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ABSTRACT

EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, AMONG CHILDREN, ADOLESCENTS, AND ADULTS, 2010-2012: A CROSS-SECTIONAL STUDY-PART 2

Objectives

To estimate the cancer incidence by age-group for the Lahore district population within the Punjab Cancer Registry (PCR), Pakistan. The average annual population of Lahore was 9.8 million in 2010-2012. This is a sequel to a study published earlier.

Design

A cross-sectional study.

Setting

The Registry has 19 centers in Lahore reporting their data to the co-ordinating office located within the Shaukat Khanum Memorial Cancer Hospital and Research Center (SKMCH & RC), Lahore, Pakistan.

Participants

Data existing in the PCR database, based on a confirmed diagnosis of cancer from January 1, 2010 through December 31, 2012, among the Lahore residents, were reviewed.

Outcome measures

Cancer counts and the Age-Standardized Incidence Rates (ASIR) per 100,000 population were computed by gender, cancer site/type, and age-group (0-14, 15-19, and ≥ 20 years).

Results

Between 2010 and 2012, of the 15,840 new cancers diagnosed, 57% were in females. The ASIRs in age-groups 0-14, 15-19, and ≥ 20 years, among females, were: 6·1, 8·4, and 170·7, respectively, and among

males, 9·3, 12·2, and 104·5, respectively. The common diagnoses in children, adolescents, and adults were: 1) among females: leukemia 2·2; bone tumor 1·4; and breast cancer 79·2 and 2) among males: leukemia 3·6; bone tumor 2·4; and prostate cancer 10·7; respectively.

Conclusions

The ASIR was higher in adult women than in men, but it was lower in girls and young women than their corresponding male counterparts. Leukemia was the most common diagnosis in children and bone tumor in adolescents, regardless of gender. Among women, breast cancer and, in men, prostate cancer, were the leading cancer types, in adults. These estimates could be used for the expansion of health coverage in the region including setting-up low cost, diagnostic tests, for early detection of cancers.

Key words: age-group, gender, incidence rates, Lahore, malignancies, the Punjab Cancer Registry.

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 population separately for children, young adults, and adults.
- A comparison has been made with the incidence rates reported by other registries around the world, where available.
- Due to sparse data available from districts contiguous to Lahore district within Punjab, comparisons with the surrounding districts could not be made.

PAPER

EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, AMONG CHILDREN, ADOLESCENTS, AND ADULTS, 2010-2012: A CROSS-SECTIONAL STUDY-PART 2

INTRODUCTION

Pakistan is a less-developed country, categorized as a lower-middle-income country by the World Bank[1], and it is also a densely populated country with its population estimated at 195.4 million in 2016[2]. Being a heavily populated country with limited resources, certain systems, well established in the more developed countries of the world, are still in the evolving phase in our country. This includes the non-communicable disease surveillance, including cancer registration, which has long been neglected in the region. Setting-up and running a registry is a challenging task but is undoubtedly needed in developing countries of the world including Pakistan. In 2005, a population-based registry called the Punjab Cancer Registry (PCR) was set-up through the joint efforts of professionals representing different health-care facilities within the district of Lahore, in the province of Punjab, Pakistan[3]. In 2016, we published a paper on the PCR with details related to the cancers registered, over a three-year period from 2010-2012, within the Lahore district, a populous district of the 36 districts of the province of Punjab, Pakistan[4]. The aforementioned paper was the first paper to report the cancer incidence within the population of the district of Lahore. The current paper is a sequel to the paper published earlier, giving the cancer statistics for the district of Lahore, by age-category. The goal of the study is to provide the age-adjusted incidence rates for children, young adults/adolescents, and adults.

METHODS

The Punjab Cancer Registry has nineteen centers in Lahore that report their data to the collaborating office located within a charitable organization, the Shaukat Khanum Memorial Cancer Hospital and Research Center, Lahore, Pakistan. The latter is also the sponsor of the Registry. For the purpose of data collection, active and passive methods were used. By evaluating the data initially retrieved from the Punjab Cancer Registry database to conduct a retrospective review of the records for our first population-

based study on newly diagnosed malignancies in Lahore between 2010 and 2012 reported in 2016, we conducted another cross-sectional study to compute the incidence rates for three age-categories: 0-14 (children), 15-19 (adolescents), and ≥ 20 years (adults), according to gender and cancer site/type. All cancers were categorized using the International Classification of Diseases, Clinical Modification, 10th revision[5]. Further groups were created using the International Classification of Childhood Cancer definitions, based on site and morphology coded according to the third edition of the International Classification of Diseases for Oncology (ICD-O-3)[6-7]. This was done to enable comparisons with results provided by other registries of the world. A check for multiple primaries was done, according to the rules set by the International Agency for Research on Cancer (IARC)[8]. The population denominators were based on the population structure of Lahore, as provided in Table 1, and computed using the average annual growth rate of 3·46% made available by the Government of Pakistan[9]. The average annual population of Lahore was estimated at 9·8 million during these three years of study. Counts and age-standardized incidence rates were calculated for each of the three age-categories under review. The ASIRs were computed using the World Standard of Segi as the standard population, by applying the direct method of age-standardization and all the rates presented as per 100,000 population[10]. Patients were followed-up between July and October 2015, by making telephone calls to them on the numbers provided on their data collection forms. The purpose of calling them was to find their status, alive/death. However, contact could be established with sixty percent of the cases only[4]. Data were analyzed using Microsoft Excel, V.2010 and SPSS, V.19. The Institutional Review Board (IRB) of the Shaukat Khanum Memorial Cancer Hospital & Research Center granted exemption from full IRB evaluation of this study. In this manuscript, the term 'Lahore' refers to the Lahore district and the 'Registry' refers to the Punjab Cancer Registry.

Table 1. Population estimates for the Lahore district, Pakistan, by age-group and year under study, 2010-2012.

Population→	0-14 yrs.		15-19 yrs.		≥ 20 yrs.	
Year↓	F	M	F	M	F	M
2010	1,810,405	1,918,190	522,833	554,620	2,164,314	2,533,509
2011	1,873,045	1,984,559	540,923	573,810	2,239,199	2,621,168
2012	1,937,852	2,053,225	559,639	593,664	2,316,675	2,711,861
Total	5,621,302	5,955,974	1,623,396	1,722,095	6,720,188	7,866,537

RESULTS

Of a total of 15,825 patients newly diagnosed with malignancies in Lahore in three years' time from 2010 to 2012, 57.3% were male and 42.7% were female. The age distribution of the entire cohort of 15,825 patients was as follows: mean 48·6 ±18·2 years, range 0-106 years, and mode 60 years (881 patients (5·6%)). The 25th percentile was 38 years, 50th percentile was 50 years, and the 75th percentile was 61 years. Almost 93·5% were microscopically confirmed as opposed to 6·5% being non-microscopically confirmed. The total number of malignancies recorded was 15,840, with 15 patients having double primaries[4]. This accounted for the difference in the numbers of patients and malignancies documented[4]. Of the 15,840 cases, 9,069 (57·3%) were diagnosed in female and 6,771 (42·7%) in male patients. The female to male ratio among children was 0·46:1, in adolescents 0·48:1, and in adults 1·07:1. Among females, the three highest ASIRs according to age-group and sub-category of tumors, were-in children: lymphoid leukemia (1·6) and, bone, eye, and brain and other Central Nervous System (CNS) tumors (0·5 each); in adolescents: bone tumors (1·4), brain and other CNS tumors (0·9), and ovary (0·8); and in adults: cancers of the breast (79·2), ovary (7·9), corpus uteri (6·1). Among males, the highest ASIRs were-in children: lymphoid leukemia (2·7), Hodgkin lymphoma (1·1), and brain and other CNS tumors (0.8); in young adults: bone (2·4), Non-Hodgkin Lymphoma (NHL (1·3)), and brain and other CNS tumors (1.2), and in adults: cancers of the prostate (10·7), bladder (8·4) and, trachea, bronchus, and lung (7.7). The proportional distribution of pediatric embryonal tumors was: retinoblastoma 5·5%, neuroblastoma 2·7%, rhabdomyosarcoma 2·1% (0-14 years) and 5·2% (15-19 years), and nephroblastoma 2·7%. The ASIR for the entire 0-19 year was also computed and it was 6·6 for female and 9·9 for male patients. Figures 1-3 and Tables 2-3 display the ASIRs by gender, age-group, and cancer type. Within Tables 2-3, incidence rates based on fewer than 10 cases are shown in italics following IARC CI5 practice to indicate unstable incidence rates. Nearly 27·5% of the 15,825 patients were alive by the cut-off date for this study, approximately 32·4% had died, and the vital status of about 40·1% could not be determined. Of the 5,134 deaths recorded, 5·7% were recorded in children, 2·3% in young adults, and 92·1% in adults.

Table 2. Age-standardized incidence rates among females, by age-group, in the Lahore district, Pakistan, 2010-2012.

Site (Females)	Count 0-14 yrs.	ASIR 0-14 yrs.	Count 15-19 yrs.	ASIR 15-19 yrs.	Count ≥ 20 yrs.	ASIR ≥ 20 yrs.
Lip	0	0.0	0	0.0	*9*	*0.2*
Tongue	0	0.0	0	0.0	129	2.8
Mouth	0	0.0	*3*	*0.2*	127	2.6
Salivary glands	*1*	*0.0*	0	0.0	40	0.7
Tonsil	0	0.0	0	0.0	*8*	*0.2*
Nasopharynx	*1*	*0.0*	*2*	*0.1*	16	0.3
Hypopharynx	0	0.0	*1*	*0.1*	31	0.6
Pharynx	*1*	*0.0*	0	0.0	*4*	*0.1*
Esophagus	0	0.0	*1*	*0.1*	94	2.0
Stomach	0	0.0	0	0.0	105	2.1
Small intestine	0	0.0	0	0.0	17	0.4
Colon	*1*	*0.0*	*5*	*0.3*	153	3.1
Rectum	*1*	*0.0*	*4*	*0.2*	132	2.5
Anus	0	0.0	0	0.0	23	0.4
Liver	*3*	*0.1*	*1*	*0.1*	173	4.0
Gall bladder, etc.	0	0.0	*1*	*0.1*	138	3.2
Pancreas	0	0.0	*1*	*0.1*	39	0.9
Other ill-defined dig. orgs.	*1*	*0.0*	*1*	*0.1*	12	0.2
Nose, sinuses	*1*	*0.0*	*2*	*0.1*	24	0.5
Larynx	0	0.0	0	0.0	28	0.6
Trachea, bronchus, & lung	*2*	*0.0*	*3*	*0.2*	87	2.0
Other thoracic organs	0	0.0	*1*	*0.1*	15	0.3
Bone	29	0.5	22	1.4	40	0.5
Melanoma of the skin	0	0.0	0	0.0	13	0.2
Other skin	*1*	*0.0*	*2*	*0.1*	193	4.4
Connective & soft tissue	19	0.3	*9*	*0.6*	80	1.4
Breast	*3*	*0.0*	*2*	*0.1*	4077	79.2
Vulva	*1*	*0.0*	0	0.0	18	0.4
Vagina	0	0.0	0	0.0	16	0.3
Cervix uteri	0	0.0	0	0.0	247	4.8
Corpus uteri	0	0.0	0	0.0	267	6.1
Uterus, unspecified	0	0.0	0	0.0	89	1.9
Ovary	12	0.2	13	0.8	417	7.9
Other female genital organ	0	0.0	0	0.0	18	0.4
Placenta	0	0.0	0	0.0	*7*	*0.1*
Kidney	15	0.3	0	0.0	87	1.7
Renal pelvis	0	0.0	0	0.0	*1*	*0.0*
Ureter	0	0.0	0	0.0	*1*	*0.0*
Bladder	*1*	*0.0*	*1*	*0.1*	107	2.4
Eye	23	0.5	0	0.0	17	0.4
Brain, nervous system	32	0.5	14	0.9	181	3.3
Thyroid	*2*	*0.0*	*3*	*0.2*	210	3.5
Adrenal	*2*	*0.0*	0	0.0	*2*	*0.0*
Hodgkin lymphoma	16	0.3	*7*	*0.4*	57	0.9
Non-Hodgkin lymphoma	18	0.3	*8*	*0.5*	251	5.3
Multiple myeloma	0	0.0	0	0.0	36	0.8
Lymphoid leukemia	89	1.6	*5*	*0.3*	18	0.3
Myeloid leukemia	13	0.2	*4*	*0.2*	45	0.7
Other leukemias	*1*	*0.0*	0	0.0	*1*	*0.0*
Leukemia, unspecified	21	0.4	*5*	*0.3*	14	0.2
Other & unspecified	17	0.3	*3*	*0.2*	516	10.8
Benign CNS	12	0.2	12	0.7	164	2.8
All sites	339 (3.7%)	6.1	136 (1.5%)	8.4	8594 (94.7%)	170.7

Table 3. Age-standardized incidence rates among males, by age-group, in the Lahore district, Pakistan, 2010-2012.

Site (Males)	Count 0-14 yrs.	ASIR 0-14 yrs.	Count 15-19 yrs.	ASIR 15-19 yrs.	Count ≥ 20 yrs.	ASIR ≥ 20 yrs.
Lip	0	0.0	0	0.0	13	0.2
Tongue	0	0.0	0	0.0	180	3.0
Mouth	*2*	*0.0*	0	0.0	210	3.6
Salivary glands	*2*	*0.0*	*1*	*0.1*	47	0.8
Tonsil	0	0.0	0	0.0	*8*	*0.1*
Other oropharynx	0	0.0	0	0.0	*6*	*0.1*
Nasopharynx	0	0.0	*2*	*0.1*	17	0.3
Hypopharynx	0	0.0	0	0.0	21	0.4
Pharynx	0	0.0	0	0.0	*5*	*0.1*
Esophagus	0	0.0	*1*	*0.1*	126	2.3
Stomach	*1*	*0.0*	0	0.0	161	2.7
Small intestine	0	0.0	0	0.0	26	0.4
Colon	*1*	*0.0*	*7*	*0.4*	222	3.9
Rectum	0	0.0	*7*	*0.4*	179	3.0
Anus	0	0.0	*2*	*0.1*	39	0.6
Liver	*1*	*0.0*	*1*	*0.1*	326	6.1
Gall bladder, etc.	0	0.0	*1*	*0.1*	92	1.7
Pancreas	0	0.0	0	0.0	57	1.1
Other ill-defined dig. orgs.	0	0.0	0	0.0	16	0.3
Nose, sinuses	*1*	*0.0*	*2*	*0.1*	29	0.5
Larynx	0	0.0	0	0.0	183	3.4
Trachea, bronchus, & lung	0	0.0	0	0.0	396	7.7
Other thoracic organs	*2*	*0.0*	*1*	*0.1*	23	0.4
Bone	38	0.6	42	2.4	63	0.9
Melanoma of the skin	*1*	*0.0*	*1*	*0.1*	11	0.2
Other skin	*8*	*0.1*	*4*	*0.2*	259	4.6
Connective & soft tissue	21	0.4	15	0.9	108	1.6
Breast	0	0.0	*1*	*0.1*	69	1.3
Penis	0	0.0	0	0.0	*1*	*0.0*
Prostate	0	0.0	0	0.0	526	10.7
Testis	*4*	*0.1*	*9*	*0.5*	77	0.9
Other male genital organs	*1*	*0.0*	0	0.0	*4*	*0.1*
Kidney	17	0.3	*2*	*0.1*	153	2.7
Renal pelvis	0	0.0	0	0.0	*1*	*0.0*
Ureter	0	0.0	0	0.0	*1*	*0.0*
Bladder	*1*	*0.0*	0	0.0	440	8.4
Other urinary organs	0	0.0	0	0.0	*2*	*0.0*
Eye	27	0.5	*2*	*0.1*	28	0.5
Brain, nervous system	48	0.8	20	1.2	390	5.8
Thyroid	*1*	*0.0*	*3*	*0.2*	77	1.2
Adrenal	*1*	*0.0*	*1*	*0.1*	*5*	*0.1*
Hodgkin lymphoma	66	1.1	17	1.0	119	1.7
Non-Hodgkin lymphoma	58	0.9	23	1.3	412	6.8
Multiple myeloma	*1*	*0.0*	0	0.0	52	0.9
Lymphoid leukemia	156	2.7	12	0.7	39	0.6
Myeloid leukemia	21	0.3	*7*	*0.4*	79	1.1
Other leukemias	0	0.0	0	0.0	*6*	*0.1*
Leukemia, unspecified	34	0.6	*3*	*0.2*	23	0.3
Other & unspecified	21	0.3	15	0.9	525	9.2
Benign CNS	19	0.3	*8*	*0.5*	155	2.1
All sites	554 (8.1%)	9.3 -	210 (3.1%)	12.2 -	6007 (88.7%)	104.5 -

DISCUSSION

In our study, the ASIR was higher in adult women than in men, but it was lower in girls and young women than their corresponding male counterparts. Leukemia was the most common diagnosis in children and bone tumor in young adults, regardless of gender. Among women, breast cancer and, in men, prostate cancer, were the leading cancer types, in adults. Further, more than 90% of the cancers were recorded in adults again reinforcing the fact that cancer is primarily a disease of the older people; over 50% of the cases were diagnosed in patients 50 years of age and above. This scenario is different from what has been observed in the United Kingdom (UK), where more than half of all cancer cases each year were diagnosed in people aged 70 and over, in 2011-2013[11]. Moreover, in our study, cancers in children accounted for about 5·6% of the cases but in the UK, these accounted for less than 1% of all new cancer cases each year, 2011-2013[11]. Both in the UK and our study, leukemia was the most commonly diagnosed cancer in children, while leukemia, lymphoma, brain and other CNS tumors together accounted for more than two-thirds of all cancers diagnosed in children[11]. In the UK, cancer in teenagers and young adults accounted for less than 1% of all new cancer cases but in our study, cancer in children and adolescents accounted for 7·8% of all diagnoses, higher than what has been reported in the UK[11]. A study recently published from Bangladesh has shown that, during 2011-2014, among children, leukemias, retinoblastoma, and malignant bone tumors were the most commonly diagnosed cancers, whereas, in adolescents, malignant bone tumors, germ cell and gonadal tumors, and epithelial tumors, were the three most common cancer types[12]. However, the ASIRs reported in the aforesaid study from Bangladesh are low as compared to our study; these are, per 100,000 population, 0·78 versus 15·4, respectively, for the 0-14 year age-group and 0·21 versus 20·6 respectively, for the 15-19 year age-group, for all sites combined. Another study reporting the findings from different regions of India has shown that, in New Delhi, the ASIR for females was 7·6 and for males 14·6, per 100,000 population, in the 0-14 year age-group during 1978-2002[13]. These figures are somewhat different from what has been reported in our study, which is 6·1 for girls and 9·3 for boys. The ASIRs per 100,000 for New Delhi and Lahore for leukemia among girls were 2·26 and 2·2, respectively, and among boys 5·11 and 3·6,

respectively; these are more similar than different from one another. In New Delhi, following leukemia, high ASIRs were recorded for brain and other CNS tumors (1·09) and kidney tumors (0·64), among girls, whereas, among boys, high ASIRs were recorded for lymphomas (2·5) and brain and other CNS tumors (1·5). The reports from Bangladesh and New Delhi provide the incidence rates per million population. However, in order to make comparisons with our study, these have been presented as per 100,000 population.

Further comparison of the incidence rates obtained in our study has been made with those provided by two other studies conducted in Lahore and with one conducted in the Karachi South district, which was part of the Karachi Cancer Registry (KCR). The studies conducted in Lahore, two in number, were based on cancer incidence in children and adolescents registered at the Shaukat Khanum Memorial Cancer Hospital and Research Center, Lahore[14-15]. The last report on Karachi South published in the Cancer Incidence in Five Continents (CI5), Volume IX, was based on the 1998-2002 data provided by Dr. Yasmin Bhurgri (late) to the Agency[16]. The average annual population of Karachi South was fewer than half a million. The age-specific rates and the population structure reported in CI5, Volume IX, for Karachi South have been used by the PCR Staff to compute the ASIRs for the Karachi South district according to three age-groups under consideration and the top ranking cancers as reported in Lahore, to enable a comparison between these two regions of Pakistan. Table 4 shows the details related to the cancers with highest ranking ASIRs seen in Lahore along with corresponding ASIRs obtained from four other studies, including India, where available. The comparison shows that the ASIRs in children were more similar than different from one another except for brain and other CNS tumors and Hodgkin lymphoma, which were relatively high in Karachi South. The incidence of pediatric brain tumors appeared to be comparatively low in Lahore; perhaps not everyone could afford an MRI/CT and some of these kids died before a diagnosis was made or, the cases were under-reported. Among adolescents, again, the incidence rates were comparable with aforementioned studies, except for ovarian cancer and NHL having higher ASIRs in Karachi South than in Lahore. A recent report on childhood cancers released by the International Agency for Research on Cancer, has shown almost the same results for the 2008-2012 time-period for Lahore district as part of the Punjab Cancer Registry, as for the three-year time-period on which our study is

based[17]. In Table 5, further comparison with the incidence rates reported by the American Cancer Society in two different studies shows the rates to be more similar than different from one another except for brain and other CNS tumors, which were noticeably low in our study; for Hodgkin lymphoma, the rate was high in our study in children but low in young adults; and for bone tumor, the rate was substantially high in our study compared to that reported in the ACS studies[18-19]. Table 5 shows the details related to the Bangladesh study, the ACS studies (two in number), and our own study.

