Association between body mass index and risk of breast cancer among females of north India

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Abstract

Background: Worldwide, breast cancer is most common cancer among women. In India and other developing countries, breast carcinoma ranks second only to cervical carcinoma among women. Although studies have been done globally, to find association between BMI and breast cancer, very few studies in India document any such association. **Purpose:** To find out the association between BMI and breast cancer. **Materials and Methods:** A Case-control study was done from August 2009 - July 2010 in the wards of General Surgery and Oncosurgery at Pt.B.D.Sharma, PGIMS Rohtak, Haryana. A total of 128 histopathologically confirmed new cases of breast cancer during the study period were taken as cases. Equal number of controls was selected by simple random sampling. Controls were matched for age with range of ±2 years. Subjects were interviewed using a pretested questionnaire after obtaining written informed consent. Data were analyzed by applying appropriate statistical tests using SPSS version 17. **Results:** Age group of the cases was 25 - 78 years, while that of the controls was 24 - 79 years. Proportion of cases and controls living in rural areas were more than those living in urban areas. A significant association of breast cancer cases was found with high BMI and high fat intake **Conclusion:** Obesity and high fat intake are the significant risk factors, which are modifiable. So women should be encouraged to take care of all these factors. Maximum cases presented in late stages so public awareness of this fatal disease must be developed.

Key words: Association, body mass index, breast cancer

Introduction

Worldwide, breast cancer is the most common cancer among women. It is probably the most feared cancer in women because of its psychological impacts. It affects the perception of sexuality and self image to a degree far greater than any other cancer. Breast cancer is most curable when detected at its earlier stages. Breast cancer is becoming number one killer in females. Therefore it has become an increasingly important problem of research all over the world. Globally, every 3 minutes a woman is diagnosed with breast cancer, amounting to one million cases annually. According to World Cancer Report the incidence could go up by 50%to 1.5 million by 2020.[1]

In India and other developing countries, breast carcinoma ranks second only to cervical carcinoma among women. But the incidence of breast cancer is on the rise and may become the number one cancer in females in the near future. It is estimated that approximately 80,000 cases occur annually; the age adjusted incidence rates varying between 16 and 25/100,000 populations.[2] Under the National Cancer Registry Program (NCRP), the Indian Council of Medical Research (ICMR) commenced a network of cancer registries across the country in December 1981. The consolidated report of population-based cancer registries (PBCRs) was published in 2005. It consisted of 2 years data for the years 1999-2000 of the five urban and one rural population-based cancer registry. The report released in December 2006 covers (a) the data of the six registries - Bangalore, Bhopal, Chennai, Delhi, Mumbai, and Barshi for the years 2001-2003, (b) the six PBCRs in the north-east for the year 2003-2004, and (c) that of the Ahmedabad PBCR covering Ahmedabad District (other than Ahmedabad Urban) for the year 2004. In the PBCR report, among females, breast cancer was the leading site of cancer in all registries, except in Barshi. This was followed by cancer cervix as the second leading site of cancer. In Barshi, the leading site of cancer was cervix uteri constituting 36.8% of all cancers followed by breast cancer. Hospital-based cancer registries (HBCRs) reported more cases of breast cancer than cervical cancer in Mumbai, Dibrugarh, and Thiruvananthapuram and more cases of cervical cancer than breast cancer in Bangalore and Chennai. The increase in the breast cancer cases is mainly being documented in the metropolitan cities; but this data are not totally reliable as many cases in the rural areas go unnoticed.[3]

Not all women have the same risk of developing breast cancer during their lifetime. Certain factors, called risk factors, increase the likelihood that a woman will develop breast cancer. Many of these risk factors are not reversible, but some can be modified. If modifiable risk factors were corrected, the situation would probably improve. Nonreproductive lifestyle factors like body weight, height, body mass index (BMI), physical activity, alcohol consumption, smoking, diet, etc., play a significant role

