

RESEARCH ARTICLE

Cancer Incidence in Jordan from 1996 to 2009 - A Comprehensive Study

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Abstract

Background: Cancer is a major health problem facing the entire world, and Jordan is no exception. However, patterns of cancer incidence and cancer burden in Jordan have never been explored thoroughly, and the aim of this study was to close this knowledge gap. **Materials and Methods:** The study was based on data obtained from the Jordan cancer registry from 1996 to 2009. All cancer cases that were diagnosed during the study period were registered and included in this study. **Results:** A total of 51,626 cases were registered in Jordan during the 14- year period. The incidence rate showed no significant increase in males (percent change PC 6.8%), while in females a marked increase was observed (PC 14.8%). The major cancer sites for males were bronchus and lung, colorectal, bladder, leukemia and prostate. In females, the leading cancer sites were breast, colorectal, leukemia, thyroid and NHL. **Conclusions:** Compared to other countries in the region, Jordan has comparable rates. On the other hand the rates of cancer are markedly lower in Jordan compared to more industrialized countries such as the US and Europe. There was an overall increase in the incidence of cancer in Jordan, especially among females, which stresses the need for programs to raise awareness on the importance of early diagnosis and preventive life style measures.

Keywords: Cancer incidence data - epidemiology trends - Jordan - leading cancer sites

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Introduction

Cancer is a major public health problem, being the second cause of death in less developed countries. An estimated 7.6 million cancer deaths occurred in 2008 with 63% of the deaths occurring in less developed regions in the world (Ferlay et al., 2008). The burden of cancer is increasing in such countries as a result of the rapid growth in these populations, poverty, cancer-related infections as well as the adoption of cancer-associated lifestyle choices including; the increase in tobacco consumption, lack of physical activity and westernization of diet (Parkin, 2001; Parkin et al., 2001)

Accurate statistics on cancer occurrence and outcome are essential not only to identify the causes of cancer but also for the development, implementation and evaluation of cancer control programs (WHO, 2002; Parkin, 2006). It is also important to take into account assessment of the future national financial burden caused by the increasing trends of cancer incidence. According to the WHO world health statistics report 2012, the estimated annual cancer deaths will increase from 7.6 million in 2008 to 13 million in 2030 (World Health Statistics Report, 2012).

In Jordan, cancer is the second leading cause of death

(after diseases of the circulatory system) (Mortality Data in Jordan, 2008) which stresses the importance of collecting and analyzing the relevant epidemiological data as such analysis will direct decision-making on the socioeconomic level and pave the way to future research aiming to investigate risk factors, prevention, treatment, patterns of incidence and other characteristics of the various types of cancer. Comparing cancer epidemiology in Jordan to that of other countries would offer a chance to evaluate and punctuate cancer-related risks the population is exposed to.

Considering the new alarming trends of cancer rates in Jordan and the scarcity of comprehensive studies on the matter, this study aims to provide a thorough epidemiological analysis of cancer trends in Jordan and compare the results with other countries in and outside of the region.

Materials and Methods

Data collection and follow-up

Jordan cancer registry is a population-based registry established in 1996. Data is collected from all governmental, private, Royal Medical Services and

university hospitals as well as clinics and laboratories throughout the kingdom. All malignant and in-situ cases diagnosed since January 1996 were registered nationwide.

Jordan cancer registry uses a combination of active and passive methods in data collection performed by trained registry staff. The active method involves data collection and abstraction through regular visits to all hospitals distributed all over the country. Passive collection involves abstraction of cancer data from patients' files and completion of a standard format. CanReg4.31 was used for data entry and duplicate entry checking (CanReg4 manual. Lyon, 2001).

Population and its age composition

The population of Jordan was estimated to be 5,980,000 in the year 2009. The population is young; 48.3% were aged less than 20 years of age, and only 5.2% were aged over 60 years. Also, 51.5% of the total population is male and 48.5% female.

The Department of Statistics (DOS) in Jordan provides mid-year age composition arranged by gender and governorate. The proportional age distribution of Jordan population for each year between 1996 and 2009 was provided by DOS.

Cancer classification and rate standardization

All cases are coded according to the International Classification of Diseases for Oncology 3rd edition (ICDO-3) and the International Classification of Diseases, 10th revision (ICD-10) in the cancer registry (Fritz, 2000). Trends of incidence rates were analyzed during three periods (1996-2000, 2001-2005, and 2006-2009). Age standardized incidence rates (ASR) were calculated by the direct method, using the world standard population (Curado et al., 2007). Rates were expressed per 100,000 person-years (Chen et al., 2006).