Among adult patients, as shown in Table 4, all the ASIRs reported for Karachi South were higher than for Lahore, except for brain and other CNS tumors. In adults, breast cancer in females and prostate cancer in males had the highest ASIRs in Lahore. In Karachi South, the ASIR for breast cancer was higher (114·9) than that recorded in Lahore (79·2). In Lahore, the ASIR for prostate cancer was 10·7 and for bladder cancer it was 8·4, among men, compared to 16·8 and 15·4, respectively, in Karachi South. Further, in Karachi South, the highest ASIRs, after breast cancer in women, were recorded for tobacco-related cancers, i.e., those of the trachea, bronchus, and lung (41·9) and lip and oral cavity (37·2), in men. The ASIR for cancers of the lip and oral cavity were also high (33·7) among women in Karachi South. The point to be noted is that in our previous publication on cancers in the Lahore district, the ASIR for breast cancer in females, for all age-groups combined[4], was reported to be 47·6 while in the current study, stratification by age-group has shown the ASIR to be 79·2 among adult women. Our literature review did not find any separate results for the broad ≥ 20 year category by the ACS or the Surveillance, Epidemiology, and End Results Program. Nevertheless, regardless of age, based on the reports available, the commonly diagnosed malignancies in women in America were tumors of the breast (ASIR 123·1), lung and bronchus (ASIR 54·1), and colon and rectum (ASIR 36·6), and in men, cancers of the prostate (ASIR 131·5), lung and bronchus (ASIR 76·7), and colon and rectum (ASIR 48·3). As these cancers are mostly diagnosed among adults, we made a comparison of the rates reported in the aforesaid study to our study, and gauged that the rates shown for the population of the United States were very high in 1975-2012[20]. Although comparisons have been made with the incidence rates reported in other regions of the world, the use of different standard populations, as the Segi World Standard Population in our study and the US 2000 Standard Population by the ACS, indicates a limitation

of our report. Further, the availability of results from the abovementioned studies for different time-periods is also suggestive of a limitation of our review. Due to sparse data available from the districts adjoining Lahore district, a comparison could not be made with other districts of the Punjab Cancer Registry.

Table 4. ASIRs per 100,000 population, as reported in two other studies conducted in Pakistan and another in India.

		PAKISTAN								INDIA	
		PCR 2010-2012: Lahore district		Badar et al. 2015: SKMCH&RC, Lahore		Badar et al. 2008: SKMCH&RC, Lahore		KCR 1998-2002: Karachi South district		1978-2002: New Delhi	
Age-group	Cancer type/site	F	M	F	M	F	M	F	M	F	M
0-14 yrs.	Lymphoid leukemia	1.6	2.7	1.5	2	0.5	0.7	1.4	3.0	1.5	3.8
	Brain, nervous system	0.5	0.8	1	1	0.3	0.7	1.3	1.5	1.1	1.5
	Bone	0.5	0.6	0.4	0.4	0.3	0.4	0.7	0.6	0.6	0.8
	Eye	0.5	0.5	0.4	0.6	0.2	0.3	0.3	0.4	0.4	0.4
	Leukemia, unspecified	0.4	0.6	0.3	0.5	0.1	0.3	0.2	0.1	0.4	0.4
	Connective & soft tissue	0.3	0.4	0.2	0.3	0.2	0.4	0.3	0.4	0.5	0.7
	Non-Hodgkin lymphoma	0.3	0.9	0.4	0.7	0.3	0.9	0.8	1.2	0.4	1.1
	Hodgkin lymphoma	0.3	1.1	0.2	0.9	0.2	0.4	0.5	1.4	0.1	1.1
	Kidney	0.3	0.3	0.1	0.5	0.3	0.3	0.3	0.5	0.6	0.7
	Myeloid leukemia	0.2	0.3	0	0.1	0.1	0	0.2	0.9	0.4	0.1
15-19 yrs.	Bone	1.4	2.4	1	2	-	-	3.3	2.4	-	-
	Brain, nervous system	0.9	1.2	1.7	1.9	-	-	1.6	2.2	-	-
	Ovary	0.8	-	0.2	-	-	-	1.9	-	-	-
	Connective & soft tissue	0.6	0.9	1	1.3	-	-	0.5	1.8	-	-
	Colon, rectum, & anus	0.5	0.9	-	-	-	-	1.2	1.2	-	-
	Non-Hodgkin lymphoma	0.5	1.3	0.7	1.3	-	-	2.1	4.2	-	-
	Hodgkin lymphoma	0.4	1	1.2	1.3	-	-	0.5	0.8	-	-
	Lymphoid leukemia	0.3	0.9	0.3	0.2	-	-	0.7	2	-	-
	Leukemia, unspecified	0.3	0.2	0.3	0.3	-	-	0.9	0.8	-	-
	Myeloid leukemia	0.2	0.4	0.2	0	-	-	2.6	2.2	-	-
	Testis	-	0.7	-	0.6	-	-	-	1	-	-
	Skin	0.1	0.3	0	0	-	-	-	0.4	-	-
≥ 20 yrs.	Breast	79.2	1.3	-	-	-	-	114.9	1.6	-	-
	Ovary	7.9	-	-	-	-	-	14.1	-	-	-
	Lip & oral cavity	6.3	7.6	-	-	-	-	33.7	37.2	-	-
	Corpus uteri	6.1	-	-	-	-	-	11.1	-	-	-
	Colon, rectum, & anus	6	7.5	-	-	-	-	7.8	10.6	-	-
	Non-Hodgkin lymphoma	5.3	6.8	-	-	-	-	7.7	11.4	-	-
	Cervix uteri	4.8	-	-	-	-	-	12.5	-	-	-
	Other skin	4.4	4.8	-	-	-	-	6.9	7.1	-	-
	Liver	4	6.1	-	-	-	-	6.1	8.9	-	-
	Thyroid	3.5	1.2	-	-	-	-	4.7	1.1	-	-
	Prostate	-	10.7	-	-	-	-	-	16.8	-	-
	Bladder	2.4	8.4	-	-	-	-	4.4	15.4	-	-
	Trachea, bronchus, & lung	2.0	7.7	-	-	-	-	5.9	41.9	-	-
	Brain, nervous system	3.3	5.8	-	-	-	-	3.5	4.3	-	-
	Larynx	0.6	3.4	-	-	-		3.0	17.9	-	-

Table 5. Comparison of the Lahore district ASIRs per 100,000 population with those reported for Bangladesh, and the United States, as compiled by the American Cancer Society, in children and adolescents.

	0-14 yrs.				15-19 yrs.			
Source/Region→	Lahore	Bangladesh	ACS	ACS	Lahore	Bangladesh	ACS	ACS
Year→	2010-2012*	2011-2014	2007-2011†	2008-2012‡	2010-2012*	2011-2014	2007-2011†	2008-2012‡
Cancer type/site↓	ASIR	ASIR	ASIR	ASIR	ASIR	ASIR	ASIR	ASIR
All ICCC groups	15.4	0.7	17.5	16.2	20.6	0.2	24.3	22.4
Leukemia	5.8	0.1	5.3	5.3	2.1	<0.1	3.2	3.3
Brain, nervous system	1.3	<0.1	4.6	3.5	2.1	<0.1	4.8	2.2
Hodgkin lymphoma	1.4	-	0.6	0.6	1.4	-	3.2	3.2
Rhabdomyosarcoma	0.4	-	0.5	0.5	0.5	-	0.4	0.4
Bone tumor∞	1.1	<0.1	0.7	0.6	3.8	<0.1	1.4	1.2
Non-Hodgkin lymphoma	1.2	-	1.0	0.9	1.8	-	1.7	1.7
Neuroblastoma	0.3	<0.1	1.1	1.1	-	-	<0.1	<0.1
Gonadal GCT	0.3	<0.1	0.3	-	1.3	<0.1	2.2	-
Nephroblastoma	0.6	<0.1	0.8	0.8	-	<0.1	<0.1	<0.1
Retinoblastoma	1.0	0.2	-	0.4	<0.1	<0.1	-	-

.*Does not include benign brain tumors. †Includes benign brain tumors. ‡Excludes benign and borderline brain tumors. ∞Bone tumor includes Ewing sarcoma and osteosarcoma.

CONCLUSIONS

In a resource-constrained country like Pakistan, having continued, sustainable reporting and registration of any disease, is a challenge. There are, however, significant gains if an accurate and sustainable registry is available for diseases with a significant burden on society. Overall, childhood malignancies are often curable if diagnosed and treated in a timely and appropriate manner, and an accurate estimate of their incidence can help health planners in accurate allocation of resources to treat these.

The Punjab Cancer Registry and the reports on cancer estimates for Lahore will perhaps bring this neglected disease to the attention of policy-makers and guide them about the allocation of health-care resources to where they are most needed incorporating specialist training, infrastructure availability, development of prevention and low cost, early detection programs and, research into putative risk factors implicated in the etiology of the disease. These reports could also motivate and facilitate other

professionals to set-up registries in their respective regions and promote cancer registration in the country, thereby enabling comparisons of incidence rates with adjacent districts.

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. SM did the case-finding, indexing, and coding of cases, computed the incidence rates, and created figures and tables.

Funding

None for this study.

Competing interests

We declare no competing interests.

Data sharing statement

No additional data available.

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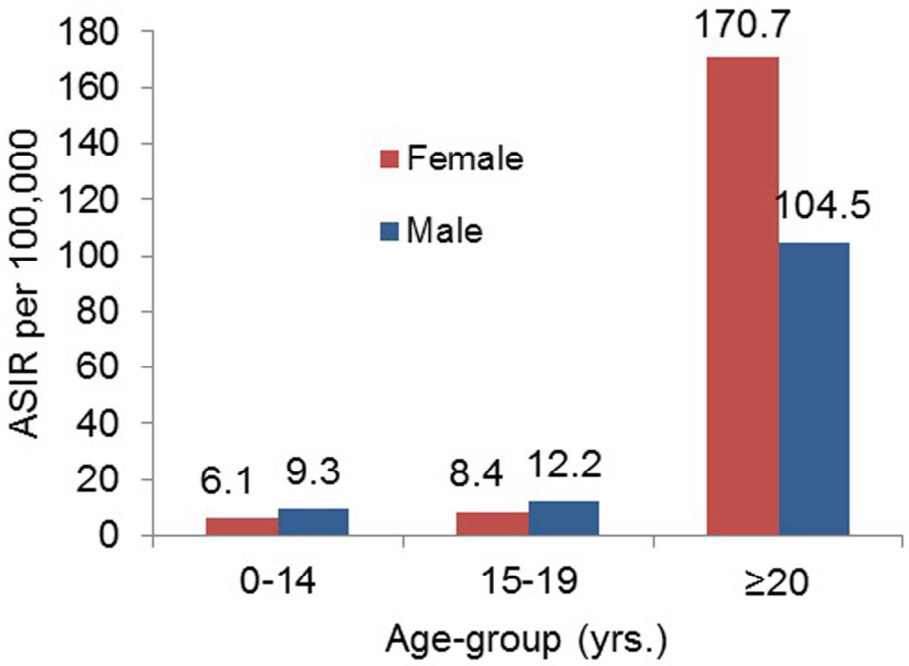

Figure 1. Age-standardized incidence rates by age-group and gender, in the Lahore district, Pakistan, 2010-2012.

142x105mm (300 x 300 DPI)

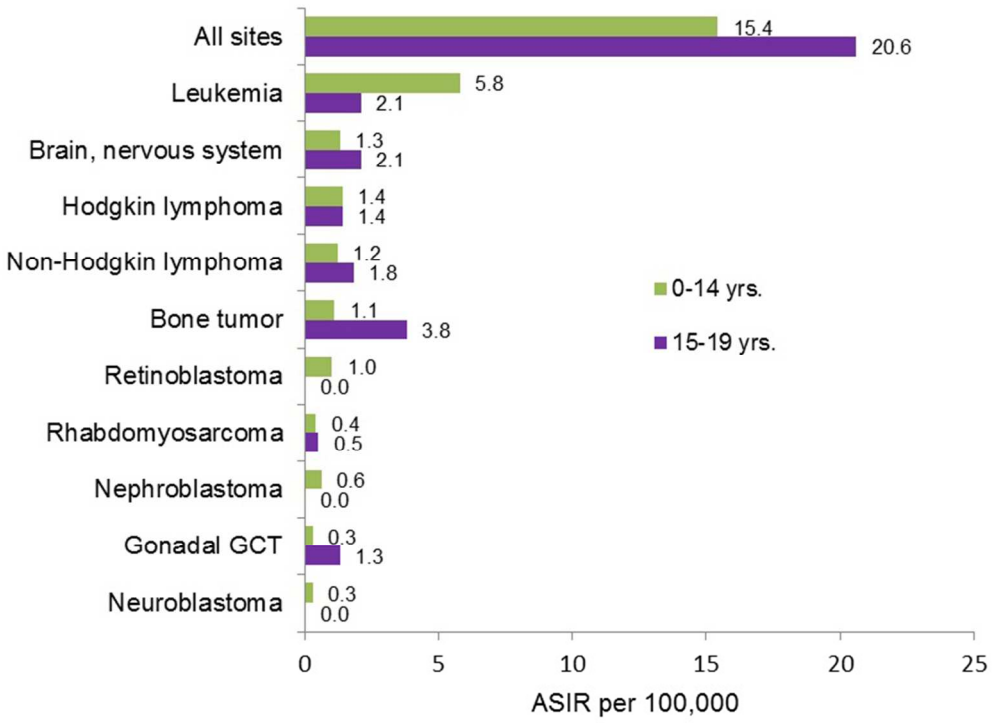

Figure 2. Age-standardized incidence rates in children and adolescents, in the Lahore district, Pakistan, 2010-2012.

68x52mm (300 x 300 DPI)

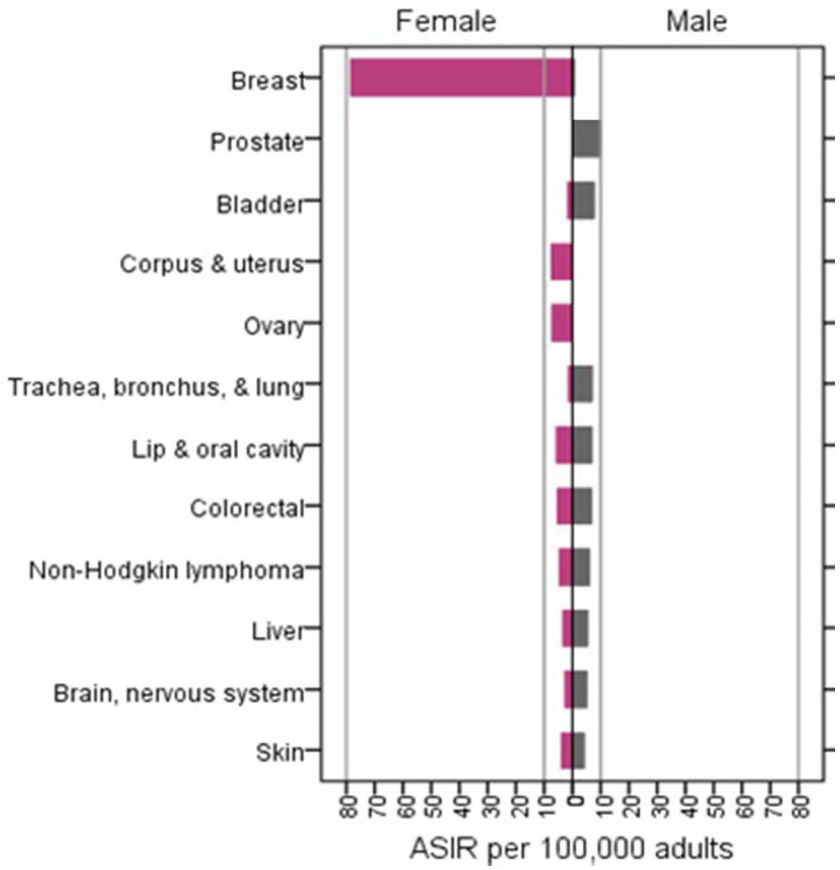

Figure 3. Age-standardized incidence rates by gender among adults, in the Lahore district, Pakistan, 2010-2012.

34x36mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5-6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-6
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	5-6
Bias	9	Describe any efforts to address potential sources of bias	5-6
Study size	10	Explain how the study size was arrived at	5-6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5-6
		(*b*) Describe any methods used to examine subgroups and interactions	5-6
		(*c*) Explain how missing data were addressed	5-6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	5-6
		(*e*) Describe any sensitivity analyses	-
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	5-7
		(b) Give reasons for non-participation at each stage	5-6
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-9
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	7-9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-9
		(*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—e.g. analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	3 and 10-14
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	3 and 12-13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	12-14
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	5 & 15

*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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EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, AMONG CHILDREN, ADOLESCENTS, AND ADULTS, 2010-2012: A CROSS-SECTIONAL STUDY-PART 2

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EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, AMONG CHILDREN, ADOLESCENTS, AND ADULTS, 2010-2012: A CROSS-SECTIONAL STUDY-PART 2

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ABSTRACT

EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, AMONG CHILDREN, ADOLESCENTS, AND ADULTS, 2010-2012: A CROSS-SECTIONAL STUDY-PART 2

Objectives

To estimate the cancer incidence by age-group for the Lahore district population within the Punjab Cancer Registry (PCR), Pakistan. The average annual population of Lahore was 9·8 million in 2010-2012. This is a sequel to a study published earlier.

Design

A cross-sectional study.

Setting

The Registry has 19 centers in Lahore reporting their data to the co-ordinating office located within the Shaukat Khanum Memorial Cancer Hospital and Research Center (SKMCH & RC), Lahore, Pakistan.

Participants

Data existing in the PCR database, based on a confirmed diagnosis of cancer from January 1, 2010 through December 31, 2012, among the Lahore residents, were reviewed.

Outcome measures

Cancer counts and the Age-Standardized Incidence Rates (ASIR) per 100,000 population were computed by gender, cancer site/type, and age-group (0-14, 15-19, and ≥ 20 years).

Results

Between 2010 and 2012, of the 15,840 new cancers diagnosed, 57% were in females. The ASIRs in age-groups 0-14, 15-19, and ≥ 20 years, among females, were: 6·1, 8·4, and 170·7, respectively, and among

males, 9·3, 12·2, and 104·5, respectively. The commonly diagnoses in children, adolescents, and adults were: 1) among females: leukemia 2·2; bone tumor 1·4; and breast cancer 79·2, respectively and 2) among males: leukemia 3·6; bone tumor 2·4; and prostate cancer 10·7, respectively.

Conclusions

The ASIR was higher in adult women than in men, but it was lower in girls and young women than their corresponding male counterparts. Leukemia was the most common diagnosis in children and bone tumor in adolescents, regardless of gender. Among women, breast cancer and, in men, prostate cancer, were the leading cancer types, in adults. These estimates could be used for the expansion of health coverage in the region including setting-up low cost, diagnostic tests, for early detection of cancers.

Key words: age-group, gender, incidence rates, Lahore, malignancies, the Punjab Cancer Registry.

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 population separately for children, young adults, and adults.
- A comparison has been made with the incidence rates reported by other registries around the world, where available.
- Due to sparse data available from districts contiguous to Lahore district within Punjab, comparisons with the surrounding districts could not be made.

PAPER

EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, AMONG CHILDREN, ADOLESCENTS, AND ADULTS, 2010-2012: A CROSS-SECTIONAL STUDY-PART 2

INTRODUCTION

Pakistan is a less-developed country, categorized as a lower-middle-income country, by the World Bank and,[1] it is also a densely populated country with its population estimated at 195·4 million in 2016.[2] Being a heavily populated country with limited resources, certain systems, well established in the more developed countries of the world, are still in the evolving phase in our country. This includes the non-communicable disease surveillance, including cancer registration, which has long been neglected in the region. Setting-up and running a registry is a challenging task but is undoubtedly needed in developing countries of the world including Pakistan. In 2005, a population-based registry called the Punjab Cancer Registry (PCR) was set-up through the joint efforts of professionals representing different health-care facilities within the district of Lahore, in the province of Punjab, Pakistan.[3] In 2016, we published a paper on the PCR with details related to the cancers registered, over a three-year period from 2010-2012, within the Lahore district, a populous district of the 36 districts of the province of Punjab, Pakistan.[4] The aforementioned paper was the first paper to report the cancer incidence within the population of the district of Lahore. The current paper is a sequel to the paper published earlier, giving the cancer statistics for the district of Lahore, by age-category. The goal of the study is to provide the age-adjusted incidence rates for children, young adults/adolescents, and adults.

