



The Analysis Study of Diagnosis and Surgical Management of Breast Cancer : A Comprehensive Systematic Review

¹ Anindya Ryan Pramudya, ¹ Dewandaru Istighfaris Agadinata Bramanti

¹ Faculty of Medicine, Muhammadiyah University of Purwokerto, Banyumas

Regency, Central Java, Indonesia

Email : anindyaryan16@gmail.com

Article History :

Received date : 2024/11/17

Revised date : 2024/12/23

Accepted date : 2025/01/12

Published date : 2025/03/02



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E-ISSN :

ISSN 3048-1368



P-ISSN :

ISSN 3048-1376



ABSTRACT

Background: Breast cancer remains a significant global health challenge, representing the most common malignancy among women and a leading cause of cancer-related mortality. This systematic review aims to synthesize current evidence on the diagnosis and surgical management of breast cancer.

Methods: The study followed PRISMA 2020 guidelines, reviewing English-language publications from 2015 to 2025. Editorials, duplicate reviews from the same journal, and papers lacking a DOI were excluded. The literature search was conducted using PubMed, SagePub, SpringerLink, and Google Scholar. **Result:** A total of 2,172 articles were initially identified through online databases (PubMed, SagePub, SpringerLink, and Google Scholar). After three rounds of screening, eight relevant studies were selected for full-text analysis.

Conclusion: Breast cancer diagnosis and surgery have evolved with advanced imaging, molecular profiling, and oncoplastic techniques, emphasizing patient-centered care. While mastectomy remains necessary in some cases, oncoplastic approaches offer safe, effective outcomes. Future research should refine techniques, staging, and therapeutic integration.

Keywords: breast cancer, diagnosis, surgical management

INTRODUCTION

Breast cancer remains a significant global health challenge, representing the most common malignancy among women and a leading cause of cancer-related mortality. Advances in early detection and treatment have contributed to improved survival rates; however, disparities in diagnosis and management persist. The transition from a standardized treatment approach to precision medicine has revolutionized breast cancer care, integrating sophisticated diagnostic tools, molecular profiling, and evolving surgical techniques.^{1,2}

Accurate diagnosis of breast cancer relies on a combination of screening methods, imaging techniques, and histopathological evaluations. Mammography remains the gold standard for population-based screening, with digital breast tomosynthesis and MRI playing crucial roles in high-risk patients. The integration of molecular biomarkers and genomic profiling has further refined diagnostic accuracy, allowing for a more individualized assessment of tumor behavior.^{3,4}

The surgical management of breast cancer has evolved significantly over the past decades, moving away from radical mastectomy towards breast-conserving strategies that prioritize oncologic safety and cosmetic outcomes. Techniques such as sentinel lymph node biopsy (SLNB) have minimized the morbidity associated with axillary lymph node dissection while maintaining adequate staging accuracy. Furthermore, oncoplastic surgery and immediate breast reconstruction have improved post-operative quality of life for many patients, reflecting the growing emphasis on patient-centered care.^{5,6}

Although breast-conserving surgery (BCS) combined with radiation therapy has demonstrated comparable survival outcomes to mastectomy in early-stage disease, patient selection remains critical. Advances in surgical planning, including preoperative imaging and neoadjuvant therapies, have expanded the indications for BCS while reducing re-excision rates. However, debates continue regarding the optimal surgical approach for different breast cancer subtypes, particularly in the context of evolving systemic treatments and targeted therapies.⁷⁻⁹ This systematic

review aims to synthesize current evidence on the diagnosis and surgical management of breast cancer.

METHODS

Protocol

The study strictly adhered to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 guidelines to ensure methodological rigor and accuracy. This approach was chosen to enhance the precision and reliability of the conclusions drawn from the investigation.

Criteria for Eligibility

This systematic review aims to synthesize current evidence on the diagnosis and surgical management of breast cancer based on literatures of the last decade. The review aimed to provide insights to improve patient treatment strategies, with an emphasis on the significance of key findings in the reviewed studies. Inclusion criteria for the study included: 1) Papers published in English, and 2) Papers published between 2014 and 2024. Exclusion criteria were: 1) Editorials, 2) Papers without a DOI, 3) Previously published review articles, and 4) Duplicate entries in journals.

