan[4]. Even though accurate population figures are not available, enthusiastic professionals have, over the years, endeavored to determine cancer estimates for Pakistan. In the past, the regional registry of the Karachi South district, in the province of Sindh, was established and managed for several years by a dedicated pathologist, Dr. Yasmin Bhurgri[5]. This registry was widely recognized at an international level for its data quality[5]. However, due to the sudden death of Dr. Bhurgri in January 2012, this registry is no longer active. Another registry in Pakistan is the Punjab Cancer Registry (PCR), which was founded collaboratively by a group of health-professionals in 2005, pioneered by the administrators of a complete cancer treatment facility in Lahore called the Shaukat Khanum Memorial Cancer Hospital and Research Center (SKMCH & RC)[6-9]. The Punjab Cancer Registry, herein, referred to as the Registry, is

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registered with, and regulated under, the Societies Registration Act, 1860, of the Government of Pakistan[10]. It is also a member of the International Association of Cancer Registries, France[11]. Appendix A shows the list of collaborating centers of the Registry.

The reporting of cancer cases to population-based cancer registries is not required by law, in Pakistan. It is, in fact, a voluntary task undertaken by professionals representing many institutions of the region. When the Registry was established in 2005, a memorandum outlining the structure and governance mechanisms was signed by the stake-holders representing both the government and private laboratories and hospitals of the city. The purpose of establishing the Registry was to determine the cancer estimates in the province of Punjab. Punjab is the most populous province of Pakistan, with a population estimated at 100 M, and 36 administrative districts, of which Lahore is the most populous, with a population of some 10 M[12,13]. For about a decade, data have been captured in a systematic and pre-defined manner, in accordance with the minimum data items required for cancer registries as well as some additional optional data items[6,9,14].

In the past, PCR data have been reported to the International Agency for Research on Cancer (IARC) in response to a call for data by the Agency. The data have been used, along with data from Dr. Yasmin Bhurgri's paper, and the Federal Bureau of Statistics, Pakistan, to provide cancer estimates for Pakistan in the Globocan 2012 report[15].

This manuscript provides population-level cancer estimates for the Lahore district, based on cases diagnosed in 2010-2012 and reported to the Registry. This is the first time that the Lahore district population-level data have been computed and are being reported.

METHODS

The population denominator

Population-level statistics cannot be computed without the availability of figures for the population under review, or the catchment population. In Pakistan, publications describing the population structure are available for the census that was conducted in 1998[12]. However, the most recent population census, initiated a year ago, has not yet been completed[16]; therefore, accurate figures describing the Pakistani population are not available. As a result, for this study, population estimates are based on population figures determined by using the average annual growth rates provided by the Government of Pakistan[12].

In the years 2010, 2011, and 2012, the population of the Lahore district was estimated at 9,503,871, 9,832,705, and 10,172,916 respectively, computed using an average annual growth rate of 3·46%[12,13]. The total area of the Lahore district is 1,772 square kilometers, with its average population density being calculated as 5,551 persons, per square kilometer, in the years under study[12]. Figure 3 is a population pyramid showing the combined population distribution of the Lahore

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district by age-group and gender, for the years 2010-2012. These population estimates were used as the population-at-risk denominator, for calculating the incidence rates for this study.

Data collection

As routine cancer registration practice, the information is collected on the PCR data collection forms developed collaboratively, following international guidelines on recording cancers (Appendix B). The pertinent question on the form states whether a patient is a resident of Lahore or has come to Lahore for diagnosis or treatment only. This has helped to identify the residents of Lahore.

Each center is allocated a separate center identification number. The forms are distributed to, and collected from, each participating center on a regular basis. Both the active and passive methods of data collection are used[14]. Registry Staff educates relevant personnel at each center with regard to data capture, missing information and answers any other queries that arise. At the Cancer Registry & Clinical Data Management unit, only authorized personnel are allowed to enter data from forms, into the database. The forms collected are stored securely and remain confidential. The information is subsequently entered into the Punjab Cancer Registry database, developed as part of the computerized Hospital Information System of SKMCH & RC (Appendices C-CCC). All authorized Staff members are given specific usernames and passwords to turn the computers on and another username-password to access the system, and thence, the PCR software. Any form of transmission of the information including printing and saving it on portable electronic devices, and aspects related to document retention, are strictly regulated by the Governing Council of the Registry and SKMCH & RC, the latter being the sponsor of the Registry. For the cases diagnosed or treated at SKMCH & RC, linkages have been developed with the pathology department and clinics to facilitate date capture.

For the purpose of recording cancers, incidence date on the PCR form is defined as the date of cytologic/histologic confirmation of a malignancy on a pathology report, date of evaluation at an outpatient clinic only, or date of clinical investigation(s) as imaging or tumor markers, confirming the diagnosis. A check for multiple primaries is done, as per IARC rules[17]. In case of duplicate registration identified by checking various combinations of name/age/sex/phone number/address/tumor morphology, the case is registered with the center where the first diagnosis was made. Edits, for the validity and for the consistency between variables, are also carried out (age/incidence, age/site/histology, site/histology, sex/site, sex/histology, behavior/site, behavior/histology, grade/histology, and basis of diagnosis/histology). Initially, cancers were coded using the International Classification of Disease for Oncology-Third Edition[18]. For this manuscript, cancers were categorized using the International Classification of Diseases, Clinical Modification, 10th revision[19].

Data access and follow-up

Release of confidential information is governed by the rules approved by the Registry, and is always without any identifiers[6]. For maintaining confidentiality of the information recorded, Staff members are made to sign a confidentially pledge at the time of employment, which remains in force after

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cessation of employment with SKMCH & RC. For the purpose of reporting the data to IARC and to determine the vital status, patients diagnosed in the time-period 2010-2012 were followed-up telephonically between July and October 2015. We were able to establish contact with only sixty percent of the cases in this way.

Cancers reported

Cancer notifications for the Lahore district have improved with the passage of time, with the cases reported to the Registry going up from 2,006 in the year 2005 to 5,123 in the year 2015. In chronologic order, the numbers reported are as follows: 2,006; 2,987; 3,617; 3,990; 5,109; 5,302; 4,949; 5,589; 6,009; 5,943; and 5,123. We are still receiving information on cases diagnosed in 2014 and 2015. Over recent years, six other districts have been included for the purpose of data collection, with the idea being to include 1-2 contiguous district(s) of Punjab every year in order to expand cancer registration. The data collection form is modified accordingly to ascertain resident status of the patients[6]. The approach related to including 1-2 districts on a regular basis has been adopted because the sponsor, SKMCH & RC, is a charitable organization, and it is logistically not possible to initiate data collection from 36 districts of Punjab simultaneously.

2010-2012 study

A cross-sectional study was conducted and the Punjab Cancer Registry data were reviewed retrospectively to retrieve information on cancer patients belonging to the Lahore district and having been diagnosed in 2010-2012. Information was collected on new cancer diagnoses (by histology and gender), the most valid basis of diagnosis as microscopically versus non-microscopically confirmed, multiple primaries, and deaths recorded. Five-year age categories were created beginning from 0-4 years and ending on 70-74 years, with all those above 75 included as 75+. Cases were stratified by year of diagnosis/gender/age-group and histology/site.

Data analysis

Counts were determined and ASIRs computed according to 5-year age-group, weighted by the Segi World Standard population[20]. ASIRs were expressed per 100,000 population, per year, separately for male and female patients. For mortality data, counts were stratified by histology/site. Overall survival interval was computed between the dates of diagnosis and last contact and analyzed using the Kaplan-Meier method. Of a total of 15,825 patients registered in the years 2010-2012, survival intervals could not be computed for nearly 43 percent of the cases. Of these, in the vast majority of cases, no contact could be established with the patients on the phone numbers provided; in some of the cases, the attendants of the patients could only communicate that the patients had died but could not recall their dates of death; and, in a few cases, the patients died on the day of cancer diagnoses and their intervals were set at naught. Although extensive survival analysis was subsequently done on the fifty-seven percent of cases on whom the duration of survival was available, the survival estimates generated were not considered valid. Therefore, survival results are not being presented in this manuscript.

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Data were analyzed using the Microsoft Excel, version 2010, and SPSS, version 19. The Institutional Review Board (IRB) of the Shaukat Khanum Memorial Cancer Hospital & Research Center granted exemption from full IRB evaluation.

RESULTS

The total population of the Lahore district, in 2010-2012, was estimated to be 29,509,492, with males accounting for 52·7% and females 47·3% of the population (Figure 3). The number of cases reported in each of the three-years under study, 2010, 2011, & 2012, along with their population denominators, were: 5,302/9,503,871, 4,949/9,832,705, and 5,589/10,172,916, respectively. Of a total of 15,840 cancers diagnosed in 15,825 patients belonging to the district of Lahore and registered in the PCR database against the corresponding years, 9,069 (57·3%) were in female and 6,771 (42·7%) in male patients. Nearly ten percent were identified to have been registered twice and were eventually assigned to the center where the first diagnosis was made, thereby, counted just once. The age-range of the patients was 0-106 years. Of all the cancers diagnosed, about 93·5% were microscopically and 6·5% were non-microscopically confirmed (Table 1). None were registered on the basis of death certificates only. Skin cancer had the highest figure in the microscopically confirmed group (99·6%), whereas, liver & intrahepatic bile duct(s) had the highest figure in the non-microscopically confirmed category (69·5%). Multiple primary cancers, upto two, were identified in 15 patients (Table 2). The ASIR for all sites combined amongst female patients was 105·1 per 100,000 women and amongst male patients, it was 66·7 per 100,000 men, per year. Tables 3-6 show the ASIRs for all the cancers recorded in the Registry, by the year of diagnosis and gender, and the age-specific rates for the 5-year age-group, separately for female and male patients. Amongst females, the highest ASIRs were recorded for the following sites and malignancies: breast 47·6, ovary 4·9, corpus uteri 3·6, Non-Hodgkin Lymphoma (NHL) 3·3, cervix uteri 2·9, and brain & CNS 2·2, whereas, in men, the highest ASIRs were: prostate 6·4, bladder 5·0, trachea, bronchus, & lung 4·6, NHL 4·5, brain & CNS 3·8, and liver 3·7.

Table 1. The basis of diagnosis, categorized as being microscopically and non-microscopically confirmed, 2010-2012, in the Lahore district (N=15,840).

	The basis of diagnosis	
Cancer site	**Microscopic (%)**	**Non-Microscopic (%)**
Lip & oral cavity	97.0	3.0
Esophagus	99.1	0.9
Stomach	99.2	0.8
Colorectal	96.9	3.1
Liver & intrahep. bile ducts	30.5	69.5
Gall bladder	92.6	7.4
Larynx	96.6	3.4
Bronchus & lung	94.7	5.3
Bone	97.0	3.0
Connective tissue	94.4	5.6
Leukemia	92.8	7.2
Breast	95.8	4.2
Cervix uteri	96.8	3.2
Corpus uteri	97.8	2.2

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Testis	98.9	1.1
Prostate	97.5	2.5
NHL	95.8	4.2
Hodgkin lymphoma	97.5	2.5
Urinary bladder	97.3	2.7
Brain	96.6	3.4
Skin	99.6	0.4
Kidney	93.4	6.6
Thyroid	97.6	2.4
Ovary	93.7	6.3

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Table 2. Details related to patients having multiple primaries in the Lahore district, 2010-2012.

Serial no.	Gender	Age (years)	Vital status	Site
1	Male	20	Alive	Colon Brain
2	Male	23	Alive	Larynx Testis
3	Male	34	Dead	Kidney Thyroid
4	Female	45	Alive	Breast Breast
5	Male	45	Alive	Ill-defined Lung
6	Female	46	Alive	Breast Ovary
7	Male	55	Alive	Spinal cord NHL
8	Male	56	Dead	Brain Unknown primary
9	Female	59	Alive	Breast Liver
10	Female	60	Dead	Breast Breast
11	Male	62	Dead	Rectum Bone
12	Female	64	Alive	Breast Breast
13	Male	67	Dead	Thyroid Stomach
14	Male	70	Dead	Connective tissue Liver
15	Female	91	Dead	Breast Ovary

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Table 3. Cancer counts and the age-standardized incidence rates of cancers diagnosed in the Lahore district, 2010-2012, according to year of diagnosis.

Site	ICD-10 code	2010		2011		2012	
		Count	ASIR	Count	ASIR	Count	ASIR
Lip	C00	13	0.2	5	*0.1*	4	*0.1*
Tongue	C01-C02	115	2.0	92	1.5	102	1.6
Mouth	C03-C06	117	2.1	110	1.8	115	1.9
Salivary glands	C07-C08	30	0.5	32	0.5	29	0.4
Tonsil	C09	3	*0.1*	3	*0.1*	10	0.1
Other oropharynx	C10	2	*0.0*	3	*0.1*	1	*0.0*
Nasopharynx	C11	13	0.2	11	0.1	14	0.2
Hypopharynx	C12-C13	22	0.4	12	0.2	19	0.3
Pharynx	C14	4	*0.1*	3	*0.0*	3	*0.0*
Esophagus	C15	76	1.4	61	1.1	85	1.4
Stomach	C16	85	1.5	86	1.4	96	1.5
Small intestine	C17	15	0.3	15	0.3	13	0.2
Colon	C18	148	2.6	106	1.7	135	2.2
Rectum	C19-C20	101	1.6	89	1.4	133	2.0
Anus	C21	21	0.4	22	0.3	21	0.3
Liver	C22	176	3.4	184	3.4	145	2.6
Gall bladder etc.	C23-C24	72	1.3	76	1.4	84	1.6
Pancreas	C25	30	0.6	30	0.6	37	0.7
Other ill-defined digestive	C26	7	*0.1*	11	0.2	12	0.2
Nose, sinuses	C30-31	17	0.3	23	0.4	19	0.3
Larynx	C32	74	1.4	55	1.0	82	1.4
Trachea, bronchus, & lung	C33-C34	162	3.2	156	2.9	170	3.2
Other thoracic organs	C37-C38	14	0.2	11	0.2	17	0.2
Bone	C40-C41	80	0.8	74	0.8	80	0.8
Melanoma of skin	C43	4	*0.1*	11	0.2	11	0.1
Other skin	C44	152	2.8	141	2.5	174	2.9
Connective & soft tissue	C47,C49	95	1.3	95	1.2	62	0.8
Breast	C50	1409	22.9	1339	21.4	1404	21.5
Vulva	C51	3	*0.1*	7	*0.2*	9	*0.4*
Vagina	C52	5	*0.2*	6	*0.2*	5	*0.2*
Cervix uteri	C53	86	3.1	69	2.4	92	3.2
Corpus uteri	C54	83	3.5	84	3.3	100	4.1
Uterus, unspecified	C55	34	1.3	27	1.1	28	1.0
Ovary	C56	138	4.6	124	4.1	180	5.8
Other female genital organ	C57	5	*0.2*	7	*0.3*	6	*0.2*
Placenta	C58	3	*0.1*	2	*0.0*	2	*0.0*
Penis	C60	-	-	1	*0.0*	-	-
Prostate	C61	165	6.2	193	7.1	168	6.0
Testis	C62	31	0.7	24	0.5	35	0.7
Other male genital organs	C63	-	-	3	*0.1*	2	*0.1*
Kidney	C64	88	1.5	97	1.5	89	1.4
Renal pelvis	C65	-	-	-	-	2	*0.0*
Ureter	C66	-	-	1	*0.0*	1	*0.0*
Bladder	C67	177	3.6	150	2.8	223	4.0
Other urinary organs	C68	-	-	2	*0.0*	-	-
Eye	C69	33	0.5	29	0.4	35	0.4
Brain, nervous system	C70-C72	248	3.5	203	2.8	234	3.0
Thyroid	C73	94	1.3	92	1.3	110	1.5
Adrenal	C74	2	*0.0*	3	*0.0*	6	*0.1*
Hodgkin lymphoma	C81	104	1.3	86	1.0	92	0.9
Non-Hodgkin lymphoma	C82-C88	274	4.4	234	3.6	262	3.9
Multiple myeloma	C90	33	0.7	26	0.5	30	0.5
Lymphoid leukemia	C91	91	0.9	71	0.7	157	1.4
Myeloid leukemia	C92-93	42	0.5	31	0.4	96	1.1
Other Leukemias	C95	30	0.3	25	0.3	45	0.4
Leukemia unspecified	C94	3	*0.0*	2	*0.0*	3	*0.0*
Other & unspecified		335	5.7	369	6.2	393	6.4
Benign CNS		138	1.9	125	1.6	107	1.3
All sites		**5302**	**97.8**	**4949**	**89.1**	**5589**	**96.8**

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Table 4. Cancer counts and age-standardized incidence rates of cancers diagnosed in the Lahore district in 2010-2012, by gender and cancer site/type.

Site	ICD-10-code	FEMALE				MALE			
		Count	%	Crude	ASIR	Count	%	Crude	ASIR
Lip	C00	9	0.1	0.1	*0.1*	13	0.2	0.1	0.1
Tongue	C01-C02	129	1.4	0.9	1.7	180	2.7	1.2	1.8
Mouth	C03-C06	130	1.4	0.9	1.6	212	3.1	1.4	2.2
Salivary glands	C07-C08	41	0.5	0.3	0.5	50	0.7	0.3	0.5
Tonsil	C09	8	0.1	0.1	*0.1*	8	0.1	0.1	*0.1*
Other oropharynx	C10	-	-	-	-	6	0.1	0.0	*0.1*
Nasopharynx	C11	19	0.2	0.1	0.2	19	0.3	0.1	0.2
Hypopharynx	C12-C13	32	0.4	0.2	0.4	21	0.3	0.1	0.2
Pharynx	C14	5	0.1	0.0	*0.1*	5	0.1	0.0	*0.0*
Esophagus	C15	95	1.0	0.7	1.2	127	1.9	0.8	1.4
Stomach	C16	105	1.2	0.8	1.3	162	2.4	1.0	1.6
Small intestine	C17	17	0.2	0.1	0.2	26	0.4	0.2	0.3
Colon	C18	159	1.8	1.1	1.9	230	3.4	1.5	2.4
Rectum	C19-C20	137	1.5	1.0	1.5	186	2.7	1.2	1.9
Anus	C21	23	0.3	0.2	0.3	41	0.6	0.3	0.4
Liver	C22	177	2.0	1.3	2.4	328	4.8	2.1	3.7
Gall bladder etc.	C23-C24	139	1.5	1.0	1.9	93	1.4	0.6	1.0
Pancreas	C25	40	0.4	0.3	0.5	57	0.8	0.4	0.6
Other ill-defined digestive	C26	14	0.2	0.1	0.1	16	0.2	0.1	0.2
Nose, sinuses	C30-31	27	0.3	0.2	0.3	32	0.5	0.2	0.3
Larynx	C32	28	0.3	0.2	0.3	183	2.7	1.2	2.0
Trachea, bronchus & lung	C33-C34	92	1.0	0.7	1.2	396	5.8	2.5	4.6
Other thoracic organs	C37-C38	16	0.2	0.1	0.2	26	0.4	0.2	0.2
Bone	C40-C41	91	1.0	0.7	0.6	143	2.1	0.9	0.9
Melanoma of skin	C43	13	0.1	0.1	0.1	13	0.2	0.1	0.1
Other skin	C44	196	2.2	1.4	2.7	271	4.0	1.7	2.8
Connective & soft tissue	C47,C49	108	1.2	0.8	1.0	144	2.1	0.9	1.2
Breast	C50	4082	45.0	29.2	47.6	70	1.0	0.5	0.8
Vulva	C51	19	0.2	0.1	0.2	-	-	-	-
Vagina	C52	16	0.2	0.1	0.2	-	-	-	-
Cervix uteri	C53	247	2.7	1.8	2.9	-	-	-	-
Corpus uteri	C54	267	2.9	1.9	3.6	-	-	-	-
Uterus unspecified	C55	89	1.0	0.6	1.1	-	-	-	-
Ovary	C56	442	4.9	3.2	4.9	-	-	-	-
Other female genital organ	C57	18	0.2	0.1	0.2	-	-	-	-
Placenta	C58	7	0.1	0.1	*0.0*	-	-	-	-
Penis	C60	-	-	-	-	1	0.0	0.0	*0.0*
Prostate	C61	-	-	-	-	526	7.8	3.4	6.4
Testis	C62	-	-	-	-	90	1.3	0.6	0.6
Other male genital organs	C63	-	-	-	-	5	0.1	0.0	*0.1*
Kidney	C64	102	1.1	0.7	1.1	172	2.5	1.1	1.7
Renal Pelvis	C65	1	0.0	0.0	*0.0*	1	0.0	0.0	*0.0*
Ureter	C66	1	0.0	0.0	*0.0*	1	0.0	0.0	*0.0*
Bladder	C67	109	1.2	0.8	1.5	441	6.5	2.8	5.0
Other urinary organs	C68	-	-	-	-	2	0.0	0.0	*0.0*
Eye	C69	40	0.4	0.3	0.4	57	0.8	0.4	0.5
Brain, nervous system	C70-C72	227	2.5	1.6	2.2	458	6.8	2.9	3.8
Thyroid	C73	215	2.4	1.5	2.2	81	1.2	0.5	0.7
Adrenal	C74	4	0.0	0.0	*0.0*	7	0.1	0.0	*0.1*
Hodgkin disease	C81	80	0.9	0.6	0.7	202	3.0	1.3	1.4
Non-Hodgkin lymphoma	C82-C88	277	3.1	2.0	3.3	493	7.3	3.2	4.5
Multiple myeloma	C90	36	0.4	0.3	0.5	53	0.8	0.3	0.6
Lymphoid leukemia	C91	112	1.2	0.8	0.7	207	3.1	1.3	1.2
Myeloid leukemia	C92-93	62	0.7	0.4	0.5	107	1.6	0.7	0.8
Other Leukemias	C94	2	0.0	0.0	*0.0*	6	0.1	0.0	*0.0*
Leukemia unspecified	C95	40	0.4	0.3	0.3	60	0.9	0.4	0.4
Other & unspecified		536	5.9	3.8	6.6	561	8.3	3.6	5.7
Benign CNS		188	2.1	1.3	1.8	182	2.7	1.2	1.4
All sites		9069	100.0	64.9	105.1	6771	100.0	43.6	66.7

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Table 5. Age-specific & age-standardized incidence rates of cancers diagnosed in the Lahore district, 2010-2012, amongst females.

Site	Total cases	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+	Crude	%	ASIR	ICD-10 codes
Lip	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	1.1	0.4	0.6	1.6	0.7	0.1	0.1	*0.1*	C00
Tongue	129	0.0	0.0	0.0	0.0	0.1	0.1	0.2	1.2	1.4	5.4	4.7	4.9	6.6	5.8	8.7	5.1	0.9	1.4	1.7	C01-C02
Mouth	130	0.0	0.0	0.0	0.2	0.2	0.3	0.2	1.5	2.9	1.6	6.0	4.6	3.5	7.0	11.1	5.1	0.9	1.4	1.6	C03-C06
Salivary glands	41	0.0	0.0	0.1	0.0	0.1	0.5	0.2	0.8	0.5	0.6	1.1	0.7	2.7	1.9	0.8	0.0	0.3	0.5	*0.5*	C07-C08
Tonsil	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.7	0.4	0.0	0.0	0.8	0.7	0.1	0.1	*0.1*	C09
Nasopharynx	19	0.0	0.0	0.1	0.1	0.1	0.2	0.3	0.0	0.3	0.6	0.2	0.4	0.4	0.0	1.6	0.0	0.1	0.2	0.2	C11
Hypopharynx	32	0.0	0.0	0.0	0.1	0.2	0.1	0.2	0.5	0.3	0.6	0.7	1.4	1.9	0.6	1.6	0.7	0.2	0.4	*0.4*	C12-C13
Pharynx	5	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.8	0.7	0.0	0.1	*0.1*	C14
Esophagus	95	0.0	0.0	0.0	0.1	0.0	0.3	0.3	0.9	1.9	4.0	1.8	2.8	5.8	4.5	4.7	3.6	0.7	1.0	1.2	C15
Stomach	105	0.0	0.0	0.0	0.0	0.3	0.1	1.0	1.3	2.2	3.8	2.5	3.9	2.7	8.9	0.0	3.6	0.8	1.2	1.3	C16
Small intestine	17	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.6	0.0	0.0	0.4	1.9	1.3	2.4	0.7	0.1	0.2	0.2	C17
Colon	159	0.0	0.0	0.1	0.3	0.1	0.7	1.3	2.0	2.0	3.4	3.3	7.0	5.0	9.6	9.5	8.0	1.1	1.8	1.9	C18
Rectum	137	0.0	0.0	0.1	0.2	0.9	0.9	1.4	1.2	1.7	3.0	3.1	4.2	5.0	4.5	6.3	5.1	1.0	1.5	1.5	C19-C20
Anus	23	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.1	0.9	0.6	0.2	0.0	0.8	0.6	2.4	0.7	0.2	0.3	0.3	C21
Liver	177	0.1	0.1	0.0	0.1	0.1	0.1	0.2	0.3	1.4	4.4	6.2	11.2	12.0	16.6	8.7	5.1	1.3	2.0	2.4	C22
Gall bladder, etc.	139	0.0	0.0	0.0	0.1	0.0	0.0	0.5	0.4	1.5	2.6	4.9	6.7	8.9	14.1	7.1	8.7	1.0	1.5	1.9	C23-C24
Pancreas	40	0.0	0.0	0.0	0.1	0.0	0.2	0.1	0.5	0.3	0.8	0.9	2.1	0.8	5.8	2.4	1.4	0.3	0.4	0.5	C25
Other ill-defined digestive	14	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.9	0.0	1.2	0.0	0.8	0.0	0.1	0.2	0.1	C26
Nose, sinuses	27	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.3	0.0	0.6	0.7	1.8	2.3	1.3	0.8	0.7	0.2	0.3	0.3	C30-31
Larynx	28	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.6	0.8	1.3	1.4	1.2	0.6	0.0	2.2	0.2	0.3	0.3	C32
Trachea, bronchus, & lung	92	0.0	0.0	0.1	0.2	0.1	0.1	0.5	0.4	0.9	1.4	1.8	4.6	5.4	8.3	6.3	5.8	0.7	1.0	1.2	C33-C34
Other thoracic organs	16	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.2	0.8	0.0	0.4	1.6	0.6	0.8	0.7	0.1	0.2	0.2	C37-C38
Bone	91	0.2	0.5	0.9	1.4	0.9	0.3	0.4	1.3	0.3	0.6	0.4	0.4	0.0	0.0	1.6	0.0	0.7	1.0	0.6	C40-C41
Melanoma of skin	13	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.2	0.4	0.4	0.7	0.0	0.0	0.8	0.7	0.1	0.1	0.1	C43
Other skin	196	0.1	0.0	0.0	0.1	0.1	0.3	0.2	1.3	2.9	2.2	5.1	6.3	11.3	16.6	19.0	19.6	1.4	2.2	2.7	C44
Connective & soft tissue	108	0.4	0.3	0.3	0.6	0.6	0.8	0.8	1.2	1.7	1.2	1.8	1.4	1.6	3.8	2.4	2.9	0.8	1.2	1.0	C47,C49
Breast	4082	0.0	0.1	0.1	0.1	3.3	14.0	32.2	55.9	86.2	126.8	130.3	158.5	154.1	157.9	124.9	92.1	29.2	45.0	47.6	C50
Vulva	19	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.4	0.2	0.2	0.0	1.4	0.8	0.6	0.8	2.9	0.1	0.2	0.2	C51
Vagina	16	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.3	0.8	0.2	0.7	0.4	0.0	0.8	1.4	0.1	0.2	0.2	C52
Cervix uteri	247	0.0	0.0	0.0	0.0	0.2	0.4	1.3	3.9	5.7	9.4	7.1	10.5	10.1	8.3	5.5	5.1	1.8	2.7	2.9	C53
Corpus uteri	267	0.0	0.0	0.0	0.0	0.0	0.2	0.6	1.5	1.9	6.0	9.8	16.5	22.1	16.0	18.2	7.2	1.9	2.9	3.6	C54
Uterus, unspecified	89	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.9	1.5	3.4	4.0	2.8	5.8	3.8	4.7	0.0	0.6	1.0	1.1	C55
Ovary	442	0.0	0.1	0.6	0.8	1.6	1.9	3.0	4.9	7.9	12.2	13.4	15.4	19.4	12.1	11.1	7.2	3.2	4.9	4.9	C56
Other female genital organ	18	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.5	0.2	0.2	0.7	2.3	0.6	0.8	0.0	0.1	0.2	0.2	C57
Placenta	7	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	*0.0*	C58
Kidney	102	0.7	0.1	0.1	0.0	0.2	0.0	0.2	1.6	2.0	1.6	2.7	4.9	3.1	3.2	3.2	4.3	0.7	1.1	1.1	C64
Renal pelvis	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C65
Ureter	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	*0.0*	C66
Bladder	109	0.1	0.0	0.0	0.1	0.0	0.1	0.2	1.1	1.2	1.6	2.7	4.9	5.0	8.9	10.3	10.1	0.8	1.2	1.5	C67
Eye	40	0.9	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.0	0.0	0.8	4.5	0.8	2.2	0.2	0.4	0.4	C69
Brain, nervous system	227	0.3	0.7	0.6	0.9	0.9	2.0	1.4	2.5	3.3	4.4	4.9	5.3	5.0	7.7	4.0	2.9	1.6	2.5	2.2	C70-C72
Thyroid	215	0.0	0.1	0.1	0.2	1.9	1.6	2.8	2.9	3.3	4.6	6.5	3.5	6.6	3.2	7.9	2.9	1.5	2.4	2.2	C73
Adrenal	4	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C74
Hodgkin lymphoma	80	0.2	0.4	0.3	0.4	0.9	1.0	0.4	1.1	0.3	1.0	0.2	1.8	1.6	0.6	2.4	0.0	0.6	0.9	0.7	C81
Non-Hodgkin lymphoma	277	0.2	0.3	0.5	0.5	0.5	0.8	0.9	2.0	3.6	5.8	7.4	12.3	10.9	14.1	13.4	18.1	2.0	3.1	3.3	C82-C88
Multiple myeloma	36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1.6	1.1	0.7	2.7	3.2	4.0	0.7	0.3	0.4	0.5	C90
Lymphoid leukemia	112	2.0	1.3	1.4	0.3	0.1	0.2	0.2	0.0	0.5	0.2	0.2	0.7	1.2	0.6	0.8	0.0	0.8	1.2	0.7	C91
Myeloid leukemia	62	0.3	0.2	0.2	0.2	0.5	0.6	0.6	0.7	0.5	0.6	1.1	1.4	0.8	0.6	1.6	0.0	0.4	0.7	0.5	C92-93
Other Leukemias	2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C94
Leukemia, unspecified	40	0.3	0.5	0.3	0.3	0.1	0.3	0.1	0.1	0.2	0.2	0.7	0.0	0.0	0.6	0.8	0.0	0.3	0.4	0.3	C95
Other & unspecified	536	0.5	0.2	0.2	0.2	1.1	1.8	2.7	4.7	7.0	12.6	14.9	24.9	24.1	33.9	26.9	18.8	3.8	5.9	6.6	Other & unspecified
Benign CNS	188	0.2	0.1	0.3	0.7	0.3	1.6	2.2	3.9	4.0	4.8	3.6	2.1	4.3	4.5	2.4	0.7	1.3	2.1	1.8	Benign CNS
All sites	9069	6.7	5.0	6.5	8.4	16.4	32.1	58.3	104.7	155.6	237.8	259.9	337.6	364.1	398.2	348.7	259.5	64.9	100.0	105.1	All sites

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Table 6. Age-specific & age-standardized incidence rates of cancers diagnosed in the Lahore district, 2010-2012, amongst males.

