

Extrinsic Risk Factors for Women Breast Cancer in Gaza Strip, Palestine: Associations and Interactions in a Case-Control Study

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Abstract

Background: Worldwide, breast cancer (BC) is the most frequently diagnosed neoplastic disease in women around menopause that is the leading cause of DALYs, because it causes a significant reduction of these women's ability to function normally in everyday life. **Methods:** The present hospital-based case-control study was carried out between January and August 2018 using a structured questionnaire on 105 breast cancer women and 210 controls who are clinically free from breast cancer. Data about the study cases were collected in the oncology day-care clinics of the two main hospitals in Gaza strip "Al-Shifa and European Gaza hospitals". Univariate logistic regression and multivariate logistic regression analyses were employed to identify the significant factors associated with BC. **Results:** Multivariate logistic regression analyses with adjustment for all confounders revealed that woman with BMI more than or equal 30 kg/m² are under risk of getting BC 2.9 times greater than those having BMI less than 29 kg/m² (AOR = 2.895; 95% CI: 1.305 - 6.423). Analysis of risk according to reaching menopause showed that the estimated AOR was greater among those reached menopause (3.137, 95% CI 1.824 - 5.395) than among those that did not reach menopause. The risk of developing BC in the case of a history of incidence of BC in the family was more than two times higher (AOR = 2.632, 95% CI 1.528 - 4.535) than in case of the history of a free family of BC. **Conclusion:** In this context, the above-mentioned risk factors must be taken into consideration in BC management processes in the Gaza strip.

Keywords

Breast Cancer, Case-Control, Risk Factors, Women, Gaza Strip

1. Introduction

Worldwide, breast cancer (BC) is the most common malignancy in women and the leading cause of cancer death. It is estimated that 1.5 million new cases of BC diagnosed annually with odds of getting BC is one in eight women [1] [2] [3]. Generally, high body mass index (BMI), low fruit and vegetable intake, lack of physical activity, tobacco use, and alcohol abuse are the five behavioral and dietary risks leading cause of 30% of cancer deaths [4] [5] [6]. International variation in female BC incidence and mortality rate could be attributed to differences in sociodemographic factors, reproductive patterns, lifestyle, and other hormonal factors [4] [7] [8]. Moreover, family history and age of women are the most two individual critical BC risk factors [9] [10].

In low-income countries, BC cases tend to young women with median age of 49 - 52 years whereas 63 years in high-income countries [11]. Early detection of BC would improve treatment and recovery, limit the complications and reduce the risk of mortality [12] [13] [14]. High BC mortality rate, particularly in developing countries, is due primarily to the detection of late-stage BC [15] [16]. Therefore, the American Cancer Society recommended that women should have the opportunity to begin annual BC screening around the age of 40 years and should be encouraged to discuss their family history and medical history with a clinician. Also, they should be provided with information on BC risk factors and risk reduction [17].

According to the Palestinian ministry of health (MOH), BC is 31.3% of women's cancers in Gaza Strip and it is the second leading cause of female death after cardiovascular disease. Since the total number of reported BC cases between 2009 and 2014 was 1283 cases, out of them, 1207 were females and 76 were males. Furthermore, as has been estimated, the incidence rate of BC among Gaza's females was about 83.9 per 100,000 women between 2009 and 2014, which was increased to 154.2 per 100,000 women in 2015 [18].

To the best of our knowledge, there was limited documented research on the extrinsic risk factors for women BC in Gaza strip. Therefore, the objective of this case-control study was to identify the distinct associations between extrinsic risk factors and developing BC among women in the Gaza strip. Understanding such associations is important to further our understanding of disease etiology and to provide personalized prevention and treatment measures.

2. Materials and Methods

2.1. Study Design and Setting

The present hospital-based case-control study was conducted between January

and August 2018 with a representative sample of BC women. The study sample was compromised of 105 BC patients and 210 controls. Data about the study cases were collected in the only two oncology day-care clinics in the two main hospitals in Gaza strip “Al-Shifa hospital in Gaza governorate and European Gaza hospitals in Khanyunis governorate”.

2.2. Study Tool and Sampling

In this study, patients and controls were interviewed by well-trained interviewers. The interviewers used a structured and a validated questionnaire to collect information on sociodemographic characteristics and potential risk factors, such history of exposure to toxic gases, radiation and pesticides, body anthropometric measurements, history of medical conditions, history of maternal and reproductive health, lifestyle, and dietary habits. The computer program Epi Info version 6.04d was used to calculate the sample size using 5% precision with 95% confidence interval from the study population comprised of 1207 breast cancer women to be 105 patients.

Patients and controls were questioned about age at breast cancer diagnosis and history of cancer and breast cancer among their first and second-degree relatives. No proxy interviews were conducted. Smokers were defined as subjects who had smoked ≥ 100 cigarettes during their lifetime. Obesity measured by body mass index (BMI), a participant's weight (in kilograms) divided by the square of her height (in meters). A participant with a BMI of 30 kg/m² or more is considered obese. The dietary habits in our study contain a list of the 19 most common food groups; based on the results of the previous study [19]. Also, Participants were asked about the number of daily meals.