Search Strategy

The keywords used for this research are breast cancer, diagnosis, surgical management. The Boolean MeSH keywords inputted on databases for this research are: *("breast neoplasms"[MeSH Terms] OR ("breast"[All Fields] AND "neoplasms"[All Fields]) OR "breast neoplasms"[All Fields] OR ("breast"[All Fields] AND "cancer"[All Fields]) OR "breast cancer"[All Fields]) AND ("diagnosable"[All Fields] OR "diagnosi"[All Fields] OR "diagnosis"[MeSH Terms] OR "diagnosis"[All Fields] OR "diagnose"[All Fields] OR "diagnosed"[All Fields] OR "diagnoses"[All Fields] OR "diagnosing"[All Fields] OR "diagnosis"[MeSH Subheading]) AND (("surgical procedures, operative"[MeSH Terms] OR ("surgical"[All Fields] AND "procedures"[All Fields] AND*

"operative"[All Fields]) OR "operative surgical procedures"[All Fields] OR "surgical"[All Fields] OR "surgically"[All Fields] OR "surgeries"[All Fields] AND ("manage"[All Fields] OR "managed"[All Fields] OR "management s"[All Fields] OR "managements"[All Fields] OR "manager"[All Fields] OR "managers"[All Fields] OR "manages"[All Fields] OR "managing"[All Fields] OR "managment"[All Fields] OR "organization and administration"[MeSH Terms] OR ("organization"[All Fields] AND "administration"[All Fields]) OR "organization and administration"[All Fields] OR "management"[All Fields] OR "disease management"[MeSH Terms] OR ("disease"[All Fields] AND "management"[All Fields]) OR "disease management"[All Fields])).

Data retrieval

Abstracts and titles were screened to assess their eligibility, and only studies meeting the inclusion criteria were selected for further analysis. Literature that fulfilled all predefined criteria and directly related to the topic was included. Studies that did not meet these criteria were excluded. Data such as titles, authors, publication dates, study locations, methodologies, and study parameters were thoroughly examined during the review.

Quality Assessment and Data Synthesis

Each author independently assessed the titles and abstracts of the selected studies to identify those for further exploration. Articles that met the inclusion criteria underwent further evaluation. Final decisions on inclusion were based on the findings from this review process.

Table 1. Article Search Strategy

Database	Keywords	Hits
Pubmed	<i>("breast neoplasms"[MeSH Terms] OR ("breast"[All Fields] AND "neoplasms"[All Fields]) OR "breast neoplasms"[All Fields] OR ("breast"[All Fields] AND "cancer"[All Fields]) OR "breast cancer"[All Fields] AND ("diagnosable"[All Fields] OR "diagnosi"[All Fields] OR "diagnosis"[MeSH Terms] OR "diagnosis"[All Fields] OR "diagnose"[All Fields] OR "diagnosed"[All Fields] OR "diagnoses"[All Fields] OR "diagnosing"[All Fields] OR "diagnosis"[MeSH Subheading]) AND ("surgical procedures, operative"[MeSH Terms] OR ("surgical"[All Fields] AND "procedures"[All Fields] AND "operative"[All Fields]) OR "operative surgical procedures"[All Fields] OR "surgical"[All Fields] OR "surgically"[All Fields] OR "surgicals"[All Fields]) AND ("manage"[All Fields] OR "managed"[All Fields] OR "managements"[All Fields] OR "managements"[All Fields] OR "manager"[All Fields] OR "manager s"[All Fields] OR "managers"[All Fields] OR "manages"[All Fields] OR "managing"[All Fields] OR "managment"[All Fields] OR "organization and administration"[MeSH Terms] OR ("organization"[All Fields] AND "administration"[All Fields]) OR "organization and administration"[All Fields] OR "management"[All Fields] OR "disease management"[MeSH Terms] OR ("disease"[All Fields] AND "management"[All Fields]) OR "disease management"[All Fields]))</i>	466
Springer Link	<i>((breast cancer) AND (diagnosis)) AND (surgical management)</i>	402
Sagepub	<i>((breast cancer) AND (diagnosis)) AND (surgical management)</i>	500
Google Scholar	<i>((breast cancer) AND (diagnosis)) AND (surgical management)</i>	804

