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The relationship between body mass index and pathological complete response in Brazilian breast cancer patients

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Body mass index (BMI) is a key factor in the progression of breast cancer (BC), with conflicting evidence on its influence on pathological complete response (pCR) following neoadjuvant chemotherapy (NAC). Despite these global findings, studies focusing on real-world Brazilian data remain scarce. This study aimed to evaluate the impact of BMI on pCR rates, recurrence-free survival (RFS), and overall survival (OS) in Brazilian women with BC treated with NAC. A retrospective cohort of 1,751 patients with stage I–III invasive primary BC treated between January 2011 and December 2020 at two public healthcare centers Hospital Pérola Byington (HPB) and Hospital do Servidor Público Estadual (HSPE) in Brazil was analyzed. Data included BMI categories (normal, overweight, and obese) and their associations with pCR, RFS, and OS outcomes. Obesity was prevalent (35.5%) among the cohort, with most patients being postmenopausal (50.9%). Tumors were predominantly stage III invasive ductal carcinoma, with triple-negative and luminal B subtypes being the most common. Radical surgery was performed in 79.8% of cases, achieving a pCR rate of 22.3%, and 30.9% of patients experienced recurrence, predominantly systemic (27.7%). No significant differences in pCR, RFS, or OS were observed across BMI categories. BMI was not associated with pCR, RFS, or OS in this large Brazilian cohort, highlighting the need for further studies to explore BMI dynamics during treatment and its potential influence on therapeutic outcomes. Future investigations in diverse healthcare settings may provide additional insights into optimizing breast cancer management across BMI strata.

Keywords Body mass index, Pathological complete response, Breast cancer, Neoadjuvant chemotherapy, Survival analysis

Breast cancer (BC) is a prevalent malignancy worldwide, with 2,308,897 new cases globally and responsible for 665,684 deaths each year[1]. In the United States, BC accounts for 31% of new cancer cases in women and is the second leading cause of cancer-related deaths, resulting in 43,170 fatalities annually[2]. In 2023, there was 73,250 new cases of BC in Brazil, with a significant proportion being diagnosed at an advanced stage[3].

There is a link between metabolic syndrome (MS) and cardiovascular risks[4], as well as a relationship between abdominal circumference, particularly in menopausal women, and an increased risk of heart attack and stroke[5]. Women with MS have a higher cardiovascular risk despite having a normal BMI[6] and BC survivors have a higher risk of MS, in addition to those in post-menopause having a greater probability of developing diabetes and chronic arterial hypertension[7].

MS has been seen as an independent risk factor for BC and the risk of postmenopausal stroke, 10 years after the diagnosis of BC, is equal to or greater than that of risk of recurrence of the neoplasm in the same period[7,8].

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Obesity promotes carcinogenesis, resulting in a higher incidence of cancer increasing its progression and mortality. In postmenopausal, obesity is associated with a higher incidence and is a risk factor for progression of BC[9] and it is well known that obesity worsens BC prognosis[10].

Body mass index (BMI) is a straightforward measure of obesity, and higher BMI levels are associated with elevated concentrations of sex hormones, insulin, and insulin-like growth factors. These factors can disrupt the normal balance between cell differentiation and apoptosis, thereby promoting the progression and proliferation of breast cancer cells[11–13].

Neoadjuvant chemotherapy (NAC) was traditionally reserved for patients with locally advanced breast cancer (BC). However, it has become an increasingly common approach for patients with early-stage BC, particularly those with high chances of achieving pathological complete response (pCR) such as triple-negative subtypes or HER-2-enriched tumors. The primary goals of NAC are to reduce tumor size, enabling less invasive surgical options, and to improve overall patient prognosis[14–16]. pCR has emerged as an important surrogate marker for evaluating the effectiveness of neoadjuvant chemotherapy (NAC). Achieving pCR is potentially associated with improved overall survival (OS) and disease-free survival (DFS), particularly in HER-2-positive and triple-negative breast cancer subtypes[17].

Obesity may be a factor associated with low pCR, lower survival and a predictor of worse BC`s prognosis[11,18] in prospective trials but not frequently available in real world data. Real-world evidence (RWE), obtained through real-world data from an uncontrolled test environment, would be a way to reveal the behavior of BMI`s impact on the pCR of Brazilian women with BC according to their peculiarities. The heterogeneity of the RWE research sample makes studies closer to real life, therefore, data from this Brazilian population analyzed in the Unified Health System (UHS) are fundamental for the best understanding of our population.

Because there is still no well-established evidence of this relationship or any Brazilian study on the subject, our objective was to conduct a multicenter study analyzing the impact of BMI on pCR rates as well as on recurrence free survival (RFS) and overall survival (OS) rates for women with BC who received NAC.