METHODS

The Punjab Cancer Registry has nineteen centers in Lahore that report their data to the collaborating office located within a charitable organization, the Shaukat Khanum Memorial Cancer Hospital and Research Center, Lahore, Pakistan. For the purpose of data collection, active and passive methods were used. Active method involved a review by the Registry staff of the outpatient and inpatient medical records of the patients and abstraction of data onto special forms. Records included pathology reports

and clinical notes from outpatient clinics and indoor patient departments representing medical and radiation oncology, radiology, and surgery. However, passive notifications were carried out by health-care workers/front desk staff other than the Registry staff and reported to the Registry staff.

Evaluating the data initially retrieved from the Punjab Cancer Registry database to conduct a retrospective review of the records for our first population-based study on newly diagnosed malignancies in Lahore between 2010 and 2012, we conducted another study to compute the incidence rates for three age-categories: 0-14 (children), 15-19 (adolescents), and ≥ 20 years (adults), according to gender and cancer site/type. All cancers were categorized using the International Classification of Diseases, Clinical Modification, 10th revision.[5] Further groups were created using the International Classification of Childhood Cancer definitions, based on site and morphology coded according to the third edition of the International Classification of Diseases for Oncology (ICD-O-3).[6,7] This was done to enable comparisons with results provided by other registries of the world. A check for multiple primaries was done, according to the rules set by the International Agency for Research on Cancer (IARC).[8] The population denominators were based on the population structure of Lahore, as provided in Table 1, and computed using the average annual growth rate of 3·46% made available by the Government of Pakistan.[9] The average annual population of Lahore was estimated at 9·8 million during these three years of study. Counts and age-standardized incidence rates were calculated for each of the three age-categories under review and subsequently for 5-year age-groups within the adult category. The ASIRs were computed using the World Standard of Segi as the standard population, by applying the direct method of age-standardization and all the rates presented as per 100,000 population.[10] Patients were followed-up between July and October 2015, by making telephone calls to them on the numbers provided on their data collection forms. The purpose of calling them was to find their status, alive/death. However, contact could be established with sixty percent of the cases only.[4] As for the rest, they either did not answer or their SIMS were blocked and if anyone did answer, they said they did not know the concerned person/patient. Data were analyzed using Microsoft Excel, V.2010 and SPSS, V.19. The Institutional Review Board (IRB) of the Shaukat Khanum Memorial Cancer Hospital & Research Center granted

exemption from full IRB evaluation of this study. In this manuscript, the term 'Lahore' refers to the Lahore district and the 'Registry' refers to the Punjab Cancer Registry.

RESULTS

Of a total of 15,825 patients newly diagnosed with malignancies in Lahore in three years' time from 2010 to 2012, 57·3% were female and 42·7% were male. The age distribution of the entire cohort of 15,825 patients was as follows: mean 48·6 ±18·2 years, range 0-106 years, and mode 60 years (881 patients (5·6%)). The 25th percentile was 38 years, 50th percentile was 50 years, and the 75th percentile was 61 years. Almost 93·5% were microscopically confirmed as opposed to 6·5% being non-microscopically confirmed. The total number of malignancies recorded was 15,840, with 15 patients having double primaries.[4] This accounted for the difference in the numbers of patients and malignancies documented.[4] Of the 15,840 cases, 9,069 (57·3%) were diagnosed in female and 6,771 (42·7%) in male patients. The female to male ratio among children was 0·46:1, in adolescents 0·48:1, and in adults 1·07:1. Among females, the three highest ASIRs according to age-group and sub-category of tumors, were-in children: lymphoid leukemia (1·6) and, bone, eye, and brain and other Central Nervous System (CNS) tumors (0·5 each); in adolescents: bone tumors (1·4), brain and other CNS tumors (0·9), and ovary (0·8); and in adults: cancers of the breast (79·2), ovary (7·9), corpus uteri (6·1). Among males, the highest ASIRs were-in children: lymphoid leukemia (2·7), Hodgkin lymphoma (1·1), and brain and other CNS tumors (0·8); in young adults: bone (2·4), Non-Hodgkin Lymphoma (NHL (1·3)), and brain and other CNS tumors (1·2), and in adults: cancers of the prostate (10·7), bladder (8·4) and, trachea, bronchus, and lung (7·7). The proportional distribution of pediatric embryonal tumors was: retinoblastoma 5·5%, neuroblastoma 2·7%, rhabdomyosarcoma 2·1% (0-14 years) and 5·2% (15-19 years), and nephroblastoma 2·7%. The ASIR for the entire 0-19 year was also computed and it was 6·6 for female and 9·9 for male patients. Figures 1-3 and Tables 2-3 display the ASIRs by gender, age-group, and cancer type. Within Tables 2-3, incidence rates based on fewer than 10 cases are shown in italics following IARC CI5 practice to indicate unstable incidence rates. Nearly 27·5% of the 15,825 patients were alive by the cut-off date for this study,

approximately 32·4% had died, and the vital status of about 40·1% could not be determined. Of the 5,134 deaths recorded, 5·7% were reported in children, 2·3% in young adults, and 92·1% in adults.

DISCUSSION

In our study, the ASIR was higher in adult women than in men, but it was lower in girls and young women than their corresponding male counterparts. Leukemia was the most common diagnosis in children and bone tumor in young adults, regardless of gender. Among women, breast cancer and, in men, prostate cancer, were the leading cancer types, in adults. Further, more than 90% of the cancers were recorded in adults again reinforcing the fact that cancer is primarily a disease of the older people; over 50% of the cases were diagnosed in patients 50 years of age and above. This scenario is different from what has been observed in the United Kingdom (UK), where more than half of all cancer cases each year were diagnosed in people aged 70 and over, in 2011-2013.[11] Moreover, in our study, cancers in children accounted for about 5·6% of the cases but in the UK, these accounted for less than 1% of all new cancer cases each year, 2011-2013.[11] Both in the UK and our study, leukemia was the most commonly diagnosed cancer in children, while leukemia, lymphoma, brain and other CNS tumors together accounted for more than two-thirds of all cancers diagnosed in children.[11] In the UK, cancer in teenagers and young adults accounted for less than 1% of all new cancer cases but in our study, cancer in children and adolescents accounted for 7·8% of all diagnoses, higher than what has been reported in the UK.[11] This may be attributed to the difference in the characteristics of the UK population from that of the Lahore population. The UK has an ageing population and a comparison of the population distributions for the UK to the Lahore district population has been made: for ages 0-15 years, 19% versus 40%; for ages 16-64 years, 64% versus 57%, and for ages 65 years and more, 18% versus 3%, respectively.[12] A study recently published from Bangladesh has shown that, during 2011-2014, among children, leukemias, retinoblastoma, and malignant bone tumors were the most commonly diagnosed cancers, whereas, in adolescents, malignant bone tumors, germ cell and gonadal tumors, and epithelial tumors, were the three most common cancer types.[13] However, the ASIRs reported in the aforesaid study from Bangladesh are low as compared to our study; these are, per 100,000 population, 0·78 versus 15·4, respectively, for the

0-14 year age-group and 0·21 versus 20·6 respectively, for the 15-19 year age-group, for all sites combined. Another study reporting the findings from different regions of India has shown that, in New Delhi, the ASIR for females was 7·6 and for males 14·6, per 100,000 population, in the 0-14 year age-group during 1978-2002.[14] These figures are somewhat different from what has been reported in our study, which is 6·1 for girls and 9·3 for boys. The ASIRs per 100,000 for New Delhi and Lahore for leukemia among girls were 2·26 and 2·2, respectively, and among boys 5·11 and 3·6, respectively; these are more similar than different from one another. In New Delhi, following leukemia, high ASIRs were recorded for brain and other CNS tumors (1·09) and kidney tumors (0·64), among girls, whereas, among boys, high ASIRs were recorded for lymphomas (2·5) and brain and other CNS tumors (1·5). The reports from Bangladesh and New Delhi provide the incidence rates per million population. However, in order to make comparisons with our study, these have been presented as per 100,000 population.

Further comparison of the incidence rates obtained in our study has been made with those provided by two other studies conducted in Lahore and with one conducted in the Karachi South district, which was part of the Karachi Cancer Registry (KCR). The studies conducted in Lahore, two in number, were based on cancer incidence in children and adolescents registered at the Shaukat Khanum Memorial Cancer Hospital and Research Center, Lahore.[15,16] The last report on Karachi South published in the Cancer Incidence in Five Continents (CI5), Volume IX, was based on the 1998-2002 data provided by Dr. Yasmin Bhurgri (late) to the Agency.[17] The average annual population of Karachi South was less than half a million. The age-specific rates and the population structure reported in CI5, Volume IX, for Karachi South have been used by the PCR Staff to compute the ASIRs for the Karachi South district according to three age-groups under consideration and the top ranking cancers as reported in Lahore, to enable a comparison between these two regions of Pakistan. Table 4 shows the details related to the cancers with highest ranking ASIRs seen in Lahore along with corresponding ASIRs obtained from four other studies, including India, where available. The comparison shows that the ASIRs in children were more similar than different from one another except for brain and other CNS tumors and Hodgkin lymphoma, which were relatively high in Karachi South. The incidence of pediatric brain tumors appeared to be comparatively low in Lahore; perhaps not everyone could afford an MRI/CT and some of these kids died before a diagnosis

was made or, the cases were under-reported. Among adolescents, again, the incidence rates were comparable with aforementioned studies, except for ovarian cancer and NHL having higher ASIRs in Karachi South than in Lahore. A recent report on childhood cancers released by the International Agency for Research on Cancer, has shown almost the same results for the 2008-2012 time-period for Lahore district as part of the Punjab Cancer Registry, as for the three-year time-period on which our study is based.[18] In Table 5, further comparison with the incidence rates reported by the American Cancer Society in two different studies shows the rates to be more similar than different from one another except for brain and other CNS tumors, which were noticeably low in our study; for Hodgkin lymphoma, the rate was high in our study in children but low in young adults; and for bone tumor, the rate was substantially high in our study compared to that reported in the ACS studies.[19,20] Table 5 shows the details related to the Bangladesh study, the ACS studies (two in number), and our own study. Tables 6 and 7 show the counts and age-specific rates by 5-year age-group for adult females and males, respectively.

Among adult patients, as shown in Table 4, all the ASIRs reported for Karachi South were higher than for Lahore, except for brain and other CNS tumors. In adults, breast cancer in females and prostate cancer in males had the highest ASIRs in Lahore. In Karachi South, the ASIR for breast cancer was higher (114·9) than that recorded in Lahore (79·2). In Lahore, the ASIR for prostate cancer was 10·7 and for bladder cancer it was 8·4, among men, compared to 16·8 and 15·4, respectively, in Karachi South. Further, in Karachi South, the highest ASIRs, after breast cancer in women, were recorded for tobacco-related cancers, i.e., those of the trachea, bronchus, and lung (41·9) and lip and oral cavity (37·2), in men. The ASIR for cancers of the lip and oral cavity were also high (33·7) among women in Karachi South. The point to be noted is that in our previous publication on cancers in the Lahore district, the ASIR for breast cancer in females, for all age-groups combined, [4] was reported to be 47·6 while in the current study, stratification by age-group has shown the ASIR to be 79·2 among adult women. The relatively high ASIR for breast cancer is intriguing as no definite risk factors have been identified so far. An epidemiologic, retrospective study of breast cancer at a cancer treatment facility in Lahore has shown that most women were parous, had breast-fed their babies, had not used any oral contraceptives or hormone replacement therapy, and there was no noteworthy difference in the pre- and post- menopausal status. A family history

of cancer was present in less than one-fifths of the patients.[21] Further, these females had a relatively low mean presenting age (48 years), age at menarche was 13·2 years, age at first childbirth was 23·7 years, and the BMI was on the higher side.[21] The vast majority of cancers appeared to be sporadic in nature while a lower age at menarche and a higher BMI appeared to be striking.[21.] Although the findings of various studies including case-control studies have not been consistent with one another, it has been demonstrated that factors as young age at menarche, single marital status, nulliparity, late first full term pregnancy, use of oral contraceptives, late menopause, high BMI, and a family history of breast cancer could be associated with an increased risk, whereas, young age at first live birth, increasing parity, and Vitamin D supplementation could be associated with a decreased risk of this disease in our population. Large-scale, population-based studies are needed to validate demographic, clinical, and lifestyle risk factors related to pathways of this disease including the abovementioned factors.[22-26]

Our literature review did not find any separate results for the broad ≥ 20 year category by the ACS or the Surveillance, Epidemiology, and End Results Program. However, stratification of the data for Lahore for adults by 5-year age-group and further comparisons of the age-specific incidence rates of the commonly diagnosed cancers with what has been reported by IARC and the SEER Program have revealed that, in general, the incidence rates for Lahore were somewhat different from those of New Delhi and Mumbai but markedly different from what has been reported by the SEER Program, with the latter showing very high incidence rates for almost all cancer types.[27,28] Compared to the Indian data from two aforementioned registries, it has been demonstrated that in males, among the residents of Lahore , the incidence rates for prostate cancer were relatively high in the 50 to 69 year age-group while the incidence rates reported for the Indians were higher for cancers of the bronchus and lung, oral cavity, colorectum, and NHL. Among females, in Lahore, the incidence rates for cancers of the breast and corpus uteri were higher than those reported for the Indians for all age-groups, except 75+, while the incidence rates for cancers of the oral cavity, colorectum, ovary, and cervix uteri were lower than those for the Indians studied. The time-periods available or used for making comparisons were 2003-2007 for New Delhi and Mumbai and 2010-2014 for the SEER Program.[27,28] Finally, a comparison with the age-specific rates for the Karachi South district of Pakistan showed that for the time-period 1998-2002, in both male and female patients , the KCR rates

were significantly high for the commonly diagnosed cancers including prostate, breast, colorectum, lip & oral cavity, cervix uteri, and corpus uteri versus those reported for Lahore.[17] The differences, although intriguing, have not been fully explored to enable us to comment on them. Extensive population-based studies on risk factors could highlight some of the reasons associated with the differences observed. Although comparisons have been made with the incidence rates reported in other regions of the world, the use of different standard populations, as the Segi World Standard Population in our study and the US 2000 Standard Population by the ACS, indicates a limitation of our report. Further, the availability of results from the abovementioned studies for different time-periods is also suggestive of a limitation of our review.

CONCLUSIONS

In a resource-constrained country like Pakistan, having continued, sustainable reporting and registration of any disease, is a challenge. There are, however, significant gains if an accurate and sustainable registry is available for diseases with a significant burden on society. Overall, childhood malignancies are often curable if diagnosed and treated in a timely and appropriate manner, and an accurate estimate of their incidence can help health planners in accurate allocation of resources to treat these.

The Punjab Cancer Registry and the reports on cancer estimates for Lahore will perhaps bring this neglected disease to the attention of policy-makers and guide them about the allocation of health-care resources to where they are most needed incorporating specialist training, infrastructure availability, development of prevention and low cost, early detection programs and, research into putative risk factors implicated in the etiology of the disease. These reports could also motivate and facilitate other professionals to set-up registries in their respective regions and promote cancer registration in the country, thereby enabling comparisons of incidence rates with adjacent districts.

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. SM did the case-finding, indexing, and coding of cases, computed the incidence rates, and created figures and tables.

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Competing interests

We declare no competing interests.

Data sharing statement

No additional data available.

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Figure 1. Age-standardized incidence rates by age-group and gender, in the Lahore district, Pakistan, 2010-2012.

Figure 2. Age-standardized incidence rates in children and adolescents, in the Lahore district, Pakistan, 2010-2012.

Figure 3. Age-standardized incidence rates by gender among adults, in the Lahore district, Pakistan, 2010-2012.

Table 1. Population estimates for the district of Lahore by gender and age-group, 2010-2012.

Year →	2010		2011		2012		Total	
Age-group (yrs.)	Female	Male	Female	Male	Female	Male	Female	Male
0-4	585,856	608,924	606,126	629,992	627,098	651,790	1,819,080	1,890,706
5-9	621,343	661,178	642,841	684,055	665,083	707,723	1,929,267	2,052,956
10-14	603,207	648,088	624,077	670,512	645,671	693,712	1,872,955	2,012,312
15-19	522,833	554,620	540,923	573,810	559,639	593,664	1,623,396	1,722,095
20-24	446,315	495,261	461,757	512,397	477,734	530,125	1,385,807	1,537,783
25-29	352,415	401,889	364,609	415,794	377,225	430,181	1,094,249	1,247,864
30-34	299,024	347,491	309,370	359,514	320,074	371,954	928,468	1,078,959
35-39	242,033	285,887	250,407	295,779	259,071	306,013	751,511	887,679
40-44	208,009	250,761	215,206	259,437	222,652	268,414	645,868	778,612
45-49	161,556	186,385	167,146	192,834	172,929	199,506	501,630	578,725
50-54	144,596	174,903	149,599	180,955	154,775	187,216	448,970	543,073
55-59	91,861	115,698	95,040	119,701	98,328	123,843	285,229	359,242
60-64	82,959	102,349	85,829	105,891	88,799	109,554	257,587	317,794
65-69	50,387	62,312	52,130	64,468	53,934	66,699	156,450	193,480
70-74	40,733	54,305	42,143	56,184	43,601	58,128	126,477	168,616
75+	44,426	56,267	45,963	58,214	47,553	60,229	137,942	174,710
All ages	4,497,552	5,006,319	4,653,167	5,179,538	4,814,167	5,358,750	13,964,885	15,544,606

Table 2. Age-standardized incidence rates among females, by age-group, in the Lahore district, Pakistan, 2010-2012.

Site (Females)	Count 0-14 yrs.	ASIR 0-14 yrs.	Count 15-19 yrs.	ASIR 15-19 yrs.	Count ≥ 20 yrs.	ASIR ≥ 20 yrs.
Lip	0	0.0	0	0.0	*9*	*0.2*
Tongue	0	0.0	0	0.0	129	2.8
Mouth	0	0.0	*3*	*0.2*	127	2.6
Salivary glands	*1*	*0.0*	0	0.0	40	0.7
Tonsil	0	0.0	0	0.0	*8*	*0.2*
Nasopharynx	*1*	*0.0*	*2*	*0.1*	16	0.3
Hypopharynx	0	0.0	*1*	*0.1*	31	0.6
Pharynx	*1*	*0.0*	0	0.0	*4*	*0.1*
Esophagus	0	0.0	*1*	*0.1*	94	2.0
Stomach	0	0.0	0	0.0	105	2.1
Small intestine	0	0.0	0	0.0	17	0.4
Colon	*1*	*0.0*	*5*	*0.3*	153	3.1
Rectum	*1*	*0.0*	*4*	*0.2*	132	2.5
Anus	0	0.0	0	0.0	23	0.4
Liver	*3*	*0.1*	*1*	*0.1*	173	4.0
Gall bladder, etc.	0	0.0	*1*	*0.1*	138	3.2
Pancreas	0	0.0	*1*	*0.1*	39	0.9
Other ill-defined dig. orgs.	*1*	*0.0*	*1*	*0.1*	12	0.2
Nose, sinuses	*1*	*0.0*	*2*	*0.1*	24	0.5
Larynx	0	0.0	0	0.0	28	0.6
Trachea, bronchus, & lung	*2*	*0.0*	*3*	*0.2*	87	2.0
Other thoracic organs	0	0.0	*1*	*0.1*	15	0.3
Bone	29	0.5	22	1.4	40	0.5
Melanoma of the skin	0	0.0	0	0.0	13	0.2
Other skin	*1*	*0.0*	*2*	*0.1*	193	4.4
Connective & soft tissue	19	0.3	*9*	*0.6*	80	1.4
Breast	*3*	*0.0*	*2*	*0.1*	4077	79.2
Vulva	*1*	*0.0*	0	0.0	18	0.4
Vagina	0	0.0	0	0.0	16	0.3
Cervix uteri	0	0.0	0	0.0	247	4.8
Corpus uteri	0	0.0	0	0.0	267	6.1
Uterus, unspecified	0	0.0	0	0.0	89	1.9
Ovary	12	0.2	13	0.8	417	7.9
Other female genital organ	0	0.0	0	0.0	18	0.4
Placenta	0	0.0	0	0.0	*7*	*0.1*
Kidney	15	0.3	0	0.0	87	1.7
Renal pelvis	0	0.0	0	0.0	*1*	*0.0*
Ureter	0	0.0	0	0.0	*1*	*0.0*
Bladder	*1*	*0.0*	*1*	*0.1*	107	2.4
Eye	23	0.5	0	0.0	17	0.4
Brain, nervous system	32	0.5	14	0.9	181	3.3
Thyroid	*2*	*0.0*	*3*	*0.2*	210	3.5
Adrenal	*2*	*0.0*	0	0.0	*2*	*0.0*
Hodgkin lymphoma	16	0.3	*7*	*0.4*	57	0.9
Non-Hodgkin lymphoma	18	0.3	*8*	*0.5*	251	5.3
Multiple myeloma	0	0.0	0	0.0	36	0.8
Lymphoid leukemia	89	1.6	*5*	*0.3*	18	0.3
Myeloid leukemia	13	0.2	*4*	*0.2*	45	0.7
Other leukemias	*1*	*0.0*	0	0.0	*1*	*0.0*
Leukemia, unspecified	21	0.4	*5*	*0.3*	14	0.2
Other & unspecified	17	0.3	*3*	*0.2*	516	10.8
Benign CNS	12	0.2	12	0.7	164	2.8
All sites	339 (3.7%)	6.1	136 (1.5%)	8.4	8594 (94.7%)	170.7

Table 3. Age-standardized incidence rates among males, by age-group, in the Lahore district, Pakistan, 2010-2012.

