

## Tracking cancer in Morocco: A systematic review

Cancer in Morocco

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**Aim:** The aim of this systematic review is to study the epidemiological, risk factors and socio-economic characteristics of cancer in Morocco.

**Material and Methods:** A protocol for conducting our systematic review was developed according to the guidelines of "Preferred reporting articles for systematic reviews and meta-analysis". Several databases and the WHO clinical trial registries were consulted. A period from March to June, 2020 was devoted to this consultation. The protocol of the review was registered in the PROSPERO.

**Results:** Forty-Four studies were selected. The age of the study population ranged from 5 to 62 years. We found a predominance of patients living in urban areas, a high frequency of illiterate and a predominance of married patients. Cancer was more prevalent among the social group with limited health insurance. Smoking, obesity/overweight and family history were identified as risk factors for cancer. Cancers were diagnosed at advanced stages, mainly for colorectal, digestive, lung and cervical cancers.

**Discussion:** Cancer in Morocco affects the young, underprivileged and uninsured population with a marked delay in diagnosis. Finally, it is recommended to study the factors of delayed diagnosis and to make more efforts in prevention and early detection in order to reduce the incidence of cancer in our country.

**Keywords**

Epidemiological Profile, Risk Factors, Socioeconomic Characteristics, Morocco

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## Introduction

In Morocco, cancer has become a public health issue [1]. The extent of the disease has become more important, with 30,000 to 40,000 new cases being detected each year [2]. The pathogenesis of cancer is multifactorial, with a proportion attributable to lifestyle and individual risk factors. Cancer is a disease of social incidence due to its socio-economic effects that affect both the patient and his or her social environment. In recent years, several studies have attempted to define cancer incidence rates and estimate its epidemiology in several populations. While the literature is extensive, the incidence ranges reported are frequently inconsistent, reflecting the biases in patient recruitment, sampling procedures, and types of instruments employed. Incidence studies are important for use in the planning of health care and epidemiological investigations, because they provide important information to estimate the burden of disease in a population. This systematic review aims to study the epidemiological profiles of cancer, the socio-demographic and socio-economic characteristics of incident cases of cancer in Morocco and the risk factors of this disease.

## Material and Methods

### Research Strategy

A protocol for conducting our systematic review was developed according to the guidelines of "Preferred reporting articles for systematic reviews and meta-analysis" (PRISMA. 2009) [3]. This protocol was registered in the international prospective register of systematic reviews (PROSPERO: CRD42020173657). In order to identify studies relevant to this review, several databases were independently searched by two reviewers (ZC and RR): Science Direct, PubMed, Clinicalkey, Web of Science, EMBASE, LILACS, GLOBAL Health and Proquest. The search had no language restrictions. WHO clinical trial registries were also consulted. The keywords used were as follows: (cancer incidence) or (trends in cancer incidence) or (increase in new cancer cases) and (epidemiological patterns of cancer) or (epidemiological aspects of cancer) or (epidemiological characteristics of cancer) or (socio-economic characteristics of cancer patients) or (socio-economic characteristics of incident cancer cases) and (individual risk behaviours) or (individual risk factors) and (Morocco) or (the Kingdom of Morocco) or (cities in Morocco).

### Criteria for inclusion:

- Studies on cancer in the Moroccan population, published between 2010 and 2019.
- Studies that have looked at the epidemiological patterns of cancer.
- Studies that have studied the socio-demographic characteristics of incident cancer cases in Morocco.
- Studies that have addressed risk factors for the disease including smoking, alcohol consumption, obesity and family history.

### Exclusion criteria:

- The studies, which studied the anatomical profiles of cancer.
- Studies that were published in non-scientific journals

### Evaluation of the Quality of Studies

A critical assessment of the quality of the selected studies was

conducted by two observers (ZC and RR) using the following tools: "Critical Appraisal Skills Program (CASP) Case-Control Study", "Critical Appraisal Skills Program (CASP) cohort study", "Quality Assessment Tool for Case Series Studies", and "Quality Assessment Tool for Cross-Sectional Studies".

### Data extraction

Two reviewers (ZC and RR) independently extracted the data using a form designed for this purpose, based on COCHRANE's guide "Data collection form for intervention reviews". The extracted data includes epidemiological patterns of cancer, socio-demographic and socio-economic characteristics of patients (age, sex, place of residence, level of education, marital status, health insurance, socio-economic level). For risk factors, we extracted consumption of both alcohol and tobacco, obesity/overweight, and family history.

## Results

Our search resulted in the selection of forty-four articles (n=44) (Figure 1).

With respect to study type: (n=10) were prospective control cases, (n=6) were retrospective case series, (n=3) were retrospective cross-sectional studies, (n=1) was a retrospective cohort study, (n=18) were retrospective studies, and (n=6) did not specify study type. About the study location: Rabat (n=14), Casablanca (n=5), Fez (n=9), Oujda (n=5), Meknes (n=1), Marrakech (n=2), Casablanca and Rabat (n=5), Marrakech and Casablanca (n=1), and two multicenter studies (n=2). All studies were conducted in the hospital setting. For the sampling, only one study (n=1) defined the sampling method and sample size. This research included people of all ages [4]. With regard to ethical considerations: (n=16) studies obtained ethics committee approval, and (n=15) had signed informed consent from patients.

The quality of the selected studies was rated as "good". For the case-control studies, the average score was 9.1/11.

Socio-demographic and socio-economic characteristics of cancer patients

### Age

Regarding the age of the study population of the selected articles, twenty-nine (n=29) studies showed an average age ranging from 8.28 to 61 years. The studies of Karkouri et al., (2010), Harmouch et al., (2012) and Hazmiri et al., (2018) had a very young study population, with an age range between 5 and 19 years [5,6,7]. Twelve studies (n=12) calculated a median age ranging from 45 to 62 years. Two studies (n=2) specified neither the average nor median age [8, 9] (Table 1, 2).

