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Epidemiological Trends and Molecular Characterization of Breast Carcinoma in Erbil, Kurdistan Region of Iraq

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***Abstract*—Accumulated evidence suggests a tangible increase in breast cancer (BC) patients in the Kurdistan region of Iraq, yet data on their histological and molecular subtypes remain limited. This study aims to assess the prevalence, histopathologic features, and molecular profiles of BC incidences in Erbil. For this purpose, 261 clinical records of histologically confirmed BC cases from Rizgary Teaching Hospital are analyzed. Results reveal that invasive ductal carcinoma (IDC) emerged as the most frequent histological subtype. In terms of hormonal receptor status, mastectomy patients who tested positive for estrogen receptor (ER), progesterone receptor (PR), and human epidermal growth factor receptor 2 (HER2) are 52.49%, 50.57%, and 18.01%, respectively, and the corresponding figures for Tru-Cut biopsy (TCB) patients are 24.90% for both ER and PR and 6.13% for HER2. Regarding tumor grading, mastectomy patients aged 51–60 have the highest grade II frequency, and TCB patients under 40 years and those between 41 and 50 years show the highest occurrence of the same grade. Moreover, tumor stages II and III made up nearly two-thirds of all cases across all age groups. For the molecular subtypes, luminal A is the most prevalent in both mastectomy and TCB patients. In conclusion, IDC is the predominant BC subtype in the region, with a higher prevalence of ER and PR positivity compared to HER2. Luminal A is the dominant molecular subtype. While stages II and III are common across all ages, tumors of grade II and stage II are frequently observed in older ages.**

***Index Terms*—Breast cancer, Mastectomy, Tru-Cut biopsy, Invasive ductal carcinoma, Estrogen receptor, Progesterone receptor, Human epidermal growth factor receptor.**

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I. Introduction

Breast cancer (BC) has a great burden on the public health sector worldwide (Wang, et al., 2016) for being a heterogeneous pathological condition and the most frequent type of cancer in females, with estimated new cases of 31% and estimated deaths of 15% out of all cancer types (Wang, et al., 2019; Siegel, et al., 2023). BC is most common in high-income countries in comparison with lower-income countries (Hu, et al., 2019), and there is a positive correlation between BC progression and the self-awareness of affected individuals (Gubari, et al., 2017). Furthermore, the sociodemographic index of countries may act as a reliable indicator for the prevention and development of cost-effective diagnosis for BC in a positive manner (Hu, et al., 2019).

The emergence of BC has been found to be associated with various risk factors. BC is more common among older females and those who have a family history of breast or ovarian cancer and individuals with genetic mutations such as BRCA2/BRCA1. Rates of BC also fluctuate among different race/ethnic groups, as it has been reported more frequently among white women than others. Women who give more births and breastfeed their children show fewer incidences of BC. The density of breast tissue is implicated in this context, as increased density correlates positively with BC development. Moreover, abnormal menstrual periods and menopause may also contribute to BC development (Weigelt, et al., 2008; Erber and Hartmann, 2020; Prat and Perou, 2011; Herschkowitz, et al., 2007; Plasilova, et al., 2016).

At the cellular level, BC is due to an uncontrollable proliferation of lining epithelial cells of the ducts or lobules of the breast, especially at the terminal duct lobular unit. Due to that, BCs in general are classified either as ductal or lobular carcinomas (Kasper and Harrison, 2005; Makki, 2015). And these two types of carcinoma could be subdivided, according to their tendency toward metastasis, into non-invasive and

invasive. The first one includes ductal carcinoma *in situ* and lobular carcinoma *in situ* (Buerger, 2000).

According to the World Health Organization, as reported by Tan et al. (2020), BC can be classified as follows: Epithelial, mesenchymal, and fibroepithelial tumors, tumors of the nipple, malignant lymphoma, and metastatic tumors. The epithelial tumor, which is the main derived source of BC, is also subdivided into: Invasive breast carcinoma, epithelial-myoepithelial tumors, precursor lesions, intraductal proliferative lesions, papillary lesions, and benign epithelial proliferations (Tan, et al., 2020).