Site (Males)	Count 0-14 yrs.	ASIR 0-14 yrs.	Count 15-19 yrs.	ASIR 15-19 yrs.	Count ≥ 20 yrs.	ASIR ≥ 20 yrs.
Lip	0	0.0	0	0.0	13	0.2
Tongue	0	0.0	0	0.0	180	3.0
Mouth	*2*	*0.0*	0	0.0	210	3.6
Salivary glands	*2*	*0.0*	*1*	*0.1*	47	0.8
Tonsil	0	0.0	0	0.0	*8*	*0.1*
Other oropharynx	0	0.0	0	0.0	*6*	*0.1*
Nasopharynx	0	0.0	*2*	*0.1*	17	0.3
Hypopharynx	0	0.0	0	0.0	21	0.4
Pharynx	0	0.0	0	0.0	*5*	*0.1*
Esophagus	0	0.0	*1*	*0.1*	126	2.3
Stomach	*1*	*0.0*	0	0.0	161	2.7
Small intestine	0	0.0	0	0.0	26	0.4
Colon	*1*	*0.0*	*7*	*0.4*	222	3.9
Rectum	0	0.0	*7*	*0.4*	179	3.0
Anus	0	0.0	*2*	*0.1*	39	0.6
Liver	*1*	*0.0*	*1*	*0.1*	326	6.1
Gall bladder, etc.	0	0.0	*1*	*0.1*	92	1.7
Pancreas	0	0.0	0	0.0	57	1.1
Other ill-defined dig. orgs.	0	0.0	0	0.0	16	0.3
Nose, sinuses	*1*	*0.0*	*2*	*0.1*	29	0.5
Larynx	0	0.0	0	0.0	183	3.4
Trachea, bronchus, & lung	0	0.0	0	0.0	396	7.7
Other thoracic organs	*2*	*0.0*	*1*	*0.1*	23	0.4
Bone	38	0.6	42	2.4	63	0.9
Melanoma of the skin	*1*	*0.0*	*1*	*0.1*	11	0.2
Other skin	*8*	*0.1*	*4*	*0.2*	259	4.6
Connective & soft tissue	21	0.4	15	0.9	108	1.6
Breast	0	0.0	*1*	*0.1*	69	1.3
Penis	0	0.0	0	0.0	*1*	*0.0*
Prostate	0	0.0	0	0.0	526	10.7
Testis	*4*	*0.1*	*9*	*0.5*	77	0.9
Other male genital organs	*1*	*0.0*	0	0.0	*4*	*0.1*
Kidney	17	0.3	*2*	*0.1*	153	2.7
Renal pelvis	0	0.0	0	0.0	*1*	*0.0*
Ureter	0	0.0	0	0.0	*1*	*0.0*
Bladder	*1*	*0.0*	0	0.0	440	8.4
Other urinary organs	0	0.0	0	0.0	*2*	*0.0*
Eye	27	0.5	*2*	*0.1*	28	0.5
Brain, nervous system	48	0.8	20	1.2	390	5.8
Thyroid	*1*	*0.0*	*3*	*0.2*	77	1.2
Adrenal	*1*	*0.0*	*1*	*0.1*	*5*	*0.1*
Hodgkin lymphoma	66	1.1	17	1.0	119	1.7
Non-Hodgkin lymphoma	58	0.9	23	1.3	412	6.8
Multiple myeloma	*1*	*0.0*	0	0.0	52	0.9
Lymphoid leukemia	156	2.7	12	0.7	39	0.6
Myeloid leukemia	21	0.3	*7*	*0.4*	79	1.1
Other leukemias	0	0.0	0	0.0	*6*	*0.1*
Leukemia, unspecified	34	0.6	*3*	*0.2*	23	0.3
Other & unspecified	21	0.3	15	0.9	525	9.2
Benign CNS	19	0.3	*8*	*0.5*	155	2.1
All sites	554 (8.1%)	9.3 -	210 (3.1%)	12.2 -	6007 (88.7%)	104.5 -

Table 4. ASIRs per 100,000 population, as reported in other studies conducted in Pakistan and in New Delhi, India.

		PAKISTAN								INDIA	
		PCR 2010-2012: Lahore district		Badar et al. 2015: SKMCH&RC, Lahore		Badar et al. 2008: SKMCH&RC, Lahore		KCR 1998-2002: Karachi South district		1978-2002: New Delhi	
Age-group	Cancer type/site	F	M	F	M	F	M	F	M	F	M
0-14 yrs.	Lymphoid leukemia	1.6	2.7	1.5	2	0.5	0.7	1.4	3.0	1.5	3.4
	Brain, nervous system	0.5	0.8	1	1	0.3	0.7	1.3	1.5	1.1	1.5
	Bone	0.5	0.6	0.4	0.4	0.3	0.4	0.7	0.6	0.6	0.8
	Eye	0.5	0.5	0.4	0.6	0.2	0.3	0.3	0.4	0.4	0.8
	Leukemia, unspecified	0.4	0.6	0.3	0.5	0.1	0.3	0.2	0.1	0.4	0.4
	Connective & soft tissue	0.3	0.4	0.2	0.3	0.2	0.4	0.3	0.4	0.5	0.7
	Non-Hodgkin lymphoma	0.3	0.9	0.4	0.7	0.3	0.9	0.8	1.2	0.4	1.4
	Hodgkin lymphoma	0.3	1.1	0.2	0.9	0.2	0.4	0.5	1.4	0.1	1.4
	Kidney	0.3	0.3	0.1	0.5	0.3	0.3	0.3	0.5	0.6	0.8
	Myeloid leukemia	0.2	0.3	0	0.1	0.1	0	0.2	0.9	0.4	0.7
15-19 yrs.	Bone	1.4	2.4	1	2	-	-	3.3	2.4	-	-
	Brain, nervous system	0.9	1.2	1.7	1.9	-	-	1.6	2.2	-	-
	Ovary	0.8	-	0.2	-	-	-	1.9	-	-	-
	Connective & soft tissue	0.6	0.9	1	1.3	-	-	0.5	1.8	-	-
	Colon, rectum, & anus	0.5	0.9	-	-	-	-	1.2	1.2	-	-
	Non-Hodgkin lymphoma	0.5	1.3	0.7	1.3	-	-	2.1	4.2	-	-
	Hodgkin lymphoma	0.4	1	1.2	1.3	-	-	0.5	0.8	-	-
	Lymphoid leukemia	0.3	0.9	0.3	0.2	-	-	0.7	2	-	-
	Leukemia, unspecified	0.3	0.2	0.3	0.3	-	-	0.9	0.8	-	-
	Myeloid leukemia	0.2	0.4	0.2	0	-	-	2.6	2.2	-	-
	Testis	-	0.7	-	0.6	-	-	-	1	-	-
	Skin	0.1	0.3	0	0	-	-	-	0.4	-	-
≥ 20 yrs.	Breast	79.2	1.3	-	-	-	-	114.9	1.6	-	-
	Ovary	7.9	-	-	-	-	-	14.1	-	-	-
	Lip & oral cavity	6.3	7.6	-	-	-	-	33.7	37.2	-	-
	Corpus uteri	6.1	-	-	-	-	-	11.1	-	-	-
	Colon, rectum, & anus	6	7.5	-	-	-	-	7.8	10.6	-	-
	Non-Hodgkin lymphoma	5.3	6.8	-	-	-	-	7.7	11.4	-	-
	Cervix uteri	4.8	-	-	-	-	-	12.5	-	-	-
	Other skin	4.4	4.8	-	-	-	-	6.9	7.1	-	-
	Liver	4	6.1	-	-	-	-	6.1	8.9	-	-
	Thyroid	3.5	1.2	-	-	-	-	4.7	1.1	-	-
	Prostate	-	10.7	-	-	-	-	-	16.8	-	-
	Bladder	2.4	8.4	-	-	-	-	4.4	15.4	-	-
	Trachea, bronchus, & lung	2.0	7.7	-	-	-	-	5.9	41.9	-	-
	Brain, nervous system	3.3	5.8	-	-	-	-	3.5	4.3	-	-
	Larynx	0.6	3.4	-	-	-		3.0	17.9	-	-

Table 5. Comparison of the Lahore district ASIRs per 100,000 population with those reported for Bangladesh, and the United States, as compiled by the American Cancer Society, in children and adolescents.

	0-14 yrs.				15-19 yrs.			
Source/Region→	Lahore	Bangladesh	ACS	ACS	Lahore	Bangladesh	ACS	ACS
Year→	2010-2012*	2011-2014	2007-2011†	2008-2012‡	2010-2012*	2011-2014	2007-2011†	2008-2012‡
Cancer type/site↓	ASIR	ASIR	ASIR	ASIR	ASIR	ASIR	ASIR	ASIR
All ICCC groups	15.4	0.7	17.5	16.2	20.6	0.2	24.3	22.4
Leukemia	5.8	0.1	5.3	5.3	2.1	<0.1	3.2	3.3
Brain, nervous system	1.3	<0.1	4.6	3.5	2.1	<0.1	4.8	2.2
Hodgkin lymphoma	1.4	-	0.6	0.6	1.4	-	3.2	3.2
Rhabdomyosarcoma	0.4	-	0.5	0.5	0.5	-	0.4	0.4
Bone tumor∞	1.1	<0.1	0.7	0.6	3.8	<0.1	1.4	1.2
Non-Hodgkin lymphoma	1.2	-	1.0	0.9	1.8	-	1.7	1.7
Neuroblastoma	0.3	<0.1	1.1	1.1	-	-	<0.1	<0.1
Gonadal GCT	0.3	<0.1	0.3	-	1.3	<0.1	2.2	-
Nephroblastoma	0.6	<0.1	0.8	0.8	-	<0.1	<0.1	<0.1
Retinoblastoma	1.0	0.2	-	0.4	<0.1	<0.1	-	-

.*Does not include benign brain tumors. †Includes benign brain tumors. ‡Excludes benign and borderline brain tumors. ∞Bone tumor includes Ewing sarcoma and osteosarcoma.

Table 6. Counts and age-specific incidence rates among adult females, by age-group, in the Lahore district, Pakistan, 2010-2012.

Site - Females	Count 20-	ASIR 20-	Count 25-	ASIR 25-	Count 30-	ASIR 30-	Count 35-	ASIR 35-	Count 40-	ASIR 40-	Count 45-	ASIR 45-	Count 50-	ASIR 50-	Count 55-	ASIR 55-	Count 60-	ASIR 60-	Count 65-	ASIR 65-	Count 70-	ASIR 70-	Count 75+	ASIR 75+
Lip	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	3	1.1	1	0.4	1	0.6	2	1.6	1	1.5
Tongue	2	0.1	1	0.1	2	0.2	9	1.2	9	1.4	27	5.4	21	4.7	14	4.9	17	6.6	9	5.8	11	8.7	5	7.5
Mouth	3	0.2	3	0.3	2	0.2	11	1.5	19	2.9	8	1.6	27	6.0	13	4.6	9	3.5	11	7.0	14	11.1	3	4.5
Salivary glands	2	0.1	6	0.5	2	0.2	6	0.8	3	0.5	3	0.6	5	1.1	2	0.7	7	2.7	3	1.9	1	0.8	1	1.5
Tonsil	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0	1	0.2	3	0.7	1	0.4	0	0.0	0	0.0	1	0.8	0	0.0
Nasopharynx	1	0.1	2	0.2	3	0.3	0	0.0	2	0.3	3	0.6	1	0.2	1	0.4	1	0.4	0	0.0	2	1.6	1	1.5
Hypopharynx	3	0.2	1	0.1	2	0.2	4	0.5	2	0.3	3	0.6	3	0.7	4	1.4	5	1.9	1	0.6	2	1.6	0	0.0
Pharynx	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0	0	0.0	1	0.8	0	0.0
Esophagus	0	0.0	3	0.3	3	0.3	7	0.9	12	1.9	20	4.0	8	1.8	8	2.8	15	5.8	7	4.5	6	4.7	3	4.5
Stomach	4	0.3	1	0.1	9	1.0	10	1.3	14	2.2	19	3.8	11	2.5	11	3.9	7	2.7	14	8.9	0	0.0	1	1.5
Small intestine	1	0.1	0	0.0	0	0.0	0	0.0	4	0.6	0	0.0	0	0.0	1	0.4	5	1.9	2	1.3	3	2.4	0	0.0
Colon	2	0.1	8	0.7	12	1.3	15	2.0	13	2.0	17	3.4	15	3.3	20	7.0	13	5.0	15	9.6	12	9.5	6	9.0
Rectum	13	0.9	10	0.9	13	1.4	9	1.2	11	1.7	15	3.0	14	3.1	12	4.2	13	5.0	7	4.5	8	6.3	3	4.5
Anus	2	0.1	0	0.0	3	0.3	1	0.1	6	0.9	3	0.6	1	0.2	0	0.0	2	0.8	1	0.6	3	2.4	0	0.0
Liver	2	0.1	1	0.1	2	0.2	2	0.3	9	1.4	22	4.4	28	6.2	32	11.2	31	12.0	26	16.6	11	8.7	5	7.5
Gall bladder etc.	0	0.0	0	0.0	5	0.5	3	0.4	10	1.5	13	2.6	22	4.9	19	6.7	23	8.9	22	14.1	9	7.1	3	4.5
Pancreas	0	0.0	2	0.2	1	0.1	4	0.5	2	0.3	4	0.8	4	0.9	6	2.1	2	0.8	9	5.8	3	2.4	1	1.5
Other ill-defined digestive	2	0.1	1	0.1	1	0.1	0	0.0	0	0.0	0	0.0	4	0.9	0	0.0	3	1.2	0	0.0	1	0.8	0	0.0
Nose, sinuses	0	0.0	0	0.0	1	0.1	2	0.3	0	0.0	3	0.6	3	0.7	5	1.8	6	2.3	2	1.3	1	0.8	0	0.0
Larynx	0	0.0	0	0.0	2	0.2	1	0.1	4	0.6	4	0.8	6	1.3	4	1.4	3	1.2	1	0.6	0	0.0	0	0.0
Trachea, bronchus & lung	1	0.1	1	0.1	5	0.5	3	0.4	6	0.9	7	1.4	8	1.8	13	4.6	14	5.4	13	8.3	8	6.3	5	7.5
Other thoracic organs	0	0.0	0	0.0	0	0.0	2	0.3	1	0.2	4	0.8	0	0.0	1	0.4	4	1.6	1	0.6	1	0.8	0	0.0
Bone	13	0.9	3	0.3	4	0.4	10	1.3	2	0.3	3	0.6	2	0.4	1	0.4	0	0.0	0	0.0	2	1.6	1	1.5
Melanoma of the skin	0	0.0	1	0.1	1	0.1	2	0.3	1	0.2	2	0.4	2	0.4	2	0.7	0	0.0	0	0.0	1	0.8	0	0.0
Other skin	1	0.1	3	0.3	2	0.2	10	1.3	19	2.9	11	2.2	23	5.1	18	6.3	29	11.3	26	16.6	24	19.0	6	9.0
Connective & soft tissue	9	0.6	9	0.8	7	0.8	9	1.2	11	1.7	6	1.2	8	1.8	4	1.4	4	1.6	6	3.8	3	2.4	1	1.5
Breast	46	3.3	153	14.0	299	32.2	420	55.9	557	86.2	636	126.8	585	130.3	452	158.5	397	154.1	247	157.9	158	124.9	121	199.5
Vulva	0	0.0	0	0.0	1	0.1	3	0.4	1	0.2	1	0.2	0	0.0	4	1.4	2	0.8	1	0.6	1	0.8	0	0.0
Vagina	0	0.0	2	0.2	0	0.0	1	0.1	2	0.3	4	0.8	1	0.2	2	0.7	1	0.4	0	0.0	1	0.8	0	0.0
Cervix uteri	3	0.2	4	0.4	12	1.3	29	3.9	37	5.7	47	9.4	32	7.1	30	10.5	26	10.1	13	8.3	7	5.5	2	3.0
Corpus uteri	0	0.0	2	0.2	6	0.6	11	1.5	12	1.9	30	6.0	44	9.8	47	16.5	57	22.1	25	16.0	23	18.2	7	10.5
Uterus unspecified	0	0.0	1	0.1	1	0.1	7	0.9	10	1.5	17	3.4	18	4.0	8	2.8	15	5.8	6	3.8	6	4.7	1	1.5
Ovary	22	1.6	21	1.9	28	3.0	37	4.9	51	7.9	61	12.2	60	13.4	44	15.4	50	19.4	19	12.1	14	11.1	4	6.0
Other female genital organ	0	0.0	1	0.1	0	0.0	2	0.3	3	0.5	1	0.2	1	0.2	2	0.7	6	2.3	1	0.6	1	0.8	0	0.0
Placenta	2	0.1	1	0.1	3	0.3	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Kidney	3	0.2	0	0.0	2	0.2	12	1.6	13	2.0	8	1.6	12	2.7	14	4.9	8	3.1	5	3.2	4	3.2	1	1.5
Renal pelvis	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Ureter	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	0.0	1	0.8	0	0.0
Bladder	0	0.0	1	0.1	2	0.2	8	1.1	8	1.2	8	1.6	12	2.7	14	4.9	13	5.0	14	8.9	13	10.3	4	6.0
Eye	0	0.0	0	0.0	0	0.0	0	0.0	2	0.3	2	0.4	0	0.0	0	0.0	2	0.8	7	4.5	1	0.8	0	0.0
Brain, nervous system	13	0.9	22	2.0	13	1.4	19	2.5	21	3.3	22	4.4	22	4.9	15	5.3	13	5.0	12	7.7	5	4.0	3	4.5
Thyroid	26	1.9	17	1.6	26	2.8	22	2.9	21	3.3	23	4.6	29	6.5	10	3.5	17	6.6	5	3.2	10	7.9	2	3.0
Adrenal	1	0.1	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Hodgkin disease	13	0.9	11	1.0	4	0.4	8	1.1	2	0.3	5	1.0	1	0.2	5	1.8	4	1.6	1	0.6	3	2.4	1	1.5
Non-Hodgkin lymphoma	7	0.5	9	0.8	8	0.9	15	2.0	23	3.6	29	5.8	33	7.4	35	12.3	28	10.9	22	14.1	17	13.4	2	3.0
Multiple myeloma	0	0.0	0	0.0	0	0.0	1	0.1	2	0.3	8	1.6	5	1.1	2	0.7	7	2.7	5	3.2	5	4.0	1	1.5
Lymphoid leukemia	2	0.1	2	0.2	2	0.2	0	0.0	3	0.5	1	0.2	1	0.2	2	0.7	3	1.2	1	0.6	1	0.8	0	0.0
Myeloid leukemia	7	0.5	7	0.6	6	0.6	5	0.7	3	0.5	3	0.6	5	1.1	4	1.4	2	0.8	1	0.6	2	1.6	0	0.0
Other leukemias	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Leukemia unspecified	2	0.1	3	0.3	1	0.1	1	0.1	1	0.2	1	0.2	3	0.7	0	0.0	0	0.0	1	0.6	1	0.8	0	0.0
Other & unspecified	15	1.1	20	1.8	25	2.7	35	4.7	45	7.0	63	12.6	67	14.9	71	24.9	62	24.1	53	33.9	34	26.9	24	39.8
Benign CNS	4	0.3	17	1.6	20	2.2	29	3.9	26	4.0	24	4.8	16	3.6	6	2.1	11	4.3	7	4.5	3	2.4	2	3.0
All sites	227 (2.6%)	16.4	351 (4.1%)	32.1	541 (6.3%)	58.3	787 (9.1%)	104.7	1005 (11.7%)	155.6	1193 (13.9%)	237.8	1167 (13.6%)	259.9	963 (11.2%)	337.6	938 (10.9%)	364.1	623 (7.2%)	398.2	441 (5.1%)	348.7	358 (4.1%)	2[illegible].5

Table 7. Counts and age-specific incidence rates among adult males by age-group, in the Lahore district, Pakistan, 2010-2012.

