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Bladder Cancer in Lebanon: Incidence and Comparison to Regional and Western Countries

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Abstract

Lebanon has one of the highest estimated age-standardized incidence rate (ASR(w)) of bladder cancer (BC) worldwide. The aim of this study is to analyze the incidence rates for BC in Lebanon over a period of 7 years and to compare them to the rates in other countries. Data were obtained from the Lebanese National Cancer Registry for the currently available years 2005 to 2011. The calculated ASR(w) and age-specific rates were expressed as per 100 000 population. From 2005 to 2011, BC has been ranked as the third most common cancer in Lebanon. It accounted for 9.0% of all newly diagnosed cancer cases excluding nonmelanoma skin cancer. It ranked second in males and ninth in females. The average ASR(w) over this period was 31.2 in men and 7.3 in women. These incidence rates are among the highest worldwide across all age groups in both sexes. This study shows that the incidence of BC in Lebanon is high and it is among the highest worldwide. It is important to reduce the risk of BC through tobacco control and by decreasing exposure to avoidable environmental and occupational risk factors.

Keywords

bladder cancer, cancer risk, cancer prevention, epidemiology, tobacco control

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Introduction

Bladder cancer (BC) is a common cancer worldwide with an estimated 429 793 new cases and 165 084 deaths in 2012.[1] Its projected age-standardized incidence rate among the world population (ASR(w)) per 100 000 person-years was reported to be 5.3 in 2012 with higher rates among males (9.0 in 2012) as compared to females (2.2 in 2012).[1,2] Excluding nonmelanoma skin cancer, BC was the ninth most common cancer in both sexes, the sixth cancer in males, and the nineteenth in females worldwide in 2012.[1] The incidence of BC is reported to be higher in industrialized developed areas such as in Europe and North America.[2]

Most BCs are associated with acquired risk factors such as tobacco smoke, followed by occupational exposure to chemical carcinogens such as polycyclic aromatic hydrocarbons, nitrosamines, arsenic, and particularly aromatic amines.[3,4] Other risk factors include urinary schistosomiasis, certain chemotherapeutic agents such as cyclophosphamide, pelvic radiation therapy, environmental pollution, and some dietary and lifestyle factors.[3-5] Inherited genetic predispositions have also been reported to influence the risk of BC, especially with an added risk effect by other factors, mainly tobacco smoke.[3] Primary prevention, through avoiding exposure to risk factors,

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is important to reduce disease-specific morbidity and mortality.[3,4] Screening for BC in high-risk populations is debatable,[6] and the current evidence is insufficient to assess the balance of benefits and harms of screening for BC in asymptomatic adults.[7,8]

Lebanon is a small developing Middle Eastern country with an estimated population of around 5 million in 2013.[9] Lebanon has health indices that are close to those of more developed countries, with a reported infant mortality rate of 8 per 1000 live births in 2012 and maternal mortality ratio of 15 per 100 000 live births in 2015.[9] Despite not being an industrialized country, Lebanon has one of the highest estimated ASR(w) of BC worldwide, with 29.1 as estimated ASR(w) of BC among males, thus falling second after Belgium (31.0).[1] After several years of being inactive during war years, the Lebanese National Cancer Registry (NCR) was officially restarted in 2002 and is believed to be an almost absolute count of all incident cases in Lebanon with data collected passively from physicians' reports (capture system) and actively from histopathological and hematological laboratories (recapture system).[10] The recapture system is used to validate and complement data obtained through passive reporting. However, this registry does not include data on noninvasive precancerous lesions and in situ lesions. The NCR has published its cancer incidence data on the official web site of the Ministry of Public Health; the available revised ones cover the period between 2005 and 2011.

The aim of this study is to analyze the 7-year incidence rates for BC in Lebanon and to compare these rates to the ones in the Middle East and North Africa (MENA) region, as well as Western and Eastern countries. This study will also review and discuss different possible BC risk factors in Lebanon.

