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### Association of BMI with Risk of Developing Breast Cancer: A Case Control Study

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#### Abstract

**Objective:** To determine the association of BMI with the risk of developing breast cancer.

**Study Setting:** Khyber Teaching Hospital Peshawar in Khyber Pakhtunkhwa.

**Study Duration:** 6 months starting from 1<sup>st</sup> September 2022 to 28<sup>th</sup> February 2023.

**Study Design:** Case-control study.

#### Material and Methods

After taking approval from the hospital ethical committee, 256 patients were included in the study, between August 2022 and January 2023, divided equally into 2 groups as cases (breast cancer) and controls (breast diseases other than cancer). BMI for all patients was calculated and categorized in Microsoft excel sheet and shifted to SPSS data base for analysis and the results shown in tables and charts.

**Results:** Data on 126 cases and 126 controls were included

in the study for analysis. For cases mean BMI was 27.9 kg/m<sup>2</sup> and most patients had BMI category 25 to 30 kg/m<sup>2</sup> {n=81 (64.3%)}. Correlation of BMI with cases (both left sided and right sided carcinomas gave us a p-value of 0.053. For controls mean BMI was 26.6 kg/m<sup>2</sup> and most patients had BMI category 25 to 30 kg/m<sup>2</sup> {n=79 (62.7%)}. Correlation of BMI with controls (patients presenting with pathologies other than breast cancer such as breast abscess, cysts, galactoceles, fibroadenomas etc.) gave us a p-value of 0.599.

#### Conclusion

The findings suggest that being overweight is associated with increased risk of developing breast cancer in both pre- and post-menopausal women as compared to other diseases related to the breast.

**Keywords:** Breast Cancer, BMI, Obesity, Overweight

#### 1. Introduction

Breast cancer is one of the most common cancers found worldwide in females especially prevalent in developed countries and the western population. In 2020, about 2.3 million women were diagnosed with breast cancer worldwide and 685,000 died [1]. Pakistan has the highest incidence of breast cancer among Asian countries [2]. According to the International Agency of Research on Cancer 2018 report, 34,066 new cases of breast cancer had been reported in Pakistani women [3]. Late detection and inappropriate screening leads to most of the patients presenting in advanced stages [4]. There are many risk factors associated with breast cancer, one of the recognized and still under research risk factor is body mass index (BMI) [5-6].

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults [7]. Obesity has affected 400 million person all over the world [8]. According to WHO around 26% women are obese in Pakistan with urban population more affected comparative to rural population [9].

Breast Cancer and obesity are two simultaneously growing global health problems and obesity has been shown to have an impact on the prognosis of breast cancer and may also increase the risk of complications [10]. Research suggests that BMI is an important predictor of cancer risk which was proven by The UK Million Women study conducted in England and Scotland between 1996-2001 [11] and the Women's Health Initiative Clinical Trial in United States [12]. The mechanism behind this finding is associated with increased blood levels of estrogen which are stored in adipose tissues in fatty females and this estrogen is postulated to promote tumor growth [13-16]. There is relatively more evidence on presence of breast cancer in obese post-menopausal women compared to pre-menopausal women [17-18]. Therefore, this study was conducted with the purpose of further augmenting the proof that patients with higher BMIs are more at risk of having breast cancer keeping our hospital in perspective.

## 2. Methodology and Study Design

This following case control study was conducted in department of surgery Khyber teaching hospital Peshawar from September 2022 to February 2023 comprising of 256 patients selected through non probability consecutive sampling.

The institution's ethical and research council gave its approval before the study could begin. All patients who met the requirements for inclusion in the study underwent screening in the OPD before being admitted to the ward for further assessment. They were made aware of the aim and purpose of the study and reassured that it was being carried out solely for research. If they agreed, informed consent was obtained.

