RESEARCH COMMUNICATION

Cancer Profile of Hyderabad, Pakistan 1998-2002

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Abstract

Hyderabad is the third largest city of Pakistan, the second largest city of Sindh Province and one of the oldest cities of the sub-continent. This administrative headquarter is located just east of the River Indus and is an important commercial and industrial center. Once a provincial capital, it is at a distance of approximately 200-km from Karachi. This present study was conducted with the objective of providing the cancer profile of Hyderabad, which has an urban population of 2,840,653 (52.2% M, 47.8% F) annual growth rate 1.13. The city is inhabited by all ethnicities of the country, however the predominant ethnicity is Sindhi, followed by Mohajirs (post-partition immigrants from India), and a lesser extent other ethnicities of Pakistan viz. Baluchs, Punjabis and Pathans.

The study includes two sets of patients. First the incident cancer cases, residents of Hyderabad, who reached Karachi for diagnosis or treatment. Second the incident cancer cases registered at the Aga Khan University Pathology-based Cancer Registry (APCR) Pathology collection points at Hyderabad and subsequently registered at APCR, during 1st January 1998 to 31st December 2002. The pathology department of the AKU has 3 centers in Hyderabad, which provide diagnostic pathology especially oncopathology services to the city. The age-standardized rates (ASR) for cancer (all sites) 1998 to 2002 in Hyderabad were 91.6/100,000 in males and 96.0/100,000 in females. The most common malignancies (ASR per 100,000) in males were oral cavity (11.8), lymphoma (10.6), lung (8.0), urinary bladder (6.8), prostate (4.8), liver (4.4), pharynx (4.2), colo-rectum (3.6), larynx (3.2), and skin (3.2). The cancers in females (ASR per 100,000) were breast (22.4), oral cavity (11.5), gall bladder (4.8), esophagus (4.2), cervix (3.6), ovary (3.4), colo-rectum (3.4), lymphoma (3.4), uterus (3.4), and thyroid (2.4). Tobacco-associated cancers were responsible for approximately 40.0% of the tumors in males and 20.0% in females. Histological confirmation remained 96.3%, with 44.5% presenting in grade II or I, 55.5% presenting as stage III and IV. Information on grade and stage of malignancy was available in 70% and 50% of the cases respectively. Males comprised 53.1%, and females 46.9% of the cases. The mean age of cancer all sites, both genders was 45.2 years (95% CI 44.4; 45.9), males 45.4 years (95% CI 44.3; 46.5); females 44.9 years (95% CI 43.9; 45.9).

Conclusions drawn from this database must be interpreted with care, as it may be identified as data from selected medical institutions. Chances of selective collection bias are minimized as the data of the AKU pathology is collected from multiple centers in the city of Hyderabad, dispersed at distances, which allows adequate sampling from the entire city. There is a slight preponderance of lymphomas in males which we feel is a true higher risk, yet it may indicate an over representation of easily accessible sites in pathology based-data. Nonetheless, this is the first attempt to determine the cancer incidence pattern of Hyderabad, and should serve as a guideline for estimation of the cancer burden and risk assessment statistics of Pakistan and the cancer control program of the country.

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Introduction

Worldwide, there are over 10 million new cases of cancer annually (4.7 million in developed countries; 5.5 million in less developed countries) and more than 6 million cancer deaths. It is estimated that there will be 15 million new cancer cases every year by 2020, and 10 million cancer deaths. To combat this cancer epidemic, cost effectively the assessment of the geographical cancer burden and the variations in different regions on the basis of risk factors is essential. Risk assessment is available for developed countries but the precise burden of cancer and risk assessment statistics are scarce for the developing countries.

Pakistan is a developing country, which falls into the

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low to medium resource category by WHO classification (WHO, 2005). The only cancer incidence data available for any region of Pakistan is from Karachi, as calculated by the Karachi Cancer Registry (KCR), established in 1995. The registry was developed with the perspective of measuring the cancer burden through a sample population of the country. KCR, the first population-based cancer registry of Pakistan has acquired 11 years stability (1995-2005) for the data of Karachi South (KS), the sample population of Pakistan (Bhurgri Y et al., 2000). At present KCR is a voting member of International Association of Cancer Registries – IACR (Bhurgri Y et al., 2002).