Site	Total cases	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+	Crude	%	ASIR	ICD-10 codes
Lip	13	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.2	0.0	0.0	0.2	0.6	1.3	0.5	0.6	0.0	0.1	0.2	0.1	C00
Tongue	180	0.0	0.0	0.0	0.0	0.3	0.6	0.6	2.0	3.5	3.6	4.4	5.0	7.2	6.2	9.5	2.3	1.2	2.7	1.8	C01-C02
Mouth	212	0.0	0.0	0.0	0.0	0.1	0.2	1.2	1.1	3.0	5.4	4.8	9.7	10.1	8.8	7.7	4.0	1.4	3.1	2.2	C03-C06
Salivary glands	50	0.0	0.0	0.1	0.1	0.1	0.2	0.3	0.7	0.6	0.7	0.7	1.1	1.9	1.6	3.0	1.7	0.3	0.7	*0.5*	C07-C08
Tonsil	8	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.2	0.3	0.6	0.5	0.0	0.0	0.1	0.1	*0.1*	C09
Other oropharynx	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.6	0.3	0.0	0.6	0.0	0.0	0.1	*0.1*	C10
Nasopharynx	19	0.0	0.0	0.0	0.1	0.1	0.0	0.2	0.1	0.3	0.3	0.2	0.8	1.3	0.5	0.0	0.0	0.1	0.3	0.2	C11
Hypopharynx	21	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.3	0.0	0.6	0.3	0.9	1.0	1.2	2.9	0.1	0.3	0.2	C12-C13
Pharynx	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	*0.0*	C14
Esophagus	127	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.8	0.5	3.1	3.1	4.5	5.3	6.2	9.5	6.9	0.8	1.9	1.4	C15
Stomach	162	0.0	0.0	0.0	0.0	0.1	0.8	0.9	1.4	2.2	3.8	3.3	4.7	4.4	10.3	8.3	3.4	1.0	2.4	1.6	C16
Small intestine	26	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.3	0.1	0.5	0.6	0.8	0.9	0.5	1.8	2.3	0.2	0.4	*0.3*	C17
Colon	230	0.0	0.0	0.0	0.4	0.8	0.6	0.7	1.5	2.1	4.8	4.4	5.8	11.6	14.5	9.5	6.3	1.5	3.4	2.4	C18
Rectum	186	0.0	0.0	0.0	0.4	0.7	0.9	1.4	1.0	1.0	3.3	3.9	5.0	8.2	11.9	4.2	6.3	1.2	2.7	1.9	C19-C20
Anus	41	0.0	0.0	0.0	0.1	0.1	0.1	0.5	0.0	0.6	0.5	1.3	0.8	2.2	1.6	0.6	1.1	0.3	0.6	0.4	C21
Liver	328	0.0	0.0	0.0	0.1	0.1	0.2	0.0	1.5	1.9	5.2	10.1	17.0	14.8	24.3	17.2	14.9	2.1	4.8	3.7	C22
Gall bladder, etc.	93	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.3	0.5	0.5	2.9	3.6	5.0	7.2	4.2	7.4	0.6	1.4	1.0	C23-C24
Pancreas	57	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.8	1.4	1.3	3.1	1.3	4.7	4.7	1.1	0.4	0.8	0.6	C25
Other ill-defined digestive	16	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.5	0.4	0.3	0.6	2.1	0.0	1.1	0.1	0.2	0.2	C26
Nose, sinuses	32	0.0	0.0	0.0	0.1	0.2	0.2	0.0	0.2	0.1	0.5	0.6	1.4	0.9	1.6	2.4	0.0	0.2	0.5	0.3	C30-31
Larynx	183	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.5	1.5	3.8	4.6	7.8	10.4	12.4	11.3	5.7	1.2	2.7	2.0	C32
Trachea, bronchus, & lung	396	0.0	0.0	0.0	0.0	0.1	0.1	0.6	1.9	1.8	5.7	4.8	13.1	21.4	32.0	37.4	32.6	2.5	5.8	4.6	C33-C34
Other thoracic organs	26	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.2	0.3	0.2	1.1	0.0	0.6	0.5	1.8	2.9	0.2	0.4	0.2	C37-C38
Bone	143	0.2	0.5	1.2	2.4	1.0	0.5	0.6	0.7	0.6	0.9	0.6	0.3	3.1	0.5	1.8	0.6	0.9	2.1	0.9	C40-C41
Melanoma of skin	13	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	1.1	0.0	0.5	0.0	1.7	0.1	0.2	0.1	C43
Other skin	271	0.1	0.1	0.1	0.2	0.3	0.9	1.6	2.0	2.3	2.8	4.1	8.6	11.3	16.5	10.1	21.2	1.7	4.0	2.8	C44
Connective & soft tissue	144	0.4	0.5	0.1	0.9	0.8	1.1	0.7	1.1	0.5	2.8	1.1	2.5	2.8	3.6	4.2	2.9	0.9	2.1	1.2	C47,C49
Breast	70	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.3	0.9	2.1	1.5	1.9	1.9	8.8	2.4	1.7	0.5	1.0	0.8	C50
Penis	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C60
Prostate	526	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.3	1.0	4.4	13.1	27.1	46.0	69.4	87.0	3.4	7.8	6.4	C61
Testis	90	0.2	0.0	0.0	0.5	1.1	1.2	1.2	1.1	1.0	0.7	0.6	0.3	0.3	1.6	0.6	0.6	0.6	1.3	0.6	C62
Other male genital organs	5	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.6	0.0	0.0	0.1	*0.1*	C63
Kidney	172	0.6	0.2	0.0	0.1	0.1	0.2	0.3	0.9	2.7	3.3	3.3	5.6	6.3	7.2	9.5	5.7	1.1	2.5	1.7	C64
Renal pelvis	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C65
Ureter	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C66
Bladder	441	0.1	0.0	0.0	0.0	0.1	0.2	0.4	1.8	2.2	5.9	7.5	19.2	23.0	30.0	29.7	42.4	2.8	6.5	5.0	C67
Other urinary organs	2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	*0.0*	C68
Eye	57	1.2	0.2	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.7	0.6	0.3	1.6	2.1	2.4	1.1	0.4	0.8	*0.5*	C69
Brain, nervous system	458	0.7	1.0	0.7	1.2	1.6	2.9	4.5	4.4	5.0	7.3	8.8	10.6	11.3	9.8	8.3	3.4	2.9	6.8	3.8	C70-C72
Thyroid	81	0.0	0.0	0.0	0.2	0.2	0.7	0.8	0.3	0.8	1.4	1.8	3.3	1.6	2.6	3.0	1.1	0.5	1.2	0.7	C73
Adrenal	7	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.3	0.0	0.0	0.6	0.0	0.0	0.1	*0.1*	C74
Hodgkin lymphoma	202	0.7	1.8	0.7	1.0	0.9	1.4	1.2	1.4	1.5	1.6	1.5	3.3	1.9	4.1	3.6	0.6	1.3	3.0	1.4	C81
Non-Hodgkin lymphoma	493	0.4	1.4	1.1	1.3	2.0	1.6	2.5	2.5	4.6	5.9	10.1	11.7	18.3	18.1	16.6	14.3	3.2	7.3	4.5	C82-C88
Multiple myeloma	53	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.5	1.2	1.3	2.5	3.1	1.6	2.4	2.3	0.3	0.8	*0.6*	C90
Lymphoid leukemia	207	3.1	2.2	2.6	0.7	0.5	0.2	0.3	0.1	0.8	0.3	0.9	0.6	0.6	2.1	0.0	1.7	1.3	3.1	1.2	C91
Myeloid leukemia	107	0.3	0.3	0.4	0.4	0.7	0.8	0.9	1.4	1.0	1.0	0.7	1.9	1.9	2.1	0.0	0.6	0.7	1.6	0.8	C92-93
Other Leukemias	6	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.4	0.0	0.0	0.0	0.6	0.0	0.0	0.1	*0.0*	C94
Leukemia, unspecified	60	0.5	0.4	0.7	0.2	0.5	0.2	0.3	0.1	0.3	0.3	0.2	0.3	0.6	0.0	0.6	0.0	0.4	0.9	0.4	C95
Other & unspecified	561	0.3	0.1	0.6	0.9	0.4	2.0	2.6	2.9	4.8	6.0	12.2	18.7	23.9	28.4	25.5	34.9	3.6	8.3	5.7	Other & unspecified
Benign CNS	182	0.3	0.4	0.2	0.5	0.8	2.0	1.9	2.4	2.1	3.3	3.3	1.1	3.1	1.6	3.0	0.6	1.2	2.7	1.4	Benign CNS
All sites	6771	9.2	9.5	9.1	12.2	14.8	20.6	27.4	38.0	53.7	93.1	118.4	194.0	255.2	337.0	329.7	328.0	43.6	100.0	66.7	All sites

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Of the 15,825 patients, death was recorded in 5,134 (32·4%) cases by the cut-off date for this study; this included 2,726 female and 2,408 male patients. Four-thousand, three-hundred and forty-seven patients were still alive (27·5%) at the time of review, whereas, the vital status of 6,344 patients (40·1%) could not be determined. Death certificates were available in each record of a hospital death for about 8% of patients (400/5,134), representing just one collaborating center, which is SKMCH & RC. Table 7 displays death counts and proportion by cancer sites. Since the follow-up information was not available for nearly 40% of the patients, the mortality to incidence ratio was not calculated either.

Table 7. Distribution of deaths recorded (5,134 (2,726 female and 2,408 male patients)), in patients diagnosed with cancer, in the Lahore district, in 2010-2012, according to gender and cancer type (top 10 cancers only).

Females	Count	%	Males	Count	%
Breast	987	36	Brain	213	9
Ovary	137	5	Bronchus & lung	207	9
Colo-rectum	127	5	NHL	169	7
NHL	109	4	Prostate	168	7
Lip & oral cavity	106	4	Colo-rectum	155	6
Brain	99	4	Lip & oral cavity	152	6
Leukemia	87	3	Liver & intrahep. bile ducts	151	6
Liver & intrahep. bile ducts	85	3	Leukemia	144	6
Cervix uteri	65	2	Urinary bladder	133	6
Corpus uteri	53	2	Stomach	73	3

Of the deaths recorded, amongst females, 36% were reported in those who had breast cancer, 5% each in those who had ovarian and colo-rectal carcinoma, 4% each in NHL, lip & oral cavity, and brain tumor, 3% each in those with leukemia and liver & intrahepatic bile ducts tumors, and 2% each in those who had cancer of the cervix and corpus uteri. In male patients, 9% each were in those who had tumor of the brain and, bronchus & lung, 7% each in those with NHL and prostate cancer, 6% each in cancers of the colo-rectum, lip & oral cavity, liver & intrahepatic bile ducts, bladder, and leukemia, and 3% in stomach carcinoma.

DISCUSSION

The Registry has been in existence since 2005 but was in an evolving phase in the initial years of its functioning. Therefore, conducting a comparison of the cases recorded over the initial years did not appear to be useful. Further, as there are notification delays and the Registry is still receiving information on cases diagnosed in the most recent years (2014-2015), mainly from one center, this time-period has not been included in the study either. It is hoped that a study conducted at a subsequent stage will cover the 2013-2015 period. For the time-period 2010-2012, the results reported

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for the population of the Lahore district show that on average, over 5,200 new cancer cases were diagnosed, every year. The fact that nearly seven percent were non-microscopically confirmed cancers as opposed to nearly 93% that were microscopically confirmed, supports that there was no over-reliance on the pathology laboratory as the source of information. These figures are similar to those reported for the Karachi Cancer Registry[5]. The ASIR for all-cancers combined was higher amongst females (105·1) than in males (66·7). These results also include the ASIRs for benign CNS tumors and other/unspecified sites. The ASIRs reported by the Surveillance, Epidemiology, and End Results (SEER) Program of the United States of America (USA), are very high (359·4 for females and 282·6 for males)[21,22]. These figures represent SEER 18 registries compiling data from all cases diagnosed since 2000 and covering approximately 30% of the US population[21,22]. The ASIRs published in the CI5-X report for Delhi in India and Riyadh in Saudi Arabia, are close to the Lahore district figures as opposed to the SEER rates; in fact, the ASIRs for females in these three regions are quite similar to one another. It is important to point out that Delhi, located in India, to the east of Lahore, is closer to Lahore than is Karachi located in southern Pakistan. As far as the South Karachi Registry is concerned, based on the last report (1998-2002) released in CI5-IX, it can be seen that the ASIRs for Karachi were relatively high (192·0 for females and 166·6 for males) as compared to those for the Lahore district. Further, in the region of Golestan in Iran (2005-2007), and for Israel, again the ASIRs were high compared to those reported for the Lahore district[19]. For the SEER Program, Delhi, Iran, and Saudi Arabia, data were reported for the 2003-2007 time period. Table 8 shows a comparison of the ASIRs according to cancer sites, though not all sites, in the aforementioned regions of the world. In women belonging to the Lahore district, the ASIR of breast cancer ranked the highest (47·6) of all the cancers, and was higher than that for Delhi (31·6), but relatively low compared to that reported for the Israeli Jews (89·4). Amongst men in the Lahore district, the ASIR of prostate cancer was the highest (6·4) of all the cancers, but was lower than that reported for Delhi (10·1) and Riyadh (7·9). Even though breast and prostate cancer were the most common diagnoses in the Lahore district, the point to be noted is that organized screening programs for early detection of these diseases do not exist in Pakistan. The ASIR of cervical cancer in Lahore was 2·9 but in Delhi it was much higher, at 17·7; this is despite the fact that the screening levels are low in the general population of India[23]. Of the factors implicated in the etiology of cervical cancer in the Indian population, the presence of specific oncogenic types of the Human Papilloma Viruses (HPV), namely types 16 and 18, plays an important role in the development of cancer of the cervix. In Pakistan, one population-based study reports HPV positivity to be nearly 2·8% in the general population (25/899) and about 92% in patients with invasive cervical cancer (83/91)[24]. However, in India, it has been reported that HPV prevalence varies from 7·5% to 16·9% in women without cervical cancer as opposed to 87·8% to 96·7% amongst cervical cancer patients[23]. Further, in the latest Globocan report, the ASIR for cancer of the cervix in Pakistan was estimated at 7·9 per 100,000 females with 5,233 cases identified in 2012[15]; in the same year, in Saudi Arabia, 241 cases were diagnosed, with the ASIR at 2·7 per 100,000 women; in contrast to this, in India, 122,844 cervical cancer cases were diagnosed, with a relatively high ASIR of 22·0 per 100,000 females[15]. Since the ASIR is low in the aforementioned Muslim countries compared to a non-Muslim country, circumcision of men may be a plausible explanation in reducing the transmission of HPV infection to their female sexual partners. Circumcision of men is the norm amongst Muslim males. The role of circumcision has been demonstrated in three separate randomized trials done in Africa[25]. Since the incidence of cervical cancer in Pakistan is relatively low and the 5-year

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prevalence is 15,323, setting-up a formal screening program may have lower yields, therefore, a low priority in resource allocation and decision making in our setting[15].

As shown in Table 8, the ASIRs per 100,000 population, per year, for ten common cancers in Pakistan, as reported in the Globocan 2012, compared to Lahore, are as follows: In women: breast 50·3, 47·6; lip & oral cavity 9·1, 3·9; cervix uteri 7·9, 2·9; ovary 5·6, 5·1; esophagus 4·4, 1·2; corpus uteri 3·6, 3·6; NHL 3·4, 3·3; colo-rectum 3·3, 3·7; liver 2·5, 2·4; and stomach 2·2, 1·3, while, amongst men: lip & oral cavity 10·5, 4·6; lung 9·8, 4·6; NHL 5·3, 4·5; prostate 6·6, 6·4; bladder 5·1, 5·0; larynx 5·0, 2·0; colo-rectum 4·7, 4·7; liver 4·7, 3·7; esophagus 3·9, 1·4; stomach 3·8, 1·6; and brain & nervous system 3·4, 3·8. The comparison shows that rates are somewhat higher for tobacco-related cancers (lip & oral cavity, lung, larynx, and esophagus), and cervical cancer, though for the latter, the rates are still lower than those reported in countries with a high HPV prevalence rate. Since the Globocan 2012 report included data from the Punjab Cancer Registry, Karachi South district, and Dr. Yasmin's paper, the relatively high cancer rates for certain cancers may be attributed to the high consumption of tobacco-related products in that part of Pakistan, in the form of cigarettes and bidi and also of smokeless tobacco as betel quid and niswar[26]. Further, Karachi South is one of the 29 districts of the province of Sindh[12], located in the south of the country and its population was 1·72 M during the period under study. Its last report published in the CI-5, IX, shows a high incidence rate for tobacco related cancers[22]. Therefore, the dissimilarity in the incidence rates could be attributed to the geographic and lifestyle differences between these two regions. Table 8, depicting the ASIRs, highlights the differences between these two regions and other regions of the world as well.

As far as the mortality data in our study are concerned, since the vital status of all the patients could not be recorded, our results have to be interpreted with caution. The highest mortality was recorded in patients diagnosed with breast cancer amongst females, and amongst those with brain tumors in males. Due to the non-availability of the vital status of nearly half of the patients, the survival statistics could not be reported either. Death certificates were available from just one collaborating center for each record of a hospital death and accounted for nearly 8% of the deaths recorded in the Registry. However, the point to be noted is that the cancer diagnoses were not merely reported from hospitals, they were also reported on patients identified as new cancer cases, from different laboratories/collection centers within the district. The establishment of a central death registry in the region could help in collecting the mortality data and determining the cause-specific mortality, along with the survival estimates for the study population. While the Government of Pakistan maintains the National Database Registration Authority with all citizens' data and biometric information, the capture of death information is variable and typically done at the local government level[27,28]. Deaths within hospitals have documented death certificates which get communicated to local government, but the recording of death diagnosis likely over-reports final mechanisms of death ('cardio respiratory failure'), rather than underlying causes. In view of this, death data and thus survival data have inherent inaccuracies in it.

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Table 8. ASIRs, per 100,000 population, per year, for selected cancer sites, in Pakistan, India, Iran, Israel, and USA.

		Pakistan	Globocan	Pakistan	India	Iran	Saudi Arabia	Israel	USA
		Lahore	Pakistan	Karachi	New Delhi	Golestan	Riyadh	Jews	SEER
		2010-2012	2012	1998-2002	2003-2007	2005-2007	2003-2007	2003-2007	2003-2007
	Oral cavity & salivary glands-C00-C08								
Male		4.6	10.5	22.5	14.0	1.7	1.6	3.3	6.9
Female		3.9	9.1	20.4	4.7	1.3	1.4	2.3	3.1
	Pharynx-C09-C14								
Male		0.6	3.8	8.2	6.6	1.0	2.4	1.5	4.4
Female		0.8	1.3	3.4	1.5	0.7	1.3	0.5	1.1
	Esophagus-C15								
Male		1.4	3.9	6.7	4.9	23.2	1.6	1.8	5.1
Female		1.2	4.4	8.6	2.9	18.8	1.3	0.9	1.2
	Stomach-C16								
Male		1.6	3.8	6.0	3.2	30.4	4.4	10.0	6.6
Female		1.3	2.2	3.6	1.5	12.6	2.3	5.4	3.3
	Small intestine-C17								
Male		0.3	-	0.2	0.2	1.4	0.5	1.0	1.5
Female		0.2	-	0.4	0.1	0.9	0.3	0.7	1.1
	Colo-rectum-C18-C21								
Male		4.7	4.7	7.1	5.5	13.6	12.5	42.8	35.3
Female		3.7	3.3	5.2	3.7	10.4	10.6	32.6	26.5
	Liver-C22								
Male		3.7	4.7	5.4	2.6	3.6	3.0	3.1	7.6
Female		2.4	2.5	3.7	1.5	2.0	6.0	1.4	2.4
	Gall bladder-C23-C24								
Male		1.0	0.9	1.3	4.0	1.2	1.2	1.7	1.7
Female		1.9	2.2	4.9	8.0	1.6	2.5	1.4	1.7
	Pancreas-C25								
Male		0.6	0.5	0.9	1.9	2.8	3.2	8.6	8.2
Female		0.5	0.4	0.5	1.1	1.0	1.9	6.4	6.2
	Nose & sinuses-C30-C31								
Male		0.3	-	0.7	0.3	0.0	0.2	0.4	0.6
Female		0.3	-	0.4	0.2	0.2	0.2	0.3	0.4
	Larynx-C32								
Male		2.0	5.0	10.7	8.0	4.1	1.7	4.1	4.3
Female		0.3	0.7	1.8	1.1	1.4	0.1	0.6	0.9
	Trachea, bronchus, & lung-C33-C34								
Male		4.6	9.8	25.2	13.7	17.5	6.3	29.8	48.3
Female		1.2	1.7	3.6	3.6	5.6	2.2	13.4	33.8
	Bone-C40-C41								
Male		0.9	-	1.3	2.0	1.3	0.8	1.3	1.0
Female		0.6	-	1.5	1.2	1.5	0.5	1.0	0.8
	Melanoma of the skin-C43								
Male		0.1	0.3	0.5	0.2	0.9	0.3	13.7	16.8
Female		0.1	0.2	0.3	0.2	0.7	0.4	11.2	12.0
	Skin-C44								
Male		2.8	-	4.3	1.3	11.0	3.8	2.8	1.3
Female		2.7	-	4.1	1.0	7.7	3.2	1.9	1.0
	Connective & soft tissue-C47-C49								
Male		1.2	-	2.4	1.5	2.1	1.3	3.2	3.0
Female		1.0	-	2.3	1.2	2.1	0.9	2.2	2.1
	Breast-C50								
Male		0.8	-	1.0	1.3	0.1	0.5	1.3	0.7
Female		47.6	50.3	69.0	31.6	28.0	21.1	89.4	86.6

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	Cervix uteri-C53							
Female	2.9	7.9	7.5	17.7	5.4	2.0	5.5	6.4
	Corpus uteri-C54							
Female	3.6	3.6	6.7	4.5	1.7	4.4	14.4	16.7
	Ovary-C56-C57.0-4							
Female	5.1	5.6	8.8	8.6	6.1	3.3	9.2	9.6
	Other female genital organs-C51-C52, C55, C58							
Female	1.5	-	1.0	1.6	1.4	0.9	1.8	2.5
	Penis-C60							
Male	-	-	0.1	1.0	0.0	0.1	0.3	0.7
	Prostate-C61							
Male	6.4	6.6	10.1	10.1	10.6	7.9	68.3	106.8
	Testis-C62							
Male	0.6	0.9	1.2	0.6	2.3	0.6	4.7	4.9
	Kidney, etc.-C64, C66, C68							
Male	1.7	1.7	1.9	2.7	2.2	3.8	13.9	137.0
Female	1.1	0.9	0.8	1.2	1.2	2.5	6.5	7.1
	Bladder-C67							
Male	5.0	5.1	9.3	6.5	8.5	5.6	25.5	20.8
Female	1.5	1.6	2.6	1.5	2.8	1.3	4.8	5.3
	Eye-C69							
Male	0.5	-	0.6	0.3	0.4	0.4	0.6	0.8
Female	0.4	-	0.3	0.2	0.2	0.2	0.4	0.6
	Brain, CNS-C70-C72							
Male	3.8	3.4	3.3	3.8	7.8	3.5	6.7	6.4
Female	2.2	2.1	2.7	2.4	5.3	2.1	5.0	4.6
	Thyroid-C73							
Male	0.7	0.7	0.7	1.1	1.2	2.5	4.8	3.9
Female	2.2	2.2	2.9	**2.5**	3.0	10.2	14.7	12.3
	Adrenal & other endocrine-C74-C75							
Male	0.1	-	0.2	0.2	0.7	0.3	0.6	0.5
Female	0.0	-	0.3	0.2	0.4	0.2	0.5	0.4
	Hodgkin lymphoma-C81							
Male	1.4	2.2	2.0	1.6	1.8	2.2	3.6	2.7
Female	0.7	0.8	1.0	0.7	1.1	2.0	3.4	2.2
	NHL-C82-C88, C96							
Male	4.5	5.3	7.6	5.6	7.2	8.6	17.9	15.5
Female	3.3	3.4	5.1	3.0	3.3	7.1	14.4	10.8
	Multiple myeloma-C88, C90							
Male	0.6	0.7	1.8	2.0	2.4	1.8	4.8	4.7
Female	0.5	0.6	1.3	1.2	2.2	1.0	3.0	3.1
	Leukemia-C91-C95							
Male	2.4	3.3	4.8	5.6	10.8	5.7	10.6	11.1
Female	1.5	2.2	4.1	3.6	7.7	4.3	6.9	7.1
	All sites-C00-C96							
Male	66.7	96.0	166.6	119.7	165.3	104.1	273.1	359.4
Female	105.1	127.7	192.0	118.4	142.0	103.9	308.5	282.6

CONCLUSION

This is the first time that an attempt has been made to determine and report the population-based cancer statistics for the Lahore district. This collaborative study highlights cancer registration and follow-up issues in a developing country like Pakistan, along with the non-availability of recent, accurate

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population estimates required as denominators in computation of the incidence rates. On average, annually, 5,200 new cases were reported in the Lahore district, in 2010-2012. Although it is likely that all the cases have not been reported, it is not possible to gauge the extent of under-reporting at this stage. The cancer statistics reported in this manuscript can be used as baseline figures for comparison with studies to be undertaken in the future. These statistics can also assist in exploring, thus, highlighting the putative risk factors associated with cancers commonly diagnosed in the region, as part of a health promotion and education program. Finally, this report can play an important role in developing prevention, early detection, and cancer control strategies in the region.

FOOTNOTES

Contributors

FB conceived the idea of the study, designed it, supervised the statistical analysis, did literature search, interpreted the results, and drafted the manuscript. FB further did the survival analysis for this study. SMa did the case-finding, coding, and indexing of cases from SKMCH & RC and computed the incidence rates and created figures and tables; RF, AY, HA, and AA validated the data, checked for duplication, and followed-up on the patients; and AQ and KLA worked on the comparison of the incidence rates with other regions. MAY and FS reviewed the paper critically and advised. MM was responsible for reporting the cancers recorded at the Institute of Nuclear Medicine & Oncology, Lahore; GRS from Ittefaq Hospital, Lahore; NC from Sheikh Zayed Hospital, Lahore; ORC from Chughtais Lahore Lab, Lahore; TM from Fatima Jinnah Medical University, Lahore; ZA and MAK from Jinnah Hospital, Lahore; GH and AA from the Children's Hospital & the Institute of Child Health, Lahore; RB from the Services Institute of Medical Sciences, Lahore; SR and IT from Fatima Memorial College of Medicine & Dentistry, Lahore; FA from Shalamar Medical & Dental College, Lahore; TA from Allama Iqbal Medical College, Lahore; SN from King Edward Medical University, Lahore; and BAS from Nawaz Sharif Social Security Hospital, Lahore. NS contributed intellectually to the study. MTM, SMu, AL, and MH did the pathologic confirmation of cases at SKMCH & RC, Lahore. SMa supervised, FB managed, and MAY and FS established and directed the Punjab Cancer Registry.

Funding

None for this study.

Competing interests

We declare no competing interests.

Data sharing statement

No additional data available.

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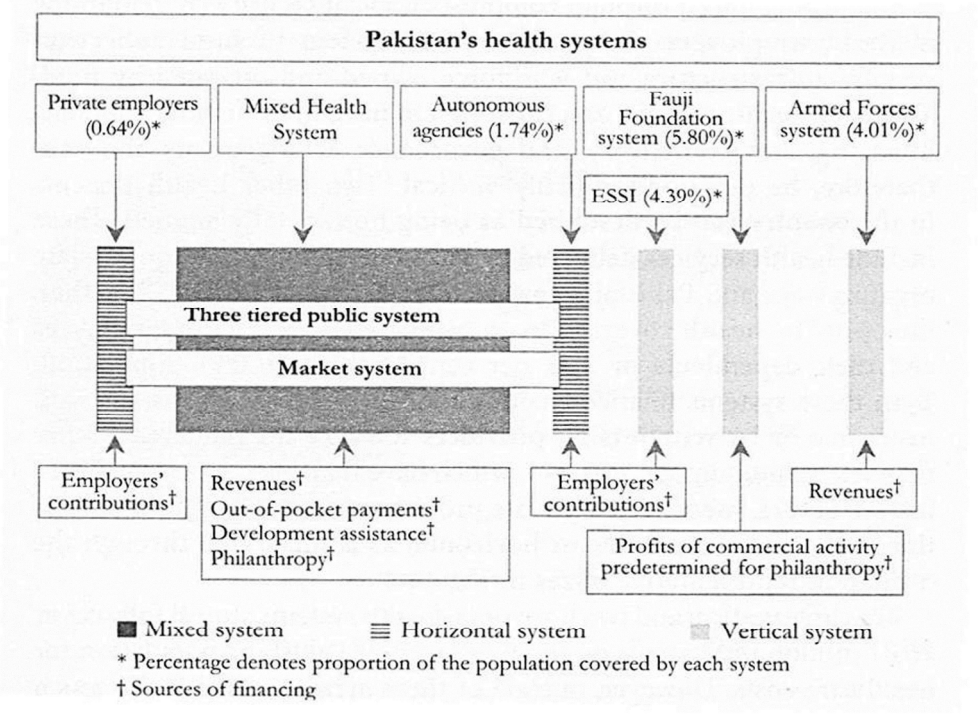

Figure 1. Health-care delivery systems in Pakistan. Image used with permission from Dr. Sania Nishtar from her book titled 'Choked Pipes'.
254x190mm (300 x 300 DPI)

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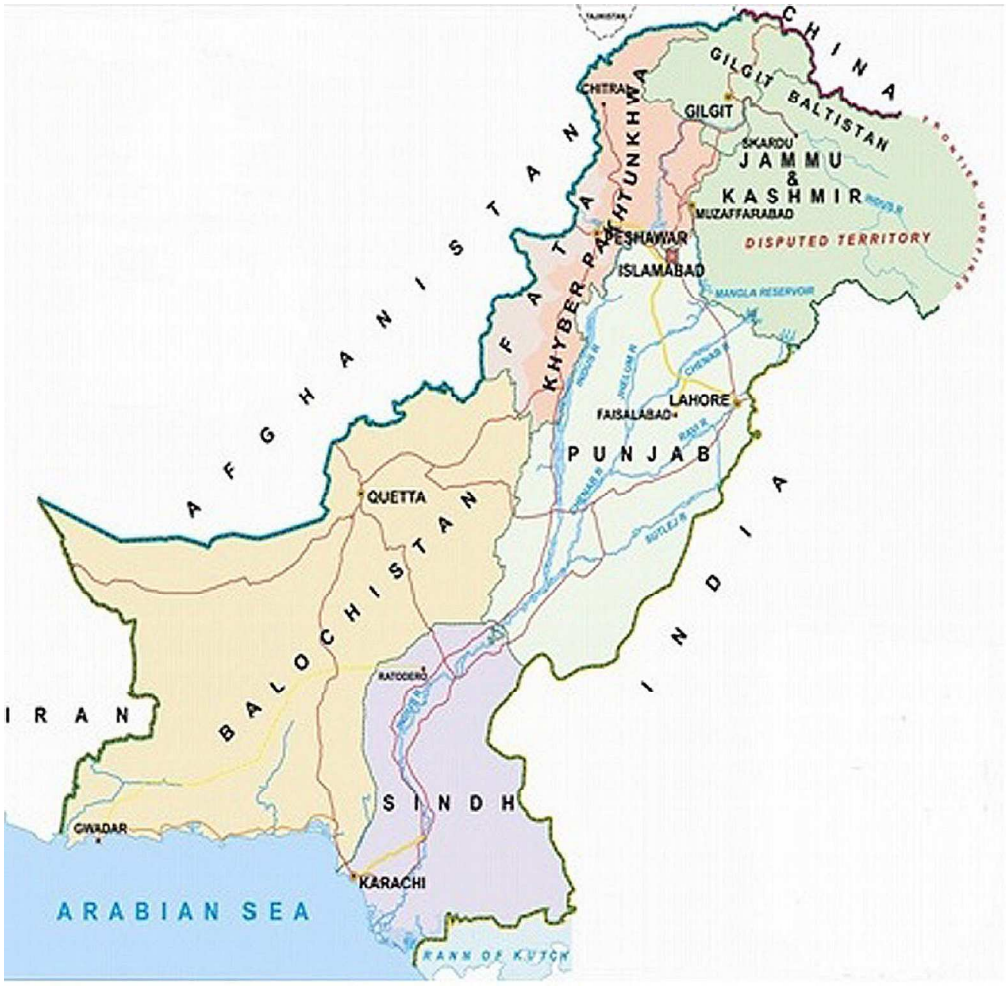

Figure 2. Map of Pakistan showing the provinces and location of the Lahore and Karachi districts and neighboring countries.
344x337mm (300 x 300 DPI)

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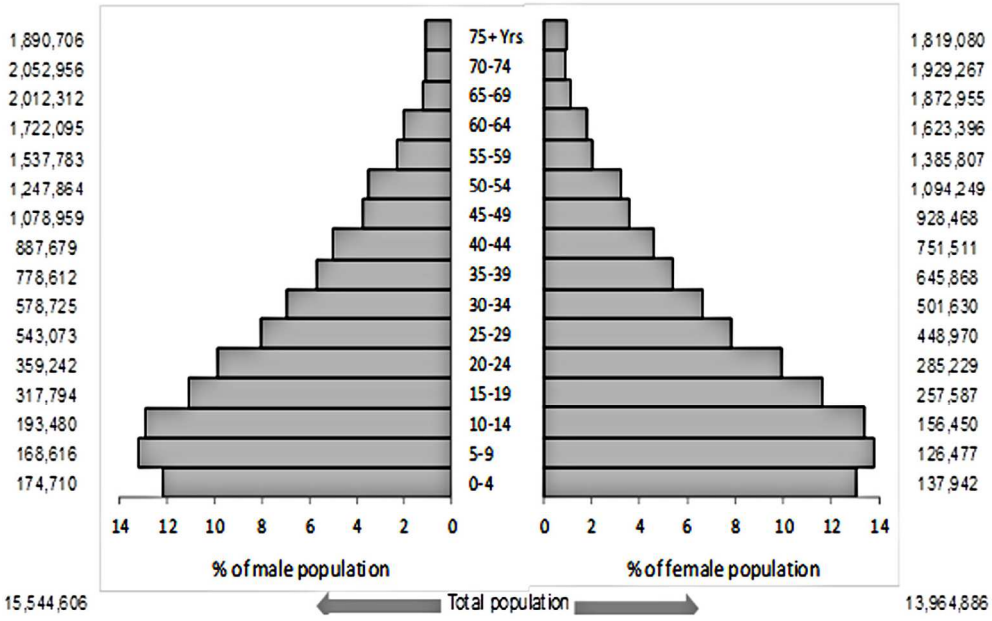

Figure 3. Population structure of the Lahore district, 2010-2012, by gender.
152x97mm (300 x 300 DPI)

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Appendix A-List of collaborating centers in Lahore. Centers are listed in descending order of the number of cases reported, to the Punjab Cancer Registry, 2010-2012.