The patients were allocated into two groups. Group A, Cases, (patients presenting with diagnosed breast cancer either unilateral or bilateral), and group B, control group, (patients presenting with pathologies other than breast cancer such as breast abscess, cysts, galactoceles, fibroadenomas etc.). The patients' anthropometric parameters such as weight, height and BMI were measured. BMI of 18.5 to <25 kg/m<sup>2</sup> was considered healthy while BMI of 25.0 to <30 kg/m<sup>2</sup> was categorized as overweight and for obese patients the BMI was 30 kg/m<sup>2</sup> or higher. Proformas were filled and all the information was transferred to Microsoft excel sheet for convenience.

Data was analyzed by using the statistical software SPSS version 23.0. Continuous variables i.e., BMI, height and weight were calculated as Means  $\pm$  Standard deviation. Categorical variables i.e., age, number of cases and controls were calculated as frequencies and percentages. The relationship of BMI with cases and control groups was determined by using the odds ratio at 95% confidence interval in a 2\*2 contingency table. A p-value of  $\leq 0.05$  was considered significant and the results were presented in the form of tables and charts.

## 3. Results

Data on 126 cases and 126 controls were included in the study for analysis. For cases, mean and standard deviation for height was 156 cm  $\pm$  6.9, weight 144.3 pounds  $\pm$  12.1 and BMI 27.9 kg/m<sup>2</sup>. Most number of participants fell in the height category of 151 to 160 cm {n = 71(56.3%)} weight category 151 to 160 pounds {n=44 (34.9%)} and BMI category 25 to 30 kg/m<sup>2</sup> {n=81 (64.3%)}. Correlation of BMI with cases (both left sided and right sided carcinomas) gave us a p-value of 0.053.

For controls, mean and standard deviation for height 155 cm  $\pm$  5.8, weight 138.1 pounds  $\pm$  15.9, BMI 26.6 kg/m<sup>2</sup>. Maximum subjects fell in the height category of 151 to 160 cm {n = 68(54%)} weight category 151 to 160 pounds {n=40 (31.7%)} and BMI category 25 to 30 kg/m<sup>2</sup> {n=79 (62.7%)}. Correlation of BMI with controls (patients

presenting with pathologies other than breast cancer such as breast abscess, cysts, galactoceles, fibroadenomas etc.) gave us a p-value of 0.599.

**Table 1:** Descriptive statistics of demographic variables

Variable	Cases Mean (SD)	Controls Mean (SD)
Age	47.8 (11.6)	33.7 (12.7)
Height (cm)	156 (6.9)	155 (5.8)
Weight (pounds)	144.3 (12.1)	138.1 (15.9)
BMI kg/m <sup>2</sup>	27.9 (3.3)	26.6 (3.4)

**Table 2:** Height categories for cases (cm)

	Frequency	Percent	Cumulative Percent
130 to 140	4	3.2	3.2
141 to 150	24	19.0	22.2
151 to 160	71	56.3	78.6
161 to 170	26	20.6	99.2
171 to 190	1	.8	100.0
Total	126	100.0	

**Table 3:** Weight categories for cases (pounds)

	Frequency	Percent	Cumulative Percent
110 to 120	5	4.0	4.0
121 to 130	16	12.7	16.7
131 to 140	18	14.3	31.0
141 to 150	38	30.2	61.1
151 to 160	44	34.9	96.0
161 to 170	5	4.0	100.0
Total	126	100.0	

**Table 4:** BMI categories for cases kg/m<sup>2</sup>

	Frequency	Percent	Cumulative Percent
Valid 18 to 24	19	15.1	15.1
25 to 30	81	64.3	79.4
31 to 38	26	20.6	100.0
Total	126	100.0	

**Table 5:** BMI groups \* Type of Disease Crosstabulation for cases

		Type of Disease		Total	OR (95%CI)	P-value
		Left breast carcinoma	Right breast carcinoma			
BMI groups	Normal weight	34	34	68	0.72 (0.53-0.99)	0.05
	Over-weight	27	12	39	1.63 (0.96-2.75)	
Total		61	46	107		

**Table 6:** BMI categories for controls

	Frequency	Percent	Cumulative Percent
18 to 24	34	13.0	27.0
25 to 30	78	29.8	88.9
31 to 38	14	5.3	100.0
Total	126	48.1	