Materials and methods

Study design and data source

This study used a retrospective cohort based on RWD of two reference centers Hospital Pérola Byington (HPB) and Hospital do Servidor Público Estadual (HSPE). Data from women diagnosed and treated in the aforementioned healthcare setting were considered for this study from January 2011 to December 2020.

Inclusion criteria

Women older than 18 years with a diagnosis of nonmetastatic BC treated with neoadjuvant chemotherapy were included in this study.

Exclusion criteria

Patients with inflammatory breast cancer, stage 4 cancer at diagnosis, missing data, or who participated in clinical trials were excluded.

Follow-up

Each patient was followed from diagnosis until their last hospital visit (if alive) or death.

Definition of analyzed variables

Age, height and weight were collected at diagnosis. To assess menopausal status, women younger than 50 years were considered premenopausal and patients older than or equal to 50 were considered postmenopausal[19]. BMI was calculated using the formula = body weight (kg) / height (m^2), and they were categorized as follows using the criteria developed by the WHO: underweight (< 18.5 kg/m^2); normal weight (18.5 to < 25); overweight (25 to < 30); obese (≥ 30)[20].

Classification of molecular subtypes was performed by assessing the presence of estrogen receptor (ER), progesterone receptor (RP) and human epidermal growth factor receptor (Her-2) via quantitative immunohistochemistry (IHC). The cut-off value for ER positivity (ER+) and PR positivity (PR+) was 1% of positive tumor cells with nuclear staining. Evaluation of hormone receptors was performed in positive or negative, and, in some cases, by the Allred score. Regarding the Ki-67 proliferation index, a cut-off value of 14% was considered for differentiating between luminal types A or B. BC subtypes were classified as follows: HER-2 overexpression, i.e., 3 + or 2 + on IHC or a positive in situ hybridization test (FISH or CISH); triple negative, i.e., absence of ER, RP and Her-2 expression; luminal A, i.e. ER + and/or PR + and low Ki-67 (< 14%); luminal B, i.e., ER + and/or PR + and high Ki-67 (≥ 14%) surgery[21].

Histological grade and type of tumor at biopsy as well as the time to local and systemic recurrence were also identified. The 8th American Joint Committee on Cancer Classification of Malignant Tumors (TNM) system was used for clinical and pathological staging of tumors[22].

Neoadjuvant chemotherapy

The patients received NAC in accordance with institutional protocols and based on the availability of access to medications. Access to medications for the treatment of HER-2 + patients is not universal in Brazil. The treatment regimens used were 4 cycles of doxorubicin + cyclophosphamide followed by 4 cycles of docetaxel for all patients. HER2- positive patients may have used the same regimen with or without trastuzumab or docetaxel, carboplatin and trastuzumab (TCH). TNBC patients may have received regimens containing carboplatin at local practice discretion.

pCR definition
pCR was defined as the absence of residual invasive cancer in the breast and axillary lymph nodes with absence (T0N0) or presence (TisN0) of tumor in situ after neoadjuvant treatment[23].

Recurrence and overall survival
RFS was considered as the survival time after the end of treatment without any signs or symptoms of cancer and OS as the survival time from the date of diagnosis until death. Both were calculated in months, considering the date of surgery as the end of treatment. For RFS, the time between surgery and the first recurrence was recorded, and for patients who didn`t have recurrence, the time between surgery and the date of the last follow-up (death or last visit). For OS, the time between diagnosis and death or the last visit was recorded.

Statistical analysis
Statistical analyses were performed using R version 4.1.3 in R studio interface, version 2022.02.0 + 443. In the analyses, $\alpha = 0.05$ was considered statistically significant.

Survival analyses were performed under 2 different outcomes. For OS, 3 types of analysis were performed: HSPE/HPB together and each separately. For RFS, only HPB was considered, as necessary information's weren`t available for HSPE. All survival analyses were stratified by BMI, and the log-rank test was used to compare survival curves. In terms of outcomes, the median survival time is presented, together with the hazard ratio (HR) and 95% confidence interval (CI95%) constructed using Cox regression.

Chi-square test was used to individually analyze the association of each variable between BMI categories. Data were stratified and considered subpopulations of BMI categories to perform the same test with the same variables but considering the individuals who achieved or not pCR.

In the logistic regression analyses, univariate analyses were used to identify the significant variables for inclusion in multivariate model. Significance level adopted for a variable to be included in the multivariate model was 10%. Crude and adjusted odds ratios (ORs) together with the CI95% of the variables included in the models were calculated.

Finally, nonparametric Kruskal–Wallis tests were used to check for differences between BMI categories and 4-time variables: time between diagnosis and initiation of chemotherapy, chemotherapy`s duration, time between ending of chemotherapy and surgery, and time between diagnosis and surgery. They were performed within the BC type`s subpopulations, menopausal status and pCR.

