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Original article:

CANCER INCIDENCE IN NORTH WEST ALGERIA (MASCARA) 2000-2010: RESULTS FROM A POPULATION-BASED CANCER REGISTRY

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ABSTRACT

Cancer is a leading cause of death worldwide accounting for 7.4 million deaths. Cancer has become a major public health concern in Algeria. The aim of the present study was to estimate cancer incidence in Mascara Province based on the population-based cancer registry.
We analyzed data from the cancer registry of Mascara covering all cancer cases diagnosed by all methods and included in the registry from 1st January 2000 to 31st December 2010. The results are presented as incidence rates of cases by site, sex, age, and crude rate. Age-standardized rates per 100,000 person-years (ASRs) were calculated, using the direct method of standardization to the world population.
A total of 1875 cases of invasive cancer were recorded. The mean age of diagnosis for all cancers was 52.66 ± 0.5 in men and 59.18 ± 0.6 in women. The ASR for all cancers in females was 27.8 per 100,000, and that for males was 23.6 per 100,000. The most important finding of the present study was the high incidence of liver cancer among males and females in Mascara. Among females, breast cancer was the most frequently reported followed by Cervix uteri, liver and colon. The most frequent cancer types in males were lung, colon, esophagus and stomach and liver.
Cancer incidence in Mascara province was lower than that reported in other national and regional registries. Findings of the present study revealed high incidence of liver cancer in the province, the highest in Algeria, suggesting high prevalence of risk factors.

Keywords: Cancer, Mascara, Algeria, registry, incidence, epidemiology, population-based

INTRODUCTION

Algeria is a big northern African country, more than five times the size of California. It is the largest country of the Mediterranean Sea, the largest on the African continent and the tenth-largest country in the world in terms of land area. It is limited by the Mediterranean Sea in the north and by the Sahara in the south. Since the 1970s, the country exhibited the typical characteristics of a developing nation with a rapidly growing economy (Bendjoudi et al., 2009). Since the 1980s, Algeria has entered an epidemiological transition characterized by a reduction in

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endemic communicable diseases and the appearance of new pathologies, particularly those linked to increased life expectancy such as cancer (AfDB, 2006).

Cancer is a leading cause of death worldwide accounting for 7.4 million deaths (around 13 % of all deaths) in 2004. The future burden of cancer in the developing world is likely to be exasperated by the expected increases in life expectancy and aging and growth of the population (Jemal et al., 2010). According to the GLOBOCAN 2008, the age-standardized incidence and mortality rates of cancer in Algeria were 105.8 and 80.3/100,000, respectively. It is projected that by 2015, the number of new cancer cases will increase by 24 %, from 28736 in 2008 to 35628 (Ferlay et al., 2010).

Population-based cancer registries collect the data on cancer new cases and deaths from covered population to describe and surveil the cancer incidence, mortality and survival (Chen et al., 2012). Among the primary goals of cancer registries is the reduction of cancer-related morbidity and mortality through the facilitation of cancer research and the education of scientists, clinicians, and the public (McLaughlin et al., 2010). Cancer registries have been widely used in epidemiological research. They are an essential component of a fully developed cancer-control program. In addition to providing information on current and future needs for services, they are used to monitor programs of prevention, early detection and cure (treatment) (Parkin, 2006). To assess cancer epidemiology in Algeria, cancer registers were established in the 1980s in various parts of the country. These registers enabled the most prevalent cancers in both men and women to be recorded and a certain number of anti-cancer actions to be undertaken (Abid, 2009). The Mascara Population-based Cancer Registry was established in 1999, and has been a member of the International Association of Cancer Registries (IACR) since 2010.

MATERIALS AND METHODS

Mascara province (5941 km²) is located in the north west of Algeria, (at 360 km of Algiers) with mediterranean climate and mean annual precipitations of about 450 mm. In 2010, the total population was 826334, with male/female ratio of about 1.04. The population pyramid of Mascara is shown in Figure 1.

Data were collected from the cancer registry of Mascara during the months of March and April 2013. We obtained the data of all cancer cases diagnosed by all methods and included in the registry from 1st January 2000 to 31st December 2010 (n = 1875).

The registry is run by the Department of Epidemiology and is supervised by the health and population administration of Mascara. Anatomical sites of cancers are coded according to the 10th edition of international classification of diseases adopted by WHO in 2002 (ICD-10). World Health Organization cancer registry software version 4 (Can Reg4) is used to enter, clean and analyze data. The software had ability to detect duplicates thereby reducing the risk of double counting of cases that might have visited several hospitals or same hospital at different times. It also had the ability to estimate the age-standardized incidence rates (Msyamboza et al., 2012).

The results are presented as incidence rates of cases by site, sex, age, and crude rate. For comparison with data from other registries, age-standardized rates per 100,000 person-years (ASRs) were calculated, using the direct method of standardization to the world population.

