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Breast Cancer–related Lymphedema in Valle del Cauca, Colombia: Prevalence, Risk Factors, and Characterization

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Background: Breast cancer–related lymphedema (BCRL) significantly affects patients' quality of life. Prevalence estimates in Latin America, particularly Colombia, remain inconsistent because of the limited research. This study aimed to determine the prevalence of BCRL and characterize its clinical and surgical aspects, as well as potential risk factors, in southwestern Colombia.
Methods: This multicenter case-control study included 334 women diagnosed with unilateral breast cancer between 1997 and 2019. The patients underwent standardized medical interviews, physical examinations, and data collection regarding clinical variables. Statistical analyses included descriptive statistics, bivariate logistic regression, and multivariable logistic regression to identify risk factors.
Results: The prevalence rate of BCRL was 23.9%. Patients with BCRL had a significantly higher body mass index and were more likely to have infiltrating ductal carcinoma. The surgical and treatment characteristics did not differ significantly between the groups. Multivariate analysis identified body mass index and arm swelling as risk factors for BCRL.
Conclusions: This study provides crucial data on the prevalence and risk factors of BCRL in Colombia, which will guide future research in developing a reproducible, easily accessible method for early lymphedema detection in remote populations. This, in turn, will enable timely referrals to centers equipped for proper management. Additionally, the findings can inform public policies aimed at preventing and improving the treatment of this complication. *(Plast Reconstr Surg Glob Open 2025;13:e6617; doi: 10.1097/GOX.0000000000006617; Published online 23 April 2025.)*

INTRODUCTION

Breast cancer is a leading cause of global cancer incidence, with an estimated 2.3 million new cases in 2022, ranking first for incidence across 157 countries (including Colombia). It is the fourth leading cause of cancer-related mortality worldwide with 666,000 deaths in 2022.[1]

Breast cancer therapy often leads to upper-limb lymphedema, a chronic complication characterized by an imbalance between interstitial fluid generation and lymphatic transport capacity.[2] Breast cancer and its specific components can trigger an imbalance in the lymphatic system.[2–4] Prevalence of breast cancer–related lymphedema (BCRL) in Latin America is inconsistently defined, because it varies between 17.0% and 44.8%,[5,6] with identified risk factors including axillary radiotherapy, axillary lymph node dissection (ALND), and high body mass index (BMI).[2,7,8] Therefore, localized research in this area is needed.

BCRL is a chronic and progressive complication that negatively affects the quality of life due to severe symptoms and limb dysfunction.[9–12] This may have limited the functionality of the patient to the extremities.[13–15] Despite its profound implications for patients' quality of life, our understanding of BCRL, particularly in Colombia, remains fragmented.

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Some tests have been recommended to detect lymphedema, including indocyanine green lymphography,[16] bioelectrical impedance spectroscopy,[17,18] and shear-wave elastography.[7,19] However, most of these methods are expensive and complex to use, and many low- and middle-income countries (LMICs) do not rely on these technologies. For this reason, clinical evaluation combined with noninvasive measurements, including the volume difference between the upper extremities, is currently recommended, similar to magnetic resonance imaging.[11,12] López et al[20] validated a computer tool called lymphedema calculator, which automatically calculates the volume difference between the upper limbs. This method provides a valid, low-cost, and fast measure that can be used for the assessment and follow-up of the affected limbs in a clinical setting (especially for developing countries).

This study aimed to estimate the prevalence of BCRL; describe the epidemiological, clinical, and surgical characteristics; and identify risk factors associated with patients from the Hemato-Oncólogos SA Cancer Center, an institution conforming to 3 different centers from southwestern Colombia.

Takeaways

Question: What is the prevalence of breast cancer–related lymphedema (BCRL) in southwestern Colombia, and what are the associated risk factors?

Findings: BCRL prevalence is 23.9%. A higher body mass index and arm swelling were more common in affected patients. No significant differences in surgical and treatment characteristics were observed, revealing gaps in management and records.

Meaning: The high prevalence highlights the need for better BCRL management in Colombia. Tailored interventions are crucial to improve detection and reduce its impact. Further research is needed to refine risk assessment and develop effective, context-specific interventions.

MATERIALS AND METHODS

This multicenter case-control study aimed to determine the prevalence and risk factors of BCRL of the upper extremities. The study was conducted in compliance with the Declaration of Helsinki and approved by the scientific ethics committee. All the participants provided informed consent.