Invasive breast carcinoma, which reflects 23% of all diagnosed cancers in women, encompasses the following subtypes: Invasive carcinoma of no special type (NST), formerly known as invasive ductal carcinoma (IDC), invasive lobular carcinoma (ILC), tubular carcinoma, cribriform carcinoma, mucinous carcinoma, carcinoma with medullary features, carcinoma with apocrine differentiation, carcinoma with signet-ring-cell differentiation, invasive micropapillary carcinoma, inflammatory BC, metaplastic carcinoma of NST, mixed metaplastic carcinoma, myoepithelial carcinoma, and other rear types (Anderson, et al., 2006; Tan, et al., 2020; Łukasiewicz, et al., 2021).

Invasive BC can also be classified according to their molecular markers into several subtypes, including luminal A and B, human epidermal growth factor receptor 2 (HER2)-enriched, basal-like, and normal breast-like. In 2007, the claudin-low BC sub-type was discovered in an integrated analysis of human and rodent mammary tumors. Basal-Like/ Triple-Negative BC (TNBC): TNBC is a heterogeneous collection of BCs characterized by estrogen receptor (ER) (estrogen)-negative, Progesterone receptor (PR) (progesterone)-negative, and HER2-negative cancer cells (Weigelt, et al., 2008; Łukasiewicz, et al., 2021). TNBC is found to be associated with 10 to 20% of all invasive BCs and is commonly found in the African-American ethic group, younger females, and higher tumor grade, and usually spotted at advanced stages (Kumar and Aggarwal, 2015).

BC has significantly increased in Iraq over the past decades (Al-Hashimi, 2021), and the Kurdistan Region, like other parts of the world, has also experienced a tangible rise in this pathological condition (Majid, et al., 2009; Khoshnaw, Mohammed and Abdullah, 2016; Mutar, et al., 2019). According to previous studies, BC in the abovementioned region is mainly detected in premenopausal women with multiple pregnancies, unlike in western countries where the incidence of BC is more common among younger individuals (Majid, et al., 2009; Molah Karim, et al., 2015).

In spite of the above-mentioned facts about BC in the Kurdistan Region of Iraq, and due to limitations of previous studies in regard to sample size, there is insufficient information in regard to tumor classification and their prevalence. In this study, we aimed to uncover the status of BC in the Erbil governorate by identifying and assessing their dominant histological and molecular subtypes, especially ER, PR, and HER2.

II. Materials and Methods

A. Data Collection

This study provides a retrospective analysis of the records of 261 patients who have been diagnosed with BC, confirmed through histological examination by the histopathologist at the Laboratory Department of Rizgary Teaching Hospital in Erbil, covering the period from January 2016 to December 2021. All BC cases that underwent immunohistochemistry investigations within the specified timeframe were included, while records of repeated BC specimens were deliberately excluded. The Hawler Medical Research Center at Halwer Medical University provided the necessary ethical approval for the carrying out of this study.

B. Histopathological Profile of the Cases

Histopathological profiles, including tumor stage, grades, and histopathological types, were recorded by the pathologists at the Laboratory Department of Rizgary Teaching Hospital based on Pragya and Jorns's (2023) guidelines. Histologic grading is a key method used to evaluate the prognosis and behavior of tumors in invasive BC, helping to identify patients at risk of adverse outcomes and identify candidates for appropriate therapies (Van Dooijeweert, Van Diest and Ellis, 2022).

C. Immuno-Histochemical and Molecular Subtypes Study

The immunohistochemistry was routinely used for the detection of ER, PR, and HER2 using the EnVision FLEX+ kit by Agilent Dako, USA (Product No. K8002) by the technicians of the Histopathology Laboratory. Molecular subtype categorization was evaluated based on immunohistochemistry surrogates for ER, PR, and HER2 status, and the criteria were as shown in Table I.