Site - Males	Count 20-	ASIR 20-	Count 25-	ASIR 25-	Count 30-	ASIR 30-	Count 35-	ASIR 35-	Count 40-	ASIR 40-	Count 45-	ASIR 45-	Count 50-	ASIR 50-	Count 55-	ASIR 55-	Count 60-	ASIR 60-	Count 65-	ASIR 65-	Count 70-	ASIR 70-	Count 75+	ASIR 75+
Lip	1	0.1	0	0.0	1	0.1	2	0.2	0	0.0	0	0.0	1	0.2	2	0.6	4	1.3	1	0.5	1	0.6	0	0.0
Tongue	4	0.3	7	0.6	6	0.6	18	2.0	27	3.5	21	3.6	24	4.4	18	5.0	23	7.2	12	6.2	16	9.5	4	2.3
Mouth	1	0.1	2	0.2	13	1.2	10	1.1	23	3.0	31	5.4	26	4.8	35	9.7	32	10.1	17	8.8	13	7.7	7	4.0
Salivary glands	2	0.1	2	0.2	3	0.3	6	0.7	5	0.6	4	0.7	4	0.7	4	1.1	6	1.9	3	1.6	5	3.0	3	1.7
Tonsil	0	0.0	1	0.1	0	0.0	1	0.1	1	0.1	0	0.0	1	0.2	1	0.3	2	0.6	1	0.5	0	0.0	0	0.0
Other oropharynx	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.3	0	0.0	2	0.6	1	0.3	0	0.0	1	0.6	0	0.0
Nasopharynx	1	0.1	0	0.0	2	0.2	1	0.1	2	0.3	2	0.3	1	0.2	3	0.8	4	1.3	1	0.5	0	0.0	0	0.0
Hypopharynx	0	0.0	1	0.1	1	0.1	1	0.1	2	0.3	0	0.0	3	0.6	1	0.3	3	0.9	2	1.0	2	1.2	5	2.9
Pharynx	0	0.0	0	0.0	0	0.0	1	0.1	1	0.1	2	0.3	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Esophagus	1	0.1	3	0.2	3	0.3	7	0.8	4	0.5	18	3.1	17	3.1	16	4.5	17	5.3	12	6.2	16	9.5	12	6.9
Stomach	1	0.1	10	0.8	10	0.9	12	1.4	17	2.2	22	3.8	18	3.3	17	4.7	14	4.4	20	10.3	14	8.3	6	3.4
Small intestine	2	0.1	0	0.0	0	0.0	3	0.3	1	0.1	3	0.5	3	0.6	3	0.8	3	0.9	1	0.5	3	1.8	4	2.3
Colon	12	0.8	8	0.6	8	0.7	13	1.5	16	2.1	28	4.8	24	4.4	21	5.8	37	11.6	28	14.5	16	9.5	11	6.3
Rectum	11	0.7	11	0.9	15	1.4	9	1.0	8	1.0	19	3.3	21	3.9	18	5.0	26	8.2	23	11.9	7	4.2	11	6.3
Anus	2	0.1	1	0.1	5	0.5	0	0.0	5	0.6	3	0.5	7	1.3	3	0.8	7	2.2	3	1.6	1	0.6	2	1.1
Liver	1	0.1	2	0.2	0	0.0	13	1.5	15	1.9	30	5.2	55	10.1	61	17.0	47	14.8	47	24.3	29	17.2	26	14.9
Gall bladder, etc.	1	0.1	1	0.1	1	0.1	3	0.3	4	0.5	3	0.5	16	2.9	13	3.6	16	5.0	14	7.2	7	4.2	13	7.4
Pancreas	1	0.1	0	0.0	1	0.1	0	0.0	6	0.8	8	1.4	7	1.3	11	3.1	4	1.3	9	4.7	8	4.7	2	1.1
Other ill-defined digestive	1	0.1	0	0.0	0	0.0	0	0.0	1	0.1	3	0.5	2	0.4	1	0.3	2	0.6	4	2.1	0	0.0	2	1.1
Nose, sinuses	3	0.2	2	0.2	0	0.0	2	0.2	1	0.1	3	0.5	3	0.6	5	1.4	3	0.9	3	1.6	4	2.4	0	0.0
Larynx	4	0.3	0	0.0	2	0.2	4	0.5	12	1.5	22	3.8	25	4.6	28	7.8	33	10.4	24	12.4	19	11.3	10	5.7
Trachea, bronchus & lung	2	0.1	1	0.1	6	0.6	17	1.9	14	1.8	33	5.7	26	4.8	47	13.1	68	21.4	62	32.0	63	37.4	57	32.6
Other thoracic organs	0	0.0	0	0.0	1	0.1	2	0.2	2	0.3	1	0.2	6	1.1	0	0.0	2	0.6	1	0.5	3	1.8	5	2.8
Bone	16	1.0	6	0.5	6	0.6	6	0.7	5	0.6	5	0.9	3	0.6	1	0.3	10	3.1	1	0.5	3	1.8	1	0.6
Melanoma of the skin	0	0.0	1	0.1	1	0.1	1	0.1	0	0.0	0	0.0	0	0.0	4	1.1	0	0.0	1	0.5	0	0.0	3	1.7
Other skin	4	0.3	11	0.9	17	1.6	18	2.0	18	2.3	16	2.8	22	4.1	31	8.6	36	11.3	32	16.5	17	10.1	37	21.2
Connective & soft tissue	13	0.8	14	1.1	8	0.7	10	1.1	4	0.5	16	2.8	6	1.1	9	2.5	9	2.8	7	3.6	7	4.2	5	2.8
Breast	1	0.1	1	0.1	0	0.0	3	0.3	7	0.9	12	2.1	8	1.5	7	1.9	6	1.9	17	8.8	4	2.4	3	1.7
Penis	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Prostate	2	0.1	1	0.1	0	0.0	0	0.0	2	0.3	6	1.0	24	4.4	47	13.1	86	27.1	89	46.0	117	69.4	152	87.0
Testis	17	1.1	15	1.2	13	1.2	10	1.1	8	1.0	4	0.7	3	0.6	1	0.3	1	0.3	3	1.6	1	0.6	1	0.6
Other male genital organs	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	1.0	1	0.6	0	0.0
Kidney	2	0.1	2	0.2	3	0.3	8	0.9	21	2.7	19	3.3	18	3.3	20	5.6	20	6.3	14	7.2	16	9.5	10	5.7
Renal pelvis	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.3	0	0.0	0	0.0	0	0.0	0	0.0
Ureter	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.3	0	0.0	0	0.0	0	0.0	0	0.0
Bladder	1	0.1	3	0.2	4	0.4	16	1.8	17	2.2	34	5.9	41	7.5	69	19.2	73	23.0	58	30.0	50	29.7	74	43.3
Other urinary organs	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6
Eye	2	0.1	1	0.1	0	0.0	1	0.1	1	0.1	4	0.7	3	0.6	1	0.3	5	1.6	4	2.1	4	2.4	2	1.1
Brain, nervous system	24	1.6	36	2.9	49	4.5	39	4.4	39	5.0	42	7.3	48	8.8	38	10.6	36	11.3	19	9.8	14	8.3	6	3.4
Thyroid	3	0.2	9	0.7	9	0.8	3	0.3	6	0.8	8	1.4	10	1.8	12	3.3	5	1.6	5	2.6	5	3.0	2	1.1
Adrenal	2	0.1	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	1	0.3	0	0.0	0	0.0	1	0.6	0	0.0
Hodgkin disease	14	0.9	18	1.4	13	1.2	12	1.4	12	1.5	9	1.6	8	1.5	12	3.3	6	1.9	8	4.1	6	3.6	1	0.6
Non-Hodgkin lymphoma	30	2.0	20	1.6	27	2.5	22	2.5	36	4.6	34	5.9	55	10.1	42	11.7	58	18.3	35	18.1	28	16.6	25	14.3
Multiple myeloma	0	0.0	0	0.0	2	0.2	2	0.2	4	0.5	7	1.2	7	1.3	9	2.5	10	3.1	3	1.6	4	2.4	4	2.3
Lymphoid leukemia	8	0.5	3	0.2	3	0.3	1	0.1	6	0.8	2	0.3	5	0.9	2	0.6	2	0.6	4	2.1	0	0.0	3	1.7
Myeloid leukemia	11	0.7	10	0.8	10	0.9	12	1.4	8	1.0	6	1.0	4	0.7	7	1.9	6	1.9	4	2.1	0	0.0	1	0.6
Other leukemias	1	0.1	1	0.1	0	0.0	0	0.0	1	0.1	0	0.0	2	0.4	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0
Leukemia unspecified	7	0.5	3	0.2	3	0.3	1	0.1	2	0.3	2	0.3	1	0.2	1	0.3	2	0.6	0	0.0	1	0.6	0	0.0
Other & unspecified	6	0.4	25	2.0	28	2.6	26	2.9	37	4.8	35	6.0	66	12.2	67	18.7	76	23.9	55	28.4	43	25.5	61	34.9
Benign CNS	12	0.8	25	2.0	21	1.9	21	2.4	16	2.1	19	3.3	18	3.3	4	1.1	10	3.1	3	1.6	5	3.0	1	0.6
All sites	228 (3.8%)	14.8	257 (4.3%)	20.6	296 (4.9%)	27.4	337 (5.6%)	38.0	418 (7.0%)	53.7	539 (9.0%)	93.1	643 (10.7%)	118.4	697 (11.6%)	194.0	811 (13.5%)	255.2	652 (10.9%)	337.0	556 (9.3%)	329.7	573 (9.5%)	328.0

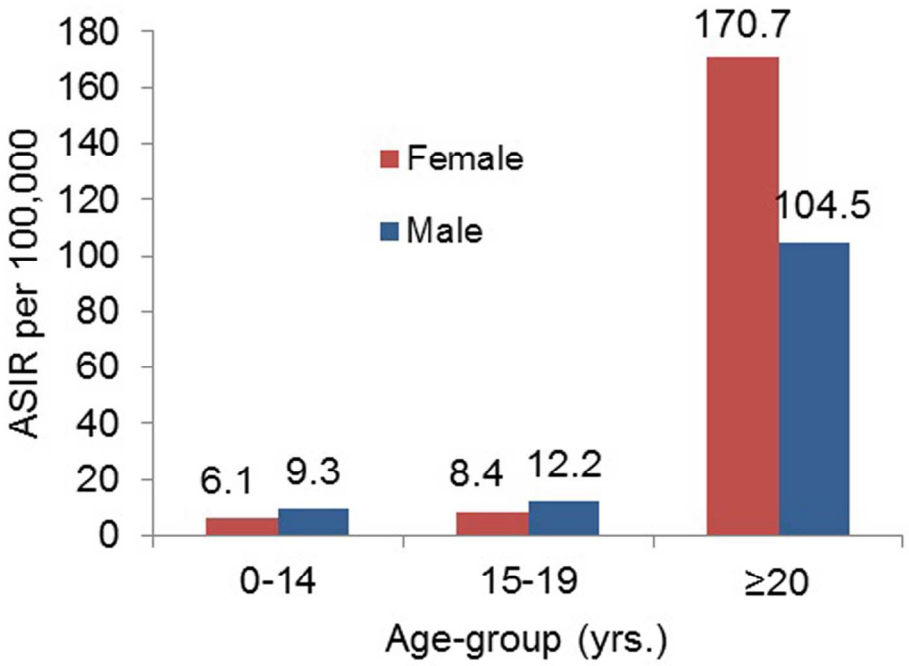

Figure 1. Age-standardized incidence rates by age-group and gender, in the Lahore district, Pakistan, 2010-2012.

142x105mm (300 x 300 DPI)

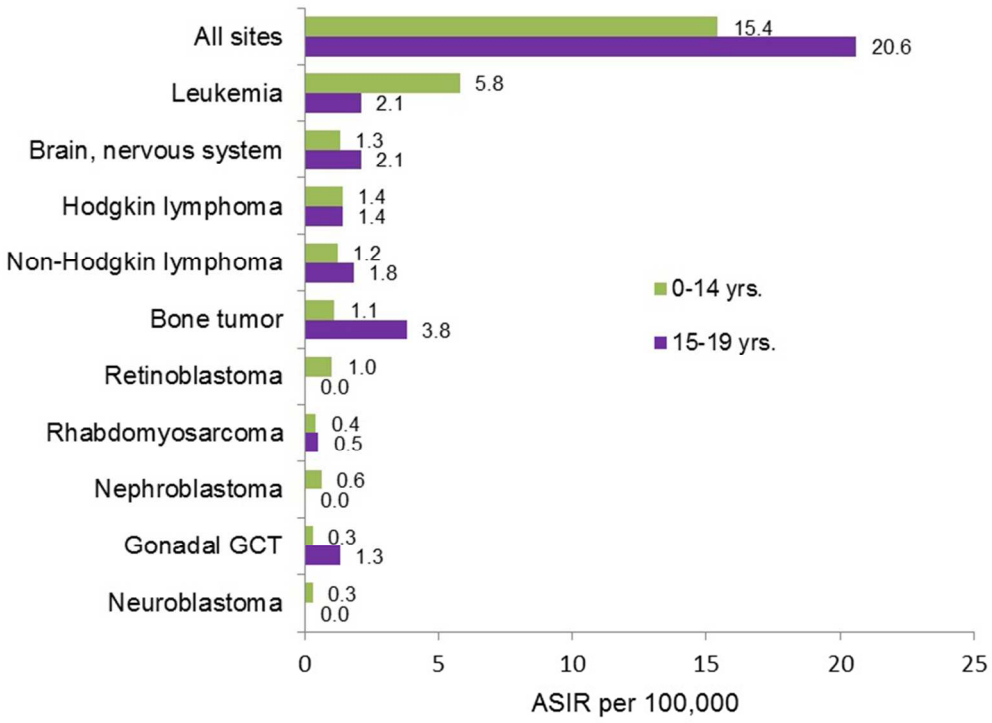

Figure 2. Age-standardized incidence rates in children and adolescents, in the Lahore district, Pakistan, 2010-2012.

68x52mm (300 x 300 DPI)

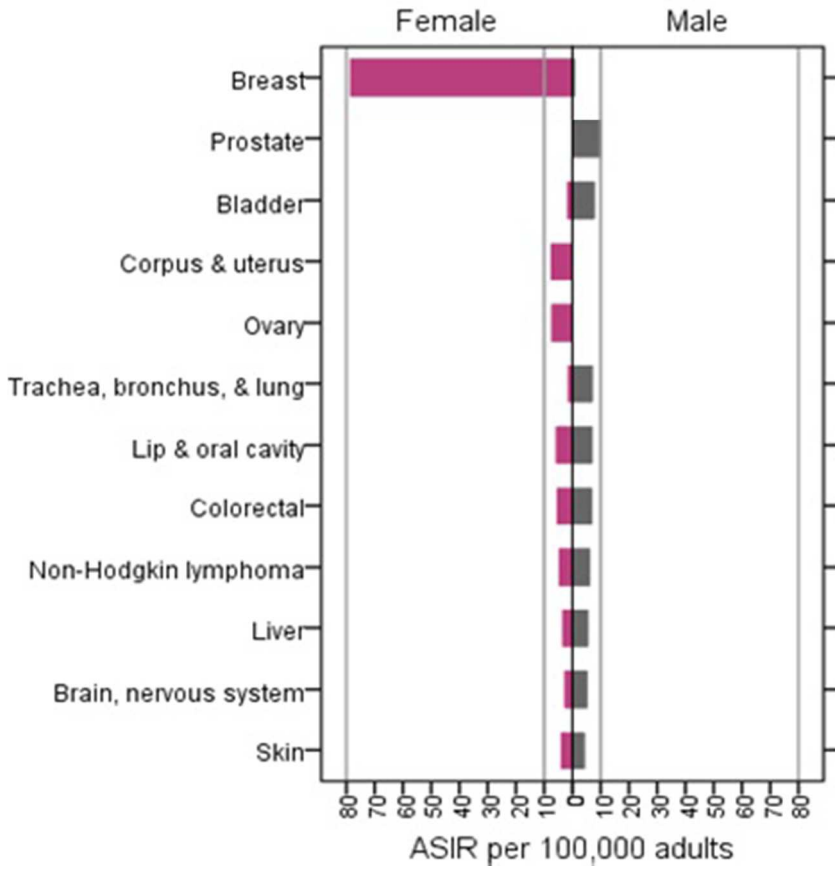

Figure 3. Age-standardized incidence rates by gender among adults, in the Lahore district, Pakistan, 2010-2012.

34x36mm (300 x 300 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5-7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-7
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	5-7
Bias	9	Describe any efforts to address potential sources of bias	5-7
Study size	10	Explain how the study size was arrived at	5-7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5-7
		(*b*) Describe any methods used to examine subgroups and interactions	5-7
		(*c*) Explain how missing data were addressed	5-7
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	5-7
		(*e*) Describe any sensitivity analyses	-
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	7-8
		(b) Give reasons for non-participation at each stage	7-8
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8 and 18-27
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	7-8 and 18-25
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-8 and 18-25
		(*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—e.g. analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	2-3 and 8-12
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	4 and 12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	8-12
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	5

*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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EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, AMONG CHILDREN, ADOLESCENTS, AND ADULTS, 2010-2012: A CROSS-SECTIONAL STUDY-PART 2

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EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, AMONG CHILDREN, ADOLESCENTS, AND ADULTS, 2010-2012: A CROSS-SECTIONAL STUDY-PART 2

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ABSTRACT

EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, AMONG CHILDREN, ADOLESCENTS, AND ADULTS, 2010-2012: A CROSS-SECTIONAL STUDY-PART 2

Objectives

To estimate the cancer incidence by age-group for the Lahore district population within the Punjab Cancer Registry (PCR), Pakistan. The average annual population of Lahore was 9·8 million in 2010-2012. This is a sequel to a study published earlier.

Design

A cross-sectional study.

Setting

The Registry has 19 centers in Lahore reporting their data to the co-ordinating office located within the Shaukat Khanum Memorial Cancer Hospital and Research Center (SKMCH & RC), Lahore, Pakistan.

Participants

Data existing in the PCR database, based on a confirmed diagnosis of cancer from January 1, 2010 through December 31, 2012, among the Lahore residents, were reviewed.

Outcome measures

Cancer counts and the Age-Standardized Incidence Rates (ASIR) per 100,000 population were computed by gender, cancer site/type, and age-group (0-14, 15-19, and ≥ 20 years).

Results

Between 2010 and 2012, of the 15,840 new cancers diagnosed, 57% were in females. The ASIRs in age-groups 0-14, 15-19, and ≥ 20 years, among females, were: 6·1, 8·4, and 170·7, respectively, and among males, 9·3, 12·2, and 104·5, respectively. The commonly diagnoses in children, adolescents, and adults were: 1) among females: leukemia 2·2; bone tumor 1·4; and breast cancer 79·2, respectively and 2) among males: leukemia 3·6; bone tumor 2·4; and prostate cancer 10·7, respectively.

Conclusions

The ASIR was higher in adult women than in men, but it was lower in girls and young women than their corresponding male counterparts. Leukemia was the most common diagnosis in children and bone tumor in adolescents, regardless of gender. Among women, breast cancer and, in men, prostate cancer, were the leading cancer types, in adults. These estimates could be used for the expansion of health coverage in the region including setting-up low cost, diagnostic tests, for early detection of cancers.

Key words: age-group, gender, incidence rates, Lahore, malignancies, the Punjab Cancer Registry.

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 population separately for children, young adults, and adults.
- A comparison has been made with the incidence rates reported by other registries around the world, where available.
- Due to sparse data available from districts contiguous to Lahore district within Punjab, comparisons with the surrounding districts could not be made.

PAPER

EPIDEMIOLOGY OF CANCERS IN LAHORE, PAKISTAN, AMONG CHILDREN, ADOLESCENTS, AND ADULTS, 2010-2012: A CROSS-SECTIONAL STUDY-PART 2

INTRODUCTION

Pakistan is a less-developed country, categorized as a lower-middle-income country, by the World Bank and,[1] it is also a densely populated country with its population estimated at 195·4 million in 2016.[2] Being a heavily populated country with limited resources, certain systems, well established in the more developed countries of the world, are still in the evolving phase in our country. This includes the non-communicable disease surveillance, including cancer registration, which has long been neglected in the region. Setting-up and running a registry is a challenging task but is undoubtedly needed in developing countries of the world including Pakistan. In 2005, a population-based registry called the Punjab Cancer Registry (PCR) was set-up through the joint efforts of professionals representing different health-care facilities within the district of Lahore, in the province of Punjab, Pakistan.[3] In 2016, we published a paper on the PCR with details related to the cancers registered, over a three-year period from 2010-2012, within the Lahore district, a populous district of the 36 districts of the province of Punjab, Pakistan.[4] The aforementioned paper was the first paper to report the cancer incidence within the population of the district of Lahore. The current paper is a sequel to the paper published earlier, giving the cancer statistics for the district of Lahore, by age-category. The goal of the study is to provide the age-adjusted incidence rates for children, young adults/adolescents, and adults.