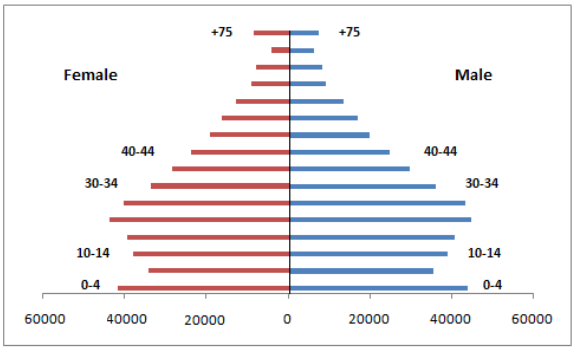

Figure 1: Population pyramid of Mascara (2010)

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RESULTS

During the 10 years (2000-2010) period of the present study, we recorded a total of 1875 cases of invasive cancer. Of the total patients 1024 (54.6 %) were males and 851 (45.4 %) were females, the sex ratio was 1:0.8. The mean age of diagnosis for all cancers was 52.66 ± 0.5 in men and 59.18 ± 0.6 in women.

The diagnosis of cancer was based on radiology in 25 %, histology of primary in 24 %, clinical in 23 %, histology of metastases in 10 %, cytology in 10 % and others in 8 % of cases (Figure 2).

Crude incidence rates for all cancers were overall higher for females than males (23.0 and 18.4 per 100,000, respectively). The ASR for all cancers in females was 27.8 per 100,000, and that for males was 23.6 per 100,000 (Tables 1 and 2). The childhood cancer incidence (0-14 years) was the same among boys (4 per 100,000) and girls (4 per 100,000). As shown in Figure 3, ASRs for all cancers increased steadily from 0-4 years to 70-74 years. ASRs were lower in 0-29 years age group and higher in 30-75+ years age group. The highest ASR (W) was found in the 70-74 years age group for both males and females. It was 169 per 100,000 for males and 157 per 100,000 for females.

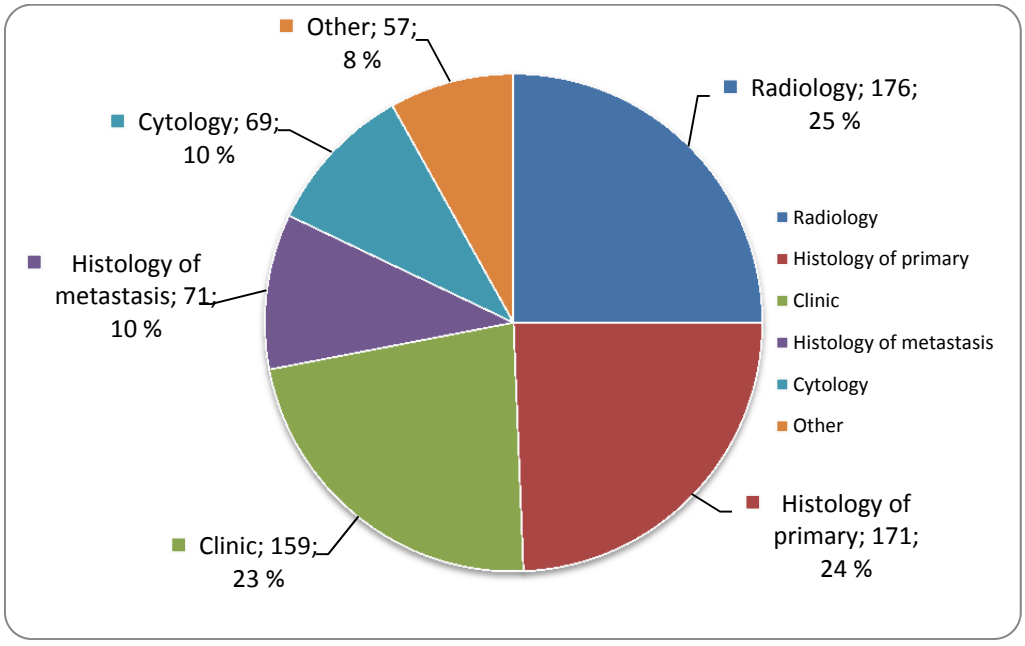

Figure 2: Common basis of diagnosis

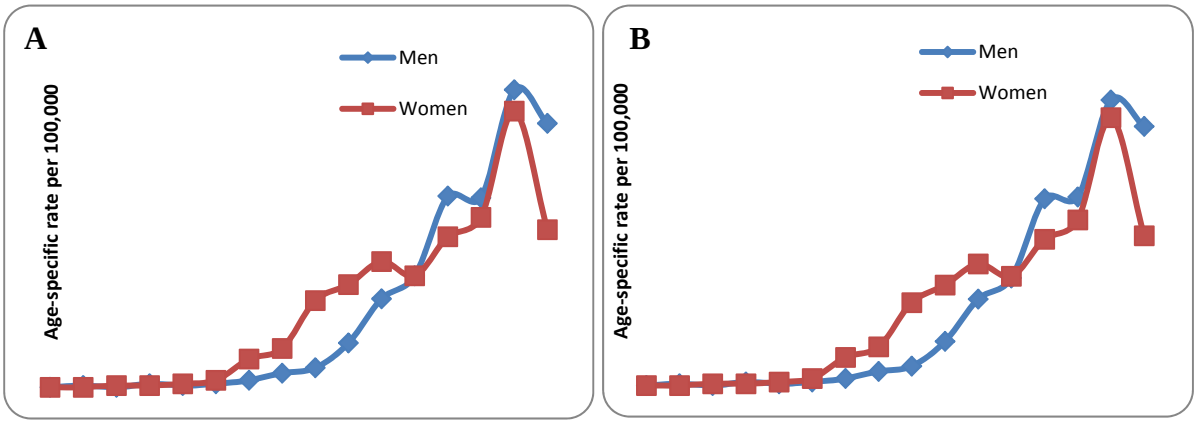

Figure 3: Age standardized rates for all cancers in men and women including **(A)** and excluding **(B)** NMSC for the period 2000–2010 in Mascara