2.3. Eligibility Criteria

The case subjects were confirmed BC women by a histopathology test and recorded in one of the two above mentioned oncology day-care clinics. Whereas, the control subjects were healthy women and genetically unrelated family members of BC patients. The reason behind excluding family members of BC patients, as controls, is to avoid induction of selection bias. Control subjects were recruited from the vaccination departments at primary health care clinics, where women take their children for vaccination. Controls and patients were recruited simultaneously. The cases and controls were frequency matched by age group, marital status, governorate of residence, and nature of housing area.

2.4. Ethical Consideration

Approval to conduct the study was gotten from the Palestinian ministry of health. Also, written consent from participants was obtained after explaining the aim of the study. Great care was taken to ensure privacy and confidentiality.

2.5. Data Analysis

Data were analyzed using the Statistical Package for Social Science (SPSS) ver-

sion 22 (IBM Corp, Armonk, NY, USA). Frequencies and percentages were calculated for all variables. Odds ratio (OR) with a 95% confidence interval was used to investigate the strength of association between the determinant factors and the outcome variable. Univariate logistic regression analysis was used to identify risk factors associated with the incidence of BC at $p < 0.05$ and 95% CI without controlling confounders. Multivariable logistic regression analysis was employed to examine the association between risk factors and BC incidence under controlling of potential confounding factors.

3. Results

3.1. Sociodemographic Characteristics and Their Association with Breast Cancer

As shown in **Table 1**, a total of 105 BC cases and 210 controls were enrolled in this study. In both cases and controls Gaza Governorate had the largest number of cases ($n = 48, 45.7\%$) as well as controls ($n = 96, 45.7\%$). Age groups were divided into five groups since the age of the majority of the study participants was above 40 years (80%). Eighty-one (77.1%) of the cases were married. Regarding the educational level of the cases, 22 (21%) hold a university degree and 19 (18.1%) had a primary degree. Most of cases and controls, ($n = 81, 77.1\%$) and ($n = 162, 77.1\%$), respectively were married. Approximately 81 breast cancer women (52.4%) were diagnosed with BC at the age between 30 and 40 years, ($n = 81, 17.1\%$) were diagnosed at the age less than 30 years, and ($n = 32, 30.5\%$) were diagnosed at the age more than 40 years. Among the presented sociodemographic features presented in **Table 1**, the difference between the two groups reached a statistical significant level ($p < 0.05$) only in three factors, namely: number of family members, number of children, and kind of family house, indicating that they affect the chance of getting breast cancer disease and classified as one of the risk factors that affect breast cancer disease among women in the Gaza strip.

3.2. Risk Factors Associated with Breast Cancer in Univariate Analysis

The binary logistic regression analysis was applied to define the association between the potential risk factors and incidence of BC among women in the Gaza strip. The strength of association was achieved using the crude odds ratio (OR) at 95% CI confidence interval. As presented in **Table 2**, a number of risk factors related to the history of exposure to toxic gases, radiation, shells and pesticides, anthropometric measurements, and history of medical conditions found to be significantly associated with the incidence of BC ($p < 0.05$) without controlling for confounders. Regarding exposure to medical radiation, 74.3% from the 105 cases indicated that they exposed to medical radiation previously compared to 58.1% from the 210 controls. The difference between the two groups reached a statistically significant level (COR = 2.2; 95% CI: 1.3 - 3.7), which means that

this factor has the ability to develop breast cancer among women two times more likely. Likewise, the increase of body mass index (BMI) more than 30 kg/m² was significantly associated with getting breast cancer ($p < 0.05$) and 3.6 times more probable to cause breast cancer (COR = 3.6; 95% CI: 1.8 - 7.5). Additionally, hypertension showed a positive association with the developing of BC ($p < 0.05$). The chance of getting breast cancer among women who had high blood pressure was three times more than women who did not have hypertension (COR = 3.0; 95% CI: 1.5 - 6.0). Diabetes was found to be positively associated with BC and it was a risk factor for developing BC (COR = 2.3; 95% CI: 1.3 - 4.4). However, no significant association was found for the other factors ($p > 0.05$).

The results in **Table 3**, present that women age at first pregnancy was significantly associated with BC ($p < 0.05$) and a difference between the two groups was shown since the age between 19 and 24 years old was protective factor (COR = 0.5; 95% CI: 0.3 - 0.9) while the age of more than 24 years old was risk factor for developing BC (COR = 1.3; 95% CI: 0.6 - 3). Also, last pregnancy time showed a statistical significance ($p < 0.05$). Furthermore, prolonged breastfeeding between 13 and 24 months displayed a statistical significance ($p < 0.05$) and protecting factor (COR = 0.3; 95% CI: 0.2 - 0.6). Likewise, reaching menopause was significantly associated with BC ($p < 0.05$) and 3.6 times more likely to develop BC among women in the Gaza strip (COR = 3.6; 95% CI: 2.2 - 5.9). Nevertheless, the other factors showed no significant association with BC.