Patients were recruited from the Hemato-Oncólogos SA Cancer Center, a multisite oncological medical center serving Valle del Cauca and Cauca populations in Colombia. Patients diagnosed with unilateral breast cancer between 1997 and 2019 by one healthcare provider were included in the study. Based on a pilot study reporting a preliminary prevalence of 37.5%, the sample size of 367 patients was calculated (alpha = 0.05, beta = 0.8).

Exclusion criteria comprised Patients with bilateral breast cancer, preexisting lymphedema before breast cancer diagnosis, recent upper extremity trauma, anatomical abnormalities, or inability to provide full consent were excluded. Stratified randomization from a database of 4794 eligible patients was performed using SAHICO 3.0 (Technologies of Colombia, Pereira, Colombia). Patients were contacted, and appointments were arranged for data collection.

A 3-step intervention was used for BCRL determination and patient characterization. Initial medical consultations included standardized interviews and physical examinations of the upper extremities. Arm measurements were conducted using the truncated cone formula developed by López et al,[20] with a difference exceeding 200 mL between the arms indicating lymphedema. For the measurements, the patients were seated in a chair next to the physician's desk and the asked to remove any arm accessories (watches, bracelets, and handcuffs), in addition to changing the shirt for a disposable gown (Fig. 1).

The physician instructed the patients to sit straight and drop their arms on a table from a comfortable position. Subsequently, measurements were performed using a measurement plastic tape following the protocol described by the Spanish Society of Rehabilitation and Physical Medicine (SERMEFiv).

Clinical records were reviewed for additional variables, including demographics, breast cancer details, and treatment history, and all measurements and data collection were performed by trained staff physicians to ensure consistency and anonymization for privacy protection.

Statistical Analysis

Continuous variables were described as medians and interquartile ranges (IQRs), whereas categorical variables were analyzed to describe frequencies/proportions. Comparisons between lymphedema and nonlymphedema groups were analyzed using the Mann-Whitney U test for continuous variables and Fisher exact test or chi-square test for categorical variables. Statistical significance was defined as a P value less than 0.05.

To estimate the association between lymphedema status and different potential risk variables, an unadjusted odds ratio (OR) was calculated using a bivariate logistic regression model. Subsequently, multivariable logistic regression analyses were performed for the adjusted OR to determine the possible risk factors associated with lymphedema related to breast cancer.

RESULTS

Patient Characteristics

A total of 334 women participated in the study, with a lymphedema prevalence of 23.9% (n = 80). The median age was 62 years (IQR 52–69 y) for the lymphedema group and 58 years (IQR 51–67 y) for the nonlymphedema group (Table 1). Women with BCRL had a significantly higher BMI (>25 kg/m^2) with an adjusted OR of 2.53 (95% confidence interval [CI]: 1.13–4.49). Infiltrating ductal carcinoma was the predominant tumor type in

