CHAPTER

2   Epidemiology of Cancer

Cancer is an important, challenging and increasing health problem. It exhibits a striking geographic variation related to differences in the age structure of populations, as well as, environmental factors.

Epidemiology is the study of the distribution of and determinants in human populations. Such studies are usually conducted in two phases. First, *descriptive epidemiology* provides an indication of the frequency of cancer and its profile. Second, *analytic epidemiology* aims at discovering possible causes by comparing cancer risks between subgroups of populations (cohort or case-controlled studies). Epidemiology provides basic information essential for the conduct of a cancer control program on a national level.

The present chapter presents both the magnitude and pattern of cancer burden at global, regional and national levels. Data from North America (an example of developed country) will be presented to allow comparison with national and regional data.

Measures of Epidemiology

Incidence rate: it is the number of new cancer patients per 100,000 persons per year, based on data from population-based cancer registry. It is a measure of disease frequency for etiologic evaluation.

Age-standardized incidence rate: it is calculated by adjusting data to a standard world population, hence allowing valid comparison of incidence data between different populations.

Mortality rate: it is the number of deaths from cancer per 100,000 persons per year. It measures the average risk to the population of dying from a specific cancer within a year.

Prevalence: describes the number of persons alive with cancer (both new and previously treated) at a particular point of time. Prevalence reflects the public health burden of cancer.

Relative frequency: it is the percentage of a given cancer to total cancers, calculated from hospital-based data.

Case fatality ratio: it is the ratio of mortality to incidence and it can be used to calculate the survival rate (e.g. a case fatality ratio of 0.7 means that 70% of patients will die and 30% will survive).

Relative risk of developing cancer: it is the ratio between cancer risk among exposed to cancer risk among non-exposed. The higher the relative risk, the higher the association and possible etiologic relation.

Risk of getting or dying from the disease before age 75 (%): The probability or risk of individuals getting/dying from cancer. It is expressed as the number of new born children (out of 100) who would be expected to develop/die from cancer before the age of 75 if they had cancer rates (in the absence of other causes of death).

THE GLOBAL CANCER PROBLEM

Incidence Profile

The world's population was only 2.6 billion in 1950, but in the year 2011 it was 7 billion, and in 2023 it is estimated to reach 8 billion. About 82% of world population is located in developing countries. The population growth rate will slow from the current 1.2 % to below one percent by 2025. Worldwide, the population of those aged 65 and older will increase from 8% in 2011 to 11% in 2025 that is more than twice as fast as the total population growth in the same period. The growth rate of the elderly age group in less developed countries will be nearly double the rate in developed countries. Growth in the youth population (ages 15 to 24) in Middle East and North Africa (MENA) has slowed and even is declining in some countries. In Egypt this sector of population showed a 33% growth between 1995-2010 which is projected to decline to only 8% between 2011-2025. (Fig 2-1) shows population pyramids for the less developed and more developed countries.

The global burden of cancer continues to increase largely because of the aging and growth of the world population alongside an increasing adoption of cancer-causing behaviors, particularly smoking, in economically developing countries. Based on the GLOBOCAN 2008 estimates (Ferlay et al, 2010), about 12.7 million cancer cases and 7.6 million cancer deaths are estimated to have occurred in 2008 (estimated to be 13.2 in 2010); of these, 56% of the cases and 64% of the
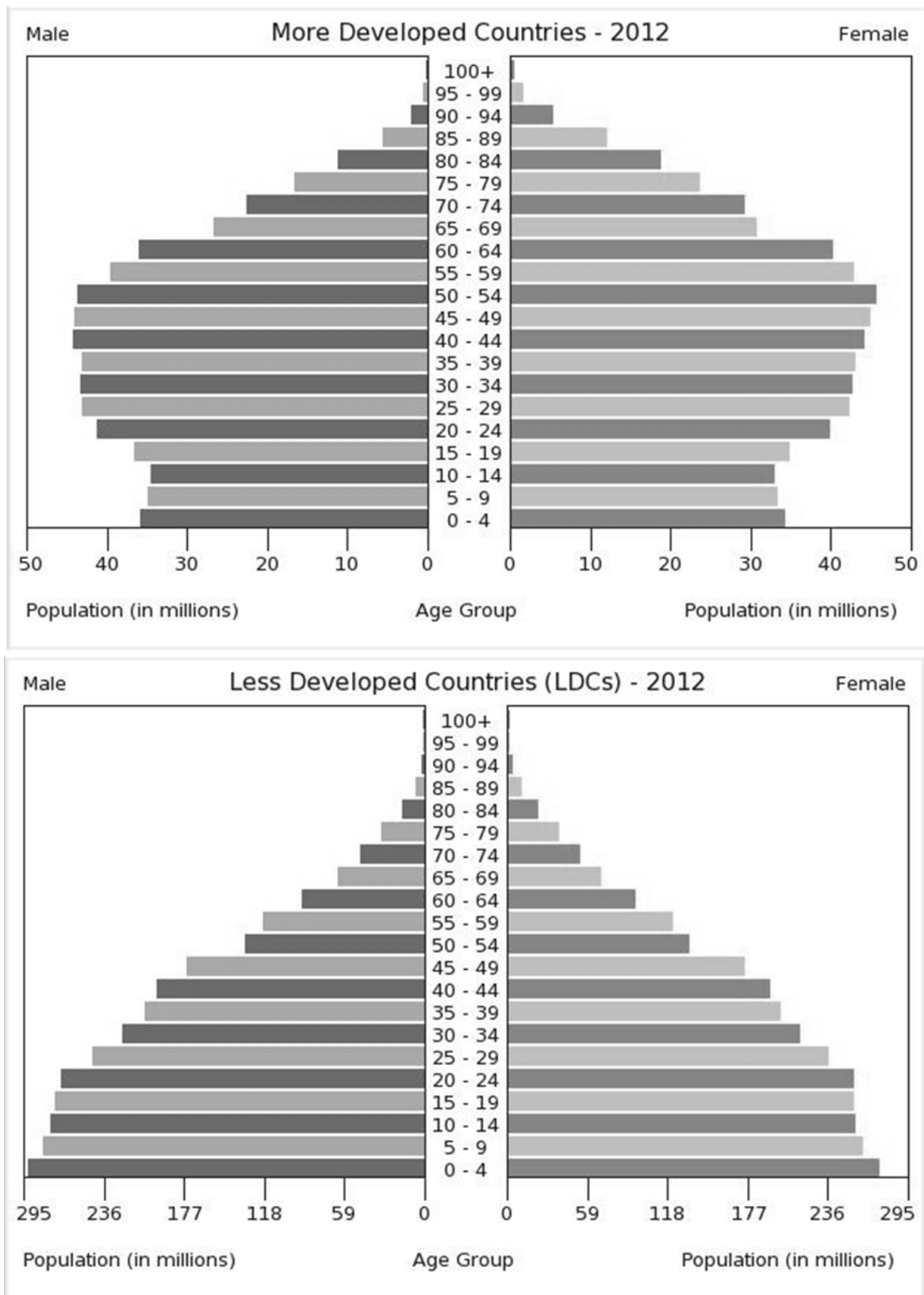
Fig 2-1 *Comparative population pyramids of the more and the less developed countries (2012 data, source: United States Census Bureau).*

deaths occurred in the economically developing world. 52% of cancers affect males and 48% affect females. Those aged more than 65 years will suffer 53% of all cancers worldwide.