Materials and Methods

Both the age-standardized and the age-specific incidence rates were calculated. The age-standardized incidence rate is a weighted average of the age-specific incidence rates per 100 000 persons, where the weights are the proportions of persons in the corresponding age groups of a standard population. Standardization is important when comparing different populations with different age structures. The most commonly used standard population is the World Standard Population, which is drawn from a pooled population of several countries. In this study, the age-standardized incidence rate was computed using the modified world population by Doll as the reference population.[11] The ASR(w) and the age-specific incidence rates were calculated based on figures available in the Lebanese NCR[12] for the years 2005 to 2011 and were expressed as per 100 000 population. The age-specific incidence rate is the number of new cancer cases occurring during a specific period, in a population of a specific age and sex group, divided by the number of midyear population of that age and sex group.[13]

The calculated ASR(w) and age-specific rates were subsequently compared with age-standardized and age-specific incidence rates from selected regional, Western, and Eastern countries as published online or from *Cancer Incidence in Five Continents (CI5)*, Volume X (2003-2007)[14] or from Globocan (2012)[1] and Globocan (2008).[15,16] Countries for which cancer data were available for a comparable period of time were used as comparison countries; we included countries that surround Lebanon geographically, as well as other randomly selected countries from the MENA region and other Western and Eastern countries. It is worth noting that the rates mentioned in the Globocan project are estimates based on data available at the International Agency for Research on Cancer or public information on the Internet; however, the rates mentioned in CI5 are built on high-quality population-based cancer registries at regional or national levels. The statistics available from Lebanon included only code C67 for BC as per the *International Classification of Disease, Tenth Revision* (*ICD-10*).

Results

Over a 7-year period (2005-2011), BC ranked as the third most common cancer in Lebanon. It accounted for 9.0% (781 cases per year) of all newly diagnosed cancer cases in this time period excluding nonmelanoma skin cancer. It ranked second in males (15.0% of male cancer cases, with an average number of 632 new cases per year) and ninth in females (3.3% of all female cancer cases, with an average number of 147 new cases per year).

The average BC ASR(w) for the years 2005 through 2011 was 31.2 for males and 7.3 for females. These rates were the highest in 2008 to 2009 as compared to previous and following years, suggesting an increase in the burden of this disease with time till 2009. In fact, this increase is also reflected at the gender-based level, whereby the ASR(w) increased from 28.1 in 2005 to 37.7 in 2009 among males (+34.2%) and from 6.6 in 2005 to 9.0 in 2008 among females (+36.4%) to decrease later with a change of around −7.5% and −12.1% among males and females, respectively, between 2005 and 2011 (Table 1).

The BC ASR(w) among males in Lebanon (34.0 in 2008 and 30.4 in 2005-2008) was among the highest when compared to other countries (Table 2), including those known to have the highest rates worldwide like Belgium (32.0 in 2003-2007) as well as other countries in the MENA region such as Egypt (26.3 in Minya in 2009 and 19.0 in Gharbia in 2003-2007) and Tunisia (12.9 in 2003-2007).

The BC ASR(w) among females in Lebanon (9.0 in 2008 and 7.3 in 2005-2008) was also among the highest when compared to other countries (Table 3), particularly those known to have the highest rates worldwide like Denmark (7.7 in 2003-2007) as well as other countries such as Belgium (6.4 in 2003-2007), Egypt (4.9 in Minya in 2009 and 5.0 in Gharbia in 2003-2007), and Tunisia (1.5 in 2003-2007).

In Lebanon, male to female ratio was 3.7 in 2008 compared to 3.3 worldwide.[15] Of patients diagnosed with BC in Lebanon, the majority were males (79%) and generally 50 years

Table 1. Bladder Cancer Age-Standardized Incidence Rate (World Population) and Age-Specific Incidence Rates (per 100 000 Person-Years) Among Males and Females in Lebanon in the Years 2005 to 2011.