### Sex

Twenty-one studies (n=21) looked at female cancer. The sex ratio was calculated in fifteen studies (n=15); male predominance was reported in thirteen studies (n=13) with a sex-ratio ranging from 0.88 to 2.5. In the study by Benlahfid et al. (2017), a male/female ratio was less than 1 (0.88) [10]. (Tables 1,2).

### Areas of residence

Fifteen studies (n=15) studied the residential environment of cancer patients: thirteen (n=13) reported a predominance of patients from urban areas with a rate between 59.2 and 80%. Two studies (n=2) by Berraho et al. (2017) and Imad et al.

(2019) found a significant difference between the two settings [11, 12]. (Tables 1,2).

#### Level of education

Ten studies (n=10) examined patient education [4, 8, 11-18]. They revealed a predominance of illiterate patients with a rate between 47.56 and 84.4% (Table 1). An association between patients' lack of schooling and increased risk of cervical cancer was reported in the study by Berraho et al., (2017) [11].

#### Marital status

This variable was examined in twelve studies (n=12). Married status predominated in all of these studies. It ranged from 56.6% reported in the study by Berraho et al. (2012) [4], to 81% reported in the studies by Maamri et al. (2011) [9] and Imad et al (2019) [15]. A significant difference between different marital status was reported in the study by Berraho et al. (2017) [11].

#### Socio-economic level

Seven studies (n=7) analyzed the socio-economic level of patients [4,8,9,11,12,14,17]. It was considered low in all studies with a percentage between 64 and 92.2. Two studies (n=2) reported low monthly income for patients [12,17]. The study by Berraho et al., (2017) showed the low socio-economic level (83.5%) by specifying the rate of unemployed patients (91%) [11].

#### Health Insurance

Four studies reported the issue of patient medical insurance [4,8,11,13]. The rate of patients with health insurance did not exceed 15% in all four studies. The study by Imad et al., (2019) found that 77.33% of the study population was affiliated to the medical assistance scheme [12].

Proportion of cancer risk factors in Morocco according to selected studies

We limited ourselves to the following four risk factors: smoking, alcohol consumption, obesity/overweight and family history. Thirteen studies (n=13) examined a single risk factor

[4,9,11,13,19-27], (n=4) studies reported two factors [14,28-30], three risk factors were addressed in (n=3) studies [10,16,17], and (n=2) studies reported all four risk factors [15,31].

Twelve studies (n=12) reported smoking as a risk factor for cancer with a percentage from 2.1 % to 86.15% [10,11,14-19,24,26-28]. It is strongly associated with lung cancer in the study by Belmokhtar et al., (2019) [19]. The study conducted in Fez by Khalis et al., (2018) showed a very high proportion of passive smokers (44.7%) [17]. Alcohol consumption was reported in (n=5) studies, with a percentage from 1.69% to 17.4%) [10,14-16,31]. A statistically non-significant inverse association was reported in (n=4) studies between alcohol consumption and the risk of developing cancer [10,14,16,31]. Obesity/ overweight was reported in (n=7) studies: (9.7-46.8%) for obesity and overweight (32.3-53%), respectively [15,17,22,23,29-31]. Fourteen studies (n=14) addressed the family history of cancer. It was between 0.64 and 22.6% (Table 3).

Epidemiological profile of cancer patients in Morocco according to the studies analyzed

The epidemiological profile of cancer patients was explored in (n=36) studies. Histologic type was revealed in (n=28) studies, age at diagnosis in fourteen studies (=14), twenty-four specified the stage of the tumor, and (n=7) studies showed medical and/or surgical history of patients.

#### Histological type by cancer site

In studies investigating lung cancer, adenocarcinoma was the most common histological type (40.2-59%) [19,27,32]. For colorectal cancer, Lieberkühnien adenocarcinoma was predominant (82-97%) [15,33]. For breast cancer in both sexes, Infiltrating Ductal Carcinoma (IDC) was common with a proportion ranging from 86 to 96.4% [25,34-39].

#### Age of patients at the time of diagnosis

Age at diagnosis ranged between 5 and 71.1 years. The average age at highest diagnosis (71.1 years) was found in patients

