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Research Article

# Environmental Lifestyle and Genetic Factors Associated with Cancer Patients in Eastern Libya: A Cross-Sectional Study

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**ABSTRACT**

Cancer is a growing public health problem in Libya, particularly in Benghazi. Multiple risk factors, including environmental, lifestyle, and dietary factors, contribute to the problem, along with stress. Despite the increasing incidence of cancer, research on the subject remains limited. This cross-sectional study aimed to identify factors associated with cancer among 200 cancer patients (130 women and 70 men) in Benghazi. The study was conducted from February to June 2025 at the Benghazi National Cancer Center, and consecutive patients were recruited. Data were collected through interviews with patients using a structured 35-item questionnaire. Descriptive statistics and the chi-square test were used to analyze the data. Ethical approval was obtained, and data were kept confidential. Most participants were female (65%), aged 41 years or older (60%), and 70% lived in urban areas. The proportion of smokers was 45%, whereas 70% of nonsmokers reported exposure to secondhand smoke. 30% live near industrial areas, 55% eat meat regularly, and only 35% eat fruits and vegetables daily. 25% reported a family history of cancer. The most common cancers were breast cancer (40%) followed by lung cancer (30%), with low levels of awareness. Only 20% of participants were aware of the link between smoking and cancer, and just 15% of women underwent early screening. These findings highlight the diversity of cancers and emphasise the need for smoking cessation, environmental monitoring, improved early screening, and culturally appropriate health education. However, the cross-sectional design among patients limits causal inference.

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## 1.Introduction

Cancer has become a major global public health problem, with an estimated 19.3 million new cases and 10 million deaths in 2020 [1]. It is the second leading cause of death worldwide after heart disease. Risk factors for cancer are multifactorial, including genetic mutations, environmental factors, and lifestyle risk factors [2], [3].

Important global risk factors include smoking, alcohol consumption, obesity, poor diet, physical inactivity, infectious diseases, and radiation exposure [4], [5], [6]. Several genetic mutations, such as mutations in the BRCA1/2 genes and abnormalities in DNA repair mechanisms, are responsible for 5 to 10% of cancer cases, underscoring the importance of genetic risk factors [7].

Early diagnosis and appropriate preventive measures can significantly reduce mortality in high-income countries. However, low- and middle-income countries experience increased cancer incidence due to poor health systems and low registration rates [8]. Libya reflects this inequality: the national cancer registry is fragmented, 70% of patients are diagnosed late [9], and environmental problems combined with conflict exacerbate the situation [9], [10]. Benghazi, Libya's second largest city, has high rates of smoking and malnutrition, [11], [12].

The study seeks to investigate cancer factors among patients in Benghazi, focusing on demographic, behavioral, environmental, nutritional, and genetic factors, with the aim of informing better public health interventions.

## 2.Methodology

### *2.1.Study design and setting*

A cross-sectional study was conducted in Benghazi National Cancer Center, a major referral center for oncology in the region, for the period from February to June 2025. The center is one of the largest specialized medical facilities and one of the leading health systems in Libya.

### *2.2.Participants and sampling*

The study included 200 cancer patients: 130 females and 70 males. Diagnoses included breast, lung, colorectal, and other cancers. A convenience sampling strategy was used for patient recruitment. This design does not include a control group, thus limiting causal inference.

### *2.3.Data collection tool*

Data were collected using a structured questionnaire including demographic information, family/ genetic health history, lifestyle, risk factors environment, diet, and health and cancer knowledge. The questionnaire was developed for this study based on literature review but was not externally validated. Trained research assistants conducted face-to-face interviews to ensure data accuracy.

### *2.4.Data analysis*

Data were analyzed using SPSS version 26. Descriptive statistics were used for Demographic and clinical profiles. Statistical analyzes were performed using chi-square tests to assess associations and Cramér's V to tests to determine strength of associations. It is important to note that these tests assess associations between different factors *within* this patient sample, and not with cancer diagnosis per se, as all participants had cancer.

### *2.5. Ethical considerations*

Ethical approval was obtained from the hospital's research committee. Informed consent was obtained from all participants, and their privacy and confidentiality were protected.

## 3.Results

### *3.1.Demographic characteristics*

Of the 200 participants, 65% were female and 35% were male. The age range of 41 to 50 years and over 50 years represented 30% of patients. Of these, 60% had completed high school and 40% university education. Urban residents made the majority (70%), followed by rural residents

(20%) and those living near factories or waste dumps (10%). These characteristics suggest that middle-aged women with lower education, living in urban environments, were more commonly impacted (Table 1).