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Table 1: Percent distribution of cancer cases by site, age-specific incidence rates per 100,000, crude and age standardized rates (ASR) adjusted to the World Standard Population (W) among males in Mascara (2000-2010)

Site (CIM-10)	n	%	Age-specific rates																	Crude rate	ASR (W)
			Age unknown	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+		
Lip(C00)	2	0.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.2	0.0	0.1
Tongue (C01-C02)	6	0.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.5	0.0	1.0	1.1	1.4	1.2	0.1	0.2
Mouth (C03-C06)	14	1.6	0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.3	0.0	0.5	1.1	2.0	1.0	1.1	1.4	3.6	0.3	0.4
Salivary glands (C07-C08)	2	0.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Tonsil (C09)	3	0.4	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Other oropharynx (C10)	11	1.3	0	0.0	0.0	0.0	0.0	0.2	0.0	0.5	0.0	0.0	0.0	1.6	0.0	2.0	1.1	0.0	2.4	0.2	0.3
Nasopharynx (C11)	27	3.2	0	0.0	0.0	0.0	0.2	0.6	0.6	0.5	0.6	0.7	0.9	1.1	0.7	3.0	2.1	4.3	1.2	0.6	0.7
Hoppharynx (C12-C13)	3	0.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	1.0	0.0	0.0	1.2	0.1	0.1
Pharynx unspecified (C14)	18	2.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	1.4	0.5	2.0	3.0	2.1	2.8	2.4	0.4	0.5
oesophagus (C15)	16	1.9	0	0.0	0.0	0.0	0.2	0.0	0.0	0.5	0.0	0.0	0.5	0.5	0.7	3.0	3.2	1.4	3.6	0.3	0.4
Stomach (C16)	65	7.6	0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.3	0.4	4.1	7.9	4.6	3.9	9.6	8.5	14.6	1.4	1.8
Small intestine (C17)	4	0.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.4	0.5	0.0	0.7	0.0	0.0	0.0	0.0	0.1	0.1
Colon (C18)	44	5.2	0	0.0	0.0	0.0	0.4	0.0	0.4	0.5	0.6	0.0	3.2	2.1	3.3	5.9	5.3	8.5	3.6	0.9	1.2
Rectum (C19-C20)	38	4.5	1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.2	1.5	1.4	3.2	1.3	4.9	3.2	7.1	4.9	0.8	1.0
Anus (C21)	1	0.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Liver (C22)	48	5.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.2	0.4	1.4	1.1	2.7	10.8	5.3	14.2	7.3	1.0	1.4
Gallbladder etc. (C23-C24)	26	3.1	0	0.0	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.4	0.0	2.1	1.3	3.9	6.4	4.3	4.9	0.6	0.8
Pancreas (C25)	27	3.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.9	1.6	4.6	4.9	2.1	5.7	2.4	0.6	0.8
Nose, sinuses etc. (C30-C31)	3	0.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	1.4	0.0	0.1	0.1
Larynx (C32)	14	1.6	0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.4	0.5	0.5	2.0	2.0	1.1	5.7	0.0	0.3	0.4
Trachea, Bronchus, Lung (C33-C34)	169	19.9	0	0.2	0.0	0.0	0.0	0.0	0.2	0 .0	1.2	1.8	3.2	10.0	17.9	29.6	25.6	42.6	25.5	3.6	4.9
Other Thoracic organs (C37-C38)	5	0.6	0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.5	0.0	0.0	1.0	2.1	0.0	0.0	0.1	0.1
Bone (C40-C41)	18	2.1	0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.3	0.4	0.5	2.1	1.3	3.0	0.0	2.8	2.4	0.4	0.5
Melanoma of skin (C43)	2	0.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.2	0.0	0.1
Other skin (C44)	12	1.4	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.3	2.0	0.0	5.7	2.4	0.3	0.3
Mesothelioma (C45)	2	0.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	1.1	0 .0	0.0	0.0	0.1
Kaposi sarcoma (C46)	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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Table 1 (cont.): Percent distribution of cancer cases by site, age-specific incidence rates per 100,000, crude and age standardized rates (ASR) adjusted to the World Standard Population (W) among males in Mascara (2000-2010)