**Table 1.** Socio-demographic characteristics of cancer patients in Morocco according to selected studies (Part I)

Studies	Cities	Age (Years)	Sex	Place of residence (%)	Level of education (%)	Marital status (%)
Imad & al. 2019 <sup>13</sup>	Casablanca	55,49	1.12 <sup>SR</sup>	75,11 <sup>UA</sup>	47,56 <sup>I</sup>	77,78 <sup>M</sup>
Abbass & al. 2011 <sup>35</sup>	Fez	45 <sup>MA</sup>	W	-	-	-
Mellouki & al. 2018 <sup>73</sup>	Fez	48	2,4 <sup>SR</sup>	-	-	-
Laamiri & al. 2013 <sup>24</sup>	Rabat	45,83 <sup>S</sup>	W	-	-	-
Lachgar & al. 2016 <sup>33</sup>	Rabat	59 <sup>MA/S</sup>	89,4% <sup>MS</sup>	-	-	-
Bourhafour & al. 2011 <sup>38</sup>	Rabat	62 <sup>MA</sup>	M	-	-	-
Khalis & al. 2018 <sup>18</sup>	Fez	48,6 <sup>S</sup>	W	67,9 <sup>UA</sup>	63,7 <sup>I</sup>	64,6 <sup>M</sup>
Slaoui & al. 2016 <sup>31</sup>	Rabat	48,9 <sup>S</sup>	W	-	-	-
Al Jarroudi & al. 2017 <sup>74</sup>	Oujda	45,6 <sup>MA/S</sup>	W	-	-	-
Raissouni & al. 2012 <sup>27</sup>	Rabat	44	2,1 <sup>SR</sup>	-	-	-
Slaoui & al. 2015 <sup>31</sup>	Rabat	58,1	M	-	-	-
Bennis & al. 2012 <sup>37</sup>	Fez	45	W	-	-	-
Belhamidi & al. 2018 <sup>34</sup>	Meknès	56,8	1,5 <sup>SR</sup>	60 <sup>RA</sup>	-	-
Laamiri & al. 2016 <sup>30</sup>	Rabat	32,84 <sup>S</sup>	W	-	-	-
Laamiri & al. 2015 <sup>22</sup>	Rabat	45,83 <sup>S</sup>	W	-	-	-
Zakkouri & al. 2015 <sup>28</sup>	Rabat	55,68	W	-	-	-
Berraho & al. 2012 <sup>5</sup>	Casablanca/Rabat	51,98	W	60,8 <sup>UA</sup>	79,5 <sup>I</sup>	56,6 <sup>M</sup>
Rais & al. 2012 <sup>26</sup>	Rabat	46 <sup>MA</sup>	W	-	-	-
Hazmiri & al. 201 <sup>88</sup>	Marrakech	8,28	1,6 <sup>SR</sup>	-	-	-

MA: median age, SR: sex ratio, FS: female sex, MS: male sex, M: men, W: women, RA: rural area, UA: urban area, I: illiterate, M: married, S: significant, RF: risk factor

**Table 2.** Socio demographic characteristics of cancer patients in Morocco according to selected studies (Part II)

Studies	Cities	Age (Years)	Sex	Place of residence (%)	Level of education (%)	Marital Status (%)
IMAD & al. 2019 <sup>16</sup>	Casablanca	56,65	1.17 <sup>SR</sup>	80 <sup>UA</sup>	50I	81 M
Belmokhtar & al.2019 <sup>20</sup>	Oujda	58 <sup>MA</sup>	91% <sup>MS</sup>	-	-	-
Boufettal & al. 2015 <sup>70</sup>	Casablanca	43	W	-	-	-
Khalil & al. 2016 <sup>21</sup>	Casablanca	47,8	W	-	-	59.3 <sup>M</sup>
Slimani & al. 2016 <sup>40</sup>	Rabat	61	M	-	-	-
Errahhali & al. 2017 <sup>8</sup>	Oujda	-	1.97 <sup>SR</sup>	79 <sup>UA</sup>	-	-
Berraho & al. 2012 <sup>5</sup>	Casablanca, Rabat	52,1	W	59.2 <sup>UA</sup>	84.4I	68.7 <sup>M</sup>
Maamri & al. 2011 <sup>9</sup>	Oujda	-	W	-	66I	81 <sup>M</sup>
KENNANY & al. 2019 <sup>32</sup>	Casablanca, Rabat, Oujda, Fez, Marrakech	56.45	50.70% <sup>FS</sup>	69.20 <sup>UA</sup>	63.20I	76.30 <sup>M</sup>
ISMAILI & al. 2014. <sup>39</sup>	Rabat	47 <sup>MA</sup>	W	-	-	-
Laamiri & al. 2014 <sup>23</sup>	Rabat	45.83 <sup>S</sup>	W	-	-	-
CHBANI & al. 2012 <sup>71</sup>	Fez	53	55% <sup>MS</sup>	-	-	-
BENBRAHIM & al. 2017 <sup>36</sup>	Fez	47 <sup>MA/ S</sup>	W	-	-	-
Karkouri & al. 2010 <sup>6</sup>	Casablanca/Rabat	9,3	1.3 <sup>SR</sup>	-	-	-
EL MAJJAOUI & al.2014 <sup>29</sup>	Marrakech	56 <sup>MA</sup>	2.08 <sup>SR</sup>	-	-	-
Benlahfid & al. 2017 <sup>11</sup>	Casablanca	55.55 <sup>RF</sup>	0.88 <sup>SR</sup>	63.8 <sup>UA</sup>	-	-
Mellouki & al. 2014 <sup>25</sup>	Fez	58	2.5 <sup>SR</sup>	56.3 <sup>UA</sup>	-	-
Elmajjaoui & al. 2016 <sup>41</sup>	Casablanca/Rabat	50 <sup>MA</sup>	W	-	-	80 <sup>M</sup>
HARMOUCH & al. 2012 <sup>7</sup>	Rabat	8,36	1.2 <sup>SR</sup>	-	-	-
Errahhali & al. 2016 <sup>10</sup>	Oujda	53 <sup>MA</sup>	2.1 <sup>SR</sup>	-	-	-
Khalis & al. 2018 <sup>18</sup>	Fez	49.7 <sup>S</sup>	W	67.9 <sup>UA</sup>	66.7I	65.3 <sup>M</sup>
Berraho & al. 2017 <sup>12</sup>	Rabat, Casablanca, Fez	51,9	W	59.4 <sup>UA</sup>	84.3I	59.7 <sup>M</sup>
Smith & al. 2015 <sup>72</sup>	Marrakech Casablanca	60 <sup>MA</sup>	1.7 <sup>SR</sup>	79 <sup>UA</sup>	-	-
EL AMRANI & al. 2018 <sup>15</sup>	Fez	40	1.16 <sup>SR</sup>	61.5 <sup>UA</sup>	48,6I	77.3 <sup>M</sup>
Obtel & al., 2015 <sup>19</sup>	Casablanca/Rabat	50.5 <sup>MA</sup>	W/M	-	-	-

MA: median age, SR: sex ratio, FS: female sex, MS: male sex, M: men, W: women, RA: rural area, UA: urban area, I: illiterate, M: married, S: significant, RF: risk factor