Table 4, indicated that a statistically significant relationship between the history of BC in the family and getting BC ($p < 0.05$) with 2.7 times more likely to cause BC (COR = 2.7; 95% CI: 1.7 - 4.4). As well, getting BC was 3.8 times more probable in the case of a history of incidence of BC in one of the first-degree relations (COR = 3.8; 95% CI: 1.4 - 10.3). The daily walking exercise was a protective factor of BC (COR = 0.6; 95% CI: 0.3 - 1.2) and (COR = 0.4; 95% CI: 0.2 - 0.7) for daily waking minutes less than 20 and between 20 and 40 minutes, respectively.

As revealed in **Table 5**, among the included 19 food groups, only sex factors were significantly associated with the incidence of BC among women in the Gaza strip ($p < 0.05$), namely: vegetable oils, snacks, fruit, beans and legumes, sugar, sweets and desserts, and vegetables. Moreover, the number of daily meals also was significantly associated with BC.

3.3. Risk Factors Associated with Breast Cancer in Multiple Logistic Regression Analysis

Variables with $p < 0.05$ in the univariate model were inserted into the multivariate model. Many variables missed their association with BC in the multivariate model under adjustment for all confounders. **Table 6**, shows that woman with BMI more than or equal 30 kg/m² are under risk of getting BC 2.9 times greater than those have BMI less than 29 kg/m² (AOR = 2.895; 95% CI: 1.305 - 6.423).

Analysis of risk according to reaching menopause showed that the estimated AOR was greater among those reached menopause (3.137, 95% CI 1.824 - 5.395) than among those did not reach menopause. The risk of developing BC in the case of a history of BC incidence in the family was more than two times higher (AOR = 2.632, 95% CI 1.528 - 4.535) than in case of the history of a free family of BC.

Table 1. Sociodemographic features of the study population.

Sociodemographic variables	Case n = 105		Control n = 210		Statistical Tests	
	n	%	n	%	COR (95% CI)	P
	Governorate					0.990
Northern	17	16.2	34	16.2	1 (0.4 - 2.5)	0.942
Gaza	48	45.7	96	45.7	0.9 (0.4 - 1.9)	0.723
Middle area	16	15.2	32	15.2	0.9 (0.4 - 2.4)	0.896
Khanyounis	13	12.4	26	12.4	0.8 (0.3 - 2.2)	0.684
Rafah	11	10.5	22	10.5	1 (reference)	
	Housing area					0.588
Agricultural	22	21.0	42	20.0	0.9 (0.5 - 1.8)	0.553
Industrial	24	22.9	48	22.9	0.9 (0.5 - 1.7)	0.628
Refugee camp	16	15.2	32	15.2	0.6 (0.3 - 1.2)	0.213
Residential towers	43	41.0	86	40.9	1 (reference)	
	Marital status					0.547
Single	8	7.6	16	7.6	1.4 (0.5 - 4.3)	0.561
Married	81	77.1	162	77.1	0.9 (0.5 - 2)	0.888
Divorced	3	2.9	6	2.9	0.4 (0.1 - 1.8)	0.263
Widow	13	12.4	26	12.4	1 (reference)	
	Age (years)					0.334
<18	0	0.0	0	0.0	0 (0 - 0)	0.000
18 - 25	1	1.0	2	1.0	0.4 (0 - 2.5)	0.265
26 - 40	20	19.0	40	19.0	0.6 (0.4 - 1.1)	0.125
>40	84	80.0	168	80.0	1 (reference)	
	Employment status					
Employed	13	12.4	22	10.5	1.2 (0.6 - 2.5)	0.582
Unemployed	92	87.6	188	89.5	1 (reference)	
	Family members					0.043

Continued

<3	28	26.7	31	14.8	1 (reference)	
3 - 5	18	17.1	46	21.9	0.4 (0.2 - 0.9)	0.017
6 - 8	23	21.9	63	30.0	0.4 (0.2 - 0.8)	0.011
>5	36	34.3	70	33.3	0.6 (0.3 - 1.1)	0.090
Number of children						0.011
0	6	5.7	39	18.6	1 (reference)	
1 - 3	24	22.9	53	25.2	2.8 (1 - 7.4)	0.043
4 - 5	56	53.3	95	45.2	3.8 (1.5 - 9.6)	0.004
>6	19	18.1	23	11.0	5.4 (1.9 - 15.4)	0.002
Educational level						0.349
Primary	19	18.1	23	11.0	1.7 (0.8 - 3.8)	0.351
Secondary	25	23.8	58	27.6	0.9 (0.5 - 1.8)	0.680
Diploma	39	37.1	83	39.5	0.9 (0.5 - 1.8)	0.305
University	22	21.0	46	21.9	1 (reference)	
Monthly income (NIS)						0.179
<500	4	3.8	9	4.3	1 (reference)	
600 - 1500	65	61.9	104	49.5	1.4 (0.4 - 4.6)	0.611
1600 - 2500	22	21.0	73	34.8	0.7 (0.2 - 2.4)	0.549
2600 - 3500	11	10.5	20	9.5	1.2 (0.3 - 5)	0.764
>3600	3	2.9	4	1.9	1.7 (0.3 - 11.3)	0.590
House type						0.036
Villa	1	1.0	2	1.0	3 (0.2 - 37.7)	0.395
Apartment	49	46.6	78	37.1	3.6 (1.5 - 8.8)	0.004
Independent house	48	45.7	88	41.9	3.3 (1.4 - 7.8)	0.008
Asbestos	7	6.7	42	20.0	1 (reference)	
House ownership						
Owned	95	90.5	178	84.8	1.7 (0.8 - 3.6)	0.176
Rented	10	9.5	32	15.2	1 (reference)	
Age at breast cancer diagnosis (year)						
<30	18	17.1				
30 - 40	55	52.4				
>41	32	30.5				