The Aga Khan University Cancer Surveillance for Pakistan (ACSP), was established in 2000 at the Aga Khan University Pathology-based Cancer Registry (APCR), and covers a large geographical area and population of Pakistan, through 69 centers. This coverage is likely to increase at the rate of a minimum of 10 new centers annually in the future. This data has been of immense value in determining the geographical variation of malignancies in Pakistan and as a strong prop for KCR. APCR is an associate member of the IACR (Bhurgri Y et al., 2002).

KCR has stable incidence rates for KS (1995-2004) and with the help of ACSP has calculated the incidence of Karachi Division (1998-2002), population of 9,802,134 [53% males (M) and 47% females (F)] annual growth rate 3.52 and Quetta (1998-1999) population 759,245 [56% males (M) and 44% females (F)], annual growth rate 4.13 (Census, 1998; Bhurgri Y et al., 2002 b and c).

This present study was conducted with the objective of providing the incidence of cancers in Hyderabad, the third largest city of Pakistan, the second largest city of Sindh Province and one of the oldest cities of the sub-continent. This administrative headquarter is located just east of the River Indus and is an important commercial and industrial center. Once a provincial capital, it is at a distance of approximately 200-km from Karachi. At present Hyderabad has an urban population of 2,840,653 (52.2% M, 47.8% F) annual growth rate 1.13 (Census, 1998). The city is inhabited by all ethnicities of the country, however the predominant ethnicity is Sindhi, followed by Mohajirs (post-partition immigrants from India), and a lesser extent other ethnicities of Pakistan viz. Baluchs, Punjabis, and Pathans.

Methodology

The study includes two sets of patients. First the incident cancer cases, residents of Hyderabad, who reached Karachi for treatment and were registered at the Karachi Cancer Registry. Second the incident cancer cases registered at the AKU Pathology collection points at Hyderabad and subsequently registered at APCR, during 1st January 1998 to 31st December 2002. The pathology department of the AKU has 3 centers in Hyderabad, which cater to the diagnostic pathology needs of the city, especially oncopathology.

The data of 'AKU Pathology Department', included for this paper was diagnosed on the basis of histopathology, fine needle aspiration cytology, fine needle aspiration biopsy and hematology during the 5 year period. The demographic details of the registered pathology data were precise and complete. Items such as age, sex, name, address, telephone numbers and nature of surgery were well recorded at the reception counter. A single medical registration number was given to each patient and different specimens of the patient given separate sub-identification numbers. At the APCR both the in-patients and the out-patients were given a specific cancer registration number and information updated with every revisit. It was thus possible to recognize duplicate examinations of the same patient. The variables that were recorded were the hospital patient-number, date of incidence, name, age, sex, address, topography, morphology, grading and staging. This required a well-trained staff available at all the collection points of this University lab in Hyderabad, and also of the registration staff at the main lab in Karachi. Awareness of the legal and academic requirements of accuracy of demographic data was a part of the training of the collection staff. Validity checks and random retrace of cases was conducted for follow-up and for confirmation of the information recorded.

Internal and external quality checks were used for diagnostic pathology. External quality assurances for diagnostic pathology were maintained by the College of American Pathologists (CAP) surveys. Internal quality control and standardization of the diagnosed data was maintained by using prompt and adequate fixation, grossing as per standard protocol and using histochemical stains, immunohistochemical techniques and biological markers as and when required. ISO 9002 certified the clinical pathology lab in 1999. Consensus diagnosis of all doubtful cases at the daily departmental consultation conferences improved the quality of diagnosed data. Immunohistochemistry was used for malignancies, which necessitated cellular typing and sub-typing.

