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The Role of Lifestyle and Sociodemographic Factors in Ovarian Cancer

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ABSTRACT

Background: Ovarian cancer (OC) is the third most common cancer in women all over the world which is often characterized by vague symptoms leading to late-stage diagnosis.
Objectives: To investigate the relationship between the development of OC and certain sociodemographic characteristics as well as risky exposures and practices.
Materials and methods: A case-control study was conducted in Mosul City, Northern Iraq. The study included 100 women with histopathological diagnosis of OC (cases) and 200 women free from any ovarian abnormality by ultrasound (control) were collected from the attendants to three different hospitals. Detailed lifestyle and sociodemographic characteristics were obtained from each participant.
Results: There was a progressive increase in the risk of OC with increasing age, being single or widowed, and having lower than university level education. Housewives had a significant two-time risk for OC, while lifestyle factors like the history of using herbal remedies show a significant four-time risk. Additionally, the consumption of tanker water consumption was significantly associated with OC occurrence (OR = 6.73, P-value = 0.003). Similarly, psychological trauma carries about seven times the risk which is highly significant. On the other hand, urban residence has a highly significant protective effect against OC.
Conclusion: This study highlights important concerns regarding potential carcinogenic factors for OC development like educational attainment, women's work, using herbal remedies, tanker water consumption, rural residence, and the presence of psychological trauma that call for implementing educational programs regarding those risk factors.
Keywords: Lifestyle; Ovarian cancer; Risk factors; Sociodemographic characteristics.

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INTRODUCTION

Ovarian cancer is the third most common gynecological cancer in women all over the world after endometrial and cervical cancer and has the highest mortality rate among other types of gynecological cancers [1]. It is known as" The silent killer"[2] because it causes no symptoms or some mild and vague symptoms till it reaches an advanced stage [2, 3]. Therefore, an appropriate management plan needs a comprehensive approach to assessment, diagnosis, and treatment [1].

Histologically, there are three most common types of OC: Epithelial ovarian cancer (EOC) originates from the ovarian surface epithelium and represents the most common type of OC. While, the other two types (germ cell, and sex-cord-stromal tumor) form about 5% of all types of OC. EOC consists of different histological subtypes. The most common subtype of it is serous ovarian carcinoma (SOC) which is usually presented in the old age group of females. While in the young age group, endometrioid carcinoma is usually presented and associated with endometriosis [1].

According to many previous studies, sociodemographic characteristics play a role in developing OC. The educational level shows an inverse relationship with the risk of OC development [2]. Various environmental and occupational exposures may increase the risk of OC as revealed by several studies. However, they have methodological limitations and need further research to clarify these associations [4].

There is a controversy about the relationship between smoking and OC, some studies indicate an increased in the

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risk [5], while others found a decreased risk of OC development [6]. Recent epidemiological studies show that severe life events like depression, anxiety, and insufficient social support may act as risk factors for some types of cancer [7].

The diagnosis is usually accessed via tumor biomarker assessment, especially cancer antigen 125 (CA125), which is commonly usually used in the diagnosis of EOC [8]. Ultrasound findings like large adnexal mass and the presence of septa sound with increased vascularity are considered high-risk features [9]. A computed tomography (CT) scan is preferred for staging purposes, while magnetic resonance imaging (MRI) study is used for surveillance [10].

The incidence has been estimated at 190,000 new cases annually, and this incidence is increasing in developed countries [1]. Despite that, the incidence rate of OC is less than breast cancer. It is estimated to be three times more lethal. Furthermore, the mortality rate is predicted to increase significantly by the year 2040 [11].

There are limited available research about OC in Iraq. Hence, the current study aims to explore the risk factors behind the development of OC in Nineveh governorate, Iraq. As such it further encourages more health educational programs to increase awareness about risk factors for OC and may enhance the screening programs, especially among risky women to avoid late diagnosis.