**Table 7:** Type of Disease \* BMI categories Crosstabulation

		BMI categories			Total	p-value
		18 to 24	25 to 30	31 to 38		
Type of Disease	Fibroadenoma	3	9	1	13	0.599
	Galactocele	1	3	1	5	
	Left accessory breast	1	1	1	3	
	Left breast abscess	9	7	2	18	
	Left breast cyst	8	16	2	26	
	Left duct ectasia	0	9	0	9	
	Mastitis	1	3	1	5	
	Post MRM DD	1	2	1	4	
	Right accessory breast	0	2	0	2	
	Right breast abscess	5	11	2	18	
	Right breast cyst	5	10	3	18	
	Right duct ectasia	0	5	0	5	
Total		34	78	14	126	

**Table 8:** Height categories for controls (cm)

	Frequency	Percent	Cumulative Percent
130 to 140	19	15.1	3.2
141 to 150	18	14.3	22.2
151 to 160	68	54	78.6
161 to 170	20	15.9	99.2
171 to 190	1	0.01	100.0
Total	126	100.0	

**Table 9:** Weight categories for controls (pounds)

	Frequency	Percent	Cumulative Percent
110 to 120	3	0.23	4.0
121 to 130	11	8.7	16.7
131 to 140	15	12	31.0
141 to 150	35	27.8	61.1
151 to 160	40	31.7	96.0
161 to 170	22	17.5	100.0
Total	126	100.0	

**Table 10:** BMI categories for controls

		Frequency	Percent	Cumulative Percent	p-value
Valid	18 to 24	34	27	27.0	0.599
	25 to 30	79	62.7	89.7	
	31 to 38	13	10.3	100.0	
	Total	126	100		

#### 4. Discussion

The results of this study show that breast cancer patients have a statistically higher mean weight and BMI as compared to patients with other breast related pathologies. The prevalence of obesity, being overweight and breast cancer is growing in a parallel fashion worldwide therefore their proven correlation is no surprise. In Asian countries this finding is more common in premenopausal age group while in the western communities its relatively more frequent in the post-menopausal age group [19].

The following study showed adjusted OR for cases having significant association between higher BMIs {OR 1.63 with 95% CI (0.96-2.75), p-value 0.05} with increased risk of breast cancer. A case control study by Singh *et al.* in New Delhi India also observed that overweight and obese women had OR of 1.06 (95% CI: 0.76–1.47) and 2.27 (95% CI: 1.28–4.01) as compared to women with normal weight<sup>20</sup> and this association is seen among east Asian woman in other studies as well [21-22]. A similar analysis by Neuhauser *et al.* [12] among south Asian women showed that there was significant correlation between being overweight and breast

cancer during premenopausal and postmenopausal periods [OR = 1.61 (95% CI 1.43–1.80)]. An earlier case-control study conducted in USA revealed that Overweight and obese women had OR of 1.14 (95% CI: 0.96–1.36) and 1.22 (95% CI: 0.99–1.50) as compared to women at normal weight [23]. Research among females in regions of Japan<sup>24</sup> and China [25] have proven this relationship. However, some authors contradict this association saying that obesity does not affect early-stages of breast cancer [26].

Our study was conducted as a simple case control design in a single study setting, we believe performing this task through meta-analysis involving multiple institutions would have given us more convincing results. There was some selection bias as far as controls are concerned. Data on this topic is quite limited in developing countries and we believe further research is needed on this subject especially in our parts of the world.

#### 5. Conclusion and recommendation statement

The results of the study depict that being overweight and obese is definitely a risk factor in breast cancer and this problem is continuously increasing in our population. Females in east Asian countries are generally deficient in their knowledge on breast cancer and it is the utmost responsibility of medical professionals and higher authorities to create as much awareness as possible in the general public to counteract this issue on time.

#### 6. Funding

The study was self-funded by all the authors in this study.

#### 7. Conflict of Interest

There was no conflict of interest among the authors.

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