The cancer data of KCR and APCR for cancer registration purpose were classified using ICD-O2 (International Classification of Diseases-Oncology, 2nd edition) and computerized using a customized version of Canreg-3 (WHO 1990). Manual and computerized validity checks for all the cancer data were performed as per recommendations of International Agency for Research on Cancer (IARC) and International Association of Cancer Registries IACR (Parkin DM et al., 1994). This involved factors influencing comparability i.e. classification and coding. All cases whether clinically diagnosed or histologically verified, were included in the study. The residency status of cases was re-ascertained and re-checked. People residing in the specified geographical regions for more than six months were considered residents. Demographical variables recorded for registration were the hospital patient-number, date of incidence, name, age, sex, address, ethnicity, topography, morphology, grading and staging. Tumors were categorized according to the UICC, TNM staging system, to standardize with the staging systems

in other parts of the world.

Incidence rates were calculated based on the 1998 census for Hyderabad, urban population of 2,840,653 (52.2% M, 47.8% F), annual growth rate 1.13% (Census 1998). The growth rates were based on the inter-census growth-rate and measures for inflow and outflow of population, calculated by the Federal Bureau of Statistics. Standardized incidence rate was calculated with an external reference population, the 'world' population with a given 'standard' age distribution (Segi, 1960). The methodology applied was direct standardization, using 5-year age groups. The rates given are the annual incidence per 100,000 population, averaged over the number of years for which data are presented. The data were analyzed using SPSS 11.0.

Results

The age-standardized rates (ASR) for cancer (all sites) 1998 to 2002 in Hyderabad were 91.6/100,000 in males and 96.0/100,000 in females. The most common malignancies (ASR per 100,000) in males were oral cavity (11.8), lymphoma (10.6), lung (8.0), urinary bladder (6.8), prostate (4.8), liver (4.4), pharynx (4.2), colo-rectum (3.6), larynx (3.2), and skin (3.2). The cancers in females (ASR per 100,000) were breast (22.4), oral cavity (11.5), gall bladder (4.8), esophagus (4.2), cervix (3.6), ovary (3.4), colo-rectum (3.4), lymphoma (3.4), uterus (3.4), and thyroid (2.4) (Figures1 and 2) Tobacco-associated cancers were responsible for approximately 40.0% of the tumors in males and 20.0% in females (Table 1). Histological confirmation remained 96.3%, with 44.5% presenting in grade II or I; 55.5% presenting as stage III and IV. Information on grade and stage of malignancy was available in 70% and 50% of the cases respectively.

Males comprised 53.1%, and females 46.9% of the cases. The mean age of cancer all sites, both genders was 45.2

Table 1. Cancer Incidence in Hyderabad (1998-2002)