**Table 3.** Risk factors for cancer in Morocco according to selected studies

Studies	Cities	Tobacco (%)	Alcohol consumption (%)	Obesity/Overweight (%)	Family History (%)
IMAD & al. 2019 <sup>16</sup>	Casablanca	32	1.69	530W/140 <sup>b</sup>	7
Belmokhtar & al. 2019 <sup>20</sup>	Oujda	86.15	-	-	-
Khalil & al. 2016 <sup>21</sup>	Casablanca	-	-	-	22.6
Berraho & al. 2012 <sup>5</sup>	Casa/Rabat	-	-	-	2.8
Maamri & al. 2011 <sup>10</sup>	Oujda	-	-	-	15 <sup>NS</sup>
KENNANY & al. 2019 <sup>32</sup>	Casablanca, Rabat, Oujda, FEZ Marrakech	12.10	2.40	43.70W/15.800 <sup>b</sup>	5.50
Laamiri & al. 2014 <sup>23</sup>	Rabat	-	-	40.40W/390 <sup>b</sup>	-
EL MAJJAOUI & al.2014 <sup>29</sup>	Marrakech	30.5	-	-	0.64
Benlahfid & al. 2017 <sup>11</sup>	Casablanca	23.4	17.4	-	19.2
Mellouki & al. 2014 <sup>25</sup>	FEZ	30.4	-	-	-
Khalis & al. 2019 <sup>17</sup>	FEZ	2.3	2	-	9.3
Berraho & al. 2017 <sup>12</sup>	Rabat, Casablanca FEZ	2.1	-	-	-
EL AMRANI & al. 2018 <sup>15</sup>	FEZ	22.4	16.7	-	-
Laamiri & al. 2013 <sup>24</sup>	Rabat	-	-	40.40W/38.40 <sup>b</sup>	-
Khalis & al. 2018 <sup>18</sup>	FEZ	44.7 <sup>PS</sup>	-	36.30W/46.80 <sup>b</sup>	16.5
Slaoui & al. 2016 <sup>31</sup>	Rabat	-	-	27.90 <sup>b</sup>	14.6
Raissouni & al. 2012 <sup>27</sup>	Rabat	12.5	-	-	-
Laamiri & al. 2016 <sup>30</sup>	Rabat	-	-	32.30W/9.70 <sup>b</sup>	7.3
Laamiri & al. 2015 <sup>22</sup>	Rabat	-	-	-	14.3
Zakkouri & al. 2015 <sup>28</sup>	Rabat	11	-	-	-
Berraho & al. 2012 <sup>5</sup>	Casa/Rabat	-	-	-	16.8
Rais & al. 2012 <sup>26</sup>	Rabat	-	-	-	7.8

OW: overweight, Ob: obesity, NS: not significant, PS: passive smoking

with colorectal cancer [33]. For pediatric tumours, the age of the children at diagnosis ranged from 5 to 9.3 years [5,7].

#### **Tumor staging**

**Colorectal Cancer:** According to the study by Belhamidi et al. (2018), 55% of the population studied had stage II colorectal cancer [33]. Two studies (n=2) attributable to Imad et al. (2019), found advanced stages of colorectal cancer: (40% stage III and 36% stage IV) in the first study (54.65% stage III and IV) in the second [12,15].

**Lung cancer:** Tumors were diagnosed at advanced stages (stage III and IV) [19,27,32]. The study by Belmokhtar and al. (2019) reported a proportion of 97% of patients with stage III and IV lung cancer [19]. The study by Obtel and al. (2015) found a significant difference between the two sexes [18].

**Breast cancer:** The study by Obtel et al. (2015) found a predominance of stage II patients (59%) [18]. In two studies (n=2), the frequency of patients with stage II breast cancer ranged from 56 to 61.1% [30,34]. For stages II and III, the proportion of patients ranged from 77.8 to 82% [37,38].

**Cervical cancer:** Patients were identified in the Obtel Study (2015) as stage III (65.7%) [18]. In addition, the study by El Majjaoui et al. (2016) classified patients with advanced cervical cancer in stages III and IV (88%) [40].

#### **Medical and Surgical History**

Diabetes was reported in (n=4) studies [10,15,19,26]. It was between 4.6 and 46.7%. Hypertension was identified in two studies (n=2), with a proportion between 2.44 and 42.6% [10,19]. The study by Benlahfid et al. (2017) found a surgical history in the study population (34%) [10]. In addition, the study by Berraho et al. (2017) on cervical cancer showed the existence of Sexually Transmitted Infections (STIs) in 92.5% of the study population [11].

#### **Discussion**

According to the results of our review, cancer in Morocco affected the young population. It appeared at an average age between 8.3 and 62.0 years. Our review revealed a high male sex ratio. Among 19 studies of both sexes, 13 reported male dominance. This may be due to the difference between the high global incidence of cancer in men compared to women.

The studies, subjects of our review, reported a high predominance of illiterate patients between 47.6 and 84.4%. This may be explained by the fact that illiterate patients do not seek early detection of cancer. Another study conducted in Tunisia confirmed that the level of education was an obstacle to cancer detection [42].

Regarding socio-economic status, we found a high percentage of patients with a low socio-economic status (64.0-92.2%). In addition, the studies by Berraho and al., (2017) and EL Amrani et al., (2018) reported a significant association between low socio-economic status and the risk of cancer occurrence [11,14]. 1st study: OR=2,2; 95% CI 1,2-3,9 and 2nd study: OR= 3,82;95% CI (1,38-10,55). These results were corroborated by a study in France, which attributed several types of cancers to low socio-economic status [43]. Thus, the study by Errahhali et al., (2017) reported 83.4% of unemployed patients [8] and 80% were poor according to another study [9]. The study by Khalis

et al., (2018) showed that 40.9% of patient households had a monthly income below 2000 MAD [17]. Low socio-economic level, in our context, is a determinant of cancer occurrence and a barrier to access to diagnosis and treatment.