III. Results and Discussion

A. Results

Two hundred sixty-one females with BC enrolled in this study, with ages ranging from 25 to 84 years. The mean age of the mastectomy patient group was 50.74 years, whereas the Tru-Cut biopsy (TCB) patient group had a mean age of 46.65 years (Fig. 1a). IDC had the greatest occurrence of BC subtypes, followed by ILC (Fig. 1b).

The number and percentage of patients who tested positive for ER, PR, and HER in the group of patients undergoing mastectomy were 137 (52.49%), 135 (50.57%), and 47 (18.01%), respectively. In the group of patients undergoing TCB, the number and percentage of positive cases were 65 (24.90%), 65 (24.90%), and 16 (6.13%).

In regard to triple-negative cases (TNBC), our data indicates that 13.41% of all patients are diagnosed with this condition (35 out of 261). While it was primarily associated with the IDC (85.71%) BC subtype, it was not that common among the ILC (2.86%) BC sub-type (Fig. 2a and b).

The majority of tumors in the patient groups undergoing mastectomy and TCB belonged to Grade II, accounting

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for 122 (46.74%) and 60 (22.99%), followed by Grade III, accounting for 53 (20.31%) and 20 (7.66%), and Grade I, accounting for 4 (1.53%) and 2 (0.77%), in that order.

When it came to the evaluation of molecular subtypes, the luminal A molecular type scored highest at 115 (44.06%) and 54 (20.69%) in the patient groups undergoing mastectomy and TCB, while the luminal B molecular type scored lowest at 64 (24.52%) and 28 (10.13%), respectively. Histological tumor stages with the highest frequencies were stage II 114 (43.68%) and stage III 44 (16.86%), followed by stage I 18 (6.89%) and stage IV 3 (1.15%) (Table II).

The age-specific distribution of tumor grades in the mastectomy patient population revealed that patients aged 41–50 and 51–60 years had the highest prevalence of grade II. However, patients aged ≤40 and 41–50 years had the highest occurrence of grade III. In the patient group undergoing a TCB, patients under 40 years and aged 41–50 had the highest occurrence of grade II. Conversely, individuals in the age groups of ≤40 and 51–60 years had the highest occurrence of grade III (Table III).

Table IV displays the pathologic stage distribution of patients having mastectomy. Stage II had the highest occurrence of cases (63.69%) and was more common in patient groups aged ≤40 and 41–50 years. Stage III had the second-highest incidence (24.58%), with the highest frequency in age groups 41–50 and 51–60. There was a greater incidence in age groups ≤40 and 41–50, with stage I and stage IV percentage distributions of 10.05% and 1.68%, respectively.

B. Discussion

While some studies have evaluated the histological subtypes of BC in the Kurdistan Region of Iraq, there are limited ones that focus on the molecular subtypes of this pathological condition (Molah Karim, et al., 2015; Khoshnaw, Mohammed and Abdullah, 2016; Mutar, et al., 2019). This is largely due to the fact that the majority of them either did not cover this angle or simply encompassed limited population sizes. In this study, we tried to fill this gap by uncovering predominant molecular BC subtypes and including more cases over a longer period of time.

A major contributing risk factor to BC development is age (Siegel, Miller and Jemal, 2018). The average age of BC

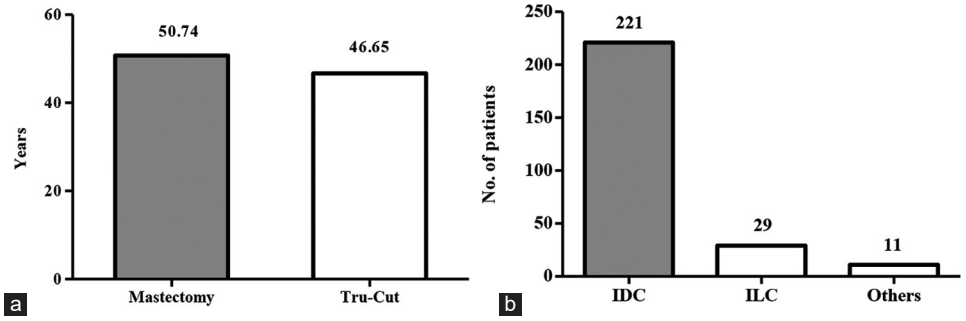

Fig. 1. Age and occurrence of patients, (a) the average age of breast cancer patients. (b) the distribution of breast cancer subtypes.