Topography	Male		Female		Male:Female		ICD (10^{th})
	Hyderabad 1998-02	K.South 1998-02	Hyderabad 1998-02	K.South 1998-02	Hyderabad	Karachi	
Oral Cavity	11.8	22.5	11.5	20.4	1.1	1.1	C00-08
Pharynx	4.2	8.2	1.6	3.1	2.6	2.7	C09-14
Esophagus	2.4	6.3	4.2	8.6	0.6	0.7	C15
Stomach	1.6	6.0	1.6	4.0	1.0	1.5	C16
S.Intestine	1.0	0.4	0.2	0.2	5.0	2.0	C17
Colo-rectum	3.6	7.8	3.4	5.2	1.0	1.5	C18-21
Liver	4.4	5.3	1.2	4.0	3.7	1.3	C22
Gall bladder	0.6	1.4	4.8	5.8	0.1	0.2	C23-24
Pancreas	0.6	1.1	0.4	0.5	1.5	2.2	C25
Nose, sinuses etc.	0.3	0.5	0.4	0.7	0.8	0.7	C30-31
Larynx	3.2	11.8	1.0	1.7	3.2	6.9	C32
Bronchus, lung	8.0	25.5	0.8	4.2	10.0	6.1	C33-38
Bone	2.0	1.5	0.8	1.8	2.5	0.8	C40-41
C. tissue	2.6	2.8	1.6	2.3	1.6	1.2	C47;49
Melanoma skin	0.4	0.6	0.1	0.1	4.0	6.0	C43
Other Skin	3.2	4.8	1.6	5.5	2.0	0.9	C44
Breast	0.2	1.0	22.4	69.1			C50
Uterus	-	-	3.4	5.0	-	-	C54-55
Cervix	-	-	3.6	8.6	-	-	C53
Placenta	-	-	0.2	0.3	-	-	C58
Ovary	-	-	3.4	7.8	-	-	C56
Female genital, other	-	-	0.2	0.5	-	-	C51-52;57
Prostate	4.6	9.8	-	-	-	-	C61
Testis	2.4	1.1	-	-	-	-	C62
Penis	0.2	0.1	-	-	-	-	C60
Other male genital		0.0	-	-	-	-	C63
Bladder	6.8	9.9	1.8	2.8	3.6	3.5	C67
Kidney	1.4	1.8	0.6	1.4	2.3	1.3	C64-66;68
Eye	0.6	0.4	0.4	0.4	1.5	1.0	C69
Brain, N. system	1.8	3.0	1.2	2.2	1.5	1.4	C70-72
Thyroid	1.2	1.0	2.4	3.3	0.5	0.3	C73
Lymphoma	10.6	9.6	3.4	7.2	3.1	1.3	C81-85;96
Multiple myeloma	0.4	1.8	0.6	1.8	0.6	1.0	C88;90
Leukemia	3.0	4.8	1.8	4.7	1.6	1.0	C91-95
Unspecified	13.2	27.6	9.9	21.1	1.3	1.3	
All sites	91.6	179.0	96.0	204.1	0.9	0.9	
Tobacco-Associated Ts.	40 %	40%	20%	18%			

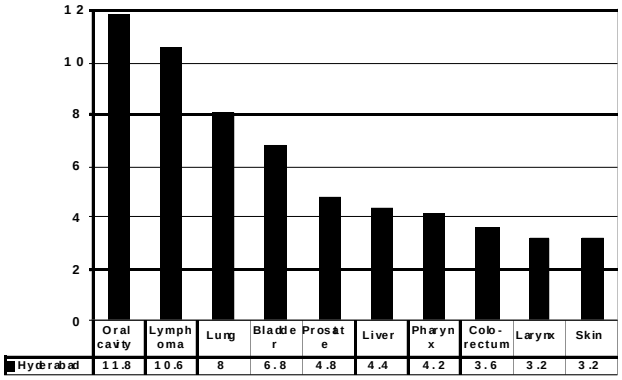

Figure 1. Cancer Incidence in Hyderabad ASR per 100,000; 1998-2002 (Male)

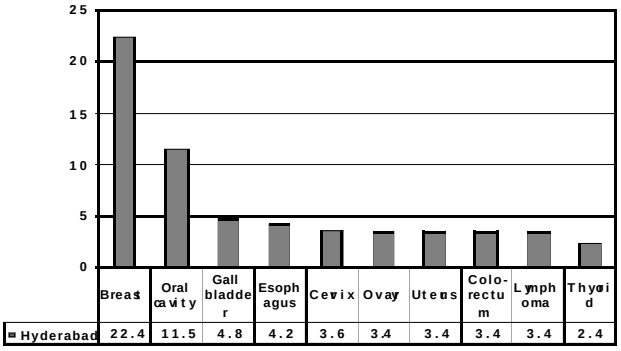

Figure 2. Cancer Incidence in Hyderabad ASR per 100,000; 1998-2002 (Female)

years (95% CI 44.4; 45.9); males 45.4 years (95% CI 44.3; 46.5); females 44.9 years (95% CI 43.9; 45.9). The minimum age was <1 year for both genders (childhood cancers) and maximum was 95 years for males and 90 years for females. The mean ages and the minimum and maximum age at diagnosis varied with different cancer sites (Table 2). A higher risk in males was observed for tobacco associated cancers and lymphoma (Table 1).