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in breast cancer like other noncommunicable diseases. Overweight and obesity, as measured by high BMI, moderately increases the risk of postmenopausal breast cancer and is one of the few modifiable risk factors for breast cancer. Compared with lean women, overweight postmenopausal women have a 10-20% increased risk of breast cancer, and obese postmenopausal women a 30% increase in risk. Women with a BMI under 22.5 have a 15% reduction in risk compared with women with a BMI of 22.5-24.9. In contrast, obese premenopausal women have a 20% reduction in cancer risk. Based on the results of the Million Women Study, an estimated 7% of breast cancers in postmenopausal women in the UK are due to overweight and obesity.[4] Although the association between high BMI and breast cancer risk is well established, the vast majority of studies have been conducted in Western countries. There has been a lot of research into the effects of dietary factors on breast cancer risk, but findings are generally inconsistent and inconclusive. The strongest evidence seems to be for fat intake: a meta-analysis of 45 studies reported that higher total fat intake increased breast cancer risk by 13%.[5] Geographical variation in the incidence and mortality rates of breast cancer suggest that the known risk factors for breast cancer may vary in different parts of world and that environmental factors are more important than genetic factors. So, the present study was aimed at detecting some of the environmental factors associated with female breast cancer in a tertiary care institute in northern India.

Materials and Methods

A case-control study was conducted from August 2009 to July 2010, in a tertiary care institute of Haryana, India. In this institute 125-150 new cases of breast cancer are admitted in the Department of Oncosurgery annually for treatment. During the study period, a total of 128 histopathologically confirmed new cases were admitted in the ward of Oncosurgery, they were entered into the study as cases. Equal number of controls was matched for the age with a difference of ±2 years without history of any type of cancer from the general surgical ward by simple random sampling. Study subjects were interviewed twice a week by pretested semi-structured proforma. The study subjects were interviewed only once and their registration number were recorded. The primary concern was on quality of data collection and every attempt was made to minimize recall bias. Written informed consent was taken before starting the interview.

Height and weight of the study subjects were measured in wards by the investigator, while using a sliding rule fixed on the bathroom scale. All subjects, dressed in light clothing and without shoes, supported their heels on the plate, and the buttocks or back were in contact with the device. The subjects looked straight in front of them but did not touch the device by the back of the head. Height and weight were measured, respectively, to the nearest 0.2 cm and to the nearest 0.3 kg. The BMI was calculated as weight (kg) divided by height squared (m^2). Anthropometric measurements were taken for most cancer cases within days of diagnosis, thus reducing measurement errors and some of the effects of therapy on body weight.

Exclusion criteria

- Women with hysterectomy and artificial menopause
- Women aged <20 years and >80 years
- Women who refused written consent.

Statistical analysis

The categorical data were analyzed statistically using Chi-Square test and Odds ratio (OR) with 95% confidence interval (CI). Continuous variables were analyzed using independent *t*-test. All the analyses were performed with Statistical Package for Social Sciences (SPSS) version 17. The data analysis was done from professional statistician using SPSS 17.

Results

Demographic variables are shown in Table 1 in which the age group of the cases was 25-78 years, while that of the controls was 24-79 years. Majority of cases and controls were in age group of 45-60 years, followed by 30-45 years age group. More than half of the study subjects belonged to the General category. While 68.8% cases were from General category, the controls were 51.6%. Risk of developing carcinoma was higher among General category patients than Backward class (OR 1.524, CI 0.782-2.969), while that of Scheduled caste was low (OR 0.571, 95% CI 0.256-1.277). The difference of occurrence of breast carcinoma in relation to caste is statistically significant (P = 0.008) [Table 1].