With regard to health insurance, our review found a very low proportion of patients with medical coverage, no more than 15%. The study by Imad et al. (2019) found a high frequency (77.33%) of patients affiliated to the medical assistance system (RAMED) [12]. This can be explained by the fact that a high proportion (78.4%) of the employed workforce in Morocco is not subject to any health insurance organism.

The pathogenesis of cancer is multifactorial. Lifestyle or behavioural factors are no longer in evidence today. Smoking is a major known cause of cancer-related deaths worldwide. In addition, a causal link has been established between smoking and twelve types of cancer [44]. In our review, smoking was considered a risk factor for several types of cancer. Indeed, the study by Belmokhtar et al. (2019) reported a highly significant association between tobacco consumption and lung cancer [19], with a significant difference between sexes ( $p < 0,001$ ). A study conducted in the United States of America (USA) in 2014 supported our results, reporting that  $\frac{3}{4}$  of incident cancer cases were smokers, with a high proportion of smokers for lung cancer (81.7%) [45].

Concerning alcohol consumption, the results of our review showed low frequencies of alcohol consumption among the populations studied (1.69-17.4%). Several studies, subjects of our review, reported a non-significant inverse association between alcohol consumption and the risk of cancer. Our results are different from those confirmed by a French study, which showed that alcohol was the cause of 28,000 new cases of cancer. The same study found that 57.7% of esophageal cancer and 48.0% of liver cancer were attributable to alcohol [46]. In addition, a review of the literature concluded that the risk of cancer becomes greater if there is a synergistic interaction between alcohol consumption and smoking [47].

Evidence of a causal link between obesity and the development of cancer has been established [48]. Several epidemiological studies have correlated overweight with an increased risk of cancer occurrence in various locations [49]. In this regard, the results of our review revealed high frequencies of obesity (9.7-46.7%) and overweight (32.3-53.0%) in the populations studied. The idea behind this confirmation is the high prevalence of obesity (14%) and overweight (30%) in the Moroccan population [50]. An American study came to support our results, revealing a significant proportion of cancer (7.8%) attributable to obesity [45].

With respect to family history of cancer, several epidemiological studies have shown their association with an increased risk of developing cancer [51]. The shares attributable to family history were proportional to the location of cancer. It was 5-10% for breast cancer [52], 2.0-9.4% for colon cancer and 4.6-9.5% for prostate cancer [51]. The results of this review reported a frequency of patients with a family history ranging from 0.64 to 22.6%. Some characteristics of cancer patients in relation to family history have been revealed in this study.

In regard to the cancer epidemiology profile, we looked at four

elements: histological type, average age at diagnosis, staging, and medical history of cancer.

For lung cancer, adenocarcinoma was the most common histological type (40.2-59.0%). This can be explained by variations in smoking behaviour and the new composition of cigarettes. Moreover, in 2015, adenocarcinoma was the predominant histological type in Tunisia (46.3%) [53].

As for colorectal cancer, a highly elevated frequency of Liberkuhnian adenocarcinoma has been reported in our review. Our results were consistent with a French study, which confirmed that more than 95% of colorectal.

For breast cancer, our review revealed that infiltrating ductal carcinoma was the most common (86- 96.4%). These results were identical to those found in a Tunisian study for breast cancer, where the frequency of ductal infiltrating carcinoma was 94.6% [54]. For cervical cancer, our review reported a high frequency of squamous cell carcinoma (94.0%). The situation was similar in the Maghreb countries, in both Tunisia and Algeria, squamous cell carcinoma was the most frequent histological type in cervical cancer patients, with 86.2% and 90.5% respectively [55]. In addition, we found that breast and cervical cancer accounted for 56.3% of female cancers [18].

Cancer in Morocco was diagnosed at a young age, 67.0% were under 50 years of age [18]. Indeed, for breast cancer, two studies reported a young age (46.0-46.8 years). This can be explained by the policy of early detection of breast cancer envisaged by the Ministry of Health in Morocco.

The highest average age at diagnosis in our review was found in patients with colorectal cancer. This can be explained by the fact that colorectal cancer is a specific tumor of the elderly with recourse to late diagnosis.

Concerning the staging of tumors, 2/3 of the studies that looked at colorectal cancers revealed a predominance of tumors classified in advanced stages (III and IV). Lack of knowledge of the symptoms associated with this type of cancer may explain the delay in diagnosis.

For lung cancer, the studies, subjects of our review, showed a highly elevated frequency of patients diagnosed at advanced stages (III and IV). This may be explained by the late onset of symptoms indicative of the disease. Our results were corroborated by a Tunisian study, which reported a high frequency of patients with lung cancer classified as advanced (IIIB and IV) [56].

The results of the studies analyzed, in relation to breast cancer, reported a predominance of diagnosed tumors oscillating between intermediate stages (I and II) and stage III. This comes back to the policy of early detection of breast cancer undertaken in Morocco for several years. The results of our review were inconsistent with those of Canada, where 70% of breast cancer cases are diagnosed early, at stages I and II [57].

For breast and cervical cancer, our review identified a delay in screening for cervical cancer, stage III and IV. This type of cancer is much more related to underprivileged social classes, which can be explained by difficulties in accessing early screening despite the efforts made.

For pancreatic cancer, we have identified 59.3% of patients diagnosed at stage IV. These results are identical to those in Canada, 57% of pancreatic cancer cases were Stage IV [58].