Quality Index and analysis

Registration validity and completeness were evaluated using registrations that are considered microscopically verified (MV%) where diagnosis is based on cytological, histological or hematological reports and registrations from information on death certificates (DCO%) (Parkin et al., 1994)

The data used in this article may not exactly correspond to those published in the same period of the article Cancer Incidence in Jordan, 1996-2005 (Al-Tarawneh et al., 2010), because of subsequent additions or corrections in the dataset.

Student-t test was used to find the significance of difference between mean values of two continuous variables. In describing the change in trend, the terms "increase" and "decrease" were used when the rates were statistically significant (p value<0.05), otherwise the term "stable" was used.

Results

Quality of cancer data

A total of 51,626 cases were registered during the 14-

year period. Almost all the cases (99.3%) were verified by histological, cytological or hematological examination (MV). The MV% was lower than average for cancers of the prostate, lung and cancers of eye, brain and the central nervous system (CNS). There were only 11 DCO cases for all sites combined (0.03%) as shown in (Table 1).

Cancer incidence 1996-2009

A total of 51,626 cases were registered in Jordan during the 14-year period with 25,633 males (49.7%) and 25,993 (50.3%) females.

The crude rate (CR) for all cancer sites during the whole 14-year period was 68.6 per 100,000 (ASR: 123.6) in men. The highest CR for males was 75.5 in 2008 (Figure 1A). For males, the top 10 sites were (in order) cancers of the bronchus and lung, colorectal, bladder, leukemia, prostate, malignant neoplasms of skin, non-Hodgkin's lymphoma (NHL), cancers of eye, brain and CNS, stomach and Hodgkin's lymphoma (Table 2).

Table 1. Cancer Data Quality in Jordan, 1996-2009

Cancer	ICD-10	No. cases	DCO ^a	MV % ^b
Stomach	C16	1712	0.00%	99.40%
Colorectal	C18-C20	5104	0.02%	99.40%
Bronchus and Lung	C34	3448	0.03%	98.00%
Malignant Neoplasm of Skin	C44	2634	0.00%	99.50%
Breast	C50	8680	0.03%	99.60%
Corpus Uteri	C54	656	0.00%	99.70%
Ovary	C56	902		99.40%
Prostate	C61	1895	0.05%	99.20%
Bladder	C67	2477	0.12%	99.50%
Eye, brain and CNS	C69-C72	2229	0.09%	97.10%
Thyroid	C73	1728	0.00%	99.90%
Hodgkin Lymphoma	C81	1611	0.00%	99.60%
NHL	C82-C86,C88	2721	0.00%	99.40%
Leukemia	C91-C95	3357	0.00%	99.90%
Total	ALL	51 626	0.03%	99.30%

^aPercentage of cases registered from information from death certificates only, ^bMicroscopical verification includes cytology/hematology and histology of primary cancers

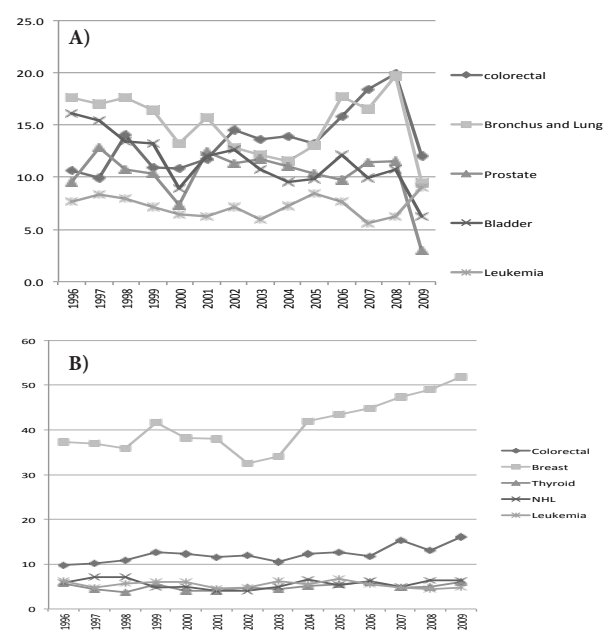


Figure 1. Trends in Incidence Rates. A) Males and B) Females (age standardized rates per 100,000) in Jordan 1996-2009

While in women, the CR for all sites was 73.7 (ASR: 122.0). The highest CR in females was 87.0 in 2009 (Figure 1B). The top 10 sites for women were cancers of the breast, colorectal, leukemia, thyroid, NHL, malignant of skin, cancers of eye, brain and CNS, ovary, Hodgkin's lymphoma and corpus uteri (Table 3).

