



## Research Article

# Environmental Risk factors associated with Breast Cancer in Gaza Strip

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## Abstract

The study aimed to identify possible environmental risk factors for breast cancer among women in Gaza Strip and conducted in 2010. A case-control study design was used with face to face interviews by structured questionnaire with breast cancer patient women as well as healthy women. Statistical Package of Social Science (SPSS) was used to analyze the collected data. The study population was 288 women, 144 were women with breast cancer (cases) and 144 were healthy women (controls) with response rate 100% for cases as well as controls. The study was carried out in the two main hospitals in Gaza Strip (El-Shifa and European Gaza) and on cases who had a regular follow up in each hospital, while controls have been chosen from women who had no history of breast cancer by mammogram or by self-examination. In this study the main statistically significant risk factors were; marital status, educational status, physical trauma on breast, medication for infertility treatment, eating red meat 500g or more weekly, eating canned food, eating chicken skin, eating raw and cooked vegetables, using oils with saturated fats in cooking, living in or beside a farm, dealing with crops with naked hands, working in a farm during pesticides application or during 24 hours of pesticides application, cleaning pesticides' equipment, living with people working in a farm or a agricultural field, and application of pesticides personally. In contrary, no statistically significant differences were found between cases and controls in relation to area of residency, exposure to X-ray in the past, having radiation therapy, getting contraceptive pills, using hair dyes, using anti-deodorant underarm, using facial cosmetics, using hair removal ointment, washing vegetables and fruits, buying and transporting pesticides, and wearing protective tools during pesticides mixing and application.

## Introduction

Worldwide, breast cancer is the most frequent cancer among women with an estimated 1.38 million new cases diagnosed in 2008 (23% of all cancer), and still as the most frequent cause of death in women in both developing (269000 deaths) and developed regions (189000 deaths) [1]. In Eastern Mediterranean region, breast cancer affects women in younger age and is detected at a late stages [2]. Nowadays, breast cancer ranks as number one between all cancer types in all countries of Arab World [3].

In Palestinian territories, the total reported new cases of cancer were 1,623 (72% in West Bank, 28% in Gaza Strip) with incidence rates of 43.1/100 000 population, breast cancer occupies the first type of cancer (17.3% of total cancer morbidity, 31.4% of female cancer, 21.1% of female morbidity) [4]. Breast cancer in Gaza Strip was the common cancer among women since 1990-1999, and ranked as number one of all cancer types in women with incidence rate of 19.3/100 000 population (32.3% among female cancer, 16.7% of cancer morbidity among the total population) [5,6]. Nowadays in Gaza strip there are 120 new breast cancer cases annually [7].

Several factors, both endogenous and exogenous are known to affect the risk of breast cancer such as lifestyle, hormonal status, anthropometric characteristics,



radiation and genetic predisposition [8-10]. Gary in 2010 [11], has linked the increasing in incidence of breast cancer to synthetic chemicals noting that such increasing had paralleled the proliferation of synthetic chemicals since World War II. It has been estimated that more than 80% of breast cancer are associated with environmental factors that include the exposure to contaminants, lifestyle, and diet [12].

There is considerable international concern where 70,000 synthetic chemicals in our environment may be directly linked to a large percentage of breast cancer cases, but there are no epidemiological studies to determine this [13,14]. Accordingly, Gaza Strip as one of the most densely populated areas worldwide has already started to experience deterioration of environmental quality where drinking water shortage, high salinity water, lack of solid waste treatment, marine pollution, poverty and some restricted, cancelled or banned pesticides still enter in Gaza Strip and widely used [6,15-17]. However, there are no previous studies in our country aimed to identify the common environmental risk factors associated with breast cancer among women. So that, this study presents the first research on such common environmental risk factors that may affect the risk of breast cancer among women which covers 5 Governorates in Gaza Strip.

## Materials and Methods

A case-control study was conducted from May 2010 to January 2011 in two main hospitals (El-Shifa and European Gaza) which cover the 5 Governorates of Gaza Strip. The eligible cases were all incident breast cancer women patients living in Gaza Strip and who had a regular follow up in the two main hospitals during the study period. We approached 144 women with breast cancer who were eligible for our study giving a participation rate for cases 100%. Women were entered into the study if they had a confirmed pathological breast cancer diagnosed from the Pathology Department of the two main hospitals.