	Males								Females							
Years	2005	2006	2007	2008	2009	2010	2011	Average (2005-2011)	2005	2006	2007	2008	2009	2010	2011	Average (2005-2011)
0-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-9	0.5	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0
10-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-19	0	0.5	0.5	0	0	0	0	0.1	0	0.5	0	0	0	0	0	0.1
20-24	0	0	0	0.5	0.5	0	0.5	0.2	0	0	0	0	0	0.5	0	0.1
25-29	0.7	1.3	0	0.6	0.6	0.6	0.6	0.6	0.6	0	0	0.5	0.5	0	0.5	0.3
30-34	0	1.4	1.4	2.6	3.2	1.9	1.2	1.7	1.3	0.6	0.6	0	0.6	0	1.1	0.6
35-39	4.6	2.6	3.4	5.7	4.8	4.7	2.3	4.0	1.7	0	2.4	0	0	0	0	0.6
40-44	12.2	15.8	8.2	16.6	13.4	13.2	6.5	12.3	6.2	1.9	3.0	2.6	5.2	1.7	0	2.9
45-49	26.9	16.6	28.5	41.6	30.4	35.6	28.2	29.7	11.7	7.2	8.8	11.2	18.6	9.7	5.3	10.4
50-54	47.5	41.1	61.1	63.8	81.4	60.3	27.8	54.7	10.2	13.3	21.0	14.9	15.9	15.6	8.3	14.2
55-59	75.1	58.1	83.7	67.9	97.8	78.8	69.6	75.9	16.7	12.6	19.0	24.8	21.7	21.4	17.3	19.1
60-64	108.3	82.4	119.8	118	134.6	137.9	93.7	113.5	18.5	20.1	21.0	34.6	21.2	25.0	23.2	23.4
65-69	150.3	172.3	152.8	215.4	230.7	194.6	180.9	185.3	23.3	26.8	22.4	72.1	72.7	32.8	26.6	39.5
70-74	196.5	228.2	255.9	275.4	329.8	272.5	193.2	250.2	40.8	48.2	53.2	51.4	57.6	47.1	55.7	50.6
75+	361.2	382.2	426.5	368.7	378.5	351.7	320.8	369.9	93.3	101.7	100.8	89.0	79.4	78.0	71.0	87.6
ASR(w)	28.1	27.4	32.0	34.0	37.7	33.4	26.0	31.2	6.6	6.4	7.3	9.0	8.9	6.8	5.8	7.3

Abbreviation: ASR(w), age-standardized incidence rate (world population).

Table 2. Bladder Cancer Age-Standardized Incidence Rates (World Population) and Age-Specific Rates per 100 000 Males in Lebanon Compared to MENA and Non-MENA.

