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Obesity in Terms of BMI and BSA in Egyptian Breast Cancer Patients: Can Tumor Behavior Be Predicted?

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Abstract

Background: Obesity is a major health problem worldwide and is involved in etiology of breast cancer. Egypt is ranked among the highest globally in obesity problem. Body mass index (BMI) is the most widely used tool to define obesity. Body surface area (BSA) is another measure used widely in clinical practice, particularly in calculating doses of chemotherapeutic agents. Both Body Surface Area (BSA) and Body Mass Index (BMI) rely on weight and height and can be used as indicators of obesity. **Patients and Methods:** This is a cross-sectional observational study that was carried out in the department of clinical oncology, Faculty of medicine, Ain Shams University Hospitals. Medical records of patients scheduled for adjuvant chemotherapy were revised regarding age, comorbidity, side of the tumor, stage, and type of the surgery performed. Immunohistochemistry (IHC) to detect ER, PR, and Her2 and molecular subtypes of the tumors was recorded. BMI and BSA were calculated for all patients. **Inclusion Criteria:** Female patients with newly diagnosed breast cancer, cases that didn't start the adjuvant treatment, data for IHC available, weight, and height of the patients recorded in the files. **Exclusion Criteria:** Male breast cancer cases, bilateral cases, metastatic cases, age above 80 years, cases with multiple primaries. **Results:** The mean age of patients was 48 ± 11 years and 60% of them were premenopausal. The mean weight in Kgs was 81 ± 13 and the mean height in cm was 156 cm ± 5. Mean BMI was 33.8 ± 6.0 and mean BSA was 1.84 ± 0.15. Comorbidities were present in 10.6% of patients. In the studied group of patients, tumors were more common of right side (55.7%), T2 tumor (40%), N1 (40.9%), and stage III in 57.4%. Regarding the hormonal receptor status, most of the patients were ER+ (76.5%), PR+ (66.1%) and Her2− (73.9%). The molecular subtypes were also estimated with HR+ subtype most common in (60%) and Her2+ subtype least common in (10.4%). Neither BMI nor BSA was different based

on menopausal status. Tumor characteristics were compared in relation to BMI and BSA, and none of the studied parameters regarding menopausal status, T staging, N staging, TNM staging, ER, PR, Her2 and molecular subtype were significantly associated with BMI or BSA. Receiver operating characteristic (ROC) curve was done for the poor prognostic variables. It was found that both BMI and BSA were poorly predictive for the prognostic tumor characteristics regarding T stage, N stage, Her2 overexpression and TN disease. **Conclusion:** Obesity is a major health problem among breast cancer patients in Egypt. Both BSA and BMI (as indicators of obesity) in Egyptian breast cancer patients are higher compared to other parts of the world. Both BMI and BSA were poorly predictive of prognostic parameters in breast cancer patients.

Keywords

BMI, BSA, Cancer Breast, ROC

1. Introduction

Obesity, which is a major health problem worldwide, is ranked the fifth cause of death accounting for 8.4% of causes [1]. Besides being a global epidemic, that is increasingly affecting the developing world, obesity is involved in etiology of many cancers with multifactorial association [2] [3]. Extensive research was conducted to investigate the association between obesity and breast cancer [4] [5] [6]. Breast cancer can be affected by obesity in many ways, as not only it is increased in obese women but also obesity can be associated with worse prognosis and aggressive tumor characteristics [2]. Obese patients were reported to have greater disease mortality, higher recurrence rate and worse overall & disease-free survival [7].

Because of ease of calculation, Body mass index (BMI) is the most widely used tool to define obesity. It is measured as the body weight divided by the square of height (kg/m^2) [8]. Body Mass Index (BMI) has widely been linked to cancer risk [6]. Breast cancer (BC) risk increased by 3.4% for every 1 kg/m^2 increment of BMI in postmenopausal women [7].

Using BMI, overweight and obesity percentage as low as 6.7% in Madagascar and as high as 50.8% in Swaziland [9] was reported. The data included about 250,000 women aging below 49 years in 32 countries of Sub-Saharan Africa. Incidence of obesity varies between rural and urban areas. Socioeconomic differences, education and wealth are factors to be considered when comparing obesity in rural and urban areas [10]. Even within rural areas, there is difference. On the one hand, rural areas residents can have low BMI due to unavailable food or more prevalent physical jobs compared to urban areas but on the other hand, obesity could also occur due to consumption of high caloric, cheap, unhealthy food [9]. Breast cancer prevalence is rising and affecting younger age [11].