For each case, 1 age-matched (within 3 years) controls were recruited from women of the same area of residency, women without any history of breast problem, women participated in the screening for early detecting of breast cancer, and women who had a mammogram and free from breast cancer to ensure that they are pathologically free from breast cancer. The main reason for matching was to minimize confounding that may influence the outcome of investigated variables. Women with a history of neoplastic disease, pregnancy, hormonal, and gynecological condition were excluded from the study.

After taking informed consent from the women, a structured questionnaire was administered and completed at the time of recruitment including the following: demographic characteristics, physical environmental risk factors such as history of radiation exposure, chemical environmental risk factors such as history of ever-use contraceptive and hormonal therapy, lifestyle, diet, and pesticides exposure.

This study did not use "blinding" procedure with respect to the case status of subjects and it is possible that women who were diagnosed with breast cancer were more likely to provide more detailed complete information about past exposure history than controls. However, the researcher was fully familiarized about the possibility of recall/interviewer bias and their potential impact on our study. A number of efforts were made to minimize such bias, including standardization of wording in the interview and repeat interviews for some participants.

The data were analyzed using SPSS version 15 [18]. Simple distribution and frequencies of the study variables, the cross tabulation, and normal Chi square had been applied. *P* value had been calculated for the ordinal level measure ( $P < 0.05$ ), variables that are statistically significant by Chi square test had been analyzed using Odds Ratio and 95% Confidence Interval.

## Results and Discussion

### Breast cancer by sociodemographic variables

Table I shows the sociodemographic characteristics of the subjects. There were a significant differences between cases and controls with regard to educational level and marital status ( $P$  value= 0.001,  $P$  value= 0.003 respectively). Our findings suggest a relationship between marital status and breast cancer, which is consistent with findings in some studies [19,20], although it was not a significant risk factor for breast cancer in some other population [21]. The basis of this difference in different population is not clear and warrants further studies.

One hundred forty four women with breast cancer matched by age group and area of residency with 144 women pathologically free from breast cancer which were selected as controls. As controls were age-matched and area of residency-matched with cases, there was no significant difference between the two groups ( $P$  value= 0.603,  $P$  value= 0.713 respectively).

### Breast cancer by physical environmental factors

Table 2 shows the physical environmental factors of the subjects. There were no significant differences between cases and controls with regard to X-ray exposure, and having a radiation therapy in the past as well. However, exposure to physical trauma on the breast was a significant risk factor (OR= 12.80,  $P$  value= 0.001). Women exposed to physical trauma on breast were found to be at higher risk for breast cancer than women did not expose to such factor on the past which is consistent with findings in some studies [22,23].

### Breast cancer by oral contraceptive pills and medication for infertility treatment

Table 3 shows the oral contraceptive pills and infertility medication of the subjects. There was no significant differences between cases and controls with regard to oral contraceptive. However, the study disclosed that the subjects treated with medication for infertility had a significantly higher risk of breast cancer compared to those without similar treatment, which was consistent with other studies [24,25]. Subject treated with such medication exhibit a six-fold excess risk (OR= 6.22).

### Breast cancer by lifestyle

Table 4 shows the lifestyle of the subjects. There was no significant differences between cases and controls with regard to using hair dyes, using anti-deodorants, using facial cosmetics and using hair removal ointments.

### Breast cancer by type of diet

Table 4 shows the type of diets of the subjects. The study detected a significant differences between cases and controls with regard to type of diet, eating 500gm/week of red meat, eating chicken skin, eating raw vegetables weekly, buying fruits and vegetables at the beginning of the season, using some materials in cooking, and eating canned food. However, there were no significant differences between cases and controls with regard to washing vegetables.

As indicated in table 5, more than half of cases ate 500gm of red meat and more/week which is inconsistent with the limited amount recommended by American Institution for Cancer Risk (2011) who recommended that to reduce cancer risk we should eat no more 510.3 gm of red meat/week. Red meat characterized by a rich source of fats where many chemicals could be accumulated there, this could be a warrants why eating more than 500gm red meat have a chance to get breast cancer, which is consistent with some findings in many studies [26,27].