Ethics
The study was approved and informed consent was waived by research ethics committee "Centro de Referência da Saúde da Mulher" signed by Roberto Euzebio dos Santos via Plataforma Brazil (https://plataformabrasil.saude.gov.br/login.jsf) (CAAE: 44206921.0.1001.0069) and was conducted in accordance with Declaration of Helsinki. The ISPE / ISPOR recommendations for the development of an exploratory study in the real world were followed.

Results
Patient cohort
From January 2011 to December 2020, 1,960 records were evaluated, and 209 patients were excluded from the sample: bilateral tumors ($n = 30$), loss to follow-up ($n = 5$), incomplete data ($n = 76$), randomized clinical trial participant ($n = 50$). Furthermore, malnourished patients were excluded ($n = 28$), as they made up a very small sample group (1.6%), in order to minimize possible biases in some calculations in the study.

Figure 1 Flowchart of the multicenter cohort. *RCT* randomized clinical trial, *BC* breast cancer.

Data of 1,751 women were analyzed (1,458 from HPB and 293 from HSPE). Proportions of patients in BMI categories at the time of diagnosis are shown in Table 1. There was a higher relative proportion of overweight group's women (35.5%), and among women with obesity, the majority was in stage I. Patients' mean age was 50.0 (43.0–58.0) years, most were postmenopausal (50.9%). Regarding tumor characteristics, 68.1% had stage III, and in 95.2% of their, the tumor invasive not otherwise specified (ductal), with triple negative and luminal B subtypes being the most numerous (31.2% and 31.1%). The main surgery performed was radical (79.8%), and the pCR's rate was only 22.3%. Of the total, 548 (30.9%) patients had recurrence, most had systemic recurrence (27.7%). These characteristics were similar in different BMI categories.

Neoadjuvant chemotherapy
On Table 2 we present the results of logistic regression for pCR in the unadjusted analyses (univariate) and in the adjusted analysis (multivariate). For the analyses of molecular subtypes (HER-2 + and triple negative) and patients who presented or didn't present this, factors with a significance of 10% in the unadjusted analyses were found; therefore, those factors were included in the adjusted analysis. Compared with that for the luminal A, pCR was different for the other subtypes: luminal B (OR 2.00 [CI95% 1.15–3.58] $p = 0.019$; HER 2 + OR 5.89 [CI95% 3.48–10.61] $p < 0.001$); triple negative (OR 6.75 [CI95% 4.02–12.08] $p < 0.001$). Patients who didn`t achieve pCR had more systemic recurrence. It was determined to be unfavorable (OR 0.18 [CI 95% 0.12–0.25] $p < 0.001$). There wasn't statistical difference regarding the different BMI categories and pCR rate (Table 2).

There was a significant difference between pCR and tumor subtype, Kruskal–Wallis tests were performed to determine whether the time variables, i.e., time between diagnosis and initiation of NAC, duration of chemotherapy, and time between ending of chemotherapy and surgery, were different. For the luminal A group, a significant difference in the duration of NAC was identified ($p = 0.034$), with a longer interval, i.e., the duration of NAC for obese with luminal A tumors was longer than that for normal-weight patients (median, 3 months