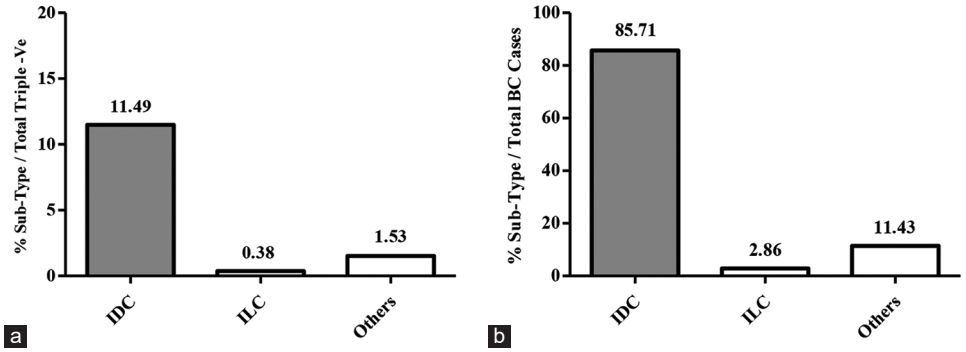

Fig. 2. The prevalence of triple-negative cases distributed over BC sub-types. (a) The percentage of each common sub-types over the total triple-negative cases (n = 35). (b) The percentage of each common sub-types over the total BC cases (n = 261).

TABLE I
Molecular Subtypes of Breast Cancer Profile*

Immuno-profile	Luminal A	Luminal B	HER2+ (Enriched)	Basal-Like
ER, PR	ER+, and PR high+	ER+, PR- low or intermediate+	ER-, PR-	ER-, PR-
HER2	HER2-	HER2+or HER2-	HER2+	HER2-
Others	Low Ki67 (<14%)	Ki67 (≥14)		CK5/6 and/or EGFR+

*This table was cited by Coates et al. (2015). ER: Estrogen receptor, PR: Progesterone receptor, HER2: Human epidermal growth factor receptor 2