MATERIALS AND METHODS

This case-control study was conducted at three governmental hospitals (Oncology and Nuclear Medicine Hospital, Ibn-Sinna Teaching Hospital, and Al-Salam Teaching Hospital), Nineveh Health Directorate, Mosul City, Iraq. The study covered a period of one year (from November 2023 to October 2024). The study was approved by the College of Medicine, University of Mosul (Reference number 9141 on 2-10-2023).

Women (of any age group) who were diagnosed with OC by a specialized physician using ultrasonography and histopathological investigations, whose residences were located within Nineveh governorate, and who attending the Oncology and Nuclear Medicine Hospital and the Oncology department of Ibn-Sinna General Teaching Hospital were included in the study. The enrolled cases were either diagnosed recently by histopathological evaluation with OC (new cases) or attending the hospital for treatment, besides the previous cases (diagnosed in previous years) who were attending the hospital for follow-up as directed by their physicians (prevalence cases). Those who live outside the Nineveh governorate and those with secondary ovarian cancer were excluded from the study. Controls were chosen from attendants to consultation units of Al-Salam Teaching Hospital and Ibn-Sinna General Teaching Hospital complaining of other diseases rather than ovarian problems and they were free from any ovarian problems based on ultrasound evaluation. All participants included in the study provided informed consent before participation, ensuring compliance with ethical research principles. The sample size has been calculated according to the following equation:

$$\eta = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \times [p_0(1-p_0) + p_1(1-p_1)/R]}{(p_0 - p_1)^2}$$

where Z$\alpha/2$ is the Z-score for significance level (for 0.05, it is 1.96), Zβ is the Z-score for power (for 80%, it is 0.84), p_0 is the proportion of exposure in the control group (10% or 0.10), and p_1 is the proportion of exposure in the case group, calculated as:

$$p_1 = \frac{OR \times p_0}{1 + (OR - 1) \times p_0}$$

- R is the case-to-control ratio at the beginning (assumed to be 1:1) then to be 1:2 to increase the power of the study.

Total population at risk (adult female in Nineveh governorate as registered by central statistical organization in Nineveh) = 1,020,203 females.

- Number of detected cases per year = 97 cases (as registered by the Oncology and Nuclear Medicine Hospital).
- Odds ratio (OR) = 3 as adopted by previous studies [12].
- P-value (significance level, α) = 0.05.
- Exposure among the control group = 10% as adopted by previous studies [12].
- Power (β) = 80% (assuming standard value)

The incidence rate is calculated as:
Incidence rate = Number of cases per year/Population at risk

The estimated incidence rate of the disease is approximately 0.0000951 (or 9.51 cases per 100,000 individuals per year).

The required sample sizes for the case-control study after applying to the above formula is:

- Cases needed: 97
- Controls needed: 97 (assuming a 1:1 case-control ratio)

The ratio of 1 case: 2 control has been adopted to enhance statistical power and reduce the influence of biases on the results. Therefore, 200 participants were enrolled as controls.

The data collection was done by direct interview using the predefined structured questionnaire which was checked for its validity and reliability. The structured questionnaire included information regarding the age at diagnosis, marital status if she is a lonely wife or there are fellow wives, residence, type of consumed water, occupation, education, history of smoking (passive and active), history of drug abuse, usage of vaginal douching, frequent exposure to X-ray, living nearby industrial area, living nearby internet or mobile phone tower, previous exposure to psychological stress along with its date, history of eating canned food, and history of using herbs.

Data coding and tabulation were done by Microsoft Excel 2010. The categorical variables were presented as frequencies and percentages in tables. The Chi-square test and Fisher exact test were used for the analysis of the variables using Minitab version 20 software. A P-value of less than 0.05 is considered a statistically significant difference.