Figure 3 shows the CR by governorate. The highest CR was in Amman; the capital, at 109.2 per 100,000 followed by Irbid (56.7). While the lowest CR was in Aqaba (28.2) followed by Mafraq (29.3). When analyzed by region, the center had the highest CR at 85.6 per 100,000 followed by the north (48.9) and then the south (35.8) (Figure 2B).

The incidence rates increased throughout the study period (PC: 10.8%). In males, the CR showed no significant increase by 6.8% (PC). For females, the CR increased significantly by 14.8%. The rates for the major sites, by time period, are shown in (Tables 2 and 3) and (Figure 1).

Lung cancer (ASR: 15.1) was the most common cancer in males in the period between 1996-2000 after which colorectal cancer replaced it (ASR: 13.7) and took the first place among all men's cancers in both the 2001-2005 and 2006-2009 periods. The incidence of lung cancer was

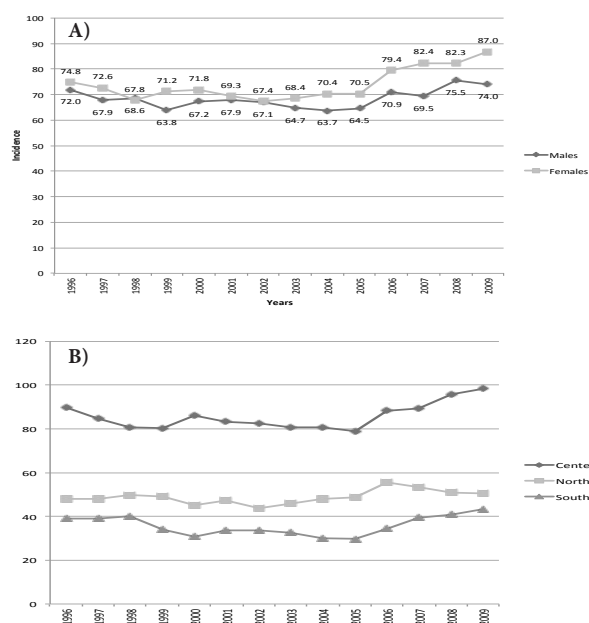


Figure 2. Crude Incidence Rate A) Gender and B) Region in Jordan from 1996-2009

Table 2. Incidence Rates (per 100,000) of Cancers at the Major Sites, in Males, 1996-2009

Cancer	ICD-10 ^a	1996-2000			2001-2005			2006-2009			1996-2009		
		No. ^b	CR ^c	ASR ^d	No.	CR	ASR	No.	CR	ASR	No.	CR	ASR
Stomach	C16	357	3	6	368	2.7	5.1	334	2.8	5	1059	2.8	5.4*
Colorectal	C18-C20	686	5.7	11.3	959	7	13.4	1115	9.3	16.5	2760	7.2	13.7*
Bronchus and Lung	C34	927	7.7	16.4	889	6.5	13.1	1054	8.8	15.9	2870	7.6	15.1*
Malignant Neoplasm of Skin	C44	501	4.2	8.5	518	3.8	7.3	561	4.7	7.8	1580	4.2	7.9
Prostate	C61	540	4.5	10.2	722	5.3	11.4	633	5.3	8.9	1895	5	10.2
Bladder	C67	750	6.3	13.4	749	5.4	11	669	5.6	9.8	2168	5.8	11.4
Eye, brain and CNS	C69-C72	451	3.8	4.9	468	3.4	4.6	391	3.3	4.8	1310	3.5	4.8*
Hodgkin's Lymphoma	C81	319	2.7	3.1	314	2.3	2.6	284	2.4	3.3	917	2.4	3.0*
NHL	C82-C86,C88	541	4.5	7.4	540	3.9	6	463	3.9	6.4	1544	4.1	6.6
Leukemia	C91-C95	662	5.5	7.5	704	5.1	7	584	4.9	7.1	1950	5.2	7.2*
All Cancers	All	8158	67.9	128	8825	65.6	113.9	8650	72.4	128.9	25633	68.6	123.6

*Significant trends (p<0.05), ^aICD-10, International Classification of Diseases, 10th revision, ^bNumber of cases, ^cCrude Rate, ^dAge standardized rate

stable at a (PC) of 16.6%, while colorectal cancer has shown a markedly increasing trend (PC: 97.4%).