Among the well-known risk factors of breast cancer, obesity is a factor that can be modified by lifestyle [6].

Egypt is ranked among the highest globally in obesity problem [12]. Though obesity problem has health and financial consequences, few studies have been published addressing the burden of disease in Egypt [13].

Body surface area (BSA) is another measure used widely in clinical practice, particularly in calculating doses of chemotherapeutic agents [14]. Though there are obvious and recorded limitations in the use of BSA for drug dose measurement, still, it is the most accepted method. There are many BSA calculating formulas among which the most used are the Mosteller and the Du Bois & Du Bois formulas [15]. Understanding the actual BSA of patients has a very important economic aspect as the cost of the treatment should be measured accurately according to surface area of the patients [16]. Both Body Surface Area (BSA) and Body Mass Index (BMI) rely on weight and height and can be used as indicators of obesity [17] [18] [19].

The research questions are: As indicators of obesity, what is the BMI, BSA of Egyptian breast cancer patients? Could obesity be associated with aggressive tumor characteristics or different tumor subtype? Is obesity (indicated by BMI/BSA) predictive of poor prognostic tumor characteristics?

2. Patients and Methods

This is a cross-sectional observational study that was carried out in the department of clinical oncology, Faculty of medicine, Ain Shams University Hospitals. Medical records of patients scheduled for adjuvant chemotherapy were revised regarding age, comorbidity, side of the tumor, stage, and type of the surgery performed. Immunohistochemistry (IHC) to detect ER, PR, and Her2 and molecular subtypes of the tumors were defined. Asper the St Gallen guidelines [11], molecular subtypes were defined as: **HR+**: those with ER+ A/ORPR+, Her2− tumors, **HR+/Her2+**: those with ER+ A/ORPR+, Her2+ tumors, **Her+**: ER−, PR−, Her2+ tumors and those with **TN**: ER−, PR−, Her2−.

BMI was calculated by the formula of weight (kg)/height^2 (m^2) and then stratified accordingly into those with BMI below 30 kg/m^2 (including UW, NW, and overweight) and obese patients (BMI ≥ 30) according to WHO classification [20]. Body surface area of the patients was retrieved regarding values that were reported into data sheets and analyzed. The formula used for BSA calculation was the Mosteller formula as per the guidelines of the chemotherapy clinic [15].

Inclusion criteria: Female patients with newly diagnosed breast cancer, cases that didn't start the adjuvant treatment, data for IHC available, weight, and height of the patients recorded in the files.

Exclusion criteria: Male breast cancer cases, bilateral cases, metastatic cases, age above 80 years, cases with multiple primaries.

3. Statistical Methods

Statistical analysis was done using Data were analyzed using the MedCalc® Sta-

tistical Software version 20 (MedCalc Software Ltd, Ostend, Belgium; https://www.medcalc.org; 2021). Continuous numerical variables are presented as mean and standard deviation and between-group differences are compared with one-way analysis of variance (ANOVA). Categorical variables are presented as counts and percentage. Receiver-operating characteristic (ROC) curve analysis is used to examine the discriminative value of continuous variables. The area under the ROC curve (AUC) is interpreted as follows: AUC < 0.6 = fail, 0.6 to 0.69 = poor, 0.7 to 0.79 = fair, 0.8 to 0.89 = good, ≥0.9 = excellent. P value < 0.05 is considered statistically significant.

4. Results

This is a cross sectional study for nonmetastatic patients with cancer breast in the period between January 2017 and December 2017 in the department of clinical oncology faculty of medicine, Ain Shams University Hospitals. Retrieving data from the files revealed that 115 patients met the inclusion criteria.