Breast cancer is the most frequently diagnosed cancer and the leading cause of cancer death among females, accounting for 23% of the total cancer cases and 14% of the cancer deaths. Lung cancer is the leading cancer site in males, comprising 17% of the total new cancer cases and 23% of the total cancer deaths. Breast cancer is now also the leading cause of cancer death among females in economically developing countries, a shift from the previous decade during which the most common cause of cancer death was cervical cancer. Further, the mortality burden for lung cancer among females in developing countries is as high as the burden for cervical cancer, with each accounting for 11% of the total female cancer deaths.

Although overall cancer incidence rates in the developing world are half those seen in the developed world in both sexes, the overall cancer mortality rates are generally similar. Cancer survival tends to be poorer in developing countries, most likely because of a combination of a late stage at diagnosis and limited access to timely and standard treatment. (Table 2-1) is a summary of cancer incidence and mortality worldwide including the five most common cancers for males, females and both sexes. (Table 2-2) shows incidence and mortality for the most common ten cancers in males, females and both sexes worldwide.

As a result of cancer prevention and screening programs, policy changes that aim at cancer prevention (e.g. restricting tobacco selling, prohibiting smoking in public places, minimization of occupational exposure), urbanization, change of dietary and personal habits as well as population mobilization, there is always a change in the incidence of cancers which are linked to any of these factors. As a result probably there will be a rise in lung, prostate and breast cancers and a decline in gastric cancer on the global level. The global incidence of lung cancer is increasing by about 0.5% per year, whereas, that of stomach cancer is decreasing by approximately 2% per year. On the contrary, in USA the incidence of lung cancer was decreasing by 1.9% in men from 2004-2008 and that of breast cancer was showing stability during the same period.

In developing countries, as in sub-Saharan Africa the most frequently diagnosed cancers in men include prostate, liver, Kaposi sarcoma, esophagus, non-Hodgkin lymphoma, colorectum then lung. Whereas, in women, the age-adjusted incidence of cancer of the uterine cervix exceeds that of the breast.

In Southeastern Asia Region (SEARO), cancers of the lung, lip and oral cavity, liver, oropharynx, stomach and esophagus are among the most prominent in men. In women; breast, cervix, colorectum, ovary and lung are the commonest in that order. (Fig 2-2) shows ranking of the ten most common cancers in the more developed and less developed countries (Ferlay et al, 2010).

Cancer caused the death of about 7.6 million persons worldwide in 2008 (about 13% of all deaths). On the global level and in developed (high-income) countries, cancer is the second cause of death after cardiovascular disorders. In developing (low and middle-income) countries, cancer is the third cause of death after infectious-parasitic diseases and diseases of the circulatory system (WHO, 2012). About 70% of all cancer deaths occurred in low- and middle-income countries. Deaths from cancer worldwide are projected to continue to rise to over 13.1 million in 2030. The leading cancers in causing death are; lung (1.37 million deaths), stomach (736 000 deaths), liver (695 000 deaths), colorectal (608 000 deaths), breast (458 000 deaths) and lastly, cervical cancer (275 000 deaths) (Ferlay et al, 2010).

WESTERN CANCER PROBLEM

The USA is taken as a model of the Western cancer problem as it is a vast country of about 314 (mid 2012 population) millions, with urban population contributing 79%. The population age structure is predominantly adults and elderly (Fig 2-3). With urbanization and increase of income, the individuals acquire western dietary habits and life style. The diet is rich in fat and protein, but deficient in vegetable and fruits. Smoking tobacco and alcohol drinking are prevalent habits but smoking is showing a steady decline in prevalence as a result of strict application of legislative measures restricting smoking coupled with public health educational programs rooting public awareness of smoking hazards. This is reflected in the spectrum of cancer.

In the USA, one in two males and one in three females will be diagnosed with cancer during their

Table 2-1 Cancer Incidence and Mortality Worldwide*

WORLD	Male	Female	Both sexes
Population (thousands)	3414566	3358715	6773281
Number of new cancer cases (thousands)	6617.8	6044.7	12662.6
Age-standardized rate (W)	202.8	164.4	180.8
Risk of getting cancer before age 75 (%)	21.1	16.5	18.6
Number of cancer deaths (thousands)	4219.6	3345.2	7564.8
Age-standardized rate (W)	127.9	87.2	105.6
Risk of dying from cancer before age 75 (%)	13.4	9.1	11.1
5-year prevalent cases, adult population (per thousands)	13514.9	15288.3	28803.2
Proportion (per 100,000)	550.6	620.8	585.8
Ranking of 5 most frequent cancers	Lung	Breast	Lung
	Prostate	Colorectum	Breast
	Colorectum	Cervix uteri	Colorectum
	Stomach	Lung	Stomach
	Liver	Stomach	Prostate

*(Ferlay et al., 2010)

and every minute a person dies from cancer (557,190 persons are expected to die of cancer in 2012). It is estimated that within five years cancer will surpass heart disease as the leading cause of death.

The National Cancer Institute estimates that nearly 12 million Americans with a history of cancer were alive in January 2008. About 1,638,910 new cancer cases are expected to be diagnosed in 2012. This estimate does not include carcinoma in situ (noninvasive cancer) of any site except urinary bladder, and does not include basal and squamous cell skin cancers, which are not required to be reported to cancer registries in the USA. The five leading cancers in USA among men (Table 2-3) are prostate (25%), lung and bronchus (15.4%), colon and rectum (10.6%), urinary bladder (6.9%) and non-Hodgkin lymphoma (4.8%), whereas, among women the leading five cancers are breast (26.4%), lung and bronchus (14.5%), colon and rectum (10.8%), corpus uteri (5.8 %), and non-Hodgkin's lymphoma (4.4%).