Bladder cancer, which was in third position in men, has shown significant decline in incidence (ASR: 11.4)

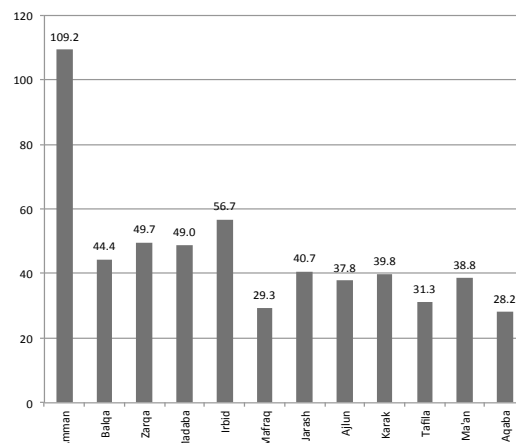


Figure 3. Average Incidence Rate by Governorate in Jordan 1996-2009

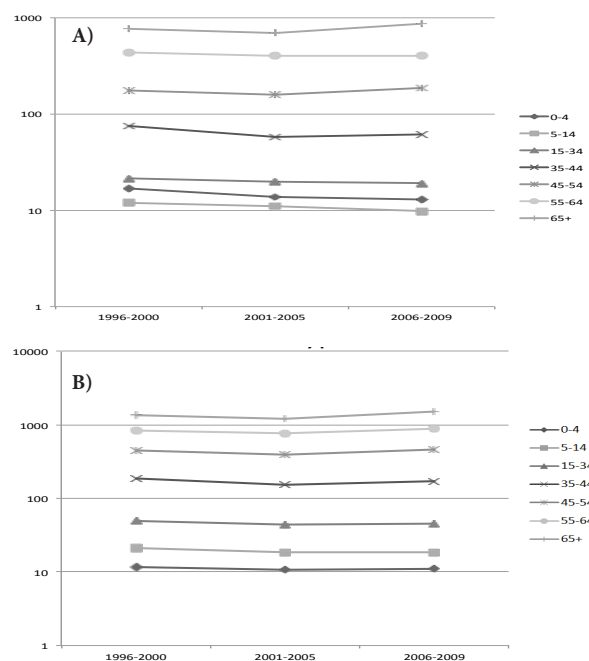


Figure 4. Time Trends in Age-Specific Rates of Cancer (all sites). A) Males and B) Females during 1996-2009 in Jordan by period

Table 3. Incidence Rates (per 100,000) of Cancers at the Major Sites, in Females, 1996-2009

Cancer	ICD-10 ^a	1996-2000			2001-2005			2006-2009			1996-2009		
		No. ^b	CR ^c	ASR ^d	No.	CR	ASR	No.	CR	ASR	No.	CR	ASR
Colorectal	C18-C20	663	6	11.1	788	6.2	11.8	893	7.9	14.1	2344	6.6	12.2*
Malignant Neoplasm of Skin	C44	402	3.6	7.3	317	2.5	5	335	3	5.6	1054	3	6
Breast	C50	2371	21.4	38	2897	22.8	38	3268	29.1	48.2	8536	24.1	40.9*
Corpus Uteri	C54	177	1.6	3.1	197	1.6	3.1	282	2.5	4.7	656	1.8	3.6
Ovary	C56	303	2.7	4.7	283	2.2	3.7	316	2.8	4.6	902	2.6	4.3
Eye, Brain and CNS	C69-C72	357	3.2	4.3	287	2.3	2.9	275	2.4	3.1	919	2.7	3.4*
Thyroid	C73	373	3.4	4.6	448	3.5	4.8	480	4.3	5.5	1301	3.7	4.9
Hodgkin Lymphoma	C81	205	1.9	2.1	249	2	2.1	240	2.1	2.2	694	2	2.1
NHL	C82-C86,C88	380	3.4	6	387	3	5	410	3.7	6	1177	3.4	5.6
Leukemia	C91-C95	485	4.4	5.7	521	4.1	5.6	401	3.6	4.8	1407	4.1	5.4
All Cancers	All	7933	71.6	123.7	8767	68.6	110.1	8650	82.8	134.9	25993	73.7	122

*Significant trends (p<0.05), ^aICD-10, International Classification of Diseases, 10th revision, ^bNumber of cases, ^cCrude Rate, ^dAge standardized rate