4.1. Clinical and Epidemiologic Parameters of Patients

The mean age of patients was 48 ± 11 years and 60% of them were premenopausal. The mean weight in Kgs was 81 ± 13 and the mean height in cm was 156 ± 5. Calculating BMI, the studied group of patients had mean of 33.8 ± 6.0. Mean BSA was calculated to be 1.84 ± 0.15. Comorbidities were present in 10.6% of patients. In the studied group of patients, tumors were more common of right side (55.7%), T2 tumor (40%), N1 (40.9%), and stage III in 57.4%. Regarding the hormonal receptor status, most of the patients were ER+ (76.5%), PR+ (66.1%) and Her2− (73.9%). The molecular subtypes were also estimated with HR+ subtype most common in (60%) and Her2+ subtype least common in (10.4%). Characteristics of the study population are shown in Table 1.

4.2. Mean BMI and BSA and Their Relation to Clinicopathologic Features

Mean BMI and BSA as defined per different variable were always of value more than 33 Kg/m^2 for BMI and 1.8 for BSA (Table 2).

Then BMI was set for a cut off value of 30 kg/m^2 and BSA was set at a cut off value of 1.85. Neither BMI nor BSA was different based on menopausal status. Tumor characteristics were compared in relation to BMI and BSA, and none of the studied parameters regarding menopausal status, T staging, N staging, TNM staging, ER, PR, Her2 and molecular subtype were significantly associated with BMI or BSA (Table 2 and Table 3).

4.3. Predictive Value of BMI and BSA for Poor Prognostic Variables

Receiver operating characteristic (ROC) curve was done for the poor prognostic variables; namely: T3/4, N2/3, stage III, Her2+ subtype, and TN subtype. Analysis for predictive value of BMI or BSA Table 4, Figures 1-4 shows that both BMI

Table 1. Characteristics of the study population.

Variable		Value
Age (years), mean ± SD (range)		48 ± 11 (24 to 73)
Menopausal status	Premenopausal	69 (60.0%)
	Postmenopausal	46 (40.0%)
Weight (kg), mean ± SD (range)		81 ± 13 (50 to 99)
Height (cm), mean ± SD (range)		156 ± 5 (145 to 170)
BMI (kg/m^2), mean ± SD (range)		33.8 ± 6.0 (19.5 to 44.0)
BMI, n (%)	≤30 kg/m^2	31 (27.0%)
	>30 kg/m^2	84 (73.0%)
BSA (m^2), mean ± SD (range)		1.84 ± 0.15 (1.40 to 2.00)
BSA, n (%)	≤1.6 m^2	16 (13.9%)
	>1.6 m^2	99 (86.1%)
BSA, n (%)	≤1.85 m^2	48 (41.7%)
	>1.85 m^2	67 (58.3%)
Comorbidities, n (%)	No comorbidity	101 (89.4%)
	Comorbidity	12 (10.6%)
Side, n (%)	Left side	51 (44.3%)
	Right side	64 (55.7%)
Surgery, n (%)	NA	15 (13.0%)
	MRM	54 (47.0%)
	BCS	46 (40.0%)
T stage, n (%)	T1/T2	70 (60.9%)
	T3/T4	45 (39.1%)
N stage, n (%)	N0/N1	70 (60.9%)
	N2/N3	45 (39.1%)
TNM stage, n (%)	Stage I/II	49 (42.6%)
	Stage III	66 (57.4%)
ER, n (%)	ER−	27 (23.5%)
	ER+	88 (76.5%)
PR, n (%)	PR−	39 (33.9%)
	PR+	76 (66.1%)
HER2, n (%)	HER2−	85 (73.9%)
	HER2+	30 (26.1%)
Molecular subtype, n (%)	HR+	69 (60.0%)
	HR+/HER2−	18 (15.7%)
	HER2+	12 (10.4%)
	TN	16 (13.9%)

BMI: Body mass index, BSA: Body surface area, NA: not available, MRM: Modified radical mastectomy, BCS: breast conservative surgery, ER: Estrogen receptor, PR: progesterone receptor, Her2: Human epidermal growth factor receptor, HR+: hormonal receptor positive tumor, HR+/HER−: Hormonal receptor positive her-subtype, HER+: Her2 over-expressed subtype, TN: triple negative subtype.

Table 2. Relation between body mass index (BMI) or body surface area (BSA) and various tumor characteristics.