This can be explained by the fact that most pancreatic cancers are not related to a preventable risk factor, and the tumor causes noticeable symptoms only in advanced stages.

As for medical history, several epidemiological studies have established an association between certain diseases and cancer. In this sense, the study by Gariani et al., (2010) confirmed a high frequency of certain cancers in the case of diabetes. Pancreatic cancer has been found in diabetics (80%), bladder cancer (40%) [59]. Similarly, diabetes increases the risk of colorectal cancer by 1.2 to 1.5 times [58]. The results of our review were consistent with those reported above. Diabetes was found in patients with colorectal cancer (19%) [15], gastric cancer (46.7%) [10] and pancreatic cancer (6%) [26]. The association between diabetes and risk of colorectal cancer occurrence can be explained by hyperinsulinemia and exposure to carcinogenic agents for the intestinal mucosa, caused by a longer intestinal transit time [59].

Concerning Arterial Hypertension (AHT), two studies in our review reported the presence of Arterial Hypertension in the populations studied: the first found a high frequency of Arterial Hypertension in patients with digestive cancer (42.6%) [10], and the second study reported 2.44% in cases of lung cancer [19]. In these two studies, AHT was found in parallel with diabetes. The presence of AHT in cancer patients can be explained by the behavioral risk factors favoring both cancer and high blood pressure (obesity, alcohol, tobacco, physical inactivity, etc.). Regarding the history of sexually transmitted infections, the study by Berraho and al. (2017), part of our review, found a high frequency of STIs (90.2%) in patients with cervical cancer [11]. These results were corroborated by a study conducted in Africa on cervical cancer, which found a high frequency of STIs (70.2%) in patients with cervical cancer [60]. This may be due to the Human Papilloma Virus (HPV) responsible for STIs.

#### **Limitations**

Our systematic review has some limitations. Cancer studies did not cover all regions of the country. No studies included in this review were conducted in the northern and southern regions of Morocco. In addition, despite data from Casablanca and Rabat registries, these studies were carried out only in university hospital centers; none of these studies considered either regional centers or private oncology centers.

#### **Conclusion**

The studies analyzed showed particularities of cancer in Morocco. Most of the population affected by cancer was young, with low-income levels and a gender predominance of males. Several types of cancer in Morocco are diagnosed at advanced stages compared to Western countries. It is highly recommended to study the factors behind the delay in diagnosis and how to deploy more efforts in the prevention and early detection in order to reduce the incidence of cancer in the Moroccan population.

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#### **Scientific Responsibility Statement**

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some



of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

#### Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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#### Conflict of interest