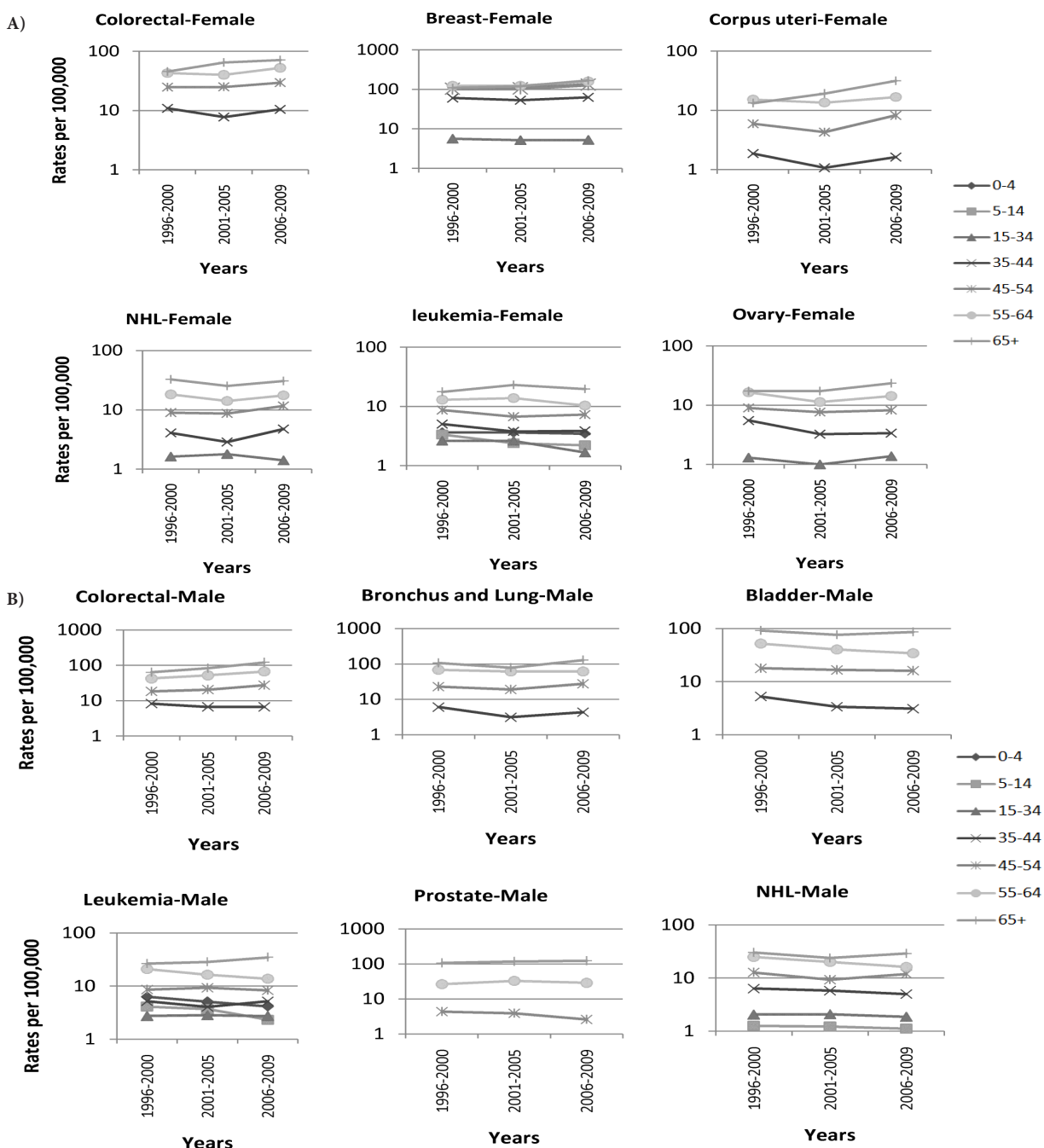


Figure 5. Time Trends in Age-Specific Rates of Some Leading Sites of Cancer for A) Females and B) Males in Jordan by Period (1996-2009)