n = Frequency; Ref = Reference category; COR = Denotes crude odds ratio using 95% confidence interval in univariate logistic regression analysis; CI = Confidence interval; p < 0.05 = significant on univariate analysis; NIS = Denotes New Israeli Shekel, the local currency (1 USD ≈ 3.63 NIS).

Table 2. History of exposure to toxic gases, radiation, shells and pesticides, anthropometric measurements, and medical conditions risk factors and BC among women in Gaza strip.

Risk factors	Case n = 105		Control n = 210		Statistical Tests	
	n	%	n	%	COR (95% CI)	P
Previous exposure to toxic gases, radiation, shells, and pesticides						
Exposed to toxic gas inhalation						
Yes	32	30.5	70	33.3	0.9 (0.5 - 1.5)	0.668
No	73	69.5	140	66.7	1 (reference)	
Exposed to medical radiation						
Yes	78	74.3	122	58.1	2.2 (1.3 - 3.7)	0.003
No	27	25.7	88	41.9	1 (reference)	
Your house or surrounding area exposed to shells						
Yes	36	34.3	77	36.7	0.9 (0.6 - 1.5)	0.744
No	69	65.7	133	63.3	1 (reference)	
Exposed to pesticides						
Yes	18	17.1	42	20.0	0.8 (0.5 - 1.6)	0.581
No	87	82.9	168	80.0	1 (reference)	
Anthropometric measurements						
Body mass index (BMI)						
≥30 kg/m ²	95	90.5	151	71.9	3.6 (1.8 - 7.5)	0.001
<29 kg/m ²	10	9.5	59	28.1	1 (reference)	
History of medical conditions						
High blood pressure						
Yes	22	21.0	16	8.2	3.0 (1.5 - 6.0)	0.002
No	83	79.0	178	91.8	1 (reference)	
Diabetes						
Yes		26	24.8	13	2.3 (1.3 - 4.4)	0.001
No	79	75.2	186	93.5	1 (reference)	
Cardiac diseases						
Yes	11	10.5	17	8.1	1.3 (0.6 - 3)	0.461
No	94	89.5	193	91.9	1 (reference)	
Anemia						
Yes	6	5.7	20	10.1	0.5 (0.2 - 1.4)	0.212
No	99	94.3	178	89.9	1 (reference)	
Inflammatory diseases						
Yes	17	16.2	41	20.6	0.8 (0.4 - 1.4)	0.383
No	88	83.8	158	79.4	1 (reference)	

Table 3. Maternal and reproductive health risk factors and BC among women in Gaza strip.

Risk factors	Case n = 105		Control n = 210		Statistical Tests	
	n	%	n	%	COR (95% CI)	P
1) Maternal and reproductive health						
Marriage age (year)						
≤18	52	49.5	91	43.3	1.2 (0.8 - 2)	0.362
>19	53	50.5	119	56.7	1 (reference)	
Age at the first menstruation (year)						
<12	11	10.5	1	5.7	0.5 (0.2 - 1.3)	0.150
13 - 16	84	80.0	166	79.0	0.3 (0.1 - 1)	0.163
<16	10	9.5	32	15.3	1 (reference)	0.052
Age at the first pregnancy (year)						
<18	25	29.4	39	20.6	1 (reference)	0.017
19 - 24	44	51.8	133	70.4	0.5 (0.3 - 0.9)	0.033
>24	16	18.8	17	9.0	1.3 (0.6 - 3)	0.545
Number of pregnancies						
≤4	69	65.7	126	60.0	1.2 (0.8 - 2)	0.372
>5	36	34.3	84	40.0	1 (reference)	
Number of deliveries						
≤4	68	64.8	121	57.6	1.3 (0.8 - 2.1)	0.261
>5	37	35.2	89	42.4	1 (reference)	
Number of abortions						
≤2	78	74.3	170	81.0	1 (reference)	0.257
>3	27	25.7	40	19.0	1.4 (0.8 - 2.4)	
The period between pregnancies (year)						
≤1	19	23.5	50	31.8	1 (reference)	0.206
>2	62	76.5	107	68.2	1.5 (0.8 - 2.7)	
Last pregnancy time (month)						
<18	41	42.7	72	36.2	1 (reference)	0.002
19 - 24	36	37.5	113	56.8	0.6 (0.3 - 0.99)	0.034
>24	19	19.8	14	7.0	2.1 (1 - 4.6)	0.063
Use natural breastfeeding						
Yes	77	87.5	177	92.2	0.6 (0.3 - 1.3)	0.198
No	11	12.5	15	7.8	1 (reference)	
Difficulties in breastfeeding						
Yes	15	17.0	25	13.0	1.2 (0.6 - 2.5)	0.562
No	73	83.0	167	87.0	1 (reference)	