S. No.	Center name
1	Shaukat Khanum Memorial Cancer Hospital & Research Center
2	Institute of Nuclear Medicine & Oncology
3	Ittefaq Hospital
4	Sheikh Zayed Hospital
5	Chughtais Lahore Lab
6	Fatima Jinnah Medical University
7	Jinnah Hospital
8	The Children's Hospital & the Institute of Child Health
9	Services Institute of Medical Sciences
10	Fatima Memorial College of Medicine & Dentistry
11	Shalamar Medical & Dental College
12	Allama Iqbal Medical College
13	King Edward Medical University
14	Nawaz Sharif Social Security Hospital
15	Akhtar Saeed Medical & Dental College
16	Post Graduate Medical Institute
17	Combined Military Hospital
18	Indus Lab
19	Pride Lab

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Appendix B-Data collection form used for the Lahore district, the Punjab Cancer Registry.

PUNJAB CANCER REGISTRY

DATA COLLECTION FORM

CENTER I.D. NO._____ PATIENT I.D NUMBER: _____ ← (To be allocated by .)

HISTOLOGY NO._____ HISTOLOGY DATE: _____/_____/_____

PATIENT'S NAME_____ _____ _____
LAST FIRST MIDDLE

SEX: MALE ☐ FEMALE ☐ NEUTER (MUKHANNA ☐) FATHER'S NAME _____

BIRTH DATE _____ AGE _____

N.I.C. NUMBER (FOR CHILDREN ≤ 18 YEARS, ID OF MOTHER/ FATHER) _____

PERMANENT ADDRESS (HOUSE AND STREET NO.) _____

_____

CITY/TOWN _____ POSTAL CODE_____

HOME/CELL TELEPHONE WITH AREA CODE_____

↓RESIDENT OF LAHORE: YES ☐ NO ☐ IF YES, duration of stay in Lahore (Months/Years) _____
کیا آپ لاہور کے رہائشی ہیں.

↓COME TO LAHORE FOR TREATMENT/DIAGNOSIS ONLY_____ (YES/NO)
یا آپ لاہور بیماری کی تشخیص یا علاج کے لیے آئے ہیں.

Procedure/surgery done at (hospital)…….
Name of surgeon……
Cytology/histopathology done at (lab.) …….

PRIMARY SITE_____ DATE OF DIAGNOSIS _____

SITE OF BIOPSY_____ METASTATIC_____ (YES/NO)

LATERALITY (where applicable) _____ MORPHOLOGY _____ BEHAVIOR_____

GRADE _____ STAGE (when available) _____

*MOST VALID BASIS OF DIAGNOSIS (Please see the list below)_____

FOR PCR CENTRAL OFFICE USE ONLY
STATUS AT LAST FOLLOW-UP _____

DATE OF DEATH _____ PLACE OF DEATH

†PCR is an acronym for the Punjab Cancer Registry.
*0. Death Certificate Only 1. Clinical; 2. Clinical investigation; 4. Specific tumor markers; 5. Cytology; 6. Histology of a metastasis; 7. Histology of primary tumor; and 9. Unknown.

xx END xx

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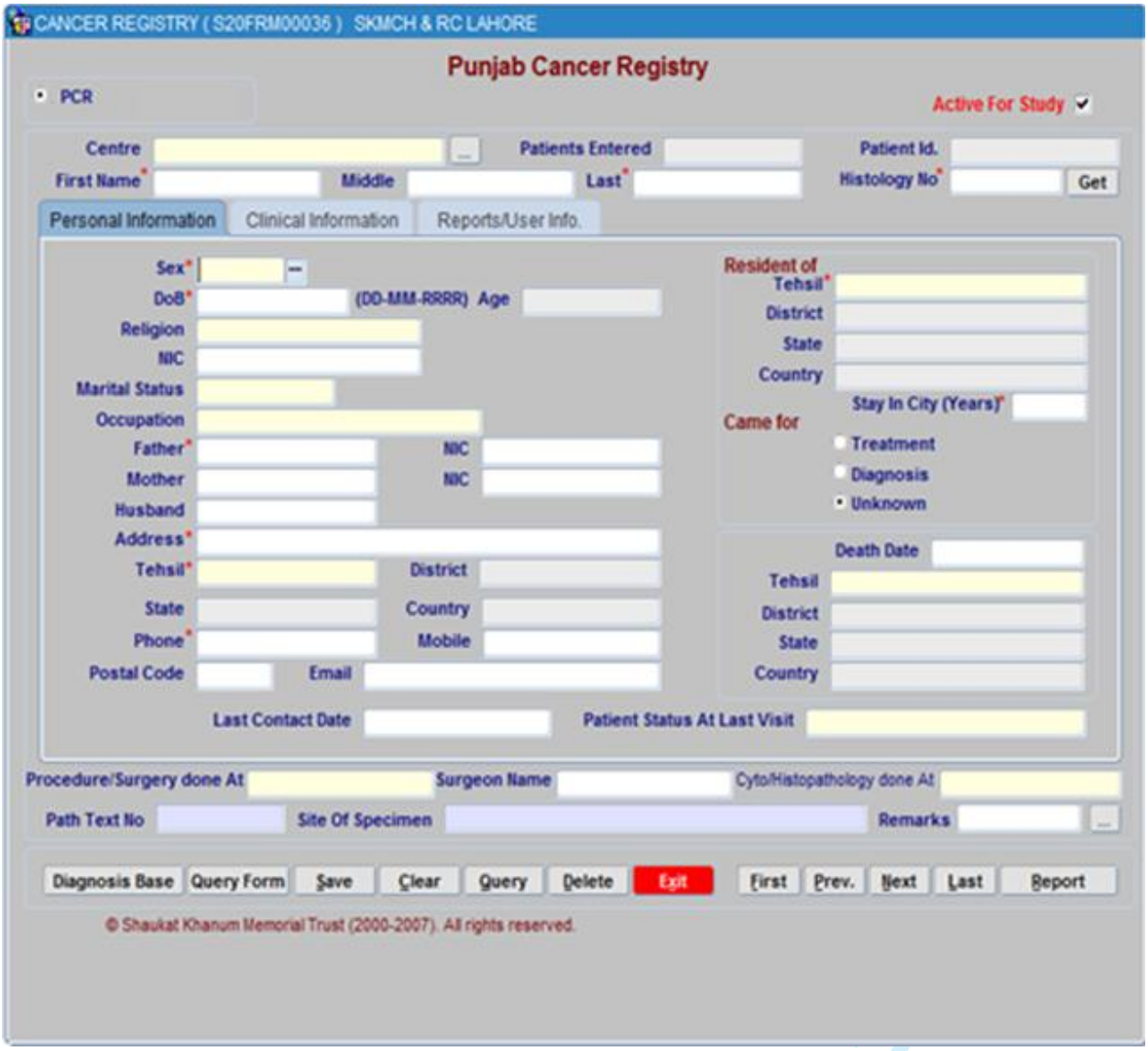
Appendix C-Screen shot of the PCR data capture form in the Hospital Information System, SKMCH & RC, Lahore, Pakistan.



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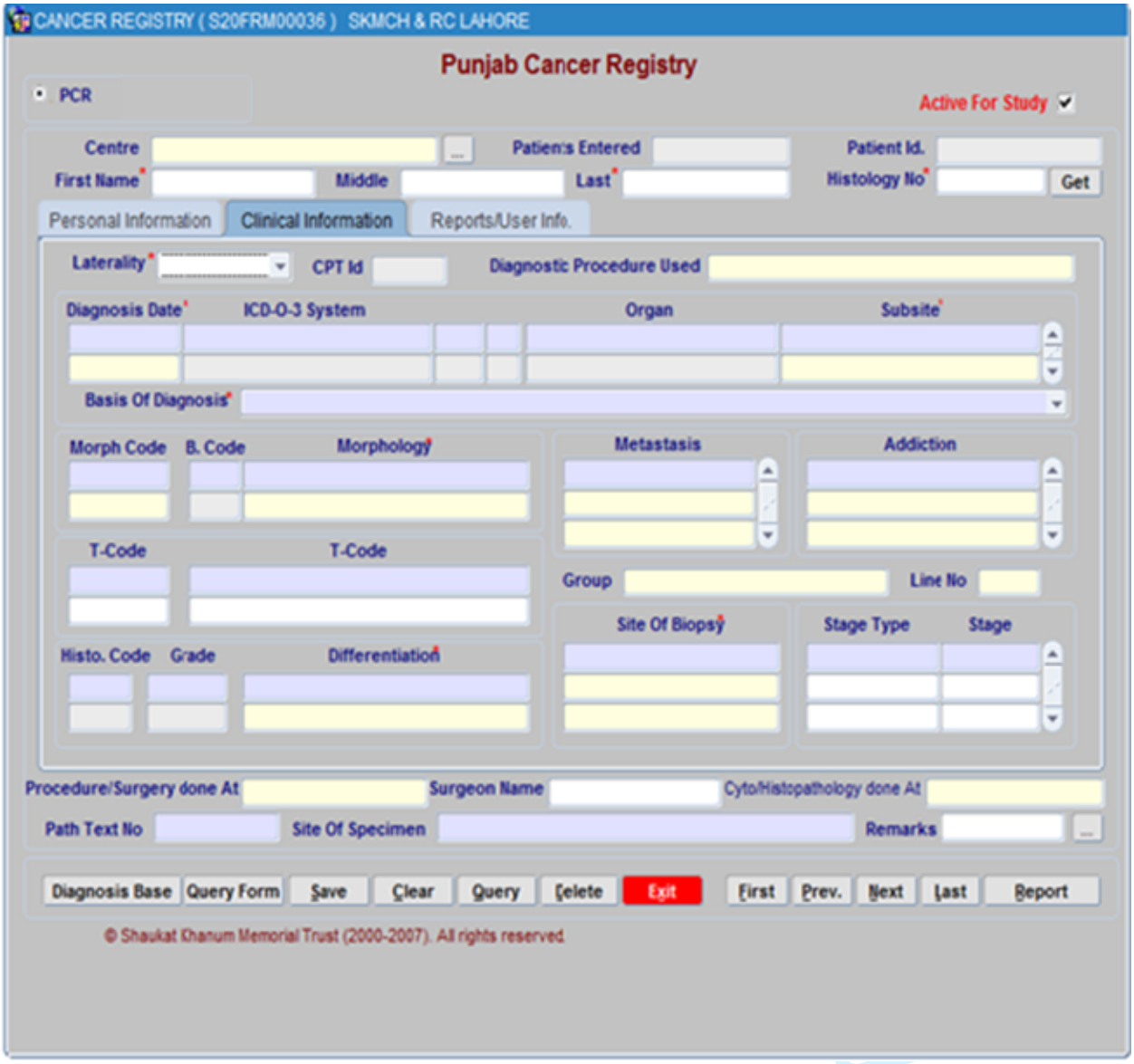
Appendix CC-Screen shot of the PCR data capture form in the Hospital Information System, SKMCH & RC, Lahore, Pakistan.



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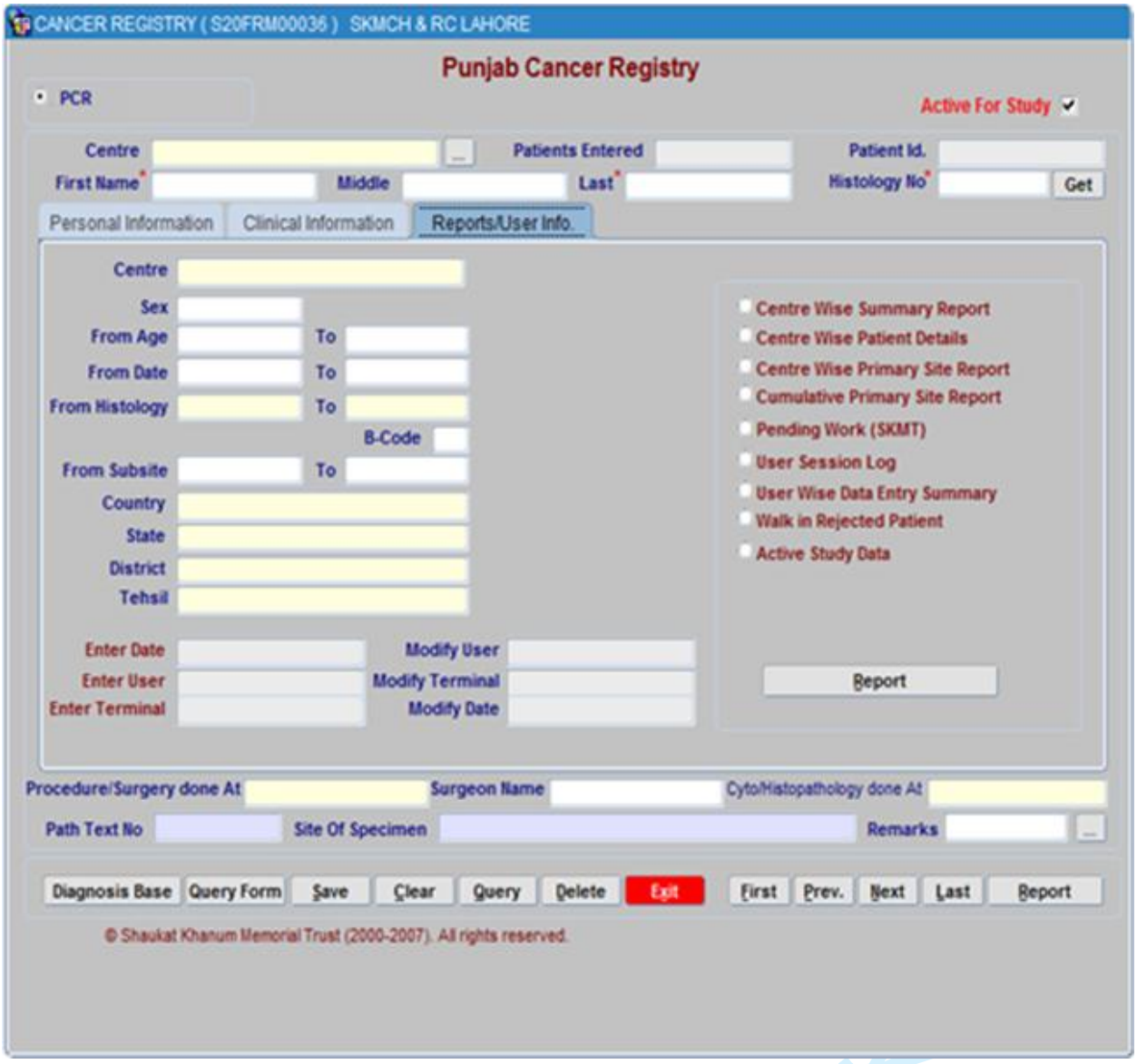
Appendix CCC-Screen shot of the PCR data capture form in the Hospital Information System, SKMCH & RC, Lahore, Pakistan.



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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract-**page 8**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found- **page 8**
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported-page **9-11**
Objectives	3	State specific objectives, including any pre-specified hypotheses-**page 11**
Methods		
Study design	4	Present key elements of study design early in the paper-**page 11-14**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection-**page 11-14**
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants-**pages 11-14**
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable-**pages 11-14**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group-**pages 14-21**
Bias	9	Describe any efforts to address potential sources of bias-**page 21**
Study size	10	Explain how the study size was arrived at-**page 11-14**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why-**page 11**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding-**page 11-14**
		(*b*) Describe any methods used to examine subgroups and interactions-**page 11-14**
		(*c*) Explain how missing data were addressed-**page 11-14**
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy- **not applicable**
		(*e*) Describe any sensitivity analyses

Continued on next page

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Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed-**pages 11-14**
		(b) Give reasons for non-participation at each stage-**pages 11-14**
		(c) Consider use of a flow diagram-**one to indicate the health systems in Pakistan (Figure 1).**
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders-**page 11-14**
		(b) Indicate number of participants with missing data for each variable of interest-**page 11-21**
		(c) *Cohort study*—Summarise follow-up time (e.g., average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures- **pages 11-21**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included-**pages 11-15**
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives-**pages 14-21**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias-**pages 21-26**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence-**pages 21-26**
Generalisability	21	Discuss the generalisability (external validity) of the study results- **pages 21-26**
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based-**pages 12 & 26**

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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THE EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, 2010-2012: A CROSS-SECTIONAL STUDY

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THE EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, 2010-2012: A CROSS-SECTIONAL STUDY

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THE EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, 2010-2012: A CROSS-SECTIONAL STUDY

ABSTRACT

Objectives

To estimate the population-level cancer estimates for the Lahore district, which is part of the Punjab Cancer Registry (PCR), Pakistan. The average population, per year, of Lahore was estimated at 9.8 million in 2010-2012.

Design

A cross-sectional study.

Setting

The Registry has nineteen collaborating centers in Lahore that report their data to the Central Office located within a tertiary care cancer treatment facility in Lahore, Pakistan.

Participants

Patients belonging to Lahore, of any age-group, and diagnosed with cancer in 2010-2012, were included in the study. Patients were followed-up between July and October 2015 to determine their vital status.

Outcome measures

Summaries were generated for gender, the basis of diagnosis, diagnoses, and deaths. The Age-Standardized Incidence Rates (ASIR) were computed per 100,000 population, by gender and cancer site. Five-year age categories were created from 0-4 till 70-74, followed by 75+ years. Death counts were reported by site.

Results

Between 2010 and 2012, in Lahore, a total of 15,840 new cancers were diagnosed-43% in male and 57% female patients; 93·5% microscopically confirmed and 6·5% non-microscopically. The ASIR amongst females was 105·1 and in males 66·7. ASIRs of leading cancers, amongst women, were: breast 47·6, ovary 4·9, and corpus uteri 3·6, whereas, amongst men: prostate 6·4, bladder 5·0, and, trachea, bronchus, & lung 4·6. A total of 5,134 deaths were recorded.

Conclusions

In Lahore, the ASIR was higher in women than in men. Amongst women, breast cancer, and in men, prostate cancer, were the leading cancer types. These estimates can be used for health promotion and policy making in the region.

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ARTICLE SUMMARY

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This is the first time that the age-standardized incidence rates have been presented for the Lahore district.
- A comparison has been made with the incidence rates reported by other registries around the world.
- There are follow-up issues related to determining the vital status of the patients, once they are registered as new cancer patients. Therefore, the limitation of the study is that the vital status of the vast majority of patients could not be determined.

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PAPER

THE EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, 2010-2012: A CROSS-SECTIONAL STUDY

INTRODUCTION

In the area of public health research, conducting high-quality, population-level studies, is hailed as the gold standard, as the outcomes truly represent the disease status of the community on whom the studies are being conducted. This includes the practice of population-based cancer registration, which not only assists in providing statistics and trends on incidence, mortality, and survival, it can also provide information on putative risk factors associated with various diseases within a defined population, living in a geographically demarcated area, over a specified period of time. However, cancer registration can only be undertaken if there is appropriate infrastructure to enable it, and suitable, well-trained staff to perform the tasks associated with it. Understandably, there is a cost associated with conducting this type of epidemiologic work, and in a resource-constrained country like Pakistan, governments are less likely to focus on the area of cancer registration than other areas deemed more immediately critical. Further, there is no legislation in the country that requires health-care practitioners to report diagnoses of cancer. Moreover, the health-care delivery in Pakistan is quite complex, and is as depicted in Figure 1. A large part of the population is served through a mixed system via multiple health providers[1].

The question whether cancer registration is a necessity or a luxury in developing countries has been debated extensively over the years. A paper published in 2008 stated that in low-income countries, cancer registration is urgently needed so as to gauge the cancer burden in the region[2]. Given that Pakistan is categorized as a 'lower-middle income country' by the World Bank, with its population estimated to be 185·0 million in the year 2014, and the life expectancy at birth being 66 years (65 years for males and 67 years for females), it seems unlikely that registration of all cancer diagnoses will be accurate and complete at the national level in the near future[3]. However, there is no denying the fact that knowing the cancer burden in the region helps in projecting regional cancer trends, establishing the required numbers of health-care facilities to cater to the needs of the patients, training sufficient numbers of health-care practitioners to manage the conditions, addressing health education, and assisting in developing prevention, early detection, and cancer control programs in the region. Figure 2 is a map of Pakistan showing the provinces of Pakistan and countries adjacent to Pakistan[4]. Even though accurate population figures are not available, enthusiastic professionals have, over the years, endeavored to determine cancer estimates for Pakistan. In the past, the regional registry of the Karachi South district, in the province of Sindh, was established and managed for several years by a dedicated pathologist, Dr. Yasmin Bhurgri[5]. This registry was widely recognized at an international level for its data quality[5]. However, due to the sudden death of Dr. Bhurgri in January 2012, this registry is no longer active. Another registry in Pakistan is the Punjab Cancer Registry (PCR), which was founded collaboratively by a group of health-professionals in 2005, pioneered by the administrators of a complete cancer treatment facility in Lahore called the Shaukat Khanum Memorial Cancer Hospital and Research Center (SKMCH & RC)[6-9]. The Punjab Cancer Registry, herein, referred to as the Registry, is

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registered with, and regulated under, the Societies Registration Act, 1860, of the Government of Pakistan[10]. It is also a member of the International Association of Cancer Registries, France[11]. Appendix A shows the list of collaborating centers of the Registry.

The reporting of cancer cases to population-based cancer registries is not required by law, in Pakistan. It is, in fact, a voluntary task undertaken by professionals representing many institutions of the region. When the Registry was established in 2005, a memorandum outlining the structure and governance mechanisms was signed by the stake-holders representing both the government and private laboratories and hospitals of the city. The purpose of establishing the Registry was to determine the cancer estimates in the province of Punjab. Punjab is the most populous province of Pakistan, with a population estimated at 100 M, and 36 administrative districts, of which Lahore is the most populous, with a population of some 10 M[12,13]. For about a decade, data have been captured in a systematic and pre-defined manner, in accordance with the minimum data items required for cancer registries as well as some additional optional data items[6,9,14].

In the past, PCR data have been reported to the International Agency for Research on Cancer (IARC) in response to a call for data by the Agency. The data have been used, along with data from Dr. Yasmin Bhurgri's paper, and the Federal Bureau of Statistics, Pakistan, to provide cancer estimates for Pakistan in the Globocan 2012 report[15].

This manuscript provides population-level cancer estimates for the Lahore district, based on cases diagnosed in 2010-2012 and reported to the Registry. This is the first time that the Lahore district population-level data have been computed and are being reported.

METHODS

The population denominator

Population-level statistics cannot be computed without the availability of figures for the population under review, or the catchment population. In Pakistan, publications describing the population structure are available for the census that was conducted in 1998[12]. However, the most recent population census, initiated a year ago, has not yet been completed[16]; therefore, accurate figures describing the Pakistani population are not available. As a result, for this study, population estimates are based on population figures determined by using the average annual growth rates provided by the Government of Pakistan[12].

In the years 2010, 2011, and 2012, the population of the Lahore district was estimated at 9,503,871, 9,832,705, and 10,172,916 respectively, computed using an average annual growth rate of 3·46%[12,13]. The total area of the Lahore district is 1,772 square kilometers, with its average population density being calculated as 5,551 persons, per square kilometer, in the years under study[12]. Figure 3 is a population pyramid showing the combined population distribution of the Lahore

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district by age-group and gender, for the years 2010-2012. These population estimates were used as the population-at-risk denominator, for calculating the incidence rates for this study.

Data collection

As routine cancer registration practice, the information is collected on the PCR data collection forms developed collaboratively, following international guidelines on recording cancers (Appendix B). The pertinent question on the form states whether a patient is a resident of Lahore or has come to Lahore for diagnosis or treatment only. This has helped to identify the residents of Lahore.

Each center is allocated a separate center identification number. The forms are distributed to, and collected from, each participating center on a regular basis. Both the active and passive methods of data collection are used[14]. Registry Staff educates relevant personnel at each center with regard to data capture, missing information and answers any other queries that arise. At the Cancer Registry & Clinical Data Management unit, only authorized personnel are allowed to enter data from forms, into the database. The forms collected are stored securely and remain confidential. The information is subsequently entered into the Punjab Cancer Registry database, developed as part of the computerized Hospital Information System of SKMCH & RC (Appendices C-CCC). All authorized Staff members are given specific usernames and passwords to turn the computers on and another username-password to access the system, and thence, the PCR software. Any form of transmission of the information including printing and saving it on portable electronic devices, and aspects related to document retention, are strictly regulated by the Governing Council of the Registry and SKMCH & RC, the latter being the sponsor of the Registry. For the cases diagnosed or treated at SKMCH & RC, linkages have been developed with the pathology department and clinics to facilitate date capture.

For the purpose of recording cancers, incidence date on the PCR form is defined as the date of cytologic/histologic confirmation of a malignancy on a pathology report, date of evaluation at an outpatient clinic only, or date of clinical investigation(s) as imaging or tumor markers, confirming the diagnosis. A check for multiple primaries is done, as per IARC rules[17]. In case of duplicate registration identified by checking various combinations of name/age/sex/phone number/address/tumor morphology, the case is registered with the center where the first diagnosis was made. Edits, for the validity and for the consistency between variables, are also carried out (age/incidence, age/site/histology, site/histology, sex/site, sex/histology, behavior/site, behavior/histology, grade/histology, and basis of diagnosis/histology). Initially, cancers were coded using the International Classification of Disease for Oncology-Third Edition[18]. For this manuscript, cancers were categorized using the International Classification of Diseases, Clinical Modification, 10th revision[19].

Data access and follow-up

Release of confidential information is governed by the rules approved by the Registry, and is always without any identifiers[6]. For maintaining confidentiality of the information recorded, Staff members are made to sign a confidentially pledge at the time of employment, which remains in force after

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cessation of employment with SKMCH & RC. For the purpose of reporting the data to IARC and to determine the vital status, patients diagnosed in the time-period 2010-2012 were followed-up telephonically between July and October 2015. We were able to establish contact with only sixty percent of the cases in this way.

Cancers reported

Cancer notifications for the Lahore district have improved with the passage of time, with the cases reported to the Registry going up from 2,006 in the year 2005 to 5,123 in the year 2015. In chronologic order, the numbers reported are as follows: 2,006; 2,987; 3,617; 3,990; 5,109; 5,302; 4,949; 5,589; 6,009; 5,943; and 5,123. We are still receiving information on cases diagnosed in 2014 and 2015. Over recent years, six other districts have been included for the purpose of data collection, with the idea being to include 1-2 contiguous district(s) of Punjab every year in order to expand cancer registration. The data collection form is modified accordingly to ascertain resident status of the patients[6]. The approach related to including 1-2 districts on a regular basis has been adopted because the sponsor, SKMCH & RC, is a charitable organization, and it is logistically not possible to initiate data collection from 36 districts of Punjab simultaneously.

2010-2012 study

A cross-sectional study was conducted and the Punjab Cancer Registry data were reviewed retrospectively to retrieve information on cancer patients belonging to the Lahore district and having been diagnosed in 2010-2012. Information was collected on new cancer diagnoses (by histology and gender), the most valid basis of diagnosis as microscopically versus non-microscopically confirmed, multiple primaries, and deaths recorded. Five-year age categories were created beginning from 0-4 years and ending on 70-74 years, with all those above 75 included as 75+. Cases were stratified by year of diagnosis/gender/age-group and histology/site.

Data analysis

Counts were determined and ASIRs computed according to 5-year age-group, weighted by the Segi World Standard population[20]. ASIRs were expressed per 100,000 population, per year, separately for male and female patients. For mortality data, counts were stratified by histology/site. Overall survival interval was computed between the dates of diagnosis and last contact and analyzed using the Kaplan-Meier method. Of a total of 15,825 patients registered in the years 2010-2012, survival intervals could not be computed for nearly 43 percent of the cases. Of these, in the vast majority of cases, no contact could be established with the patients on the phone numbers provided; in some of the cases, the attendants of the patients could only communicate that the patients had died but could not recall their dates of death; and, in a few cases, the patients died on the day of cancer diagnoses and their intervals were set at naught. Although extensive survival analysis was subsequently done on the fifty-seven percent of cases on whom the duration of survival was available, the survival estimates generated were not considered valid. Therefore, survival results are not being presented in this manuscript.

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Data were analyzed using the Microsoft Excel, version 2010, and SPSS, version 19. The Institutional Review Board (IRB) of the Shaukat Khanum Memorial Cancer Hospital & Research Center granted exemption from full IRB evaluation.

RESULTS

The total population of the Lahore district, in 2010-2012, was estimated to be 29,509,492, with males accounting for 52·7% and females 47·3% of the population (Figure 3). The number of cases reported in each of the three-years under study, 2010, 2011, & 2012, along with their population denominators, were: 5,302/9,503,871, 4,949/9,832,705, and 5,589/10,172,916, respectively. Of a total of 15,840 cancers diagnosed in 15,825 patients belonging to the district of Lahore and registered in the PCR database against the corresponding years, 9,069 (57·3%) were in female and 6,771 (42·7%) in male patients. Multiple primary cancers, up to two, were identified in 15 patients (Table 1), explaining the discrepancy between the number of cases recorded and the patients registered. Nearly ten percent were identified to have been registered twice and were eventually assigned to the center where the first diagnosis was made, thereby, counted just once. The age-range of the patients was 0-106 years. Of all the cancers diagnosed, about 93·5% were microscopically and 6·5% were non-microscopically confirmed (Table 2). None were registered on the basis of death certificates only. Skin cancer had the highest figure in the microscopically confirmed group (99·6%), whereas, liver & intrahepatic bile duct(s) had the highest figure in the non-microscopically confirmed category (69·5%). The ASIR for all sites combined amongst female patients was 105·1 per 100,000 women and amongst male patients, it was 66·7 per 100,000 men, per year. Tables 3-6 show the ASIRs for all the cancers recorded in the Registry, by the year of diagnosis and gender, and the age-specific rates for the 5-year age-group, separately for female and male patients. Amongst females, the highest ASIRs were recorded for the following sites and malignancies: breast 47·6, ovary 4·9, corpus uteri 3·6, Non-Hodgkin Lymphoma (NHL) 3·3, cervix uteri 2·9, and brain & CNS 2·2, whereas, in men, the highest ASIRs were: prostate 6·4, bladder 5·0, trachea, bronchus, & lung 4·6, NHL 4·5, brain & CNS 3·8, and liver 3·7.