Oral cancer accounted for 11.8% of all cancer cases in the males and 9.8% in the females. In males the most common site was the mucosa cheek (48.3%), followed by tongue (35.7%), lip (6.3%), gum (4.2%), palate (3.5%) and floor of mouth (2.1%). The distribution in females was mucosa cheek (48.0%), followed by tongue (31.0%), gum (8.0%), lip (6.0%), floor of mouth (4.0%) and palate (3.0%). The minimum age at diagnosis was 7 years in the males and 14 years in the females. About 25.9% of the oral cancer cases occurred in patients 40 years and younger and 12.3% occurred in patients 65 years and older.

The common childhood cancers were Hodgkins Disease, non-Hodgkins Lymphoma, retinoblastoma, soft tissue and bone sarcomas and gonadal malignancies. Some unusual sites for childhood cancers were liver, skin, oral cavity, small intestine and colorectum (Table 2).

Table 2. Mean, Minimum and Maximum Age at Diagnosis of Cancer Patients in Hyderabad (1998-2002)

Topography	Male			Female		
	Mean age in years (95%CI)	Minimum; Maximum age at diagnosis (years)		Mean age in years (95%CI)	Minimum; Maximum age at diagnosis (years)	
Oral Cavity	45.8 (43.8; 47.9)	7	90	50.1 (47.7; 52.4)	14	80
Pharynx	50.3 (43.2; 57.4)	30	80	49.1 (45.1; 53.1)	23	75
Oesophagus	50.3 (43.3; 57.3)	30	80	47.1 (30.7; 63.6)	25	75
Stomach	53.4 (47.7; 59.0)	35	71	47.0 (38.1; 55.9)	25	75
S.Intestine	48.7(39.7; 57.7)	20	65	33.0 (24.5; 41.5)	13	55
Colo-rectum	41.7(33.7; 49.7)	2	90	45.7 (38.0; 53.4)	14	70
Liver	52.5(43.6; 61.4)	2	84	45.9 (35.9; 55.9)	5	70
Gall bladder	53.3(44.8; 61.8)	28	65	54.6 (47.9; 61.3)	27	80
Larynx	48.6(41.6; 55.6)	25	72	59.1 (48.2; 70.0)	35	85
Bronchus, lung	56.2 (53.2; 59.3)	30	85	59.6 (49.5; 69.7)	35	83
Bone	24.3(31.1; 17.5)	3	60	24.4 (17.8; 31.0)	3	60
C. tissue	34.7(24.4; 45.0)	1	70	32.2 (23.5; 40.9)	6	70
Skin	49.2 (40.8; 57.6)	5	80	48.0 (41.0; 55.0)	6	65
Breast	-	-	-	45.2 (43.8; 46.0)	16	80
Uterus	-	-	-	51.0 (44.6; 57.4)	22	75
Cervix	-	-	-	45.5 (41.5; 49.5)	22	65
Ovary	-	-	-	41.4 (32.5; 50.3)	4	76
Prostate	64.8 (53.4; 76.2)	35	90	-	-	-
Testis	31.9 (25.2; 38.6)	3	65	-	-	-
Bladder	58.1 (51.1; 65.2)	20	95	59.3 (51.3; 67.5)	35	90
Kidney	54.3 (50.4; 58.5)	2	95	51.6 (38.5; 58.2)	1	90
Eye	3.4 (0.9; 4.9)	1	7	17.3 (10.1; 29.4)	2	60
Brain, N. system	26.7 (15.7; 35.2)	3	78	26.5 (14.2; 36.3)	7	60
Thyroid	40.1 (33.3; 47.7)	13	68	40.5 (32.3; 47.6)	13	60
Lymphoma	35.6 (25.1; 46.0)	2	78	36.9 (25.2; 44.0)	6	75
All sites	45.4 (44.3; 46.5)	1	95	44.9 (43.9; 45.9)	<1.0	90