Site (CIM-10)	n	%	Age-specific rates																	Crude rate	ASR (W)
			Age unknown	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+		
Connective and soft tissue (C47-C49)	4	0.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.5	0.7	1.0	0.0	0.0	0.0	0.1	0.1
Breast (C50)	6	0.7	0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.5	0.7	0.0	1.1	0.0	0.0	0.1	0.2
Penis (C60)	2	0.2	0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0
Prostate (C61)	54	6.3	0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	0.4	0.0	0.5	1.3	6.9	3.2	14.2	34.0	1.2	1.5
Testis (C62)	4	0.5	0	0.0	0.5	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.1	0.1
Other male genital (C63)	1	0.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0
Kidney (C64)	11	1.3	1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.7	0.0	2.1	2.8	0.0	0.2	0.2	0.3
Renal Pelvis (C65)	1	0.1	0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ureter (C66)	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bladder (C67)	51	6	3	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	0.0	0.5	2.1	3.3	5.9	6.4	18.5	13.3	1.1	1.5
Other Urinary organs (C68)	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eye (C69)	6	0.7	1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	2.1	0.0	0.0	0.1	0.2
Brain, Nervous system (C70-C72)	19	2.2	1	0.0	0.3	0.5	0.0	0.4	0.2	0.3	0.9	0.0	0.5	1.1	1.3	0.0	3.2	0.0	0.0	0.4	0.4
Thyroid (C73)	5	0.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.0	1.1	1.4	0.0	0.1	0.2
Adrenal gland (C74)	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Endocrine (C75)	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hodgkin disease (C81)	1	0.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0
Non-Hodgkin lymphoma (C82-C85 ; C96)	19	2.2	1	0.0	0.3	0.0	0.0	0.2	0.2	0.0	0.9	0.0	0.5	2.1	0.0	1.0	4.3	1.4	1.2	0.4	0.5
Immunoproliferative disease (C88)	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Multiple Myeloma (C90)	4	0.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.5	0.0	0.0	0.0	0.0	1.2	0.1	0.1
Lymphoid Leukaemia (C91)	4	0.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	1.1	1.4	1.2	0.1	0.1
Myeloid Leukaemia (C92-C94)	3	0.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	1.0	1.1	0.0	0.0	0.1	0.1
Leukaemia, cell unspecified (C95)	1	0.1	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other & unspecified	75	8.8	0	0.0	0.8	0.2	0.7	0.6	0.2	1.3	0.9	2.2	1.8	4.7	4.6	5.9	6.4	9.9	13.3	1.6	1.9
All sites Total	851		11	1	2	1	3	2	3	5	9	12	26	51	64	109	108	169	150	18.4	23.6
All sites but C44	839		10	1	2	1	3	2	3	5	9	12	26	50	62	107	108	163	148	18.1	23.2

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Table 2: Percent distribution of cancer cases by site, age-specific incidence rates per 100,000, crude and age standardized rates (ASR) adjusted to the World Standard Population (W) among females in Mascara (2000-2010)

Site (CIM-10)	n	%	Age-specific rate																	Crude rate	ASR (W)
			Age unknown	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+		
Lip(C00)	1	0.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0
Tongue (C01-C02)	3	0.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	2.1	1.1	0.1	0.1
Mouth (C03-C06)	3	0.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.6	0.0	0.0	0.0	2.1	0.0	0.1	0.1
Salivary glands (C07-C08)	3	0.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.1	0.1
Tonsil (C09)	3	0.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Other oropharynx (C10)	3	0.3	0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.1	0.1
Nasopharynx (C11)	10	1.0	0	0.0	0.0	0.2	0.7	0.2	0.0	0.3	0.3	0.8	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.2	0.2
Hoppharynx (C12-C13)	2	0.2	0	0.0	0.3	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Pharynx unspecified (C14)	4	0.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.4	0.0	0.0	0.0	1.0	0.0	0.0	0.1	0.1	0.1
oesophagus (C15)	5	0.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	1.0	1.1	0.0	2.1	0.1	0.1
Stomach (C16)	50	4.9	0	0.0	0.0	0.0	0.0	0.2	0.4	1.3	0.3	1.1	1.9	4.4	1.4	7.9	5.5	6.3	8.4	1.1	1.4
Small intestine (C17)	1	0.1	0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Colon (C18)	35	3.4	0	0.0	0.0	0.2	0.0	0.4	0.0	0.5	0.0	1.5	1.9	3.3	2.8	2.0	6.7	4.2	2.1	0.8	1.0
Rectum (C19-C20)	45	4.4	0	0.0	0.0	0.0	0.0	0.2	0.7	0.5	0.9	1.5	2.3	2.2	2.8	3.0	4.4	14.6	5.3	1.0	1.3
Anus (C21)	1	0.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0
Liver (C22)	44	4.3	0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.0	0.8	2.3	4.4	2.8	4.9	6.7	6.3	8.4	1.0	1.3
Gallbladder etc. (C23-C24)	49	4.8	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.5	2.3	5.0	2.1	10.8	8.9	8.4	3.2	1.1	1.5
Pancreas (C25)	20	2.0	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	2.2	2.1	5.9	1.1	6.3	1.1	0.4	0.7
Nose, sinuses etc. (C30-C31)	2	0.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0
Larynx (C32)	2	0.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	1.1	0.0	0.0	0.0	0.1
Trachea, Bronchus, Lung (C33-C34)	29	2.8	0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.6	0.8	0.9	0.6	1.4	4.9	3.3	10.4	5.3	0.7	0.9
Other Thoracic organs (C37-C38)	1	0.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bone (C40-C41)	18	1.8	0	0.0	0.3	0.2	0.2	0.8	0.0	0.0	0.3	0.4	0.9	0.0	1.4	1.0	0.0	2.1	3.2	0.4	0.4
Melanoma of skin (C43)	1	0.1	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other skin (C44)	27	2.6	1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.6	2.3	1.4	2.2	0.7	2.0	1.1	4.2	4.2	0.6	0.7
Mesothelioma (C45)	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kaposi sarcoma C46)	1	0.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0
Connective and soft tissue (C47-C49)	6	0.6	0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.4	0.0	0.0	0.7	1.0	1.1	0.0	0.0	0.1	0.2
Breast (C50)	374	36.5	3	0.0	0.3	0.2	0.2	0.0	1.6	8.9	14.5	26.7	29.0	22.6	19.6	21.7	28.9	39.7	13.7	8.4	9.7