The 5-year relative survival rate for all cancers diagnosed between 2001 and 2007 was 67%, up from 49% in 1975-1977. The improvement in survival reflects both progress in diagnosing certain
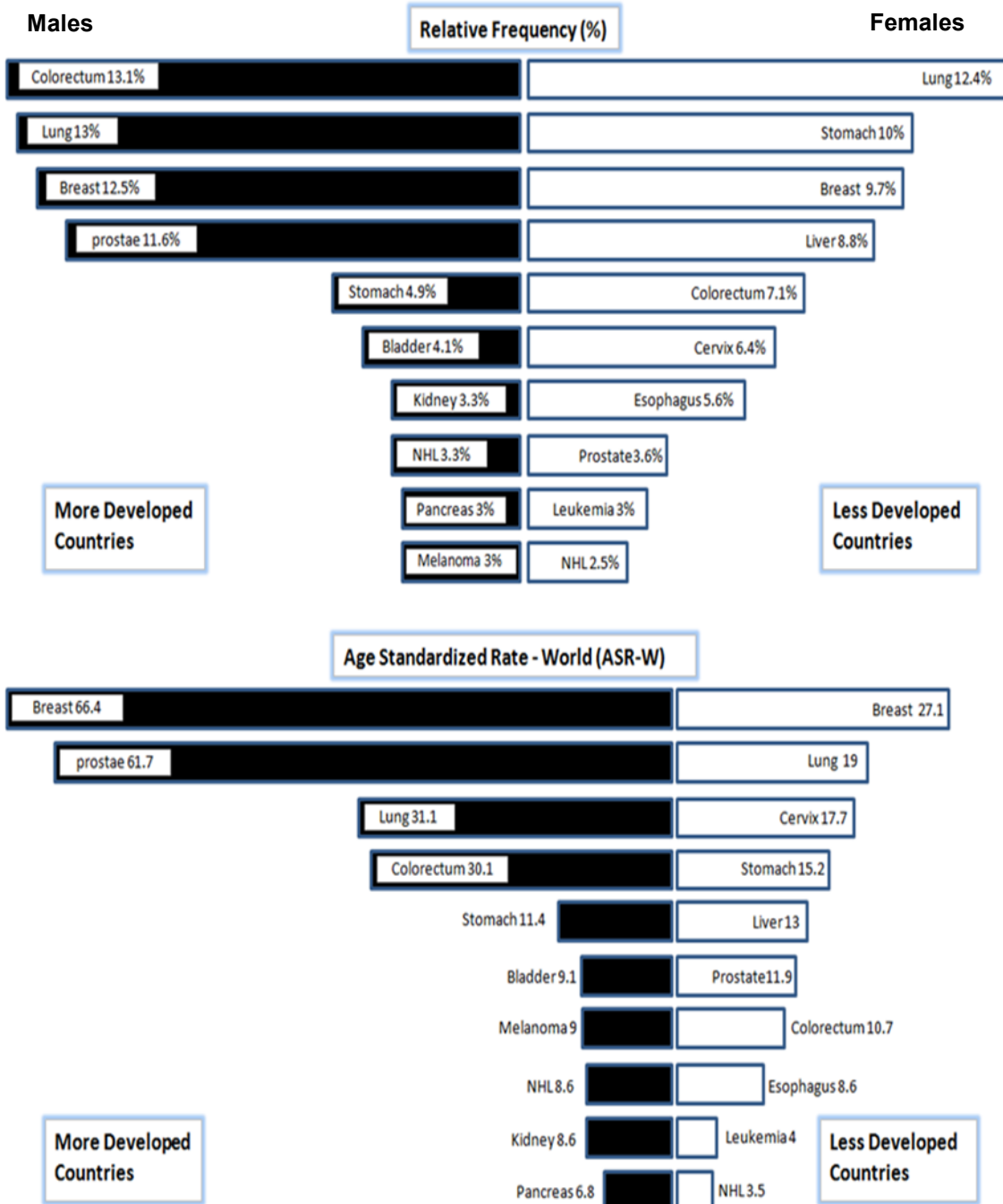
Males **Relative Frequency (%)** **Females**

Males		Females
Colorectum 13.1%		Lung 12.4%
Lung 13%		Stomach 10%
Breast 12.5%		Breast 9.7%
prostae 11.6%		Liver 8.8%
Stomach 4.9%		Colorectum 7.1%
Bladder 4.1%		Cervix 6.4%
Kidney 3.3%		Esophagus 5.6%
NHL 3.3%		Prostate 3.6%
Pancreas 3%		Leukemia 3%
Melanoma 3%		NHL 2.5%

More Developed Countries **Less Developed Countries**

Age Standardized Rate - World (ASR-W)

Males		Females
Breast 66.4		Breast 27.1
prostae 61.7		Lung 19
Lung 31.1		Cervix 17.7
Colorectum 30.1		Stomach 15.2
Stomach 11.4		Liver 13
Bladder 9.1		Prostate 11.9
Melanoma 9		Colorectum 10.7
NHL 8.6		Esophagus 8.6
Kidney 8.6		Leukemia 4
Pancreas 6.8		NHL 3.5

More Developed Countries **Less Developed Countries**

Fig 2-2 *Ranking of the ten most common cancers in the more developed countries and less developed countries (Ferlay et al, 2010).*

Table 2-2 Estimated Incidence and Mortality of Major Cancers in Men, Women and Both Sexes Worldwide, 2008

	MEN				WOMEN				BOTH SEXES			
	Incidence		Mortality		Incidence		Mortality		Incidence		Mortality	
Site	%	ASR	%	ASR	Site %	ASR	%	ASR	Site %	ASR	%	ASR
Lung 16.5	33.8	22.5	29.2	*Breast* 22.9	38.9	13.7	12.4	*Lung* 12.7	22.9	18.2	19.3	
Prostate 13.6	27.9	6.1	7.4	*Colorectum* 9.4	14.6	8.6	7	*Breast* 10.9	38.9	6.1	12.4	
Colorectum 10	20.3	7.6	9.6	*Cervix uteri* 8.8	15.2	8.2	7.8	*Colorectum* 9.8	17.2	8.1	8.2	
Stomach 9.7	19.7	11	14.2	*Lung* 8.5	13.5	12.8	10.9	*Stomach* 7.8	14	9.7	10.3	
Liver 7.9	16	11.3	14.5	*Stomach* 5.8	9.1	8.2	6.9	*Prostate* 7.1	27.9	3.4	7.4	
Esophagus 4.9	10.1	6.5	8.5	*Corpus uteri* 4.8	8.2	2.2	1.9	*Liver* 5.9	10.8	9.2	9.9	
Bladder 4.4	8.9	2.7	3.3	*Liver* 3.7	6	6.5	5.7	*Cervix uteri* 4.2	15.2	3.6	7.8	
NHL 3	6	2.6	3.3	*Ovary* 3.7	6.3	4.2	3.8	*Esophagus* 3.8	7	5.4	5.8	
Leukemia 3	5.8	3.4	4.3	*Thyroid* 2.7	4.7	0.7	0.6	*Bladder* 3	5.3	2	2	
Lip, oral cavity 2.6	5.2	2	2.6	*Esophagus* 2.6	4.2	3.9	3.4	*NHL* 2.8	5.1	2.5	2.7	
All cancers 100	203	100	128	*All cancers* 100	164	100	87.2	*All cancers* 100	181	100	106	

