



Body Mass Index and its Association with Treatment Outcomes in Breast Cancer Patients: An Observational & Prospective Study

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ABSTRACT

Introduction: Data on the relationship between BMI and outcomes for Breast cancer patients are inconclusive. While some research supports the obesity paradox in cancer patients, suggesting that patients in overweight or obese category with respect to body mass index may predict positive outcomes after chemotherapy in breast cancer patients, other research suggests the contrary. Geographical variations in cancer mortality and incidence rates imply that identified risk factors for breast cancer may alter depending on where in the world a person lives and that environmental variables are more significant than genetic ones.

Aims/ objective: To study body mass index in breast cancer patients and its association with outcome after chemotherapy in cancer patients.

Materials and Method: According to the updated consensus recommendations for India, the study participants were classified as underweight (BMI less than 18.5 kg/m²), normal (BMI between 18.5 to 22.9 kg/m²), overweight (BMI between 23.0 to 24.9 kg/m²), and obese (BMI greater than 25 kg/m²).²¹ Baseline demographic and clinical characteristics such as diagnosis, relevant medical history etc. were collected in a proforma. After six months of follow-up, the patients' quality of life (QoL) was assessed using certain modifications to the EORTC QLQ-C30, a questionnaire developed by the European Organisation for Research and Treatment of Cancer.

Results: Most of the patients (65.33%) were either overweight or obese. 32.27% breast cancer patients were having BMI in normal range. Only 2.4% of patients were underweight. We found significant association between age and BMI of breast cancer patients ($p < 0.0001$) with most of the overweight and obese patients having age greater than 45. There was significant association between poor quality of life and higher body mass index after chemotherapy in breast cancer patients ($p < 0.05$). Obese and underweight cancer patients had significantly higher mortality as compared to patients with normal BMI ($p < 0.05$).

Conclusion: There were greater proportion of overweight and obese patients in breast cancer patients indicating association of high body mass index (BMI) with risk of developing cancer. Quality of life was poor in both underweight and obese individuals with higher mortality after chemotherapy.

Keywords: Body Mass Index, Cancer, Obesity, Chemotherapy, Quality of Life, Mortality.

INTRODUCTION

Being overweight or obese raises the risk of mortality overall and the likelihood of getting a wide range of cancers in the population as a whole, as is well documented in various studies.^{1,2} Conversely, a paradox relationship was discovered in individuals with a chronic disease (such as heart disease, lung disease, and chronic kidney diseases), in which patients falling in overweight or obese category with respect to body mass index seems to be coincide with a reduced mortality risk, a trend known as the "obesity paradox."³

A sizable and expanding community of patients with breast carcinoma and survivors of breast cancer are very enthusiastic about learning how to change their lifestyles to enhance their health.⁴ Current recommendations encourage patients with breast carcinoma and survivors of cancer to reach or preserve body weight within normal range of BMI, and they are mostly extrapolated from evidence on prevention.⁵⁻⁷

However, the physiological role of high BMI in the pathogenesis of breast cancer may not be the same as that in the outcome after chemotherapy. There is currently no

evidence from a randomised controlled study to assess the influence of purposeful weight adjustment on cancer prognosis. The implications of BMI after diagnosis on outcomes on chemotherapy are still not completely understood in breast cancer patients.⁸

Data on the relationship between BMI and outcomes for cancer patients are inconclusive. While some research supports the obesity paradox in breast cancer patients,⁹⁻¹³ suggesting that patients in overweight or obese category with respect to body mass index may predict positive outcomes after chemotherapy in breast cancer patients,¹³⁻¹⁴ other research suggests the contrary.¹⁵⁻¹⁸

One of the several controllable risk factors for breast cancer is being overweight or obese as defined by a high body mass index as it slightly raises the likelihood of developing post-menopausal breast cancer. Post-menopausal women who are overweight or obese with respect to BMI have a ten to twenty percent higher chance of developing breast cancer than lean ones, and vice versa. Compared to women having a body mass index of 22.5 to 24.9, those with a body mass index less than 22.5 have a 15 percent reduced chance of developing certain cancers.



In contrast, pre-menopausal women with high BMI have a 20% lower risk of developing cancer. According to the findings of the Million Women Study, obesity and being overweight are thought to be the cause of 7% of breast cancers in post-menopausal women in the United Kingdom.¹⁹

By carcinoma site, the stage, and mode of therapy, relationships may change, according to some data.^{11, 12} Despite the fact that this relationship is the subject of several research, a great deal of them have been carried out in Western nations. The impact of dietary components on risk of cancer has been extensively studied, but results have often been conflicting and ambiguous. Consumption of fat appears to be supported by the most compelling data; a meta-analysis of 45 studies found that increased total fat intake raised the risk of breast cancer by 13%.²⁰

Geographical variations in breast cancer mortality and incidence rates imply that identified risk factors for cancer may alter depending on where in the world a person lives and that environmental variables are more significant than genetic ones. So, this study was carried out to study body mass index in breast cancer patients and its association with outcome after chemotherapy in cancer patients. The objective was to determine the prevalence of underweight, normal, overweight, and obese individuals among breast cancer patients and compare treatment outcomes among these patients.