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Table 2 (cont.): Percent distribution of cancer cases by site, age-specific incidence rates per 100,000, crude and age standardized rates (ASR) adjusted to the World Standard Population (W) among females in Mascara (2000-2010)

Site (CIM-10)	n	%	Age-specific rate																	Crude rate	ASR (W)
			Age unknown	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75+		
Vulva (C51)	5	0.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	1.0	0.0	2.1	2.1	0.1	0.2
Vagina (C52)	1	0.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0
Cervix uteri (C53)	108	10.5	1	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.6	5.6	8.4	10.5	14 .0	7.9	8.9	14.6	5.3	2.4	3.1
Corpus uteri (C54)	5	0.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.7	0.0	0.0	2.1	0.0	0.1	0.2
Uterus unspecified (C55)	17	1.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.5	2.2	2.8	1.0	2.2	2.1	2.1	0.4	0.5
Ovary (C56)	25	2.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.1	1.4	2.8	2.8	2.0	4.4	0.0	1.1	0.6	0.7
Other Female Genital (C57)	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Placenta (C58)	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kidney (C64)	8	0.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	1.4	0.0	0.0	1.0	0.0	2.1	1.1	0.2	0.2
Renal Pelvis (C65)	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ureter (C66)	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bladder (C67)	12	1.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.5	0.6	0.0	2.0	2.2	2.1	2.1	0.3	0.4
Other Urinary organs (C68)	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eye (C69)	2	0.2	0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.1
Brain, Nervous system (C70-C72)	13	1.3	0	0.0	0.3	0.0	0.2	0.2	0.2	0.0	0.0	0.8	0.0	0.6	1.4	1.0	0.0	2.1	2.1	0.3	0.3
Thyroid (C73)	7	0.7	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.1	0.0	1.0	0.0	2.1	0.0	0.2	0.2
Adrenal gland (C74)	1	0.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Endocrine (C75)	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hodgkin disease (C81)	6	0.6	0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.6	0.0	0.5	0.0	0.7	0.0	0.0	0.0	0.0	0.1	0.1
Non-Hodgkin lymphoma (C82-C85 ; C96)	8	0.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.4	0.5	0.6	0.7	0.0	0.0	2.1	1.1	0.2	0.2
Immunoproliferative disease (C88)	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Multiple Myeloma (C90)	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lymphoid Leukaemia (C91)	2	0.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	1.1	0.0	0.1
Myeloid Leukaemia (C92-C94)	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Leukaemia, cell unspecified (C95)	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other & unspecified	61	0.6	0	0.9	0.0	0.7	0.2	0.4	0.9	1.9	1.6	1.1	1.4	2.2	1.4	1.0	6.7	16.7	8.4	1.4	1.6
			0																		
All sites Total	1024		9	1	1	2	2	3	5	17	23	50	59	72	64	86	97	157	90	23.0	27.8
All sites but C44	997		8	1	1	2	2	3	5	17	23	48	58	70	63	84	95	153	86	22.4	27.1

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Among females, breast cancer was the most frequently reported (36.5 %), followed by Cervix uteri (10.5 %), liver (9.1 %) and colon (7.8 %) (Table 3). The most frequent cancer types in males were lung (19.9 %), colon (9.7 %), esophagus and stomach (9.5 %) and liver (8.7 %) (Table 4).

DISCUSSION

Algeria has been the only country in North Africa in which the burden of cancer has been measured quite regularly for 20 years (Zanetti et al., 2010). The present study is based on the cancer registry of Mascara (North West of Algeria) created in 1999. The registry covers an area of 5941 km², and caters to a population of about 826334. To our knowledge there is no previous study about the incidence or pattern of cancer in Mascara. The most interesting feature among our results is the low incidence of cancer. We found an overall ASR for all cancers in females of 27.8 per 100,000, and that for males of 23.6 per 100,000. These rates are lower than national ASR of 104.9 and 108.7, respectively (Ferlay et al., 2010). Interestingly, cancer incidence in Mascara was lower than that reported in other regions in Algeria and North Africa (Table 5a and b). These differences could be due to geographic and/or ethnic factors (Masoompour et al., 2011) and low prevalence of risk factors, as Mascara is a rural region located in internal west of Algeria. Distribution of many cancers within developed and developing countries shows a lower incidence in rural than in urban areas (Hislop et al., 1986; Hall et al., 2005; Hammouda et al., 2007; Swaminathan et al., 2009; Dey et al, 2011).