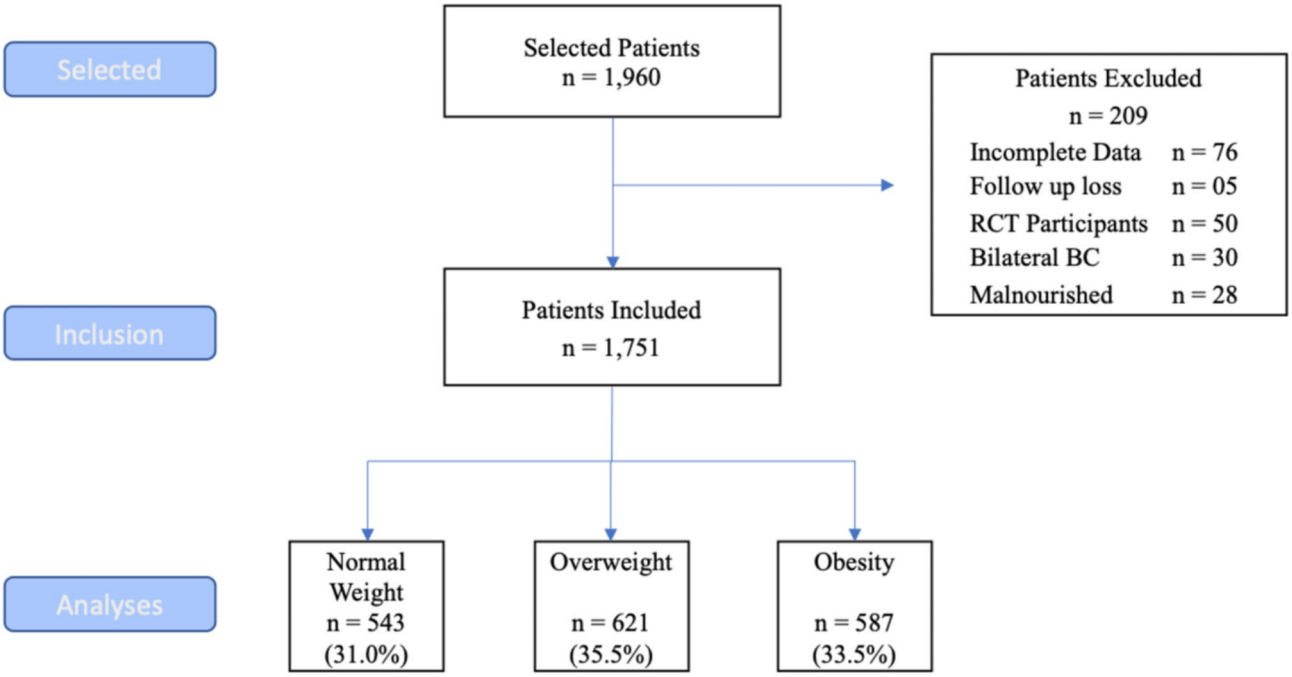

Fig. 1. shows detailed information on the excluded patients.

[Q1 = 3; Q3 = 4] normal-weight and 4 months [Q1 = 3; Q3 = 5] obese, $p = 0.026$). No difference was observed in pCR for duration of NAC between BMI categories and cancer subtypes, as shows Fig. 2.

Survival analyses

In total, 367 patients in this database died, 137 deaths were directly related to BC, representing 7.7% of whom underwent NAC. Among the causes of deaths not related to BC, 26.2% (56) were due to respiratory failure, 25.7% (55) to sepsis, 24.8% (53) to cardiovascular causes (stroke and pulmonary thromboembolism), 16.8% (36) due to bronchopneumonia, 3.7% (8) due to multiple organ failure and 2.8% (6) due to COVID-19. It is worth noting that out of these 230 patients who died from causes not directly related to BC, we did not have access to the specific causes of 16 of them (6.9%).

The median OS estimated by Kaplan-Meier analysis was 102 months (HR 1.12 CI95% 0.46–2.75) for normal-weight, 99 months (HR 1.23 CI95% 0.50–3.02) for overweight and 101 months (HR 1.31 CI 95% 0.53–3.20) for obese (Fig. 3). There weren't statistically significant differences in the survival curves for BMI groups ($p = 0.67$), as shows Fig. 3.

For the RFS analyses, 1,458 patients were included, and 387 women had recurrence after surgery (22 local, 355 systemic, 10 both of types). A median RFS wasn't reached for any BMI category as well as there wasn`t statistically significant difference between BMI groups ($p = 0.70$).

Discussion

The clinical significance of pCR in breast cancer has long been a topic of substantial interest and debate among researchers and clinicians. Numerous studies have demonstrated that achieving pCR is associated with improved long-term outcomes, such as OS and RFS, when compared to patients with residual tumors at the time of surgery[24–27].

These findings have firmly established pCR as a surrogate marker of favorable prognosis and a key outcome in evaluating the efficacy of NAC. The importance of pCR has been particularly emphasized in aggressive breast cancer subtypes, such as TNBC[28] and HER-2-positive disease[29,30], where novel targeted therapies have significantly improved response rates. However, access to these advanced therapies remains significantly limited in resource-constrained settings like Brazil. This limitation was evident in our study, conducted within the Brazilian Unified Health System (UHS), where the observed pCR rate of 22.3% is consistent with findings from other studies conducted in regions with restricted access to advanced treatments[31]. This highlights the urgent need to address disparities in treatment access within Brazil's public healthcare system where NAC is available only for patients with stage III disease or with involved lymph.

BMI, as measured at diagnosis, may not be a decisive factor in treatment outcomes within our cohort, aligning with findings from some studies[12,13]. This finding contrasts with other international studies, which have reported associations between lower BMI and higher pCR rates[11,18,32]. While BMI was not associated with pCR, RFS, or OS in this large Brazilian cohort, these findings should be interpreted cautiously. The retrospective design, potential biases, and lack of dynamic BMI data during treatment highlight the need for further studies to validate these results in diverse settings and with longer follow-up periods. Discrepancies in findings may