Table 2. JBI *Critical appraisal of Study*

Parameters	Jonczyk (2019)	Simons (2019)	Huang (2016)	Carter (2016)	Crown (2015)	Fitzal (2022)	Jafari (2017)	No no u (2015)
1. Bias related to temporal precedence								
Is it clear in the study what is the “cause” and what is the “effect” (ie, there is no confusion about which variable comes first)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Bias related to selection and allocation								
Was there a control group?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Bias related to confounding factors								
Were participants included in any comparisons similar?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Bias related to administration of intervention/exposure								
Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	No.	No.	No.	No.	No.	No.	No.	No.
5. Bias related to assessment, detection, and measurement of the outcome								
Were there multiple measurements of the outcome, both pre and post the intervention/exposure?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Were the outcomes of participants included in any comparisons measured in the same way?	No.	No.	No.	No.	No.	No.	No.	No.
Were outcomes measured in a reliable way?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6. Bias related to participant retention								
Was follow-up complete and, if not, were differences between groups in terms of their follow-up adequately described and analyzed?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Statistical conclusion validity								
Was appropriate statistical analysis used?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

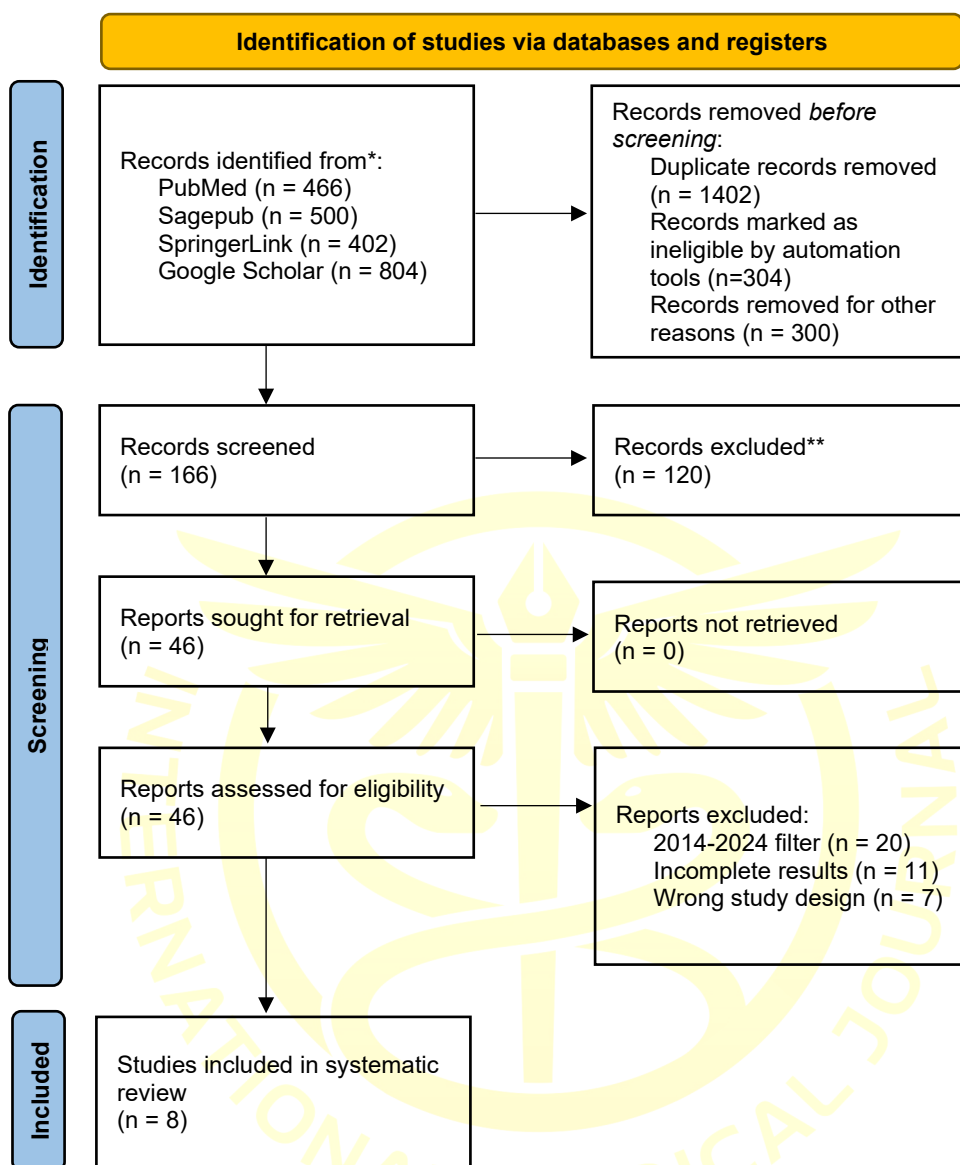


Figure 1. Article search flowchart

RESULT

The initial number of articles retrieved from online databases (PubMed, SagePub, SpringerLink, and Google Scholar) is 2,172 articles. After conducting three levels of screening, eight articles that directly relate to the current systematic review have been chosen for further assessment through full-text reading and analysis. Table 3 presents the selected literature included in this analysis.

Table 3. The literature included in this study

No.	Author	Origin	Method	Sample	Result