Majority of study subjects weighed between 50 and 60 kg. Very few subjects weighed over 70 kg. Risk of developing breast carcinoma increased as the weight increased. The difference in weight between cases and controls was

Table 1: Distribution of study population by demographic variables

	Cases	Controls	Odds ratio	95% CI	*P* value
Age (years)					
<30	09 (7.0)	12 (9.4)	Matched		
45-60	33 (25.8)	31 (24.2)			
30-45	63 (49.2)	57 (44.5)			
>60	23 (18.0)	28 (21.9)			
Caste					
General category	88 (68.8)	66 (51.6)	1.524	0.782-2.969	0.008*
Backward class	21 (16.4)	24 (18.8)	1		
Scheduled caste	19 (14.8)	38 (29.7)	0.571	0.256-1.277	
Residence					
Urban	56 (43.8)	47 (36.7)	1.340	0.812-2.212	0.251
Rural	72 (56.3)	81 (63.3)	1		

The figures in parenthesis are in percentages, *=Significant, CI=Confidence interval

statistically significant (*P* value 0.048). Height of majority of the study subjects was in the range of 150-155 cm, followed by in the range of 155-160 cm. Although there was a difference between the height of cases and controls, it was found to be statistically insignificant (*P* value 0.278) [Table 2].

BMI was found to be in the normal range (18.5-23) in 46.1% of the study subjects. The risk of developing breast carcinoma was less among the subjects with BMI below 18.5 as compared with those with normal BMI. The risk of carcinoma increased as the BMI increased. The difference found was statistically significant (*P* <0.0001). Majority of cases had history of medium to high fat intake, while in controls the visible fat intake was low to medium. The risk of developing carcinoma increased as the amount of visible fat intake increased. The risk of developing cancer was almost half (OR low fat vs medium fat = 0.497, 95% CI = 0.267-0.925) in subjects who had taken low amount of visible fat, and about five times in those with high fat intake (OR high fat vs medium fat = 5.255, 95% CI = 2.584-10.688). The difference found was statistically significant (*P* <0.0001) [Table 2].

Table 2: Distribution of study population by weight, height, and BMI

Weight (kg)	Cases	Controls	OR	95% CI	*P* value
<50	25 (19.5)	35 (27.4)	0.798	0.42-1.48	0.048*
50-60	60 (46.9)	67 (52.3)	1		
60-70	21 (16.4)	17 (13.3)	1.379	0.66-2.85	
>70	22 (17.2)	09 (7.0)	2.730	1.16-6.38	
Height (cm)					
<150	15 (11.7)	07 (5.5)	2.488	0.95-6.49	0.278
150-155	62 (48.4)	72 (56.3)	1		
155-160	40 (31.3)	40 (31.3)	1.161	0.66-2.02	
>160	11 (8.6)	09 (7.0)	1.419	0.55-3.64	
BMI					
<18.5	03 (2.3)	26 (20.3)	0.115	0.03-0.40	<0.0001*
18.5-23	59 (46.1)	59 (46.1)	1		
23-25	23 (18.0)	18 (14.1)	1.278	0.62-2.61	
25-30	25 (19.5)	19 (14.8)	1.316	0.65-2.64	
>30	18 (14.1)	06 (4.7)	3.000	1.11-8.08	
Visible fat intake					
Low	22 (17.2)	54 (42.2)	0.497	0.26-0.92	<0.0001*
Medium	50 (39.1)	61 (47.7)	1		
High	56 (43.8)	13 (10.2)	5.255	2.58-10.68	

Figures in parenthesis are in percentages, *=significant, BMI=Body mass index, OR=Odds ratio, CI=Confidence interval

When analysis was done separately in premenopausal and postmenopausal women, the BMI and visible fat intake were also found statistically significant, but the difference in weight and height was found statistically insignificant in both premenopausal and postmenopausal women [Table 3].

Continuous variables of the study population were analyzed by independent *t*-tests. Mean age of cases was 49.98 ± 11.6 years and the mean age of controls was 49.54 ± 12.0; cases and controls were matched for the age at diagnosis with range of 2 years. Cases and controls differed significantly by weight and BMI (*P* <0.0001) [Table 4].