Discussion

The patterns of malignancy in Hyderabad are similar to the cancer profile of Karachi, with a few exceptions. The age-standardized rates (ASR) for cancer (all sites) 1998 to 2002 in Hyderabad were 91.6/100,000 in males and 96.0/ 100,000 in females. These rates are low in comparison to the incidence rates of Karachi South, and the probable reason is approximate 20-30% incompleteness in the Hyderabad data, all data source not being utilized. We are missing the malignancies in Hyderabad which were not diagnosed at the AKU pathology department; though a large number of these cases either came to Karachi for diagnosis, treatment or simply a second opinion. The registry data at KCR and APCR had a reasonable precision of recorded addresses. However other than this, the clinical and pathology data in Hyderabad was not utilized as records were either not preserved or preserved without addresses thus the residency status could not be established. The death registry data was also not informative as the cause of death was not specified. As with most developing country cancer registration we may also be missing cases with advanced malignancies who may not be subjected to intense diagnostic procedures, older patients or females who may not be entering the health sector and the socio-economically deprived who may not have access to medical care. The percentage of cases with microscopic verification is high and similar to the values in the developed countries reflecting the predominantly pathology-based origin of the data. The cases coming to Karachi for treatment and reported to KCR have a high microscopic verification due to insistence of clinicians establishing verification prior to initiation of therapy.

Hyderabad like Karachi falls into the Asian high oral cancer zone, which includes a part of Pakistan adjacent to India. Cancer oral cavity (ICD C00-06) is the most common malignancy in males and the second commonest in the females. A wide age-range was observed, the youngest patient being 7 years and the oldest 90 years of age. Oral cancer in the younger patients was associated with underlying submucous fibrosis a risk factor of oral cancer associated with areca nut chewing (IARC, 2003). The incidence of oral cancer and site of malignancy also reflect exposure to risk factors. The high incidence of oral mucosa and tongue lesions lend support to oncogenesis associated with chewing which may be areca nut, betel quid, pan masala, gutka, poor diet, aspergillus contamination of areca nut, though all tobacco use puts the population at risk. In Pakistan generally, alcohol is a notable omission as a risk factor. The higher rates for tobacco-related cancers in Karachi are indicative of a similarity of tobacco-habits in the Mohajir (Indian immigrant) population in Karachi and the Indian region, however the risk seems slightly lower in Hyderabad in comparision (Jafarey NA, 1994; Alam SE, 1998; Merchant AT et al., 1998; Sankaranarayanan R et al., 1989; Sankaranarayanan R et al., 1990).

The age-standardized annual incidence for cancer of the lip is low as smoking is less popular then chewing. The

Figure 3. The Emerging 'Oral Cancer' Map of Pakistan, with a High Risk Zone in Karachi, a Moderately High Risk in Hyderabad, and a Relatively Lower Risk in Quetta

incidence rates of oral cancer in Hyderabad are lower than in Karachi, but higher than Quetta (Figure 3). In Karachi a predominantly Mohajir population and lifestyle pattern, a rising incidence, strong socio-economic factor and poorer, low literacy profile of oral cancer has been observed in the last decade. Quetta is situated outside the high oral cancer zone of Pakistan, closer to and at the periphery of the Asian esophageal cancer zone, in the North West of Pakistan (Bhurgri Y et al., 2003).

Like Karachi, Hypopharynx was the most common site for cancers in the pharynx, a pattern observed in other regions of the subcontinent. The incidence rates of cancer lung, larynx and esophagus are lower than the rates in Karachi and may represent either a lower prevalence of risk factors such as tobacco smoking or under-registration of these cancers. A slight deficit of lung cancer is visible, as not all the cases of lung cancer are necessarily biopsied, however the difference is marginal. The age-standardised incidence rate for lung cancer was moderately high for males. Males showed a ten times higher risk as compared with the females, the ratio being one of the highest in the world region. The age-standardised rates for oral cavity cancer in females are high in contrast to lung cancer, this being attributable to the difference in the tobacco-habits in them. Squamous cell carcinoma, with a lesser percentage of small cell and large cell carcinoma are the predominant morphology of lung cancer in the males. The small percent of adenocarcinomas were predominantly observed in the females. The age specific rates show a gradual rise from the 4th to 6th decade with a sharp accent in the 7th decade. The stage at diagnosis is very advanced. The vast majority being diagnosed with a

stage 4 disease.