RESULTS

Table 1 shows that there is a progressively increased risk of OC with increasing age, as OR for the age group (30–49) is 1.65, however, it is not significant (P-value = 0.186), and this risk becomes highly significantly increased by about five folds and nine folds (OR = 4.94, 8.86), (P-value = 0.001, = 0.001) for (50-69 year) and (70-89 year) age groups respectively in comparison to reference (10-29 year) age group. The single women are risky for developing OC in comparison to the married group as (OR = 3.78), and it is highly significant (P-value = 0.002), and the widows carry a highly significant risk for developing OC as (OR = 3.02, P-value = 0.005). Living in urban areas reveals a very highly significant protective effect in comparison to living in a rural area (OR = 0.26), (P-value = 0.001). The women who do not read nor write, with

Table 1. The association between sociodemographic characteristics and the occurrence of ovarian cancer in the study population*.

Characters	Cases (n=100)		Controls (n=200)		OR	95% C.I.	P-value*
	No.	(%)	No.	(%)			
Age (year)							
10–29	12	12.0	58	29.0	———	———	Reference
30–49	31	31.0	91	45.5	1.65	0.78–3.46	0.186
50–69	46	46.0	45	22.5	4.94	2.35–10.41	0.001
70–89	11	11.0	6	3.0	8.86	2.74–28.64	0.001**
Marital status							
Single	13	13.0	9	4.5	3.78	1.54–9.26	0.002
Married	65	65.0	170	85.0	———	———	Reference
Divorced	07	7.0	8	4.0	2.29	0.80–6.57	0.142**
Widow	15	15.0	13	6.5	3.02	1.36–6.69	0.005
Number of wives (Only married)							
The lonely wife	58	89.2	148	87.1	1.23	0.50–3.04	0.651
The presence of fellow wives	7	10.8	22	12.9			
Residence							
Urban	54	54.0	164	82.0	0.26	0.15–0.44	0.001
Rural	46	46.0	36	18.0			
Education							
Not read nor write	40	40.0	57	28.5	4.81	1.98–11.72	0.001
Primary school	39	39.0	70	35.0	3.82	1.58–9.25	0.002
Secondary school	14	14.0	25	12.5	3.84	1.37–10.74	0.008
University +	7	7.0	48	24.0	———	———	Reference
Occupation							
Housewives	90	90.0	151	75.5	2.92	1.41–6.05	0.003
Employed***	10	10.0	49	24.5			

* Chi-square test was used. ** Fisher exact test was used. *** Employed and private work.

primary school attainment, and secondary school attainment show a significantly high risk for developing OC in comparison to women with university + attainment, as (OR = 4.81, 3.82, 3.84), (P-value = 0.001, 0.002, 0.008) respectively. Housewives' women show a highly significant risk for developing OC in comparison to employed women (OR = 2.92, P-value = 0.003).

Table 2 shows that living near a net or mobile tower exerts 1.74 times the risk, however, this association is near to significance (P-value = 0.055). The history of using any type of herbal remedy, regardless of its duration of use, has a highly significant risk effect for OC development (OR = 4.75, P-value = 0.001). When the consumed water is from tankers that deliver water from anywhere, like rivers or springs, shows a highly significant risk effect for OC development (OR = 6.73, P-value = 0.003) in comparison to consuming tap water.

Table 3 shows displays that there is an increased risk of OC development due to a history of previous psychological trauma, this risk increases as the time of exposure further away, (OR = 1.51, 3.32), for the groups with a history of exposures (< 6 months), and (6–12 months) respectively. However, it is statistically not significant. This risk increases by about seven folds as the time since exposure distant further away to > 1 year and becomes highly significant as (OR = 6.80, P-value = 0.001) by comparing to the non-exposed group to psychological trauma which demonstrates very highly significant protective effect as (OR = 0.25, P-value = 0.001).

Table 4 reveals that the smoking habit for both active and passive smokers shows no significant risk effect for developing OC in comparison to the non-smoker group among the study population (P-value > 0.05).

DISCUSSION

OC is the most deadly women's cancer among all gynecological malignancies globally [13]. It is a serious health problem that has been exacerbated in recent years, as there is a global increase in the incidence of OC [14]. This study is the first conducted in Nineveh Governorate that examined multiple risk factors for the development of OC.