TABLE II
DISTRIBUTION OF BREAST CANCER PATIENTS ACCORDING TO PATHOLOGICAL CHARACTERISTICS

Mastectomy	2016	2017	2018	2019	2020		2021			Total No. (%)
	14 IDC Patient No. (%)	33 IDC Patients No. (%)	14 IDC Patient No. (%)	28 IDC Patients No. (%)	8 IDC Patients No. (%)	15 ILC Patients No. (%)	53 IDC Patients No. (%)	3 ILC Patients No. (%)	11 other types No. (%)	
ER										
N	3 (12)	6 (15.38)	5 (27.78)	4 (11.429)	1 (3.125)	0	19 (16.964)	1 (0.893)	3 (2.679)	42 (16.09)
P	11 (44)	27 (69.23)	9 (50)	24 (68.571)	7 (21.875)	15 (46.875)	34 (30.357)	2 (1.786)	8 (7.143)	137 (52.49)
PR										
N	4 (16)	6 (15.38)	5 (27.78)	4 (11.429)	1 (3.125)	1 (3.125)	19 (16.964)	1 (0.893)	3 (2.679)	44 (16.86)
P	10 (40)	27 (69.23)	9 (50)	24 (68.571)	7 (21.875)	14 (43.75)	34 (30.357)	2 (1.786)	8 (7.143)	135 (50.57)
HER										
N	9 (36)	21 (53.85)	12 (66.67)	19 (54.286)	8 (25)	14 (43.75)	38 (33.929)	3 (2.679)	8 (7.143)	132 (50.57)
P	5 (20)	12 (30.77)	2 (11.11)	9 (25.714)	0	1 (3.125)	15 (13.393)	0	3 (2.679)	47 (18.01)
Grade										
I	0	0	0	0	1 (3.125)	0	2 (1.786)	0	1 (0.893)	4 (1.53)
II	10 (40)	23 (58.97)	11 (61.11)	19 (54.286)	5 (15.625)	14 (43.75)	33 (29.464)	2 (1.786)	5 (4.464)	122 (46.74)
III	4 (16)	10 (25.64)	3 (16.67)	9 (25.714)	2 (6.25)	1 (3.125)	18 (16.071)	1 (0.893)	5 (4.464)	53 (20.31)
Molecular sub-type (Ki 67)										
Luminal A	9 (36)	22 (56.41)	12 (66.67)	15 (42.857)	6 (18.75)	14 (43.75)	28 (25)	2 (1.786)	7 (6.25)	115 (44.06)
Luminal B	5 (20)	11 (28.21)	2 (11.11)	13 (37.143)	2 (6.25)	1 (3.125)	25 (22.321)	1 (0.893)	4 (3.571)	64 (24.52)
Stage										
I	1 (4)	0	4 (22.22)	3 (8.571)	2 (6.25)	1 (3.125)	6 (5.357)	0	1 (0.893)	18 (6.89)
II	10 (40)	21 (53.85)	7 (38.89)	17 (48.571)	4 (12.5)	11 (34.375)	34 (30.357)	1 (0.893)	9 (8.036)	114 (43.68)
III	2 (8)	12 (30.77)	3 (16.67)	8 (22.857)	2 (6.25)	3 (9.375)	11 (9.821)	2 (1786)	1 (0.893)	44 (16.86)
IV	1 (4)	0	0	0	0	0	2 (1.786)	0	0	3 (1.15)

Tru-Cut biopsy	2016	2017	2018	2019	2020		2021		Total No. (%)
	11 IDC patients No. (%)	6 IDC patients No. (%)	4 IDC patients No. (%)	7 IDC patients No. (%)	1 IDC patient No. (%)	8 ILC patients No. (%)	42 IDC patients No. (%)	3 ILC patients No. (%)	
ER									
N	2 (8)	3 (7.69)	1 (5.56)	0	0	1 (3.125)	10 (8.926)	0	17 (6.51)
P	9 (36)	3 (7.69)	3 (16.67)	7 (20)	1 (3.125)	7 (21.875)	32 (28.571)	3 (2.679)	65 (24.90)
PR									
N	2 (8)	3 (7.69)	1 (5.56)	0	0	1 (3.125)	9 (9.0357)	1 (0.893)	17 (6.51)
P	9 (36)	3 (7.69)	3 (16.67)	7 (20)	1 (3.125)	7 (21.875)	33 (29.464)	2 (1.786)	65 (24.90)
HER									
N	7 (28)	6 (15.38)	3 (16.67)	3 (8.571)	1 (3.125)	8 (25)	35 (31.25)	3 (2.679)	66 (25.29)
P	4 (16)	0	1 (5.56)	4 (11.429)	0	0	7 (6.25)	0	16 (6.13)
Grade									
I	0	0	0	0	0	0	2 (1.786)	0	2 (0.77)
II	9 (36)	6 (15.38)	3 (16.67)	5 (14.286)	1 (3.125)	7 (21.875)	27 (24.107)	2 (1.786)	60 (22.99)
III	2 (8)	0	1 (5.56)	2 (5.714)	0	1 (3.125)	13 (11.607)	1 (0.893)	20 (7.66)
Molecular sub-type (Ki 67)									
Luminal A	9 (36)	6 (15.38)	2 (11.11)	3 (8.571)	0	5 (15.625)	28 (25)	1 (0.893)	54 (20.69)
Luminal B	2 (8)	0	2 (11.11)	4 (11.429)	1 (3.125)	3 (9.375)	14 (12.5)	2 (1.786)	28 (10.73)
Total number of cases	25	39	18	35	32		112		261