(Ferlay et al, 2010) Abbreviations: NHL non-Hodgkin Lymphoma, ASR age standardized rate per 100,000, all cancers: non melanoma skin cancer excluded
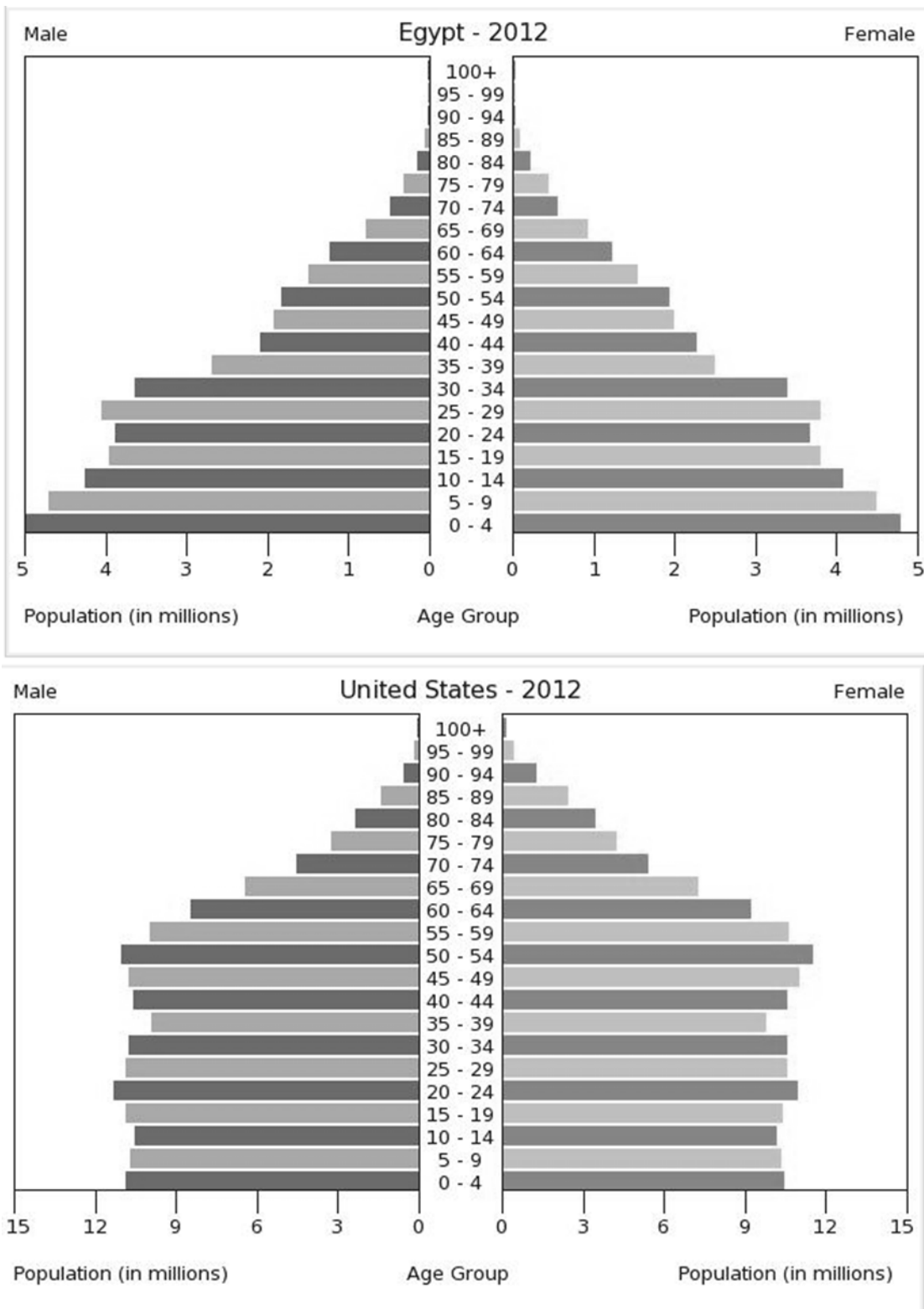
Fig 2-3 *Comparative Age Structure of Egypt and The United States of America, population pyramids 2012 data (source: United States Census Bureau).*

cancers at an earlier stage and improvements in treatment. The incidence rates of many cancers have declined in recent years due to numerous factors. Decreases in smoking have manifested as declines in lung cancer incidence rates among men, and more recently among women. Colorectal and cervical cancer incidence rates have declined due in part to early detection and removal of precancerous lesions The incidence of stomach cancer has declined due to a decreasing prevalence of Helicobacter pylori infection associated with improved hygiene and overall improvements in diet and food storage practices. More recently, declines in prostate cancer incidence may be associated with a plateau in prostate-specific antigen (PSA) screening among men. Female breast cancer incidence rates have remained stable after declining 7% from 2002 to 2003, largely due to reductions in the use of hormone replacement therapy, an important risk factor for breast cancer

Despite these improvements in incidence trends for the major cancer sites, incidence rates for several cancers are increasing, including: human papillomavirus (HPV)-related oropharyngeal cancer; esophageal adenocarcinoma; melanoma of the skin; and cancers of the pancreas, liver and intrahepatic bile duct, thyroid, and kidney and renal pelvis. The causes of these increasing incidence trends are unclear, but may reflect the combined effects of changes in cancer risk factors and detection practices. Notably, as the USA population continues to shift to older age groups where cancer risk is highest, if rates of other more common cancers remain unchanged or decline, cancers with increasing trends will account for a greater proportion of all cancer cases over time.

THE REGIONAL CANCER PROBLEM

The Arab world includes 22 countries with a total population of about 362 million. The urban/rural population split is about 55.8/45.2 %. The Arab world has the following common epidemiological features which contribute to the profile of cancer problem : (1) high incidence of infections and malnutrition (2) young age of the population (3) increasing industrialization and urbanization unaccompanied by protective measures (4) high solar exposure (5) inadequate public education leading to late presentation of cases. National cancer registries are available in Gulf countries, Lebanon and Jordan. Regional registries are present in Egypt, Algeria and Tunisia.

The profile of cancer among Arab population is characterized by: a high frequency of breast, prostate, bladder, colorectum, lung, liver, esophagus, and cervix. Relatively high frequency figures of lung cancer were reported only from Bahrain, Tunisia, Libya, Morocco and Algeria. (Table 2-4) shows cancer incidence and the top five common cancers in Arab countries.

Breast cancer is the most common malignant tumor in all Arab countries with the exception of Mauritania where it comes second after cancer cervix. The highest incidence is reported in Lebanon, Bahrain, Kuwait, Jordan, Qatar and Egypt in a descending order.

Bladder cancer is frequent where Schistosoma hematobium is endemic, namely: Egypt, Iraq, Sudan, Southern Saudi Arabia (Jizan region) and Yemen. The relative frequency of bladder cancer is 18.3% in Egypt, 6.5% in Iraq and 6% in Jizan region. Lebanon shows a high incidence of bladder cancer (ASR 14.5) possibly due to the combined effect of industrial pollution, smoking and infection.