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Table 1. Details related to patients having multiple primaries in the Lahore district, 2010-2012.

Serial no.	Gender	Age (years)	Vital status	Multiple sites
1.	Male	20	Alive	Colon & brain
2.	Male	23	Alive	Larynx & testis
3.	Male	34	Dead	Kidney & thyroid
4.	Female	45	Alive	Breast & breast
5.	Male	45	Alive	Ill-defined & lung
6.	Female	46	Alive	Breast & ovary
7.	Male	55	Alive	Spinal cord & NHL
8.	Male	56	Dead	Brain & unknown primary
9.	Female	59	Alive	Breast & liver
10.	Female	60	Dead	Breast & breast
11.	Male	62	Dead	Rectum & bone
12.	Female	64	Alive	Breast & breast
13.	Male	67	Dead	Thyroid & stomach
14.	Male	70	Dead	Connective tissue & liver
15.	Female	91	Dead	Breast & ovary

Table 2. The basis of diagnosis, categorized as being microscopically and non-microscopically confirmed, 2010-2012, in the Lahore district (N=15,840).

	The basis of diagnosis	
Cancer site	Microscopic (%)	Non-Microscopic (%)
Lip & oral cavity	97.0	3.0
Esophagus	99.1	0.9
Stomach	99.2	0.8
Colorectal	96.9	3.1
Liver & intrahep. bile ducts	30.5	69.5
Gall bladder	92.6	7.4
Larynx	96.6	3.4
Bronchus & lung	94.7	5.3
Bone	97.0	3.0
Connective tissue	94.4	5.6
Leukemia	92.8	7.2
Breast	95.8	4.2
Cervix uteri	96.8	3.2
Corpus uteri	97.8	2.2
Testis	98.9	1.1
Prostate	97.5	2.5
NHL	95.8	4.2
Hodgkin lymphoma	97.5	2.5
Urinary bladder	97.3	2.7
Brain	96.6	3.4
Skin	99.6	0.4
Kidney	93.4	6.6
Thyroid	97.6	2.4
Ovary	93.7	6.3

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Table 3. Cancer counts and the age-standardized incidence rates of cancers diagnosed in the Lahore district, 2010-2012, according to year of diagnosis.

		2010		2011		2012	
Site	ICD-10 code	Count	ASIR	Count	ASIR	Count	ASIR
Lip	C00	13	0.2	5	*0.1*	4	*0.1*
Tongue	C01-C02	115	2.0	92	1.5	102	1.6
Mouth	C03-C06	117	2.1	110	1.8	115	1.9
Salivary glands	C07-C08	30	0.5	32	0.5	29	0.4
Tonsil	C09	3	*0.1*	3	*0.1*	10	0.1
Other oropharynx	C10	2	*0.0*	3	*0.1*	1	*0.0*
Nasopharynx	C11	13	0.2	11	0.1	14	0.2
Hypopharynx	C12-C13	22	0.4	12	0.2	19	0.3
Pharynx	C14	4	*0.1*	3	*0.0*	3	*0.0*
Esophagus	C15	76	1.4	61	1.1	85	1.4
Stomach	C16	85	1.5	86	1.4	96	1.5
Small intestine	C17	15	0.3	15	0.3	13	0.2
Colon	C18	148	2.6	106	1.7	135	2.2
Rectum	C19-C20	101	1.6	89	1.4	133	2.0
Anus	C21	21	0.4	22	0.3	21	0.3
Liver	C22	176	3.4	184	3.4	145	2.6
Gall bladder, etc.	C23-C24	72	1.3	76	1.4	84	1.6
Pancreas	C25	30	0.6	30	0.6	37	0.7
Other ill-defined digestive	C26	7	*0.1*	11	0.2	12	0.2
Nose, sinuses	C30-31	17	0.3	23	0.4	19	0.3
Larynx	C32	74	1.4	55	1.0	82	1.4
Trachea, bronchus, & lung	C33-C34	162	3.2	156	2.9	170	3.2
Other thoracic organs	C37-C38	14	0.2	11	0.2	17	0.2
Bone	C40-C41	80	0.8	74	0.8	80	0.8
Melanoma of the skin	C43	4	*0.1*	11	0.2	11	0.1
Other skin	C44	152	2.8	141	2.5	174	2.9
Connective & soft tissue	C47,C49	95	1.3	95	1.2	62	0.8
Breast	C50	1409	22.9	1339	21.4	1404	21.5
Vulva	C51	3	*0.1*	7	*0.2*	9	*0.4*
Vagina	C52	5	*0.2*	6	*0.2*	5	*0.2*
Cervix uteri	C53	86	3.1	69	2.4	92	3.2
Corpus uteri	C54	83	3.5	84	3.3	100	4.1
Uterus, unspecified	C55	34	1.3	27	1.1	28	1.0
Ovary	C56	138	4.6	124	4.1	180	5.8
Other female genital orgs.	C57	5	*0.2*	7	*0.3*	6	*0.2*
Placenta	C58	3	*0.1*	2	*0.0*	2	*0.0*
Penis	C60	-	-	1	*0.0*	-	-
Prostate	C61	165	6.2	193	7.1	168	6.0
Testis	C62	31	0.7	24	0.5	35	0.7
Other male genital organs	C63	-	-	3	*0.1*	2	*0.1*
Kidney	C64	88	1.5	97	1.5	89	1.4
Renal pelvis	C65	-	-	-	-	2	*0.0*
Ureter	C66	-	-	1	*0.0*	1	*0.0*
Bladder	C67	177	3.6	150	2.8	223	4.0
Other urinary organs	C68	-	-	2	*0.0*	-	-
Eye	C69	33	0.5	29	0.4	35	0.4
Brain, nervous system	C70-C72	248	3.5	203	2.8	234	3.0
Thyroid	C73	94	1.3	92	1.3	110	1.5
Adrenal	C74	2	*0.0*	3	*0.0*	6	*0.1*
Hodgkin lymphoma	C81	104	1.3	86	1.0	92	0.9
Non-Hodgkin lymphoma	C82-C88	274	4.4	234	3.6	262	3.9
Multiple myeloma	C90	33	0.7	26	0.5	30	0.5
Lymphoid leukemia	C91	91	0.9	71	0.7	157	1.4
Myeloid leukemia	C92-93	42	0.5	31	0.4	96	1.1
Other leukemias	C95	30	0.3	25	0.3	45	0.4
Leukemia, unspecified	C94	3	*0.0*	2	*0.0*	3	*0.0*
Other & unspecified	-	335	5.7	369	6.2	393	6.4
Benign CNS	-	138	1.9	125	1.6	107	1.3
All sites		5302	97.8	4949	89.1	5589	96.8

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Table 4. Cancer counts and age-standardized incidence rates of cancers diagnosed in the Lahore district in 2010-2012, by gender and cancer site/type.

		FEMALE				MALE			
Site	ICD-10-code	Count	%	Crude	ASIR	Count	%	Crude	ASIR
Lip	C00	9	0.1	0.1	*0.1*	13	0.2	0.1	0.1
Tongue	C01-C02	129	1.4	0.9	1.7	180	2.7	1.2	1.8
Mouth	C03-C06	130	1.4	0.9	1.6	212	3.1	1.4	2.2
Salivary glands	C07-C08	41	0.5	0.3	0.5	50	0.7	0.3	0.5
Tonsil	C09	8	0.1	0.1	*0.1*	8	0.1	0.1	*0.1*
Other oropharynx	C10	-	-	-	-	6	0.1	0.0	*0.1*
Nasopharynx	C11	19	0.2	0.1	0.2	19	0.3	0.1	0.2
Hypopharynx	C12-C13	32	0.4	0.2	0.4	21	0.3	0.1	0.2
Pharynx	C14	5	0.1	0.0	*0.1*	5	0.1	0.0	*0.0*
Esophagus	C15	95	1.0	0.7	1.2	127	1.9	0.8	1.4
Stomach	C16	105	1.2	0.8	1.3	162	2.4	1.0	1.6
Small intestine	C17	17	0.2	0.1	0.2	26	0.4	0.2	0.3
Colon	C18	159	1.8	1.1	1.9	230	3.4	1.5	2.4
Rectum	C19-C20	137	1.5	1.0	1.5	186	2.7	1.2	1.9
Anus	C21	23	0.3	0.2	0.3	41	0.6	0.3	0.4
Liver	C22	177	2.0	1.3	2.4	328	4.8	2.1	3.7
Gall bladder, etc.	C23-C24	139	1.5	1.0	1.9	93	1.4	0.6	1.0
Pancreas	C25	40	0.4	0.3	0.5	57	0.8	0.4	0.6
Other ill-defined digestive	C26	14	0.2	0.1	0.1	16	0.2	0.1	0.2
Nose, sinuses	C30-31	27	0.3	0.2	0.3	32	0.5	0.2	0.3
Larynx	C32	28	0.3	0.2	0.3	183	2.7	1.2	2.0
Trachea, bronchus, & lung	C33-C34	92	1.0	0.7	1.2	396	5.8	2.5	4.6
Other thoracic organs	C37-C38	16	0.2	0.1	0.2	26	0.4	0.2	0.2
Bone	C40-C41	91	1.0	0.7	0.6	143	2.1	0.9	0.9
Melanoma of the skin	C43	13	0.1	0.1	0.1	13	0.2	0.1	0.1
Other skin	C44	196	2.2	1.4	2.7	271	4.0	1.7	2.8
Connective & soft tissue	C47,C49	108	1.2	0.8	1.0	144	2.1	0.9	1.2
Breast	C50	4082	45.0	29.2	47.6	70	1.0	0.5	0.8
Vulva	C51	19	0.2	0.1	0.2	-	-	-	-
Vagina	C52	16	0.2	0.1	0.2	-	-	-	-
Cervix uteri	C53	247	2.7	1.8	2.9	-	-	-	-
Corpus uteri	C54	267	2.9	1.9	3.6	-	-	-	-
Uterus, unspecified	C55	89	1.0	0.6	1.1	-	-	-	-
Ovary	C56	442	4.9	3.2	4.9	-	-	-	-
Other female genital organs	C57	18	0.2	0.1	0.2	-	-	-	-
Placenta	C58	7	0.1	0.1	*0.0*	-	-	-	-
Penis	C60	-	-	-	-	1	0.0	0.0	*0.0*
Prostate	C61	-	-	-	-	526	7.8	3.4	6.4
Testis	C62	-	-	-	-	90	1.3	0.6	0.6
Other male genital organs	C63	-	-	-	-	5	0.1	0.0	*0.1*
Kidney	C64	102	1.1	0.7	1.1	172	2.5	1.1	1.7
Renal pelvis	C65	1	0.0	0.0	*0.0*	1	0.0	0.0	*0.0*
Ureter	C66	1	0.0	0.0	*0.0*	1	0.0	0.0	*0.0*
Bladder	C67	109	1.2	0.8	1.5	441	6.5	2.8	5.0
Other urinary organs	C68	-	-	-	-	2	0.0	0.0	*0.0*
Eye	C69	40	0.4	0.3	0.4	57	0.8	0.4	0.5
Brain, nervous system	C70-C72	227	2.5	1.6	2.2	458	6.8	2.9	3.8
Thyroid	C73	215	2.4	1.5	2.2	81	1.2	0.5	0.7
Adrenal	C74	4	0.0	0.0	*0.0*	7	0.1	0.0	*0.1*
Hodgkin lymphoma	C81	80	0.9	0.6	0.7	202	3.0	1.3	1.4
Non-Hodgkin lymphoma	C82-C88	277	3.1	2.0	3.3	493	7.3	3.2	4.5
Multiple myeloma	C90	36	0.4	0.3	0.5	53	0.8	0.3	0.6
Lymphoid leukemia	C91	112	1.2	0.8	0.7	207	3.1	1.3	1.2
Myeloid leukemia	C92-93	62	0.7	0.4	0.5	107	1.6	0.7	0.8
Other leukemias	C94	2	0.0	0.0	*0.0*	6	0.1	0.0	*0.0*
Leukemia, unspecified	C95	40	0.4	0.3	0.3	60	0.9	0.4	0.4
Other & unspecified	-	536	5.9	3.8	6.6	561	8.3	3.6	5.7
Benign CNS	-	188	2.1	1.3	1.8	182	2.7	1.2	1.4
All sites		9069	100.0	64.9	105.1	6771	100.0	43.6	66.7

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Table 5. Age-specific & age-standardized incidence rates of cancers diagnosed in the Lahore district, 2010-2012, amongst females.

Site	Total cases	0-	5-	10-	15-	20-	25-	30-	35-	40-	45-	50-	55-	60-	65-	70-	75-	Crude	%	ASIR	ICD-10 codes
Lip	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	1.1	0.4	0.6	1.6	0.7	0.1	0.1	*0.1*	C00
Tongue	129	0.0	0.0	0.0	0.0	0.1	0.1	0.2	1.2	1.4	5.4	4.7	4.9	6.6	5.8	8.7	5.1	0.9	1.4	1.7	C01-C02
Mouth	130	0.0	0.0	0.0	0.2	0.2	0.3	0.2	1.5	2.9	1.6	6.0	4.6	3.5	7.0	11.1	5.1	0.9	1.4	1.6	C03-C06
Salivary glands	41	0.0	0.0	0.1	0.0	0.1	0.5	0.2	0.8	0.5	0.6	1.1	0.7	2.7	1.9	0.8	0.0	0.3	0.5	*0.5*	C07-C08
Tonsil	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.7	0.4	0.0	0.0	0.8	0.7	0.1	0.1	*0.1*	C09
Nasopharynx	19	0.0	0.0	0.1	0.1	0.1	0.2	0.3	0.0	0.3	0.6	0.2	0.4	0.4	0.0	1.6	0.0	0.1	0.2	0.2	C11
Hypopharynx	32	0.0	0.0	0.0	0.1	0.2	0.1	0.2	0.5	0.3	0.6	0.7	1.4	1.9	0.6	1.6	0.7	0.2	0.4	*0.4*	C12-C13
Pharynx	5	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.8	0.7	0.0	0.1	*0.1*	C14
Esophagus	95	0.0	0.0	0.0	0.1	0.0	0.3	0.3	0.9	1.9	4.0	1.8	2.8	5.8	4.5	4.7	3.6	0.7	1.0	1.2	C15
Stomach	105	0.0	0.0	0.0	0.0	0.3	0.1	1.0	1.3	2.2	3.8	2.5	3.9	2.7	8.9	0.0	3.6	0.8	1.2	1.3	C16
Small intestine	17	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.6	0.0	0.0	0.4	1.9	1.3	2.4	0.7	0.1	0.2	0.2	C17
Colon	159	0.0	0.0	0.1	0.3	0.1	0.7	1.3	2.0	2.0	3.4	3.3	7.0	5.0	9.6	9.5	8.0	1.1	1.8	1.9	C18
Rectum	137	0.0	0.0	0.1	0.2	0.9	0.9	1.4	1.2	1.7	3.0	3.1	4.2	5.0	4.5	6.3	5.1	1.0	1.5	1.5	C19-C20
Anus	23	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.1	0.9	0.6	0.2	0.0	0.8	0.6	2.4	0.7	0.2	0.3	0.3	C21
Liver	177	0.1	0.1	0.0	0.1	0.1	0.1	0.2	0.3	1.4	4.4	6.2	11.2	12.0	16.6	8.7	5.1	1.3	2.0	2.4	C22
Gall bladder, etc.	139	0.0	0.0	0.0	0.1	0.0	0.0	0.5	0.4	1.5	2.6	4.9	6.7	8.9	14.1	7.1	8.7	1.0	1.5	1.9	C23-C24
Pancreas	40	0.0	0.0	0.0	0.1	0.0	0.2	0.1	0.5	0.3	0.8	0.9	2.1	0.8	5.8	2.4	1.4	0.3	0.4	0.5	C25
Other ill-defined digestive	14	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.9	0.0	1.2	0.0	0.8	0.0	0.1	0.2	0.1	C26
Nose, sinuses	27	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.3	0.0	0.6	0.7	1.8	2.3	1.3	0.8	0.7	0.2	0.3	0.3	C30-31
Larynx	28	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.6	0.8	1.3	1.4	1.2	0.6	0.0	2.2	0.2	0.3	0.3	C32
Trachea, bronchus, & lung	92	0.0	0.0	0.1	0.2	0.1	0.1	0.5	0.4	0.9	1.4	1.8	4.6	5.4	8.3	6.3	5.8	0.7	1.0	1.2	C33-C34
Other thoracic organs	16	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.2	0.8	0.0	0.4	1.6	0.6	0.8	0.7	0.1	0.2	0.2	C37-C38
Bone	91	0.2	0.5	0.9	1.4	0.9	0.3	0.4	1.3	0.3	0.6	0.4	0.4	0.0	0.0	1.6	0.0	0.7	1.0	0.6	C40-C41
Melanoma of the skin	13	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.2	0.4	0.4	0.7	0.0	0.0	0.8	0.7	0.1	0.1	0.1	C43
Other skin	196	0.1	0.0	0.0	0.1	0.1	0.3	0.2	1.3	2.9	2.2	5.1	6.3	11.3	16.6	19.0	19.6	1.4	2.2	2.7	C44
Connective & soft tissue	108	0.4	0.3	0.3	0.6	0.6	0.8	0.8	1.2	1.7	1.2	1.8	1.4	1.6	3.8	2.4	2.9	0.8	1.2	1.0	C47,C49
Breast	4082	0.0	0.1	0.1	0.1	3.3	14.0	32.2	55.9	86.2	126.8	130.3	158.5	154.1	157.9	124.9	92.1	29.2	45.0	47.6	C50
Vulva	19	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.4	0.2	0.2	0.0	1.4	0.8	0.6	0.8	2.9	0.1	0.2	0.2	C51
Vagina	16	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.3	0.8	0.2	0.7	0.4	0.0	0.8	1.4	0.1	0.2	0.2	C52
Cervix uteri	247	0.0	0.0	0.0	0.0	0.2	0.4	1.3	3.9	5.7	9.4	7.1	10.5	10.1	8.3	5.5	5.1	1.8	2.7	2.9	C53
Corpus uteri	267	0.0	0.0	0.0	0.0	0.0	0.2	0.6	1.5	1.9	6.0	9.8	16.5	22.1	16.0	18.2	7.2	1.9	2.9	3.6	C54
Uterus, unspecified	89	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.9	1.5	3.4	4.0	2.8	5.8	3.8	4.7	0.0	0.6	1.0	1.1	C55
Ovary	442	0.0	0.1	0.6	0.8	1.6	1.9	3.0	4.9	7.9	12.2	13.4	15.4	19.4	12.1	11.1	7.2	3.2	4.9	4.9	C56
Other female genital organs	18	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.5	0.2	0.2	0.7	2.3	0.6	0.8	0.0	0.1	0.2	0.2	C57
Placenta	7	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	*0.0*	C58
Kidney	102	0.7	0.1	0.1	0.0	0.2	0.0	0.2	1.6	2.0	1.6	2.7	4.9	3.1	3.2	3.2	4.3	0.7	1.1	1.1	C64
Renal pelvis	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C65
Ureter	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	*0.0*	C66
Bladder	109	0.1	0.0	0.0	0.1	0.0	0.1	0.2	1.1	1.2	1.6	2.7	4.9	5.0	8.9	10.3	10.1	0.8	1.2	1.5	C67
Eye	40	0.9	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.0	0.0	0.8	4.5	0.8	2.2	0.2	0.4	0.4	C69
Brain, nervous system	227	0.3	0.7	0.6	0.9	0.9	2.0	1.4	2.5	3.3	4.4	4.9	5.3	5.0	7.7	4.0	2.9	1.6	2.5	2.2	C70-C72
Thyroid	215	0.0	0.1	0.1	0.2	1.9	1.6	2.8	2.9	3.3	4.6	6.5	3.5	6.6	3.2	7.9	2.9	1.5	2.4	2.2	C73
Adrenal	4	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C74
Hodgkin lymphoma	80	0.2	0.4	0.3	0.4	0.9	1.0	0.4	1.1	0.3	1.0	0.2	1.8	1.6	0.6	2.4	0.0	0.6	0.9	0.7	C81
Non-Hodgkin lymphoma	277	0.2	0.3	0.5	0.5	0.5	0.8	0.9	2.0	3.6	5.8	7.4	12.3	10.9	14.1	13.4	18.1	2.0	3.1	3.3	C82-C88
Multiple myeloma	36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1.6	1.1	0.7	2.7	3.2	4.0	0.7	0.3	0.4	0.5	C90
Lymphoid leukemia	112	2.0	1.3	1.4	0.3	0.1	0.2	0.2	0.0	0.5	0.2	0.2	0.7	1.2	0.6	0.8	0.0	0.8	1.2	0.7	C91
Myeloid leukemia	62	0.3	0.2	0.2	0.2	0.5	0.6	0.6	0.7	0.5	0.6	1.1	1.4	0.8	0.6	1.6	0.0	0.4	0.7	0.5	C92-93
Other leukemias	2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C94
Leukemia, unspecified	40	0.3	0.5	0.3	0.3	0.1	0.3	0.1	0.1	0.2	0.2	0.7	0.0	0.0	0.6	0.8	0.0	0.3	0.4	0.3	C95
Other & unspecified	536	0.5	0.2	0.2	0.2	1.1	1.8	2.7	4.7	7.0	12.6	14.9	24.9	24.1	33.9	26.9	18.8	3.8	5.9	6.6	Other & unspecified
Benign CNS	188	0.2	0.1	0.3	0.7	0.3	1.6	2.2	3.9	4.0	4.8	3.6	2.1	4.3	4.5	2.4	0.7	1.3	2.1	1.8	Benign CNS
All sites	9069	6.7	5.0	6.5	8.4	16.4	32.1	58.3	104.7	155.6	237.8	259.9	337.6	364.1	398.2	348.7	259.5	64.9	100.0	105.1	All sites

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Table 6. Age-specific & age-standardized incidence rates of cancers diagnosed in the Lahore district, 2010-2012, amongst males.

Site	Total cases	0-	5-	10-	15-	20-	25-	30-	35-	40-	45-	50-	55-	60-	65-	70-	75-	Crude	%	ASIR	ICD-10 codes
Lip	13	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.2	0.0	0.0	0.2	0.6	1.3	0.5	0.6	0.0	0.1	0.2	0.1	C00
Tongue	180	0.0	0.0	0.0	0.0	0.3	0.6	0.6	2.0	3.5	3.6	4.4	5.0	7.2	6.2	9.5	2.3	1.2	2.7	1.8	C01-C02
Mouth	212	0.0	0.0	0.0	0.0	0.1	0.2	1.2	1.1	3.0	5.4	4.8	9.7	10.1	8.8	7.7	4.0	1.4	3.1	2.2	C03-C06
Salivary glands	50	0.0	0.0	0.1	0.1	0.1	0.2	0.3	0.7	0.6	0.7	0.7	1.1	1.9	1.6	3.0	1.7	0.3	0.7	*0.5*	C07-C08
Tonsil	8	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.2	0.3	0.6	0.5	0.0	0.0	0.1	0.1	*0.1*	C09
Other oropharynx	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.6	0.3	0.0	0.6	0.0	0.0	0.1	*0.1*	C10
Nasopharynx	19	0.0	0.0	0.0	0.1	0.1	0.0	0.2	0.1	0.3	0.3	0.2	0.8	1.3	0.5	0.0	0.0	0.1	0.3	0.2	C11
Hypopharynx	21	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.3	0.0	0.6	0.3	0.9	1.0	1.2	2.9	0.1	0.3	0.2	C12-C13
Pharynx	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	*0.0*	C14
Esophagus	127	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.8	0.5	3.1	3.1	4.5	5.3	6.2	9.5	6.9	0.8	1.9	1.4	C15
Stomach	162	0.0	0.0	0.0	0.0	0.1	0.8	0.9	1.4	2.2	3.8	3.3	4.7	4.4	10.3	8.3	3.4	1.0	2.4	1.6	C16
Small intestine	26	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.3	0.1	0.5	0.6	0.8	0.9	0.5	1.8	2.3	0.2	0.4	*0.3*	C17
Colon	230	0.0	0.0	0.0	0.4	0.8	0.6	0.7	1.5	2.1	4.8	4.4	5.8	11.6	14.5	9.5	6.3	1.5	3.4	2.4	C18
Rectum	186	0.0	0.0	0.0	0.4	0.7	0.9	1.4	1.0	1.0	3.3	3.9	5.0	8.2	11.9	4.2	6.3	1.2	2.7	1.9	C19-C20
Anus	41	0.0	0.0	0.0	0.1	0.1	0.1	0.5	0.0	0.6	0.5	1.3	0.8	2.2	1.6	0.6	1.1	0.3	0.6	0.4	C21
Liver	328	0.0	0.0	0.0	0.1	0.1	0.2	0.0	1.5	1.9	5.2	10.1	17.0	14.8	24.3	17.2	14.9	2.1	4.8	3.7	C22
Gall bladder, etc.	93	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.3	0.5	0.5	2.9	3.6	5.0	7.2	4.2	7.4	0.6	1.4	1.0	C23-C24
Pancreas	57	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.8	1.4	1.3	3.1	1.3	4.7	4.7	1.1	0.4	0.8	0.6	C25
Other ill-defined digestive	16	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.5	0.4	0.3	0.6	2.1	0.0	1.1	0.1	0.2	0.2	C26
Nose, sinuses	32	0.0	0.0	0.0	0.1	0.2	0.2	0.0	0.2	0.1	0.5	0.6	1.4	0.9	1.6	2.4	0.0	0.2	0.5	0.3	C30-31
Larynx	183	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.5	1.5	3.8	4.6	7.8	10.4	12.4	11.3	5.7	1.2	2.7	2.0	C32
Trachea, bronchus, & lung	396	0.0	0.0	0.0	0.0	0.1	0.1	0.6	1.9	1.8	5.7	4.8	13.1	21.4	32.0	37.4	32.6	2.5	5.8	4.6	C33-C34
Other thoracic organs	26	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.2	0.3	0.2	1.1	0.0	0.6	0.5	1.8	2.9	0.2	0.4	0.2	C37-C38
Bone	143	0.2	0.5	1.2	2.4	1.0	0.5	0.6	0.7	0.6	0.9	0.6	0.3	3.1	0.5	1.8	0.6	0.9	2.1	0.9	C40-C41
Melanoma of the skin	13	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	1.1	0.0	0.5	0.0	1.7	0.1	0.2	0.1	C43
Other skin	271	0.1	0.1	0.1	0.2	0.3	0.9	1.6	2.0	2.3	2.8	4.1	8.6	11.3	16.5	10.1	21.2	1.7	4.0	2.8	C44
Connective & soft tissue	144	0.4	0.5	0.1	0.9	0.8	1.1	0.7	1.1	0.5	2.8	1.1	2.5	2.8	3.6	4.2	2.9	0.9	2.1	1.2	C47,C49
Breast	70	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.3	0.9	2.1	1.5	1.9	1.9	8.8	2.4	1.7	0.5	1.0	0.8	C50
Penis	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C60
Prostate	526	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.3	1.0	4.4	13.1	27.1	46.0	69.4	87.0	3.4	7.8	6.4	C61
Testis	90	0.2	0.0	0.0	0.5	1.1	1.2	1.2	1.1	1.0	0.7	0.6	0.3	0.3	1.6	0.6	0.6	0.6	1.3	0.6	C62
Other male genital organs	5	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.6	0.0	0.0	0.1	*0.1*	C63
Kidney	172	0.6	0.2	0.0	0.1	0.1	0.2	0.3	0.9	2.7	3.3	3.3	5.6	6.3	7.2	9.5	5.7	1.1	2.5	1.7	C64
Renal pelvis	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C65
Ureter	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C66
Bladder	441	0.1	0.0	0.0	0.0	0.1	0.2	0.4	1.8	2.2	5.9	7.5	19.2	23.0	30.0	29.7	42.4	2.8	6.5	5.0	C67
Other urinary organs	2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	*0.0*	C68
Eye	57	1.2	0.2	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.7	0.6	0.3	1.6	2.1	2.4	1.1	0.4	0.8	*0.5*	C69
Brain, nervous system	458	0.7	1.0	0.7	1.2	1.6	2.9	4.5	4.4	5.0	7.3	8.8	10.6	11.3	9.8	8.3	3.4	2.9	6.8	3.8	C70-C72
Thyroid	81	0.0	0.0	0.0	0.2	0.2	0.7	0.8	0.3	0.8	1.4	1.8	3.3	1.6	2.6	3.0	1.1	0.5	1.2	0.7	C73
Adrenal	7	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.3	0.0	0.0	0.6	0.0	0.0	0.1	*0.1*	C74
Hodgkin lymphoma	202	0.7	1.8	0.7	1.0	0.9	1.4	1.2	1.4	1.5	1.6	1.5	3.3	1.9	4.1	3.6	0.6	1.3	3.0	1.4	C81
Non-Hodgkin lymphoma	493	0.4	1.4	1.1	1.3	2.0	1.6	2.5	2.5	4.6	5.9	10.1	11.7	18.3	18.1	16.6	14.3	3.2	7.3	4.5	C82-C88
Multiple myeloma	53	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.5	1.2	1.3	2.5	3.1	1.6	2.4	2.3	0.3	0.8	*0.6*	C90
Lymphoid leukemia	207	3.1	2.2	2.6	0.7	0.5	0.2	0.3	0.1	0.8	0.3	0.9	0.6	0.6	2.1	0.0	1.7	1.3	3.1	1.2	C91
Myeloid leukemia	107	0.3	0.3	0.4	0.4	0.7	0.8	0.9	1.4	1.0	1.0	0.7	1.9	1.9	2.1	0.0	0.6	0.7	1.6	0.8	C92-93
Other leukemias	6	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.4	0.0	0.0	0.0	0.6	0.0	0.0	0.1	*0.0*	C94
Leukemia, unspecified	60	0.5	0.4	0.7	0.2	0.5	0.2	0.3	0.1	0.3	0.3	0.2	0.3	0.6	0.0	0.6	0.0	0.4	0.9	0.4	C95
Other & unspecified	561	0.3	0.1	0.6	0.9	0.4	2.0	2.6	2.9	4.8	6.0	12.2	18.7	23.9	28.4	25.5	34.9	3.6	8.3	5.7	Other & unspecified
Benign CNS	182	0.3	0.4	0.2	0.5	0.8	2.0	1.9	2.4	2.1	3.3	3.3	1.1	3.1	1.6	3.0	0.6	1.2	2.7	1.4	Benign CNS
All sites	6771	9.2	9.5	9.1	12.2	14.8	20.6	27.4	38.0	53.7	93.1	118.4	194.0	255.2	337.0	329.7	328.0	43.6	100.0	66.7	All sites

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Of the 15,825 patients, death was recorded in 5,134 (32·4%) cases by the cut-off date for this study; this included 2,726 female and 2,408 male patients. Four-thousand, three-hundred and forty-seven patients were still alive (27·5%) at the time of review, whereas, the vital status of 6,344 patients (40·1%) could not be determined. Death certificates were available in each record of a hospital death for about 8% of patients (400/5,134), representing just one collaborating center, which is SKMCH & RC. Table 7 displays death counts and proportion by cancer sites. Since the follow-up information was not available for nearly 40% of the patients, the mortality to incidence ratio was not calculated either.

Table 7. Distribution of deaths recorded (5,134 (2,726 female and 2,408 male patients)), in patients diagnosed with cancer, in the Lahore district, in 2010-2012, according to gender and cancer type (top 10 cancers only).