Characteristics	Total cohort $n=1751$	Normal weight 543 (31,0)	Overweight 621 (35,5)	Obesity 587 (33,5)	p-valor
Age (years)[a]	50 (43–58)	48 (41–57)	50 (42–57)	51 (44–59)	0.0003[b]*
Menopausal status					
Post-menopause	891 (50,9)	248 (45,7)	315 (50,7)	328 (55,9)	0.003*
Pre-menopause	860 (49,1)	295 (54,3)	306 (49,3)	259 (44,1)	
Histological type					
Mucinous	15 (0,9)	4 (0,7)	8 (1,3)	3 (0,5)	0.036*
Papillary	5 (0,3)	0 (0)	5 (0,8)	0 (0)	
Micropapillary	4 (0,2)	2 (0,4)	0 (0)	2 (0,3)	
Ductal	1667 (95,2)	520 (95,9)	581 (93,9)	566 (96,4)	
Lobular	55 (3,1)	14 (2,6)	25 (2,6)	16 (2,7)	
Metaplastic	5 (0,3)	3 (0,6)	2 (0,6)	0 (0)	
Clinical staging					
I	30 (1,7)	11 (2,0)	12 (1,9)	7 (1,2)	0.1349
II	529 (30,2)	172 (31,9)	200 (32,2)	157 (26,7)	
III	1192 (68,1)	360 (66,4)	409 (65,9)	423 (72,1)	
Cancer subtypes					
Luminal A	217 (12,4)	77 (14,2)	75 (12,1)	65 (11,1)	0.3609
Luminal B	544 (31,1)	172 (31,7)	176 (28,3)	196 (33,4)	
HER2	443 (25,3)	132 (24,4)	167 (26,9)	144 (24,5)	
Triple negative	547 (31,2)	162 (29,9)	203 (32,7)	182 (31,0)	
Type of surgery					
BCS	353 (20,2)	97 (17,9)	128 (20,6)	128 (21,8)	0.3418
Mastectomy	1397 (79,8)	446 (82,3)	492 (79,2)	459 (78,2)	
Neoadjuvant response					
pCR	390 (22,3)	115 (21,2)	141 (22,7)	134 (22,8)	0.7607
Non-pCR	1361 (77,7)	428 (78,8)	480 (77,3)	453 (77,2)	
Relapses					
Local	55 (3,1)	18 (3,3)	20 (3,2)	17 (2,9)	0.9818
Systemic	486 (27,8)	153 (28,2)	179 (28,8)	154 (26,2)	
Death causes					
Other	363 (20,7)	106 (19,6)	132 (21,3)	125 (21,3)	0.5426
Breast cancer	136 (7,8)	33 (6,1)	52 (8,4)	51 (8,7)	

Table 1. Characteristics related to BC patients undergoing NAC. *BC* breast cancer, *BMI* body mass index, *pCR* pathological complete response, *BCS* breast conservative surgery. [a]The median (interquartile range). [b]Kruskal-Wallis test. *Statistically significant difference ($p<0.05$).

reflect differences in healthcare environments, with the Brazilian public healthcare system facing challenges in accessing advanced therapies. Additionally, variations in patient demographics, tumor biology, sample sizes, and neoadjuvant chemotherapy regimens likely contribute to these differences. For instance, some international studies have linked higher BMI to lower pCR rates, potentially due to differences in adherence to treatment protocols or availability of targeted therapies. The association between BMI and pCR rates was evaluated in a meta-analysis, which found that BMI was not established as a clinically relevant factor. Instead, variables such as lymphovascular invasion, grade 3 tumors, luminal-like subtypes, and HER2-positive breast cancer subtypes demonstrated predictive and prognostic significance in patients undergoing NAC[12]. In the other hand, a recent a meta-analysis[33] found that overweight and obese women were less likely to achieve pCR compared to normal or underweight women. However, a key limitation of meta-analyses is their tendency to include studies with varying methodologies and heterogeneous populations, which can lead to less reliable and potentially inaccurate conclusions.

As a retrospective unselected study in a real-world public healthcare setting enables us to capture a more diverse patient population that better represents the challenges faced in routine clinical practice, including disparities in treatment access, variations in comorbidities, and adherence to treatment protocols. Unlike controlled clinical trials, which often apply strict inclusion and exclusion criteria that may omit patients with significant comorbid conditions or limited access to care, our retrospective study provides a comprehensive overview of BMI's impact on breast cancer outcomes in a resource-constrained setting. Furthermore, this study underscores the importance of evaluating treatment outcomes in diverse, real-world settings to inform evidence-based public health strategies and improve healthcare delivery in resource-limited environments.