Continued

	Weaning time (month)					0.002
≤6	7	8.0	15	7.8	1 (reference)	
7 - 12	16	18.1	77	40.1	0.7 (0.3 - 1.9)	0.528
13 - 24	65	73.9	100	52.1	0.3 (0.2 - 0.6)	0.001
Reached menopause						
Yes	63	60.0	60	28.6	3.6 (2.2 - 5.9)	0.001
No	42	40.0	150	71.4	1 (reference)	
Age at menopause (year)						
≤45	31	40.3	30	42.3	1 (reference)	0.658
>46	46	59.7	41	57.7	1.2 (0.6 - 2.2)	
Use of contraceptives						
Yes	27	28.1	57	28.8	0.9 (0.5 - 1.6)	0.752
No	69	71.9	141	71.2	1 (reference)	
Preeclampsia						
Yes	4	3.8	17	8.6	0.3 (0.1 - 1.0)	0.056
No	101	96.2	180	91.4	1 (reference)	
Supplements during pregnancy						
Yes	49	46.7	119	56.7	0.7 (0.4 - 1.1)	0.121
No	56	53.3	9	43.3	1 (reference)	
If yes, what kind						
Iron	17	37.8	67	62.0	4.7 (1.8 - 12.8)	0.002
Prenatal Vitamins	12	26.7	10	9.3	0.9 (0.2 - 4.4)	0.873
Folate	2	4.4	9	8.3	2.4 (0.9 - 6.3)	0.086
Fish Oil	9	20.0	15	13.9	2.8 (0.8 - 10)	0.109
Others	5	11.1	7	6.5	1 (reference)	

Table 4. Family history of cancer and life style risk factors and BC among women in Gaza strip.

Risk factors	Case n = 105		Control n = 210		Statistical Tests	
	n	%	n	%	COR (95% CI)	P
1) Family history of cancer						
One member of the family had cancer						
Yes	38	36.2	63	30.0	1.3 (0.8 - 2.1)	0.349
No	67	63.8	147	70.0	1 (reference)	
If yes, degree of relation						
First degree	48	82.8	53	70.7	1.9 (0.8 - 4.5)	0.131
Second degree	10	17.2	22	29.3	1 (reference)	

Continued

One member of the family had breast cancer						
Yes	58	55.2	64	30.5	2.7 (1.7 - 4.4)	0.001
No	47	44.8	146	69.5	1 (reference)	
If yes, degree of relation						
First degree	31	81.6	42	58.3	3.8 (1.4 - 10.3)	0.008
Second degree	7	18.4	30	41.7	1 (reference)	
2) Life style						
Smoker						
Yes	2	1.9	7	3.3	1.7 (0.4 - 8.6)	0.490
No	103	98.1	203	96.7	1 (reference)	
Expose to secondhand smoke						
Yes	54	51.4	86	41.0	1.6 (1 - 2.5)	0.061
No	51	48.6	124	59.0	1 (reference)	
Daily walking (minute)						
<20	16	20.3	33	23.2	0.6 (0.3 - 1.2)	0.117
20 - 40	19	24.1	58	40.8	0.4 (0.2 - 0.7)	0.004
>41	44	55.7	51	35.9	1 (reference)	
Sleeping hours						
<6	14	13.3	12	7.8	2.4 (1.0 - 6.2)	0.060
6 - 8	70	66.7	97	63.4	1.5 (0.8 - 2.7)	0.207
>8	21	20.0	44	28.8	1 (reference)	
Monthly breast self-exam						
Yes	17	16.2	24	11.4	1.5 (0.8 - 3)	0.220
No	88	83.8	186	88.6	1 (reference)	

Table 5. Univariate model of dietary habits and their association with breast cancer among women in Gaza strip.