Table 3: Percent distribution of the 7 most common cancers by site, frequency (n), percentage, crude and age standardized rates (ASR) adjusted to the World Standard Population (W) among **females**

Rank	Site	n	%	Crude rate	ASR (W)
1	Breast	374	36.5	8.4	9.7
2	Cervix	108	10.5	2.4	3.1
3	Liver	93	9.1	2.1	2.8
4	Colon	80	7.8	1.8	2.3
5	Stomach	50	4.9	1.1	1.4
6	Lung	29	2.8	0.7	0.9
7	Ovary	25	2.4	0.6	0.7

Table 4: Percent distribution of the 7 most common cancers by site, frequency (n), percentage, crude and age standardized rates (ASR) adjusted to the World Standard Population (W) among **males**

Rank	Site	n	%	Crude rate	ASR (W)
1	Lung	196	19.9	3.6	4.9
2	Colon	82	9.7	1.7	2.2
3	Liver	74	8.7	1.6	2.2
4	Stomach	65	7.6	1.4	1.8
5	Pharynx	59	7	1.3	1.6
6	Prostate	54	6.3	1.2	1.5
7	Bladder	51	6	1.1	1.5

The most important finding of the present study was the high incidence of liver cancer among males and females in Mascara, 2.2 and 2.8/100,000, respectively. It was nine-fold higher than that in females in Oran (0.3/100,000) (Mokhtari et al., 2007), nearly five-fold higher than that in females in Batna (Bouhidel et al., 2006) and Casablanca (0.6/100,000) (Benider et al., 2012). Among males, the incidence was eleven-fold higher than that in Batna (0.2/100,000), similar to that observed in Algiers (2.42/100,000) and lower than that in Benghazi and Aswan (El Mistiri et al., 2004; Ibrahim, 2010). This may be due to high prevalence of risk factors such as chronic hepatitis B viral infection, and exposure to aflatoxin in food (Mohammad et al., 2009) or pollution due to insecticides (Salim et al., 2009). Indeed, HBV incidence in Mascara is 1.5-fold higher than that in all Algeria (7.16 *vs* 4.76/100,000) (INSP, 2007). Hepatitis B virus (HBV) is considered to be one of the most important causes of chronic hepatitis, cirrhosis and hepatocellular carcinoma (HCC) (Gasim, 2013). Patients

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with chronic HBV infection have a 15–25 % risk of dying prematurely from HBV-related cirrhosis or HCC (Mihigo et al., 2013). It has been reported that 48 % of HCC and 44 % of cirrhosis were attributable to HBV infection in African countries such as Algeria (Perz et al., 2006).

Table 5a: Age-standardized incidence rates directly adjusted to the World Standard Population per 100,000 for top the most common cancers in Mascara among **males** compared to those in selected northern African registries

		All sites	Lung	Colon	Stomach	Liver	Pharynx	Prostate	Bladder
Algeria	**Mascara (present study)**	23.6	4.9	2.2	1.8	2.2	1.6	1.5	1.5
	Algeria (2008) (Ferlay et al., 2010)	108.7	19.4	10.6	7.1	1.3	1.0	7.1	11.9
	Algiers (2007) (Hammouda et al., 2007)	148.0	23.07	8.17	10.22	2.42	0.05	13.57	12.53
	Oran (2006) (Mokhtari and Ammour, 2007)	44.3	6.8	2.1	3.3	1.4	0.0	1.1	4.9
	Batna(2006) (Bouhidel et al., 2006)	65.4	9.7	4.5	4.7	0.2	0.2	3.6	5.2
Morroco	**Grand Casablanca (2005-2007) (Benider et al., 2012)**	120.7	25.9	4.7	4.8	0.7	0.0	13.5	8.7
Tunisia	**Nord Tunisie (2004-2006) (Benabdelah and Hizem Ben-ayoub, 2004)**	136.2	32.5	7.1	6.1	1.8	0.1	11.8	13.7
Libya	**Benghazi (2004) (El Mistiri et al., 2004)**	129.5	26.66	8.75	4.46	4.88	0.3	9.8	12.64
Egypt	**Aswan (2008) (Ibrahim et al., 2010)**	142.5	11.2	3.9	4.1	17.4	0.3	9.2	18.6

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Table 5b: Age-standardized incidence rates directly adjusted to the World Standard Population per 100,000 for top the most common cancers in Mascara among **females** compared to those in selected northern African registries

		All sites	Breast	Cervix	Liver	Colon	Esophagus and stomach	Lung	Ovary
Algeria	**Mascara (present study)**	27.8	9.7	3.1	2.8	2.3	1.4	0.9	0.7
	Algeria (2008) (Ferlay et al., 2010)	104.9	28.6	10.4	1.1	9.1	4.4	2.5	4.0
	Algiers (2007) (Hammouda et al., 2007)	165.6	65.1	10.0	1.3	10.4	6.8	5.0	8.7
	Oran (2006) (Mokhtari and Ammour, 2007)	82.7	34.7	15.1	0.3	1.6	1.7	1.5	1.9
	Batna(2006) (Bouhidel et al., 2006)	65.5	16.1	4.6	0.6	2.1	2.6	0.4	1.0
Morroco	**Grand Casablanca (2005-2007) (Benider et al., 2012)**	115.9	36.4	15.0	0.6	3.2	2.7	2.9	5.3
Tunisia	**Nord Tunisie (2004-2006) (Benabdelah and Hizem Ben-ayoub, 2004)**	102.3	31.84	4.19	1.17	5.89	3.67	2.88	4.14
Libya	**Benghazi (2004) (El Mistiri et al., 2004)**	104.26	23.27	3.48	2.53	8 .1	2.07	2.02	3.9
Egypt	**Aswan (2008) (Ibrahim et al., 2010)**	166.8	63.9	0.9	8.7	3.5	2.4	3.8	9.1