	Country	Year(s)	ASR(w)	20-24 Years	25-29 Years	30-34 Years	35-39 Years	40-44 Years	45-49 Years	50-54 Years	55-59 Years	60-64 Years	65-69 Years	70-74 Years	75+Years
MENA countries	Cyprus[19]	2008	20.8	3.1	–	7.8	4.0	–	3.8	33.8	45.9	92.0	110.1	219.3	239.1
	Egypt (Aswan)[20]	2008	18.6	–	2.6	–	–	–	17.6	46.3	74.5	49.6	104.2	128.2	220.5
	Egypt (Damietta)[20]	2009	18.0	–	–	2.4	9.9	2.6	3.1	18.9	50.3	46.1	96.4	202.5	256.5
	Egypt (Minya)[20]	2009	26.3	0.4	1.7	0.8	0.8	8.6	16.1	44.9	96.4	138.8	147.5	217.0	201.7
	Egypt (Gharbia)[14]	2003-2007	19.0	0.2	0.5	2.0	2.2	6.4	13.1	34.6	52.2	73.0	121.0	167.9	189.7
	Iran (Golestan)[14]	2003-2007	8.5	0.3	0.4	2.0	0.6	4.4	3.5	9.7	19.0	39.3	41.8	65.3	122.5
	Israeli (Jews)[14]	2003-2007	25.5	0.3	0.4	1.9	3.6	6.6	16.1	29.5	61.9	95.3	156.5	231.2	331.4
	Israeli (Non-Jews)[14]	2003-2007	24.3	0.0	0.7	1.6	1.8	9.2	18.2	26.6	60.9	71.8	163.2	231.6	312.7
	Israeli (Arabs)[21]	2008	22.9	–	–	1.8	2.1	4.9	18.2	37.7	47.1	102.9	158.4	242.4	189.2
	Jordan[22]	2008	11.4	0.3	1.1	0.4	0.5	4.9	14.1	21.7	25.2	37.1	73.4	89.2	119.8
	Lebanon[12]	**2005-2008**	**30.4**	**0.1**	**0.7**	**1.4**	**4.1**	**13.2**	**28.4**	**53.4**	**71.2**	**107.1**	**172.7**	**239.0**	**384.7**
	Morocco (Casablanca)[23]	2005-2007	8.7	0.2	0.4	0.2	0.2	2.3	5.0	12.4	22.3	37.6	60.9	86.3	77.5
	Saudi-Arabia (Riyadh: Saudi)[14]	2003-2007	5.6	0.2	0.2	1.7	1.6	3.8	6.3	11.1	12.4	24.4	24.8	40.6	56.6
	Tunisia (North)[14]	2003-2007	12.9	0.1	0.3	0.5	1.9	2.8	8.2	16.3	34.1	51.2	98.6	119.4	121.9
Non-MENA countries	Belgium[14]	2003-2007	32.0	0.7	1.4	1.9	3.1	8.0	17.1	37.7	77.0	127.7	195.7	272.5	428.7
	Denmark[14]	2003-2007	26.2	0.5	0.7	0.9	3.7	7.5	13.5	28.0	58.1	95.0	164.7	265.3	340.3
	Italy[17]	2006-2008	32.1	1.0	2.0	2.7	4.4	9.4	18.4	43.8	85.5	138.2	201.6	271.7	357.8
	Italy (Naples)[14]	2003-2007	48.5	–	2.8	3.6	6.2	17.2	33.9	71.9	135.7	200.4	307.9	453.6	460.4
	Japan[18]	2003-2008	8.6	0.2	0.3	0.5	1.3	2.6	5.9	10.5	19.5	30.8	42.7	74.6	131.8
	Japan (Hiroshima)[14]	2003-2007	21.0	0.6	–	0.8	1.4	4.3	15.3	21.7	52.2	67.6	121.7	199.4	305.0
	Malaysia (Penang: Malay)[14]	2003-2007	7.3	0.4	0.9	0.9	2.0	3.7	7.1	4.9	17.4	22.3	36.7	69.4	102.2
	Spain (Mallorca)[14]	2003-2007	44.5	–	2.9	1.1	5.7	11.0	29.9	70.8	145.9	200.2	286.1	350.9	419.3
	Sweden[14]	2003-2007	17.5	0.6	1.0	1.0	2.1	3.7	8.3	19.7	35.0	68.8	108.2	162.0	240.2
	UK England[14]	2003-2007	19.6	0.3	0.6	1.4	2.3	4.7	9.2	19.9	39.4	74.0	119.0	178.5	286.0
	US SEER[14]	2003-2007	29.5	0.3	0.5	1.1	2.1	4.9	10.8	22.0	44.3	76.9	128.3	190.3	298.6

Abbreviations: ASR(w): age-standardized incidence rates (world population); MENA: Middle East and North Africa.

and older (90%). The age-specific incidence rate was found to increase with age in both sexes, reaching its maximum in the age group 75 years and older (369.9 for males and 87.6 for females; Figure 1). The incidence rates were among the highest worldwide across all age groups in both sexes (Tables 2 and 3).

Table 3. Bladder Cancer Age-Standardized Incidence Rates (World Population) and Age-Specific Rates per 100 000 Females in Lebanon Compared to MENA and Non-MENA Countries.