METHODS

The Punjab Cancer Registry has nineteen centers in Lahore that report their data to the collaborating office located within a charitable organization, the Shaukat Khanum Memorial Cancer Hospital and Research Center, Lahore, Pakistan. For the purpose of data collection, active and passive methods were used. Active method involved a review by the Registry staff of the outpatient and inpatient medical records of the patients and abstraction of data onto special forms. Records included pathology reports

and clinical notes from outpatient clinics and indoor patient departments representing medical and radiation oncology, radiology, and surgery. However, passive notifications were carried out by health-care workers/front desk staff other than the Registry staff and reported to the Registry staff.

Evaluating the data initially retrieved from the Punjab Cancer Registry database to conduct a retrospective review of the records for our first population-based study on newly diagnosed malignancies in Lahore between 2010 and 2012, we conducted another study to compute the incidence rates for three age-categories: 0-14 (children), 15-19 (adolescents), and ≥ 20 years (adults), according to gender and cancer site/type. All cancers were categorized using the International Classification of Diseases, Clinical Modification, 10th revision.[5] Further groups were created using the International Classification of Childhood Cancer definitions, based on site and morphology coded according to the third edition of the International Classification of Diseases for Oncology (ICD-O-3).[6,7] This was done to enable comparisons with results provided by other registries of the world. A check for multiple primaries was done, according to the rules set by the International Agency for Research on Cancer (IARC).[8] The population denominators were based on the population structure of Lahore, as provided in Table 1, and computed using the average annual growth rate of 3·46% made available by the Government of Pakistan.[9] The average annual population of Lahore was estimated at 9·8 million during these three years of study. Counts and age-standardized incidence rates were calculated for each of the three age-categories under review and subsequently for 5-year age-groups within the adult category. The ASIRs were computed using the World Standard of Segi as the standard population, by applying the direct method of age-standardization and all the rates presented as per 100,000 population.[10] Patients were followed-up between July and October 2015, by making telephone calls to them on the numbers provided on their data collection forms. The purpose of calling them was to find their status, alive/death. However, contact could be established with sixty percent of the cases only.[4] As for the rest, they either did not answer or their SIMS were blocked and if anyone did answer, they said they did not know the concerned person/patient. Data were analyzed using Microsoft Excel, V.2010 and SPSS, V.19. The Institutional Review Board (IRB) of the Shaukat Khanum Memorial Cancer Hospital & Research Center granted

exemption from full IRB evaluation of this study. In this manuscript, the term 'Lahore' refers to the Lahore district and the 'Registry' refers to the Punjab Cancer Registry.

RESULTS

Of a total of 15,825 patients newly diagnosed with malignancies in Lahore in three years' time from 2010 to 2012, 57·3% were female and 42·7% were male. The age distribution of the entire cohort of 15,825 patients was as follows: mean 48·6 ±18·2 years, range 0-106 years, and mode 60 years (881 patients (5·6%)). The 25th percentile was 38 years, 50th percentile was 50 years, and the 75th percentile was 61 years. Almost 93·5% were microscopically confirmed as opposed to 6·5% being non-microscopically confirmed. The total number of malignancies recorded was 15,840, with 15 patients having double primaries.[4] This accounted for the difference in the numbers of patients and malignancies documented.[4] Of the 15,840 cases, 9,069 (57·3%) were diagnosed in female and 6,771 (42·7%) in male patients. The female to male ratio among children was 0·46:1, in adolescents 0·48:1, and in adults 1·07:1. Among females, the three highest ASIRs according to age-group and sub-category of tumors, were-in children: lymphoid leukemia (1·6) and, bone, eye, and brain and other Central Nervous System (CNS) tumors (0·5 each); in adolescents: bone tumors (1·4), brain and other CNS tumors (0·9), and ovary (0·8); and in adults: cancers of the breast (79·2), ovary (7·9), corpus uteri (6·1). Among males, the highest ASIRs were-in children: lymphoid leukemia (2·7), Hodgkin lymphoma (1·1), and brain and other CNS tumors (0·8); in young adults: bone (2·4), Non-Hodgkin Lymphoma (NHL (1·3)), and brain and other CNS tumors (1·2), and in adults: cancers of the prostate (10·7), bladder (8·4) and, trachea, bronchus, and lung (7·7). The proportional distribution of pediatric embryonal tumors was: retinoblastoma 5·5%, neuroblastoma 2·7%, rhabdomyosarcoma 2·1% (0-14 years) and 5·2% (15-19 years), and nephroblastoma 2·7%. The ASIR for the entire 0-19 year group was also computed and it was 6·6 for female and 9·9 for male patients. Figures 1-3 and Tables 2-3 display the ASIRs by gender, age-group, and cancer type. Within Tables 2-3, incidence rates based on fewer than 10 cases are shown in italics following IARC CI5 practice to indicate unstable incidence rates. Tables 4 and 5 display the 5-year age-specific incidence rates in adults by cancer type, for females and males, respectively. Table 6 shows a comparison of our

results with the incidence rates stated in different studies conducted in Pakistan and New Delhi according to three broad age-categories, Table 7 shows a comparison of our results with those reported in America and Bangladesh in children and young adults, while Appendix A shows a comparison of our results in four groups within the 50-69 year age-band with those reported by two registries in India and in the UK.

Nearly 27·5% of the 15,825 patients were alive by the cut-off date for this study, approximately 32·4% had died, and the vital status of about 40·1% could not be determined. Of the 5,134 deaths recorded, 5·7% were reported in children, 2·3% in young adults, and 92·1% in adults.

DISCUSSION

In our study, the ASIR was higher in adult women than in men, but it was lower in girls and young women than their corresponding male counterparts. Leukemia was the most common diagnosis in children and bone tumor in young adults, regardless of gender. Among women, breast cancer and, in men, prostate cancer, were the leading cancer types, in adults. Further, more than 90% of the cancers were recorded in adults again reinforcing the fact that cancer is primarily a disease of the older people; over 50% of the cases were diagnosed in patients 50 years of age and above. This scenario is different from what has been observed in the United Kingdom (UK), where more than half of all cancer cases each year were diagnosed in people aged 70 and over, in 2011-2013.[11] Moreover, in our study, cancers in children accounted for about 5·6% of the cases but in the UK, these accounted for less than 1% of all new cancer cases each year, 2011-2013.[11] Both in the UK and our study, leukemia was the most commonly diagnosed cancer in children, while leukemia, lymphoma, brain and other CNS tumors together accounted for more than two-thirds of all cancers diagnosed in children.[11] In the UK, cancer in teenagers and young adults accounted for less than 1% of all new cancer cases but in our study, cancer in children and adolescents accounted for 7·8% of all diagnoses, higher than what has been reported in the UK.[11] This may be attributed to a difference in the characteristics of the UK population from that of the Lahore population. The UK has an ageing population and a comparison of the population distributions for the UK to the Lahore district population has been made: for ages 0-15 years, 19% versus 40%; for ages 16-64

years, 64% versus 57%, and for ages 65 years and more, 18% versus 3%, respectively.[12] A study recently published from Bangladesh has shown that, during 2011-2014, among children, leukemias, retinoblastoma, and malignant bone tumors were the most commonly diagnosed cancers, whereas, in adolescents, malignant bone tumors, germ cell and gonadal tumors, and epithelial tumors, were the three most common cancer types.[13] However, the ASIRs reported in the aforesaid study from Bangladesh are low as compared to our study; these are, per 100,000 population, 0·78 versus 15·4, respectively, for the 0-14 year age-group and 0·21 versus 20·6 respectively, for the 15-19 year age-group for all sites combined. Another study reporting the findings from different regions of India has shown that, in New Delhi, the ASIR for females was 7·6 and for males 14·6, per 100,000 population, in the 0-14 year age-group during 1978-2002.[14] These figures are somewhat different from what has been reported in our study, which is 6·1 for girls and 9·3 for boys. The ASIRs per 100,000 for New Delhi and Lahore for leukemia among girls were 2·26 and 2·2, respectively, and among boys 5·11 and 3·6, respectively; these are more similar than different from one another. In New Delhi, following leukemia, high ASIRs were recorded for brain and other CNS tumors (1·09) and kidney tumors (0·64), among girls, whereas, among boys, for lymphomas (2·5) and brain and other CNS tumors (1·5). The reports from Bangladesh and New Delhi provide the incidence rates per million population. However, in order to make comparisons with our study, these have been presented as per 100,000 population.

Further comparison of the incidence rates obtained in our study has been made with those provided by two other studies conducted in Lahore and with one conducted in the Karachi South district, which was part of the Karachi Cancer Registry (KCR). The studies conducted in Lahore, two in number, were based on cancer incidence in children and adolescents registered at the Shaukat Khanum Memorial Cancer Hospital and Research Center, Lahore.[15,16] The last report on Karachi South published in the Cancer Incidence in Five Continents (CI5), Volume IX, was based on the 1998-2002 data provided by Dr. Yasmin Bhurgri (late) to the Agency.[17] The average annual population of Karachi South was less than half a million. The age-specific rates and the population structure reported in CI5, Volume IX, for Karachi South have been used by the PCR Staff to compute the ASIRs for the Karachi South district according to three age-groups under consideration and the top ranking cancers as reported in Lahore, to enable a

comparison between these two regions of Pakistan. Table 6 shows the details related to the cancers with highest ranking ASIRs seen in Lahore along with corresponding ASIRs obtained from four other studies, including India, where available. The comparison shows that the ASIRs in children were more similar than different from one another except for brain and other CNS tumors and Hodgkin lymphoma, which were relatively high in Karachi South. The incidence of pediatric brain tumors appeared to be comparatively low in Lahore; perhaps not everyone could afford an MRI/CT and some of these kids died before a diagnosis was made or, the cases were under-reported. Among adolescents, again, the incidence rates were comparable with aforementioned studies, except for ovarian cancer and NHL having higher ASIRs in Karachi South than in Lahore. A recent report on childhood cancers released by the International Agency for Research on Cancer, has shown almost the same results for the 2008-2012 time-period for Lahore district as part of the Punjab Cancer Registry, as for the three-year time-period on which our study is based.[18] In Table 7, further comparison with the incidence rates reported by the American Cancer Society in two different studies shows the rates to be more similar than different from one another except for brain and other CNS tumors, which were noticeably low in our study; for Hodgkin lymphoma, the rate was high in our study in children but low in young adults; and for bone tumor, the rate was substantially high in our study compared to that reported in the ACS studies.[19,20] Table 7 shows the details related to the Bangladesh study, the ACS studies (two in number), and our own study.

Among adult patients, as shown in Table 6, all the ASIRs reported for Karachi South were higher than for Lahore, except for brain and other CNS tumors. In adults, breast cancer in females and prostate cancer in males had the highest ASIRs in Lahore. In Karachi South, the ASIR for breast cancer was higher (114·9) than that recorded in Lahore (79·2). In Lahore, the ASIR for prostate cancer was 10·7 and for bladder cancer it was 8·4, among men, compared to 16·8 and 15·4, respectively, in Karachi South. Further, in Karachi South, the highest ASIRs, after breast cancer in women, were recorded for tobacco-related cancers, i.e., those of the trachea, bronchus, and lung (41·9) and lip and oral cavity (37·2), in men. The ASIR for cancers of the lip and oral cavity were also high (33·7) among women in Karachi South. The point to be noted is that in our previous publication on cancers in the Lahore district, the ASIR for breast cancer in females, for all age-groups combined,[4] was reported to be 47·6 while in the current study,

stratification by age-group has shown the ASIR to be 79·2 among adult women. The relatively high ASIR for breast cancer is intriguing as no definite risk factors have been identified so far. An epidemiologic, retrospective study on breast cancer at a cancer treatment facility in Lahore has shown that most women were parous, had breast-fed their babies, had not used any oral contraceptives or hormone replacement therapy, and there was no noteworthy difference in the pre- and post- menopausal status. A family history of cancer was present in less than one-fifths of the patients.[21] Further, these females had a relatively low mean presenting age (48 years), age at menarche was 13·2 years, age at first childbirth was 23·7 years, and the BMI was on the higher side.[21] The vast majority of cancers appeared to be sporadic in nature while a lower age at menarche and a higher BMI appeared to be striking.[21.] Although the findings of various studies including case-control studies have not been consistent with one another, it has been demonstrated that factors as young age at menarche, single marital status, nulliparity, late first full term pregnancy, use of oral contraceptives, late menopause, high BMI, and a family history of breast cancer could be associated with an increased risk, whereas, young age at first live birth, increasing parity, and Vitamin D supplementation could be associated with a decreased risk of this disease in our population. Large-scale, population-based studies are needed to validate demographic, clinical, and lifestyle risk factors related to pathways of this disease including the abovementioned factors.[22-26]

Our literature review did not find any separate results for the broad ≥ 20 year category by the ACS or the Surveillance, Epidemiology, and End Results Program. However, stratification of the data for Lahore for adults by 5-year age-group (Tables 4-5) and further comparisons of the age-specific incidence rates of the commonly diagnosed cancers with what has been reported by IARC in CI5 Volume X and the SEER Program have revealed that, in general, the incidence rates for Lahore were somewhat different from those of New Delhi and Mumbai but markedly different from what has been reported by the SEER Program and the UK (England), with the latter two showing very high incidence rates for almost all cancer types.[27,28] As for New Delhi and Mumbai, it has been shown that in males, the Lahore district incidence rates for prostate cancer were relatively high in the 50-54, 55-59, 60-64, 65-69 year age-groups compared to those for Mumbai but lower than those for New Delhi and markedly low compared to the UK incidence rates.[28] Appendix A show a comparison of three different types of cancers by region and four

aforementioned age-groups. Further, the incidence rates for cancers of the trachea, bronchus, and lung, for Lahore were quite low compared to the aforementioned regions especially the UK and similar differences were observed for cancers of the oral cavity, colorectum, and NHL, in adults in all of the 5-year age-categories. Among females, in all age-groups in adults, the incidence rates for cancer of the breast were higher than those reported for the Indian registries under discussion except those 75+ years of age, but markedly low compared to the UK rates except the 20-34 year age-category in which the incidence rates were higher than the UK rates. Appendix A shows a comparison of some of the age-groups for breast cancer by region. Moreover, the incidence rates for cancers of the corpus uteri were high as compared to Mumbai except in those 75+, but lower than New Delhi's. Incidence rates for cancers of the ovary, oral cavity, and colorectum were low and for cancer of the cervix uteri significantly lower than those for the Indian registries studied. The time-periods available or used for making comparisons were 2003-2007 for New Delhi, Mumbai, and the UK and 2010-2014 for the SEER Program.[27,28] Finally, a comparison with the age-specific rates for the Karachi South district of Pakistan showed that for the time-period 1998-2002, in both male and female patients, the KCR rates were significantly high for the commonly diagnosed cancers including prostate, breast, colorectum, lip & oral cavity, cervix uteri, and corpus uteri versus those reported for Lahore.[17] The differences, although intriguing, have not been fully explored to enable us to comment on them. Extensive population-based studies on risk factors could highlight some of the reasons associated with the differences observed. Although comparisons have been made with the incidence rates reported in other regions of the world, the use of different standard populations, as the Segi World Standard Population in our study and the US 2000 Standard Population by the ACS, indicates a limitation of our report. Further, the availability of results from the abovementioned studies for different time-periods is also suggestive of a limitation of our review.

Generalizability of the results

In Pakistan, the last census was held in 1998 and there is an on-going one this year. In March 1998, the total population of the district of Lahore was recorded to be 6,318,745 with an intercensal increase of 78·3 percent since March 1981 when it was 3,544,942.[9] The average annual growth rate of Lahore was nearly

3·5 percent during this period. In the 1998 census report, the total area of Lahore was documented as 1,772 square kilometers which gives a population density of 3,566 persons per square kilometer as against 2,000 persons observed in 1981, thus indicating a high growth rate of the population.[29] A comparison of the population density per square kilometer of the Lahore district with other populous districts of Punjab, as reported in 1998, has been made: Gujranwala 939; Faisalabad 927; Sialkot 903; and Multan 838 persons. [29] It is, however, noticeable that the land area of these districts is vast as compared to the Lahore district.[29] The urban population of the Lahore district accounted for 82·4 percent of the total population of the district in 1998, which grew at an average rate of 3·3 percent during 1981-1998, but the urban population of the province of Punjab was 31·3 percent. [29] Urban population in other provinces of Pakistan was reported as: Sindh 48·8%, Balochistan 23·9%, and Khyber Pakhtunkhwa 16·9%, according to the 1998 population census. [29] The differences are stark reflecting that Lahore has had a very high population density for decades and the ratio of urban to rural population has also remained extremely high for as long. These dissimilarities are meaningful and one can question whether the cancer distributions reported for Lahore can be extrapolated to the inhabitants of other districts of Punjab or to other provinces of the country. Once the latest census findings are released completely and studies on cancer registration conducted in other districts of the region, will we be able to see the actual scenario related to the incidence rates and will hopefully clarify this matter further.

CONCLUSIONS

In a resource-constrained country like Pakistan, having continued, sustainable reporting and registration of any disease, is a challenge. There are, however, significant gains if an accurate and sustainable registry is available for diseases with a significant burden on society. Overall, childhood malignancies are often curable if diagnosed and treated in a timely and appropriate manner, and an accurate estimate of their incidence can help health planners in accurate allocation of resources to treat these.

The Punjab Cancer Registry and the reports on cancer estimates for Lahore will perhaps bring this neglected disease to the attention of policy-makers and guide them about the allocation of health-care resources to where they are most needed incorporating specialist training, infrastructure availability,

development of prevention programs, establishment of low cost, early detection/diagnosis methods/techniques, and research into putative risk factors implicated in the etiology of the disease. These reports could also motivate and facilitate other professionals to set-up registries in their respective regions and promote cancer registration in the country, thereby enabling comparisons of incidence rates with adjacent districts.

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. SM did the case-finding, indexing, and coding of cases, computed the incidence rates, and created figures and tables.

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Competing interests

We declare no competing interests.

Data sharing statement

No additional data available.

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Figure 1. Age-standardized incidence rates by age-group and gender, in the Lahore district, Pakistan, 2010-2012.

Figure 2. Age-standardized incidence rates in children and adolescents, in the Lahore district, Pakistan, 2010-2012.

Figure 3. Age-standardized incidence rates by gender among adults, in the Lahore district, Pakistan, 2010-2012.

Table 1. Population estimates for the district of Lahore by gender and age-group, 2010-2012.

Year →	2010		2011		2012		Total	
Age-group (yrs.)	Female	Male	Female	Male	Female	Male	Female	Male
0-4	585,856	608,924	606,126	629,992	627,098	651,790	1,819,080	1,890,706
5-9	621,343	661,178	642,841	684,055	665,083	707,723	1,929,267	2,052,956
10-14	603,207	648,088	624,077	670,512	645,671	693,712	1,872,955	2,012,312
15-19	522,833	554,620	540,923	573,810	559,639	593,664	1,623,396	1,722,095
20-24	446,315	495,261	461,757	512,397	477,734	530,125	1,385,807	1,537,783
25-29	352,415	401,889	364,609	415,794	377,225	430,181	1,094,249	1,247,864
30-34	299,024	347,491	309,370	359,514	320,074	371,954	928,468	1,078,959
35-39	242,033	285,887	250,407	295,779	259,071	306,013	751,511	887,679
40-44	208,009	250,761	215,206	259,437	222,652	268,414	645,868	778,612
45-49	161,556	186,385	167,146	192,834	172,929	199,506	501,630	578,725
50-54	144,596	174,903	149,599	180,955	154,775	187,216	448,970	543,073
55-59	91,861	115,698	95,040	119,701	98,328	123,843	285,229	359,242
60-64	82,959	102,349	85,829	105,891	88,799	109,554	257,587	317,794
65-69	50,387	62,312	52,130	64,468	53,934	66,699	156,450	193,480
70-74	40,733	54,305	42,143	56,184	43,601	58,128	126,477	168,616
75+	44,426	56,267	45,963	58,214	47,553	60,229	137,942	174,710
All ages	4,497,552	5,006,319	4,653,167	5,179,538	4,814,167	5,358,750	13,964,885	15,544,606

Table 2. Age-standardized incidence rates among females, by age-group, in the Lahore district, Pakistan, 2010-2012.