MATERIALS AND METHODS

This was an observational and prospective study carried out in a tertiary care hospital of eastern India from July 2021 to June 2023. The study was conducted after taking approval from the Institutional Ethics Committee under the guidelines of Good Clinical Practice and Declaration of Helsinki. The written informed consent was taken after providing and explaining participant information sheet.

Inclusion Criteria:

- Only Female patients
- Aged 18 years and above
- diagnosed case of invasive ductal breast cancer within 1 year of recruitment
- Receiving NACT, adjuvant chemotherapy and adjuvant Radiotherapy
- Comorbidities with hypertension and Diabetes mellitus.

Exclusion Criteria:

- Male Patients
- Age less than 18 years and more than 80 years
- Any benign tumours
- On palliative treatment

Sample Size

Consecutive sampling method was used, and all patients found eligible according to our inclusion and exclusion criteria during the study period were enrolled. A total of 375 patients were surveyed and included in our analysis.

Methodology

Weight and height were obtained by healthcare providers as part of routine examinations during visit of patients to outpatient department, and the body mass index (weight in kg) / (height in metre)² was calculated at every visit. According to the updated consensus recommendations for India, the study participants were classified as underweight (BMI less than 18.5 kg/m²), normal (BMI between 18.5 to 22.9 kg/m²), overweight (BMI between 23.0 to 24.9 kg/m²), and obese (BMI greater than 25 kg/m²).²¹ Baseline demographic and clinical characteristics such as diagnosis, relevant medical history etc. were collected in a proforma.

After six months of follow-up, the patients' quality of life (QoL) was assessed using certain modifications to the EORTC QLQ-C30, a questionnaire developed by the European Organisation for Research and Treatment of Cancer. The questionnaire was comprised of 56 questions divided into five domains:²²

- Patient's general conditions
- Patient's physical activities
- Social status and occupational function
- Sleep pattern

Total score is 280 with 207-280 denoting good outcome, 131-206 denoting average outcomes and 56-130 denoting poor outcomes.

Statistical Analysis

Data collected from enrolled patients in proforma were presented in tabular form using Microsoft Excel 365. Descriptive analysis was done to express the overall data into mean, standard deviation (SD), frequency and percentage. Categorical data such as age-group, grade of QoL, cancer type, and co-morbid disorders were expressed as frequency and percentage and statistical significance of difference between different groups of BMI was tested using chi-square test with a p-value of less than 0.05 denoting statistical significance.

RESULTS

Among 375 breast cancer patients, most of them were overweight (34.13%), followed by normal weight (32.27%), obese (31.20%), and underweight (2.40%).



Table 1: Distribution of breast cancer patients in different categories with respect to BMI

Category	Number of Patients	Percentage (n = 375)
Underweight (BMI<18.5 kg/m ²)	9	2.40
Normal (BMI: 18.5–22.9 kg/m ²)	121	32.27
Overweight (BMI: 23.0 –24.9 kg/m ²)	128	34.13
Obese (BMI ≥25 kg/m ²)	117	31.20

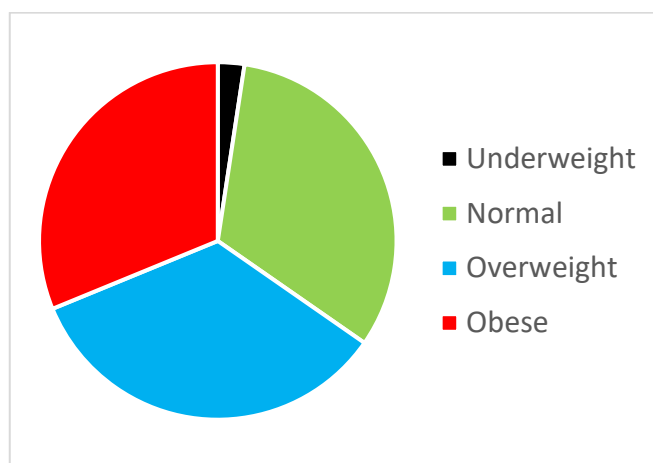


Figure 1: Distribution of breast cancer patients in different categories with respect to BMI

Most of the patients (65.33%) were either overweight or obese. 32.27% breast cancer patients were having BMI in normal range. Only 2.4% of patients were underweight.