**Table 1:** Sociodemographic characteristics of the subjects.

Variable		Case (n= 144)		Control (n= 144)		P. value
		No.	%	No.	%	
Governorate	North Gaza	25	17.4	25	17.4	0.999
	Gaza	37	25.7	35	24.3	
	Middle Zone	16	11.1	17	11.8	
	Khan Yunis	34	23.6	34	23.6	
	Rafah	32	22.2	33	22.9	
Living area	City	53	36.8	52	36.1	0.713
	Camp	51	35.4	57	39.6	
	Village	40	27.8	35	24.3	
Age group	25-35	16	11.1	15	10.4	0.603
	36-46	34	23.6	39	27.1	
	47-57	44	30.6	52	36.1	
	58-68	38	26.4	28	19.4	
	69 ≤	12	8.3	10	6.9	
Education	Less than secondary	79	54.9	46	31.9	0.001
	Secondary	37	25.7	18	12.5	
	Diploma	10	6.9	36	25.0	
	University	18	12.5	44	30.6	
Marital status	Married	121	84.0	97	67.4	0.003
	Single	7	4.9	14	9.7	
	Divorced	3	2.1	15	10.4	
	Widowed	13	9.0	18	12.5	

**Table 2:** The physical environmental factors of the subjects.

Variable		Case (n= 144)		Control (n= 144)		P. value	CI	Odds ratio
		No.	%	No.	%			
Have x-ray in the past	Yes	64	44.4	62	43.1	0.812	0.65 -1.73	1.06
	No	80	55.6	82	56.9			
Radiation therapy in the past	Yes	2	1.4	2	1.4	1.00	0.139 – 7.197	1.00
	No	142	98.6	142	98.6			
Exposed to trauma on the breast	Yes	22	15.3	2	1.4	0.001	0.018 -0.339	12.80
	No	122	84.7	142	98.6			

**Table 3:** Oral contraceptive pills and medication for infertility of the subjects.

Variable		Case (n= 144)		Control (n= 144)		P. Value	CI	Odds ratio
		No.	%	No.	%			
Contraceptive pills	Yes	34	23.6	37	25.7	0.682	0.50 -1.58	0.89
	No	110	76.4	107	74.3			
Infertility treatment medication	Yes	52	36.1	12	8.3	0.001	3.01 -13.0	6.22
	No	92	63.9	132	91.7			

**Table 4:** The lifestyle of subjects.

Variable		Case (n= 144)		Control (n=144)		P. value	CI	Odds ratio
		No.	%	No.	%			
Using hair dyes	Yes	72	50.0	71	49.3	0.906	0.63 -1.68	1.03
	No	72	50.0	73	50.7			
Using anti- deodorants	Yes	50	34.7	46	31.9	0.617	0.67 -1.91	1.13
	No	94	65.3	98	68.1			
Using facial cosmetics	Yes	101	70.1	106	73.6	0.512	0.49 -1.45	0.842
	No	43	29.9	38	26.4			
Using hair removal ointments	Yes	12	8.3	9	6.2	0.497	0.51 -3.65	1.36
	No	132	91.7	135	93.8			

**Table 5:** Type of diets of the subjects.

Variable	Case		Control		P Value	CI	Odds ratio	
	No.	%	No.	%				
Type of diet	Vegetarian	1	0.7	5	4.2	0.001	-	-
	Animal	15	10.4	0	0.0			
	Normal	128	88.9	138	95.8			
Total	144	100	144	100				
Eating 500gm/week of red meat	Yes	59	41.0	23	16.0	0.001	-	-
	More than 500gm/week	18	12.5	1	0.7			
	Less than 500gm/week	67	46.5	120	83.3			
Total	144	100	144	100				
Eating chicken skin	Yes	51	35.7	7	5.3	0.001	4.12 -25.28	9.98
	No	92	64.3	126	94.7			
Total	143	100	133	100				
Eating raw vegetables weekly	Large amount	4	2.8	36	25.0	0.001	-	-
	Moderate amount	110	76.4	108	75.0			
	Small amount	30	20.8	0	0.0			
Eating cooked vegetables weekly	Large amount	3	2.1	25	17.4	0.001	-	-
	Moderate amount	111	77.1	119	82.6			
	Small amount	30	20.8	0	0.0			
Buying fruits and vegetables at the beginning of the season	Yes	119	82.6	12	8.3	0.001	23.91- 117.24	52.36
	No	25	17.4	132	91.7			
Washing vegetables and fruits	Yes	142	98.6	143	99.3	0.562	0.02-7.06	0.50
	No	2	1.4	1	0.7			
Materials used in cooking	Olive oil	9	6.3	3	2.1	0.001	-	-
	Butter	2	1.4	2	1.4			
	Margarine	16	11.1	1	0.7			
	Others	117	81.3	138	95.8			
Eating Canned food	Yes	107	74.3	92	63.9	0.05	0.96-2.80	1.63
	No	37	25.7	52	36.1			