The present study shows a significant increase in the risk of OC with increasing age which agrees with a recent study by Ali et al. (2023) [15], who stated that OC is a postmenopausal cancer. Furthermore, according to the study conducted by Buckler et al. (2013) [16], the median age of OC ranges between 60 and 65 years all over the world.

The current study revealed that single women had a significantly higher risk of developing OC. This could be related to the nulliparity theory, which suggests the effect of sustaining the non-opposite action of estrogen which affects the health of the ovary with "incessant ovulation" [17]. Similarly, widowhood shows a highly significant risk effect for developing OC. This may be due to the bereavement feeling and psychological stress. This result agrees with another 20-year prospective cohort study conducted by Trudel-Fitzgerald et al. (2019) [18], which stated that the widowhood state has a significantly high risk for developing OC. In addition to the protective factors of married women as parity mentioned by Toufakis et al. (2021) study [19], or the protective role of oral

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Table 2. The association between some risky exposures and practices and the occurrence of ovarian cancer in the study population*.

Characters	Cases (n=100)		Controls (n=200)		OR	95% CI (OR)	P-value*
	No.	(%)	No.	(%)			
Drug abuse***							
Present	12	12.0	16	8.0	1.57	0.71–3.46	0.262
Absent	88	88.0	184	92.0			
Frequent exposure to X-ray							
Present	12	12.0	18	9.0	1.38	0.64–2.99	0.414
Absent	88	88.0	182	91.0			
Using vaginal douching							
Present	12	12.0	21	10.5	1.16	0.55–2.47	0.695
Absent	88	88.0	179	89.5			
Living near the net or mobile phone tower							
Present	27	0.27	35	17.5	1.74	0.98–3.09	0.055
Absent	73	73.0	165	82.5			
Living near the industrial place							
Present	5	5.0	7	3.5	1.45	0.45–4.69	0.543**
Absent	95	95.0	193	96.5			
Using herbal remedies							
Present	20	20.0	10	5.0	4.75	2.13–10.60	0.001
Absent	80	80.0	190	95.0			
Using canned food							
Present	48	48.0	75	37.5	1.54	0.95–2.50	0.081
Absent	52	52.0	125	62.5			
Type of consumed water							
Tap water	78	78.0	175	87.5	———	———	Reference
Wells	6	6.0	11	5.5	1.22	0.44–3.43	0.700
Purified bottles	7	7.0	11	5.5	1.43	0.53–3.82	0.476
Tankers	9	9.0	3	1.5	6.73	1.77–25.54	0.003**

* Chi-square test was used. ** Fisher exact test was used. *** Including any medications such as antihistamines, analgesics, rheumatological treatments, or any drug-causing addiction.

Table 3. The association between the history of psychological trauma with the occurrence of ovarian cancer in the study population*.

Psychological Trauma	Cases		Controls		OR	95% CI (OR)	P-value*
	No.	(%)	No.	(%)			
Present							
< 6 months***	10	10.0	22	11.0	1.51	0.67–3.41	0.321
6–12 months	2	2.0	2	1.0	3.32	0.46–24.21	0.238**
> 1 year	41	41.0	20	10.0	6.80	3.64–12.73	0.001
Absent (Reference group)	47	47.0	156	78.0	0.25	0.15–0.42	0.001
Total	100	100.0	200	100.0			

* Chi-square test was used. ** Fisher exact test was used. *** The duration calculated between trauma and diagnosis in cases while in control was between trauma and interview.

contraceptive pills (OCP) [20], or may have more chance to have pelvic ultrasound check-ups which indirectly affects the risk of OC like early diagnosis and treatment of endometriosis which is a known risk for OC development [21] leading to cut-off pathway of transformation of endometriosis to OC.

The present study found that living in an urban area revealed a highly significant protective effect, this could be related to the educational level differences or environmental effect of the presence of factories or oil refineries, or the agricultural fertilizers in rural areas or could be due to excessive use of OCP by urban over rural women [22]. Sometimes rural women prefer to use alternative medicine despite its side effects [23]. This result is inconsistent with the results of research done in Al-Sulaymaniyah city which reported that the number of OC cases was higher among urban women [24] which may be traced to lifestyle differences. In contrast, another study revealed that there is no correlation between OC development and variation in residency [25].