The incidence of stomach cancer is low in Hyderabad, despite a high prevalence of Helicobacter pylori infection in the population. The pattern is similar to Karachi and other regions of the subcontinent, indicating a role of dietary protective factors (Kazi JI et al., 1990). The incidence of cancer gall bladder is also high, in females comparable to the high risk regions of the world. In Karachi gall bladder cancer is associated with gall stones; however no studies are available for Hyderabad. Dietary risk factors, association with hormones and genetic susceptibility are risk factors to be studied in this population.

Breast cancer is the most frequent cancer in the females. This pattern is observed in almost all regions of Pakistan though the ASR is higher in Karachi South, a more westernized region of the country. The only exception is Quetta which reports esophageal cancer as the most frequent cancer in females followed by breast as the second-most common cancer. The age-specific curves show a gradual increase in risk uptil the 6th decade, followed by a flattening. Reproductive factors cannot be considered risk factors in Pakistan, as early marriages, multiple births and prolonged breast-feeding are the prevalent cultural norm. Early menarche, late menopause and thus the prolonged effect of reproductive hormones could be other possible risk factors along with dietary factors and obesity. The predominant histological type was duct cell carcinoma.

Malignancies of the female genital tract i.e. cervix, ovary and uterus (body) comprised 10.9% of the total cancers in the females. Morphologically the vast majority of the cases are adenocarcinomas. Sarcomas in contrast are few. The rates for cancer cervix are low compared to the Asian region, especially India but similar to the Western Asian Muslim countries. Squamous cell carcinoma with a smaller percent of adenocarcinoma were the predominant histological pattern observed, as elsewhere. Cancer screening has not been implemented and older age groups may be missing the health-care system due to neglect or social inhibitions, the age-standardised rate of 3.6 for cervix cancer reflects overt cancers in stage 3 or 4. Implementations of population screening and early detection programs are likely to record a sudden increase in incidence due to the early detection of cervical cancer.

Cancer of the ovary is the sixth most common malignancy rated at number three in Karachi South. Morphologically a third of the cancers were reported as adenocarcinomas, followed by the serous and the mucinous carcinoma. Germ cell tumours were the dominant morphology in the younger age group. The age-specific curves show a gradual increase in risk uptil the 7th decade, for uterus and ovary and the 8th decade for cervix. The apparent lower risk for prostate cancer may be an indicator of 'missing cancers' diagnosed on the basis of clinical investigations. The lower life expectancy in Pakistan and also the lack of post-mortems substantially contribute to the low age-standardised incidence rates for prostate in comparison to the developed countries.

'It is an acceptable fact that information on cancers obtained from the registers or databases of selected medical institutions, represent only a proportion of all those occurring in the population. The data may be biased in terms of tumor type, sex, age, socio-economic group, etc, depending on the nature of the institution(s) and the treatment facilities available (Parkin, DM et al., 1986)'. The data of the AKU pathology is collected from multiple centers in the city of Hyderabad. These centers are dispersed at distances which allow adequate sampling from the entire city. The data covers a wide age range (Table 2), therefore chances of selective collection bias is minimized.

Conclusions drawn from this database must be interpreted with care. Easily accessible sites like skin cancer show a uniform representation but bone and soft tissue tumors are marginally over-represented. Unlike Karachi the incidence of lymphoma, eye, gonad and bone tumors is high in the males. A slight preponderance of lymphomas may indicate an internationally accepted over representation of easily accessible sites in pathology based-data and the pattern of a referral center for lymphomas. However, this may be a true higher risk, because a pathology-based bias would also be reflected in the females, but that is not observed. Viral infections and genetic causes associated with consanguineous marriage should be studied in this population.

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