*3.2.Behavioral and environmental factors*

Smoking Frequency: 45% of participants reported regular smoking and 25% reported heavy smoking (more than 20 cigarettes per day). Interestingly, 70% of non-smokers reported exposure to secondhand.

Environmental factors were also important: 30% of participants lived near industrial sites and 40% reported exposure to air pollution (Figure 1).

**Table 1.** Sociodemographic Characteristics of the Study Sample (n=200)

| Variable | Category | Frequency | Percentage (%) |
|---|---|---|---|
| **Sex** | Male | 70 | 35 |
| | Female | 130 | 65 |
| | Total | 200 | 100 |
| **Age (years)** | ≤30 | 40 | 20 |
| | 31–40 | 40 | 20 |
| | 41–50 | 60 | 30 |
| | >50 | 60 | 30 |
| | Total | 200 | 100 |
| **Education** | High school or less | 120 | 60 |
| | University or higher | 80 | 40 |
| | Total | 200 | 100 |
| **Residence** | Urban | 140 | 70 |
| | Rural | 40 | 20 |
| | Near factories/waste | 20 | 10 |
| | Total | 200 | 100 |

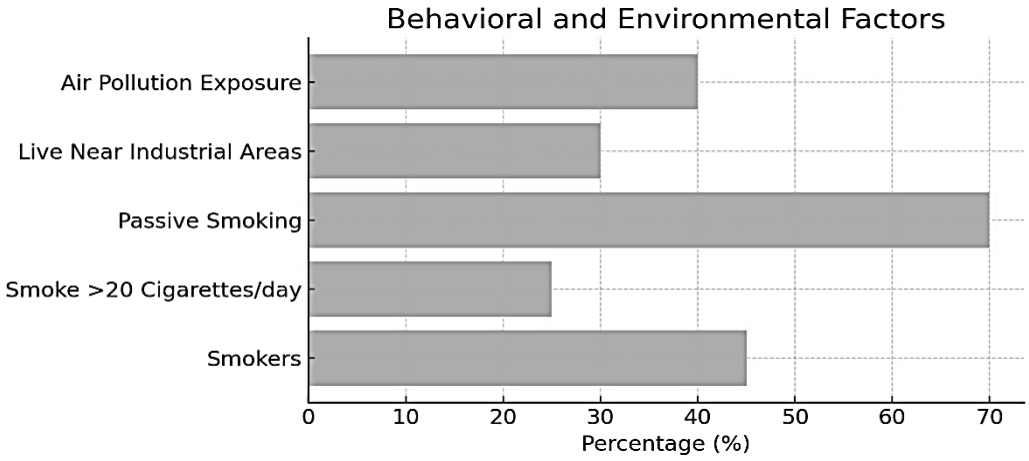


**Figure 1**. Prevalence of Behavioral and Environmental Risk Factors among Study Participants

### *3.3. Dietary habits*

More than half of the study participants (55%) regularly ate processed meat, while only 35% ate fruits and vegetables daily. Another 45% ate fruits and vegetables less than three times a week (Figure 2).

### *3.4.Family history and cancer types*

One in four (25%) reported a family history of cancer. The types of cancer included breast cancer (40%), lung cancer (30%), colon cancer (20%), and other types of cancer (10%) (Figure 3).

### *3.5.Awareness*

Low awareness: Only 20% knew about the link between smoking and cancer, and 15% of women had their first breast cancer screening (Figure 4).

### *3.6.Statistical associations*

A strong association has been demonstrated between cancer and Lifestyle-related factors in the literature; within our patient sample, we observed associations between certain factors. Smoking ($\chi^2 = 96.67$, $p < 0.001$, $V = 0.69$) and chronic stress ($\chi^2 = 62.34$, $p < 0.001$, $V = 0.56$) showed a strong association, while sun exposure showed a moderate association ($\chi^2 = 45.12$, $p = 0.001$, $V = 0.47$). Age ($\chi^2 = 12.45$, $p = 0.014$, $V= 0.25$) and obesity ($\chi^2 = 8.22$, $p = 0.004$, $V = 0.20$) showed weak but significant correlations (Table 2). These results paint a complex picture of cancer burden among the studied patients.