Females	Count	%	Males	Count	%
Breast	987	36	Brain	213	9
Ovary	137	5	Bronchus & lung	207	9
Colo-rectum	127	5	NHL	169	7
NHL	109	4	Prostate	168	7
Lip & oral cavity	106	4	Colo-rectum	155	6
Brain	99	4	Lip & oral cavity	152	6
Leukemia	87	3	Liver & intrahep. bile ducts	151	6
Liver & intrahep. bile ducts	85	3	Leukemia	144	6
Cervix uteri	65	2	Urinary bladder	133	6
Corpus uteri	53	2	Stomach	73	3

Of the deaths recorded, amongst females, 36% were reported in those who had breast cancer, 5% each in those who had ovarian and colo-rectal carcinoma, 4% each in NHL, lip & oral cavity, and brain tumor, 3% each in those with leukemia and liver & intrahepatic bile ducts tumors, and 2% each in those who had cancer of the cervix and corpus uteri. In male patients, 9% each were in those who had tumor of the brain and, bronchus & lung, 7% each in those with NHL and prostate cancer, 6% each in cancers of the colo-rectum, lip & oral cavity, liver & intrahepatic bile ducts, bladder, and leukemia, and 3% in stomach carcinoma.

DISCUSSION

The Registry has been in existence since 2005 but was in an evolving phase in the initial years of its functioning. Therefore, conducting a comparison of the cases recorded over the initial years did not appear to be useful. Further, as there are notification delays and the Registry is still receiving information on cases diagnosed in the most recent years (2014-2015), mainly from one center, this time-period has not been included in the study either. It is hoped that a study conducted at a subsequent stage will cover the 2013-2015 period. For the time-period 2010-2012, the results reported

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for the population of the Lahore district show that on average, over 5,200 new cancer cases were diagnosed, every year. The fact that nearly seven percent were non-microscopically confirmed cancers as opposed to nearly 93% that were microscopically confirmed, supports that there was no reliance on the pathology laboratory as the only source of information. These figures are similar to those reported for the Karachi Cancer Registry[5]. However, some of the cases diagnosed clinically might not have been reported to the Registry but we have no way of knowing that, at present. The ASIR for all-cancers combined was higher amongst females (105·1) than in males (66·7). These results also include the ASIRs for benign CNS tumors and other/unspecified sites. The ASIRs reported by the Surveillance, Epidemiology, and End Results (SEER) Program of the United States of America (USA), are very high (359·4 for females and 282·6 for males)[21,22]. These figures represent SEER 18 registries compiling data from all cases diagnosed since 2000 and covering approximately 30% of the US population[21,22]. The ASIRs published in the CI5-X report for Delhi in India and Riyadh in Saudi Arabia, are close to the Lahore district figures as opposed to the SEER rates; in fact, the ASIRs for females in these three regions are quite similar to one another. It is important to point out that Delhi, located in India, to the east of Lahore, is closer to Lahore than is Karachi located in southern Pakistan. As far as the South Karachi Registry is concerned, based on the last report (1998-2002) released in CI5-IX, it can be seen that the ASIRs for Karachi were relatively high (192·0 for females and 166·6 for males) as compared to those for the Lahore district. Further, in the region of Golestan in Iran (2005-2007), and for Israel, again the ASIRs were high compared to those reported for the Lahore district[19]. For the SEER Program, Delhi, Iran, and Saudi Arabia, data were reported for the 2003-2007 time period. Table 8 shows a comparison of the ASIRs according to cancer sites, though not all sites, in the aforementioned regions of the world. In women belonging to the Lahore district, the ASIR of breast cancer ranked the highest (47·6) of all the cancers, and was higher than that for Delhi (31·6), but relatively low compared to that reported for the Israeli Jews (89·4). Amongst men in the Lahore district, the ASIR of prostate cancer was the highest (6·4) of all the cancers, but was lower than that reported for Delhi (10·1) and Riyadh (7·9). Even though breast and prostate cancer were the most common diagnoses in the Lahore district, the point to be noted is that organized screening programs for early detection of these diseases do not exist in Pakistan. The ASIR of cervical cancer in Lahore was 2·9 but in Delhi it was much higher, at 17·7; this is despite the fact that the screening levels are low in the general population of India[23]. Of the factors implicated in the etiology of cervical cancer in the Indian population, the presence of specific oncogenic types of the Human Papilloma Viruses (HPV), namely types 16 and 18, plays an important role in the development of cancer of the cervix. In Pakistan, one population-based study reports HPV positivity to be nearly 2·8% in the general population (25/899) and about 92% in patients with invasive cervical cancer (83/91)[24]. However, in India, it has been reported that HPV prevalence varies from 7·5% to 16·9% in women without cervical cancer as opposed to 87·8% to 96·7% amongst cervical cancer patients[23]. Further, in the latest Globocan report, the ASIR for cancer of the cervix in Pakistan was estimated at 7·9 per 100,000 females with 5,233 cases identified in 2012[15]; in the same year, in Saudi Arabia, 241 cases were diagnosed, with the ASIR at 2·7 per 100,000 women; in contrast to this, in India, 122,844 cervical cancer cases were diagnosed, with a relatively high ASIR of 22·0 per 100,000 females[15]. Since the ASIR is low in the aforementioned Muslim countries compared to a non-Muslim country, circumcision of men may be a plausible explanation in reducing the transmission of HPV infection to their female sexual partners. Circumcision of men is the norm amongst Muslim males. The role of circumcision has been

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demonstrated in three separate randomized trials done in Africa[25]. Since the incidence of cervical cancer in Pakistan is relatively low and the 5-year prevalence is 15,323, setting-up a formal screening program may have lower yields, therefore, a low priority in resource allocation and decision making in our setting[15].

As shown in Table 8, the ASIRs per 100,000 population, per year, for ten common cancers in Pakistan, as reported in the Globocan 2012, compared to Lahore, are as follows: In women: breast 50·3, 47·6; lip & oral cavity 9·1, 3·9; cervix uteri 7·9, 2·9; ovary 5·6, 5·1; esophagus 4·4, 1·2; corpus uteri 3·6, 3·6; NHL 3·4, 3·3; colo-rectum 3·3, 3·7; liver 2·5, 2·4; and stomach 2·2, 1·3, while, amongst men: lip & oral cavity 10·5, 4·6; lung 9·8, 4·6; NHL 5·3, 4·5; prostate 6·6, 6·4; bladder 5·1, 5·0; larynx 5·0, 2·0; colo-rectum 4·7, 4·7; liver 4·7, 3·7; esophagus 3·9, 1·4; stomach 3·8, 1·6; and brain & nervous system 3·4, 3·8. The comparison shows that rates are somewhat higher for tobacco-related cancers (lip & oral cavity, lung, larynx, and esophagus), and cervical cancer, though for the latter, the rates are still lower than those reported in countries with a high HPV prevalence rate. Since the Globocan 2012 report included data from the Punjab Cancer Registry, Karachi South district, and Dr. Yasmin's paper, the relatively high cancer rates for certain cancers may be attributed to the high consumption of tobacco-related products in that part of Pakistan, in the form of cigarettes and bidi and also of smokeless tobacco as betel quid and niswar[26]. Further, Karachi South is one of the 29 districts of the province of Sindh[12], located in the south of the country and its population was 1·72 M during the period under study. Its last report published in the CI-5, IX, shows a high incidence rate for tobacco related cancers[22]. Therefore, the dissimilarity in the incidence rates could be attributed to the geographic and lifestyle differences between these two regions. Table 8, depicting the ASIRs, highlights the differences between these two regions and other regions of the world as well.

As far as the mortality data in our study are concerned, since the vital status of all the patients could not be recorded, our results have to be interpreted with caution. The highest mortality was recorded in patients diagnosed with breast cancer amongst females, and amongst those with brain tumors in males. Due to the non-availability of the vital status of nearly half of the patients, the survival statistics could not be reported either. Death certificates were available from just one collaborating center for each record of a hospital death and accounted for nearly 8% of the deaths recorded in the Registry. However, the point to be noted is that the cancer diagnoses were not merely reported from hospitals, they were also reported on patients identified as new cancer cases, from different laboratories/collection centers within the district. The establishment of a central death registry in the region could help in collecting the mortality data and determining the cause-specific mortality, along with the survival estimates for the study population. While the Government of Pakistan maintains the National Database Registration Authority with all citizens' data and biometric information, the capture of death information is variable and typically done at the local government level[27,28]. Deaths within hospitals have documented death certificates which get communicated to local government, but the recording of death diagnosis likely over-reports final mechanisms of death ('cardio respiratory failure'), rather than underlying causes. In view of this, death data and thus survival data have inherent inaccuracies in it.

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Table 8. ASIRs, per 100,000 population, per year, for selected cancer sites, in Pakistan, India, Iran, Israel, and USA.

	Pakistan	Globocan	Pakistan	India	Iran	Saudi Arabia	Israel	USA
	Lahore	Pakistan	Karachi	New Delhi	Golestan	Riyadh	Jews	SEER
	2010-2012	2012	1998-2002	2003-2007	2005-2007	2003-2007	2003-2007	2003-2007
Oral cavity & salivary glands-C00-C08								
Male	4.6	10.5	22.5	14.0	1.7	1.6	3.3	6.9
Female	3.9	9.1	20.4	4.7	1.3	1.4	2.3	3.1
Pharynx-C09-C14								
Male	0.6	3.8	8.2	6.6	1.0	2.4	1.5	4.4
Female	0.8	1.3	3.4	1.5	0.7	1.3	0.5	1.1
Esophagus-C15								
Male	1.4	3.9	6.7	4.9	23.2	1.6	1.8	5.1
Female	1.2	4.4	8.6	2.9	18.8	1.3	0.9	1.2
Stomach-C16								
Male	1.6	3.8	6.0	3.2	30.4	4.4	10.0	6.6
Female	1.3	2.2	3.6	1.5	12.6	2.3	5.4	3.3
Small intestine-C17								
Male	0.3	-	0.2	0.2	1.4	0.5	1.0	1.5
Female	0.2	-	0.4	0.1	0.9	0.3	0.7	1.1
Colo-rectum-C18-C21								
Male	4.7	4.7	7.1	5.5	13.6	12.5	42.8	35.3
Female	3.7	3.3	5.2	3.7	10.4	10.6	32.6	26.5
Liver-C22								
Male	3.7	4.7	5.4	2.6	3.6	3.0	3.1	7.6
Female	2.4	2.5	3.7	1.5	2.0	6.0	1.4	2.4
Gall bladder-C23-C24								
Male	1.0	0.9	1.3	4.0	1.2	1.2	1.7	1.7
Female	1.9	2.2	4.9	8.0	1.6	2.5	1.4	1.7
Pancreas-C25								
Male	0.6	0.5	0.9	1.9	2.8	3.2	8.6	8.2
Female	0.5	0.4	0.5	1.1	1.0	1.9	6.4	6.2
Nose & sinuses-C30-C31								
Male	0.3	-	0.7	0.3	0.0	0.2	0.4	0.6
Female	0.3	-	0.4	0.2	0.2	0.2	0.3	0.4
Larynx-C32								
Male	2.0	5.0	10.7	8.0	4.1	1.7	4.1	4.3
Female	0.3	0.7	1.8	1.1	1.4	0.1	0.6	0.9
Trachea, bronchus, & lung-C33-C34								
Male	4.6	9.8	25.2	13.7	17.5	6.3	29.8	48.3
Female	1.2	1.7	3.6	3.6	5.6	2.2	13.4	33.8
Bone-C40-C41								
Male	0.9	-	1.3	2.0	1.3	0.8	1.3	1.0
Female	0.6	-	1.5	1.2	1.5	0.5	1.0	0.8
Melanoma of the skin-C43								
Male	0.1	0.3	0.5	0.2	0.9	0.3	13.7	16.8
Female	0.1	0.2	0.3	0.2	0.7	0.4	11.2	12.0
Skin-C44								
Male	2.8	-	4.3	1.3	11.0	3.8	2.8	1.3
Female	2.7	-	4.1	1.0	7.7	3.2	1.9	1.0
Connective & soft tissue-C47-C49								
Male	1.2	-	2.4	1.5	2.1	1.3	3.2	3.0
Female	1.0	-	2.3	1.2	2.1	0.9	2.2	2.1
Breast-C50								
Male	0.8	-	1.0	1.3	0.1	0.5	1.3	0.7
Female	47.6	50.3	69.0	31.6	28.0	21.1	89.4	86.6

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Cervix uteri-C53								
Female	2.9	7.9	7.5	17.7	5.4	2.0	5.5	6.4
Corpus uteri-C54								
Female	3.6	3.6	6.7	4.5	1.7	4.4	14.4	16.7
Ovary-C56-C57.0-4								
Female	5.1	5.6	8.8	8.6	6.1	3.3	9.2	9.6
Other female genital organs-C51-C52, C55, C58								
Female	1.5	-	1.0	1.6	1.4	0.9	1.8	2.5
Penis-C60								
Male	-	-	0.1	1.0	0.0	0.1	0.3	0.7
Prostate-C61								
Male	6.4	6.6	10.1	10.1	10.6	7.9	68.3	106.8
Testis-C62								
Male	0.6	0.9	1.2	0.6	2.3	0.6	4.7	4.9
Kidney, etc.-C64, C66, C68								
Male	1.7	1.7	1.9	2.7	2.2	3.8	13.9	137.0
Female	1.1	0.9	0.8	1.2	1.2	2.5	6.5	7.1
Bladder-C67								
Male	5.0	5.1	9.3	6.5	8.5	5.6	25.5	20.8
Female	1.5	1.6	2.6	1.5	2.8	1.3	4.8	5.3
Eye-C69								
Male	0.5	-	0.6	0.3	0.4	0.4	0.6	0.8
Female	0.4	-	0.3	0.2	0.2	0.2	0.4	0.6
Brain, CNS-C70-C72								
Male	3.8	3.4	3.3	3.8	7.8	3.5	6.7	6.4
Female	2.2	2.1	2.7	2.4	5.3	2.1	5.0	4.6
Thyroid-C73								
Male	0.7	0.7	0.7	1.1	1.2	2.5	4.8	3.9
Female	2.2	2.2	2.9	**2.5**	3.0	10.2	14.7	12.3
Adrenal & other endocrine-C74-C75								
Male	0.1	-	0.2	0.2	0.7	0.3	0.6	0.5
Female	0.0	-	0.3	0.2	0.4	0.2	0.5	0.4
Hodgkin lymphoma-C81								
Male	1.4	2.2	2.0	1.6	1.8	2.2	3.6	2.7
Female	0.7	0.8	1.0	0.7	1.1	2.0	3.4	2.2
NHL-C82-C88, C96								
Male	4.5	5.3	7.6	5.6	7.2	8.6	17.9	15.5
Female	3.3	3.4	5.1	3.0	3.3	7.1	14.4	10.8
Multiple myeloma-C88, C90								
Male	0.6	0.7	1.8	2.0	2.4	1.8	4.8	4.7
Female	0.5	0.6	1.3	1.2	2.2	1.0	3.0	3.1
Leukemia-C91-C95								
Male	2.4	3.3	4.8	5.6	10.8	5.7	10.6	11.1
Female	1.5	2.2	4.1	3.6	7.7	4.3	6.9	7.1
All sites-C00-C96								
Male	66.7	96.0	166.6	119.7	165.3	104.1	273.1	359.4
Female	105.1	127.7	192.0	118.4	142.0	103.9	308.5	282.6

CONCLUSION

This is the first time that an attempt has been made to determine and report the population-based cancer statistics for the Lahore district. This collaborative study highlights cancer registration and follow-up issues in a developing country like Pakistan, along with the non-availability of recent, accurate population estimates required as denominators in computation of the incidence rates. On average, annually, 5,200 new cases were reported in the Lahore district, in 2010-2012. Although it is likely that all

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the cases have not been reported, it is not possible to gauge the extent of under-reporting at this stage. The cancer statistics reported in this manuscript can be used as baseline figures for comparison with studies to be undertaken in the future. These statistics can also assist in exploring, thus, highlighting the putative risk factors associated with cancers commonly diagnosed in the region, as part of a health promotion and education program. Finally, this report can play an important role in developing prevention, early detection, and cancer control strategies in the region.

FOOTNOTES

Contributors

FB conceived the idea of the study, designed it, supervised the statistical analysis, did literature search, interpreted the results, and drafted the manuscript. FB further did the survival analysis for this study. SMa did the case-finding, coding, and indexing of cases from SKMCH & RC and computed the incidence rates and created figures and tables; RF, AY, HA, and AA validated the data, checked for duplication, and followed-up on the patients; and AQ and KLA worked on the comparison of the incidence rates with other regions. MAY and FS reviewed the paper critically and advised. MM was responsible for reporting the cancers recorded at the Institute of Nuclear Medicine & Oncology, Lahore; GRS from Ittefaq Hospital, Lahore; NC from Sheikh Zayed Hospital, Lahore; ORC from Chughtais Lahore Lab, Lahore; TM from Fatima Jinnah Medical University, Lahore; ZA and MAK from Jinnah Hospital, Lahore; GH and AA from the Children's Hospital & the Institute of Child Health, Lahore; RB from the Services Institute of Medical Sciences, Lahore; SR and IT from Fatima Memorial College of Medicine & Dentistry, Lahore; FA from Shalamar Medical & Dental College, Lahore; TA from Allama Iqbal Medical College, Lahore; SN from King Edward Medical University, Lahore; and BAS from Nawaz Sharif Social Security Hospital, Lahore. NS contributed intellectually to the study. MTM, SMu, AL, and MH did the pathologic confirmation of cases at SKMCH & RC, Lahore. SMa supervised, FB managed, and MAY and FS established and directed the Punjab Cancer Registry.

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Competing interests

We declare no competing interests.

Data sharing statement

No additional data available.

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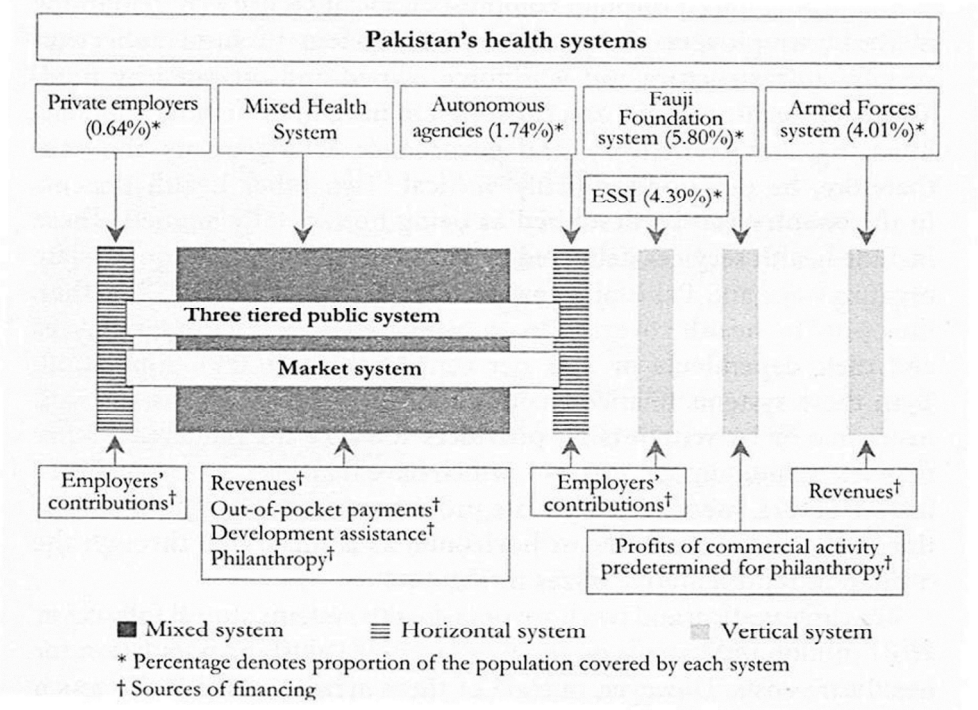

Figure 1. Health-care delivery systems in Pakistan. Image used with permission from Dr. Sania Nishtar from her book titled 'Choked Pipes'.
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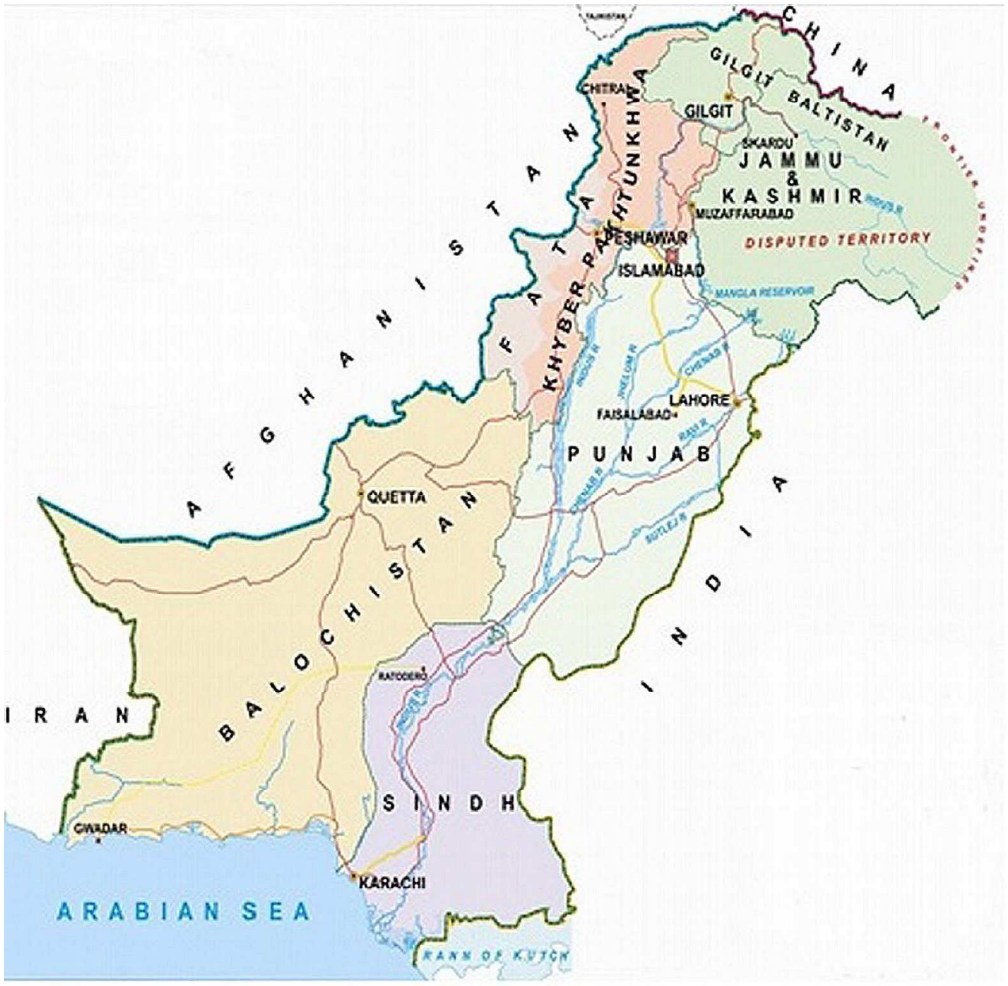

Figure 2. Map of Pakistan showing the provinces and location of the Lahore and Karachi districts and neighboring countries.
344x337mm (300 x 300 DPI)

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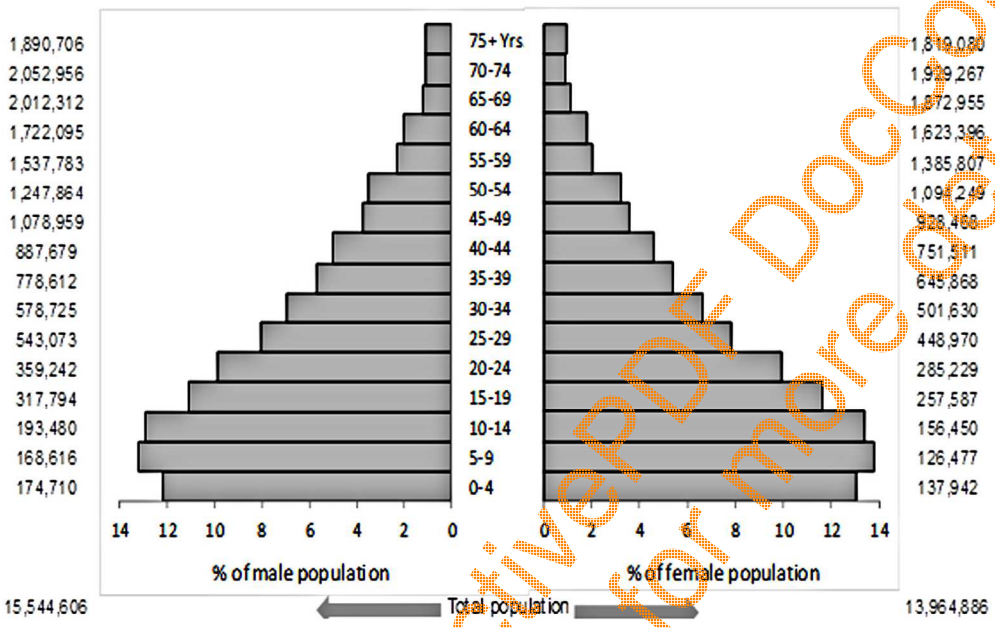

Figure 3. Population structure of the Lahore district, 2010-2012, by gender.
152x97mm (300 x 300 DPI)

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Appendix A-List of collaborating centers in Lahore. Centers are listed in descending order of the number of cases reported, to the Punjab Cancer Registry, 2010-2012.

S. No.	Center name
1	Shaukat Khanum Memorial Cancer Hospital & Research Center
2	Institute of Nuclear Medicine & Oncology
3	Ittefaq Hospital
4	Sheikh Zayed Hospital
5	Chughtais Lahore Lab
6	Fatima Jinnah Medical University
7	Jinnah Hospital
8	The Children's Hospital & the Institute of Child Health
9	Services Institute of Medical Sciences
10	Fatima Memorial College of Medicine & Dentistry
11	Shalamar Medical & Dental College
12	Allama Iqbal Medical College
13	King Edward Medical University
14	Nawaz Sharif Social Security Hospital
15	Akhtar Saeed Medical & Dental College
16	Post Graduate Medical Institute
17	Combined Military Hospital
18	Indus Lab
19	Pride Lab

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Appendix B-Data collection form used for the Lahore district, the Punjab Cancer Registry.

PUNJAB CANCER REGISTRY

DATA COLLECTION FORM

CENTER I.D. NO._____ PATIENT I.D NUMBER: _____ ← (To be allocated by .

HISTOLOGY NO._____ HISTOLOGY DATE: _____/_____/_____

PATIENT'S NAME_____ _____ _____
LAST FIRST MIDDLE

SEX: MALE ☐ FEMALE ☐ NEUTER (MUKHANNA ☐) FATHER'S NAME _____

BIRTH DATE _____ AGE _____

N.I.C. NUMBER (FOR CHILDREN ≤ 18 YEARS, ID OF MOTHER/ FATHER) _____

PERMANENT ADDRESS (HOUSE AND STREET NO.) _____

_____

CITY/TOWN _____ POSTAL CODE_____

HOME/CELL TELEPHONE WITH AREA CODE_____

↓RESIDENT OF LAHORE: YES ☐ NO ☐ IF YES, duration of stay in Lahore (Months/Years) _____
کیا آپ لاہور کے رہائشی ہیں.

↓COME TO LAHORE FOR TREATMENT/DIAGNOSIS ONLY_____ (YES/NO)
یا آپ لاہور بیماری کی تشخیص یا علاج کے لیے آئے ہیں.

Procedure/surgery done at (hospital)…….
Name of surgeon……
Cytology/histopathology done at (lab.) …….

PRIMARY SITE_____ DATE OF DIAGNOSIS _____

SITE OF BIOPSY_____ METASTATIC_____ (YES/NO)

LATERALITY (where applicable) _____ MORPHOLOGY _____ BEHAVIOR_____

GRADE _____ STAGE (when available) _____

*MOST VALID BASIS OF DIAGNOSIS (Please see the list below)_____

FOR PCR CENTRAL OFFICE USE ONLY
STATUS AT LAST FOLLOW-UP _____

DATE OF DEATH _____ PLACE OF DEATH

†PCR is an acronym for the Punjab Cancer Registry.
*0. Death Certificate Only 1. Clinical; 2. Clinical investigation; 4. Specific tumor markers; 5. Cytology; 6. Histology of a metastasis; 7. Histology of primary tumor; and 9. Unknown.

xx END xx

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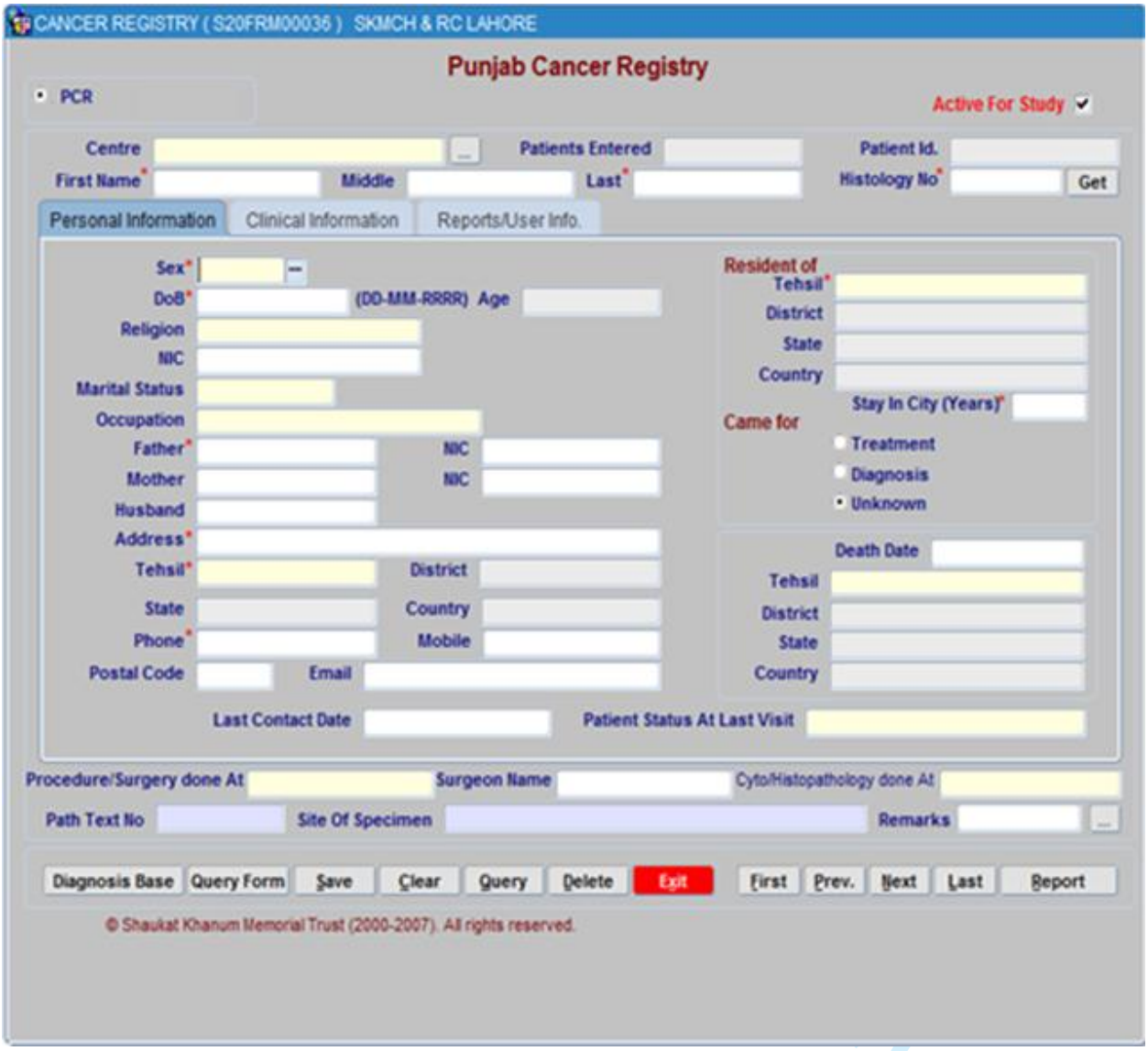
Appendix C-Screen shot of the PCR data capture form in the Hospital Information System, SKMCH & RC, Lahore, Pakistan.