Table 4. The association between smoking habit and the occurrence of ovarian cancer in the study population*.

Smoking	Cases (n=100)		Controls (n=200)		OR	95% CI (OR)	P-value*
	No.	(%)	No.	(%)			
Active smoker	7	7.0	10	5.0	1.80	0.64–5.10	0.264
Passive smoker	58	58.0	100	50.0	1.49	0.90–2.48	0.121
Non-smoker	35	35.0	90	45.0	———	———	Reference

* Chi-square test was used.

The present study reported that women with lower than university + have a highly significant risk effect of developing OC, this risky effect is likely mediated through a combination of poorer health literacy and less access to health care. This agrees with the result of an Egyptian study done by Ahmed and Yassien (2019) [26], which showed a higher educational level associated with a lower risk of OC.

Employed women show a significant risk of developing OC in comparison to housewives. This result conforms with another study which reveals that increased physical activity will decrease the risk of OC development [27].

In this study, statistical analysis of the P-value (0.055) for the risk of OC development due to living near a net or mobile phone tower is significance threshold, this result raises concerns about a potential risk that warrants further vigorous studies with larger sample size and taking into consideration of confounding factors. This was confirmed by Myung et al. (2009) [28] who demonstrated the potential risk of development of various cancer types associated with living near mobile towers.

The risky effect of herbal remedies that have been identified by the current study aligns with the study conducted by Guldiken et al.(2018) [19], which suggests certain herbs may contain compounds and phytochemicals, could potentially influence the development of many types of cancer [29].

The consumption of water from tankers that deliver water from anywhere such as rivers or springs in the current study shows a highly significant risk, this risk may return to pollution from water sources or the tanker itself by various contaminants like heavy metals, pesticides, industrial pollutants, and disinfection by-products that lead to carcinogenesis [30].

The cumulative risky effect of a history of psychological trauma for developing OC may be due to psychologically induced hormonal changes which have been linked to cancer development [31]. In addition to that, chronic psychological stress plays a role in some biological effects such as cellular ageing processes, stress-induced inflammation, immunity dysregulation [7], and psychoneuroimmunology pathways [32], all of which have been contributing to cancer development.

The smoking shows no significant risk of developing OC perhaps due to widespread exposure to smoking among the study population in cases and control at all. This result agrees with the results of many early studies that suggested no risk of smoking for developing OC [33].

There are some limitations of the current study including recall bias and couldn't rule out the effect of the confounding factors. A matched case-control study was unapplied because of the challenge of finding the appropriate matches for all cases given the time-consuming and resource-intensive nature, therefore, making it unfeasible within the available resources.

CONCLUSION

Increasing age is considered a risk factor for OC. Certain sociodemographic characteristics being single or widowed, living in rural areas, having low to moderate educational levels, and being housewife' women show significant risk effects for developing OC. The risk of OC increases by specific exposures including the use of any type of herbal remedies, consumption water from a tanker, and living near networker mobile phone towers. There is a cumulative risky effect of psychological trauma was observed, which is associated with an increased risk of OC development. Further study is needed to investigate the temporal relationship and establish a conclusion for these risk factors.

ETHICAL DECLARATIONS

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Ethics Approval and Consent to Participate

The study was conducted with ethical approval granted by the Scientific Committee at the College of Medicine, University of Mosul (Reference number 9141 at 2-10-2023). Informed consent was obtained from every participant.

Consent for Publication

It is approved to publish, as no individual personal data is included in this manuscript.

Availability of Data and Material

The data generated and analysed during this study are available from the authors upon reasonable request.

Competing Interests

The authors declare that there is no conflict of interest.

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Authors' Contributions

Fadhil DA, and Omaima Abdulrazzaq Zubair OA made significant, direct, and intellectual contributions to the design, implementation, and writing of this study. The authors have read and approved the final version of the manuscript.

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