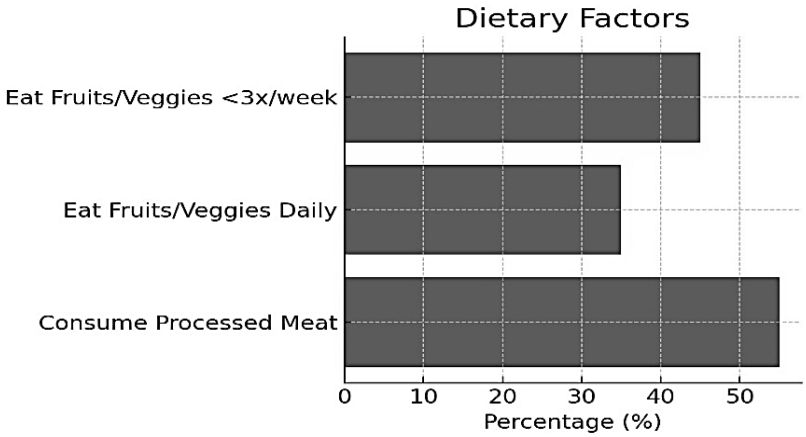


**Figure 2.** Prevalence of Key Dietary Factors among Study Participants

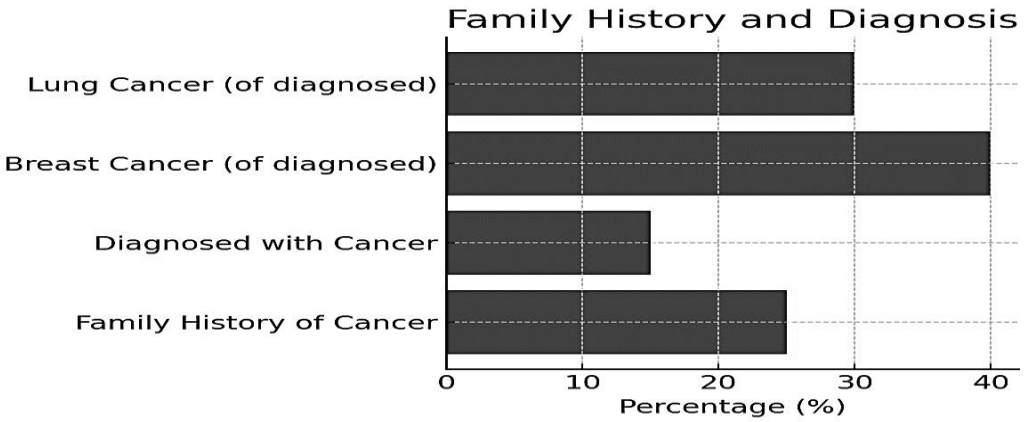


**Figure 3** Prevalence of Family History of Cancer and Distribution of Diagnosed Cancer Types

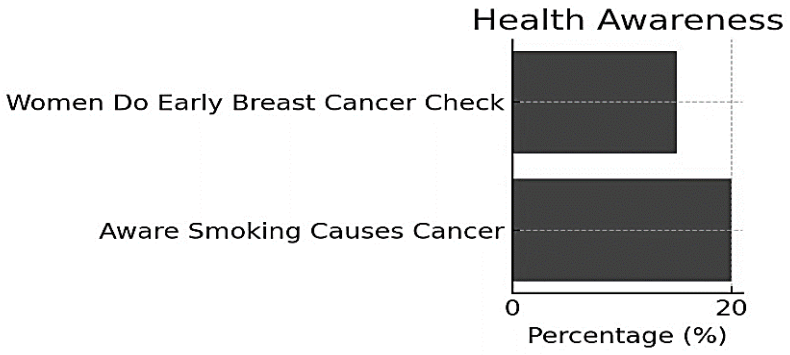


**Figure 4** Level of awareness of cancer risk factors and early screening practices

**Table 2.** Statistical association and strength of correlation (Cramér's v) between risk factors and cancer diagnosis

| Variable | $\chi^2$ | p-value | Cramér's V | Strength / Interpretation |
|---|---|---|---|---|
| Smoking | 96.67 | <0.001 | 0.69 | Very Strong |
| Chronic stress | 62.34 | <0.001 | 0.56 | Strong |
| Sun exposure | 45.12 | <0.001 | 0.47 | Moderate |
| Age | 12.45 | 0.014 | 0.25 | Weak |
| Obesity | 8.22 | 0.004 | 0.2 | Weak |
| Living near factory | 2.14 | 0.143 | 0.1 | No significant association |
| Family cancer history | 1.27 | 0.26 | 0.08 | No significant association |