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#### References

- Brahmi SA, Zahra ZF, Seddik Y, Afqir S. The problem of the cost of new therapeutics in oncology: what about Morocco? *Pan Afr Med J*. 2016;24(1):51.
- Mechita NB, Tazi MA, Er-Raki A, Mrabet M, Saadi A, Benjaafar N et al. *Survie au cancer du sein à Rabat (Maroc) 2005-2008*. *Pan Afr Med J*. 2016;25.
- Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Reprint—preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *J Physical Therapy*. 2009;89(9):873-80.
- Berraho M, Bendahhou K, Obtel M, Zidouh A, Benider A, Errihani H et al. Cervical cancer in Morocco: epidemiological profile from two main oncological centers. *J Asian Pac J Cancer Prev*. 2012;13(7):3153-7.
- Karkouri M, Zafad S, Khattab M, Benjaafar N, El Kacemi H, Sefiani S et al. Epidemiological profile of pediatric brain tumors in Morocco. *J Child's Nervous System*. 2010;26(8):1021-17.
- Harmouch A, Taleb M, Lasseini A, Maher M, Sefiani S. Epidemiology of pediatric primary tumors of the nervous system: a retrospective study of 633 cases from a single Moroccan institution. *J Neurochirurgie*. 2012;58(1):14-18.
- Hazmiri F-E, Boukif F, Benali SA, El Ganouni NCI, Rais H. Brain tumors in children: about 136 cases. *Pan African Medical Journal*. 2018; 30:291.
- Errahhali ME, Errahhali ME, Ouarzane M, Boulouiz R, Bellaoui M. Cancer incidence in eastern Morocco: cancer patterns and incidence trends, 2005–2012. *J BMC cancer*. 2017;17(1):587.
- Maamri A, El Hfid M, Chafi A, Boutayeb A. Cervix and breast cancers in Oujda city in Eastern Morocco: Determinants and risk factors. *Open journal of preventive medicine*. 2012; (2):1.
- Errahhali ME, Errahhali ME, Abda N, Ⓞ Bellaoui, M. Correction: Exploring Geographic Variability in Cancer Prevalence in Eastern Morocco: a Retrospective Study over Eight Years. *Plos one*, 2016; 11(5), e0155200.
- Benlahfid M, Erguibi D, Elhattabi K, Bensardi F, Khaiz D, Lafriekh R et al. Descriptive epidemiology of rettene carcinosis of digestive origin at the Ibn Rochd University Hospital of Casablanca (2008-2010). *Pan Afr Med J*. 2017;27.
- Berraho M, Amarti-Riffi A, El-Mzibri M, Bezad R, Benjaafar N, Benideer A et al. HPV and cofactors for invasive cervical cancer in Morocco: a multicentre case-control study. *J BMC Cancer*. 2017;17(1):435.
- Imad FE, Drissi H, Tawfiq N, Bendahhou K, Jouti N T, Benider A et al. Influence of socio-economic factors and education level on colorectal cancer in the Moroccan population. *Pan Afr Med J*. 2019; 34:209.
- Berraho M, Obtel M, Bendahhou K, Zidouh A, Errihani H, Benider A et al. Sociodemographic factors and delay in the diagnosis of cervical cancer in Morocco. *Pan Afr Med J*. 2012;12(1): 1-8.
- El-Amrani-Joutey M, Jiménez-García R, Linares-García-Valdecasas R, Palomar-Gallego MA, Jiménez-Trujillo I, López-de-Andrés A et al. Infection by Epstein-Barr virus in Fes (Morocco). Prevalence and predictors of positivity in nasopharyngeal cancer. *Journal of Infection Public Health*. 2018;11(6):807-11.
- Imad FE, Drissi H, Tawfiq N, Bendahhou K, Jouti N T, Radallah D. Epidemiological, nutritional and anatomopathological aspects of colorectal cancers in the greater Casablanca region. *The Pan African Medical Journal*. 2019;32.
- Khalis M, Chajès V, Moskal A, Biessy C, Huybrechts I, Rinaldi S et al. Healthy lifestyle and breast cancer risk: A case-control study in Morocco. *J Cancer Epidemiology*. 2019; 58:160-166.
- Khalis M, Charbotel B, Chajès V, Rinaldi S, Moskal A, Biessy C et al. Menstrual and reproductive factors and risk of breast cancer: A case-control study in the Fez region, Morocco. *J PLoS One*. 2018;13(1):e0191333.
- Obtel M, Lyoussi B, Tachfouti N, Pelissier SM, Nejari C. Using surveillance data to understand cancer trends: an overview in Morocco. *J Archives of Public Health*. 2015;73(1):45.
- Belmokhtar KY, Tajir M, Boulouiz R, Bennani A, Brahmi SA, Alloubi I et al. Lung cancer in Eastern Morocco: where do we stand? . *Pan Afr Med J*.2019;34.
- Khalil Al, Bendahhou K, Mestaghanmi H, Saile R, Benider A. Bilateral Synchronous Breast Cancer: Experiences of the Mohammed VI Center for the Treatment of Cancer CHU Ibn Rochd Casablanca. *Pan Afr Med J* 2016;25.
- Laamiri FZ, Bouayad A, Hasswane N, Ahid S, Mrabet M, Amina B. Risk Factors for Breast Cancer of Different Age Groups: Moroccan Data? *J Open Journal of Obstetrics Gynecology*. 2015;5(02):79.
- Laamiri FZ, Bouayad A, Otmani A, Ahid S, Mrabet M, Barkat A. Dietary factor obesity microenvironment and breast cancer. *J Gland Surgery*. 2014;3(3):165.
- Laamiri FZ, Otmani A, Ahid S, Barkat A. Lipid profile among Moroccan overweight women and breast cancer: a case-control study. *International journal of general medicine*. 2013;6:439.
- Mellouki I, Laazar N, Benyachou B, Aqodad N, Ibrahim A. Epidemiology of gastric cancer: experience of a Moroccan hospital. . *Pan Afr Med J*. 2014;17:42. 26.
- Rais G, Raissouni S, Aitelhaj M, Rais F, Naciri S, Khoyaali S et al. Triple negative breast cancer in Moroccan women: clinicopathological and therapeutic study at the National Institute of Oncology. *J BMC Women's Health*. 2012;12(1):1-9.
- Raissouni S, Rais G, Mrabti H, Raissouni F, Mouzount H, Aitelhaj M et al. Pancreatic adenocarcinoma in young adults in a moroccan population. *J Gastrointest Canc*. 2012;43(4):607-11.
- Zakkouri FA-z, Saloua O, Halima A, Rachid R, Hind M, Hassan E. Smoking, passive smoking and lung cancer cell types among women in Morocco: analysis of epidemiological profiling of 101 cases. *BMC Res Notes*. 2015;8(1):530.
- Elmajaoui S, Ismaili N, Zaidi H, Elkacemi H, Hassouni K, Kebdani T et al. Epidemiological, clinical, pathological, and therapeutic aspects of gastric cancer in Morocco. *Clin Cancer Investig J*. 2014;3(1):3.
- Laamiri FZ, Hasswane N, Kerbach A, Aguenau H, Taboz Y, Benkirane H et al. Risk factors associated with a breast cancer in a population of Moroccan women whose age is less than 40 years: a case control study. *Pan Afr Med J*. 2016;24(1): 2-8.
- Slaoui M, Mouh FZ, Ghanname I, Razine R, El Mzibri M, Amrani M. Outcome of breast cancer in Moroccan young women correlated to clinic-pathological features, risk factors and treatment: a comparative study of 716 cases in a single institution. *J PLoS One*. 2016;11(10):e0164841.
- El Kinany K, Huybrechts I, Kampman E, Boudouaya HA, Hatime Z, Mint Sidi Deoula M et al. Concordance with the World Cancer Research Fund/American Institute for Cancer Research recommendations for cancer prevention and colorectal cancer risk in Morocco: A large, population- based case-control study. *Int. J. Cancer*. 2019;145(7):1829-37.
- Lachgar A, Tazi M, Afif M, Er-Raki A, Kebdani T, Benjaafar N. Lung cancer: Incidence and survival in Rabat, Morocco. *J Revue d'épidémiologie et de sante publique*. 2016;64(6):391-5.
- Belhamidi MS, Sinaa M, Kaoukabi A, Krimou H, Menfaa M, Sakit F et al. Epidemiological and pathological profile of colorectal cancer: about 36 cases. *Pan Afr Med J*. 2018;30: 159.
- Abbass F, Bennis S, Znati K, Akasbi Y, Amrani JK, El Mesbahi O et al. Epidemiological and biologic profile of breast cancer in Fez-Boulemane, Morocco. *EMHJ-Eastern Mediterranean Health Journal*. 2011;17: 930-6.
- Benbrahim Z, Berrada A, Amaadour L, El Mrabet F Z, Elfatemi H, Elfakir S et al. Comparative study of inflammatory and non-inflammatory locally advanced breast cancer – the experience of a Moroccan hospital. *J Gynécologie Obstétrique Fertilité Sénologie*. 2017;45(11):604-8.
- Bennis S, Abbass F, Akasbi Y, Znati K, Joutei KA, El Mesbahi O et al. Prevalence of molecular subtypes and prognosis of invasive breast cancer in north-east of Morocco: retrospective study. *BMC Res Notes*. 2012;5(1):436.
- Bourhafour M, Belbaraka R, Souadka A, Mrabti H, Tijami F, Errihani H. Male breast cancer: a report of 127 cases at a Moroccan institution. *BMC Res Notes*. 2011;4(1):219.
- Ismaili N, Elyaakoubi H, Bensouda Y, Errihani H. Demographic, clinical, pathological, molecular, treatment characteristics and outcomes of nonmetastatic inflammatory breast cancer in Morocco: 2007 and 2008. *Exp Hematol Oncol* . 2014;3(1):1-4.
- Slimani KA, Debbagh A, Sbitti Y, Errihani H, Ichou M. Male breast cancer in Morocco: Epidemiology and prognostic factors. A report of 140 cases. *J Gynécologie Obstétrique Fertilité*. 2016;44(11):636-40.
- Elmajaoui S, Ismaili N, El Kacemi H, Kebdani T, Sifat H, Benjaafar N. Epidemiology and outcome of cervical cancer in national institute of Morocco. *BMC women's health*. 2016;16(1):62.
- Belaid I, Said N, Gahbiche S, Hochlef M, Chabchoub I, Ezzairi F. What could be the reasons of late diagnosis of breast cancer in Tunisia? *Tunis Med*. 2018;96(10-11):665-71.
- Menvielle G, Kulhánová I, Bryere J, Launoy G, Eilstein D, Delpierre C et al. Tobacco-attributable burden of cancer according to socioeconomic position in France. *Int. J. Cancer*. 2018;143(3):478-85.
- Mons U, Gredner T, Behrens G, Stock C, Brenner H. Cancers due to smoking and high alcohol consumption: estimation of the attributable cancer burden in Germany. *J Deutsches Ärzteblatt International*. 2018;115(35-36):571.
- Islami F, Goding Sauer A, Miller KD, Siegel RL, Fedewa S A, Jacobs EJ et al. Proportion and number of cancer cases and deaths attributable to potentially modifiable risk factors in the United States. *JCA: a cancer journal for clinicians*. 2018;68(1):31-54.
- Shield KD, Marant Micallef C, Hill C, Touvier M, Arwidson P, Bonaldi C et al. New cancer cases in France in 2015 attributable to different levels of alcohol consumption. *J Addiction*. 2018;113(2):247-56.
- Roquette R, Painho M, Nunes B. Spatial epidemiology of cancer. *J Geospatial Health*. 2017;12(1): 1-4.
- Vucenik I, Stains JP. Obesity and cancer risk: evidence, mechanisms, and recommendations. *Ann. N.Y. Acad. Sci*. 2012; 1271(1): 37-47.
- Lewandowska AM, Rudzki M, Rudzki S, Lewandowski T, Laskowska B. Environmental risk factors for cancer-review paper. *Ann Agric Environ Med*. 2018;26(1):1-7
- El Rhazi K, Nejari C, Zidouh A, Bakkali R, Berraho M, Gateau PB. Prevalence of