Variable		BMI (kg/m²)				BSA (m²)		
		Count	Mean	SD	P-value†	Mean	SD	P-value†
Menopausal	**Premenopausal**	**69**	**33.99**	**6.35**	**0.608**	**1.85**	**0.17**	**0.820**
	Postmenopausal	**46**	**33.42**	**5.43**		**1.84**	**0.12**	
T staging	T1	24	33.1	6.0	0.705	1.84	0.15	0.581
	T2	46	34.2	5.8		1.85	0.15	
	T3	39	33.3	6.6		1.83	0.17	
	T4	6	35.9	2.8		1.92	0.08	
T stage	T1/T2	70	33.8	5.8	0.911	1.85	0.15	0.767
	T3/T4	45	33.7	6.3		1.84	0.16	
N stage	N0/N1	70	34.0	6.1	0.586	1.86	0.15	0.121
	N2/N3	45	33.4	5.9		1.82	0.16	
Tumor stage	Stage I/II	49	33.1	6.2	0.347	1.83	0.16	0.464
	Stage III	66	34.2	5.8		1.85	0.15	
ER	ER−	27	34.2	5.7	0.694	1.86	0.15	0.549
	ER+	88	33.6	6.1		1.84	0.15	
PR	PR−	39	33.7	5.5	0.920	1.84	0.16	0.936
	PR+	76	33.8	6.2		1.85	0.15	
HER2	HER2−	85	33.7	6.3	0.762	1.85	0.15	0.441
	HER2+	30	34.0	5.1		1.83	0.15	
Molecular subtype	HR+	69	33.7	6.4	0.841	1.85	0.15	0.841
	HR+/HER2−	18	33.3	4.8		1.82	0.16	
	HER2+	12	35.2	5.4		1.84	0.14	
	TN	16	33.6	5.8		1.86	0.15	

†One-way analysis of variance (ANOVA) SD = Standard deviation.

and BSA were poorly predictive for any of the prognostic tumor characteristics regarding T stage, N stage, Her2 overexpression and TN disease.

5. Discussion

Little is known about the average BSA or BMI of the Egyptian females in view of the prevalent obesity among them. This cross-sectional study of nonmetastatic patients with cancer breast was carried out in the department of clinical oncology faculty of medicine, Ain Shams University Hospitals to measure the BMI and BSA of this group of patients and to detect whether BMI/BSA representing obesity are predictive of more aggressive tumor behavior and less favorable molecular subtype. Retrieving data from the files revealed that 115 patients met the inclusion criteria.

Table 3. Relation between high body mass index (BMI) or high body surface area (BSA) and various tumor characteristics.

Variable		BMI		P-value†	BSA		P-value†
		≤30 kg/m²	>30 kg/m²		≤1.85 m²	>1.85 m²	
		N = 31 (%)	N = 84 (%)		N (%)	N (%)	
Menopausel status	Premenopausal	18 (58.1%)	51 (60.7%)	0.799	26 (54.2%)	43 (64.2%)	0.284
	Postmenopausal	13 (41.9%)	33 (39.3%)		22 (45.8%)	24 (35.8%)	
T staging	T1	5 (16.1%)	19 (22.6%)	0.857‡	12 (25%)	12 (17.9%)	0.236‡
	T2	13 (41.9%)	33 (39.3%)		19 (39.6%)	27 (40.3%)	
	T3	13 (41.9%)	26 (31%)		16 (33.3%)	23 (34.3%)	
	T4	0 (0%)	6 (7.1%)		1 (2.1%)	5 (7.5%)	
Stage T3/T4	T1/T2	18 (58.1%)	52 (61.9%)	0.708	31 (64.6%)	39 (58.2%)	0.490
	T3/T4	13 (41.9%)	32 (38.1%)		17 (35.4%)	28 (41.8%)	
N stage	N0	6 (19.4%)	17 (20.2%)	0.692‡	11 (22.9%)	12 (17.9%)	0.272‡
	N1	12 (38.7%)	35 (41.7%)		13 (27.1%)	34 (50.7%)	
	N2	10 (32.3%)	26 (31%)		19 (39.6%)	17 (25.4%)	
	N3	3 (9.7%)	6 (7.1%)		5 (10.4%)	4 (6%)	
Stage N2/N3 Tumor staging	N0/N1	18 (58.1%)	52 (61.9%)	0.708	24 (50%)	46 (68.7%)	0.043
	N2/N3	13 (41.9%)	32 (38.1%)		24 (50%)	21 (31.3%)	
	Stage I	0 (0%)	6 (7.1%)		1 (2.1%)	5 (7.5%)	
	Stage II	16 (51.6%)	27 (32.1%)	0.68‡	22 (45.8%)	21 (31.3%)	0.741‡
	Stage III	15 (48.4%)	51 (60.7%)		25 (52.1%)	41 (61.2%)	
Tumor stage I, II/III	Stage I/II	16 (51.6%)	33 (39.3%)	0.236	23 (47.9%)	26 (38.8%)	0.330
	Stage III	15 (48.4%)	51 (60.7%)		25 (52.1%)	41 (61.2%)	
ER	ER−	8 (25.8%)	19 (22.6%)	0.72	11 (22.9%)	16 (23.9%)	0.904
	ER+	23 (74.2%)	65 (77.4%)		37 (77.1%)	51 (76.1%)	
PR	PR−	11 (35.5%)	28 (33.3%)	0.829	19 (39.6%)	20 (29.9%)	0.277
	PR+	20 (64.5%)	56 (66.7%)		29 (60.4%)	47 (70.1%)	
HER2	HER2−	24 (77.4%)	61 (72.6%)	0.603	33 (68.8%)	52 (77.6%)	0.286
	HER2+	7 (22.6%)	23 (27.4%)		15 (31.3%)	15 (22.4%)	
Molecular subtype	HR+	19 (61.3%)	50 (59.5%)	0.888‡	26 (54.2%)	43 (64.2%)	0.448‡
	HR+/HER2+	4 (12.9%)	14 (16.7%)		9 (18.8%)	9 (13.4%)	
	HER2+	3 (9.7%)	9 (10.7%)		6 (12.5%)	6 (9%)	
	TN	5 (16.1%)	11 (13.1%)		7 (14.6%)	9 (13.4%)	