Site (Females)	Count 0-14 yrs.	ASIR 0-14 yrs.	Count 15-19 yrs.	ASIR 15-19 yrs.	Count ≥ 20 yrs.	ASIR ≥ 20 yrs.
Lip	0	0.0	0	0.0	*9*	*0.2*
Tongue	0	0.0	0	0.0	129	2.8
Mouth	0	0.0	*3*	*0.2*	127	2.6
Salivary glands	*1*	*0.0*	0	0.0	40	0.7
Tonsil	0	0.0	0	0.0	*8*	*0.2*
Nasopharynx	*1*	*0.0*	*2*	*0.1*	16	0.3
Hypopharynx	0	0.0	*1*	*0.1*	31	0.6
Pharynx	*1*	*0.0*	0	0.0	*4*	*0.1*
Esophagus	0	0.0	*1*	*0.1*	94	2.0
Stomach	0	0.0	0	0.0	105	2.1
Small intestine	0	0.0	0	0.0	17	0.4
Colon	*1*	*0.0*	*5*	*0.3*	153	3.1
Rectum	*1*	*0.0*	*4*	*0.2*	132	2.5
Anus	0	0.0	0	0.0	23	0.4
Liver	*3*	*0.1*	*1*	*0.1*	173	4.0
Gall bladder, etc.	0	0.0	*1*	*0.1*	138	3.2
Pancreas	0	0.0	*1*	*0.1*	39	0.9
Other ill-defined dig. orgs.	*1*	*0.0*	*1*	*0.1*	12	0.2
Nose, sinuses	*1*	*0.0*	*2*	*0.1*	24	0.5
Larynx	0	0.0	0	0.0	28	0.6
Trachea, bronchus, & lung	*2*	*0.0*	*3*	*0.2*	87	2.0
Other thoracic organs	0	0.0	*1*	*0.1*	15	0.3
Bone	29	0.5	22	1.4	40	0.5
Melanoma of the skin	0	0.0	0	0.0	13	0.2
Other skin	*1*	*0.0*	*2*	*0.1*	193	4.4
Connective & soft tissue	19	0.3	*9*	*0.6*	80	1.4
Breast	*3*	*0.0*	*2*	*0.1*	4077	79.2
Vulva	*1*	*0.0*	0	0.0	18	0.4
Vagina	0	0.0	0	0.0	16	0.3
Cervix uteri	0	0.0	0	0.0	247	4.8
Corpus uteri	0	0.0	0	0.0	267	6.1
Uterus, unspecified	0	0.0	0	0.0	89	1.9
Ovary	12	0.2	13	0.8	417	7.9
Other female genital organ	0	0.0	0	0.0	18	0.4
Placenta	0	0.0	0	0.0	*7*	*0.1*
Kidney	15	0.3	0	0.0	87	1.7
Renal pelvis	0	0.0	0	0.0	*1*	*0.0*
Ureter	0	0.0	0	0.0	*1*	*0.0*
Bladder	*1*	*0.0*	*1*	*0.1*	107	2.4
Eye	23	0.5	0	0.0	17	0.4
Brain, nervous system	32	0.5	14	0.9	181	3.3
Thyroid	*2*	*0.0*	*3*	*0.2*	210	3.5
Adrenal	*2*	*0.0*	0	0.0	*2*	*0.0*
Hodgkin lymphoma	16	0.3	*7*	*0.4*	57	0.9
Non-Hodgkin lymphoma	18	0.3	*8*	*0.5*	251	5.3
Multiple myeloma	0	0.0	0	0.0	36	0.8
Lymphoid leukemia	89	1.6	*5*	*0.3*	18	0.3
Myeloid leukemia	13	0.2	*4*	*0.2*	45	0.7
Other leukemias	*1*	*0.0*	0	0.0	*1*	*0.0*
Leukemia, unspecified	21	0.4	*5*	*0.3*	14	0.2
Other & unspecified	17	0.3	*3*	*0.2*	516	10.8
Benign CNS	12	0.2	12	0.7	164	2.8
All sites	339 (3.7%)	6.1	136 (1.5%)	8.4	8594 (94.7%)	170.7

Table 3. Age-standardized incidence rates among males, by age-group, in the Lahore district, Pakistan, 2010-2012.

Site (Males)	Count 0-14 yrs.	ASIR 0-14 yrs.	Count 15-19 yrs.	ASIR 15-19 yrs.	Count ≥ 20 yrs.	ASIR ≥ 20 yrs.
Lip	0	0.0	0	0.0	13	0.2
Tongue	0	0.0	0	0.0	180	3.0
Mouth	*2*	*0.0*	0	0.0	210	3.6
Salivary glands	*2*	*0.0*	*1*	*0.1*	47	0.8
Tonsil	0	0.0	0	0.0	*8*	*0.1*
Other oropharynx	0	0.0	0	0.0	*6*	*0.1*
Nasopharynx	0	0.0	*2*	*0.1*	17	0.3
Hypopharynx	0	0.0	0	0.0	21	0.4
Pharynx	0	0.0	0	0.0	*5*	*0.1*
Esophagus	0	0.0	*1*	*0.1*	126	2.3
Stomach	*1*	*0.0*	0	0.0	161	2.7
Small intestine	0	0.0	0	0.0	26	0.4
Colon	*1*	*0.0*	*7*	*0.4*	222	3.9
Rectum	0	0.0	*7*	*0.4*	179	3.0
Anus	0	0.0	*2*	*0.1*	39	0.6
Liver	*1*	*0.0*	*1*	*0.1*	326	6.1
Gall bladder, etc.	0	0.0	*1*	*0.1*	92	1.7
Pancreas	0	0.0	0	0.0	57	1.1
Other ill-defined dig. orgs.	0	0.0	0	0.0	16	0.3
Nose, sinuses	*1*	*0.0*	*2*	*0.1*	29	0.5
Larynx	0	0.0	0	0.0	183	3.4
Trachea, bronchus, & lung	0	0.0	0	0.0	396	7.7
Other thoracic organs	*2*	*0.0*	*1*	*0.1*	23	0.4
Bone	38	0.6	42	2.4	63	0.9
Melanoma of the skin	*1*	*0.0*	*1*	*0.1*	11	0.2
Other skin	*8*	*0.1*	*4*	*0.2*	259	4.6
Connective & soft tissue	21	0.4	15	0.9	108	1.6
Breast	0	0.0	*1*	*0.1*	69	1.3
Penis	0	0.0	0	0.0	*1*	*0.0*
Prostate	0	0.0	0	0.0	526	10.7
Testis	*4*	*0.1*	*9*	*0.5*	77	0.9
Other male genital organs	*1*	*0.0*	0	0.0	*4*	*0.1*
Kidney	17	0.3	*2*	*0.1*	153	2.7
Renal pelvis	0	0.0	0	0.0	*1*	*0.0*
Ureter	0	0.0	0	0.0	*1*	*0.0*
Bladder	*1*	*0.0*	0	0.0	440	8.4
Other urinary organs	0	0.0	0	0.0	*2*	*0.0*
Eye	27	0.5	*2*	*0.1*	28	0.5
Brain, nervous system	48	0.8	20	1.2	390	5.8
Thyroid	*1*	*0.0*	*3*	*0.2*	77	1.2
Adrenal	*1*	*0.0*	*1*	*0.1*	*5*	*0.1*
Hodgkin lymphoma	66	1.1	17	1.0	119	1.7
Non-Hodgkin lymphoma	58	0.9	23	1.3	412	6.8
Multiple myeloma	*1*	*0.0*	0	0.0	52	0.9
Lymphoid leukemia	156	2.7	12	0.7	39	0.6
Myeloid leukemia	21	0.3	*7*	*0.4*	79	1.1
Other leukemias	0	0.0	0	0.0	*6*	*0.1*
Leukemia, unspecified	34	0.6	*3*	*0.2*	23	0.3
Other & unspecified	21	0.3	15	0.9	525	9.2
Benign CNS	19	0.3	*8*	*0.5*	155	2.1
All sites	554 (8.1%)	9.3 -	210 (3.1%)	12.2 -	6007 (88.7%)	104.5 -

Table 4. Counts and age-specific incidence rates among adult females, by age-group, in the Lahore district, Pakistan, 2010-2012.

Site - Females	Count 20-	ASIR 20-	Count 25-	ASIR 25-	Count 30-	ASIR 30-	Count 35-	ASIR 35-	Count 40-	ASIR 40-	Count 45-	ASIR 45-	Count 50-	ASIR 50-	Count 55-	ASIR 55-	Count 60-	ASIR 60-	Count 65-	ASIR 65-	Count 70-	ASIR 70-	Count 75+	ASIR 75+
Lip	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	3	1.1	1	0.4	1	0.6	2	1.6	1	1.1
Tongue	2	0.1	1	0.1	2	0.2	9	1.2	9	1.4	27	5.4	21	4.7	14	4.9	17	6.6	9	5.8	11	8.7	5	5.5
Mouth	3	0.2	3	0.3	2	0.2	11	1.5	19	2.9	8	1.6	27	6.0	13	4.6	9	3.5	11	7.0	14	11.1	3	3.3
Salivary glands	2	0.1	6	0.5	2	0.2	6	0.8	3	0.5	3	0.6	5	1.1	2	0.7	7	2.7	3	1.9	1	0.8	1	1.1
Tonsil	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0	1	0.2	3	0.7	1	0.4	0	0.0	0	0.0	1	0.8	0	0.0
Nasopharynx	1	0.1	2	0.2	3	0.3	0	0.0	2	0.3	3	0.6	1	0.2	1	0.4	1	0.4	0	0.0	2	1.6	1	1.1
Hypopharynx	3	0.2	1	0.1	2	0.2	4	0.5	2	0.3	3	0.6	3	0.7	4	1.4	5	1.9	1	0.6	2	1.6	0	0.0
Pharynx	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0	0	0.0	1	0.8	0	0.0
Esophagus	0	0.0	3	0.3	3	0.3	7	0.9	12	1.9	20	4.0	8	1.8	8	2.8	15	5.8	7	4.5	6	4.7	3	3.3
Stomach	4	0.3	1	0.1	9	1.0	10	1.3	14	2.2	19	3.8	11	2.5	11	3.9	7	2.7	14	8.9	0	0.0	1	1.1
Small intestine	1	0.1	0	0.0	0	0.0	0	0.0	4	0.6	0	0.0	0	0.0	1	0.4	5	1.9	2	1.3	3	2.4	0	0.0
Colon	2	0.1	8	0.7	12	1.3	15	2.0	13	2.0	17	3.4	15	3.3	20	7.0	13	5.0	15	9.6	12	9.5	6	6.6
Rectum	13	0.9	10	0.9	13	1.4	9	1.2	11	1.7	15	3.0	14	3.1	12	4.2	13	5.0	7	4.5	8	6.3	3	3.3
Anus	2	0.1	0	0.0	3	0.3	1	0.1	6	0.9	3	0.6	1	0.2	0	0.0	2	0.8	1	0.6	3	2.4	0	0.0
Liver	2	0.1	1	0.1	2	0.2	2	0.3	9	1.4	22	4.4	28	6.2	32	11.2	31	12.0	26	16.6	11	8.7	3	3.3
Gall bladder etc.	0	0.0	0	0.0	5	0.5	3	0.4	10	1.5	13	2.6	22	4.9	19	6.7	23	8.9	22	14.1	9	7.1	2	2.2
Pancreas	0	0.0	2	0.2	1	0.1	4	0.5	2	0.3	4	0.8	4	0.9	6	2.1	2	0.8	9	5.8	3	2.4	1	1.1
Other ill-defined digestive	2	0.1	1	0.1	1	0.1	0	0.0	0	0.0	0	0.0	4	0.9	0	0.0	3	1.2	0	0.0	1	0.8	0	0.0
Nose, sinuses	0	0.0	0	0.0	1	0.1	2	0.3	0	0.0	3	0.6	3	0.7	5	1.8	6	2.3	2	1.3	1	0.8	0	0.0
Larynx	0	0.0	0	0.0	2	0.2	1	0.1	4	0.6	4	0.8	6	1.3	4	1.4	3	1.2	1	0.6	0	0.0	0	0.0
Trachea, bronchus & lung	1	0.1	1	0.1	5	0.5	3	0.4	6	0.9	7	1.4	8	1.8	13	4.6	14	5.4	13	8.3	8	6.3	5	5.5
Other thoracic organs	0	0.0	0	0.0	0	0.0	2	0.3	1	0.2	4	0.8	0	0.0	1	0.4	4	1.6	1	0.6	1	0.8	0	0.0
Bone	13	0.9	3	0.3	4	0.4	10	1.3	2	0.3	3	0.6	2	0.4	1	0.4	0	0.0	0	0.0	2	1.6	1	1.1
Melanoma of the skin	0	0.0	1	0.1	1	0.1	2	0.3	1	0.2	2	0.4	2	0.4	2	0.7	0	0.0	0	0.0	1	0.8	0	0.0
Other skin	1	0.1	3	0.3	2	0.2	10	1.3	19	2.9	11	2.2	23	5.1	18	6.3	29	11.3	26	16.6	24	19.0	13	14.3
Connective & soft tissue	9	0.6	9	0.8	7	0.8	9	1.2	11	1.7	6	1.2	8	1.8	4	1.4	4	1.6	6	3.8	3	2.4	2	2.2
Breast	46	3.3	153	14.0	299	32.2	420	55.9	557	86.2	636	126.8	585	130.3	452	158.5	397	154.1	247	157.9	158	124.9	121	99.5
Vulva	0	0.0	0	0.0	1	0.1	3	0.4	1	0.2	1	0.2	0	0.0	4	1.4	2	0.8	1	0.6	1	0.8	0	0.0
Vagina	0	0.0	2	0.2	0	0.0	1	0.1	2	0.3	4	0.8	1	0.2	2	0.7	1	0.4	0	0.0	1	0.8	0	0.0
Cervix uteri	3	0.2	4	0.4	12	1.3	29	3.9	37	5.7	47	9.4	32	7.1	30	10.5	26	10.1	13	8.3	7	5.5	2	2.2
Corpus uteri	0	0.0	2	0.2	6	0.6	11	1.5	12	1.9	30	6.0	44	9.8	47	16.5	57	22.1	25	16.0	23	18.2	9	9.9
Uterus unspecified	0	0.0	1	0.1	1	0.1	7	0.9	10	1.5	17	3.4	18	4.0	8	2.8	15	5.8	6	3.8	6	4.7	3	3.3
Ovary	22	1.6	21	1.9	28	3.0	37	4.9	51	7.9	61	12.2	60	13.4	44	15.4	50	19.4	19	12.1	14	11.1	7	7.7
Other female genital organ	0	0.0	1	0.1	0	0.0	2	0.3	3	0.5	1	0.2	1	0.2	2	0.7	6	2.3	1	0.6	1	0.8	0	0.0
Placenta	2	0.1	1	0.1	3	0.3	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Kidney	3	0.2	0	0.0	2	0.2	12	1.6	13	2.0	8	1.6	12	2.7	14	4.9	8	3.1	5	3.2	4	3.2	1	1.1
Renal pelvis	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Ureter	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	0.0	1	0.8	0	0.0
Bladder	0	0.0	1	0.1	2	0.2	8	1.1	8	1.2	8	1.6	12	2.7	14	4.9	13	5.0	14	8.9	13	10.3	4	4.4
Eye	0	0.0	0	0.0	0	0.0	0	0.0	2	0.3	2	0.4	0	0.0	0	0.0	2	0.8	7	4.5	1	0.8	0	0.0
Brain, nervous system	13	0.9	22	2.0	13	1.4	19	2.5	21	3.3	22	4.4	22	4.9	15	5.3	13	5.0	12	7.7	5	4.0	2	2.2
Thyroid	26	1.9	17	1.6	26	2.8	22	2.9	21	3.3	23	4.6	29	6.5	10	3.5	17	6.6	5	3.2	10	7.9	3	3.3
Adrenal	1	0.1	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Hodgkin disease	13	0.9	11	1.0	4	0.4	8	1.1	2	0.3	5	1.0	1	0.2	5	1.8	4	1.6	1	0.6	3	2.4	1	1.1
Non-Hodgkin lymphoma	7	0.5	9	0.8	8	0.9	15	2.0	23	3.6	29	5.8	33	7.4	35	12.3	28	10.9	22	14.1	17	13.4	2	2.2
Multiple myeloma	0	0.0	0	0.0	0	0.0	1	0.1	2	0.3	8	1.6	5	1.1	2	0.7	7	2.7	5	3.2	5	4.0	1	1.1
Lymphoid leukemia	2	0.1	2	0.2	2	0.2	0	0.0	3	0.5	1	0.2	1	0.2	2	0.7	3	1.2	1	0.6	1	0.8	0	0.0
Myeloid leukemia	7	0.5	7	0.6	6	0.6	5	0.7	3	0.5	3	0.6	5	1.1	4	1.4	2	0.8	1	0.6	2	1.6	1	1.1
Other leukemias	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Leukemia unspecified	2	0.1	3	0.3	1	0.1	1	0.1	1	0.2	1	0.2	3	0.7	0	0.0	0	0.0	1	0.6	1	0.8	0	0.0
Other & unspecified	15	1.1	20	1.8	25	2.7	35	4.7	45	7.0	63	12.6	67	14.9	71	24.9	62	24.1	53	33.9	34	26.9	24	19.8
Benign CNS	4	0.3	17	1.6	20	2.2	29	3.9	26	4.0	24	4.8	16	3.6	6	2.1	11	4.3	7	4.5	3	2.4	2	2.2
All sites	227 (2.6%)	16.4	351 (4.1%)	32.1	541 (6.3%)	58.3	787 (9.1%)	104.7	1005 (11.7%)	155.6	1193 (13.9%)	237.8	1167 (13.6%)	259.9	963 (11.2%)	337.6	938 (10.9%)	364.1	623 (7.2%)	398.2	441 (5.1%)	348.7	358 (4.1%)	258.5

Table 5. Counts and age-specific incidence rates among adult males by age-group, in the Lahore district, Pakistan, 2010-2012.