## 5. Discussion

This study paints a concerning picture of cancer risk among patients in Benghazi. However, the cross-sectional design and lack of a control group preclude causal conclusions. Smoking rates were remarkably high, and exposure to second-hand smoke was widespread, revealing gaps in the enforcement of tobacco control measures [11]. Environmental conditions also played a role: living close to industrial facilities and being exposed to air pollution were both reported and may be linked to a higher likelihood of developing cancer [12].

Dietary habits stood out as another key factor. Many participants frequently consumed processed meats while eating insufficient amounts of fruits and vegetables. Such patterns are consistent with international research connecting these dietary behaviors to colorectal cancer [13], [14]. Additionally, around a quarter of the patients reported a family history of cancer, highlighting the importance of genetic susceptibility, especially in a context where genetic counselling and testing are largely unavailable [7].

Perhaps the most alarming finding was the very low level of awareness about cancer risks and the limited engagement in early screening programs, particularly among women. This points to structural gaps in preventive health initiatives. Compared to other low- and middle-income countries, residents of Benghazi face greater exposure to second-hand smoke and have lower awareness of preventive measures---a situation worsened by years of conflict and the breakdown of the healthcare system.

This cross-sectional study is one of the first comprehensive examinations of environmental, genetic, and lifestyle-related cancer risk factors in eastern Libya. It shows a high-risk profile among patients, demonstrates how modifiable

and non-modifiable factors interact, and highlights the urgent need for coordinated cancer prevention and control strategies in a post-conflict environment. Key limitations include the use of a patient-only sample, convenience sampling, and a non-validated questionnaire, which may affect generalizability and introduce bias.

### *5.1.Prevalence of Smoking and Exposure to Second hand Smoke*

The study revealed that 45% of participants were smokers, while 70% of non-smokers reported regular exposure to second-hand smoke. This reflects weak enforcement of tobacco control policies [11] and aligns with previous research linking smoking to lung and bladder cancers [4]. The strong statistical link between smoking and cancer (V=0.69) reinforces that tobacco use remains a leading preventable risk factor in this population.

### *5.2. Environmental and Lifestyle Factors*

Environmental risks were also significant. About 30% of participants lived near industrial areas, and 40% were frequently exposed to air pollution, both contributing to higher cancer rates [12]. Similar findings from other urban regions confirm that unregulated industrial emissions and carcinogenic pollutants are associated with increased cancer incidence [1]. Lifestyle factors were equally concerning, with 55% of participants frequently consuming processed meats and only 35% eating fruits and vegetables daily. These behaviors are well-established contributors to colorectal cancer.

### *5.3. Genetic Susceptibility and Family History*

Approximately one in four patients had a family history of cancer, emphasizing the role of genetic predisposition. Yet, the lack of genetic counseling and testing services in Libya reflects broader disparities in global research, leaving Arab populations underrepresented [7].

### *5.4. Awareness and Early Detection*

One of the most striking findings was the extremely low awareness of cancer risks and preventive practices, particularly among women. Only 15% of women had undergone early breast cancer screening, showing a significant gap compared to high-income countries [15]. This indicates structural shortcomings in preventive health programs, compounded by years of conflict and systemic collapse. The most common cancers observed in the sample were breast cancer (40%) and lung cancer (30%), according to the Libya National Cancer Registry (2020) [9].

## 6. Conclusion

The cancer burden in Benghazi among this patient sample is shaped by a combination of risk factors, most of which are preventable. Smoking, exposure to second-hand smoke, poor dietary habits, and environmental pollution all play a major role. Genetic predisposition and structural weaknesses in the healthcare system further exacerbate the situation. Without urgent and effective preventive strategies, the rates of cancer, along with related illness and mortality, are likely to keep rising. These findings, though descriptive and based on a patient sample, point to important areas for public health focus.

## Recommendations

- Implement and enforce comprehensive tobacco control policies, including restrictions on shisha.
- Strengthen environmental monitoring of industrial emissions and pollution.
- Expand cancer screening programs, including mobile units and genetic counseling.
- Increase public health education campaigns tailored to local cultural contexts.
- Develop a comprehensive national cancer control plan and registry.

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## Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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