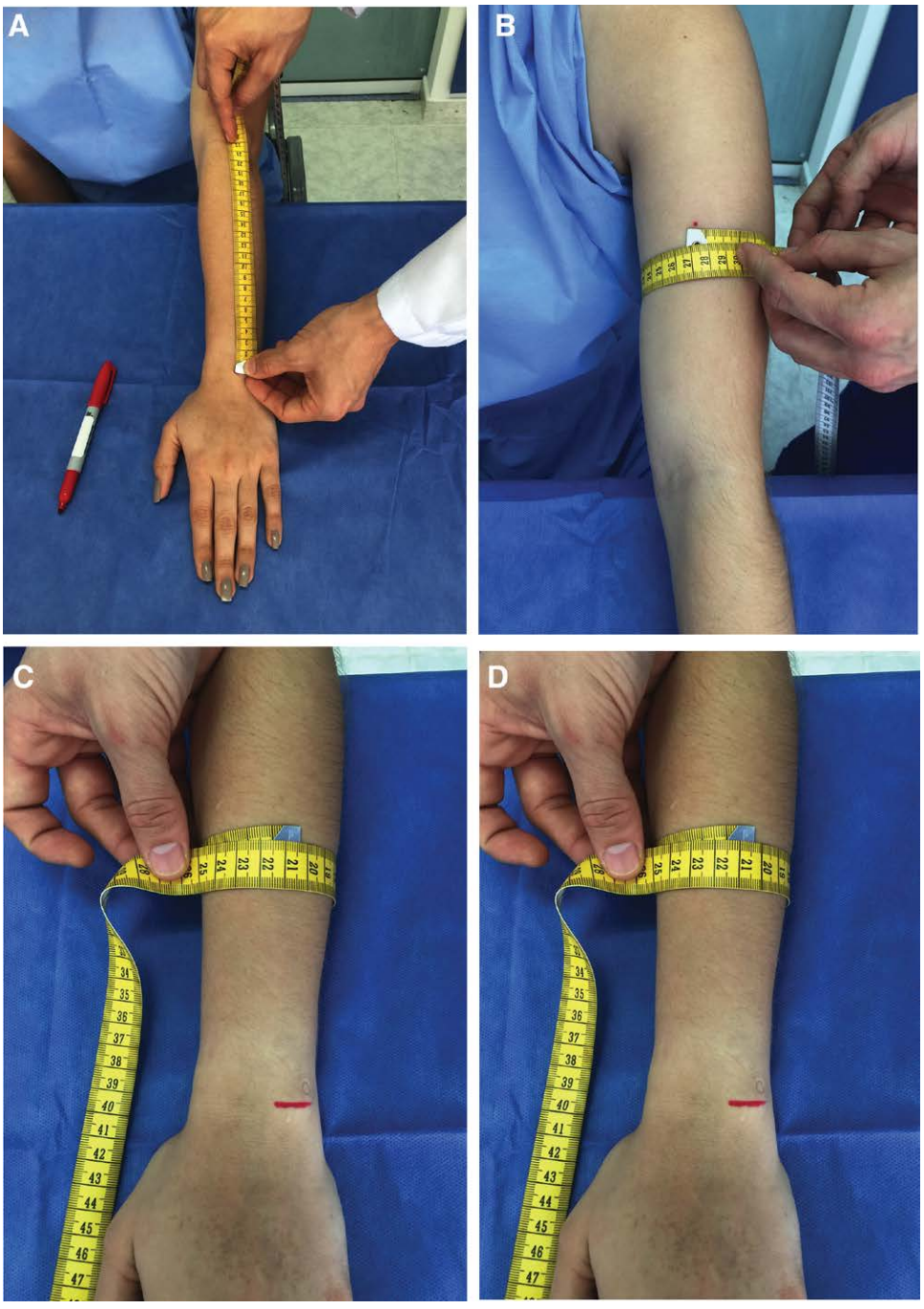

Fig. 1. Measurement process for calculating the truncated cone formula for lymphedema assessment. A, Measurement of the forearm, using the olecranon of the elbow as the proximal anatomical reference and the styloid of the ulna as the distal reference. B, Measurement of the diameter of the arm (the marks of the mentioned anatomical references can be seen with red marker). C, Measurement of the diameter of the mid forearm. D, Diameter measurements at metacarpophalangeal levels.

both groups, with an adjusted OR of 2.06 (95% CI: 0.52–8.26).

Breast Cancer Treatments

Among patients with lymphedema, 86.25% underwent oncological surgery, predominantly quadrantectomy (53.8%). Adjuvant chemotherapy was administered to 37.5% and radiotherapy to 71.3% of patients, with an adjusted OR of 1.58 (95% CI: 0.7–3.8). In the nonlymphedema group, 81.8% underwent oncological surgery, 37.8% received adjuvant chemotherapy, and 67.7% radiotherapy.

Characteristics of Lymphedema and Symptoms

The assessed symptoms for the patients included pain, upper-limb swelling, and limited movement. Logistic regression revealed an OR of 2.69 (95% CI: 1.3–5.8) for