The most important finding of the present study was the high incidence of liver cancer among males and females in Mascara, 2.2 and 2.8/ 100,000, respectively. It was nine-fold higher than that in females in Oran (0.3/ 100,000) (Mokhtari et al., 2007), nearly five-fold higher than that in females in Batna (Bouhidel et al., 2006) and Casablanca (0.6/100,000) (Benider et al., 2012). Among males, the incidence was eleven-fold higher than that in Batna (0.2/100,000), similar to that observed in Algiers (2.42/100,000) and

lower than that in Benghazi and Aswan (El Mistiri et al., 2004; Ibrahim, 2010). This may be due to high prevalence of risk factors such as chronic hepatitis B viral infection, and exposure to aflatoxin in food (Mohammad et al., 2009) or pollution due to insecticides (Salim et al., 2009). Indeed, HBV incidence in Mascara is 1.5-fold higher than that in all Algeria (7.16 *vs* 4.76/ 100,000) (INSP, 2007). Hepatitis B virus (HBV) is considered to be one of the most important causes of chronic hepatitis, cirrhosis and hepatocellular carcinoma (HCC) (Gasim, 2013). Patients with chronic HBV infection have a 15–25 % risk of dying prematurely from HBV-related cirrhosis or HCC (Mihigo et al., 2013). It has been reported that 48 % of HCC and 44 % of cirrhosis were attributable to HBV infection in African countries such as Algeria (Perz et al., 2006).

It is well documented that ingestion of foods contaminated with the mycotoxin, aflatoxin is an important risk factor among people in developing countries, together with active hepatitis virus infection (WHO, 2003). Aflatoxins are important causal factors of liver cancer (Ferrante et al, 2012). In Algeria, foods most susceptible to aflatoxin contamination are locally produced or imported cereals such as wheat. Climatic conditions characterized by high humidity and temperature and inadequate storage practices contribute to the potential for significant exposure of the Algerian population to aflatoxins (Riba et al., 2010). It has been reported that 25–40 % of cereals consumed in the world are contaminated by these compounds (Pittet, 1998). Riba et al. (2008) revealed the widespread occurrence of aflatoxigenic strains of *Aspegillus flavus* in Algeria. Aflatoxigenic *Aspergillus* (belonging to section Flavi and Nigri) were the major fungal species most commonly isolated from Algerian wheat. Recently, Gacem et al. (2011) demonstrated important contaminations of local and imported wheat stored in west Algeria. The aflatoxinogenic genus *Aspergillus* represented 41 to over 86 % of the total flora. Furthermore, in Algeria about 400 pesticides are homologated, and more than 30000 tons of pesticides are used every year. The excessive and non rational use of these chemicals, with the absence of basic security measures makes of Algerians as the most exposed ones to be affected by pesticides (Slimani et al., 2011).

Regarding the most frequent cancers among males (Table 5a), lung cancer was the leading site followed by colon cancer. In Algeria, lung cancer has been reported to be the commonest cancer in males with an ASR of 19.4/100,000 (Ferlay et al., 2011). As shown in Figure 4, the incidence of lung cancer increases steadily with age, from the 40–49 year age group to reach the highest ASR observed in 70-74 year age group. Lung cancer has been closely linked to tobacco smoking (Binu et al., 2007). Around 85 - 90 % of lung cancer could be attributed to the use of tobacco directly or indirectly. In developing regions, 53 % of cancer deaths are caused by smoking (Ezzati et al., 2005). The trend for incidence ASRs of lung cancer shows obvious correlation with the smoking frequency in most of the Arab countries such as Algeria (Salim et al., 2011). Male smoking prevalence in Algeria is 33.9 % (WHO, 2011). In Northern Africa, over 90 % of lung cancer cases in men are attributable to smoking, revealing a smaller environmental contribution (< 2 % of incident cancers) (McCormack and Schüz, 2012). On other hand, cannabis smoking was found to be one of the important causes of lung cancer in men in Algeria (Berthiller et al, 2008).

According to our results, breast cancer was the most common malignancy in females accounting for 36.9 % of the total female cancers in Mascara. Its incidence (9.6/100,000) is the lowest reported from any other Algerian and North African registries (Table 5b). In addition, cervix cancer ranked 2nd among females with an ASR of 3.1/ 100,000. These findings are comparable to the pattern found in other regions in Algeria (Ferlay et al., 2010) and in some Arab countries like Morroco (Benider et al., 2011) or Lebanon (Adib et al., 1998).

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The low incidence of breast cancer in Mascara can be read in two different ways: first, these results may reflect the reality, possibly due to low prevalence of certain risk factors. Secondly, these results can be skewed by the fact that women do not have access to health care services and do not benefit from early diagnosis, or are supported in a facility outside Mascara. Breast cancer development is a multifactorial process. This complex process is a result of biologic, environmental, genetic, hormonal, and life-style factors (Gross, 2000).