Others reported that the temperature used for meat cooking plays a significant role in affecting breast cancer risk where amino acids could react with a creatine at high temperature to produce heterocyclic amine which is known as a carcinogenic compound [28]. The methods of preparing meat is playing a significant role in human cancers where polycyclic aromatic hydrocarbons adhere to the surface of meat, and the more intensive the heat, the more polycyclic aromatic hydrocarbons are present [29].

Chicken typically are raised in factory farms under extremely confined and unsanitary conditions that require use of antibiotics and antimicrobial drugs to maintain their health and maximize their growth. Palestinian society depends in their diets on chicken as a source of protein and other vitamins such as B 12, but the majority of the population like a small weight chicken more than the big one which exposed them to more accumulated chemicals in chicken especially in fats under the skin like dioxins [30]. Also the preparation methods of chicken plays an important role in the production of a well-known carcinogenic compound (Heterocyclic Amines) which is produced by the reaction between amino acids and creatine under high temperature [28]. Polycyclic aromatic hydrocarbons also can adhere to the skin of chicken during grilling of chicken, and the more intense the heat, the more polycyclic aromatic hydrocarbons are presents which play a significant role in human cancer [29].

Regarding eating raw vegetables, our findings were inconsistent with other findings in many studies. So that, the researcher suggest that the excess use of pesticides in Gaza Strip which might be deposit in vegetables where there was no protocols to monitor pesticides residues in agricultural crops that might endanger the health of the whole population in Gaza Strip [6,31]. In this regard, we can say that vegetables used in Gaza Strip may have been exposed to many pesticides that do not have control during use in

addition to the exposure of these chemicals to high temperature which may lead them to produce more dangerous chemicals on human health especially during cooking.

Regarding buying fruits and vegetables at the beginning of the season, this factor seriously affect the chance of getting breast cancer where women who bought vegetables and fruits at the beginning of their season had a chance of getting breast cancer fifty two times (OR= 52.36) more than women who did not buy them at the beginning of the season. Therefore, it is considered as a risk factor of breast cancer among women. As we know, vegetables and fruits in Gaza Strip exposed to high amounts of pesticides that accumulate in them especially at the beginning of their season, also some farmers exploit the beginning of vegetables and fruits season to sell them in markets in order to get the highest price, irrespective of the extent of danger on human health.

Thiebaut et al. [32], showed that there were association between saturated and monounsaturated fat intake with the risk of postmenopausal invasive breast cancer. Sierris et al. [27] and Balasubramaniam et al. [33] showed that there were an association between high saturated fat intake and breast cancer risk and there were no significant association of breast cancer with total monounsaturated or polyunsaturated fats. As well known, butter is loaded with saturated fats and is ultimate high fat dairy product which may also contain residues of pesticides mainly chlorinated hydrocarbons and other environmental toxins that tend to concentrate in fats, making high-fat dairy products more dangerous than low fats or, especially, nonfat ones.

Regarding canned food, they are imported to us from unknown source so they might contain some toxic chemicals such as pesticides that might effect on women health. Bisphenol A is an unstable polymer that presented as a liner in canned food is a lipophilic, it can leach into food products especially when heated [34]. The researcher think that we need precise information about the dose of BPA taken by women during their depending on canned food if we need to be accurate in judgment on BPA effects on breast cancer risk.

### Breast cancer by pesticides

Table 6 shows exposure of subjects to pesticides. There was a significant differences between cases and controls with regard to all variables mentioned in table VI except the variable buying and transporting of pesticides.

As well known, living in a farm or beside a farm and a rural area makes women more vulnerable to environmental hazards of which they are exposed through the food they eat, the air they breathe, and the water they drink. Actually, all factors included in pesticides domain showed a direct contact with these pesticides through the three routs of exposure absorption, digestion and inhalation. During pesticides domain, mainly all the variables related to it are associated with the risk of breast cancer. Pesticides still one the most serious public health problems in Gaza Strip by which there were uncontrolled and heavy use of pesticides and some of these pesticides are internationally suspended, banned, and cancelled are still used in the agricultural environment of Gaza Strip [15-17].