Table 1. Sociodemographic and Clinical Characteristics of the Sample

Patient Characteristics	Total, n = 334	Nonlymphedema, n = 254	Lymphedema, n = 80	*P*
Age, y	59 (IQR 53–69)	58 (IQR 51–67)	62 (IQR 53–69)	0.10
Sex (female)	334 (100%)	254 (100%)	80 (100%)	—
Weight status				
Normal range	117 (35.0%)	95 (37.4%)	22 (27.5%)	0.10
Underweight	6 (1.8%)	6 (2.4%)	0	0.34
BMI > 25	211 (63.2%)	153 (60.2%)	58 (72.5%)	0.04
Histological diagnosis of tumor				
Infiltrating ductal carcinoma	202 (60.5%)	152 (59.8%)	50 (62.5%)	0.77
In situ ductal carcinoma	20 (6%)	17 (6.7%	3 (3.8%)	
Invasive lobular carcinoma	17 (5.1%)	14 (5.5%)	3 (3.8%)	
Invasive tubular carcinoma	2 (0.6%)	2 (0.8%)	0	
Others	27 (8.1%)	19 (7.5%)	8 (10%)	
No data	66 (19.8%)	50 (19.7%)	16 (20%)	—
Grade of tumor				
0	2 (0.6%)	2 (0.8%)	0	0.95
IA	28 (8.4%)	23 (9.1%)	5 (6.3%)	
IB	1 (0.3%)	1 (0.4%)	0	
IC	6 (1.8%)	5 (2%)	1 (1.3%)	
IIA	82 (24.6%)	64 (25.2%)	18 (22.5%)	
IIB	41 (12.3%)	29 (11.4%)	12 (15%)	
IIIA	48 (14.4%)	36 (14.2%)	12 (15%)	
IIIB	25 (7.5%)	19 (7.5%)	6 (7.5%)	
IIIC	7 (2.1%)	5 (2%)	2 (2.5%)	
IVA	14 (4.2%)	10 (3.9%)	4 (5%)	
IVB	6 (1.8%)	4 (1.6%)	2 (2.5%)	
Not classified	28 (8.4%)	24 (9.4%)	4 (5%)	
No data	46 (13.8%)	32 (12.6%)	14 (17.5%)	
Reconstructive surgery				
Free flap	1	1	0	1
DMF	11	10	1	
DMF + breast implant or expansor	5	5	0	
Breast implant + mesh	1	1	0	
Breast implant or expansor	6	5	1	
No reconstructive surgery	310 (92.8%)	232 (91.3%)	78 (97.5%)	
Symptoms				
Pain	159 (47.6%)	124 (48.8%)	35 (43.8%)	0.42
Heaviness	123 (36.8%)	90 (35.4%)	33 (41.3%)	0.34
Swelling arm	77 (23.1%)	47 (18.5%)	30 (37.5%)	<0.01
Limitation of movement	123 (36.8%)	94 (37%)	29 (36.3%)	1
Treatments				
Neoadjuvant chemotherapy	120 (35.9%)	96 (37.8%)	24 (30%)	0.20
Adjuvant chemotherapy	126 (37.7%)	96 (37.8%)	30 (37.5%)	0.96
Taxanes	182 (54.4%)	141 (55.5%)	41 (51.3%)	0.50
Radiotherapy	229 (68.6%)	172 (67.7%)	57 (71.3%)	0.55
Oncological surgery				
Quadrantectomy	184 (55.1%)	141 (55.5%)	43 (53.8%)	0.13
Simple mastectomy	27 (8.1%)	22 (8.7%)	5 (6.3%)	
Radical mastectomy	3 (0.9%)	2 (0.8%)	1 (1.3%)	
Modified radical mastectomy	44 (13.2%)	28 (11%)	16 (20%)	
Skin and nipple sparing mastectomy	6 (1.8%)	5 (2%)	1 (1.3%)	
No data	13 (3.9%)	11 (4.3%)	66 (82.5%)	
Axillary surgery				
Sentinel lymph node biopsy	77 (23.1%)	61 (24%)	16 (20%)	0.29
ALND	175 (52.4%)	127 (50%)	48 (60%)	
No axillar surgery	82 (24.6%)	16 (6.3%)	66 (82.5%)	

BMI, body mass index; DMF, dorsal muscular flap.

swelling and 1.31 (95% CI: 0.6–2.8) for heaviness. Risk factors identified using the logistic model included BMI and arm swelling (Table 2).

Infiltrating ductal carcinoma, arm heaviness, radiotherapy, and ALND also exhibited adjusted ORs greater than 1, albeit with highly heterogeneous CIs.