Malignant Lymphoma is a relatively common malignancy with reported ASR of 8.4 in Egypt, 7.1 in Kuwait, 6.6 in Iraq and 6 in both Djibouti and Yemen. There is also a high frequency of gastrointestinal localization of non-Hodgkin's lymphoma.

The increasing incidence of prostate cancer is attributed to aging of population as a result of improved socioeconomic standards and health care (including the adoption of PSA screening programs). High prostate cancer is seen in Lebanon, Mauritania, Qatar, Bahrain, Jordan, Tunisia, Kuwait, Western Sahara, and Libya.

Cancer cervix is frequent in Mauritania (ranking 1st), Djibouti, Morocco and Eritrea where it comes in 2nd rank, Algeria (3rd rank), UAE and Sudan. This is probably related to HPV infection.

Liver cancer shows marked increase in its incidence in some Arab countries in the last decade due to high prevalence of viral hepatitis. It is relatively common in Mauritania, Egypt and Yemen with ASR 16.4, 9.3 and 8.8 respectively.

Colorectal cancer Jordan, Kuwait and KSA where it comes as the 2nd common cancer in these three countries. It is also relatively common in Lebanon, Libya and Qatar. This is etiologically linked to dietary and bowel habits.

Kaposi sarcoma is relatively common in Djibouti, Somalia, and Eritrea due to prevalence of HIV infection. Oral cancer is relatively fre-

Table 2-3 Estimated Incidence and Mortality of Major Cancers in Men, Women and Both Sexes, USA, 2008

MEN

Site	Incidence %	Incidence ASR	Mortality %	Mortality ASR
Prostate	25	83.8	9.7	9.7
Lung	15.4	49.5	30.9	38.2
Colorectum	10.6	34.1	8.3	9.9
Bladder	6.9	21.1	3.4	3.7
NHL	4.8	16.3	3.3	4
Melanoma of skin	4.7	16.3	1.8	2.3
Kidney	4.6	16.1	2.9	3.6
Leukemia	3.4	12.1	4.2	5.2
Pancreas	2.5	8	6	7.3
Lip, oral cavity	2.1	7.3	0.8	1.1
All cancers	100	335	100	121.4

WOMEN

Site	Incidence %	Incidence ASR	Mortality %	Mortality ASR
Breast	26.4	76	14.9	14.7
Lung	14.5	36.2	26.2	24.1
Colorectum	10.8	25	9.6	7.7
Corpus uteri	5.8	16.5	2.8	2.5
NHL	4.4	11.5	3.5	2.8
Thyroid	4.1	15.1	0.3	0.3
Melanoma of skin	4	12.8	1.1	1.1
Kidney	3.2	8.7	1.9	1.7
Ovary	3.1	8.8	5.7	5.4
Leukemia	2.8	7.9	3.4	3
All cancers	100	274.4	100	90.6

BOTH SEXES

Site	Incidence %	Incidence ASR	Mortality %	Mortality ASR
Lung	15	42.1	28.6	30.4
Prostate	13	83.8	5.1	9.7
Breast	12.7	76	7.2	14.7
Colorectum	10.7	29.2	9	8.8
Bladder	4.8	12.7	2.5	2.2
NHL	4.6	13.7	3.4	3.3
Melanoma of skin	4.3	14.3	1.5	1.7
Kidney	3.9	12.1	2.4	2.6
Leukemia	3.1	9.9	3.8	4
Corpus uteri	2.8	16.5	1.3	2.5
All cancers	100	300.2	100	104.1

(Ferlay et al, 2010) Abbreviations: NHL non-Hodgkin's lymphoma, ASR age-standardized rate per 100,000, all cancers: excluding non melanoma skin cancer

Table 2-4 Cancer Incidence and Top 5 Most Common Cancers in Arab Countries, 2008

Country	Incidence ASR	Top 5 most common Cancers (incidence expressed as ASR)				
		1st	**2nd**	**3rd**	**4th**	**5th**
Lebanon	169.6	Breast 55.4	Prostate 25.4	Lung 18.0	Bladder 14.5	Colorectum 13.0
Bahrain	129.6	Breast 49.8	Lung 19.7	Colorectum 13.3	Prostate 10.2	Bladder 7.8
Jordan	128.9	Breast 47.0	Colorectum 16.8	Prostate 13.9	Lung 11.2	Corpus uteri 6.9
Tunisia	121.9	Breast 30.3	Lung 17.4	Prostate 11.6	Colorectum 11.6	Bladder 8.5
Kuwait	117.2	Breast 47.7	Colorectum 12.1	Prostate 11.6	Lung 9.4	NHL*** 7.1
Qatar	116.9	Breast 38.1	Prostate 15.0	Lung 11.9	Colorectum 10.7	Bladder 9.4
Somalia	113.5	Breast 21.1	Cervix 20.3	Esophagus 9.1	Prostate 8.9	Colorectum 5.7
Libya	111.3	Breast 23.1	Lung 14.6	Colorectum 11.8	Prostate 10.3	Corpus uteri 7.8
Western Sahara	109.8	Breast 30.8	Cervix 28.4	Stomach 11.9	Prostate 11.2	Lung 7.9
Egypt	108.4	Breast 37.3	Bladder 13.5	Liver 9.3	NHL 8.7	Lung 5.9
Algeria	105.8	Breast 28.6	Lung 10.5	Cervix 10.4	Colorectum 9.8	Prostate 7.1
Iraq	104.9	Breast 31.1	Lung 8.3	Bladder 8.1	NHL 6.6	Leukemia 5.9
Mauritania	103.0	Cervix 35.1	Breast 23.9	Prostate 17.9	Liver 16.4	Stomach 6.2
Morocco	101.9	Breast 36.5	Cervix 14.1	Lung 13.3	Prostate 9.8	Colorectum 7.3
Djibouti	98.0	Breast 21.8	Cervix 12.7	Prostate 7.2	Kaposi 6.9	NHL 6.0
Eritrea	95.8	Breast 22.0	Cervix 12.9	Prostate 7.8	Esophagus 5.9	NHL 5.6
Yemen	89.8	Breast 20.8	Liver 8.8	NHL 6.0	Esophagus 5.8	Stomach 5.2
UAE	88.8	Breast 36.7	Prostate 9.6	Colorectum 7.5	Cervix 7.4	Lung 7.3
Oman	87.6	Breast 28.6	Prostate 9.0	Colorectum 7.2	Lung 6.0	NHL 5.9
KSA	87.6	Breast 22.4	Colorectum 12.1	Prostate 7.7	Lung 5.2	NHL 5.2
Sudan	81.5	Breast 24.6	Prostate 9.0	Cervix 7.0	NHL 5.9	Ovary 5.8
Syria	72.2	Breast 23.0	Colorectum 6.5	Lung 6.1	Prostate 5.6	Bladder 4.4
Palestine	54.9	Breast 12.5	Prostate 7.4	Lung 5.9	Colorectum 5.6	CNS 4.2

(Ferlay et al, 2010) Abbreviations: NHL non-Hodgkin lymphoma, ASR age-standardized rate per 100,000, non-melanoma skin cancer excluded

quent in Saudi Arabia (particularly Jizan area) and Yemen. This is related to chewing tobacco mixture.