1.	Jonczyk, et al. ¹⁰ (2019)	USA	Retrospective cohort	197,387	The analysis of 197,387 patients from the NSQIP database diagnosed with invasive breast cancer (IBC) or ductal carcinoma in situ (DCIS) revealed evolving trends in breast cancer surgery. While the rate of partial mastectomy (PM) remained stable, mastectomy (M) alone significantly decreased, and mastectomy with reconstruction (M+R) increased. Notably, oncoplastic surgery (OS) became more prevalent among patients undergoing breast conservation. Among those undergoing mastectomy, the use of muscular flap reconstruction declined, while implant-based reconstruction nearly doubled. These findings highlight the growing emphasis on breast reconstruction and its implications for future surgical practices and training programs.
2.	Simons, et al. ¹¹ , (2019)	Netherlands	Retrospective cohort	2217	A quantitative analysis of 20 studies involving 2,217 patients evaluated axillary staging techniques post-neoadjuvant systemic therapy (NST). Sentinel lymph node biopsy (SLNB) showed an identification failure rate (IFR) of 89%, a false-negative

					rate (FNR) of 17%, and a negative predictive value (NPV) ranging from 57% to 86%. The MARI procedure had better accuracy, with an IFR of 97%, an FNR of 7%, and an NPV of 83%. The combination of SLNB and excision of a pre-NST marked positive lymph node demonstrated the highest accuracy, with an IFR of 100%, an FNR of 2–4%, and an NPV of 92–97%. The findings suggest that the combination procedure is the most reliable for axillary staging after NST, but further validation through prospective multicenter trials is needed.
3.	Huang, et al. ¹² (2016)	China	Retrospective cohort	18,502	The median age of breast cancer patients was 50 years, with stage distribution as follows: 12.5% at stage 0, 30.2% at stage I, 40.0% at stage II, and 17.3% at stage III. Estrogen receptor (ER) positivity was found in 67.1% of cases. Over the past 15 years, surgical trends have shifted from radical mastectomy to modified radical mastectomy and simple mastectomy with sentinel lymph node biopsy. Most patients (81.7%) underwent mastectomy without immediate reconstruction, while 15.2% had breast-conserving surgery (BCS), and 3.7% received immediate reconstruction. The 5-year recurrence-free survival (RFS) rates were 87.6% for mastectomy, 93.2% for BCS, and 91.7% for reconstruction ($P < 0.001$), with distant recurrence being the main driver of outcomes. Multivariate analysis identified tumor stage, grade,