IDC: Invasive ductal carcinoma; ILC: Invasive lobular carcinoma; Other types included, IDC with ILC, IDC with micro-papillary carcinoma, IDC with mucinous carcinoma, inflammatory carcinoma, medullary carcinoma, metaplastic carcinoma, micro-papillary carcinoma, and papillary carcinoma. ER: Estrogen receptor

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TABLE III
PREVALENCE OF BREAST CANCER GRADE ACCORDING TO AGE GROUPS

Mastectomy	Grade I (6 [2.3%])				Grade II (179 [68.58%])				Grade III (76 [29.12%])			
	≤40	41–50	51–60	≥61	≤40	41–50	51–60	≥61	≤40	41–50	51–60	≥61
2016												
14 IDC patients	0	0	0	0	1	5	3	1	1	1	1	1
2017												
33 IDC patients	0	0	0	0	7	9	3	4	3	3	3	1
2018												
14 IDC patients	0	0	0	0	2	2	3	4	1	0	1	1
2019												
28 IDC patients	0	0	0	0	2	7	7	3	4	1	2	2
2020												
8 IDC patients	0	1	0	0	1	0	2	2	0	1	1	0
15 ILC patients	0	0	0	0	3	3	5	3	0	1	0	0
2021												
53 IDC patients	0	1	0	1	9	11	8	5	6	5	3	4
3 ILC patients	0	0	0	0	0	2	0	0	0	0	0	1
11 others	0	0	0	1	1	3	0	1	3	1	0	1
Number of cases	0	2	0	2	26	42	31	23	18	13	11	11
Tru-Cut biopsy												
2016												
11 IDC patients	0	0	0	0	2	3	1	3	1	0	0	1
2017												
6 IDC patients	0	0	0	0	2	2	1	1	0	0	0	0
2018												
4 IDC patients	0	0	0	0	0	1	0	2	1	0	0	0
2019												
7 IDC patients	0	0	0	0	2	0	0	0	1	0	3	1
2020												
1 IDC patients	0	0	0	0	1	0	0	0	0	0	0	0
8 ILC patients	0	0	0	0	2	1	2	2	0	0	1	0
2021												
42 IDC patients	0	1	1	0	6	13	3	5	4	2	3	4
3 ILC patients	0	0	0	0	0	2	0	0	1	0	0	0
Number of cases	0	1	1	0	15	22	7	13	8	2	7	6
Total number (%)	0 (0.0%)	3 (1.15%)	1 (0.38%)	2 (0.77%)	41 (15.71%)	64 (24.52%)	38 (14.56%)	36 (13.79%)	26 (9.96%)	15 (5.75%)	18 (6.9%)	17 (6.52%)

IDC: Invasive ductal carcinoma; ILC: Invasive lobular carcinoma; Other types included, IDC with ILC, IDC with micro-papillary carcinoma, IDC with mucinous carcinoma, inflammatory carcinoma, medullary carcinoma, metaplastic carcinoma, micro-papillary carcinoma, and papillary carcinoma.

cases in this study and who had a mastectomy was around 50 years, whereas the cases that underwent TCB were around the age of 46 years. In agreement with our data, Salman et al. (2021) and Abdulkareem, Ghalib and Rashaan (2023) in their studies that were conducted on Iraqi BC patients had reported similar results. There are other studies that were also conducted on Iraqi BC patients but reported slight differences in comparison to our data. For instance, Khalaf et al. (2022) reported the peak incidence of BC was between 40 and 49 years (n = 251). These variances might be due to the differences in the sample size of the study or the applied methodology in sample collection (i.e., whether it was random or not).

Our results indicate that the IDC histological subtype was the most prevalent among BC cases, making up more than 84% of all cases. Previous research conducted in Erbil, Baghdad, and Turkey has resulted in similar findings (Khoshnaw, Ganjo and Salih, 2023; Mohsin and Mohamad, 2024; Duraker, et al., 2020). Unfortunately, IDC histological subtype is usually associated with limited clinical outcomes (Goh, et al., 2019; Han, Wang and Xu, 2020), which may contribute to difficulties in curing affected patients.