Table 4. Age-Standardized Incidence Rate (ASR) Per 100,000 World Population

Country	Males	Females	Study
Jordan	123.6	122	Current study
Tunisia	148.3	102.3	(Missaoui et al., 2010)
Palestine	183	134	(Curado MP, 2007)
Egypt	162	122	(Curado MP, 2007)
Saudi Arabia	59	58	(Bazarbashi S, De vol EB, Ravichandran, Young SE)
Oman	105	91	(Curado MP, 2007)
Bahrain	160	143	(Curado MP, 2007)
Qatar	51	87	(Bener, Ayub, Kakil, Ibrahim, 2008)
Kuwait	121	129	(Curado MP, 2007)
Cyprus	173.3	159.4	(Freedman, Edwards, Ries, Yound, 2006)
Israel (Jews)	282.6	272.1	(Freedman, Edwards, Ries, Yound, 2006)
Lebanon	169.3	176.8	(Adib, 2003)
Iraq	107.7	111.6	(Habib et al., 2010)
USA	553	416.5	(Siegel, Naishadham, Jemal, 2012)
China	195.8	96.1	(Chen et al., 2006)
Australia	356.8	276.4	(Ferlay et al. 2008)
Central/eastern Europe	259.2	184.2	(Ferlay et al. 2008)

with a PC of -23.2%. Prostate cancer was the fourth amongst male cancers, with an ASR of 10.2 per 100,000, with no significant change in incidence rates during the observation period (PC: 24.1%). Also, malignant neoplasms of skin (ASR: 7.9) ranked fifth throughout the whole 14-year period, with no significant changes in trend (PC: 12.2%).

Leukemia which was ranked sixth on the scale of most common cancers in men (ASR: 7.2) declined significantly over the 14- year period (PC: -13.6%). NHL (ASR: 6.6) remained seventh throughout the observation period. It remained stable with a PC of -9.0%.

There was significant decreasing trends for stomach, cancers of eye, brain and CNS tumors and Hodgkin's lymphoma, which have remained the eighth, ninth and tenth principal malignancies in men. The PC was -19.3%, -12.4% and -15.7% respectively.

Breast cancer has remained the most common cancer in females during the 14- year period (ASR: 40.9). The incidence increased markedly at a PC of 45.2%. Colorectal cancer (ASR: 12.2) has ranked second after breast cancer exhibiting a significant increase with a PC of 60.0%.

Malignant neoplasms of skin and NHL ranked as the third and fourth most frequent cancers in females with ASR 6.0 and 5.6 per 100,000 respectively. They remained stable in the observation period (PC: -19.8%, - 4.6% respectively).

Only cancers of eye, brain and CNS, which was the ninth in position among women showed significant decrease over the whole 14-year period (ASR: 3.4, PC: -31.1%).

Age-specific incidence rates

Figure 4 show time trends for all cancers combined, in males and females, by age group. Cancer incidence in the age group 15-35 has decreased in both sexes. The age groups 45-54 and 55-64, incidence has decreased for males only, while remaining stable in females. Incidence rates have tended to increase in those over 65 in both males

and females. The cancer incidence in childhood (under age 15) has tended to decrease in both sexes.

Figure 5 show age-specific incidence rates of the leading sites of cancer. Colorectal cancer has shown a steady increase above the age of 35 for males throughout the whole period. Notable increase has taken place in the incidence of leukemia in males over 65 and increasing trends in the incidence of breast cancer are significant mainly for women aged 45-64.

Discussion

A total of 12.6% of worldwide deaths are caused by cancer, which is more than the percentage of deaths caused by HIV/AIDS, tuberculosis and malaria put together (World Health Organization (WHO), International Union against Cancer (IICC). Global action against cancer (Geneva, 2003). Cancer is usually considered a disease of the industrialized countries, whereas infectious diseases constitute the major burden in less developed countries. However, the increase in life expectancy in the less developed countries and the rapid changes in lifestyle (Parkin, 2001; Parkin et al., 2001), have led to an epidemic of cancer in the less developed countries. With current trends it is estimated that by the year 2020, around 70% of cancer deaths will be in less developed countries (Sener and Grey, 2005).

In Jordan, health care services are well developed, and they go side by side with established national programs on disease control, health promotion campaigns and health education. Child mortality and morbidity from certain infectious diseases have decreased significantly to levels comparable to developed countries. Life expectancy at birth has risen from 67.7 for males and 71.1 for females in 1996 to 71.8 and 74.7, respectively, by Ministry of Health, Jordan (2009).

The level of MV cases (99.3%) is an indicator of the validity of diagnosis (Parkin et al, 1994; Curado et al, 2007). The pathology departments in Jordan work according to the updated revised World Health Organization (WHO) International Histological Classification of Tumors. Also, the diagnostic procedures, equipment and skills are fully adequate. There were only 0.03% of cases reported by DCO. This indicates that our data is highly accurate and the percentages of MV and DCO are comparable with many other cancer registries in North America and Europe (Curado et al., 2007). The MV% did not change significantly from 1996-2002 to 2003-2009, the MV% were 99.0% and 99.5% respectively, thus trends in cancer incidence are not likely to be caused by changes in the degree of ascertainment.