THE NATIONAL CANCER PROBLEM

Incidence Profile

In Egypt, the mean age of cancer patients is 48 years, about two decades younger than the mean age of American cancer patients. This is a reflection of the young age structure of the Egyptian population, with about 32.7% below the age of 15 years compared to 20.1 in USA (Fig 2-3). A comparison of the age distribution of cancer patients in Egypt and USA is presented in (Table 2-5). There is a very slight male predominance in cancer incidence with a ratio of 1.05:1 (NCI data 2002-2007, Ali Eldein, 2010). This is almost equal to the male to female ratio in the Egyptian population which is 1.03:1. It is also similar to pattern seen in developed countries, with a ratio of 1.07:1 in the USA (2012 estimated data).

Cancer registration is a vital tool for sizing the cancer problem, hence enabling strategic planning for treatment, control and prevention. Table 2-6 Summarizes history of Cancer Registration in Egypt. (Table 2-7) shows estimated incidence and mortality of top ten major cancers in Egypt, distributed by sex and collectively (Globocan 2008).

The leading cancers in Egyptian patients are breast, urinary bladder, NHL, liver, lung, leukemia, colorectal, brain, CNS, prostate and ovary. At NCI, the top ten cancers are slightly different, possibly representing bias of referral and lack of some services as neurosurgery. In a series of 55740 patients (2002-2007), the top ten cancers were: breast, urinary bladder, leukemia, liver, NHL, colorectal, lungs, soft tissue sarcomas, pancreas and CNS.

The profile of cancer in Egyptian patients has some features in common with that in developed countries, other features similar to developing countries, in addition to some specific features of its own (Tables 2-8). Thus, similarity to the developed countries includes the high incidence of breast cancer and the infrequency of testicular and nasopharyngeal cancers, whereas, similarity to the pattern in the less developed countries includes the infrequency of prostatic cancers which is related aging of population and frequency of liver cancer which is related to prevalence of hepatotropic

Table 2-5 Age Distribution of Cancer Patients in Egypt and USA

	Pediatric (< 20y)	Adults (20-65 y)	Elderly (>65 y)
Egypt*	8.5%	67.6%	23.9%
USA**	1.1%	45.7%	53.2%

* Ali-Eldein, 2012, ** SEER data 2012

viruses and food contamination. The two cancer patterns which are peculiar to Egyptian patients are the high frequency of bladder cancer related to Schistosomiasis and the high frequency of malignant lymphoma possibly related to viral infection and malnutrition.

A time trend analysis was reported from the pathology cancer registry of NCI, Cairo University (Mokhtar et al, 2007) in which the relative frequencies of cancers in two series with 14 years interval in between. The old series included 16138 patients (treated in the years 1985-1989), whereas, the more recent series included 9808 patients (treated during two years 2003-2004). By comparing the two series, an increase in the relative frequency of breast and lung cancers was observed, but, a decline in bladder cancer. The frequency of other malignancies remained rather stationary.

Pediatric Cancer

Adult cancers usually form in epithelial tissues and are believed often to be the result of a long biological process related to the interaction of exogenous exposures with genetic and other endogenous characteristics among susceptible people. However, in young children, particularly infants, the aberrant genetic processes that fail to safeguard against the clonal proliferation of cells with unregulated growth potential occur very early in life and progress very quickly. Pediatric tumors are of either mesenchymal or neuroectodermal origin. Another difference between adult and pediatric cancer is the primary mode of treatment which is surgery in the former and chemotherapy (combined with surgery and radiation therapy in some instances) in the latter. On the other hand, pediatric and young adult age groups share certain tumors (Ewing sarcoma family of tumors, osteosarcoma, synovial sarcoma and rhabdomyosarcoma). These tumors possess the same morphol-

Table 2-6 History of Cancer Registration in Egypt

Authors	Publication year	Center	Number of cases	Years covered
Dolbey RV and Mooro AW	1924	Kasr El-Aini	671	1920-1923
El-Sebai I, El-Bolkainy MN and Hussein MH	1973	The National Cancer Institute (NCI)	4602	1971-1972
Bedwani R	1978	High Institute of Medical Research, Alexandria	6789	1974-1977
Sherif M and Ibrahim AS	1987	The National Cancer Institute (NCI)	32305	1970-1985
Mokhtar NM	1991	NCI, Pathology Series	15112	1985-1989
El-Bolkainy MN	1991	Private Pathology Series	7513	1985-1989
Ibrahim AS, Coordinator	2002	NCR, MOH* (Compilation of 7 hospital-based registries and one regional population-based registry (Gharbiah)	18420	1999-mid 2001
El-Bolkainy MN, El-Hattab OH and Nouh MA	2005	Private Pathology Series	13000	1990-1997
Elattar IA, Ali-eldin NH, Moneer MM, Elbasmy AA, et al		The National Cancer Institute (NCI) Registry 2002-2003	18496	2002-2003
Ibrahim As, Seif-Eldein IA, Ismail K, Hablas A, Hssein H, Elhamzawy H	2007	Gharbiah Cancer registry, Regional population-based	10440	2000-2002
Mokhtar NM, Gouda I and Adel I	2007	NCI, Pathology Series	9808	2003-2004
Ibrahim AS and Mikhail NN	2010	Aswan Cancer registry, Regional population-based	1150	2008
Ali-Eldein NH		The National Cancer Institute (NCI) Registry 2002-2007	55740	2002-2007
Ibrahim AS, Mikhail NN, Darwesh H and Heikel T	2011	Damietta Cancer registry, Regional population-based	1461	2009

* NCR, MOH = National Cancer Registry, Ministry of Health
N.B. Data from Children Cancer Hospital (CCH 57357) were not included due to lack of publications.