Table 2. Multivariate Logistic Regression Analysis for the Possible BCRL Risk Factors

	Crude (Unadjusted)				Logistic Model (Adjusted)			
	P	Crude OR	95% CI (LL)	95% CI (UL)	*P*	OR	95% CI (LL)	95% CI (UL)
Age	0.10	1.01	0.99	1.03	0.95	0.99	0.97	1.02
BMI > 25	0.04	1.74	0.97	3.17	0.02	2.25	1.13	4.49
Histological diagnosis of tumor								
Invasive ductal carcinoma	0.77	1.86	0.52	6.63	0.30	2.07	0.52	8.26
Invasive lobular carcinoma		1.21	0.21	6.98	1.0	1.02	0.15	7.05
Invasive tubular carcinoma		1.00	1.00	1.00	1.0	1.00	1.00	1.00
Others		2.38	0.54	10.47	0.1	3.50	0.7	17.8
Symptoms								
Pain	0.43	0.81	0.47	1.39	0.08	0.53	0.3	1.1
Heaviness	0.34	1.28	0.7375	2.20	0.5	1.31	0.6	2.8
Swelling arm	<0.001	2.64	1.46	4.75	0.0	2.69	1.3	5.8
Limitation of movement	1	0.97	0.55	1.68	0.7	0.85	0.4	1.8
Treatment								
Neo adjuvant chemotherapy	0.21	0.71	0.39	1.25	0.3	0.63	0.2	1.6
Radiotherapy	0.55	1.18	0.66	2.15	0.3	1.58	0.7	3.8
Taxanes	0.50	0.84	0.49	1.44	0.9	1.045	0.4	2.8
Oncological surgery	0.37	1.38	0.66	3.14	0.7	0.75	0.16	3.55
Reconstructive surgery	0.06	0.27	0.03	1.14	0.1	0.12	0.0	1.0
Axillary surgery								
Sentinel lymph node biopsy	0.29	1.44	0.76	2.74	0.09	2.09	0.90	4.86
ALND		0.92	0.43	2.01	0.98	0.98	0.22	4.45

BMI, body mass index; LL, low limit; UL, upper limit.

DISCUSSION

The results revealed no significant differences in tumor characteristics or cancer-related treatments between the lymphedema and nonlymphedema groups. Arm swelling and BMI greater than 25 kg/m^2 emerged as factors associated with BCRL in our study, underscoring the importance of these variables in BCRL risk assessment.

This study marks the first investigation into BCRL prevalence in Colombia, an area with limited research background in Latin America and other LMICs. A systematic review and meta-analysis of the prevalence and incidence of BCRL in LMICs revealed considerable heterogeneity, with Brazil being the sole Latin American country with the included studies. The pooled prevalence of arm lymphedema was 27% with considerable heterogeneity (95% CI: 20.0–34.0, I^2 = 94.69%; n = 13 studies).[21] Our findings align closely with the pooled prevalence reported in this review (23.9%), although they differ from those of other studies in Brazil (44.8%), possibly due to variations in the sample inclusion criteria and BCRL diagnosis methods.[6]

Diagnostic Method for BCRL

Regarding the diagnostic method, there is no consensus on the gold-standard assessment for BCRL.[22] Indocyanine green lymphography is one of the most valuable methods for preoperative work-up, surgical planning, intraoperative guidance and for assessing the efficacy of surgical treatments.[23,24] In Colombia, it is essential to establish an appropriate diagnosis of lymphedema to ensure timely referral to the fourth-level hospitals, which are located in the country's largest cities. These hospitals are equipped with the necessary resources and specialized expertise to provide advanced interventions, including diagnostic methods such as indocyanine green lymphography. This referral process is crucial to improving patient outcomes.

The studies included in the systematic review and meta-analysis by Torgbenu et al[21] used circumferential measurements and patient self-reports in the majority, and only 1 study used bioimpedance spectroscopy.[25] Circumferential measurement, a noninvasive and cost-effective method, remains widely used despite its subjectivity.[26–28] Furthermore, self-reporting is open to subjective variability and is likely to report higher rates of lymphedema.[27,29] In our study, we used a validated computer tool, the "lymphedema calculator," which offers a reliable and accessible alternative.[20]

Symptoms and Epidemiological Characteristics

Symptoms associated with BCRL are numerous, complicating diagnosis.[7,30,31] The presence of 1 or more symptom of moderate or high severity at baseline is associated with increased odds of developing BCRL.[27] However, this study lacked external validation. In our study, the symptom of arm swelling was related to BCRL, which is a commonly reported symptom that has been used in prediction models.[7,32]

A high BMI (>25 kg/m^2) has emerged as a significant risk factor for arm lymphedema,, with studies reporting ORs up to 5.9 (95% CI: 1.382–21.82).[21,33–37] These findings are consistent with previous research underscoring the importance of promoting physical activity and healthy lifestyles during breast cancer treatment.[38]

Treatment-related Factors

One of the most common secondary lymphedema causes is malignancy, which is related to breast cancer treatment.[36] Treatment-related factors, including ALND

and regional lymph node radiation, are established risk factors for BCRL.[39] Axillary radiotherapy, in particular, has been associated with a significant risk of BCRL, with ORs up to (OR = 15.34; 95% CI: 5.52–42.58).[21,34,37] This indicates that radiotherapy plays a substantial role in the development of lymphedema by damaging lymphatic vessels and exacerbating the risk of fluid retention in the affected area.