Weight gain during NAC is common[34]. However, the clinical relevance of BMI as an independent factor remains unclear, particularly in diverse real-world settings. Importantly, our study assessed BMI at diagnosis

	ORg	IC 95%	*P*-value
BMI			
Normal weight	0.83	0.33–2.25	0.69
Overweight	0.98	0.40–2.67	0.97
Obesity	0.8	0.32–2.14	0.62
Cancer subtype			
Luminal A	1.00	–	–
Luminal B	2.00	1,16 – 3,67	0.017*
HER2	5.89	3,48 – 10,61	< 0.001*
Triple negative	6.75	4,02–12,09	< 0.001*
Systemic recurrence			
No	1.00	–	–
Yes	0.18	0.12–0.25	< 0.001*

Table 2. Results of logistic regression of pCR in the unadjusted analysis (univariate) and in the adjusted analysis (multivariate). Logistic regression (gross OR and adjusted OR) considering pCR as outcome of interest. *OR* odds ratio, *IC95%* Confidence Interval of 95%, *BMI* body mass index. *Statistically significant difference ($p < 0.05$). [a]OR gross was considered to BMI, cancer subtype, systemic recurrence; statistically significant difference ($p < 0.10$) was considered to adjusted analyses. [b]OR adjusted to BMI, cancer subtype and systemic recurrence.

and did not account for changes in weight during NAC, a common phenomenon that could influence treatment outcomes. Previous studies have suggested that while weight gain during NAC may not directly affect pCR rates, it can independently predict worse disease-free and overall survival[35]. Future studies should focus on assessing dynamic BMI changes and their potential impact on treatment outcomes.

Beyond its potential role in pCR, obesity is a well-established risk factor for poor breast cancer outcomes[10] and is often associated with MS, which increases the risk of surgical complications, including infections, cardiovascular events, and prolonged hospital stays[36]. In our study, patients with higher BMI experienced longer intervals between the completion of NAC and surgery, potentially reflecting obesity-related comorbidities and challenges in surgical management. However, due to the limitations of our retrospective analysis, we could not comprehensively evaluate these comorbidities. The strong association between obesity and chronic conditions such as diabetes, hypertension, and cardiovascular disease (CVD) further reinforces the need for a multidisciplinary approach to managing breast cancer in overweight and obese patients[37].

The prevalence of obesity in our cohort—where over 50% of patients were classified as overweight or obese—mirrors a broader public health challenge in Brazil. National data show that nearly 63% of Brazilian women were overweight, and 29.5% were obese in 2019, representing a significant increase compared to previous years[38]. In our study, the prevalence of BC was higher in older women (postmenopausal), independently of the BMI. This growing epidemic of obesity has serious implications for breast cancer management, particularly in resource-constrained healthcare systems. Addressing obesity as a modifiable risk factor is critical not only for improving cancer outcomes but also for reducing the burden of obesity-related comorbidities on the healthcare system. Given the rising prevalence of obesity in Brazil, integrating weight management programs into breast cancer treatment is critical. Multidisciplinary care teams should address comorbidities like cardiovascular disease alongside oncologic care. Public health policies should prioritize educational campaigns and access to lifestyle interventions to reduce obesity-related risks, ultimately improving breast cancer outcomes.

Interestingly, our analysis revealed that tumor subtype was a much stronger predictor of pCR than BMI. Specifically, TNBC and HER-2-positive tumors were significantly more likely to achieve pCR compared to hormone receptor-positive subtypes, such as luminal A. This finding aligns with the broader literature, which consistently demonstrates that the aggressiveness of certain subtypes correlates with higher response rates to NAC[28,33].

Another key finding from our study was the high rate of non-cancer-related deaths, particularly due to CVD, respiratory failure, and sepsis. These causes of mortality highlight the need for comprehensive survivorship care that addresses not only oncologic outcomes but also the broader health risks faced by breast cancer survivors. Previous studies have shown that, within ten years post-treatment, the risk of CVD in breast cancer survivors can equal or even exceed the risk of cancer recurrence[7]. This emphasizes the need for integrated survivorship programs that include cardiovascular risk assessment and prevention strategies, particularly for patients with obesity and related metabolic conditions. In summary, our study, based on RWD from Brazilian patients receiving NAC for breast cancer treatment, demonstrates that BMI was not relevant for pCR rate.

Our study has some limitations. This retrospective design introduces risks of selection bias, as the cohort includes only patients treated at two public healthcare centers, potentially limiting generalizability. Information bias may arise from inaccuracies in medical records. Additionally, BMI was only assessed at diagnosis, and dynamic changes during treatment—which could impact outcomes—were not evaluated. These limitations underscore the need for prospective studies to better elucidate these relationships.