Table 2: Comparison of baseline demographic and clinical characteristics between different categories of breast cancer patients with respect to BMI

Variables	Total (%)	Underweight (%)	Normal (%)	Overweight (%)	Obese (%)	P-value
Age-Group						
18-30	34	3 (33.33)	21 (17.36)	6 (4.69)	3 (2.56)	<0.0001
31-45	81	1 (11.11)	38 (31.4)	23 (17.97)	19 (16.24)	
46-60	149	1 (11.11)	37 (30.58)	71 (55.47)	40 (34.19)	
>60	111	4 (44.44)	25 (20.66)	28 (21.88)	54 (46.15)	
Co-Morbid Condition						
Diabetes Mellitus	197	3 (33.33)	30 (24.79)	61 (47.66)	103 (88.03)	0.36
Hypertension	167	0 (0.00)	31 (25.62)	51 (39.84)	85 (72.65)	

We found significant association between age and BMI of breast cancer patients ($p < 0.0001$) with most of the overweight and obese patients having age greater than 45. Prevalence of diabetes and hypertension was also greater in overweight and obese patients.

Table 3: Comparison of Quality of Life after 6 months of chemotherapy between different categories of breast cancer patients with respect to BMI

Quality of Life	Underweight (%) n = 9	Normal (%) n = 121	Overweight (%) n = 128	Obese (%) n = 117
Good	1 (11.11)	13 (10.74)	10 (7.81)	7 (5.98)
Average	4 (44.44)	79 (65.29)	75 (58.59)	57 (48.72)
Poor	4 (44.44)	29 (23.97)	43 (33.59)	53 (45.30)
P-Value	0.04			

There was significant association between poor quality of life and higher body mass index after chemotherapy in breast cancer patients ($p < 0.05$).

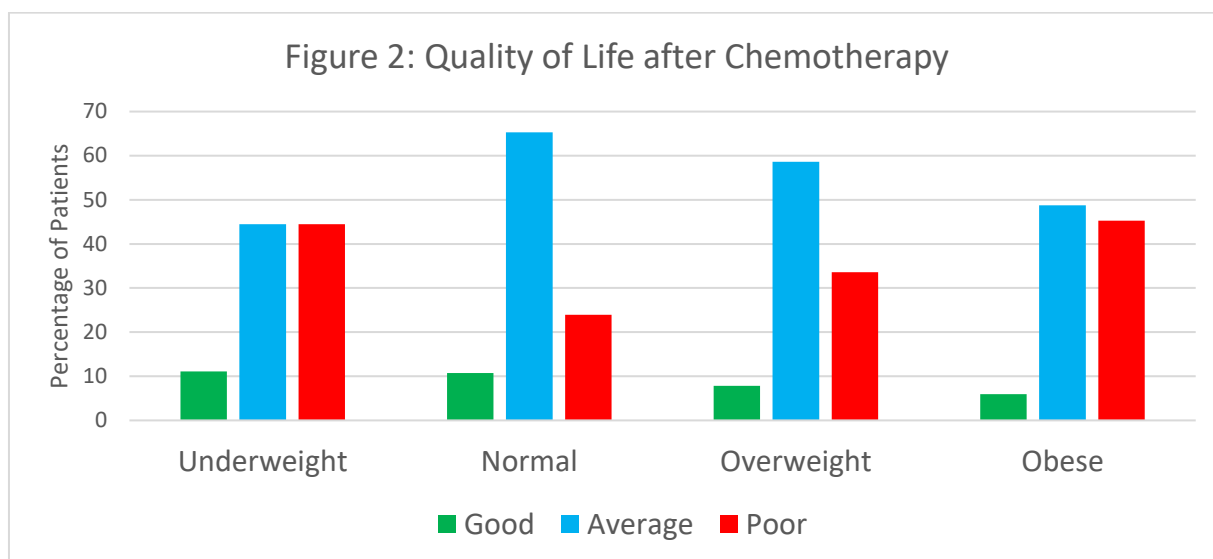


Table 4: Comparison of Mortality between different categories of breast cancer patients with respect to BMI

Quality of Life	Underweight (%) n =9	Normal (%) n = 121	Overweight (%) n =128	Obese (%) n =117
Alive	6 (66.67)	103 (85.12)	99 (77.34)	78 (66.67)
Dead	3 (33.33)	18 (14.88)	29 (22.66)	39 (33.33)
P-Value	0.01			

Obese and underweight breast cancer patients had significantly higher mortality as compared to patients with normal BMI ($p < 0.05$).

DISCUSSION

In this observational and prospective study, we found that most of the breast cancer patients were either overweight or obese. Obesity was also associated with poor outcome with respect to quality of life and mortality. Our study results suggest further studies with correlation of breast cancer risk and outcome with additional parameters of metabolic dysfunction such as waist circumference.