Factors that contribute to the increasing trends in breast cancer incidence are not fully understood, but thought to reflect lifestyle changes associated with westernization. The "Westernization" of Algerian population is due to delayed childbearing, lower parity, reduced breast-feeding, decreased exercise and dietary changes (Jalkh et al., 2012).

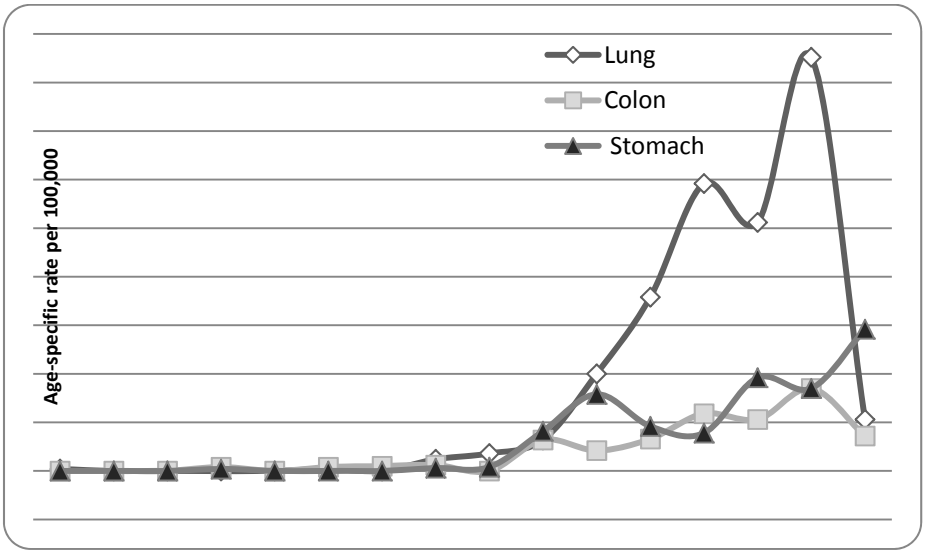

Figure 4: Age specific incidence rates for lung, colon and stomach cancer in **males** for the period 2000–2010 in Mascara

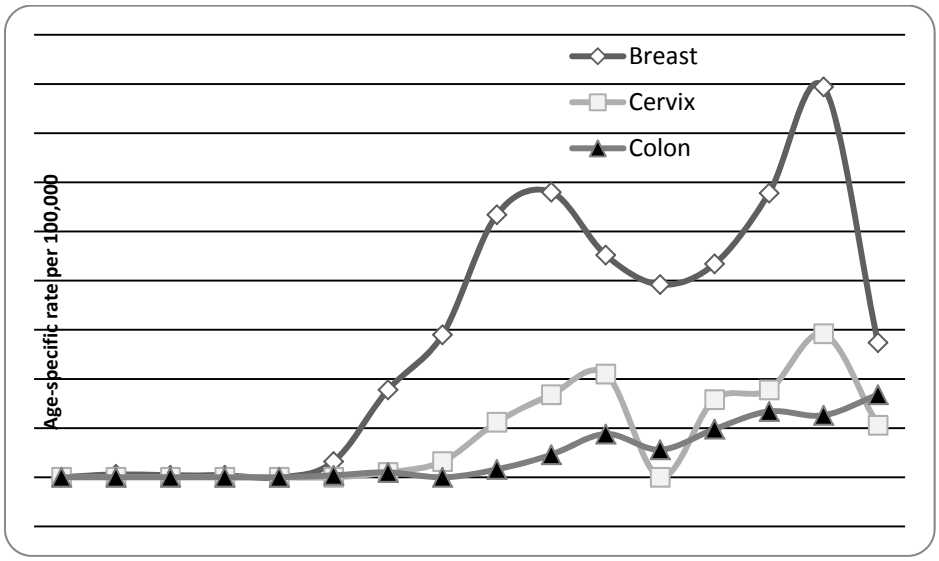

Figure 5: Age specific incidence rates for breast, cervix and colon cancer in **females** for the period 2000–2010 in Mascara

Although ASRs of breast cancer among females in Mascara increase with age to reach a peak up to 5th decade, ASRs increase to reach a second peak in 70-74 years age group (Figure 5). This is in sharp contrast to the current age pattern at diagnosis of breast cancer in low-risk countries characterized by an increase in the rate around menopause, and a decrease thereafter (Rodriguez-Cuevas et al., 2001). The second peak in 70-74 years age group may be attributed to late presentation reflecting poor health seeking behavior (Oluwagbemiga et al., 2012).

CONCLUSION

Despite the fact that the present study covers ten years from 2000 to 2010, some limitations should be considered. An important limitation is the retrospective nature of the study. Another limitation is that the cancer registry was established only in 1999 and no previous studies on cancer incidence in Mascara were available. Furthermore, under-reporting may have underestimated the rate estimates.

The present study is the first estimating cancer incidence in Mascara province. Cancer incidence was lower than that reported in other regions in Algeria and North Africa. Understanding this fact needs further investigations of geographic and/or ethnic characteristics of the local population. The high incidence of liver cancer in Mascara, the highest in Algeria, highlights an urgent need to examine prevalence of related risk factors such chronic hepatitis B viral infection. Regarding the most frequent cancers (lung among males and breast cancer among females), our results indicate the necessity of developing screening programs (aiming early detection) and better cancer prevention policy.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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