†Pearson Chi-squared test unless otherwise indicated; ‡Chi-squared test for trend; N (%) = Number (column percentage).

Table 4. Receiver operating characteristic (ROC) curve analysis for predictive value of BMI or BSA.

	BMI				BSA			
Outcome	T3/4	N2/3	Stage III	HER2+/TN	T3/4	N2/3	Stage III	HER2+/TN
AUC	0.50	0.53	0.54	0.53	0.50	0.59	0.53	0.51
SE	0.05	0.05	0.05	0.06	0.05	0.05	0.05	0.06
95% CI	0.40 - 0.59	0.44 - 0.63	0.452 - 0.64	0.43 - 0.62	0.41 - 0.60	0.49 - 0.68	0.43 - 0.62	0.41 - 0.60
P-value[†]	0.97	0.50	0.39	0.61	0.91	0.09	0.53	0.87

[†]DeLong method, 95% CI = 95% confidence interval, AUC = area under ROC curve, SE = standard error.

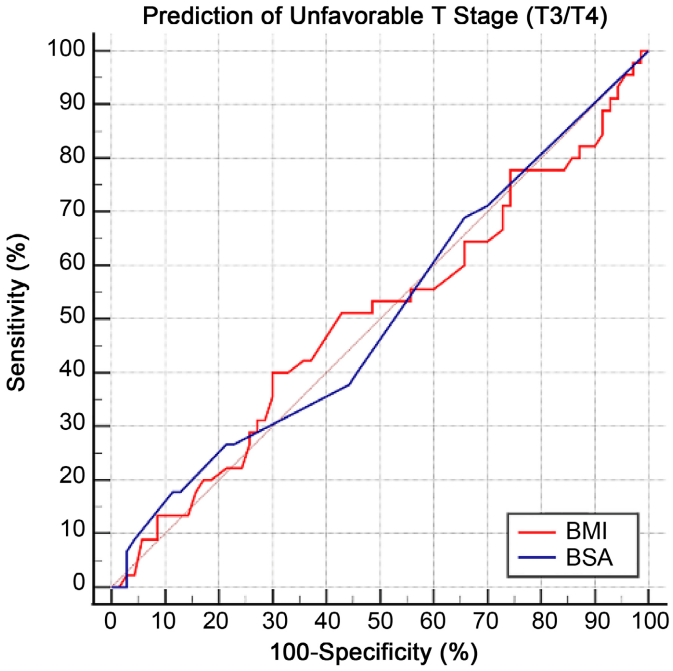

Figure 1. Receiver operating characteristic (ROC) curve for value of BMI or BSA for prediction of unfavorable T stage (T3/4) using BMI or BSA. Both variables had poor predictive value (AUC, 0.502; 95% CI = 0.407 to 0.597 and AUC, 0.506; 95% CI = 0.411 to 0.601, respectively).