Both the mastectomy and the TCB BC patients in our investigation had high rates of ER-positive, which is in line with what Khoshnaw, Ganjo and Salih (2023) and Mohsin and Mohamad (2024) found in their studies. However, this is not always the case, as a high incidence of ER-negative BCs has also been reported. This could be attributed to different factors, such as variations in the used staining protocols, the age of the patients (as younger patients tend to exhibit higher rates of ER-negative), and the stage of progression at the time of diagnosis (Shet, et al., 2009; Chen, et al., 2023). Identifying a significant number of ER-positive cases indicates that endocrine therapy may present a promising treatment option for this particular group of patients (Manjunath, et al., 2011).

Our data revealed that the majority of BC patients were PR-positive, which is consistent with findings from studies in both Iran (Jahanbin, et al., 2023) and Iraq (Khoshnaw, Ganjo and Salih, 2023). Moreover, most patients who underwent

TABLE IV
Prevalence of Breast Cancer Stage According to Age Groups

Mastectomy group	2016	2017	2018	2019	2020		2021			Total number of cases (%)
	14 IDC patients	33 IDC patients	14 IDC patients	28 IDC patients	8 IDC patients	15 ILC patients	53 IDC patients	3 ILC patients	11 other types	
Stage I 18 (10.05%)										
≤40	1	0	1	1	0	1	2	0	0	6 (3.35)
41–50	0	0	2	0	2	0	2	0	0	6 (3.35)
51–60	0	0	0	2	0	0	1	0	0	3 (1.68)
≥61	0	0	1	0	0	0	1	0	1	3 (1.68)
Stage II 114 (63.69%)										
≤40	1	6	2	5	1	2	11	0	4	32 (17.88)
41–50	4	8	1	5	0	2	11	0	1	32 (17.88)
51–60	5	3	0	4	2	5	6	0	2	27 (15.08)
≥61	0	4	4	3	1	2	6	1	2	23 (12.85)
Stage III 44 (24.58%)										
≤40	0	4	0	0	0	0	1	0	0	5 (2.79)
41–50	1	4	1	3	1	2	4	2	1	19 (10.61)
51–60	0	3	2	3	1	0	4	0	0	13 (7.26)
≥61	1	1	0	2	0	1	2	0	0	7 (3.91)
Stage IV 3 (1.68%)										
≤40	0	0	0	0	0	0	1	0	0	1 (0.56)
41–50	1	0	0	0	0	0	1	0	0	2 (1.12)
51–60	0	0	0	0	0	0	0	0	0	0 (0.0)
≥61	0	0	0	0	0	0	0	0	0	0 (0.0)

IDC: Invasive ductal carcinoma; ILC: Invasive lobular carcinoma; Other types included, IDC with ILC, IDC with micro-papillary carcinoma, IDC with mucinous carcinoma, inflammatory carcinoma, medullary carcinoma, metaplastic carcinoma, micro-papillary carcinoma and papillary carcinoma

both a mastectomy and a TCB were classified as HER negative. This came in agreement with another study, also from Iran, which reported a high frequency in HER-negative BC cases (Akbari, et al., 2017). Recently, a multi-omics study covering HER status in 579 BC patients that was reported by Jin et al. (2023) identified four molecular subtypes of this receptor, each of which exhibits unique biological and clinical characteristics: canonical luminal, immunogenic, proliferative, and receptor tyrosine kinase (RTK)-promoted (Jin, et al., 2023). Their findings indicate the necessity of further investigations in BC subtypes and uncovering their heterogeneity to have a clearer idea about these tumors and the best strategy to eradicate or inhibit them.

According to our findings, TNBC was diagnosed in 13.41% of patients, more than 85% of whom were associated with IDC, and it was less common among other BC subtypes. Our data align with a previous study reported by Kumar and Aggarwal (2015), indicating that 10–20% of BC patients worldwide suffer from TNBC. On the other hand, other reports indicate slight fluctuations in TNBC rates among Iraqi BC patients: Alwan, Tawfeeq and Muallah (2017) (15.6%, n = 686), Mohsin and Mohamad (2024) (28.89%, n = 89), and Khalaf et al. (2022) (48.6%, n = 251). Study sample sizes may influence these fluctuation rates, as Alwan, Tawfeeq and Muallah (2017) and Mohsin and Mohamad (2024) studies have both been conducted on BC patients in Baghdad.