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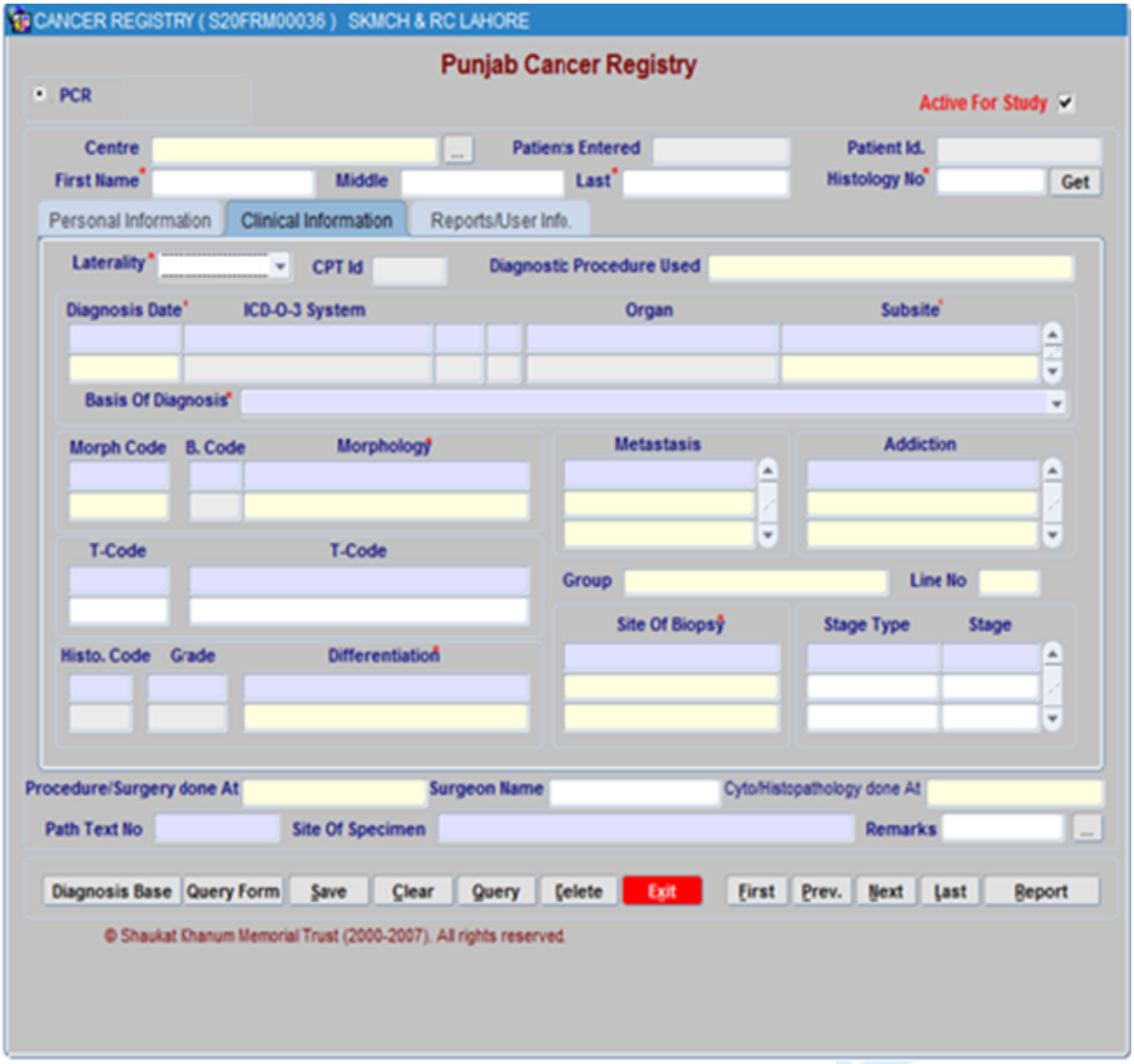
Appendix CC-Screen shot of the PCR data capture form in the Hospital Information System, SKMCH & RC, Lahore, Pakistan.



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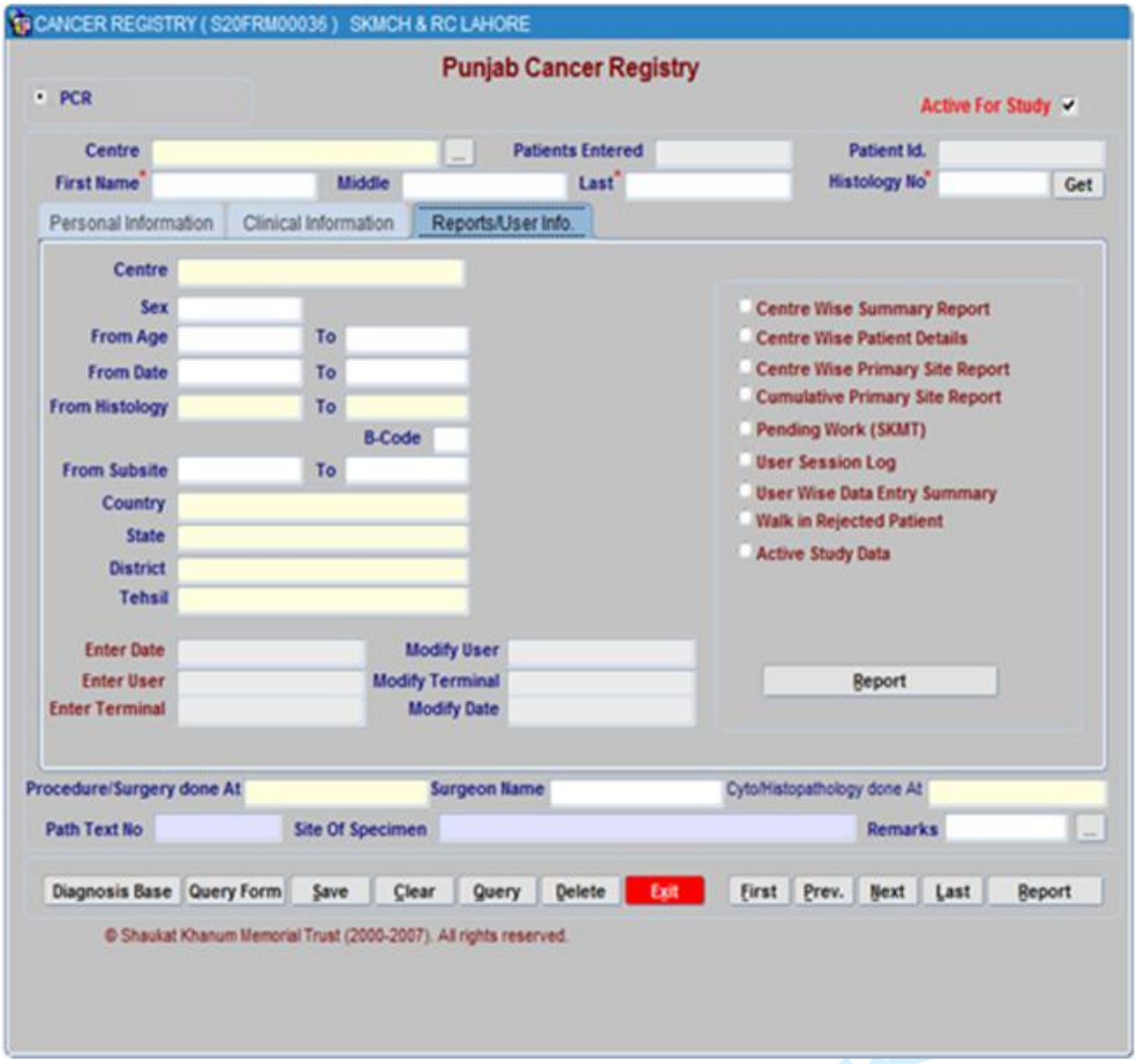
Appendix CCC-Screen shot of the PCR data capture form in the Hospital Information System, SKMCH & RC, Lahore, Pakistan.



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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract-**page 8**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found- **page 8**
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported-page **9-11**
Objectives	3	State specific objectives, including any pre-specified hypotheses-**page 11**
Methods		
Study design	4	Present key elements of study design early in the paper-**page 11-14**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection-**page 11-14**
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants-**pages 11-14**
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable-**pages 11-14**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group-**pages 14-21**
Bias	9	Describe any efforts to address potential sources of bias-**page 21**
Study size	10	Explain how the study size was arrived at-**page 11-14**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why-**page 11**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding-**page 11-14**
		(*b*) Describe any methods used to examine subgroups and interactions-**page 11-14**
		(*c*) Explain how missing data were addressed-**page 11-14**
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy- **not applicable**
		(*e*) Describe any sensitivity analyses

Continued on next page

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Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed-**pages 11-14**
		(b) Give reasons for non-participation at each stage-**pages 11-14**
		(c) Consider use of a flow diagram-**one to indicate the health systems in Pakistan (Figure 1).**
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders-**page 11-14**
		(b) Indicate number of participants with missing data for each variable of interest-**page 11-21**
		(c) *Cohort study*—Summarise follow-up time (e.g., average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures- **pages 11-21**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included-**pages 11-15**
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives-**pages 14-21**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias-**pages 21-26**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence-**pages 21-26**
Generalisability	21	Discuss the generalisability (external validity) of the study results- **pages 21-26**
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based-**pages 12 & 26**

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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THE EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, 2010-2012: A CROSS-SECTIONAL STUDY

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THE EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, 2010-2012: A CROSS-SECTIONAL STUDY

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THE EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, 2010-2012: A CROSS-SECTIONAL STUDY

ABSTRACT

Objectives

To estimate the population-level cancer estimates for the Lahore district, which is part of the Punjab Cancer Registry (PCR), Pakistan. The average population, per year, of Lahore was estimated at 9.8 million in 2010-2012.

Design

A cross-sectional study.

Setting

The Registry has nineteen collaborating centers in Lahore that report their data to the Central Office located within a tertiary care cancer treatment facility in Lahore, Pakistan.

Participants

Patients belonging to Lahore, of any age-group, and diagnosed with cancer in 2010-2012, were included in the study. Patients were followed-up between July and October 2015 to determine their vital status.

Outcome measures

Summaries were generated for gender, the basis of diagnosis, diagnoses, and deaths. The Age-Standardized Incidence Rates (ASIR) were computed per 100,000 population, by gender and cancer site. Five-year age categories were created from 0-4 till 70-74, followed by 75+ years. Death counts were reported by site.

Results

Between 2010 and 2012, in Lahore, a total of 15,840 new cancers were diagnosed-43% in male and 57% female patients; 93·5% microscopically confirmed and 6·5% non-microscopically. The ASIR amongst females was 105·1 and in males 66·7. ASIRs of leading cancers, amongst women, were: breast 47·6, ovary 4·9, and corpus uteri 3·6, whereas, amongst men: prostate 6·4, bladder 5·0, and, trachea, bronchus, & lung 4·6. A total of 5,134 deaths were recorded.

Conclusions

In Lahore, the ASIR was higher in women than in men. Amongst women, breast cancer, and in men, prostate cancer, were the leading cancer types. These estimates can be used for health promotion and policy making in the region.

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ARTICLE SUMMARY

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This is the first time that the age-standardized incidence rates have been presented for the Lahore district.
- A comparison has been made with the incidence rates reported by other registries around the world.
- There are follow-up issues related to determining the vital status of the patients, once they are registered as new cancer patients. Therefore, the limitation of the study is that the vital status of the vast majority of patients could not be determined.

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PAPER

THE EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, 2010-2012: A CROSS-SECTIONAL STUDY

INTRODUCTION

In the area of public health research, conducting high-quality, population-level studies, is hailed as the gold standard, as the outcomes truly represent the disease status of the community on whom the studies are being conducted. This includes the practice of population-based cancer registration, which not only assists in providing statistics and trends on incidence, mortality, and survival, it can also provide information on putative risk factors associated with various diseases within a defined population, living in a geographically demarcated area, over a specified period of time. However, cancer registration can only be undertaken if there is appropriate infrastructure to enable it, and suitable, well-trained staff to perform the tasks associated with it. Understandably, there is a cost associated with conducting this type of epidemiologic work, and in a resource-constrained country like Pakistan, governments are less likely to focus on the area of cancer registration than other areas deemed more immediately critical. Further, there is no legislation in the country that requires health-care practitioners to report diagnoses of cancer. Moreover, the health-care delivery in Pakistan is quite complex, and is as depicted in Figure 1. A large part of the population is served through a mixed system via multiple health providers[1].

The question whether cancer registration is a necessity or a luxury in developing countries has been debated extensively over the years. A paper published in 2008 stated that in low-income countries, cancer registration is urgently needed so as to gauge the cancer burden in the region[2]. Given that Pakistan is categorized as a 'lower-middle income country' by the World Bank, with its population estimated to be 185·0 million in the year 2014, and the life expectancy at birth being 66 years (65 years for males and 67 years for females), it seems unlikely that registration of all cancer diagnoses will be accurate and complete at the national level in the near future[3]. However, there is no denying the fact that knowing the cancer burden in the region helps in projecting regional cancer trends, establishing the required numbers of health-care facilities to cater to the needs of the patients, training sufficient numbers of health-care practitioners to manage the conditions, addressing health education, and assisting in developing prevention, early detection, and cancer control programs in the region. Figure 2 is a map of Pakistan showing the provinces of Pakistan and countries adjacent to Pakistan[4]. Even though accurate population figures are not available, enthusiastic professionals have, over the years, endeavored to determine cancer estimates for Pakistan. In the past, the regional registry of the Karachi South district, in the province of Sindh, was established and managed for several years by a dedicated pathologist, Dr. Yasmin Bhurgri[5]. This registry was widely recognized at an international level for its data quality[5]. However, due to the sudden death of Dr. Bhurgri in January 2012, this registry is no longer active. Another registry in Pakistan is the Punjab Cancer Registry (PCR), which was founded collaboratively by a group of health-professionals in 2005, pioneered by the administrators of a complete cancer treatment facility in Lahore called the Shaukat Khanum Memorial Cancer Hospital and Research Center (SKMCH & RC)[6-9]. The Punjab Cancer Registry, herein, referred to as the Registry, is

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registered with, and regulated under, the Societies Registration Act, 1860, of the Government of Pakistan[10]. It is also a member of the International Association of Cancer Registries, France[11]. Appendix A shows the list of collaborating centers of the Registry.

The reporting of cancer cases to population-based cancer registries is not required by law, in Pakistan. It is, in fact, a voluntary task undertaken by professionals representing many institutions of the region. When the Registry was established in 2005, a memorandum outlining the structure and governance mechanisms was signed by the stake-holders representing both the government and private laboratories and hospitals of the city. The purpose of establishing the Registry was to determine the cancer estimates in the province of Punjab. Punjab is the most populous province of Pakistan, with a population estimated at 100 M, and 36 administrative districts, of which Lahore is the most populous, with a population of some 10 M[12,13]. For about a decade, data have been captured in a systematic and pre-defined manner, in accordance with the minimum data items required for cancer registries as well as some additional optional data items[6,9,14].

In the past, PCR data have been reported to the International Agency for Research on Cancer (IARC) in response to a call for data by the Agency. The data have been used, along with data from Dr. Yasmin Bhurgri's paper, and the Federal Bureau of Statistics, Pakistan, to provide cancer estimates for Pakistan in the Globocan 2012 report[15].

This manuscript provides population-level cancer estimates for the Lahore district, based on cases diagnosed in 2010-2012 and reported to the Registry. This is the first time that the Lahore district population-level data have been computed and are being reported.

METHODS

The population denominator

Population-level statistics cannot be computed without the availability of figures for the population under review, or the catchment population. In Pakistan, publications describing the population structure are available for the census that was conducted in 1998[12]. However, the most recent population census, initiated a year ago, has not yet been completed[16]; therefore, accurate figures describing the Pakistani population are not available. As a result, for this study, population estimates are based on population figures determined by using the average annual growth rates provided by the Government of Pakistan[12].

In the years 2010, 2011, and 2012, the population of the Lahore district was estimated at 9,503,871, 9,832,705, and 10,172,916 respectively, computed using an average annual growth rate of 3·46%[12,13]. The total area of the Lahore district is 1,772 square kilometers, with its average population density being calculated as 5,551 persons, per square kilometer, in the years under study[12]. Figure 3 is a population pyramid showing the combined population distribution of the Lahore

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district by age-group and gender, for the years 2010-2012. These population estimates were used as the population-at-risk denominator, for calculating the incidence rates for this study.

Data collection

As routine cancer registration practice, the information is collected on the PCR data collection forms developed collaboratively, following international guidelines on recording cancers (Appendix B). The pertinent question on the form states whether a patient is a resident of Lahore or has come to Lahore for diagnosis or treatment only. This has helped to identify the residents of Lahore.

Each center is allocated a separate center identification number. The forms are distributed to, and collected from, each participating center on a regular basis. Both the active and passive methods of data collection are used[14]. Registry Staff educates relevant personnel at each center with regard to data capture, missing information and answers any other queries that arise. At the Cancer Registry & Clinical Data Management unit, only authorized personnel are allowed to enter data from forms, into the database. The forms collected are stored securely and remain confidential. The information is subsequently entered into the Punjab Cancer Registry database, developed as part of the computerized Hospital Information System of SKMCH & RC (Appendices C-CCC). All authorized Staff members are given specific usernames and passwords to turn the computers on and another username-password to access the system, and thence, the PCR software. Any form of transmission of the information including printing and saving it on portable electronic devices, and aspects related to document retention, are strictly regulated by the Governing Council of the Registry and SKMCH & RC, the latter being the sponsor of the Registry. For the cases diagnosed or treated at SKMCH & RC, linkages have been developed with the pathology department and clinics to facilitate date capture.

For the purpose of recording cancers, incidence date on the PCR form is defined as the date of cytologic/histologic confirmation of a malignancy on a pathology report, date of evaluation at an outpatient clinic only, or date of clinical investigation(s) as imaging or tumor markers, confirming the diagnosis. A check for multiple primaries is done, as per IARC rules[17]. In case of duplicate registration identified by checking various combinations of name/age/sex/phone number/address/tumor morphology, the case is registered with the center where the first diagnosis was made. Edits, for the validity and for the consistency between variables, are also carried out (age/incidence, age/site/histology, site/histology, sex/site, sex/histology, behavior/site, behavior/histology, grade/histology, and basis of diagnosis/histology). Initially, cancers were coded using the International Classification of Disease for Oncology-Third Edition[18]. For this manuscript, cancers were categorized using the International Classification of Diseases, Clinical Modification, 10th revision[19].

Data access and follow-up

Release of confidential information is governed by the rules approved by the Registry, and is always without any identifiers[6]. For maintaining confidentiality of the information recorded, Staff members are made to sign a confidentially pledge at the time of employment, which remains in force after

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cessation of employment with SKMCH & RC. For the purpose of reporting the data to IARC and to determine the vital status, patients diagnosed in the time-period 2010-2012 were followed-up telephonically between July and October 2015. We were able to establish contact with only sixty percent of the cases in this way.

Cancers reported

Cancer notifications for the Lahore district have improved with the passage of time, with the cases reported to the Registry going up from 2,006 in the year 2005 to 5,123 in the year 2015. In chronologic order, the numbers reported are as follows: 2,006; 2,987; 3,617; 3,990; 5,109; 5,302; 4,949; 5,589; 6,009; 5,943; and 5,123. We are still receiving information on cases diagnosed in 2014 and 2015. Over recent years, six other districts have been included for the purpose of data collection, with the idea being to include 1-2 contiguous district(s) of Punjab every year in order to expand cancer registration. The data collection form is modified accordingly to ascertain resident status of the patients[6]. The approach related to including 1-2 districts on a regular basis has been adopted because the sponsor, SKMCH & RC, is a charitable organization, and it is logistically not possible to initiate data collection from 36 districts of Punjab simultaneously.

2010-2012 study

A cross-sectional study was conducted and the Punjab Cancer Registry data were reviewed retrospectively to retrieve information on cancer patients belonging to the Lahore district and having been diagnosed in 2010-2012. Information was collected on new cancer diagnoses (by histology and gender), the most valid basis of diagnosis as microscopically versus non-microscopically confirmed, multiple primaries, and deaths recorded. Five-year age categories were created beginning from 0-4 years and ending on 70-74 years, with all those above 75 included as 75+. Cases were stratified by year of diagnosis/gender/age-group and histology/site.

Data analysis

Counts were determined and ASIRs computed according to 5-year age-group, weighted by the Segi World Standard population[20]. ASIRs were expressed per 100,000 population, per year, separately for male and female patients. For mortality data, counts were stratified by histology/site. Overall survival interval was computed between the dates of diagnosis and last contact and analyzed using the Kaplan-Meier method. Of a total of 15,825 patients registered in the years 2010-2012, survival intervals could not be computed for nearly 43 percent of the cases. Of these, in the vast majority of cases, no contact could be established with the patients on the phone numbers provided; in some of the cases, the attendants of the patients could only communicate that the patients had died but could not recall their dates of death; and, in a few cases, the patients died on the day of cancer diagnoses and their intervals were set at naught. Although extensive survival analysis was subsequently done on the fifty-seven percent of cases on whom the duration of survival was available, the survival estimates generated were not considered valid. Therefore, survival results are not being presented in this manuscript.

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Data were analyzed using the Microsoft Excel, version 2010, and SPSS, version 19. The Institutional Review Board (IRB) of the Shaukat Khanum Memorial Cancer Hospital & Research Center granted exemption from full IRB evaluation.

RESULTS

The total population of the Lahore district, in 2010-2012, was estimated to be 29,509,492, with males accounting for 52·7% and females 47·3% of the population (Figure 3). The number of cases reported in each of the three-years under study, 2010, 2011, & 2012, along with their population denominators, were: 5,302/9,503,871, 4,949/9,832,705, and 5,589/10,172,916, respectively. Of a total of 15,840 cancers diagnosed in 15,825 patients belonging to the district of Lahore and registered in the PCR database against the corresponding years, 9,069 (57·3%) were in female and 6,771 (42·7%) in male patients. Multiple primary cancers, up to two, were identified in 15 patients (Table 1), explaining the discrepancy between the number of cases recorded and the patients registered. Nearly ten percent were identified to have been registered twice and were eventually assigned to the center where the first diagnosis was made, thereby, counted just once. The age-range of the patients was 0-106 years. Of all the cancers diagnosed, about 93·5% were microscopically and 6·5% were non-microscopically confirmed (Table 2). None were registered on the basis of death certificates only. Skin cancer had the highest figure in the microscopically confirmed group (99·6%), whereas, liver & intrahepatic bile duct(s) had the highest figure in the non-microscopically confirmed category (69·5%). The ASIR for all sites combined amongst female patients was 105·1 per 100,000 women and amongst male patients, it was 66·7 per 100,000 men, per year. Tables 3-6 show the ASIRs for all the cancers recorded in the Registry, by the year of diagnosis and gender, and the age-specific rates for the 5-year age-group, separately for female and male patients. Amongst females, the highest ASIRs were recorded for the following sites and malignancies: breast 47·6, ovary 4·9, corpus uteri 3·6, Non-Hodgkin Lymphoma (NHL) 3·3, cervix uteri 2·9, and brain & CNS 2·2, whereas, in men, the highest ASIRs were: prostate 6·4, bladder 5·0, trachea, bronchus, & lung 4·6, NHL 4·5, brain & CNS 3·8, and liver 3·7.

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Table 1. Details related to patients having multiple primaries in the Lahore district, 2010-2012.

Serial no.	Gender	Age (years)	Vital status	Multiple sites
1.	Male	20	Alive	Colon & brain
2.	Male	23	Alive	Larynx & testis
3.	Male	34	Dead	Kidney & thyroid
4.	Female	45	Alive	Breast & breast
5.	Male	45	Alive	Ill-defined & lung
6.	Female	46	Alive	Breast & ovary
7.	Male	55	Alive	Spinal cord & NHL
8.	Male	56	Dead	Brain & unknown primary
9.	Female	59	Alive	Breast & liver
10.	Female	60	Dead	Breast & breast
11.	Male	62	Dead	Rectum & bone
12.	Female	64	Alive	Breast & breast
13.	Male	67	Dead	Thyroid & stomach
14.	Male	70	Dead	Connective tissue & liver
15.	Female	91	Dead	Breast & ovary

Table 2. The basis of diagnosis, categorized as being microscopically and non-microscopically confirmed, 2010-2012, in the Lahore district (N=15,840).

	The basis of diagnosis	
Cancer site	Microscopic (%)	Non-Microscopic (%)
Lip & oral cavity	97.0	3.0
Esophagus	99.1	0.9
Stomach	99.2	0.8
Colorectal	96.9	3.1
Liver & intrahep. bile ducts	30.5	69.5
Gall bladder	92.6	7.4
Larynx	96.6	3.4
Bronchus & lung	94.7	5.3
Bone	97.0	3.0
Connective tissue	94.4	5.6
Leukemia	92.8	7.2
Breast	95.8	4.2
Cervix uteri	96.8	3.2
Corpus uteri	97.8	2.2
Testis	98.9	1.1
Prostate	97.5	2.5
NHL	95.8	4.2
Hodgkin lymphoma	97.5	2.5
Urinary bladder	97.3	2.7
Brain	96.6	3.4
Skin	99.6	0.4
Kidney	93.4	6.6
Thyroid	97.6	2.4
Ovary	93.7	6.3

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Table 3. Cancer counts and the age-standardized incidence rates of cancers diagnosed in the Lahore district, 2010-2012, according to year of diagnosis.

		2010		2011		2012	
Site	**ICD-10 code**	**Count**	**ASIR**	**Count**	**ASIR**	**Count**	**ASIR**
Lip	C00	13	0.2	5	*0.1*	4	*0.1*
Tongue	C01-C02	115	2.0	92	1.5	102	1.6
Mouth	C03-C06	117	2.1	110	1.8	115	1.9
Salivary glands	C07-C08	30	0.5	32	0.5	29	0.4
Tonsil	C09	3	*0.1*	3	*0.1*	10	0.1
Other oropharynx	C10	2	*0.0*	3	*0.1*	1	*0.0*
Nasopharynx	C11	13	0.2	11	0.1	14	0.2
Hypopharynx	C12-C13	22	0.4	12	0.2	19	0.3
Pharynx	C14	4	*0.1*	3	*0.0*	3	*0.0*
Esophagus	C15	76	1.4	61	1.1	85	1.4
Stomach	C16	85	1.5	86	1.4	96	1.5
Small intestine	C17	15	0.3	15	0.3	13	0.2
Colon	C18	148	2.6	106	1.7	135	2.2
Rectum	C19-C20	101	1.6	89	1.4	133	2.0
Anus	C21	21	0.4	22	0.3	21	0.3
Liver	C22	176	3.4	184	3.4	145	2.6
Gall bladder, etc.	C23-C24	72	1.3	76	1.4	84	1.6
Pancreas	C25	30	0.6	30	0.6	37	0.7
Other ill-defined digestive	C26	7	*0.1*	11	0.2	12	0.2
Nose, sinuses	C30-31	17	0.3	23	0.4	19	0.3
Larynx	C32	74	1.4	55	1.0	82	1.4
Trachea, bronchus, & lung	C33-C34	162	3.2	156	2.9	170	3.2
Other thoracic organs	C37-C38	14	0.2	11	0.2	17	0.2
Bone	C40-C41	80	0.8	74	0.8	80	0.8
Melanoma of the skin	C43	4	*0.1*	11	0.2	11	0.1
Other skin	C44	152	2.8	141	2.5	174	2.9
Connective & soft tissue	C47,C49	95	1.3	95	1.2	62	0.8
Breast	C50	1409	22.9	1339	21.4	1404	21.5
Vulva	C51	3	*0.1*	7	*0.2*	9	*0.4*
Vagina	C52	5	*0.2*	6	*0.2*	5	*0.2*
Cervix uteri	C53	86	3.1	69	2.4	92	3.2
Corpus uteri	C54	83	3.5	84	3.3	100	4.1
Uterus, unspecified	C55	34	1.3	27	1.1	28	1.0
Ovary	C56	138	4.6	124	4.1	180	5.8
Other female genital orgs.	C57	5	*0.2*	7	*0.3*	6	*0.2*
Placenta	C58	3	*0.1*	2	*0.0*	2	*0.0*
Penis	C60	-	-	1	*0.0*	-	-
Prostate	C61	165	6.2	193	7.1	168	6.0
Testis	C62	31	0.7	24	0.5	35	0.7
Other male genital organs	C63	-	-	3	*0.1*	2	*0.1*
Kidney	C64	88	1.5	97	1.5	89	1.4
Renal pelvis	C65	-	-	-	-	2	*0.0*
Ureter	C66	-	-	1	*0.0*	1	*0.0*
Bladder	C67	177	3.6	150	2.8	223	4.0
Other urinary organs	C68	-	-	2	*0.0*	-	-
Eye	C69	33	0.5	29	0.4	35	0.4
Brain, nervous system	C70-C72	248	3.5	203	2.8	234	3.0
Thyroid	C73	94	1.3	92	1.3	110	1.5
Adrenal	C74	2	*0.0*	3	*0.0*	6	*0.1*
Hodgkin lymphoma	C81	104	1.3	86	1.0	92	0.9
Non-Hodgkin lymphoma	C82-C88	274	4.4	234	3.6	262	3.9
Multiple myeloma	C90	33	0.7	26	0.5	30	0.5
Lymphoid leukemia	C91	91	0.9	71	0.7	157	1.4
Myeloid leukemia	C92-93	42	0.5	31	0.4	96	1.1
Other leukemias	C95	30	0.3	25	0.3	45	0.4
Leukemia, unspecified	C94	3	*0.0*	2	*0.0*	3	*0.0*
Other & unspecified	-	335	5.7	369	6.2	393	6.4
Benign CNS	-	138	1.9	125	1.6	107	1.3
All sites		5302	97.8	4949	89.1	5589	96.8

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Table 4. Cancer counts and age-standardized incidence rates of cancers diagnosed in the Lahore district in 2010-2012, by gender and cancer site/type.