5.1. BMI and BSA of the Egyptian Patients with Cancer Breast Is Higher

The mean BMI ± SD of patients in the current study was 33.8 ± 6.0. This means BMI is higher than the average recorded by the WHO for Egyptian female which is 30.7 kg/m^2 [21]. Hajian-Tilak *et al.* 2011 in a study on Iranian women reported a mean difference in BMI between breast cancer patients and normal controls of 4.6 kg/m^2 [22].

The figure of mean BMI recorded in the current study is higher than that recorded by Loi *et al.*, 2005, [23] which was (24.5 kg/m^2) in a study from Australia, and that reported by Ewertz *et al.* 2012, [24] in an analysis of the Breast International Group (BIG) 1 - 98 trial in which BMI had a mean of = 26.8 kg/m^2 ± 5.1 SD.

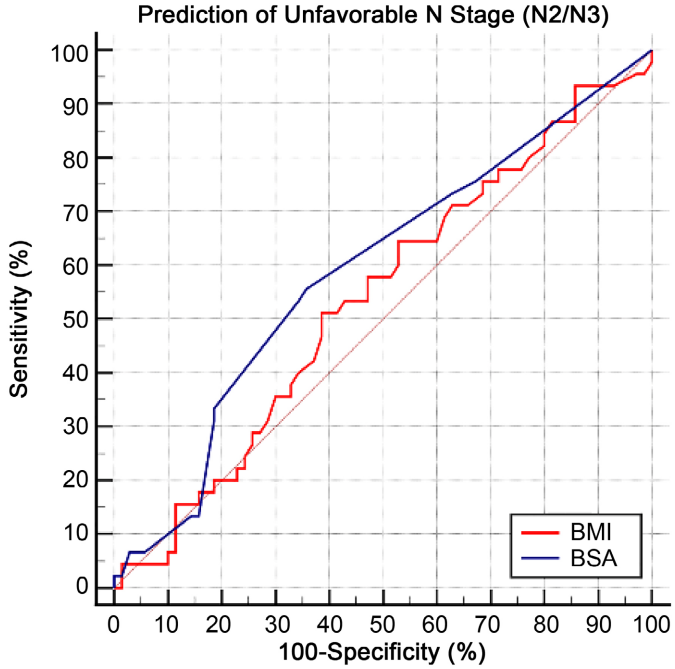

Figure 2. Receiver operating characteristic (ROC) curve for value of BMI or BSA for prediction of unfavorable N stage (N2/3) using BMI or BSA. Both variables had poor predictive value (AUC, 0.537; 95% CI = 0.441 to 0.630 and AUC, 0.591; 95% CI = 0.495 to 0.682, respectively).

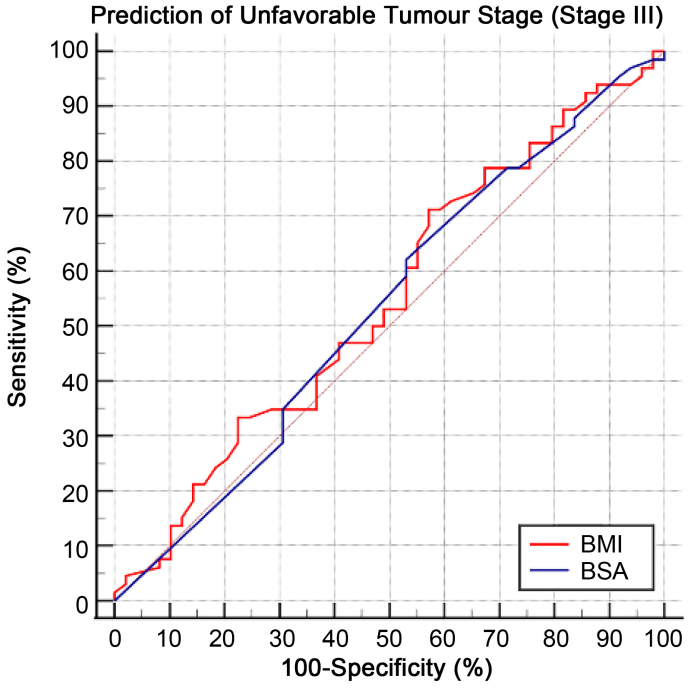

Figure 3. Receiver operating characteristic (ROC) curve for value of BMI or BSA for prediction of unfavorable tumor stage (Stage III) using BMI or BSA. Both variables had poor predictive value (AUC, 0.547; 95% CI = 0.441 to 0.630 and AUC, 0.534; 95% CI = 0.438 to 0.627, respectively).