	Country	Year(s)	ASR(w)	20-24 Years	25-29 Years	30-34 Years	35-39 Years	40-44 Years	45-49 Years	50-54 Years	55-59 Years	60-64 Years	65-69 Years	70-74 Years	75+Years
MENA countries	Cyprus[19]	2008	3.9	–	–	–	–	3.7	0.0	8.4	–	15.8	32.6	31.5	53.4
	Egypt (Aswan)[20]	2008	6.6	–	–	–	2.9	–	12.4	–	24.5	23.1	51.9	16.5	79.2
	Egypt (Damietta)[20]	2009	5.1	–	–	–	–	–	–	16.0	11.9	7.9	46.7	31.2	71.9
	Egypt (Minya)[20]	2009	4.9	–	0.6	–	0.7	2.9	5.1	11.6	21.8	18.2	17.7	42.7	37.6
	Egypt (Gharbia)[14]	2003-2007	5.0	–	–	0.5	0.6	1.0	4.4	5.6	15.7	28.7	27.7	49.6	38.5
	Iran (Golestan)[14]	2003-2007	2.8	1.0	0.8	1.0	1.9	2.9	1.8	4.6	9.3	6.5	19.3	13.2	24.4
	Israeli (Jews)[14]	2003-2007	4.8	0.1	0.3	0.1	0.6	0.7	3.2	6.7	11.7	20.2	29.3	36.6	61.3
	Israeli (Non-Jews)[14]	2003-2007	2.7	0.0	0.0	0.0	0.5	0.6	1.5	3.0	4.0	13.0	17.4	20.6	37.1
	Israeli (Arabs)[21]	2008	4.2	–	–	–	4.4	–	6.3	8.5	11.6	–	19.6	50.6	189.2
	Jordan[22]	2008	1.8	–	–	0.5	0.0	2.2	3.1	1.4	3.0	5.6	7.5	7.5	29.4
	Lebanon[12]	**2005-2008**	**7.3**	**0.0**	**0.3**	**0.6**	**1.0**	**3.4**	**9.7**	**14.9**	**18.3**	**23.6**	**36.2**	**48.4**	**96.2**
	Morocco (Casablanca)[23]	2005-2007	1.1	–	–	–	–	0.2	0.8	1.8	1.6	8.6	6.3	12.3	7.8
	Saudi-Arabia (Riyadh: Saudi)[14]	2003-2007	1.3	0.1	0.2	0.1	0.7	1.1	0.9	2.2	3.0	7.1	3.2	7.6	16.3
	Tunisia (North)[14]	2003-2007	1.5		0.3		0.2	0.4	1.2	2.3	2.8	5.1	7.3	13.3	20.9
Non-MENA countries	Belgium[14]	2003-2007	6.4	0.4	0.5	0.7	1.6	1.9	5.5	10.3	15.9	25.8	35.4	51.0	72.3
	Denmark[14]	2003-2007	7.7	0.1	–	0.8	0.5	3.7	4.1	12.1	19.1	29.2	51.2	73.4	78.3
	Italy[17]	2006-2008	6.0	0.6	0.7	1.1	1.9	2.5	5.9	9.8	16.6	24.1	33.8	43.6	59.6
	Italy (Naples)[14]	2003-2007	6.8	–	0.9	0.8	2.5	4.6	7.6	11.3	16.3	26.5	49.8	41.1	56.0
	Japan[18]	2003-2008	1.9	–	0.1	0.2	0.4	0.4	1.2	2.2	4.1	5.5	8.9	16.8	32.4
	Japan (Hiroshima)[14]	2003-2007	4.0	–	0.5	–	0.5	0.0	1.7	6.2	6.7	15.0	27.1	34.3	59.1
	Malaysia (Penang: Malay)[14]	2003-2007	1.7	0.0	0.0	0.0	0.5	0.0	2.3	4.1	0.0	5.9	11.9	16.9	21.7
	Spain (Mallorca)[14]	2003-2007	5.3	–	1.2	0.6	1.2	2.0	3.8	10.5	17.0	22.3	25.7	27.6	68.0
	Sweden[14]	2003-2007	4.9	–	0.7	0.3	0.5	1.8	3.3	6.5	13.6	22.5	30.2	37.0	53.6
	UK England[14]	2003-2007	5.5	0.2	0.2	0.5	0.9	1.6	3.4	6.4	12.5	21.3	32.8	45.9	75.5
	US SEER[14]	2003-2007	5.3	0.2	0.2	0.4	0.8	1.8	3.5	6.9	12.0	20.8	33.3	44.0	66.1

Abbreviations: ASR(w): age-standardized incidence rates (world population); MENA: Middle East and North Africa.