Furthermore, ALND is associated with a 4-fold higher incidence of lymphedema compared with sentinel lymph node biopsy (19.9%; 95% CI: 13.5–28.2), especially when more than 25 lymph nodes are removed during mastectomy, with an OR of 4.88 (95% CI: 2.25–10.58) compared with cases where fewer lymph nodes are removed.[21,40] Importantly, these findings align with those from studies conducted in high-income countries and low-income countries. Together, radiotherapy and extensive lymphadectomy may significantly increase the likelihood of BCRL. However, our study did not find a significant association.

The incidence of arm lymphedema seems to increase up to two years after diagnosis or surgery for breast cancer.[26] The modified radical mastectomy has been associated with an OR of 4.3 (95% CI: 2.3–7.9).[37] This differs from our results that showed no differences between groups. Nevertheless, the findings are supported by other recent studies on risk factors for BCRL in patients undergoing 3 years of prospective surveillance with intervention; in these studies, mastectomy, age, hypertension, diabetes, seroma, smoking, and air travel were not associated with BCRL risk.[41] Moreover, lumpectomy has not been identified as a risk factor for arm lymphedema.[21]

The emerging body data indicate that breast reconstruction does not adversely affect the risk of BCRL.[39,42] However, in our study, either a significant number of patients did not undergo reconstructive surgery or we lacked data on whether they received this procedure. This limitation stems from the fragmented nature of clinical records in Colombia. Often, patients are referred to different hospitals based on the level of complexity required for their ongoing treatment, as determined by their healthcare providers. As a result, it is challenging to access the full clinical history of these patients, especially when they are transferred between institutions. This fragmentation in healthcare records, coupled with limited patient education in some cases, hinders our ability to track surgical interventions such as breast reconstruction and complicates long-term follow-up for lymphedema cases.

Taxane chemotherapy did not result in a significant difference between groups. The effect of chemotherapy on BCRL is controversial,[8] and the discussion in the study by Tsai et al[43] showed that BCRL is not a direct cause of BCRL because patients receiving chemotherapy were more likely to undergo invasive surgery and regional lymph node radiation, which can be a confusing factor.[41] Currently, there is no consensus on which procedure (lymphovenous bypass or vascular lymph node transplantation) is more effective (grade 2C) for the surgical prevention of lymphedema.[44]

BCRL development is multifactorial and is influenced by treatment strategies (ALND, regional nodal irradiation, and taxane-based chemotherapy),[41] individual factors that are potentially modifiable, such as BMI, and perhaps by the individual patient's ability to form collateral lymphatic pathways after injury.[39] In recent years, there has been growing evidence of prediction models of lymphedema made from a combination of multiple predictors for the disease, using machine learning algorithms and other mathematical methods. It calculates specific risk values for individuals, and can predict the risk of related outcomes. It is a powerful tool for individualized diagnosis and treatment.[45] Most studies have focused on treatment methods for diseases and physiological conditions of patients. Therefore, further studies are aimed at externally validating models to evaluate the extrapolation of the model.[32]

This study serves as a foundational step in BCRL research in Colombia, although its limitations arise from incomplete reporting and missing data, especially regarding treatment, which can lead to a bias. This is due to barriers to accessing healthcare in Colombia and the fragmented system (different health providers and a lack of unified medical records). Moreover, patients often originate from rural areas with inadequate information regarding their medical conditions and experience loss of medical records. In addition, the prevalence of lymphedema was measured at only 1 time point, and the sample included patients at different points in the treatment timeline. Further research is crucial to refine risk assessments and intervention strategies to improve patient outcomes and quality of life.

This study aimed to raise awareness among medical doctors so that they can conduct reports to develop interventions to improve the early detection of BCRL and treatment strategies and improve the quality of life of patients. Further research is crucial to refine risk assessments and intervention strategies to improve patient outcomes and quality of life.

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DISCLOSURES

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