Maximum cases (42.2%) presented in the fourth stage of cancer, followed by stage 2 and stage 3. Only six (4.7%) cases presented in the first stage of breast carcinoma. This clearly shows lack of awareness regarding breast cancer among the study population [Table 5].

Table 3: Distribution of variables according to menopausal status

	Premenopausal		OR	*P* value	Postmenopausal		OR	*P* value
	Cases	Controls			Cases	Controls		
Weight (kg)								
<50	06 (12.2)	19 (25.7)	0.496	0.143	19 (24.1)	16 (29.6)	1.018	0.202
50-60	21 (42.9)	33 (44.5)	1		28 (35.4)	24 (44.4)	1	
60-70	12 (24.5)	15 (20.3)	1.257		16 (20.3)	10 (18.5)	1.371	
>70	10 (20.4)	07 (9.5)	2.245		16 (20.3)	04 (7.4)	3.429	
Height (cm)								
<150	07 (14.3)	3 (4.1)	3.569	0.089	08 (10.1)	04 (7.4)	2.375	0.107
150-155	17 (34.7)	26 (35.1)	1		16 (20.3)	19 (35.2)	1	
155-160	12 (24.5)	30 (40.5)	0.612		44 (55.7)	20 (37.0)	2.613	
>160	13 (26.5)	15 (20.3)	1.325		11 (13.9)	11 (20.4)	1.188	
BMI								
<18.5	0 (0.0)	13 (17.6)	0.0	0.002*	04 (5.1)	13 (24.1)	0.217	0.016*
18.5-23	25 (51.0)	35 (47.3)	1		34 (43.0)	24 (44.4)	1	
23-25	9 (18.4)	12 (16.2)	1.050		14 (17.7)	06 (11.1)	1.647	
25-30	04 (8.2)	10 (13.5)	0.560		21 (26.6)	9 (16.7)	1.647	
>30	11 (22.4)	4 (5.4)	3.850		06 (7.6)	02 (3.7)	2.118	
Fat intake								
Low	03 (6.1)	28 (37.8)	0.193	<0.001*	04 (5.1)	26 (48.1)	0.124	<0.001*
Medium	20 (40.8)	36 (48.6)	1		31 (39.2)	25 (46.3)	1	
High	26 (53.1)	10 (13.5)	4.680		44 (55.7)	03 (5.6)	11.82	

Figures in parenthesis are in percentages, *=significant, BMI=Body mass index, OR=Odds ratio

Table 4: Analysis of continuous variables by independent *t*-tests

Variables	Cases	Control	*t*-test (*P* value)	95% CI
Age	49.98±11.6	49.54±12.0	Matched	
Weight	58.93±11.58	53.35±9.59	<0.001*	2.96-8.19
Height	154.71±4.69	155.24±4.65	0.364	−1.68-61
BMI	24.62±4.79	22.06±3.74	<0.0001*	0.150-3.61

*Significant, CI=Confidence interval, BMI=Body mass index

Table 5: Distribution of cases by stage at the diagnosis of breast carcinoma

Stages	Frequency of cases	Percentage
1	06	4.7
2	38	29.7
3	30	23.4
4	54	42.2

Discussion

Breast cancer incidence rates are increasing worldwide. The continuing rise in breast cancer incidence has created an urgent need to develop strategies for its prevention. Age is an important risk factor. The breast cancer risk increases as the age advances. In the present study, mean age of cases was 49.98 ± 11.6 years and mean age of controls was 49.54 ± 12.0 years. Average age of the patients seen in the six hospital-based cancer registries, during the period 1994-1998, was found to be 44.2 years in Dibrugarh and 49.6 years in Bangalore and Chennai.[6] The study conducted in Iranian women reported that patients were mostly aged above 44 years (44%); the breast cancer cases (n = 150) with median age 47.49 ± 11.43 years and control group (n = 147) with median age 40.75 ± 10.54 years.[7] Other studies also reported similar findings.[2,8] The average age of occurrence of breast cancer among US White females has been reported to be 61.0 years.[9] The average age of occurrence of the breast cancer in India reveals that the disease occurs a decade earlier, as compared with the Western countries. The reason for early age of occurrence among Indian women needs to be studied.