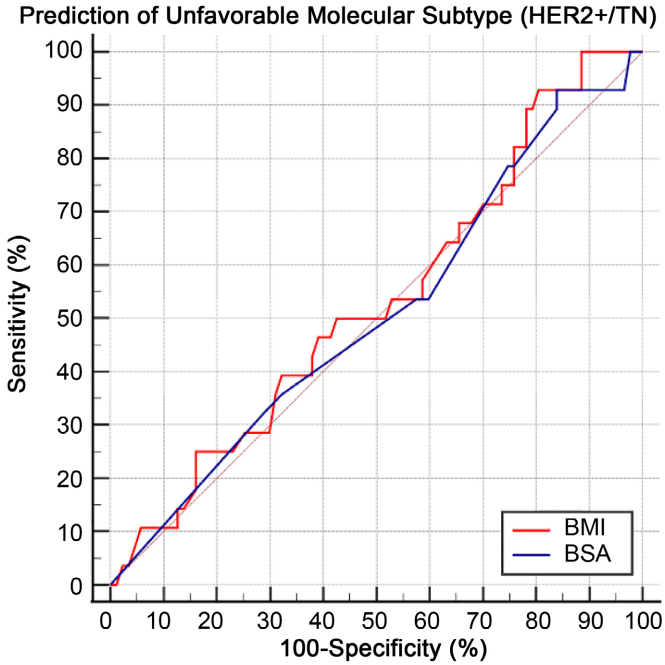

Figure 4. Receiver operating characteristic (ROC) curve for value of BMI or BSA for prediction of unfavorable molecular subtype (HER2+/TN) using BMI or BSA. Both variables had poor predictive value (AUC, 0.532; 95% CI = 0.452 to 0.640 and AUC, 0.534; 95% CI = 0.415 to 0.604, respectively).

The mean age of patients was 48 years, and majority of them (73%) were obese (BMI ≥ 30 kg/m^2) Shaaban *et al*. 2020 [25] in a multicenter trial from Egypt for a similar group of patients reported on mean age of 51.1 years and 60.5% with BMI ≥ 30 kg/m^2 [25]. Bouguerra *et al*. reported in a study on 262 Tunisian breast cancer patients that the mean age was 50.9 (±11.9) and 63.3% were with BMI ≥ 30 kg/m^2 [6]. Other studies reported a significantly less proportion of obese patients.

Kann *et al*., 2014 in a study from Switzerland reported a BMI of ≥ 30 kg/m^2 in 17% of patients [2]. Loi *et al*. 2005, reported on obese patients percentage of 12% [23], Lee *et al*. [26] in a study from Korea, reported on 4.3% obese patients and Ewertz *et al*. reported 23% obese patients (BMI ≥ 30 kg/m^2).

Mean body surface area (BSA) also was high as the mean BSA was 1.85 m^2. This study to the best of our knowledge is the first to address BSA in Egyptian breast cancer patients. Sacco *et al*. 2010, in a study from England reported on BSA mean of 1.74 m^2 for breast cancer patients [16]. Dooley *et al*. in an Australian study, of 2838 chemotherapy scheduled patients reported mean surface area of 1.70 m^2 in female patients [27].

Sixty percent of the whole group were premenopausal. In the current study, 51/69 (74%) of premenopausal patients and 33/46 (72%) of postmenopausal patients were obese in terms of BMI ≥ 30 kg/m^2 representing around 3/4 of the whole group of patients to be obese regardless of menopausal status.

The mean BSA in premenopausal patients was 1.85 m^2 this could indicate the magnitude of the problem of obesity in younger age in Egyptian patients.