Food groups	Case n = 105		Control n = 210		Statistical Tests	
	n	%	n	%	COR (95% CI)	P
High - fat dairy products						
Daily	34	32.4	67	31.9	0.7 (0.3 - 1.3)	0.262
2 - 3 times weekly	32	30.5	68	32.4	0.6 (0.3 - 1.3)	0.228
Weekly	13	12.4	26	12.4	0.7 (0.3 - 1.6)	0.405
Monthly	5	4.8	20	9.5	0.3 (0.1 - 1.1)	0.065
Never	21	20.0	29	13.8	1 (reference)	
Eggs						
Daily	20	19.2	53	25.4	1.4 (0.3 - 5.5)	0.644
2 - 3 times weekly	61	58.7	91	43.5	2.4 (0.6 - 8.9)	0.195
Weekly	13	12.5	42	20.1	1.1 (0.3 - 4.7)	0.861
Monthly	7	6.7	12	5.7	2.1 (0.4 - 10.4)	0.346
Never	3	2.9	11	5.3	1 (reference)	

Continued

	Red meat					0.108
Daily	11	10.5	10	4.8	1.4 (0.5 - 4.2)	0.503
2 - 3 times weekly	31	29.5	59	28.1	0.7 (0.3 - 1.5)	0.352
Weekly	32	30.5	76	36.1	0.5 (0.2 - 1.1)	0.106
Monthly	15	14.3	44	21.0	0.4 (0.2 - 1.1)	0.072
Never	16	15.2	21	10.0	1 (reference)	0.503
	Organ meat					0.157
Daily	21	20.0	53	25.4	1.5 (0.4 - 5.7)	0.594
2 - 3 times weekly	61	58.1	91	43.5	2.4 (0.6 - 8.9)	0.195
Weekly	13	12.3	42	20.1	1.1 (0.3 - 4.7)	0.861
Monthly	7	6.7	12	5.7	2.1 (0.4 - 10.4)	0.346
Never	3	2.9	11	5.3	1 (reference)	
	High-fat dairy products					0.108
Daily	11	10.5	10	4.8	1.4 (0.5 - 4.2)	0.503
2 - 3 times weekly	31	29.5	59	28.1	0.7 (0.3 - 1.5)	0.352
Weekly	32	30.5	76	36.2	0.5 (0.2 - 1.1)	0.106
Monthly	15	14.3	44	21.0	0.4 (0.2 - 1.1)	0.072
Never	16	15.2	21	10.0	1 (reference)	
	Hydrogenated fats					0.171
Daily	4	3.8	17	8.1	0.3 (0.1 - 1.1)	0.071
2 - 3 times weekly	12	11.4	30	14.3	0.6 (0.3 - 1.3)	0.173
Weekly	21	20.0	45	21.4	0.6 (0.3 - 1.2)	0.170
Monthly	27	13.2	38	18.1	0.5 (0.3 - 1.1)	0.092
Never	54	51.4	80	38.1	1 (reference)	0.071
	Vegetable oils					0.025
Daily	7	6.7	21	10.0	0.4 (0.1 - 0.9)	0.036
2 - 3 times weekly	9	8.6	19	9.0	0.6 (0.3 - 1.5)	0.272
Weekly	11	10.5	42	20.0	0.3 (0.2 - 0.7)	0.005
Monthly	27	25.7	62	29.5	0.6 (0.3 - 1)	0.053
Never	51	48.5	66	31.5	1 (reference)	
	Poultry					0.125
Daily	4	3.8	13	6.2	2.3 (0.4 - 14.7)	0.376
2 - 3 times weekly	27	25.7	42	20.0	4.8 (1 - 22.8)	0.047
Weekly	61	58.1	105	50.0	4.2 (0.9 - 19.2)	0.060
Monthly	11	10.5	35	16.7	2.4 (0.5 - 12)	0.301
Never	2	1.9	15	7.1	1 (reference)	
	Beverages					0.672
Daily	7	6.7	13	6.2	1.1 (0.4 - 3)	0.924
2 - 3 times weekly	7	6.7	17	8.1	1 (0.4 - 2.7)	0.983
Weekly	21	20.0	39	18.6	1.3 (0.7 - 2.6)	0.413
Monthly	37	35.2	60	28.6	1.5 (0.9 - 2.7)	0.158
Never	33	31.4	81	38.5	1 (reference)	