According to this study, ASR per 100,000 world population for males in Jordan (123.6) were found to be rather close to the results reported in many countries in the Middle East including; Kuwait (121), Tunisia (148.3), Iraq (107.7). However, the rates were remarkably lower in Saudi Arabia and Qatar (59 and 51 respectively) and higher in Palestine (183), Egypt (162) and Bahrain (160). Comparing the results of the less developed countries to the more developed countries; the results were found to be

remarkably higher in the more developed countries such as USA (553) and Australia (356.8) (Table 4).

ASR per 100,000 world population for females in Jordan (122) was also found to be rather close to other countries in the region such as Egypt (122), Kuwait (129) and Palestine (134). The rates were lower in Saudi Arabia (58), Qatar (87) and Oman (91). Higher rates were reported in more developed countries such as USA (416.5) and Australia (276.4).

The differences in rates between a developing country like Jordan and other more developed and industrialized countries is usually attributed to the degree of modernization and changes in lifestyle including smoking, eating habits and physical activities (Popkin, 1994). Jordanian traditional diet is known to be rich in vegetables and fruits compared to the diet of more industrialized countries and to contain less fat and meat (Behavioral risk factors survey. Amman, 2005).

Breast Cancer continues to be the most important cancer in women, being responsible for 33% of all female cancers, with significant increasing trends throughout the whole 14- year period. These trends maybe related to changes in the lifestyle of Jordanian women known to increase the risk of breast cancer. Changes in diet with an increase in energy from fat and decrease in physical activity, especially among urban residents, resulting in an increase in obesity are all among the factors proven to increase the risk in breast cancer (Ajlouni et al., 1998; Shu et al., 2001; Popkin, 2004; Khader et al., 2008). The rising trends in breast cancer also seem to be related to a decline in the number of children and an increase in the age of first childbirth (Chen et al., 2006). These demographic changes are reflected by the decline in the number of children from 0-14 from 41% in 1996 to 37% in 2009 (DOS). The ASR for breast cancer in Jordan (38.0) is higher than Tunisia (27.9) (Missaoui et al., 2010) UAE (22.8), Oman (17.5) and Saudi Arabia (14.8) (Al-Hamdan et al., 2009) but lower than Bahrain (53.4), Qatar (48.2), Kuwait (46.6) (Al-Hamdan et al., 2009) and Egypt (49.6). Compared to Israel (Jews) (93.1) (Freedman et al., 2006) US SEER (91.1) (Ries et al., 2009) England (88.1) (Stewart-Knox et al., 2009) and Lebanon (71.0) (Lakkis et al., 2010) Jordan has a much lower ASR. The variability in ASR between Jordan and other countries in the Middle East can be attributed to differences in the lifestyle and certain genetic variations (Bernstein et al., 2003; Chlebowski et al., 2005).

Colorectal cancer is the third most common cancer in men (10.0%) and the second in women (9.4%) worldwide (Curado et al., 2007). In Jordan colorectal cancer replaced lung cancer as the first most common cancer in men in the periods 2001-2005 and 2006-2009 and the second most common cancer in women. The rates of colorectal cancer increased significantly throughout the whole period which may be attributed to changes in diet and the westernization of the lifestyle (Popkin, 1994; Giovannucci, 2002). ASR in Jordan was 13.7 and 12.2 for males and females respectively. In males the trends were lower than Qatar (16.1), Kuwait (15.2) and Bahrain (14.3) but much higher than Tunisia (10.7) (Missaoui et al., 2010), United Arab of Emirates (7.1), Saudi Arabia (6.4), Oman (5.3) (Al-Hamdan et al., 2009) and Lebanon

(9.0) (Adib, 2003). Almost 60% of the cases occur in the more developed regions (Curado et al., 2007). Compared to USA SEER (54.0) (Ries et al., 2009) and the United Kingdom (55.4) (Office for National Statistics, Cancer Statistics registrations: Cancer incidence and mortality in the United Kingdom, 2004-2006) the trends in Jordan were much lower.

The rapid increase in colorectal cancer in both males and females maybe associated with the fast rate of adoption of risk behaviors including heavy alcohol consumption (Kontou et al., 2012), smoking (Botteri et al., 2008; Belbeisi et al., 2009) and high fat diets (Ajlouni et al., 1998; Larsson and Wolk, 2007). The increase in type 2 diabetes in Jordan may be associated with the increasing rates of colorectal cancer (Yang et al., 2005; Ajlouni et al., 2008). Colorectal cancer screening is cost effective irrespective of the method used (Hawk and Levin, 2005). In the USA, the increase in colorectal cancer testing has contributed to a decline in the incidence of colorectal cancer (Meissner et al., 2006, Edwards et al., 2010). In Jordan there are no screening programs, even for first degree relatives of colon cancer cases (Arafa et al., 2011).