Unlike our results, Shabaan *et al*. [25] and Bouguerra *et al*. [6] reported on overweight and obesity to be more prevalent in postmenopausal patients. Still these figures coming from Egypt and Tunisia are higher than the reported from China where Wang *et al*. [7], reported on 23.8%, and 33.1% of premenopausal and postmenopausal respectively to be overweight and obese (BMI ≥ 25).

Rudat *et al*. 2013, in a multi-institutional study from Saudi Arabia reported on BMI to be lower in postmenopausal breast cancer patients compared to control individuals [28].

5.2. Is High BMI Associated with Poorpathological Prognostic Features?

In the current study Tumor characteristics were compared in relation to BMI and BSA. There was a tendency of the poor pathologic features to be associated with high BMI and BSA, yet none of the correlations was of statistical significance. Patients with tumors 5 cm or larger (T3, 4), more than three involved LNs (N2, N3), and stage III disease were of high BMI (32/45) 71%, (32/49) 65% and (51/66) 77% respectively. The link between BMI and histopathological criteria was addressed in many African studies [6] [25] [29] [30]. Other studies [25] [31] [32] [33] [34] reported also on positive correlation between obesity and tumor size and high grade.

Wang *et al*. 2020, reported that obese patients were more likely to have lymph node metastases compared with non-obese patients in a retrospective review of 1352 breast cancer patients [7]. This point of view of association between obesity and increased number of involved axillary nodes was supported by others [35] [36]. On the other hand, nonstatistically significant association between BMI and number of involved axillary lymph node was also reported in many studies [6] [37] [38].

Association with larger tumor size and advancing grade of the tumor was also reported [2] [6] [38] [39] [40] [41].

In the current study no specific poor prognostic criterion was associated with menopausal status in obese patients. Wang *et al*. 2019 in a report from China reported that postmenopausal patients had less favorable tumor characteristics in form of more lymphovascular invasion and axillary lymph node metastasis [7].

5.3. Is Obesity Associated with Specific Molecular Subtype

Obesity was associated with less HR and HER2 positivity, so 8/27 were ER+, 10/30 PR+, and 7/30 were Her2+ but none reached statistical significance. Molecular subtypes of HR−/HER+ and TN were (9/12) and (11/16) respectively. similar to our results, Zhu *et al*. 2005, reported high BMI associated with ER− and TN disease [42]. Gierach *et al*., 2010, reported that high BMI was associated with less Her2 expression irrespective of ER status [43].

In the current study, molecular subtype was not affected by menopausal status in obese patients. Many studies reported that obese premenopausal tended to have hormonal receptor negative tumors and triple negative disease [7] [44] [45] [46] [47], and postmenopausal tended to have HR+ disease [2] [6] [47] [48] [49] [50].

5.4. Is Obesity Predictive of Poor Prognostic Features

The whole group of patients was obese. Trying to investigate the role of BMI and BSA as tools for predicting unfavorable characteristics of the tumor, ROC was done with AUC set to estimate whether obesity would predict the tumor being of poor prognostic feature or not. It was found that both BMI and BSA had poor predictive value in such matter. Bouguerra *et al*. reported on high sensitivity of BMI on the prediction of high grade tumors but not specific tumor subtype. Hajian-Tilak *et al*. 2011, in their study, ROC curves were able to predict cancer risk (AUC = 0.79) in both pre and postmenopausal females. But ROC was able to predict cancer risk in high BMI more than normal BMI patients. It was concluded that BMI had a predictive ability for breast cancer risk in both pre- and post-menopausal women [22].

6. Conclusion

Obesity is a major health problem among breast cancer patients in Egypt. Both BSA and BMI (as indicators of obesity) in Egyptian breast cancer patients are higher compared to other parts of the world. Both BMI and BSA were poorly predictive of prognostic parameters in breast cancer patients. Body surface area is a medical tool that can't be overlooked. Similar studies addressing each cancer category, gender and age groups are needed to develop national guidelines for cancer therapy dosing and screening programs. Other parameters for obesity as fat distribution, waist circumference, lipid profile should be included in further studies.

7. Limitations

Retrospective nature of the study, incomplete data and small sample size are important limitation.

Ethical Considerations

Ethical review and approval were obtained for the current study.

Conflicts of Interest

Authors declare no conflict of interest.

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