		FEMALE				MALE			
Site	ICD-10-code	Count	%	Crude	ASIR	Count	%	Crude	ASIR
Lip	C00	9	0.1	0.1	*0.1*	13	0.2	0.1	0.1
Tongue	C01-C02	129	1.4	0.9	1.7	180	2.7	1.2	1.8
Mouth	C03-C06	130	1.4	0.9	1.6	212	3.1	1.4	2.2
Salivary glands	C07-C08	41	0.5	0.3	0.5	50	0.7	0.3	0.5
Tonsil	C09	8	0.1	0.1	*0.1*	8	0.1	0.1	*0.1*
Other oropharynx	C10	-	-	-	-	6	0.1	0.0	*0.1*
Nasopharynx	C11	19	0.2	0.1	0.2	19	0.3	0.1	0.2
Hypopharynx	C12-C13	32	0.4	0.2	0.4	21	0.3	0.1	0.2
Pharynx	C14	5	0.1	0.0	*0.1*	5	0.1	0.0	*0.0*
Esophagus	C15	95	1.0	0.7	1.2	127	1.9	0.8	1.4
Stomach	C16	105	1.2	0.8	1.3	162	2.4	1.0	1.6
Small intestine	C17	17	0.2	0.1	0.2	26	0.4	0.2	0.3
Colon	C18	159	1.8	1.1	1.9	230	3.4	1.5	2.4
Rectum	C19-C20	137	1.5	1.0	1.5	186	2.7	1.2	1.9
Anus	C21	23	0.3	0.2	0.3	41	0.6	0.3	0.4
Liver	C22	177	2.0	1.3	2.4	328	4.8	2.1	3.7
Gall bladder, etc.	C23-C24	139	1.5	1.0	1.9	93	1.4	0.6	1.0
Pancreas	C25	40	0.4	0.3	0.5	57	0.8	0.4	0.6
Other ill-defined digestive	C26	14	0.2	0.1	0.1	16	0.2	0.1	0.2
Nose, sinuses	C30-31	27	0.3	0.2	0.3	32	0.5	0.2	0.3
Larynx	C32	28	0.3	0.2	0.3	183	2.7	1.2	2.0
Trachea, bronchus, & lung	C33-C34	92	1.0	0.7	1.2	396	5.8	2.5	4.6
Other thoracic organs	C37-C38	16	0.2	0.1	0.2	26	0.4	0.2	0.2
Bone	C40-C41	91	1.0	0.7	0.6	143	2.1	0.9	0.9
Melanoma of the skin	C43	13	0.1	0.1	0.1	13	0.2	0.1	0.1
Other skin	C44	196	2.2	1.4	2.7	271	4.0	1.7	2.8
Connective & soft tissue	C47,C49	108	1.2	0.8	1.0	144	2.1	0.9	1.2
Breast	C50	4082	45.0	29.2	47.6	70	1.0	0.5	0.8
Vulva	C51	19	0.2	0.1	0.2	-	-	-	-
Vagina	C52	16	0.2	0.1	0.2	-	-	-	-
Cervix uteri	C53	247	2.7	1.8	2.9	-	-	-	-
Corpus uteri	C54	267	2.9	1.9	3.6	-	-	-	-
Uterus, unspecified	C55	89	1.0	0.6	1.1	-	-	-	-
Ovary	C56	442	4.9	3.2	4.9	-	-	-	-
Other female genital organs	C57	18	0.2	0.1	0.2	-	-	-	-
Placenta	C58	7	0.1	0.1	*0.0*	-	-	-	-
Penis	C60	-	-	-	-	1	0.0	0.0	*0.0*
Prostate	C61	-	-	-	-	526	7.8	3.4	6.4
Testis	C62	-	-	-	-	90	1.3	0.6	0.6
Other male genital organs	C63	-	-	-	-	5	0.1	0.0	*0.1*
Kidney	C64	102	1.1	0.7	1.1	172	2.5	1.1	1.7
Renal pelvis	C65	1	0.0	0.0	*0.0*	1	0.0	0.0	*0.0*
Ureter	C66	1	0.0	0.0	*0.0*	1	0.0	0.0	*0.0*
Bladder	C67	109	1.2	0.8	1.5	441	6.5	2.8	5.0
Other urinary organs	C68	-	-	-	-	2	0.0	0.0	*0.0*
Eye	C69	40	0.4	0.3	0.4	57	0.8	0.4	0.5
Brain, nervous system	C70-C72	227	2.5	1.6	2.2	458	6.8	2.9	3.8
Thyroid	C73	215	2.4	1.5	2.2	81	1.2	0.5	0.7
Adrenal	C74	4	0.0	0.0	*0.0*	7	0.1	0.0	*0.1*
Hodgkin lymphoma	C81	80	0.9	0.6	0.7	202	3.0	1.3	1.4
Non-Hodgkin lymphoma	C82-C88	277	3.1	2.0	3.3	493	7.3	3.2	4.5
Multiple myeloma	C90	36	0.4	0.3	0.5	53	0.8	0.3	0.6
Lymphoid leukemia	C91	112	1.2	0.8	0.7	207	3.1	1.3	1.2
Myeloid leukemia	C92-93	62	0.7	0.4	0.5	107	1.6	0.7	0.8
Other leukemias	C94	2	0.0	0.0	*0.0*	6	0.1	0.0	*0.0*
Leukemia, unspecified	C95	40	0.4	0.3	0.3	60	0.9	0.4	0.4
Other & unspecified	-	536	5.9	3.8	6.6	561	8.3	3.6	5.7
Benign CNS	-	188	2.1	1.3	1.8	182	2.7	1.2	1.4
All sites		9069	100.0	64.9	105.1	6771	100.0	43.6	66.7

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Table 5. Age-specific & age-standardized incidence rates of cancers diagnosed in the Lahore district, 2010-2012, amongst females.

Site	Total cases	0-	5-	10-	15-	20-	25-	30-	35-	40-	45-	50-	55-	60-	65-	70-	75-	Crude	%	ASIR	ICD-10 codes
Lip	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	1.1	0.4	0.6	1.6	0.7	0.1	0.1	*0.1*	C00
Tongue	129	0.0	0.0	0.0	0.0	0.1	0.1	0.2	1.2	1.4	5.4	4.7	4.9	6.6	5.8	8.7	5.1	0.9	1.4	1.7	C01-C02
Mouth	130	0.0	0.0	0.0	0.2	0.2	0.3	0.2	1.5	2.9	1.6	6.0	4.6	3.5	7.0	11.1	5.1	0.9	1.4	1.6	C03-C06
Salivary glands	41	0.0	0.0	0.1	0.0	0.1	0.5	0.2	0.8	0.5	0.6	1.1	0.7	2.7	1.9	0.8	0.0	0.3	0.5	*0.5*	C07-C08
Tonsil	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.7	0.4	0.0	0.0	0.8	0.7	0.1	0.1	*0.1*	C09
Nasopharynx	19	0.0	0.0	0.1	0.1	0.1	0.2	0.3	0.0	0.3	0.6	0.2	0.4	0.4	0.0	1.6	0.0	0.1	0.2	0.2	C11
Hypopharynx	32	0.0	0.0	0.0	0.1	0.2	0.1	0.2	0.5	0.3	0.6	0.7	1.4	1.9	0.6	1.6	0.7	0.2	0.4	*0.4*	C12-C13
Pharynx	5	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.8	0.7	0.0	0.1	*0.1*	C14
Esophagus	95	0.0	0.0	0.0	0.1	0.0	0.3	0.3	0.9	1.9	4.0	1.8	2.8	5.8	4.5	4.7	3.6	0.7	1.0	1.2	C15
Stomach	105	0.0	0.0	0.0	0.0	0.3	0.1	1.0	1.3	2.2	3.8	2.5	3.9	2.7	8.9	0.0	3.6	0.8	1.2	1.3	C16
Small intestine	17	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.6	0.0	0.0	0.4	1.9	1.3	2.4	0.7	0.1	0.2	0.2	C17
Colon	159	0.0	0.0	0.1	0.3	0.1	0.7	1.3	2.0	2.0	3.4	3.3	7.0	5.0	9.6	9.5	8.0	1.1	1.8	1.9	C18
Rectum	137	0.0	0.0	0.1	0.2	0.9	0.9	1.4	1.2	1.7	3.0	3.1	4.2	5.0	4.5	6.3	5.1	1.0	1.5	1.5	C19-C20
Anus	23	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.1	0.9	0.6	0.2	0.0	0.8	0.6	2.4	0.7	0.2	0.3	0.3	C21
Liver	177	0.1	0.1	0.0	0.1	0.1	0.1	0.2	0.3	1.4	4.4	6.2	11.2	12.0	16.6	8.7	5.1	1.3	2.0	2.4	C22
Gall bladder, etc.	139	0.0	0.0	0.0	0.1	0.0	0.0	0.5	0.4	1.5	2.6	4.9	6.7	8.9	14.1	7.1	8.7	1.0	1.5	1.9	C23-C24
Pancreas	40	0.0	0.0	0.0	0.1	0.0	0.2	0.1	0.5	0.3	0.8	0.9	2.1	0.8	5.8	2.4	1.4	0.3	0.4	0.5	C25
Other ill-defined digestive	14	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.9	0.0	1.2	0.0	0.8	0.0	0.1	0.2	0.1	C26
Nose, sinuses	27	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.3	0.0	0.6	0.7	1.8	2.3	1.3	0.8	0.7	0.2	0.3	0.3	C30-31
Larynx	28	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.6	0.8	1.3	1.4	1.2	0.6	0.0	2.2	0.2	0.3	0.3	C32
Trachea, bronchus, & lung	92	0.0	0.0	0.1	0.2	0.1	0.1	0.5	0.4	0.9	1.4	1.8	4.6	5.4	8.3	6.3	5.8	0.7	1.0	1.2	C33-C34
Other thoracic organs	16	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.2	0.8	0.0	0.4	1.6	0.6	0.8	0.7	0.1	0.2	0.2	C37-C38
Bone	91	0.2	0.5	0.9	1.4	0.9	0.3	0.4	1.3	0.3	0.6	0.4	0.4	0.0	0.0	1.6	0.0	0.7	1.0	0.6	C40-C41
Melanoma of the skin	13	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.2	0.4	0.4	0.7	0.0	0.0	0.8	0.7	0.1	0.1	0.1	C43
Other skin	196	0.1	0.0	0.0	0.1	0.1	0.3	0.2	1.3	2.9	2.2	5.1	6.3	11.3	16.6	19.0	19.6	1.4	2.2	2.7	C44
Connective & soft tissue	108	0.4	0.3	0.3	0.6	0.6	0.8	0.8	1.2	1.7	1.2	1.8	1.4	1.6	3.8	2.4	2.9	0.8	1.2	1.0	C47,C49
Breast	4082	0.0	0.1	0.1	0.1	3.3	14.0	32.2	55.9	86.2	126.8	130.3	158.5	154.1	157.9	124.9	92.1	29.2	45.0	47.6	C50
Vulva	19	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.4	0.2	0.2	0.0	1.4	0.8	0.6	0.8	2.9	0.1	0.2	0.2	C51
Vagina	16	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.3	0.8	0.2	0.7	0.4	0.0	0.8	1.4	0.1	0.2	0.2	C52
Cervix uteri	247	0.0	0.0	0.0	0.0	0.2	0.4	1.3	3.9	5.7	9.4	7.1	10.5	10.1	8.3	5.5	5.1	1.8	2.7	2.9	C53
Corpus uteri	267	0.0	0.0	0.0	0.0	0.0	0.2	0.6	1.5	1.9	6.0	9.8	16.5	22.1	16.0	18.2	7.2	1.9	2.9	3.6	C54
Uterus, unspecified	89	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.9	1.5	3.4	4.0	2.8	5.8	3.8	4.7	0.0	0.6	1.0	1.1	C55
Ovary	442	0.0	0.1	0.6	0.8	1.6	1.9	3.0	4.9	7.9	12.2	13.4	15.4	19.4	12.1	11.1	7.2	3.2	4.9	4.9	C56
Other female genital organs	18	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.5	0.2	0.2	0.7	2.3	0.6	0.8	0.0	0.1	0.2	0.2	C57
Placenta	7	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	*0.0*	C58
Kidney	102	0.7	0.1	0.1	0.0	0.2	0.0	0.2	1.6	2.0	1.6	2.7	4.9	3.1	3.2	3.2	4.3	0.7	1.1	1.1	C64
Renal pelvis	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C65
Ureter	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	*0.0*	C66
Bladder	109	0.1	0.0	0.0	0.1	0.0	0.1	0.2	1.1	1.2	1.6	2.7	4.9	5.0	8.9	10.3	10.1	0.8	1.2	1.5	C67
Eye	40	0.9	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.0	0.0	0.8	4.5	0.8	2.2	0.2	0.4	0.4	C69
Brain, nervous system	227	0.3	0.7	0.6	0.9	0.9	2.0	1.4	2.5	3.3	4.4	4.9	5.3	5.0	7.7	4.0	2.9	1.6	2.5	2.2	C70-C72
Thyroid	215	0.0	0.1	0.1	0.2	1.9	1.6	2.8	2.9	3.3	4.6	6.5	3.5	6.6	3.2	7.9	2.9	1.5	2.4	2.2	C73
Adrenal	4	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C74
Hodgkin lymphoma	80	0.2	0.4	0.3	0.4	0.9	1.0	0.4	1.1	0.3	1.0	0.2	1.8	1.6	0.6	2.4	0.0	0.6	0.9	0.7	C81
Non-Hodgkin lymphoma	277	0.2	0.3	0.5	0.5	0.5	0.8	0.9	2.0	3.6	5.8	7.4	12.3	10.9	14.1	13.4	18.1	2.0	3.1	3.3	C82-C88
Multiple myeloma	36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	1.6	1.1	0.7	2.7	3.2	4.0	0.7	0.3	0.4	0.5	C90
Lymphoid leukemia	112	2.0	1.3	1.4	0.3	0.1	0.2	0.2	0.0	0.5	0.2	0.2	0.7	1.2	0.6	0.8	0.0	0.8	1.2	0.7	C91
Myeloid leukemia	62	0.3	0.2	0.2	0.2	0.5	0.6	0.6	0.7	0.5	0.6	1.1	1.4	0.8	0.6	1.6	0.0	0.4	0.7	0.5	C92-93
Other leukemias	2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C94
Leukemia, unspecified	40	0.3	0.5	0.3	0.3	0.1	0.3	0.1	0.1	0.2	0.2	0.7	0.0	0.0	0.6	0.8	0.0	0.3	0.4	0.3	C95
Other & unspecified	536	0.5	0.2	0.2	0.2	1.1	1.8	2.7	4.7	7.0	12.6	14.9	24.9	24.1	33.9	26.9	18.8	3.8	5.9	6.6	Other & unspecified
Benign CNS	188	0.2	0.1	0.3	0.7	0.3	1.6	2.2	3.9	4.0	4.8	3.6	2.1	4.3	4.5	2.4	0.7	1.3	2.1	1.8	Benign CNS
All sites	9069	6.7	5.0	6.5	8.4	16.4	32.1	58.3	104.7	155.6	237.8	259.9	337.6	364.1	398.2	348.7	259.5	64.9	100.0	105.1	All sites

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Table 6. Age-specific & age-standardized incidence rates of cancers diagnosed in the Lahore district, 2010-2012, amongst males.

Site	Total cases	0-	5-	10-	15-	20-	25-	30-	35-	40-	45-	50-	55-	60-	65-	70-	75-	Crude	%	ASIR	ICD-10 codes
Lip	13	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.2	0.0	0.0	0.2	0.6	1.3	0.5	0.6	0.0	0.1	0.2	0.1	C00
Tongue	180	0.0	0.0	0.0	0.0	0.3	0.6	0.6	2.0	3.5	3.6	4.4	5.0	7.2	6.2	9.5	2.3	1.2	2.7	1.8	C01-C02
Mouth	212	0.0	0.0	0.0	0.0	0.1	0.2	1.2	1.1	3.0	5.4	4.8	9.7	10.1	8.8	7.7	4.0	1.4	3.1	2.2	C03-C06
Salivary glands	50	0.0	0.0	0.1	0.1	0.1	0.2	0.3	0.7	0.6	0.7	0.7	1.1	1.9	1.6	3.0	1.7	0.3	0.7	*0.5*	C07-C08
Tonsil	8	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.2	0.3	0.6	0.5	0.0	0.0	0.1	0.1	*0.1*	C09
Other oropharynx	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.6	0.3	0.0	0.6	0.0	0.0	0.1	*0.1*	C10
Nasopharynx	19	0.0	0.0	0.0	0.1	0.1	0.0	0.2	0.1	0.3	0.3	0.2	0.8	1.3	0.5	0.0	0.0	0.1	0.3	0.2	C11
Hypopharynx	21	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.3	0.0	0.6	0.3	0.9	1.0	1.2	2.9	0.1	0.3	0.2	C12-C13
Pharynx	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	*0.0*	C14
Esophagus	127	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.8	0.5	3.1	3.1	4.5	5.3	6.2	9.5	6.9	0.8	1.9	1.4	C15
Stomach	162	0.0	0.0	0.0	0.0	0.1	0.8	0.9	1.4	2.2	3.8	3.3	4.7	4.4	10.3	8.3	3.4	1.0	2.4	1.6	C16
Small intestine	26	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.3	0.1	0.5	0.6	0.8	0.9	0.5	1.8	2.3	0.2	0.4	*0.3*	C17
Colon	230	0.0	0.0	0.0	0.4	0.8	0.6	0.7	1.5	2.1	4.8	4.4	5.8	11.6	14.5	9.5	6.3	1.5	3.4	2.4	C18
Rectum	186	0.0	0.0	0.0	0.4	0.7	0.9	1.4	1.0	1.0	3.3	3.9	5.0	8.2	11.9	4.2	6.3	1.2	2.7	1.9	C19-C20
Anus	41	0.0	0.0	0.0	0.1	0.1	0.1	0.5	0.0	0.6	0.5	1.3	0.8	2.2	1.6	0.6	1.1	0.3	0.6	0.4	C21
Liver	328	0.0	0.0	0.0	0.1	0.1	0.2	0.0	1.5	1.9	5.2	10.1	17.0	14.8	24.3	17.2	14.9	2.1	4.8	3.7	C22
Gall bladder, etc.	93	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.3	0.5	0.5	2.9	3.6	5.0	7.2	4.2	7.4	0.6	1.4	1.0	C23-C24
Pancreas	57	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.8	1.4	1.3	3.1	1.3	4.7	4.7	1.1	0.4	0.8	0.6	C25
Other ill-defined digestive	16	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.5	0.4	0.3	0.6	2.1	0.0	1.1	0.1	0.2	0.2	C26
Nose, sinuses	32	0.0	0.0	0.0	0.1	0.2	0.2	0.0	0.2	0.1	0.5	0.6	1.4	0.9	1.6	2.4	0.0	0.2	0.5	0.3	C30-31
Larynx	183	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.5	1.5	3.8	4.6	7.8	10.4	12.4	11.3	5.7	1.2	2.7	2.0	C32
Trachea, bronchus, & lung	396	0.0	0.0	0.0	0.0	0.1	0.1	0.6	1.9	1.8	5.7	4.8	13.1	21.4	32.0	37.4	32.6	2.5	5.8	4.6	C33-C34
Other thoracic organs	26	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.2	0.3	0.2	1.1	0.0	0.6	0.5	1.8	2.9	0.2	0.4	0.2	C37-C38
Bone	143	0.2	0.5	1.2	2.4	1.0	0.5	0.6	0.7	0.6	0.9	0.6	0.3	3.1	0.5	1.8	0.6	0.9	2.1	0.9	C40-C41
Melanoma of the skin	13	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	1.1	0.0	0.5	0.0	1.7	0.1	0.2	0.1	C43
Other skin	271	0.1	0.1	0.1	0.2	0.3	0.9	1.6	2.0	2.3	2.8	4.1	8.6	11.3	16.5	10.1	21.2	1.7	4.0	2.8	C44
Connective & soft tissue	144	0.4	0.5	0.1	0.9	0.8	1.1	0.7	1.1	0.5	2.8	1.1	2.5	2.8	3.6	4.2	2.9	0.9	2.1	1.2	C47,C49
Breast	70	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.3	0.9	2.1	1.5	1.9	1.9	8.8	2.4	1.7	0.5	1.0	0.8	C50
Penis	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C60
Prostate	526	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.3	1.0	4.4	13.1	27.1	46.0	69.4	87.0	3.4	7.8	6.4	C61
Testis	90	0.2	0.0	0.0	0.5	1.1	1.2	1.2	1.1	1.0	0.7	0.6	0.3	0.3	1.6	0.6	0.6	0.6	1.3	0.6	C62
Other male genital organs	5	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.6	0.0	0.0	0.1	*0.1*	C63
Kidney	172	0.6	0.2	0.0	0.1	0.1	0.2	0.3	0.9	2.7	3.3	3.3	5.6	6.3	7.2	9.5	5.7	1.1	2.5	1.7	C64
Renal pelvis	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C65
Ureter	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	C66
Bladder	441	0.1	0.0	0.0	0.0	0.1	0.2	0.4	1.8	2.2	5.9	7.5	19.2	23.0	30.0	29.7	42.4	2.8	6.5	5.0	C67
Other urinary organs	2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	*0.0*	C68
Eye	57	1.2	0.2	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.7	0.6	0.3	1.6	2.1	2.4	1.1	0.4	0.8	*0.5*	C69
Brain, nervous system	458	0.7	1.0	0.7	1.2	1.6	2.9	4.5	4.4	5.0	7.3	8.8	10.6	11.3	9.8	8.3	3.4	2.9	6.8	3.8	C70-C72
Thyroid	81	0.0	0.0	0.0	0.2	0.2	0.7	0.8	0.3	0.8	1.4	1.8	3.3	1.6	2.6	3.0	1.1	0.5	1.2	0.7	C73
Adrenal	7	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.3	0.0	0.0	0.6	0.0	0.0	0.1	*0.1*	C74
Hodgkin lymphoma	202	0.7	1.8	0.7	1.0	0.9	1.4	1.2	1.4	1.5	1.6	1.5	3.3	1.9	4.1	3.6	0.6	1.3	3.0	1.4	C81
Non-Hodgkin lymphoma	493	0.4	1.4	1.1	1.3	2.0	1.6	2.5	2.5	4.6	5.9	10.1	11.7	18.3	18.1	16.6	14.3	3.2	7.3	4.5	C82-C88
Multiple myeloma	53	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.5	1.2	1.3	2.5	3.1	1.6	2.4	2.3	0.3	0.8	*0.6*	C90
Lymphoid leukemia	207	3.1	2.2	2.6	0.7	0.5	0.2	0.3	0.1	0.8	0.3	0.9	0.6	0.6	2.1	0.0	1.7	1.3	3.1	1.2	C91
Myeloid leukemia	107	0.3	0.3	0.4	0.4	0.7	0.8	0.9	1.4	1.0	1.0	0.7	1.9	1.9	2.1	0.0	0.6	0.7	1.6	0.8	C92-93
Other leukemias	6	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.4	0.0	0.0	0.0	0.6	0.0	0.0	0.1	*0.0*	C94
Leukemia, unspecified	60	0.5	0.4	0.7	0.2	0.5	0.2	0.3	0.1	0.3	0.3	0.2	0.3	0.6	0.0	0.6	0.0	0.4	0.9	0.4	C95
Other & unspecified	561	0.3	0.1	0.6	0.9	0.4	2.0	2.6	2.9	4.8	6.0	12.2	18.7	23.9	28.4	25.5	34.9	3.6	8.3	5.7	Other & unspecified
Benign CNS	182	0.3	0.4	0.2	0.5	0.8	2.0	1.9	2.4	2.1	3.3	3.3	1.1	3.1	1.6	3.0	0.6	1.2	2.7	1.4	Benign CNS
All sites	6771	9.2	9.5	9.1	12.2	14.8	20.6	27.4	38.0	53.7	93.1	118.4	194.0	255.2	337.0	329.7	328.0	43.6	100.0	66.7	All sites

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Of the 15,825 patients, death was recorded in 5,134 (32·4%) cases by the cut-off date for this study; this included 2,726 female and 2,408 male patients. Four-thousand, three-hundred and forty-seven patients were still alive (27·5%) at the time of review, whereas, the vital status of 6,344 patients (40·1%) could not be determined. Death certificates were available in each record of a hospital death for about 8% of patients (400/5,134), representing just one collaborating center, which is SKMCH & RC. Table 7 displays death counts and proportion by cancer sites. Since the follow-up information was not available for nearly 40% of the patients, the mortality to incidence ratio was not calculated either.

Table 7. Distribution of deaths recorded (5,134 (2,726 female and 2,408 male patients)), in patients diagnosed with cancer, in the Lahore district, in 2010-2012, according to gender and cancer type (top 10 cancers only).

Females	Count	%	Males	Count	%
Breast	987	36	Brain	213	9
Ovary	137	5	Bronchus & lung	207	9
Colo-rectum	127	5	NHL	169	7
NHL	109	4	Prostate	168	7
Lip & oral cavity	106	4	Colo-rectum	155	6
Brain	99	4	Lip & oral cavity	152	6
Leukemia	87	3	Liver & intrahep. bile ducts	151	6
Liver & intrahep. bile ducts	85	3	Leukemia	144	6
Cervix uteri	65	2	Urinary bladder	133	6
Corpus uteri	53	2	Stomach	73	3

Of the deaths recorded, amongst females, 36% were reported in those who had breast cancer, 5% each in those who had ovarian and colo-rectal carcinoma, 4% each in NHL, lip & oral cavity, and brain tumor, 3% each in those with leukemia and liver & intrahepatic bile ducts tumors, and 2% each in those who had cancer of the cervix and corpus uteri. In male patients, 9% each were in those who had tumor of the brain and, bronchus & lung, 7% each in those with NHL and prostate cancer, 6% each in cancers of the colo-rectum, lip & oral cavity, liver & intrahepatic bile ducts, bladder, and leukemia, and 3% in stomach carcinoma.

DISCUSSION

The Registry has been in existence since 2005 but was in an evolving phase in the initial years of its functioning. Therefore, conducting a comparison of the cases recorded over the initial years did not appear to be useful. Further, as there are notification delays and the Registry is still receiving information on cases diagnosed in the most recent years (2014-2015), mainly from one center, this time-period has not been included in the study either. It is hoped that a study conducted at a subsequent stage will cover the 2013-2015 period. For the time-period 2010-2012, the results reported

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for the population of the Lahore district show that on average, over 5,200 new cancer cases were diagnosed, every year. The fact that nearly seven percent were non-microscopically confirmed cancers as opposed to nearly 93% that were microscopically confirmed, supports that there was no reliance on the pathology laboratory as the only source of information. These figures are similar to those reported for the Karachi Cancer Registry[5]. However, some of the cases diagnosed clinically might not have been reported to the Registry but we have no way of knowing that, at present. The ASIR for all-cancers combined was higher amongst females (105·1) than in males (66·7). These results also include the ASIRs for benign CNS tumors and other/unspecified sites. The ASIRs reported by the Surveillance, Epidemiology, and End Results (SEER) Program of the United States of America (USA), are very high (359·4 for females and 282·6 for males)[21,22]. These figures represent SEER 18 registries compiling data from all cases diagnosed since 2000 and covering approximately 30% of the US population[21,22]. The ASIRs published in the CI5-X report for Delhi in India and Riyadh in Saudi Arabia, are close to the Lahore district figures as opposed to the SEER rates; in fact, the ASIRs for females in these three regions are quite similar to one another. It is important to point out that Delhi, located in India, to the east of Lahore, is closer to Lahore than is Karachi located in southern Pakistan. As far as the South Karachi Registry is concerned, based on the last report (1998-2002) released in CI5-IX, it can be seen that the ASIRs for Karachi were relatively high (192·0 for females and 166·6 for males) as compared to those for the Lahore district. Further, in the region of Golestan in Iran (2005-2007), and for Israel, again the ASIRs were high compared to those reported for the Lahore district[19]. For the SEER Program, Delhi, Iran, and Saudi Arabia, data were reported for the 2003-2007 time period. Table 8 shows a comparison of the ASIRs according to cancer sites, though not all sites, in the aforementioned regions of the world. In women belonging to the Lahore district, the ASIR of breast cancer ranked the highest (47·6) of all the cancers, and was higher than that for Delhi (31·6), but relatively low compared to that reported for the Israeli Jews (89·4). Amongst men in the Lahore district, the ASIR of prostate cancer was the highest (6·4) of all the cancers, but was lower than that reported for Delhi (10·1) and Riyadh (7·9). Even though breast and prostate cancer were the most common diagnoses in the Lahore district, the point to be noted is that organized screening programs for early detection of these diseases do not exist in Pakistan. The ASIR of cervical cancer in Lahore was 2·9 but in Delhi it was much higher, at 17·7; this is despite the fact that the screening levels are low in the general population of India[23]. Of the factors implicated in the etiology of cervical cancer in the Indian population, the presence of specific oncogenic types of the Human Papilloma Viruses (HPV), namely types 16 and 18, plays an important role in the development of cancer of the cervix. In Pakistan, one population-based study reports HPV positivity to be nearly 2·8% in the general population (25/899) and about 92% in patients with invasive cervical cancer (83/91)[24]. However, in India, it has been reported that HPV prevalence varies from 7·5% to 16·9% in women without cervical cancer as opposed to 87·8% to 96·7% amongst cervical cancer patients[23]. Further, in the latest Globocan report, the ASIR for cancer of the cervix in Pakistan was estimated at 7·9 per 100,000 females with 5,233 cases identified in 2012[15]; in the same year, in Saudi Arabia, 241 cases were diagnosed, with the ASIR at 2·7 per 100,000 women; in contrast to this, in India, 122,844 cervical cancer cases were diagnosed, with a relatively high ASIR of 22·0 per 100,000 females[15]. Since the ASIR is low in the aforementioned Muslim countries compared to a non-Muslim country, circumcision of men may be a plausible explanation in reducing the transmission of HPV infection to their female sexual partners. Circumcision of men is the norm amongst Muslim males. The role of circumcision has been

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demonstrated in three separate randomized trials done in Africa[25]. Since the incidence of cervical cancer in Pakistan is relatively low and the 5-year prevalence is 15,323, setting-up a formal screening program may have lower yields, therefore, a low priority in resource allocation and decision making in our setting[15].

As shown in Table 8, the ASIRs per 100,000 population, per year, for ten common cancers in Pakistan, as reported in the Globocan 2012, compared to Lahore, are as follows: In women: breast 50·3, 47·6; lip & oral cavity 9·1, 3·9; cervix uteri 7·9, 2·9; ovary 5·6, 5·1; esophagus 4·4, 1·2; corpus uteri 3·6, 3·6; NHL 3·4, 3·3; colo-rectum 3·3, 3·7; liver 2·5, 2·4; and stomach 2·2, 1·3, while, amongst men: lip & oral cavity 10·5, 4·6; lung 9·8, 4·6; NHL 5·3, 4·5; prostate 6·6, 6·4; bladder 5·1, 5·0; larynx 5·0, 2·0; colo-rectum 4·7, 4·7; liver 4·7, 3·7; esophagus 3·9, 1·4; stomach 3·8, 1·6; and brain & nervous system 3·4, 3·8. The comparison shows that rates are somewhat higher for tobacco-related cancers (lip & oral cavity, lung, larynx, and esophagus), and cervical cancer, though for the latter, the rates are still lower than those reported in countries with a high HPV prevalence rate. Since the Globocan 2012 report included data from the Punjab Cancer Registry, Karachi South district, and Dr. Yasmin's paper, the relatively high cancer rates for certain cancers may be attributed to the high consumption of tobacco-related products in that part of Pakistan, in the form of cigarettes and bidi and also of smokeless tobacco as betel quid and niswar[26]. Further, Karachi South is one of the 29 districts of the province of Sindh[12], located in the south of the country and its population was 1·72 M during the period under study. Its last report published in the CI-5, IX, shows a high incidence rate for tobacco related cancers[22]. Therefore, the dissimilarity in the incidence rates could be attributed to the geographic and lifestyle differences between these two regions. Table 8, depicting the ASIRs, highlights the differences between these two regions and other regions of the world as well.

As far as the mortality data in our study are concerned, since the vital status of all the patients could not be recorded, our results have to be interpreted with caution. The highest mortality was recorded in patients diagnosed with breast cancer amongst females, and amongst those with brain tumors in males. Due to the non-availability of the vital status of nearly half of the patients, the survival statistics could not be reported either. Death certificates were available from just one collaborating center for each record of a hospital death and accounted for nearly 8% of the deaths recorded in the Registry. However, the point to be noted is that the cancer diagnoses were not merely reported from hospitals, they were also reported on patients identified as new cancer cases, from different laboratories/collection centers within the district. The establishment of a central death registry in the region could help in collecting the mortality data and determining the cause-specific mortality, along with the survival estimates for the study population. While the Government of Pakistan maintains the National Database Registration Authority with all citizens' data and biometric information, the capture of death information is variable and typically done at the local government level[27,28]. Deaths within hospitals have documented death certificates which get communicated to local government, but the recording of death diagnosis likely over-reports final mechanisms of death ('cardio respiratory failure'), rather than underlying causes. In view of this, death data and thus survival data have inherent inaccuracies in it.

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Table 8. ASIRs, per 100,000 population, per year, for selected cancer sites, in Pakistan, India, Iran, Israel, and USA.