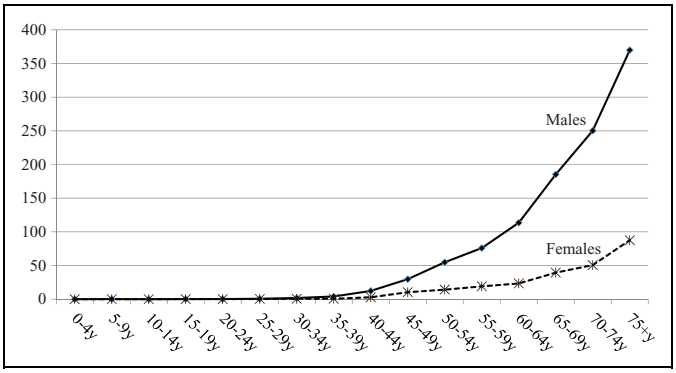

Figure 1. Age-specific incidence rates (per 100 000 population) for bladder cancer, Lebanon 2005 to 2011. Source: Lebanese Ministry of Public Health—Epidemiological Surveillance Program—National Cancer Registry, September 2016.

Discussion

Lebanon has one of the highest BC incidence rates worldwide. The highest reported ASR(w) among males were from some areas in Europe like Naples in Italy and Mallorca in Spain, which had the highest BC incidence rates worldwide in 2003 to 2007 (48.5 and 44.5, respectively),[14] and the highest reported ASR(w) among females were from some areas in the world like Antofagasta in Chile (9.8), Blantyre in Malawi (9.2), and Northwest Canadian territories (9.1), which had the highest BC incidence rates worldwide in 2003 to 2007.[14] It is worth noting that the BC ASR(w) varies considerably worldwide. This can probably be attributed to the variation in BC registration and coding practices between different regions and countries. In fact, the *ICD-10* code C67 in some registries may include cancers in situ and of uncertain or unknown behavior together with invasive cancers,[14] for example, in situ BC is considered as BC in Denmark.[24]

Transitional cell carcinoma (TCC) is the most common type of BC in Lebanon.[10,25] Transitional cell carcinoma is also reported as the most common type of BC among Israeli Jews and in most Western countries (North America, Europe, and Australia).[26]

Different risk factors were incriminated for the increasing risk of BC worldwide.[3,4,26-28] Tobacco smoke is the most recognized risk factor for both TCC and non-TCC BC worldwide in both genders[26-30] and in Lebanon.[25] The risk of developing BC is about 4.1 times and 2.1 times greater in current smokers and former smokers, respectively, than in non-smokers.[27] Smoking duration and intensity are directly related to increased risk.[29,30] Smoking is estimated to account for 27% of BC cases in North America (34% of cases in men and 30% of cases in women) and 37% of BC cases in Europe (43% of cases in men and 26% of cases in women).[31] Moreover, 38% of BC cases in men and 34% of cases in women are attributable to smoking in the United Kingdom.[32] Therefore, smoking tobacco is the principal preventable risk factor for BC in both men and

women in different countries. Lebanon has one of the weakest tobacco control regulatory environments in the Middle East region, with both active and passive smoking being a major public health problem. The high rate of BC in Lebanon may be partly explained by the high rates of smoking, given the alarming high prevalence of active smoking, particularly using narghile, among adolescents and adults[33,34] in addition to passive smoking.[35] According to the World Health Organization (WHO), the age-standardized estimated prevalence of smoking (any smoked tobacco) among individuals 15 years or more of both sexes in Lebanon (34%) is among the highest in the region, bypassing Tunisia (32.6%) and Egypt (24.6%).[33] It also exceeds the prevalence of smoking in the United States and Europe.[34] Around 42.9% of male adults and 26.3% of female adults are cigarette smokers in Lebanon,[36] compared to an estimated 20% of adults (with almost similar prevalence among males and females) in the United States and Europe.[3] In a survey covering 32 countries, Lebanon was found to be among the 3 countries with the highest concentrations of tobacco smoke–derived particle levels in indoor public places.[37]

Inherited gene variants of glutathione S-transferase Mu1 and N-acetyltransferase enzymes (NAT), particularly NAT2, are related to BC risk, and the risk is increased with smoking for NAT2.[26] A case–control study conducted in Lebanon showed that patients with BC had significant higher clustering of NAT1*14A compared to controls,[38] and this was in concordance with an earlier study conducted in a Lebanese community residing in Michigan.[39]