It is very important to mention here that there were more than 900 metric tons of formulated pesticides used annually in Gaza Strip, with more than 10,000 tons of organic fertilizers also were used annually in 2001 in the presence of formal Ministry of Agriculture [6]. Nowadays could we imagine the amount of pesticides currently used in Gaza Strip where tunnels open for everyone to import anything without monitoring and clear rules and regulations regarding to the kinds of pesticides that are safety for users and general population.

There were no protocols to monitor pesticides residues in agricultural crops that might endanger the health of whole population in Gaza [6,31], also there were

**Table 6:** Pesticides exposure of the subjects.

Variable	Case		Control		P Value	CI	Odds ratio	
	No.	%	No.	%				
Living in a farm	Yes	71	49.3	55	38.2	0.05	0.96-2.59	1.57
	No	73	50.7	89	61.8			
Total		144	100	144	100			
Period of living in a farm	≤20Y	59	83.1	40	72.7	0.05	-	-
	21-40	12	16.9	11	20.0			
	≥41 Y	0	0	4	7.3			
Total		71	100	55	100			
Pesticides used in the farm	Yes	65	91.5	36	65.5	0.001	1.92-17.75	5.72
	No	6	8.5	19	34.5			
Total		71	100	55	100			
Working with crops by naked hands	Yes	29	20.1	5	3.5	0.001	2.48-21.36	7.01
	No	115	79.9	139	96.5			
Total		144	100	144	100			
Working in the field while pesticides applied at the same time or within 24 hours	Yes	30	20.8	1	0.7	0.001	5.37-753.1	37.63
	No	114	79.2	143	99.3			
Total		144	100	144	100			
Buying and transporting of pesticides	Yes	2	1.4	0	0.0	0.156	-	-
	No	142	98.6	144	100			
Total		144	100	144	100			
Cleaning of pesticides mixing and application equipments	Yes	22	15.3	2	1.4	0.001	2.83-80.46	12.80
	No	122	84.7	142	98.6			
Total		71	100	55	100			
Personal application of pesticides	Yes	7	4.9	0	0.0	0.007	-	-
	No	137	95.1	144	100			
Total		144	100	144	100			
Living with anyone worked in a farm	Yes	30	20.8	17	11.8	0.038	0.99-3.95	1.97
	No	114	79.2	127	88.2			
Total		144	100	144	100			
Contact with working cloths, tools, equipment	Yes	27	90.0	5	29.4	0.001	3.65-152.60	21.6
	No	3	10.0	12	70.6			
Total		30	100	17	100			
Father, mother brother, sister working in a farm	Yes	34	23.6	19	13.2	0.023	1.05-3.95	2.03
	No	110	76.4	125	86.8			
Total		144	100	144	100			
Period of living with them	≤10Y	14	41.2	7	36.8	0.024	-	-
	11-21	15	44.1	4	21.1			
	22-32	1	2.9	6	31.6			
	≥33	4	11.8	2	10.5			
Total		34	100	19	100			
Living beside a farm or rural area	Yes	67	46.5	46	31.9	0.011	1.12-3.08	1.85
	No	77	53.5	98	68.1			
Total		144	100	144	100			
Smelling strange odors like pesticides.	Yes	66	98.5	21	45.7	0.001	10.19-1651.7	78.57
	No	1	1.5	25	54.3			
Total		67	100	46	100			

no restrictions on the sale and use of pesticides in Gaza, farmers have easy access to all pesticides including banned, highly toxic and restricted species. Therefore, all of the above makes users of pesticides and general population in particular women vulnerable to public health problems such as breast cancer.

Our findings showed that women who worked in the field at the time of applying pesticides or during 24 hours of their application had elevation in breast cancer risk which supported by Duell et al. [35] and Ferro et al. [36] who reported that there were an increased risk of breast cancer in women who likely exposed to pesticides in particular women present in field during or shortly after pesticides application. Also Brophy et al. [37], support our results through his findings that find a 3-9 fold increase in incidence of breast cancer amongst women with history of agriculture. Findings also showed that living beside a rural area or in a farm lead to increase the risk of

breast cancer which is also supported by Engle et al. [38] who found an elevated risk of breast cancer among women whose homes were closest to area of pesticides application. Band et al. [39], found a significant association in both menopausal and postmenopausal women between breast cancer and involvement in crop farming and fruits and vegetables production which was likely exposed to pesticides which support our study findings.

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