obesity and associated sociodemographic and lifestyle factors in Morocco. *Public Health Nutrition*. 2011; 14(1):160-7.

51. Murff HJ, Spigel DR, Syngal S. Does this patient have a family history of cancer?: an evidence-based analysis of the accuracy of family cancer history. *JAMA Neurology*. 2004;292(12):1480-9.

52. Seven M, Bağcıvan G, Akyuz A, Bölükbaşı F. Women with family history of breast cancer: How much are they aware of their risk? *J Canc Educ*. 2018;33(4):915-21.

53. Jemia EB, Kamoun H, Louhaichi S, Smadhi H, Greb D, Akrouf I, et al. Variation in the histological profile of lung cancer over the last 25 years in a pneumology department in Tunis. *J Revue des Maladies Respiratoires*. 2017;34: A79.

54. Khelifi A, Ziadi S, Trimeche M, Hidar S, Mokni M, Bakir DA, et al. Clinicopathological study of lobular carcinomas of the breast in the Tunisian Center: about 74 cases. *J Afr Cancer*. 2011;3(3):155-62.

55. Yazghich I, Berraho M. Cervical cancer in the Maghreb countries (Morocco - Algeria - Tunisia): epidemiological-clinical profile and control policy. *Tunis Med*. 2018; 96 ( 10-11 ): 647 - 57.

56. Mejri I, Saad SB, Daghfous H, Khelifa MB, Tritar F. Primary lung cancer in Tunisia: from diagnosis to treatment. *J Revue des Maladies Respiratoires*. 2015;32:A131.

57. Liede A, Jerzak KJ, Hernandez RK, Wade SW, Sun P, Narod SA. The incidence of bone metastasis after early-stage breast cancer in Canada. *Breast Cancer Res Treat*. 2016 ; 156(3): 587-95.

58. Mohsen Mroueh F. Diabète et cancer colorectal: épidémiologie et physiopathologie. Strasbourg; 2017. p.30-48.

59. Gariani K, Tran C, Philippe J. Diabetes and cancer: a pernicious association. *J Revue médicale suisse*. 2010;6(252):1193-4, 11968.

60. N'guessan K, Kouakou F, Loué V, Angoi V, Abauleth Y, Boni S. Cervical Cancer: Epidemiological Aspects and Management in African Settings. *J Mali Méd*. 2009;24(3):27-30.

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