Environmental pollution, particularly water and air pollution, have been suspected to increase the risk of BC. Pollution of drinking water and subsequent exposure to arsenic have been recognized as a cause of BC,[3,5] with a long-term impact seen in Chile.[40] Chlorination by-products in drinking water and exposure to trihalomethanes have been viewed as a source of relevant bladder carcinogens.[3,5] In Lebanon, drinking water is either chlorinated directly at the source (bore holes and springs) or treated at a centralized water treatment plant. Its quality may then worsen during distribution (such as cross contamination by waste water network, rusting water conduits, and sometimes by pollution from industries and thermal power plants) to hold some levels of pesticides and high concentrations of heavy metals including arsenic.[41,42] Furthermore, air pollution, especially the petrochemical type, is highly incriminated for the increasing risk of BC in residential areas.[43,44] Petrochemical air pollution is mainly secondary to the diesel-fueled electric generators present in most Lebanese streets or buildings and to the high traffic load in Beirut as in many other overpopulated capitals.[45,46]

Occupation exposure is viewed as the second most important risk factor for BC worldwide.[3] The association between exposure to selected chemical carcinogens, particularly aromatic amines, occupations or industries, and BC is well-established, and it is estimated that 20% to 27% of BCs are attributable to occupational exposures in industrialized countries.[3,4,47] Lebanon is not an industrial country, but exposure to occupational diesel or fuel combustion fumes, which is highly prevalent in the country's cities, was found to be an independent risk factor for BC.[25]

Schistosomiasis is known to be associated with the squamous cell type of BC. In Lebanon, the majority of the BC cases are nonsquamous cell carcinoma reflecting that they are not due to schistosoma infection.[10,25,48] In fact, according to the WHO report in 2007, schistosomiasis has been eliminated in Lebanon as no new cases were detected over the past few years.[49] In Egypt, the success in controlling schistosomiasis has led to decrease in the incidence of BC with a change in the BC pattern to the nonsquamous type, similar to Western countries.[50] The high ASR(w) reported in Minya in Egypt (26.3) might be explained by the presence of certain foci of schistosoma detected in the area.[51]

Dietary habits, including alcohol consumption, tea consumption, artificial sweeteners consumption,[5] and drinking coffee,[52] were not found to be associated with BC risk. The same findings were also reported in a Lebanese case–control study.[25]

Finally, the changing trends in this short period could be due to better diagnosis which could be rooted to better awareness among health-care providers and patients and/or more utilization of diagnostic tools.

The following can be considered as limitations of this study; first, the inconsistency in including in situ cancers with invasive cancers in some of the registries might lead to a bias when age-standardized incidence rates are compared. Second, the information about the mortality or survival at 1, 2, and 5 years is lacking despite many improvements that have been achieved in the NCR in terms of case counting during the last few years. This requires further efforts from different stakeholders in order to develop a more comprehensive and complete database.

Conclusion

This study shows that the incidence of BC in Lebanon is among the highest worldwide.

There is currently no strong recommendation to screen for BC in asymptomatic adults in Western countries,[7,8] and screening for BC in high-risk populations has been debated[6] and needs further investigation in Lebanon.[53]

Smoking and environmental pollution may be associated with the concerning trends in BC in Lebanon. Therefore, it is important to focus on reducing the exposure to these avoidable risk factors in order to reduce the risk of BC. The high number of smokers in Lebanon calls for prioritizing prevention and control through enforcement of restrictive policies on cigarette and narghile smoking, taking into consideration that Lebanon has one of the weakest tobacco control regulatory environments in the Middle East region.

Moreover, efforts should be exerted to develop policies that decrease and control environmental pollution in Lebanon in view of the high levels of petrochemical air pollution resulting from high diesel-fueled generators use due to the continuous electricity outage, as well as the high levels of car fuel

combustion amid high traffic load. Drinking water chlorination and contamination with heavy metals including arsenic should be regulated as well.

Authors' Note

The research does not include any human subjects, there is no patient consent, and there is no need for ethical approval.

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