In addition to association of obesity with high risk of cancer, we have also found significant association of obesity with poor outcome after chemotherapy. These results are in line with some studies,¹⁵⁻¹⁸ but contrary to obesity paradox reported in some studies.⁹⁻¹³

Large scale prospective studies have been conducted since the beginning of the 21st century, and they have contributed significantly to our current understanding of the connections between cancer and overweight and obesity. One such study, the Cancer Prevention Study-2 (CPS II), monitored participants from 1982 to 1996 and involved more than 1 million adult Americans. The body mass index (BMI), which was derived from the self-reported height and weight of study participants, was evaluated in relation to death from cancer. The majority of patients with high BMI had a 40 to 80 percent greater risk of death from cancer as per finding of the study.²³

After sixteen years of follow-up, the same researchers later released a more thorough analysis of the CPS II cohort and the relationship between obesity and death from cancer at particular sites. They found a linear relationship between rising body mass index (BMI) and a rise in cancer-related overall mortality as well as increases in non-Hodgkin's lymphoma and multiple myeloma deaths in both genders, as well as breast, endometrial, cervical, and ovarian carcinoma in females and leukaemia, and carcinoma of oesophagus, stomach, and prostate in males. Both genders showed a negative correlation between body mass index and lung cancer mortality, but no correlation was seen for melanoma, cerebral, or bladder carcinoma with obesity.²⁴

The correlation between high BMI and higher breast cancer-related mortality has been demonstrated in a number of subsequent research and meta-analyses. Obese people also have a greater risk of several malignancies. In 2007, 221 datasets from various populations were included in a thorough meta-analysis. The researchers who were part of this study discovered that there was a greater risk of oesophageal, thyroid, renal, and colorectal cancers, as well as melanoma, leukaemia, and multiple myeloma, in males for each 5 kg/m² rise in body mass index. Carcinoma of endometrium, gallbladder, oesophagus, kidney, thyroid, breast, pancreas, and colon as well as multiple myeloma, non-Hodgkin lymphoma, and leukaemia were found to be

associated with higher risk in postmenopausal obese females. Again, the risk of breast cancer and lung cancer was inversely correlated with obesity.^{9, 25}

Although high BMI is frequently linked to a higher risk of breast cancer death, some research have shown that individuals with high BMI had a lower incidence of breast cancer and prostate cancer as well.^{9, 10, 26, 27} Overall, it seems that obesity could raise the risk of a more severe illness while decreasing the risk of locally advanced breast carcinoma.²⁸ It is unclear why there is considerable variation in incidence of breast carcinoma and death rates associated with it. Although it is plausible that decreased levels of progesterone in people with high BMI diminish their risk of cancer, endogenous insulin and lipids may also have a role in tumour growth once cancer has already manifested.

Furthermore, even though body mass index is within the normal range, certain groups, such as those in South-East Asia, typically have these metabolic anomalies.²⁹ Compared to body mass index, fewer research has specifically looked at how the waist circumference affects cancer incidence and death rate. Waist circumference was found to be associated with postmenopausal breast cancer risk in the CPS II research of mostly white women, but it did not provide a more accurate predictor of risk than body mass index in this cohort.³⁰ However, it was discovered that waist circumference was related to risk of breast carcinoma in post-menopausal women in the Nurses' Health Study group, particularly in women who had never undergone post-menopausal HRT (hormone replacement therapy).³¹

According to a meta-analysis, BMI adjusted waist circumference was found specifically associated with the likelihood of breast cancer in pre-menopausal females but body mass index was not.³² In a meta-analysis, it was discovered that each 2 cm rise in the waist circumference was linked to a 4% greater likelihood of carcinoma of the colon.³³ Interestingly, the Women's Health Initiative found that the waist circumference was directly proportional to risk of breast cancer in current and past smokers, despite the fact that other studies have found an inverse relationship between body mass index and risk of breast carcinoma.³⁴ According to these research, metabolic dysregulation, even in those with normal body mass index, is linked to an elevated likelihood of developing several malignancies.

CONCLUSION

There were greater proportion of overweight and obese patients in breast cancer patients indicating association of high body mass index (BMI) with risk of developing breast cancer. Quality of life was poor in both underweight and obese individuals with higher mortality after chemotherapy. The results of our study suggest further studies including more parameters of metabolic dysfunction such as waist circumference and mid-arm circumference. Meta-analysis of these type of studies are needed to resolve the conflicting results and establish the

stronger evidence. The step in developing evidence-based weight management strategy should be taken.

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Conflicting Interest: Nil

Ethical clearance: Institutional Ethics Committee of NMCH, Patna.

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