Table 2-7 Estimated Incidence and Mortality of Major Cancers in Men, Women and Both Sexes, Egypt, 2008

	MEN					WOMEN					BOTH SEXES			
	Incidence**		Mortality			Incidence		Mortality			Incidence		Mortality	
Site	%	ASR	%	ASR	Site	%	ASR	%	ASR	Site	%	ASR	%	ASR
Bladder	19.0	23.7	15.6	16.3	Breast	37.7	37.3	29.1	20.1	Breast	18.3	37.3	12.9	20.1
Liver	11.9	14.6	14.4	14.4	NHL	6.6	6.7	8.0	5.4	Bladder	11.6	13.5	10.3	9.1
NHL	10.1	10.8	10.1	8.9	Ovary	4.7	4.7	5.1	3.6	NHL	8.4	8.7	9.2	7.1
Lung	7.5	9.6	8.7	9.1	Colorectum	4.3	4.3	4.9	3.3	Liver	8.0	9.3	10.5	9.1
Prostate	4.7	6.6	4.5	5.1	Leukemia	4.2	3.9	5.8	3.6	Lung	5.0	5.9	6.3	5.5
Leukemia	4.7	4.8	5.5	4.5	Liver	3.9	4.2	5.7	4.2	Leukemia	4.5	4.3	5.6	4.0
Colorectum	4.2	4.6	4.0	3.6	Bladder	3.8	4.1	3.7	2.7	Colorectum	4.2	4.4	4.4	3.5
Brain, nervous system	3.9	3.9	3.6	3.0	Brain, nervous system	2.8	2.6	3.2	2.0	Brain, nervous system	3.4	3.3	3.4	2.5
Larynx	2.6	3.2	1.8	1.9	Lung	2.3	2.5	3.2	2.3	Prostate	2.4	6.6	2.5	5.1
Stomach	2.4	2.8	2.8	2.7	Thyroid	2.3	2.3	1.7	1.3	Ovary	2.3	4.7	2.3	3.6
All cancers	100.0	118.3	100.0	96.8	All cancers	100.0	100.3	100.0	69.3	All cancers	100.0	108.4	100.0	82.1

(Ferlay et al, 2010) N.B. Incidence rates for the country have been estimated as the simple mean of the incidence rates from Aswan (1999-2003) and Gharbiah (1999-2002) and applied to the 2008 population. Abbreviations: NHL non-Hodgkin lymphoma, ASR age-standardized rate per 100,000, non-melanoma skin cancer is excluded from all cancers.

Table 2-8 Estimated Incidence of Top Ten Cancers in Egypt Compared to Less and More Developed Countries, 2008

Less Developed			Egypt			More Developed		
Site	Incidence		Site	Incidence		Site	Incidence	
	%	ASR		%	ASR		%	ASR
Lung	12.4	19	*Breast*	18.3	37.3	*Colorectum*	13.1	30.1
Stomach	10	15.2	*Bladder*	11.6	13.5	*Lung*	13	31.3
Breast	9.7	27.1	*NHL*	8.4	8.7	*Breast*	12.5	66.4
Liver	8.8	13	*Liver*	8	9.3	*Prostate*	11.6	61.7
Colorectum	7.1	10.7	*Lung*	5	5.9	*Stomach*	4.9	11.4
Cervix uteri	6.4	17.7	*Leukemia*	4.5	4.3	*Bladder*	4.1	9.1
Esophagus	5.6	8.6	*Colorectum*	4.2	4.4	*Kidney*	3.3	8.6
Prostate	3.6	11.9	*CNS*	3.4	3.3	*NHL*	3.3	8.6
Leukemia	3	4	*Prostate*	2.4	6.6	*Pancreas*	3	6.8
NHL	2.5	3.5	*Ovary*	2.3	4.7	*Skin Melanoma*	3	9
All cancers	100	146.8	*All cancers*	100	108.4	*All cancers*	100	255.8

(Ferlay et al, 2010), Abbreviations: NHL non-Hodgkin lymphoma, excluding non-melanoma skin cancer from all cancers, ASR age-standardized rate per 100,000.

ogy in these two groups and are treated with similar protocols (Pizzo, 2011).

Cancer is the second most common cause of death among children ages 1 to 14 years in the United States, surpassed only by accidents. In the United States of America, from 2004 to 2008, the overall incidence rate for cancer in children aged 14 years and younger increased slightly by 0.5% per year, a trend that has been consistent since 1975. The death rate for childhood cancer has decreased by more than half over the past 3 decades, from 4.9 (per 100,000) in 1975 to 2.2 in 2008. The 5-year relative survival rate for all cancers combined improved from 58% for children diagnosed between 1975 and 1977 to 83% for those diagnosed between 2001 and 2007. The substantial progress for all of the major childhood cancers reflects both improvements in treatment and high levels of participation in clinical trials. Comparative verification of the situation in Egypt was not feasible as we were not able to obtain any data regarding treatment results from The Children Cancer Hospital (CCH 57357), the leading center in children cancer management, recently established in Cairo.

The age of peak cancer incidence among children occurred during the first year of life. Malignancies of infancy represented 10% of all cancer that was diagnosed among children younger than 15 years of age. Neuroblastoma comprised 28% of infant cancer cases and was the most common malignancy among these young children (compared to 8% of cancer cases among children younger than 15 years of age,). Leukemias as a group, represented the next most common type of cancer in infants, comprising 17% of all cases. Central nervous system malignancies comprised 13% of infant cancer. Astrocytomas and other gliomas (combined) accounted for half of the between CNS malignancies, followed by primitive neuroectodermal tumors/medulloblastomas and ependymomas. Retinoblastoma and Wilms' tumor followed CNS cancer in order of occurrence among infants. Retinoblastoma accounted for about 12% of infant cancer and Wilms' tumor an additional 9%. The incidence rates for malignant germ cell tumors (including intracranial) and malignant soft tissue tumors were essentially the same (each comprised about 6% of infant cancer). Liver tumors in infants (3.75%) are almost exclusively hepatoblastoma, Lymphomas and bone cancers, which are quite important cancers among adolescents, are extremely rare in infants (Gurney et al, 1999).

Pediatric cancers are relatively common in Egypt contributing about 8.5% of all cancer

patients, as compared to 1.1 % in USA (Table 2-5). The relative frequency of pediatric cancers in Egypt (2002-2007) as compared to the USA as a representative of the western World is given in (Table 2-9). It is well noted that though the relative frequency of lymphoid leukemia and Hodgkin's lymphoma in Egypt has comparable figures to that of the Western World, myelogenous leukemia and NHL lymphomas show a markedly higher figure. Leukemia/lymphoma ratio as a group is the same in Egyptian series compared to the Western World (1.6 in both). The relatively small frequency of CNS malignancy in NCI-Egypt series (8%) compared to the Western data (17%) is probably a bias due to lack of neurosurgery services at NCI-Egypt (Fig 2-4 and Fig 2-5).

The distribution of cancer diagnoses for children (< 15 years) and adolescents (15 - 20 years) is different. ALL, brain tumors, blastemal tumors and rhabdomyosarcoma predominate in children. On the other hand, Hodgkin disease, osteosarcoma, non-rhabdomyosarcoma soft tissue tumors, germ cell tumors, thyroid cancer and melanoma are more common in adolescents.