Lung cancer ranks the third of all cancers among cases diagnosed in the period of the study with a percentage of 6.7% for both sexes and 11.2% of all male cancer cases. Lung cancer was the most common among males in the years (1996-2000) after which it fell second to colorectal cancer in the years (2001-2009). On the other hand, in females, lung cancer has been fairly stable (PC: 5.7%).

The ASR of lung cancer among males in Jordan is (7.7) which is consistent with some countries in the region; UAE (9.9) (Al-Hamdan et al., 2009), Saudi Arabia (4.8) but much lower than other countries such as Lebanon (28.3) (Adib, 2003), Tunisia (34.7) (Missaoui et al., 2010). As for females the ASR in Jordan is (3.1) falling in the 13th place among the top cancers in females. Comparing the results to that of other countries Jordan is similar to Egypt (3.7) (Freedman et al., 2006) but lower than Lebanon (11.9) (Adib, 2003), Israeli Jews (11.4), Israeli Arabs (4.8) (Freedman et al., 2006), Kuwait (6.9) and Bahrain (10.2) (Al-Hamdan et al., 2009). In the more developed countries the results were much higher for both males and females, USA (48.6 and 31.9 respectively) (Freedman et al., 2006).

The most recognizable risk factor associated with lung cancer is smoking; 54.4% of lung cancer patients are/were smokers. The notable increase of the trend of lung cancer among Jordanian females could be due to the observed increase in the number of females who smoke Narghile (Hubbly bubbly or water pipe) and the fact that cigarette smoking among females has become more socially acceptable and hence more common (Dar-Odeh and Abu-Hammad, 2011).

Bladder cancer is one of the most common cancers among men in some Middle East countries especially Egypt with an ASR of 37 per 100,000 (Jemal et al., 2011). In Egypt the main risk factor related to bladder cancer is schistosomiasis (Mostafa et al., 1999). On the other hand, in Jordan the main risk factor is cigarette smoking (D'Avanzo et al., 1990). The ASR in Jordan exhibited significant declining trends over the whole study period, decreasing from 13.4 in 1996-2000 to 9.8 in 2006-2009.

Compared to neighboring countries Jordan has relatively low rates. Israeli Jews have one of the highest rates in the region (27.5), followed by the Cypriots (20.5) and Israeli Arabs (16.0) (Freedman et al., 2006). ASR in Jordan is higher than United Arab Emirates (5.2), Saudi Arabia (3.7), Oman (5.6), and Kuwait (7.3) but lower than Bahrain (13.4) Qatar (14.3) (Al-Hamdan et al., 2009) and United Kingdom (19.7) (Office for National Statistics, Cancer Statistics registrations: Cancer incidence and mortality in the United Kingdom, 2004-2006).

Leukemia incidence rates were declining in males. In Jordan, ASR for males was 7.2 which is much higher than that of the Gulf Countries (4.1). Israeli Jews showed higher rates (10.5), while Egyptian men exhibited lower rates (6.0). ASR in the US was 8.8 (Freedman et al., 2006). Furthermore, in the last few years incidence trends of leukemia in the US remained stable (Xie et al., 2003).

In conclusion, this study is an inclusive report concerning cancer incidence in Jordan in a 14-year period (1996-2009). The Data, obtained from the Jordan cancer registry, includes information collected for 51 626 diagnosed cases of Jordanian nationality. The overall increase in the rates of cancer incidence spanning the whole study period is 10.9%. Breast cancer is the most common cancer among females throughout the period of this study showing an alarming increase in the second half of the 14- year period. Lung cancer and colorectal cancer are the most common among males over the periods of 1996-2000 and 2001-2009 respectively.

Despite the availability of data on cancer cases in the Jordan cancer registry, poor documentation of mortality data caused limitations in studying the trends of mortality and the years of survival of cancer patients. Therefore, it is highly recommended that the specific documentation of such data becomes a priority. We believe that this study provides a precise description of the trends of cancer incidence in Jordan over a considerable time period, which could be a reliable source to further study the burden and the risk factors for significant changes in cancer trends. Our findings also provide reason for the development and improvement of our plans to control and prevent the cancer epidemic.

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