					lymphovascular invasion (LVI), and ER status as independent prognostic factors, while surgical modality itself was not. Despite an increase in BCS utilization, mastectomy remains the most common approach in China, with patient selection relying on comprehensive clinicopathological assessment.
4.	Carter, et al. ¹³ (2016)	USA	Retrospective cohort	9861	Among 9,861 breast cancer patients who underwent 10,607 surgeries, the use of breast-conserving surgery with reconstruction (BCS + R) increased nearly fourfold during the study period. Most BCS + R patients (75%) had T1 or T2 tumors. The procedure was performed at similar rates across breast quadrants, except for the lower outer quadrant, where it was more common (11.1% vs. 6.8%; $p < 0.0001$). Compared to BCS alone, BCS + R had a lower incidence of seroma formation (13.4% vs. 18%; $p = 0.002$) and fewer cases of positive or close margins (5.8% vs. 8.3%; $p = 0.04$). No significant differences in overall or recurrence-free survival were observed between BCS, BCS + R, and total mastectomy (TM). These findings suggest that BCS + R is a safe and effective option without increasing complications or compromising short-term oncologic outcomes.
5.	Crown, et al. ¹⁴ (2015)	USA	Retrospective cohort	812	In a study of 812 breast cancer patients, 425 were treated with standard surgery (SS) and 387 with oncoplastic surgery (OS). The mastectomy rate was significantly lower in the OS group (15% vs.

					34%; $p < 0.001$). Among patients undergoing breast-conserving surgery (BCS), the OS group had larger tumors on average (15.4 mm vs. 12.7 mm; $p = 0.04$) but a significantly lower re-excision rate (18% vs. 32%; $p < 0.001$). These findings suggest that oncoplastic BCS allows for the treatment of larger tumors while reducing the need for mastectomy and re-excision, optimizing both oncologic and cosmetic outcomes.
6.	Fitzal, et al. ¹⁵ (2022)	Austria	Retrospective cohort	3177	In a study of 3,177 women, 30% underwent oncoplastic breast surgery (OBC), with 663 in the OBCI group and 297 in the OBCII group. The BCS/OBCI group had smaller tumors and narrower margins than OBCII (pT1: 50% vs. 37%, $p = 0.002$; margin < 1 mm: 17% vs. 6%, $p < 0.001$). Re-excision rates due to positive margins were higher in the BCS/OBCI group (11% vs. 7%; $p = 0.049$). Despite larger tumor resections in OBCII, there were no significant differences in recurrence-free or overall survival between the groups. These findings suggest that larger resections in oncoplastic surgery improve margin clearance while maintaining oncologic outcomes comparable to standard breast-conserving surgery.
7.	Jafari, et al. ¹⁶ (2017)	Iran	Retrospective cohort	-	Breast cancer is the second leading cause of cancer-related death among women, with both genetic and environmental factors contributing to its initiation and progression. Early diagnosis is crucial for effective treatment, and imaging techniques play a key role

					in detecting and monitoring the disease. Various imaging modalities, including mammography, MRI, PET, CT, and SPECT, provide valuable diagnostic insights across different stages of breast cancer. In addition to imaging, biochemical biomarkers such as proteins, DNAs, mRNAs, and microRNAs have emerged as promising diagnostic and therapeutic tools. This review summarizes the role of imaging techniques and molecular biomarkers in breast cancer diagnosis, with a particular focus on microRNAs and exosomes as novel biomarkers for disease monitoring and treatment.
8.	Nonou, et al. ¹⁷ (2015)	Egypt	Retrospective cohort	-	Breast cancer remains the most common cancer in women worldwide, with survival rates improving due to advancements in screening, early diagnosis, and treatment innovations. Classification and staging methods have evolved, with molecular subtyping playing a crucial role in clinical trials and disease understanding. Emerging technologies are enhancing the detection of metastases, recurrence, and treatment response assessment. Ongoing research is focused on developing novel therapeutics for clinical application. Recent studies and patents explore strategies such as targeted drug development, multifunctional carrier systems, drug conjugation with diagnostic or targeting moieties, and innovative approaches like genetic

					engineering, stem cells, and vaccinations.
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DISCUSSION

Breast cancer is the most commonly diagnosed malignancy in women worldwide, with survival rates improving due to advancements in early detection and treatment. Over the past few decades, precision medicine has played a crucial role in integrating imaging, molecular biomarkers, and individualized surgical approaches to enhance patient outcomes.¹⁰