It is noteworthy to document disappointment of the authors not to include data from the Children Cancer Hospital (Hospital 57357) which is considered now as a leading hospital in pediatric cancer treatment established several years ago, due to lack of publications from hospital covering this important topic. Personal communication with hospital authorities was not more fruitful.
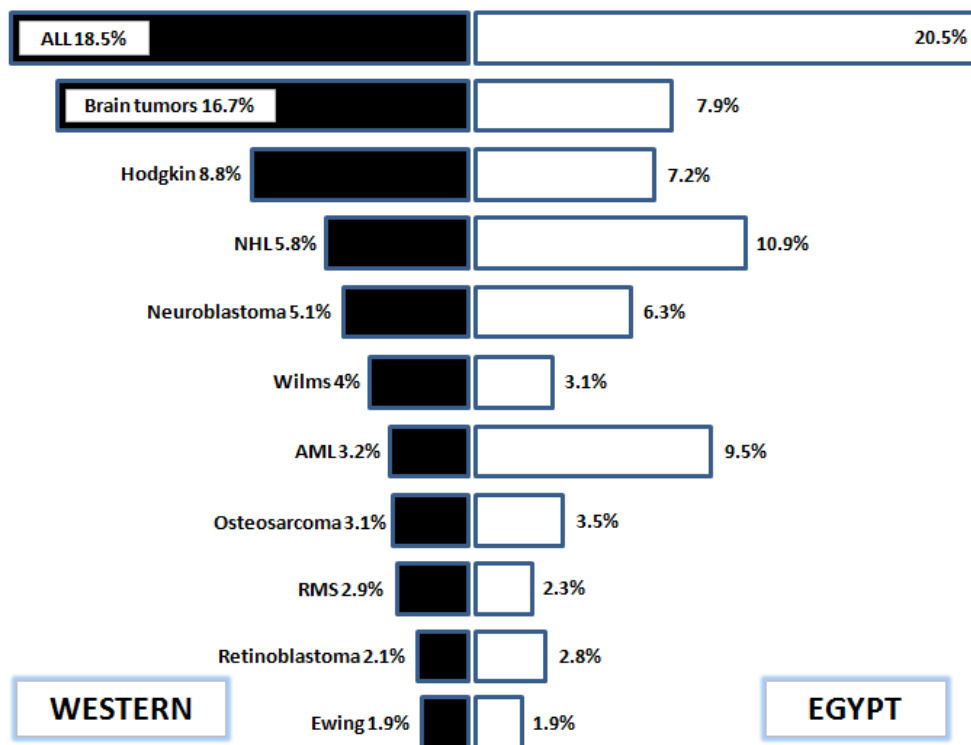
	WESTERN	EGYPT
ALL	18.5%	20.5%
Brain tumors	16.7%	7.9%
Hodgkin	8.8%	7.2%
NHL	5.8%	10.9%
Neuroblastoma	5.1%	6.3%
Wilms	4%	3.1%
AML	3.2%	9.5%
Osteosarcoma	3.1%	3.5%
RMS	2.9%	2.3%
Retinoblastoma	2.1%	2.8%
Ewing	1.9%	1.9%

Fig 2-4 *Comparative Relative Frequency (%) of Western (SEER data 1973-2006) and Egyptian Pediatric Cancer (NCI data 2002-2007). Myelogenous leukemia and NHL lymphomas show a markedly higher figure in Egyptian series. However, Leukemia lymphoma ratio as a group is the same in Egyptian series compared to the Western World (1.6 in both). The relatively small frequency of CNS malignancy in NCI-Egypt series (8%) compared to the Western data (17%) is probably a bias due to lack of neurosurgery services at NCI-Egypt .*

Table 2-9 Comparative Relative Frequency (%) of Western* and Egyptian** Pediatric Cancer Subclassified into Childhood (< 15 years) and Adolescent (15 - 20 years).

Tumor	Pediatric (<20 y)		Children (<15 y)		Adolescents (15 - 20 y)	
	Western	NCI Cairo	Western	NCI Cairo	Western	NCI Cairo
Acute lymphocytic leukemia (ALL)	18.5	20.5	24.5	22.5	6.4	16.4
Acute myelogenous leukemia (AML)	3.2	9.5	3.2	8.9	3.2	10.9
NHL	5.8	10.9	5.5	11.1	6.6	10.8
Hodgkin lymphoma	8.8	7.2	4.4	6.0	17.7	10.4
Brain Tumors	16.7	7.9	20.6	8.2	9.5	7.8
Neuroblastoma	5.1	6.3	7	9.0	0.3	1.1
Wilms Tumor	4.0	3.1	5.4	4.3	0.0	0.3
Rhabdomyosarcoma	2.9	2.3	3.4	2.7	1.9	1.3
Retinoblastoma	2.1	2.8	2.9	3.9	0.0	0.2
Osteosarcoma	3.1	3.5	2.5	5.0	4.4	9.4
Ewing sarcoma	1.9	1.9	1.5	1.2	2.3	3.2
Others	27.5	24.2	19.4	17.2	48***	28.1
Total	**100**	**100**	**100**	**100**	**52**	**100**

* SEER data 1973-2006 (29659 cases, 66.9% are children), Ries et al, 1999.

** Ali-Eldein NH, 2012 (NCI data 2002-2007, 5017 cases, 70.3% are children)

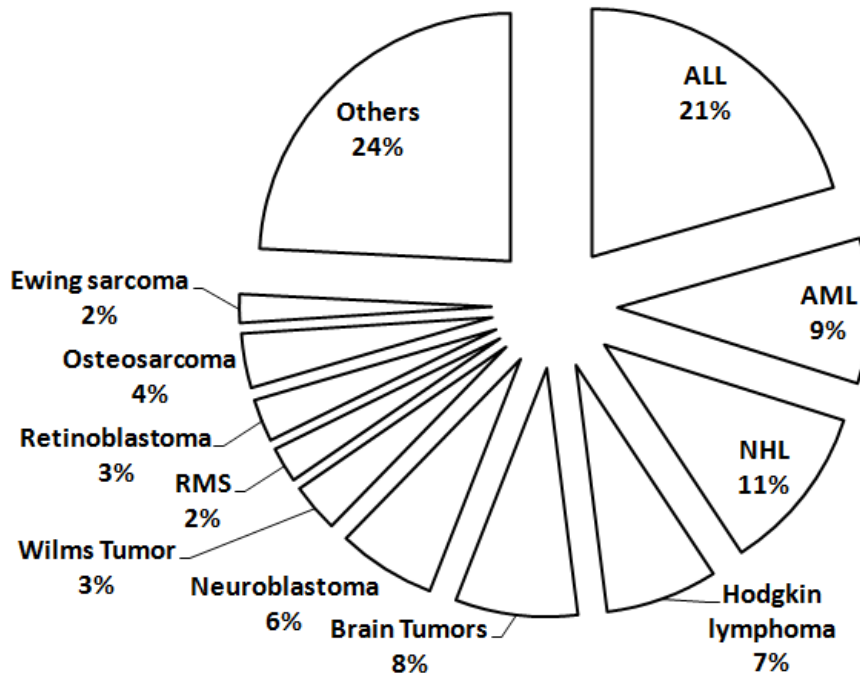*** These include 13.9% germ cell tumors, 14.1% carcinomas and 6.8% melanomas

Fig 2-5 *Relative Frequency (%) of Egyptian Pediatric Cancer (NCI data 2002-2007, 5017 cases). Hematolymphoid and neuroectodermal malignancies constitute 65% of all pediatric cancers.*

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