The strength of our study lies in the analysis of data from 1,751 unselected patients in a real-world setting, addressing the lack of real-world data from Brazil's public healthcare system as compared to private patients. The

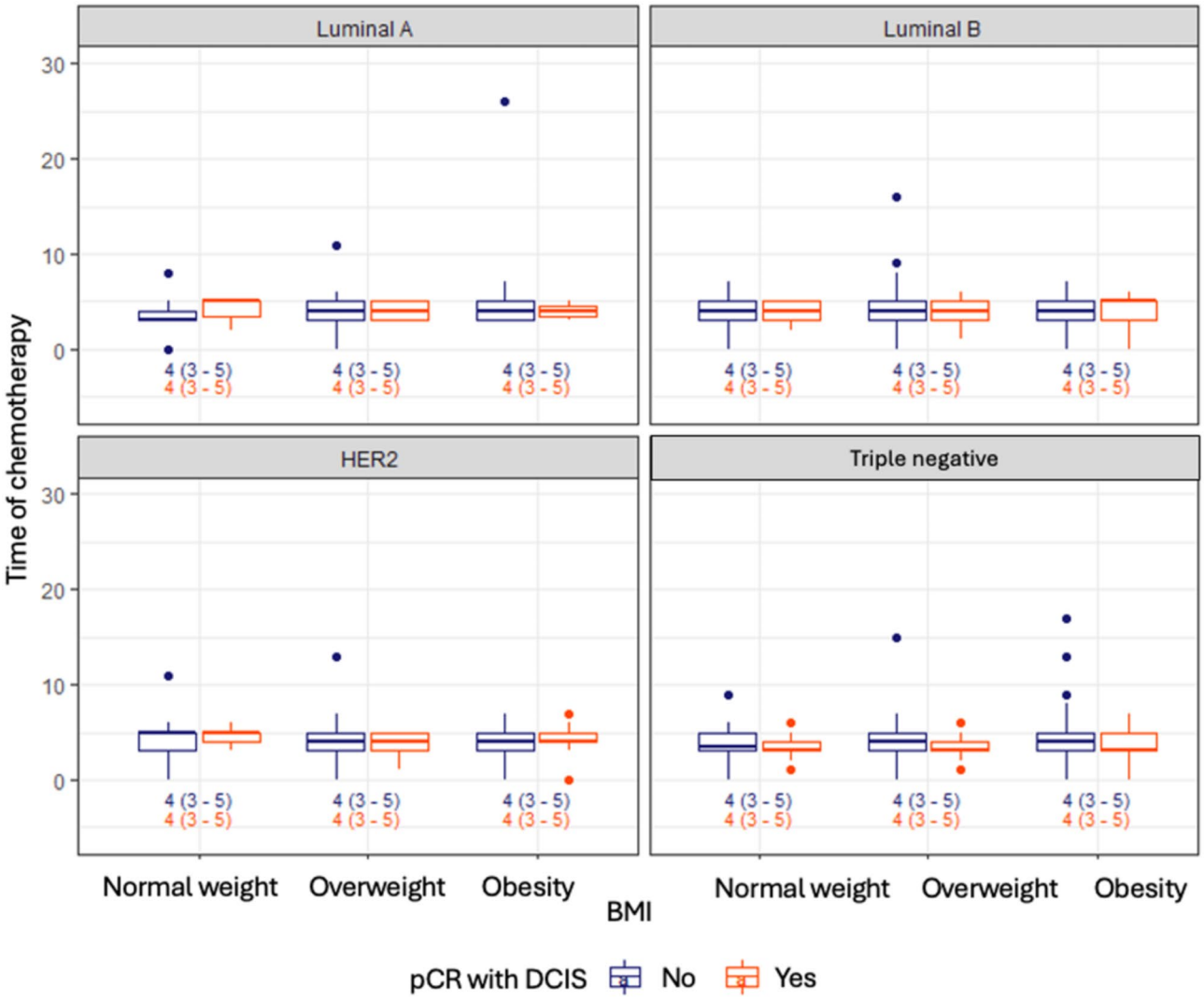

Fig. 2. Relationship of time of chemotherapy, BMI categories and cancer subtypes according to pCR. Time months, *pCR* pathologic complete response, *BMI* body mass index.

lack of significant associations in our study should not diminish the importance of addressing obesity as a public health issue, particularly given its well-documented impact on overall health and cancer prognosis. Future research should prioritize prospective studies to assess dynamic BMI changes during treatment and explore interventions for managing weight and comorbidities.

Conclusion

Our study provides robust real-world evidence from a large cohort of Brazilian breast cancer patients treated with NAC. While BMI at diagnosis was not identified as a significant predictor of pCR, RFS, or OS, these findings underscore the intricate interplay between obesity, cancer biology, and treatment outcomes. Improving access to advanced therapies and modern treatment protocols within the UHS remains pivotal, particularly for patients with aggressive subtypes such as TNBC and HER-2-positive cancers. Furthermore, the escalating prevalence of obesity in Brazil necessitates urgent public health initiatives and targeted strategies to address this growing concern. Such efforts are vital not only to optimize breast cancer care but also to mitigate health disparities and enhance outcomes for patients nationwide.