Early diagnosis significantly improves survival outcomes, with imaging techniques being the foundation of breast cancer detection. Mammography remains the gold standard, while digital breast tomosynthesis has improved cancer detection rates and reduced false positives. Advanced imaging modalities such as MRI, PET, CT, and SPECT provide detailed tumor characterization and staging. Additionally, biochemical biomarkers, including proteins, DNAs, mRNAs, and microRNAs, are increasingly used as complementary diagnostic tools to identify tumor subtypes and predict treatment response.¹⁶

Breast cancer staging follows the TNM classification system, which assesses tumor size, nodal involvement, and distant metastasis. Most cases are diagnosed at stage II, followed by stage I and III. Axillary lymph node assessment is a critical component of staging, with sentinel lymph node biopsy (SLNB) being the preferred method in clinically node-negative patients. Studies indicate that the MARI procedure, which involves marking and excising positive lymph nodes before neoadjuvant therapy, improves accuracy over SLNB, offering lower false-negative rates and more precise staging.¹¹

Ultrasound (USG) and CT scans are frequently employed in breast cancer evaluation. USG helps differentiate solid from cystic lesions and assess axillary lymph node involvement, making it a valuable adjunct to mammography, particularly in younger women with dense breasts. CT scans are instrumental in evaluating the extent of disease, particularly in detecting metastases in advanced

cases. These imaging techniques are also essential in guiding biopsy procedures and monitoring treatment responses in patients undergoing neoadjuvant therapy.¹⁶

Surgical intervention remains a primary treatment modality for early-stage breast cancer. The main indications for surgery include localized invasive breast cancer (IBC), ductal carcinoma in situ (DCIS), and cases without distant metastases. The choice of surgical procedure depends on factors such as tumor size, location, lymph node involvement, and patient preference. Breast-conserving surgery (BCS) has become increasingly favored over mastectomy due to its comparable survival outcomes and superior cosmetic benefits.¹²

Breast cancer surgery has evolved significantly, shifting from radical mastectomy to more conservative and reconstructive techniques. Studies show a decline in mastectomy rates, with a corresponding rise in oncoplastic surgery (OS) and implant-based reconstruction. Oncoplastic breast surgery (OBC) combines oncologic resection with plastic surgery techniques, ensuring better aesthetic outcomes without compromising oncologic safety. Techniques include lumpectomy with volume displacement, therapeutic mammoplasty, and mastectomy with immediate or delayed reconstruction.¹⁰

The selection of the optimal surgical technique depends on tumor characteristics, patient anatomy, and expected outcomes. Oncoplastic BCS reduces the need for mastectomy while maintaining safe margins and minimizing re-excision rates. Studies show that BCS with reconstruction has a lower rate of seroma formation and fewer cases of positive margins compared to standard BCS. Larger resections in oncoplastic surgery improve margin clearance while maintaining survival rates similar to standard BCS, making it a preferred approach for many patients.^{13,14}

Survival outcomes after breast cancer surgery depend on tumor biology, stage at diagnosis, and adjuvant therapy. Studies report 5-year recurrence-free survival (RFS) rates of 87.6% for mastectomy, 93.2% for BCS, and 91.7% for reconstruction. The primary determinant of RFS is distant recurrence rather than local recurrence, emphasizing the importance of systemic therapy in disease control. Multivariate analyses highlight tumor stage, grade, lymphovascular

invasion, and estrogen receptor (ER) status as independent prognostic factors for survival, rather than the type of surgical procedure.¹²

Ongoing research continues to refine surgical approaches to minimize morbidity while ensuring oncologic safety. Emerging technologies, including targeted drug development, innovative carrier systems, and genetic engineering techniques, are revolutionizing breast cancer management. The integration of molecular diagnostics with imaging and surgical planning is expected to further improve personalized treatment strategies, ultimately enhancing patient outcomes.¹⁷

CONCLUSION

Breast cancer diagnosis and surgery have evolved with advanced imaging, molecular profiling, and oncoplastic techniques, emphasizing patient-centered care. While mastectomy remains necessary in some cases, oncoplastic approaches offer safe, effective outcomes. Future research should refine techniques, staging, and therapeutic integration.

DISCLOSURE STATEMENT

- Disclosure Statement : The authors have no conflicts of Interest to declare
- Funding Sources : None
- Acknowledgements : -
- Author Contribution : All authors discussed and contributed the final content for journal submission and publication.

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