Continued

	Soft drinks					0.326
Daily	5	4.8	17	8.1	0.5 (0.2 - 1.5)	0.220
2 - 3 times weekly	6	5.7	8	3.8	1.3 (0.4 - 4)	0.612
Weekly	7	6.7	23	11.0	0.4 (0.2 - 1.1)	0.091
Monthly	21	20.0	45	21.4	0.8 (0.5 - 1.5)	0.535
Never	66	62.9	117	55.7	1 (reference)	
	Fish and shellfish products					0.433
Daily	4	3.8	13	6.2	0.6 (0.2 - 2.5)	0.498
2 - 3 times weekly	17	16.2	51	24.3	0.7 (0.2 - 1.8)	0.432
Weekly	29	27.6	51	24.3	1.1 (0.4 - 2.8)	0.880
Monthly	47	44.8	79	37.6	1.2 (0.5 - 3)	0.712
Never	8	7.6	16	7.6	1 (reference)	
	Nuts and seed products					0.352
Daily	17	16.2	47	22.4	0.4 (0.1 - 2)	0.239
2 - 3 times weekly	42	40.0	90	42.9	0.5 (0.1 - 2.3)	0.341
Weekly	31	29.5	56	26.7	0.6 (0.1 - 2.9)	0.485
Monthly	12	11.4	14	6.7	0.9 (0.1 - 5.1)	0.865
Never	3	2.9	3	1.4	1 (reference)	
	Snacks					0.001
Daily	86	81.9	118	56.2	1.2 (0.4 - 3.4)	0.745
2 - 3 times weekly	11	10.5	71	33.8	0.3 (0.1 - 0.9)	0.026
Weekly	1	1.0	6	2.9	0.3 (0 - 2.9)	0.285
Monthly	1	1.0	5	2.4	0.3 (0 - 3.6)	0.364
Never	6	5.7	10	4.8	1 (reference)	
	Fruit					0.001
Daily	67	63.8	64	30.5	5.1 (1.1 - 24.1)	0.041
2 - 3 times weekly	20	19.0	77	36.7	1.3 (0.3 - 6.4)	0.748
Weekly	12	11.4	40	19.0	1.5 (0.3 - 7.8)	0.630
Monthly	4	3.8	19	9.0	1.1 (0.2 - 6.8)	0.957
Never	2	1.9	10	4.8	1 (reference)	
	Beans and legumes					0.016
Daily	41	39.0	50	23.8	1.2 (0.5 - 3.1)	0.676
2 - 3 times weekly	24	22.9	51	24.2	0.7 (0.3 - 1.9)	0.528
Weekly	21	20.0	44	21.0	0.7 (0.3 - 2)	0.554
Monthly	10	9.5	51	24.3	0.3 (0.1 - 0.9)	0.031
Never	9	8.6	14	6.7	1 (reference)	

Continued

	Potatoes					0.051
Daily	74	70.5	112	53.3	1.5 (0.4 - 6)	0.561
2 - 3 times weekly	18	17.1	56	26.7	0.8 (0.2 - 3.2)	0.698
Weekly	5	4.8	26	12.4	0.4 (0.1 - 2.4)	0.343
Monthly	5	4.8	9	4.3	1.3 (0.2 - 7.4)	0.770
Never	3	2.9	7	3.3	1 (reference)	
	Sugar, sweets, and desserts					0.011
Daily	21	20.0	48	22.9	0.7 (0.2 - 2)	0.496
2 - 3 times weekly	16	15.2	65	31.0	0.4 (0.1 - 1.1)	0.067
Weekly	27	25.7	44	21.0	1 (0.3 - 2.8)	0.946
Monthly	34	32.4	42	20.0	1.3 (0.4 - 3.6)	0.653
Never	7	6.7	11	5.2	1 (reference)	
	Vegetables					0.036
Daily	12	11.4	24	11.4	0.7 (0.3 - 1.5)	0.306
2 - 3 times weekly	13	12.4	24	11.4	0.7 (0.3 - 1.6)	0.400
Weekly	15	14.3	45	21.4	0.4 (0.2 - 0.8)	0.012
Monthly	16	15.2	52	24.8	0.4 (0.2 - 0.8)	0.009
Never	49	46.7	65	31.0	1 (reference)	
	Refined grains					0.990
Daily	26	24.8	52	24.8	1.1 (0.4 - 2.9)	0.809
2 - 3 times weekly	37	35.2	71	33.8	1.1 (0.4 - 2.8)	0.803
Weekly	17	16.2	38	18.1	1 (0.4 - 2.8)	0.990
Monthly	17	16.2	31	14.8	1.2 (0.4 - 3.4)	0.687
Never	8	7.6	18	8.6	1 (reference)	
	Number of daily meals					0.002
1	10	9.5	16	7.6	2.1 (0.5 - 9.5)	0.342
2	38	36.2	37	17.6	3.4 (0.9 - 13.4)	0.078
3	48	45.7	139	66.2	1.1 (0.3 - 4.2)	0.869
4	6	5.7	8	3.8	2.5 (0.5 - 13.3)	0.282
>4	3	2.9	10	4.8	1 (reference)	

Table 6. Multiple logistic regression model of risk factors and BC among women in Gaza strip.

Factors	B	S.E.	Wald	P	AOR (95% CI)
Body mass index	1.1	0.4	6.8	0.009	2.895 (1.305 - 6.423)
Reached menopause	1.1	0.3	17.1	<0.001	3.137 (1.824 - 5.395)
One member of the family had breast cancer	1.0	0.3	12.2	<0.001	2.632 (1.528 - 4.535)
Constant	2.4 -	0.5	28.0	<0.001	0.087

AOR = Denotes adjusted odds ratio using 95% confidence interval in multivariable logistic regression analysis; B = slope; CI = Confidence interval; p < 0.05: Significant, p > 0.05: Not significant.