In the present study, proportion of cases (56.3%) and controls (63.3%) living in rural areas were more than those living in urban areas but it was statistically insignificant (*P* value 0.251). Mathew *et al*. reported that breast cancer incidence in India is approximately twice in urban area than in rural area.[10] Dalton *et al*. found an urban–rural gradient, with higher risk among rural women (OR = 1.10; 95% CI = 1.02-1.18) and lower risk among women in the capital suburbs (OR = 0.85; 95% CI = 0.78-0.93) and capital area (OR = 0.93; 95% CI = 0.84-1.02).[11] Other studies reported that 55%[12] and 60%[13] of women with breast cancer were from the rural areas. The reason may be the large number of people (around 70%) residing in rural areas and higher amount of fat intake in rural areas as compared with urban areas.

Overweight and obesity are common health conditions and their prevalence is increasing globally. It is well known that excess weight is associated with an increased incidence of particular diseases and certain cancers such as digestive cancer and those associations of excess weight with overweight and obesity-related morbidity may differ among racial and ethnic groups.[14] This hospital-based case control study found that the risk of developing breast cancer increased with increase in BMI at the time of diagnosis. In the present study, BMI was found to be in the normal range (18.5-23) in 46.1% of the study subjects. The risk of developing breast carcinoma was less among the subjects with BMI below 18.5 as compared with those with normal BMI. The risk of carcinoma increased as the BMI increased. BMI was significantly higher among the cases than controls. Other studies also found that females with high BMI were at increased risk of breast cancer.[15,16] Kato *et al*. observed that association with obesity was more pronounced for postmenopausal breast cancer.[17] But in our study, obesity and breast cancer were found to be significantly associated in both premenopausal and postmenopausal women. Link between BMI and breast cancer risk is likely to be due to hormones. The increased risk in overweight women may be chiefly due to higher levels of free estrogen produced by excess aromatase activity in peripheral adipose tissue.

In the present study, the risk of getting carcinoma increased as the amount of visible fat intake increased. The risk of cancer was 5.255 times in those cases who were taking high amount of visible fat as compared with those cases who were taking medium visible fat. The difference found was statistically highly significant. The findings were similar to the meta-analysis of 45 studies, which reported that higher total fat intake increased breast cancer risk.[4]

Maximum cases (42.2%) presented in the fourth stage of cancer, followed by stage 2, then stage 3. Only six (4.7%) cases presented in the first stage of breast carcinoma. This clearly shows lack of awareness regarding breast cancer among the study population. The findings of the present study were similar to a study by Meshram *et al*., in which >90% patients presented in late stages of cancer.[18] Harrison *et al*. also found that most of the cases were detected in stage 3 (46%) or stage 4 (36.5%) of the disease when treatment options are limited and cure is difficult.[19] It was found that the proportion of late-stage cancer was clearly decreased when tumors were detected by screening at early stage.[20] Our study showed that late presentation to the hospital is an area of concern. The major contributing factor for the problem is dearth of organized screening program for early detection of breast cancer.

Conclusions and Recommendations

- In the present study, obesity and high fat intake were found to be significant risk factors. These are modifiable factors. Hence, women should be encouraged to take care of all these factors to decrease

their risk of breast cancer.

- Maximum cases (42.2%) presented in the fourth stage of cancer followed by stage 2 and stage 3. This clearly shows lack of awareness regarding breast cancer among the study population. Public awareness of this fatal disease must be developed; it helps in detection of breast cancer in early stages. If cancer is detected in early stages, it is curable. Considering the low awareness levels of the participants and nonexistent screening practices, a targeted intervention to tackle this problem seems to be the need of the hour.

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