Site - Males	Count 20-	ASIR 20-	Count 25-	ASIR 25-	Count 30-	ASIR 30-	Count 35-	ASIR 35-	Count 40-	ASIR 40-	Count 45-	ASIR 45-	Count 50-	ASIR 50-	Count 55-	ASIR 55-	Count 60-	ASIR 60-	Count 65-	ASIR 65-	Count 70-	ASIR 70-	Count 75+	ASIR 75+
Lip	1	0.1	0	0.0	1	0.1	2	0.2	0	0.0	0	0.0	1	0.2	2	0.6	4	1.3	1	0.5	1	0.6	0	0.0
Tongue	4	0.3	7	0.6	6	0.6	18	2.0	27	3.5	21	3.6	24	4.4	18	5.0	23	7.2	12	6.2	16	9.5	4	2.3
Mouth	1	0.1	2	0.2	13	1.2	10	1.1	23	3.0	31	5.4	26	4.8	35	9.7	32	10.1	17	8.8	13	7.7	7	4.0
Salivary glands	2	0.1	2	0.2	3	0.3	6	0.7	5	0.6	4	0.7	4	0.7	4	1.1	6	1.9	3	1.6	5	3.0	3	1.7
Tonsil	0	0.0	1	0.1	0	0.0	1	0.1	1	0.1	0	0.0	1	0.2	1	0.3	2	0.6	1	0.5	0	0.0	0	0.0
Other oropharynx	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.3	0	0.0	2	0.6	1	0.3	0	0.0	1	0.6	0	0.0
Nasopharynx	1	0.1	0	0.0	2	0.2	1	0.1	2	0.3	2	0.3	1	0.2	3	0.8	4	1.3	1	0.5	0	0.0	0	0.0
Hypopharynx	0	0.0	1	0.1	1	0.1	1	0.1	2	0.3	0	0.0	3	0.6	1	0.3	3	0.9	2	1.0	2	1.2	5	2.9
Pharynx	0	0.0	0	0.0	0	0.0	1	0.1	1	0.1	2	0.3	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Esophagus	1	0.1	3	0.2	3	0.3	7	0.8	4	0.5	18	3.1	17	3.1	16	4.5	17	5.3	12	6.2	16	9.5	12	6.9
Stomach	1	0.1	10	0.8	10	0.9	12	1.4	17	2.2	22	3.8	18	3.3	17	4.7	14	4.4	20	10.3	14	8.3	6	3.4
Small intestine	2	0.1	0	0.0	0	0.0	3	0.3	1	0.1	3	0.5	3	0.6	3	0.8	3	0.9	1	0.5	3	1.8	4	2.3
Colon	12	0.8	8	0.6	8	0.7	13	1.5	16	2.1	28	4.8	24	4.4	21	5.8	37	11.6	28	14.5	16	9.5	11	6.3
Rectum	11	0.7	11	0.9	15	1.4	9	1.0	8	1.0	19	3.3	21	3.9	18	5.0	26	8.2	23	11.9	7	4.2	11	6.3
Anus	2	0.1	1	0.1	5	0.5	0	0.0	5	0.6	3	0.5	7	1.3	3	0.8	7	2.2	3	1.6	1	0.6	2	1.1
Liver	1	0.1	2	0.2	0	0.0	13	1.5	15	1.9	30	5.2	55	10.1	61	17.0	47	14.8	47	24.3	29	17.2	26	14.9
Gall bladder, etc.	1	0.1	1	0.1	1	0.1	3	0.3	4	0.5	3	0.5	16	2.9	13	3.6	16	5.0	14	7.2	7	4.2	13	7.4
Pancreas	1	0.1	0	0.0	1	0.1	0	0.0	6	0.8	8	1.4	7	1.3	11	3.1	4	1.3	9	4.7	8	4.7	2	1.1
Other ill-defined digestive	1	0.1	0	0.0	0	0.0	0	0.0	1	0.1	3	0.5	2	0.4	1	0.3	2	0.6	4	2.1	0	0.0	2	1.1
Nose, sinuses	3	0.2	2	0.2	0	0.0	2	0.2	1	0.1	3	0.5	3	0.6	5	1.4	3	0.9	3	1.6	4	2.4	0	0.0
Larynx	4	0.3	0	0.0	2	0.2	4	0.5	12	1.5	22	3.8	25	4.6	28	7.8	33	10.4	24	12.4	19	11.3	10	5.7
Trachea, bronchus & lung	2	0.1	1	0.1	6	0.6	17	1.9	14	1.8	33	5.7	26	4.8	47	13.1	68	21.4	62	32.0	63	37.4	57	32.2
Other thoracic organs	0	0.0	0	0.0	1	0.1	2	0.2	2	0.3	1	0.2	6	1.1	0	0.0	2	0.6	1	0.5	3	1.8	5	2.8
Bone	16	1.0	6	0.5	6	0.6	6	0.7	5	0.6	5	0.9	3	0.6	1	0.3	10	3.1	1	0.5	3	1.8	1	0.6
Melanoma of the skin	0	0.0	1	0.1	1	0.1	1	0.1	0	0.0	0	0.0	0	0.0	4	1.1	0	0.0	1	0.5	0	0.0	3	1.7
Other skin	4	0.3	11	0.9	17	1.6	18	2.0	18	2.3	16	2.8	22	4.1	31	8.6	36	11.3	32	16.5	17	10.1	37	21.2
Connective & soft tissue	13	0.8	14	1.1	8	0.7	10	1.1	4	0.5	16	2.8	6	1.1	9	2.5	9	2.8	7	3.6	7	4.2	5	2.8
Breast	1	0.1	1	0.1	0	0.0	3	0.3	7	0.9	12	2.1	8	1.5	7	1.9	6	1.9	17	8.8	4	2.4	3	1.7
Penis	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Prostate	2	0.1	1	0.1	0	0.0	0	0.0	2	0.3	6	1.0	24	4.4	47	13.1	86	27.1	89	46.0	117	69.4	152	87.2
Testis	17	1.1	15	1.2	13	1.2	10	1.1	8	1.0	4	0.7	3	0.6	1	0.3	1	0.3	3	1.6	1	0.6	1	0.6
Other male genital organs	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	1.0	1	0.6	0	0.0
Kidney	2	0.1	2	0.2	3	0.3	8	0.9	21	2.7	19	3.3	18	3.3	20	5.6	20	6.3	14	7.2	16	9.5	10	5.7
Renal pelvis	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.3	0	0.0	0	0.0	0	0.0	0	0.0
Ureter	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.3	0	0.0	0	0.0	0	0.0	0	0.0
Bladder	1	0.1	3	0.2	4	0.4	16	1.8	17	2.2	34	5.9	41	7.5	69	19.2	73	23.0	58	30.0	50	29.7	74	42.4
Other urinary organs	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6
Eye	2	0.1	1	0.1	0	0.0	1	0.1	1	0.1	4	0.7	3	0.6	1	0.3	5	1.6	4	2.1	4	2.4	2	1.1
Brain, nervous system	24	1.6	36	2.9	49	4.5	39	4.4	39	5.0	42	7.3	48	8.8	38	10.6	36	11.3	19	9.8	14	8.3	6	3.4
Thyroid	3	0.2	9	0.7	9	0.8	3	0.3	6	0.8	8	1.4	10	1.8	12	3.3	5	1.6	5	2.6	5	3.0	2	1.1
Adrenal	2	0.1	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	1	0.3	0	0.0	0	0.0	1	0.6	0	0.0
Hodgkin disease	14	0.9	18	1.4	13	1.2	12	1.4	12	1.5	9	1.6	8	1.5	12	3.3	6	1.9	8	4.1	6	3.6	1	0.6
Non-Hodgkin lymphoma	30	2.0	20	1.6	27	2.5	22	2.5	36	4.6	34	5.9	55	10.1	42	11.7	58	18.3	35	18.1	28	16.6	25	14.3
Multiple myeloma	0	0.0	0	0.0	2	0.2	2	0.2	4	0.5	7	1.2	7	1.3	9	2.5	10	3.1	3	1.6	4	2.4	4	2.3
Lymphoid leukemia	8	0.5	3	0.2	3	0.3	1	0.1	6	0.8	2	0.3	5	0.9	2	0.6	2	0.6	4	2.1	0	0.0	3	1.7
Myeloid leukemia	11	0.7	10	0.8	10	0.9	12	1.4	8	1.0	6	1.0	4	0.7	7	1.9	6	1.9	4	2.1	0	0.0	1	0.6
Other leukemias	1	0.1	1	0.1	0	0.0	0	0.0	1	0.1	0	0.0	2	0.4	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0
Leukemia unspecified	7	0.5	3	0.2	3	0.3	1	0.1	2	0.3	2	0.3	1	0.2	1	0.3	2	0.6	0	0.0	1	0.6	0	0.0
Other & unspecified	6	0.4	25	2.0	28	2.6	26	2.9	37	4.8	35	6.0	66	12.2	67	18.7	76	23.9	55	28.4	43	25.5	61	34.9
Benign CNS	12	0.8	25	2.0	21	1.9	21	2.4	16	2.1	19	3.3	18	3.3	4	1.1	10	3.1	3	1.6	5	3.0	1	0.6
All sites	228 (3.8%)	14.8	257 (4.3%)	20.6	296 (4.9%)	27.4	337 (5.6%)	38.0	418 (7.0%)	53.7	539 (9.0%)	93.1	643 (10.7%)	118.4	697 (11.6%)	194.0	811 (13.5%)	255.2	652 (10.9%)	337.0	556 (9.3%)	329.7	573 (9.5%)	328.0

Table 6. ASIRs per 100,000 population, as reported in other studies conducted in Pakistan and in New Delhi, India.

		PAKISTAN								INDIA	
		PCR 2010-2012: Lahore district		Badar et al. 2015: SKMCH&RC, Lahore		Badar et al. 2008: SKMCH&RC, Lahore		KCR 1998-2002: Karachi South district		1978-2002: New Delhi	
Age-group	Cancer type/site	F	M	F	M	F	M	F	M	F	M
0-14 yrs.	Lymphoid leukemia	1.6	2.7	1.5	2	0.5	0.7	1.4	3.0	1.5	3.4
	Brain, nervous system	0.5	0.8	1	1	0.3	0.7	1.3	1.5	1.1	1.5
	Bone	0.5	0.6	0.4	0.4	0.3	0.4	0.7	0.6	0.6	0.8
	Eye	0.5	0.5	0.4	0.6	0.2	0.3	0.3	0.4	0.4	0.4
	Leukemia, unspecified	0.4	0.6	0.3	0.5	0.1	0.3	0.2	0.1	0.4	0.6
	Connective & soft tissue	0.3	0.4	0.2	0.3	0.2	0.4	0.3	0.4	0.5	0.7
	Non-Hodgkin lymphoma	0.3	0.9	0.4	0.7	0.3	0.9	0.8	1.2	0.4	1.1
	Hodgkin lymphoma	0.3	1.1	0.2	0.9	0.2	0.4	0.5	1.4	0.1	1.0
	Kidney	0.3	0.3	0.1	0.5	0.3	0.3	0.3	0.5	0.6	0.6
	Myeloid leukemia	0.2	0.3	0	0.1	0.1	0	0.2	0.9	0.4	0.6
15-19 yrs.	Bone	1.4	2.4	1	2	-	-	3.3	2.4	-	-
	Brain, nervous system	0.9	1.2	1.7	1.9	-	-	1.6	2.2	-	-
	Ovary	0.8	-	0.2	-	-	-	1.9	-	-	-
	Connective & soft tissue	0.6	0.9	1	1.3	-	-	0.5	1.8	-	-
	Colon, rectum, & anus	0.5	0.9	-	-	-	-	1.2	1.2	-	-
	Non-Hodgkin lymphoma	0.5	1.3	0.7	1.3	-	-	2.1	4.2	-	-
	Hodgkin lymphoma	0.4	1	1.2	1.3	-	-	0.5	0.8	-	-
	Lymphoid leukemia	0.3	0.9	0.3	0.2	-	-	0.7	2	-	-
	Leukemia, unspecified	0.3	0.2	0.3	0.3	-	-	0.9	0.8	-	-
	Myeloid leukemia	0.2	0.4	0.2	0	-	-	2.6	2.2	-	-
	Testis	-	0.7	-	0.6	-	-	-	1	-	-
	Skin	0.1	0.3	0	0	-	-	-	0.4	-	-
≥ 20 yrs.	Breast	79.2	1.3	-	-	-	-	114.9	1.6	-	-
	Ovary	7.9	-	-	-	-	-	14.1	-	-	-
	Lip & oral cavity	6.3	7.6	-	-	-	-	33.7	37.2	-	-
	Corpus uteri	6.1	-	-	-	-	-	11.1	-	-	-
	Colon, rectum, & anus	6	7.5	-	-	-	-	7.8	10.6	-	-
	Non-Hodgkin lymphoma	5.3	6.8	-	-	-	-	7.7	11.4	-	-
	Cervix uteri	4.8	-	-	-	-	-	12.5	-	-	-
	Other skin	4.4	4.8	-	-	-	-	6.9	7.1	-	-
	Liver	4	6.1	-	-	-	-	6.1	8.9	-	-
	Thyroid	3.5	1.2	-	-	-	-	4.7	1.1	-	-
	Prostate	-	10.7	-	-	-	-	-	16.8	-	-
	Bladder	2.4	8.4	-	-	-	-	4.4	15.4	-	-
	Trachea, bronchus, & lung	2.0	7.7	-	-	-	-	5.9	41.9	-	-
	Brain, nervous system	3.3	5.8	-	-	-	-	3.5	4.3	-	-
	Larynx	0.6	3.4	-	-	-	-	3.0	17.9	-	-

Table 7. Comparison of the Lahore district ASIRs per 100,000 population with those reported for Bangladesh, and the United States, as compiled by the American Cancer Society, in children and adolescents.

	0-14 yrs.				15-19 yrs.			
Source/Region→	Lahore	Bangladesh	ACS	ACS	Lahore	Bangladesh	ACS	ACS
Year→	2010-2012*	2011-2014	2007-2011†	2008-2012‡	2010-2012*	2011-2014	2007-2011†	2008-2012‡
Cancer type/site↓	ASIR	ASIR	ASIR	ASIR	ASIR	ASIR	ASIR	ASIR
All ICCC groups	15.4	0.7	17.5	16.2	20.6	0.2	24.3	22.4
Leukemia	5.8	0.1	5.3	5.3	2.1	<0.1	3.2	3.3
Brain, nervous system	1.3	<0.1	4.6	3.5	2.1	<0.1	4.8	2.2
Hodgkin lymphoma	1.4	-	0.6	0.6	1.4	-	3.2	3.2
Rhabdomyosarcoma	0.4	-	0.5	0.5	0.5	-	0.4	0.4
Bone tumor∞	1.1	<0.1	0.7	0.6	3.8	<0.1	1.4	1.2
Non-Hodgkin lymphoma	1.2	-	1.0	0.9	1.8	-	1.7	1.7
Neuroblastoma	0.3	<0.1	1.1	1.1	-	-	<0.1	<0.1
Gonadal GCT	0.3	<0.1	0.3	-	1.3	<0.1	2.2	-
Nephroblastoma	0.6	<0.1	0.8	0.8	-	<0.1	<0.1	<0.1
Retinoblastoma	1.0	0.2	-	0.4	<0.1	<0.1	-	-

.*Does not include benign brain tumors. †Includes benign brain tumors. ‡Excludes benign and borderline brain tumors. ∞Bone tumor includes Ewing sarcoma and osteosarcoma.

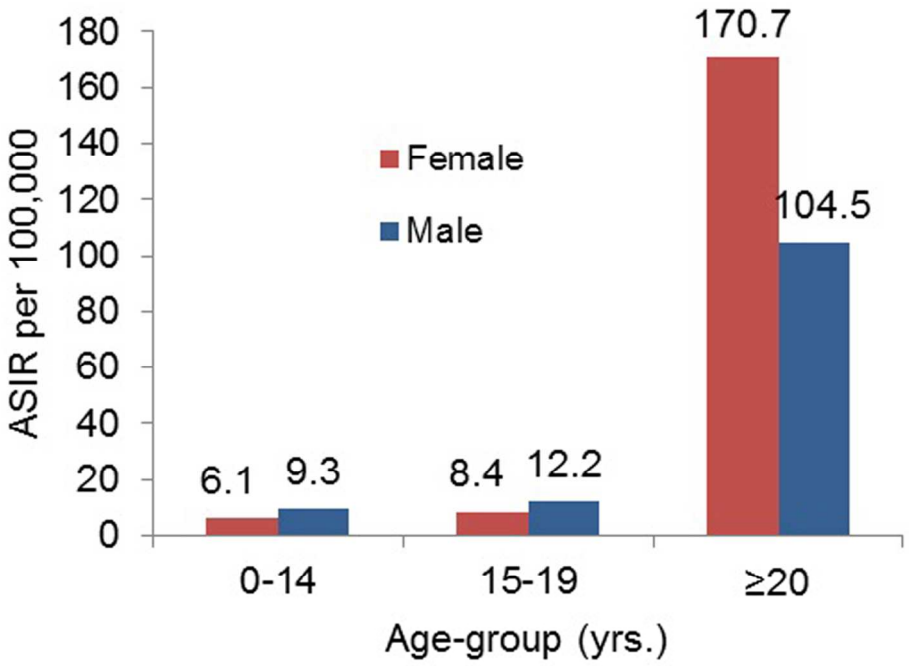

Figure 1. Age-standardized incidence rates by age-group and gender, in the Lahore district, Pakistan, 2010-2012.

142x105mm (300 x 300 DPI)

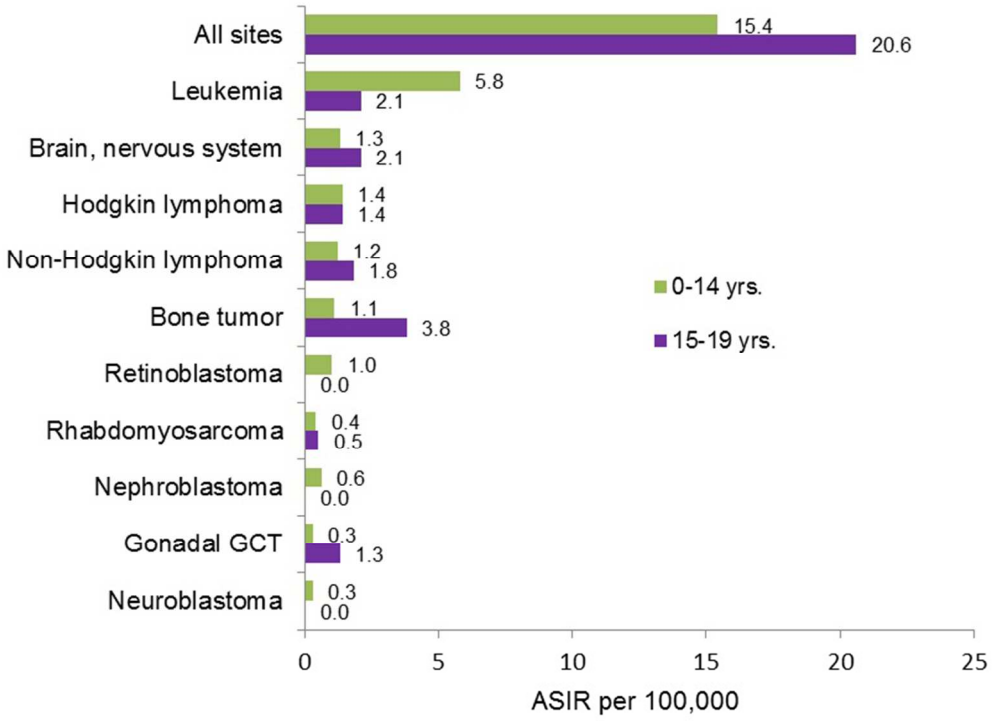

Figure 2. Age-standardized incidence rates in children and adolescents, in the Lahore district, Pakistan, 2010-2012.

68x52mm (300 x 300 DPI)

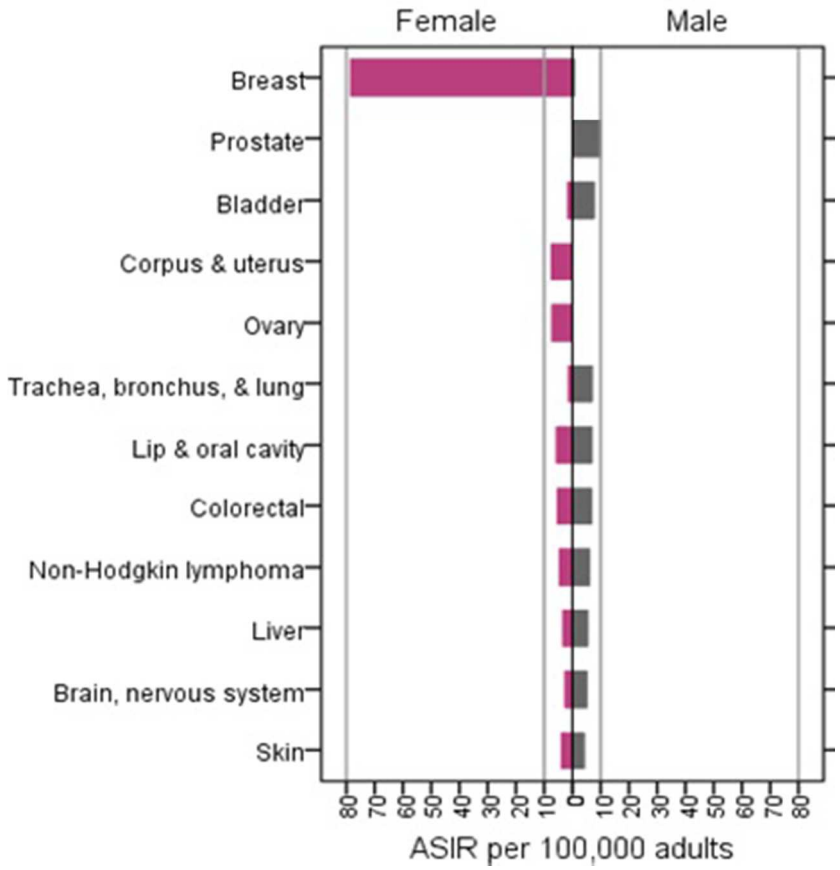

Figure 3. Age-standardized incidence rates by gender among adults, in the Lahore district, Pakistan, 2010-2012.

34x36mm (300 x 300 DPI)

Table 1. A comparison of the incidence rates for 5-year age-groups between 50-69 years for cancers of the breast, prostate, and trachea/bronchus/lung in four different regions of the world.

FEMALE	Population & age-group (yrs.)	50-	55-	60-	65-69
Breast	New Delhi	105.7	110.9	123.4	106.9
	Mumbai	89.0	98.2	106.8	101.7
	UK-England	259.5	281.5	332.5	360.3
	Lahore	130.3	158.5	154.1	157.9
MALE	**Population & age-group (yrs.)**	**50-**	**55-**	**60-**	**65-69**
Prostate	New Delhi	5.0	1.7	40.2	65.5
	Mumbai	3.4	10.2	20.0	36.4
	UK-England	46.4	143.6	295.9	652.7
	Lahore	4.4	13.1	27.1	46.0
Trachea, bronchus, and lung	New Delhi	30.5	47.4	79.0	82.0
	Mumbai	13.7	26.9	40.8	57.4
	UK-England	43.4	86.4	163.2	254.2
	Lahore	4.8	13.1	21.4	32.0

Time periods for: New Delhi-India, Mumbai-India, and UK-England (2003-2007) from IARC's CI5 Volume X and Lahore-Pakistan (2010-2012).

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5-7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5-7
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	5-7
Bias	9	Describe any efforts to address potential sources of bias	5-7
Study size	10	Explain how the study size was arrived at	5-7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5-7
		(*b*) Describe any methods used to examine subgroups and interactions	5-7
		(*c*) Explain how missing data were addressed	5-7
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	5-7
		(*e*) Describe any sensitivity analyses	-
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	7-8
		(b) Give reasons for non-participation at each stage	7-8
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7-8 and 18-27
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	7-8 and 18-27
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	7-8 and 18-27
		(*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—e.g. analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	2-3, 8-12, and Appendix A
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	4, 12-13, and Appendix A
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	8-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12-13
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	5

*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.