4. Discussion

The primary purpose of knowing the risk factors related to breast cancer is to take precautionary measures to prevent the incidence of breast cancer. Therefore, we investigate potential risk factors for breast cancer among women in the Gaza strip, Palestine. The outcomes of this study, in the multivariate model, have indicated three risk factors associated with the incidence of BC among Gazan's women namely: high BMI more than or equal 30 kg/m², reaching menopause, and history of BC incidence in the family. On the other hand, in the univariate model, several factors seemed to be risk factors for BC.

Previous epidemiological studies have reported that premenopausal obesity is generally protective for breast cancer [20], while postmenopausal obesity is associated with increased risk [21]. Our case-control analysis revealed that patients with a BMI of 30 kg/m² or more had more chance for getting disease compared with patients with a BMI below 29 kg/m² ($p < 0.001$). Our findings in this regard are in line with the results of former research in other countries [22] [23] [24]. Moreover, there is no evidence that the assumption of a simple linear or a log-linear relationship between BMI and BC risk is real, in particular when BMI is less than 25 kg/m² [25]. The mechanisms underlying the relationship between high BMI and BC in women was discussed in the literature and it was primarily the result of the associated increase in estrogens, particularly bioavailable estradiol [22] [26].

With respect to menopause age and risk of breast cancer in women, findings of the present study also indicated that reaching menopause was significantly associated with developing of breast cancer among women in Gaza strip. Similar outcomes were reported in previous studies stated that breast cancer is a disease of older women and its incidence increases with age, and it is rare below the age of 20 years [27] [28] [29] [30]. More than half of patients in our study were between the third and fourth decade of their life, in contrast to the western countries where only 23% of women younger than 40 years presented with breast cancer [31].

The significant association between the family history and BC among women in Gaza strip indicated to imply a genetic predisposition [32]. We herein, recommend more investigation to find out what gene linked to BC. In any case, the literature indicates a family history of BC in any first-degree relative is known to increase a women risk of disease onset [32] [33] [34] [35]. In addition, these results are consistent with the work of Buxton *et al.*, [36], Caruso *et al.*, [37], Silk *et al.*, [38], Aljohani *et al.*, [39], and a meta-analytic review by Katapodi *et al.*, [40] all of whom found an association between risk perception and family history of breast cancer. In developed countries, about twenty-five percent of inter-individual differences mainly due to genetic causes of BC [41]. Our finding regarding the significant association between the exposure to ionizing radiation and the initiation of breast carcinoma was compatible with the results of previous research [42] [43].

According to the results of previous research, exposure to ionizing radiation

after 40 years of age does not significantly influence the genesis of breast cancer, but exposure to radiation before 20 years of age significantly influences the initiation of breast carcinoma [27]. An investigation indicated that exposure to diagnostic radiation is accountable for 29 BC cases per year in women in the UK, aged up to 75 years [44].

Our study indicated that there is no association between breast cancer and exposure to pesticides, although there is growing scientific evidence of a link between exposure to pesticides and increased incidence of breast cancer [45].

The present study findings in the univariate model revealed that diabetes and hypertension were a risk factors for BC, this results were consistent with the conclusion of the Boyle *et al.*, meta-analysis found a significantly increased risk of breast cancer among women with diabetes, furthermore, the mechanisms that could increase the breast cancer risk were discussed [46]. Though our study had limited power, our result warrants further investigation and future studies should stratify their analyses by menopausal status particularly because of the increase of chronic diseases epidemics such as hypertension and diabetes among Palestinian population [47]. The potential for an increased risk of BC in women with hypertension has been the subject of a great deal of recent research. A strong correlation between hypertension and BC in women has concluded in some earlier studies [48] [49] [50] [51], however weak relationship was reported in other research [50] [51]. Furthermore, several studies showed that the association was confounded by obesity and high BMI [52] [53].

In this study, the association between BC and intake of different food groups such as vegetable oils, snacks, fruit, beans and legumes, sugar, sweets and deserts, and vegetables. However, other studies revealed that intakes of cereals and grains, vegetables and beans are associated with the reduction in risk of early-stage breast cancer among young women [54]. High risk was shown for all types of meat and fish intake, whereas intakes of eggs and milk were associated with a decreased risk of breast cancer [55].

5. Conclusion

Knowing the risk factors for breast cancer may help take preventive measures to reduce the likelihood of developing the disease. Our survey shows that women with body mass index, reaching menopause, and history of BC in the family are the three main risk factors of BC among women in Gaza strip. Here, educational programs target at women living in Gaza to make them aware and address the misconceptions of the BC risk factors. Moreover, campaigns to promote the concept of screening for breast cancer among both public and healthcare sectors are critical to improving the rates of early detection of breast cancer in Gaza in order to be able to save lives and for reinforcing societal positive attitudes towards breast health care, including support from family and friends.

Study Limitation

Some patients did not respond to questionnaire and reject to participate in the study.

Authors' Contributions

SY and MY participated in the design of the study and data collection. MD and AM performed the statistical analysis and drafted the manuscript. SA supervised the study and participated in draft review. All authors have read and approved the final version of the manuscript and agree with the order of presentation of the authors.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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