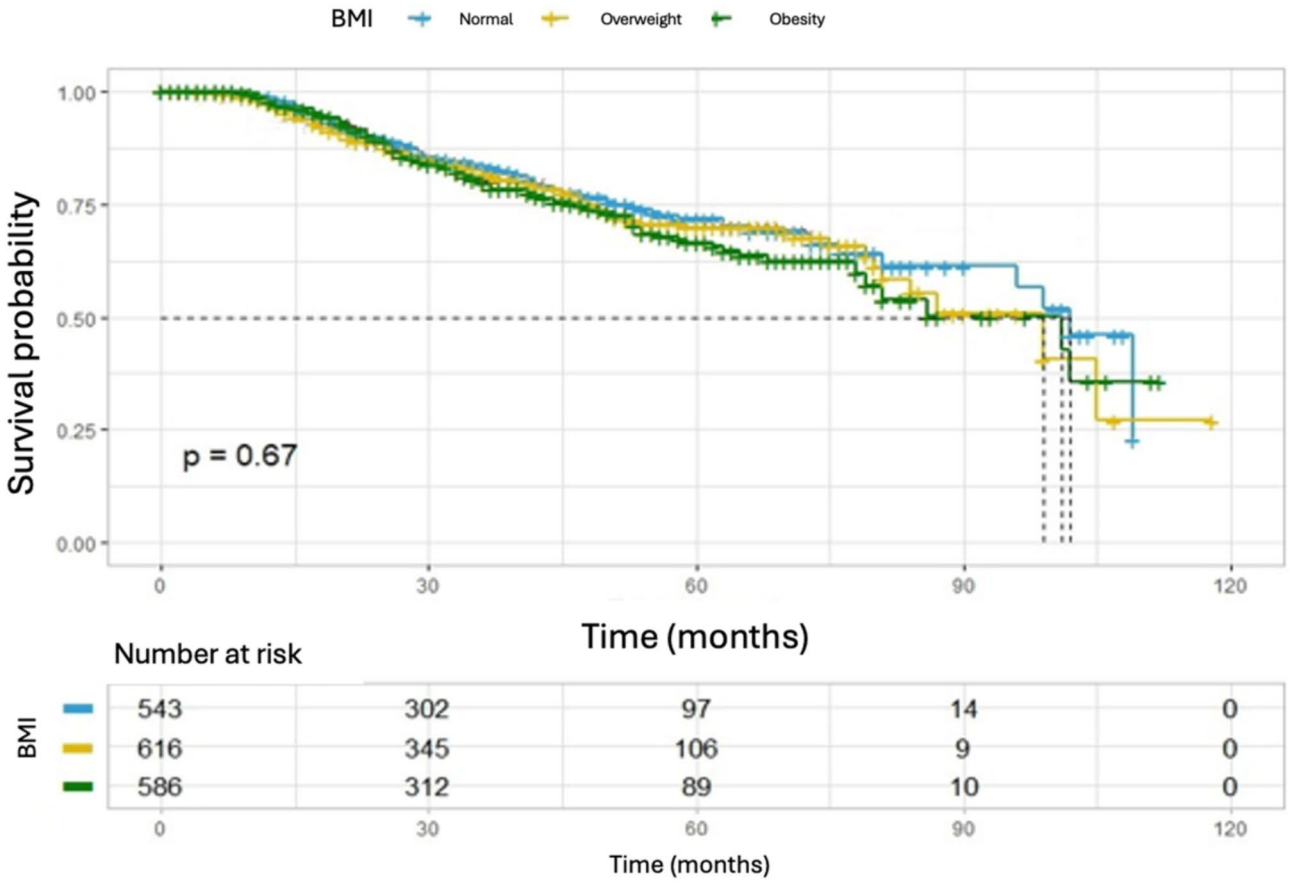

Fig. 3. The median OS (Kaplan–Meier) for BMI groups. *BMI* body mass index.

Data availability

The data are fully available from the author upon request, please contact Fernanda Grace Bauk Richter fegrace@hotmail.com or André Mattar mattar.andre@gmail.com.

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Declarations

Competing interests
The authors declare no competing interests.

Ethical approval
The study was approved by research ethics committee "Centro de Referência da Saúde da Mulher" signed by Roberto Euzebio dos Santos via Plataforma Brazil (https://plataformabrasil.saude.gov.br/login.jsf) (CAAE: 44206921.0.1001.0069) and was conducted in accordance with Declaration of Helsinki. Informed consent was waived because the identity of patients was coded, the data were obtained from medical records. The ISPE / ISPOR recommendations for the development of an exploratory study in the real world were followed.

Additional information

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