	Pakistan	Globocan	Pakistan	India	Iran	Saudi Arabia	Israel	USA
	Lahore	Pakistan	Karachi	New Delhi	Golestan	Riyadh	Jews	SEER
	2010-2012	2012	1998-2002	2003-2007	2005-2007	2003-2007	2003-2007	2003-2007
Oral cavity & salivary glands-C00-C08								
Male	4.6	10.5	22.5	14.0	1.7	1.6	3.3	6.9
Female	3.9	9.1	20.4	4.7	1.3	1.4	2.3	3.1
Pharynx-C09-C14								
Male	0.6	3.8	8.2	6.6	1.0	2.4	1.5	4.4
Female	0.8	1.3	3.4	1.5	0.7	1.3	0.5	1.1
Esophagus-C15								
Male	1.4	3.9	6.7	4.9	23.2	1.6	1.8	5.1
Female	1.2	4.4	8.6	2.9	18.8	1.3	0.9	1.2
Stomach-C16								
Male	1.6	3.8	6.0	3.2	30.4	4.4	10.0	6.6
Female	1.3	2.2	3.6	1.5	12.6	2.3	5.4	3.3
Small intestine-C17								
Male	0.3	-	0.2	0.2	1.4	0.5	1.0	1.5
Female	0.2	-	0.4	0.1	0.9	0.3	0.7	1.1
Colo-rectum-C18-C21								
Male	4.7	4.7	7.1	5.5	13.6	12.5	42.8	35.3
Female	3.7	3.3	5.2	3.7	10.4	10.6	32.6	26.5
Liver-C22								
Male	3.7	4.7	5.4	2.6	3.6	3.0	3.1	7.6
Female	2.4	2.5	3.7	1.5	2.0	6.0	1.4	2.4
Gall bladder-C23-C24								
Male	1.0	0.9	1.3	4.0	1.2	1.2	1.7	1.7
Female	1.9	2.2	4.9	8.0	1.6	2.5	1.4	1.7
Pancreas-C25								
Male	0.6	0.5	0.9	1.9	2.8	3.2	8.6	8.2
Female	0.5	0.4	0.5	1.1	1.0	1.9	6.4	6.2
Nose & sinuses-C30-C31								
Male	0.3	-	0.7	0.3	0.0	0.2	0.4	0.6
Female	0.3	-	0.4	0.2	0.2	0.2	0.3	0.4
Larynx-C32								
Male	2.0	5.0	10.7	8.0	4.1	1.7	4.1	4.3
Female	0.3	0.7	1.8	1.1	1.4	0.1	0.6	0.9
Trachea, bronchus, & lung-C33-C34								
Male	4.6	9.8	25.2	13.7	17.5	6.3	29.8	48.3
Female	1.2	1.7	3.6	3.6	5.6	2.2	13.4	33.8
Bone-C40-C41								
Male	0.9	-	1.3	2.0	1.3	0.8	1.3	1.0
Female	0.6	-	1.5	1.2	1.5	0.5	1.0	0.8
Melanoma of the skin-C43								
Male	0.1	0.3	0.5	0.2	0.9	0.3	13.7	16.8
Female	0.1	0.2	0.3	0.2	0.7	0.4	11.2	12.0
Skin-C44								
Male	2.8	-	4.3	1.3	11.0	3.8	2.8	1.3
Female	2.7	-	4.1	1.0	7.7	3.2	1.9	1.0
Connective & soft tissue-C47-C49								
Male	1.2	-	2.4	1.5	2.1	1.3	3.2	3.0
Female	1.0	-	2.3	1.2	2.1	0.9	2.2	2.1
Breast-C50								
Male	0.8	-	1.0	1.3	0.1	0.5	1.3	0.7
Female	47.6	50.3	69.0	31.6	28.0	21.1	89.4	86.6

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Cervix uteri-C53								
Female	2.9	7.9	7.5	17.7	5.4	2.0	5.5	6.4
Corpus uteri-C54								
Female	3.6	3.6	6.7	4.5	1.7	4.4	14.4	16.7
Ovary-C56-C57.0-4								
Female	5.1	5.6	8.8	8.6	6.1	3.3	9.2	9.6
Other female genital organs-C51-C52, C55, C58								
Female	1.5	-	1.0	1.6	1.4	0.9	1.8	2.5
Penis-C60								
Male	-	-	0.1	1.0	0.0	0.1	0.3	0.7
Prostate-C61								
Male	6.4	6.6	10.1	10.1	10.6	7.9	68.3	106.8
Testis-C62								
Male	0.6	0.9	1.2	0.6	2.3	0.6	4.7	4.9
Kidney, etc.-C64, C66, C68								
Male	1.7	1.7	1.9	2.7	2.2	3.8	13.9	137.0
Female	1.1	0.9	0.8	1.2	1.2	2.5	6.5	7.1
Bladder-C67								
Male	5.0	5.1	9.3	6.5	8.5	5.6	25.5	20.8
Female	1.5	1.6	2.6	1.5	2.8	1.3	4.8	5.3
Eye-C69								
Male	0.5	-	0.6	0.3	0.4	0.4	0.6	0.8
Female	0.4	-	0.3	0.2	0.2	0.2	0.4	0.6
Brain, CNS-C70-C72								
Male	3.8	3.4	3.3	3.8	7.8	3.5	6.7	6.4
Female	2.2	2.1	2.7	2.4	5.3	2.1	5.0	4.6
Thyroid-C73								
Male	0.7	0.7	0.7	1.1	1.2	2.5	4.8	3.9
Female	2.2	2.2	2.9	**2.5**	3.0	10.2	14.7	12.3
Adrenal & other endocrine-C74-C75								
Male	0.1	-	0.2	0.2	0.7	0.3	0.6	0.5
Female	0.0	-	0.3	0.2	0.4	0.2	0.5	0.4
Hodgkin lymphoma-C81								
Male	1.4	2.2	2.0	1.6	1.8	2.2	3.6	2.7
Female	0.7	0.8	1.0	0.7	1.1	2.0	3.4	2.2
NHL-C82-C88, C96								
Male	4.5	5.3	7.6	5.6	7.2	8.6	17.9	15.5
Female	3.3	3.4	5.1	3.0	3.3	7.1	14.4	10.8
Multiple myeloma-C88, C90								
Male	0.6	0.7	1.8	2.0	2.4	1.8	4.8	4.7
Female	0.5	0.6	1.3	1.2	2.2	1.0	3.0	3.1
Leukemia-C91-C95								
Male	2.4	3.3	4.8	5.6	10.8	5.7	10.6	11.1
Female	1.5	2.2	4.1	3.6	7.7	4.3	6.9	7.1
All sites-C00-C96								
Male	66.7	96.0	166.6	119.7	165.3	104.1	273.1	359.4
Female	105.1	127.7	192.0	118.4	142.0	103.9	308.5	282.6

CONCLUSION

This is the first time that an attempt has been made to determine and report the population-based cancer statistics for the Lahore district. This collaborative study highlights cancer registration and follow-up issues in a developing country like Pakistan, along with the non-availability of recent, accurate population estimates required as denominators in computation of the incidence rates. On average, annually, 5,200 new cases were reported in the Lahore district, in 2010-2012. Although it is likely that all

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the cases have not been reported, it is not possible to gauge the extent of under-reporting at this stage. The cancer statistics reported in this manuscript can be used as baseline figures for comparison with studies to be undertaken in the future. These statistics can also assist in exploring, thus, highlighting the putative risk factors associated with cancers commonly diagnosed in the region, as part of a health promotion and education program. Finally, this report can play an important role in developing prevention, early detection, and cancer control strategies in the region.

FOOTNOTES

Contributors

FB conceived the idea of the study, designed it, supervised the statistical analysis, did literature search, interpreted the results, drafted the manuscript, and finalized it. FB further did the survival analysis for this study. SM did the case-finding, indexing, and coding of cases, computed the incidence rates, and created figures and tables. MAY and FS reviewed the paper critically for important intellectual content, interpretation of the results, and final approval of the version to be published.

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Competing interests

We declare no competing interests.

Data sharing statement

No additional data available.

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Hussain did the pathologic confirmation of cases at SKMCH & RC, Lahore. Raqib Faraz, Aneel Yousaf, Hina Asif, and Adna Atif validated the data, checked for duplication, and followed-up on the patients; and Ain ul Quader and Kamran Liaqat Ali worked on the comparison of the incidence rates with other regions.

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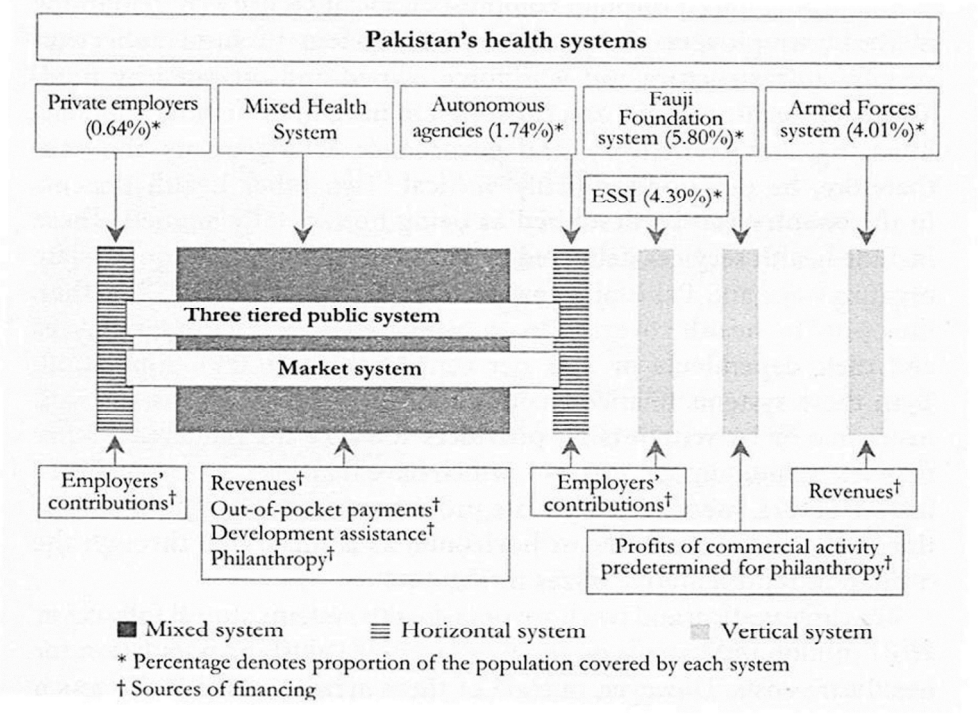

Figure 1. Health-care delivery systems in Pakistan. Image used with permission from Dr. Sania Nishtar from her book titled 'Choked Pipes'.
254x190mm (300 x 300 DPI)

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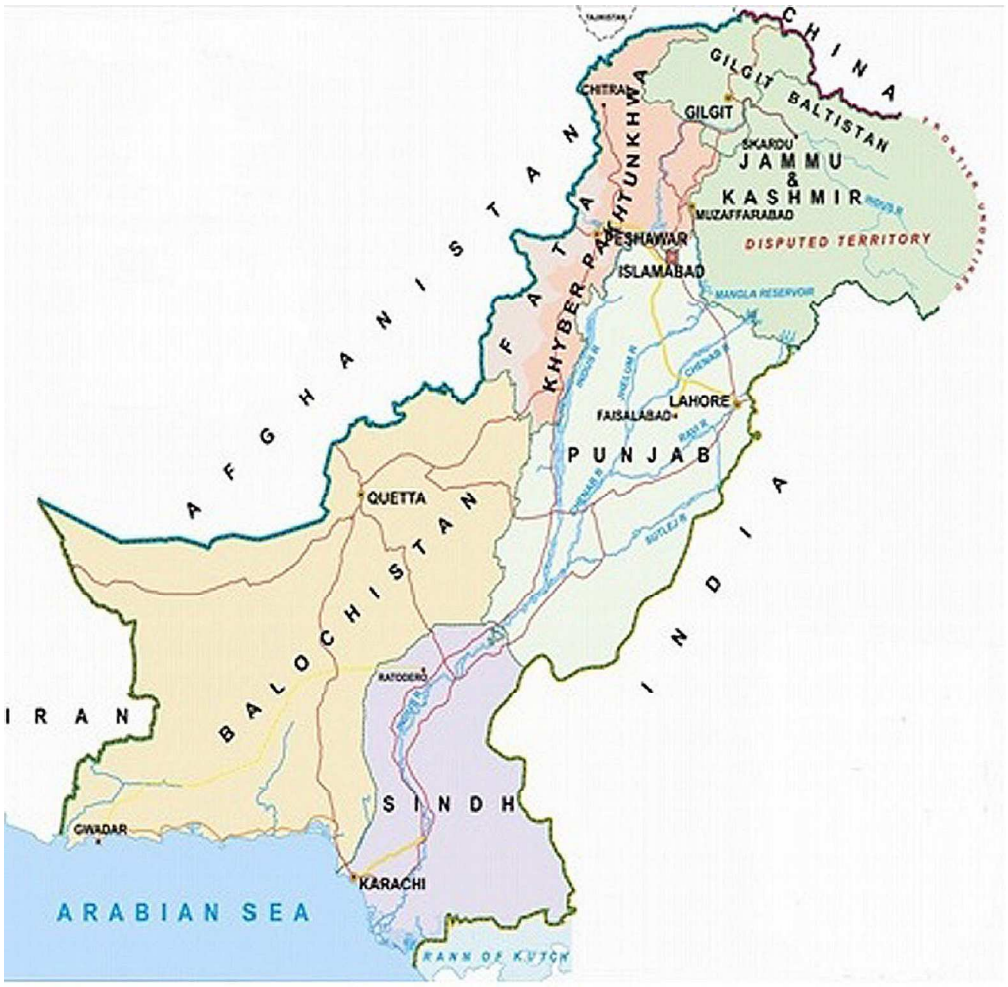

Figure 2. Map of Pakistan showing the provinces and location of the Lahore and Karachi districts and neighboring countries.
344x337mm (300 x 300 DPI)

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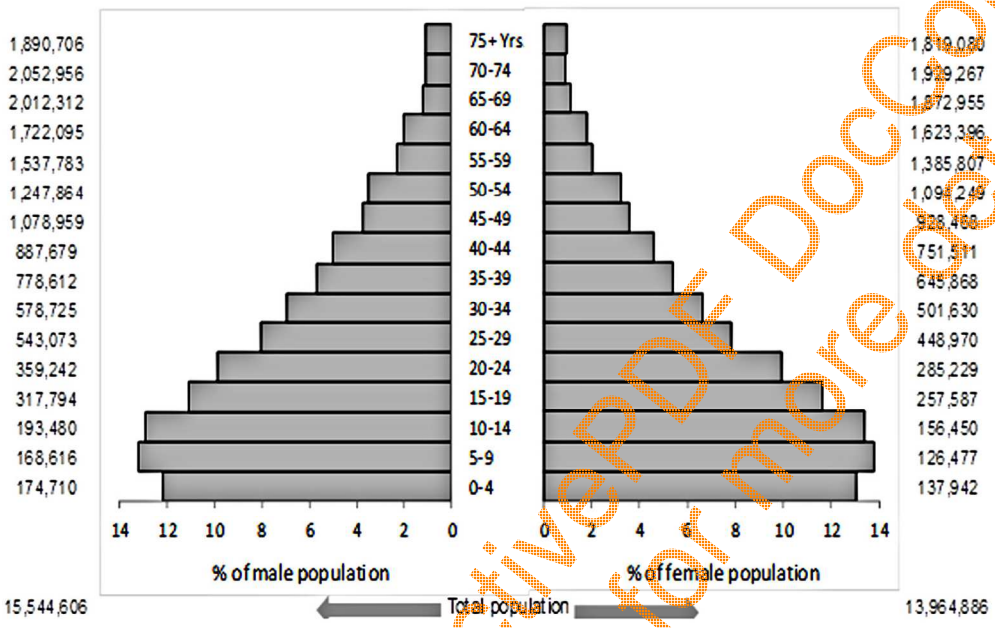

Figure 3. Population structure of the Lahore district, 2010-2012, by gender.
152x97mm (300 x 300 DPI)

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Appendix A-List of collaborating centers in Lahore. Centers are listed in descending order of the number of cases reported, to the Punjab Cancer Registry, 2010-2012.

S. No.	Center name
1	Shaukat Khanum Memorial Cancer Hospital & Research Center
2	Institute of Nuclear Medicine & Oncology
3	Ittefaq Hospital
4	Sheikh Zayed Hospital
5	Chughtais Lahore Lab
6	Fatima Jinnah Medical University
7	Jinnah Hospital
8	The Children's Hospital & the Institute of Child Health
9	Services Institute of Medical Sciences
10	Fatima Memorial College of Medicine & Dentistry
11	Shalamar Medical & Dental College
12	Allama Iqbal Medical College
13	King Edward Medical University
14	Nawaz Sharif Social Security Hospital
15	Akhtar Saeed Medical & Dental College
16	Post Graduate Medical Institute
17	Combined Military Hospital
18	Indus Lab
19	Pride Lab

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Appendix B-Data collection form used for the Lahore district, the Punjab Cancer Registry.

PUNJAB CANCER REGISTRY

DATA COLLECTION FORM

CENTER I.D. NO._____ PATIENT I.D NUMBER: _____ ← (To be allocated by .)

HISTOLOGY NO._____ HISTOLOGY DATE: _____/_____/_____

PATIENT'S NAME_____ _____ _____
LAST FIRST MIDDLE

SEX: MALE ☐ FEMALE ☐ NEUTER (MUKHANNA ☐) FATHER'S NAME _____

BIRTH DATE _____ AGE _____

N.I.C. NUMBER (FOR CHILDREN ≤ 18 YEARS, ID OF MOTHER/ FATHER) _____

PERMANENT ADDRESS (HOUSE AND STREET NO.) _____

_____

CITY/TOWN _____ POSTAL CODE_____

HOME/CELL TELEPHONE WITH AREA CODE_____

↓RESIDENT OF LAHORE: YES ☐ NO ☐ IF YES, duration of stay in Lahore (Months/Years) _____
کیا آپ لاہور کے رہائشی ہیں.

↓COME TO LAHORE FOR TREATMENT/DIAGNOSIS ONLY_____ (YES/NO)
یا آپ لاہور بیماری کی تشخیص یا علاج کے لیے آئے ہیں.

Procedure/surgery done at (hospital)…….
Name of surgeon……
Cytology/histopathology done at (lab.) …….

PRIMARY SITE_____ DATE OF DIAGNOSIS _____

SITE OF BIOPSY_____ METASTATIC_____ (YES/NO)

LATERALITY (where applicable) _____ MORPHOLOGY _____ BEHAVIOR_____

GRADE _____ STAGE (when available) _____

*MOST VALID BASIS OF DIAGNOSIS (Please see the list below)_____

FOR PCR CENTRAL OFFICE USE ONLY
STATUS AT LAST FOLLOW-UP _____

DATE OF DEATH _____ PLACE OF DEATH

†PCR is an acronym for the Punjab Cancer Registry.
*0. Death Certificate Only 1. Clinical; 2. Clinical investigation; 4. Specific tumor markers; 5. Cytology; 6. Histology of a metastasis; 7. Histology of primary tumor; and 9. Unknown.

xx END xx

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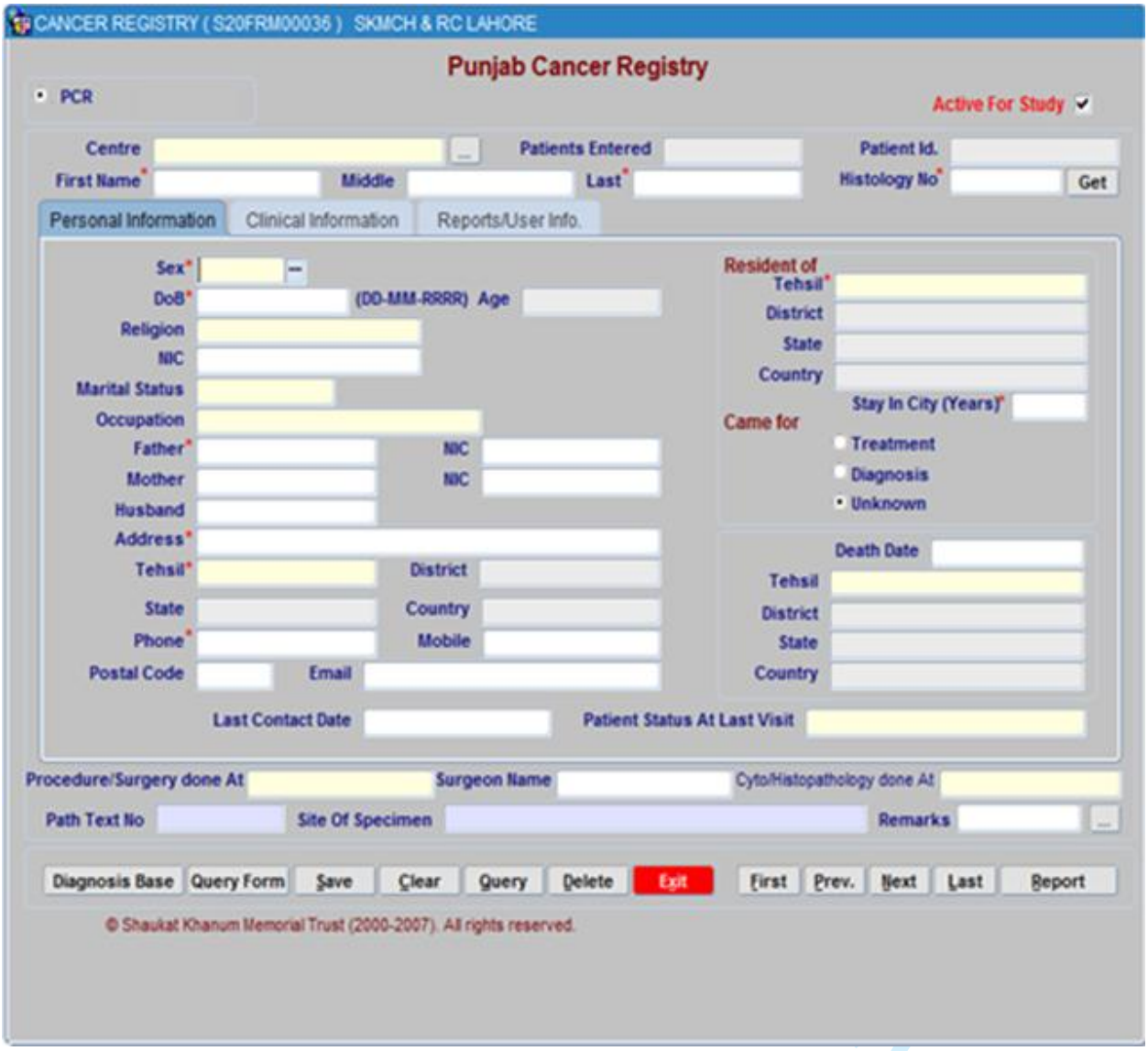
Appendix C-Screen shot of the PCR data capture form in the Hospital Information System, SKMCH & RC, Lahore, Pakistan.



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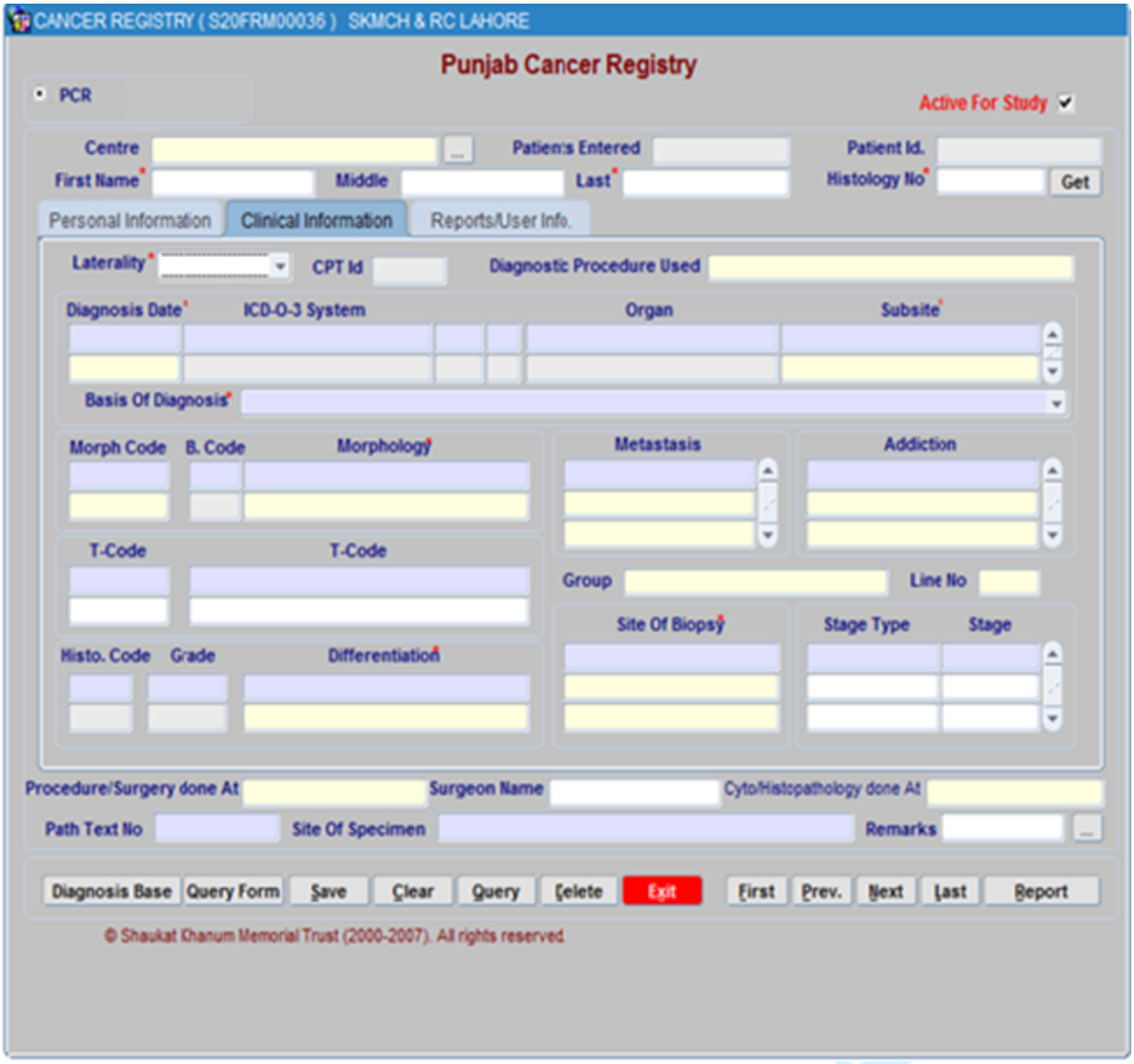
Appendix CC-Screen shot of the PCR data capture form in the Hospital Information System, SKMCH & RC, Lahore, Pakistan.



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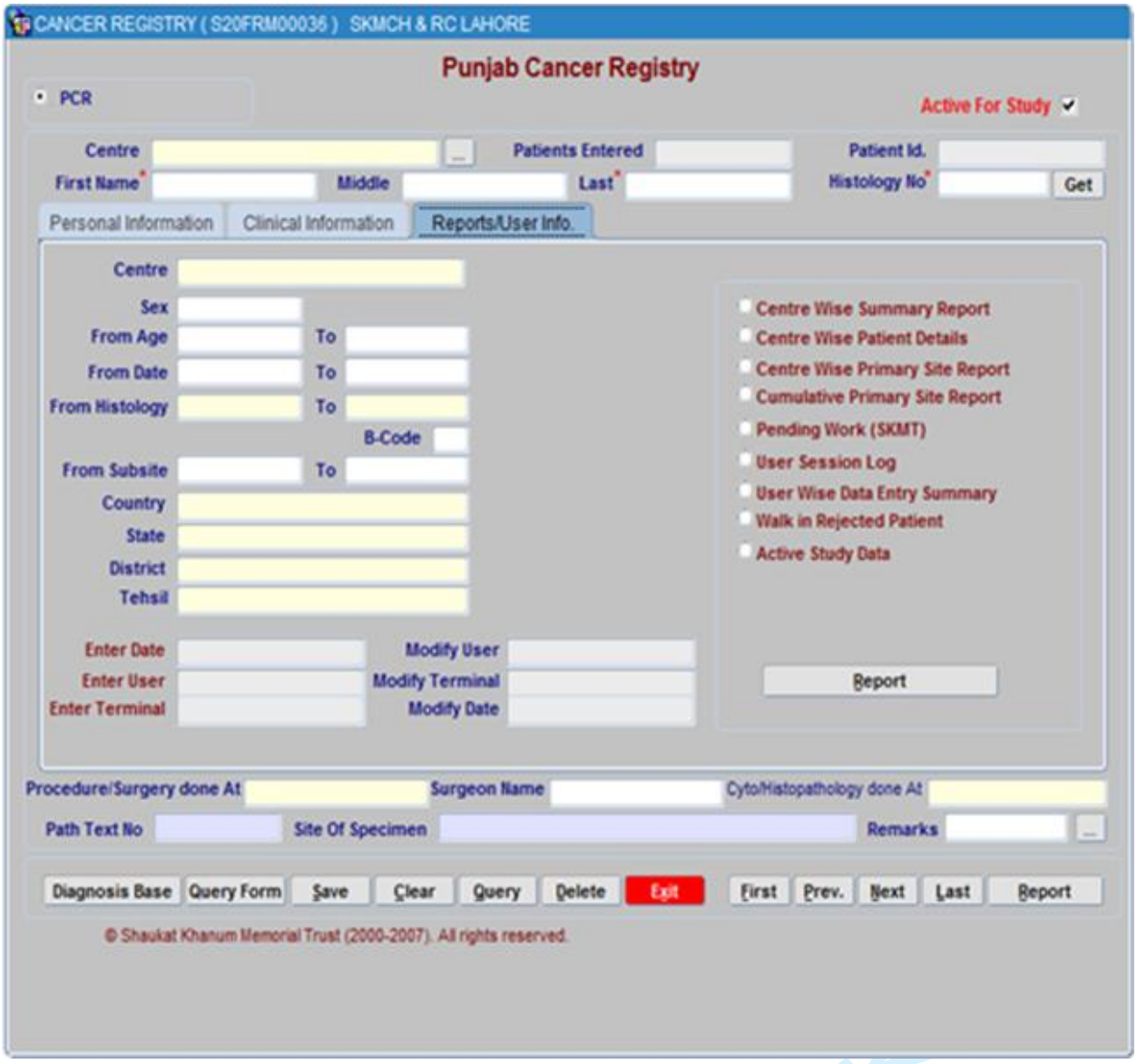
Appendix CCC-Screen shot of the PCR data capture form in the Hospital Information System, SKMCH & RC, Lahore, Pakistan.



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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract-**page 8**
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found- **page 8**
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported-page **9-11**
Objectives	3	State specific objectives, including any pre-specified hypotheses-**page 11**
Methods		
Study design	4	Present key elements of study design early in the paper-**page 11-14**
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection-**page 11-14**
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants-**pages 11-14**
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable-**pages 11-14**
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group-**pages 14-21**
Bias	9	Describe any efforts to address potential sources of bias-**page 21**
Study size	10	Explain how the study size was arrived at-**page 11-14**
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why-**page 11**
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding-**page 11-14**
		(*b*) Describe any methods used to examine subgroups and interactions-**page 11-14**
		(*c*) Explain how missing data were addressed-**page 11-14**
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy- **not applicable**
		(*e*) Describe any sensitivity analyses

Continued on next page

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Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed-**pages 11-14**
		(b) Give reasons for non-participation at each stage-**pages 11-14**
		(c) Consider use of a flow diagram-**one to indicate the health systems in Pakistan (Figure 1).**
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders-**page 11-14**
		(b) Indicate number of participants with missing data for each variable of interest-**page 11-21**
		(c) *Cohort study*—Summarise follow-up time (e.g., average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures- **pages 11-21**
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included-**pages 11-15**
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives-**pages 14-21**
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias-**pages 21-26**
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence-**pages 21-26**
Generalisability	21	Discuss the generalisability (external validity) of the study results- **pages 21-26**
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based-**pages 12 & 26**

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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