In regard to tumor grading at the time of diagnosis, grade II underscored the highest frequency among BC patients in our study, and grade III came in second place. This aligns with what was reported earlier by Mohsin and Mohamad (2024) (64.44%, n = 89) in Iraq, Sajitha et al. (2022) (47%, n = 34) in India, Abousahmeen et al. (2023) (37.0%, n = 319) in Libya, and Oluogun et al. (2019) (71%, n = 343) in Nigeria. Accordingly, it's clear that most of the BC patients, either in the Kurdistan Region of Iraq or other places, are submitting for clinical examination in the late stages. Thus working on public awareness is quite crucial to interne at the right time.

Across the IHC technique retrieved data, our analysis revealed that the predominant molecular subtype of mastectomy and TCB was luminal A 115 (44.06%) and 54 (20.69%), respectively. Similar to our findings, studies from Iraq (Alwan, Tawfeeq and Muallah, 2017) and Iran (Ariabod, et al., 2021) also reported luminal A as the most frequent subtype of BC. In contrast, in other parts of the world, such as South Africa (van den Berg, et al., 2021) and Libya (Abousahmeen, et al., 2023) luminal B has emerged as the most prevalent subtype. Higher frequencies in luminal A among the included population may present a good sign for positive clinical outcomes, as luminal B is more common in younger BC patients and associated with higher grades and nodal metastasis (Hashmi, et al., 2018). Moreover, higher rates of luminal A among our study sample size are consistent with Hashmi et al. (2018)'s data as the majority of BC patients in our study are of older ages.

The extracted data indicates that the majority of BC patients were diagnosed with tumors at stages II and III, a pattern consistent with a previous study reported by Oluogun et al., 2019. This late-stage diagnosis may be attributable, in part, to several epidemiological factors, including sociocultural barriers, poverty, and insufficient health awareness (Gubari,

et al., 2017; Hu, et al., 2019). These outcomes highlight the need for targeted public health intervention to improve early detection by addressing the above-mentioned obstacles that may ease regular checkups.

Our analysis of the extracted data showed that patients who underwent mastectomy and TCB had a greater incidence of tumor grade II (24.52%) among 41–50 years and tumor grade III (9.96%) among ≤40 years. This came in agreement with what was previously reported by Hassoon, Ali and Said (2021) who suggested a connection between the above-mentioned tumor grades and patient ages, especially between 40 and 60 years. This correlation highlights the importance of age-specific screening and diagnostic practices for dealing with different grade distributions across different age groups.

Last but not least, our data uncovered that BC patients, at the diagnosis stage, were likely to have tumor stage II at age ≤50 and stage III at age 41–50 years. This came in alignment with studies that covered this matter across various age groups and reached a conclusion that patients with BC who were older than 40 years had a greater incidence of tumor stages II and III at the time of detection (Akbari, et al., 2017; Zeeshan, et al., 2019). This consistency across studies, again, highlights the necessity for age-specific strategies in screening and early detection. We should also point out the fact that BC, if diagnosed and treated as soon as possible, in the majority of cases may not result in the death of the affected patients (Akbari, et al., 2017).

IV. Conclusion

BC in the Erbil governorate of the Kurdistan Region of Iraq is more common among older females than younger ones and exhibits a high prevalence of IDC. Positive ER and PR statuses were reported more frequently than negative ones, whereas positive HER2 was less common. In comparison with the luminal B, the luminal A molecular subtype was the most dominant, accounting for about two-thirds of all BC patients. Among patients aged ≥41 years, there was a higher proportion of tumor grades II and III. Furthermore, diagnoses of tumor stages II and III reflected about two-thirds of all cases across all age categories. Overall, our findings emphasize the importance of age-specific strategies in screening and timely interventions to improve BC outcomes.

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