RESEARCH ARTICLE

Editorial Process: Submission:08/11/2025 Acceptance:04/16/2026 Published:05/18/2026

Breast Cancer Screening Patterns Following National Crises: Experience from a Lebanese Tertiary Center

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Abstract

Background: Lebanon's recent compounded crises-including economic collapse, the COVID-19 pandemic, and the Beirut Port explosion-have disrupted healthcare access, including breast cancer (BC) screening. This study assesses adherence to BC screening after the onset of these crises and evaluates associated imaging outcomes. **Methods:** This retrospective, single-center study included women aged ≥40 who underwent screening mammography (± ultrasound) at Lebanese Hospital Geitaoui (LHG) between October 2018 and October 2019, during the year that preceded the crisis. Exclusions included known BC, symptomatic imaging, and age <40. Data were extracted from the Picture Archiving and Communication System (PACS) and pathology records, including demographic, clinical, and imaging variables. Participants were stratified into two groups: Group Loyal (prior LHG screening) and Group New (no prior LHG screening). Imaging, histopathologic, and follow-up data (2019–2022) were analyzed. Non-adherent Group Loyal subjects were contacted via survey to explore screening barriers. **Results:** Among 642 women screened, 461 met inclusion criteria (Group Loyal: 247; Group New: 214). Group Loyal had a higher family history of BC (31.6% vs. 21.5%, $p = 0.005$) and lower baseline BI-RADS scores. Overall, 191/461 (41.4%) underwent follow-up screening, with significantly higher adherence in Group Loyal (54.6%) than Group New (26.2%, $p < 0.001$). Among 44 Group Loyal non-adherent respondents, 47% cited crisis-related barriers. Nine women had increased BI-RADS over time; one was diagnosed with infiltrative ductal carcinoma. Baseline biopsies confirmed four malignancies, yielding a cancer detection rate of 8.6 per 1,000. **Conclusion:** Post-crisis BC screening adherence declined significantly, particularly among women without prior institutional screening. Continued follow-up was associated with more stable BI-RADS outcomes and earlier-stage cancer detection. Sustained public health strategies are needed to mitigate the impact of national emergencies on cancer prevention.

Keywords: Breast cancer screening- BI-RADS- COVID-19- Lebanese economic crisis- Beirut Port explosion

Asian Pac J Cancer Prev, **27 (5)**, 1717-1723

Introduction

Breast cancer (BC) is the most commonly diagnosed cancer among women in Lebanon, accounting for over one-third of female cancer cases, with an incidence of 96.8 per 100,000 women [1]. Since 2002, the Ministry of Public Health has led annual awareness campaigns offering free or discounted mammography screenings for women aged 40 and above. These efforts significantly improved early detection rates and reduced late-stage diagnoses [2].

However, since 2019, Lebanon has experienced a series of severe disruptions including political and financial collapse, the COVID-19 pandemic, and the Beirut Port explosion collectively referred to in this study as the "triple shock crisis." These events have drastically impacted healthcare access and led to the suspension of national BC screening campaigns between 2019 and 2023.

Preliminary observations suggest a substantial decline in mammography use during this period, but limited data exist to quantify this drop or explore contributing factors. The extent and causes of post-crisis non-adherence to BC screening remain poorly understood, hindering the development of effective public health strategies.

The primary aim of this study is to evaluate the rate of adherence to BC screening at Lebanese Hospital Geitaoui (LHG) following the onset of the triple shock crisis. Secondary objectives include assessing patient-reported barriers related to each component of the crisis, comparing socio-demographic characteristics (such as age and family history) between adherent and non-adherent women, and analyzing BIRADS distribution with histopathologic correlation for higher-risk categories.

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Materials and Methods

This retrospective observational study was conducted at LHG. It included women aged ≥40 years who underwent BC screening defined as mammography with or without breast ultrasound between October 1, 2018, and October 17, 2019. This timeframe corresponds to the year immediately preceding the onset of Lebanon's economic collapse, the first component of the "triple shock crisis."

Inclusion and Exclusion Criteria
Inclusion criteria were

- Female patients aged 40 years or older as of 2018
- Underwent breast imaging at LHG for routine screening during the defined period

Exclusion criteria were

- Known diagnosis of BC under follow-up
- Imaging for symptomatic indications (e.g., palpable mass, nipple discharge)
- Male patients
- Women younger than 40 years

Data Collection and Variables

Using the hospital's Picture Archiving and Communication System (PACS), all eligible mammograms within the specified period were identified. Data extracted from radiology reports included: age, family history of BC, previous screening history, imaging modality, BI-RADS classification, and follow-up imaging or biopsy results. MRI and ultrasound findings were included where available. In cases where each breast had a different BI-RADS score, the higher category was used for analysis. BI-RADS scores were grouped as follows:

- BI-RADS 0: Indeterminate
- BI-RADS 1–2: Benign
- BI-RADS 3: Probably benign
- BI-RADS 4–5: Suspicious/malignant, requiring histological sampling

Changes in BI-RADS were tracked across follow-up exams for a 3 years period and categorized as increased or decreased based on clinically relevant thresholds. An increase in BI-RADS category was defined as a shift toward more suspicious findings such as moving from BI-RADS 1 or 2 to BI-RADS 0, 3, or 4, or from BI-RADS 3 to 0 or 4. A decrease in BI-RADS category indicated a shift toward less suspicious findings for example, from BI-RADS 0 to 1, 2, or 3; from BI-RADS 3 to 2; or from BI-RADS 4 to 3.

All biopsy results were fetched from the histopathology department when applicable.

Group Stratification and Rationale

To evaluate whether institutional familiarity influenced screening adherence during the crisis period, participants were stratified based on their screening history at LHG:
$Group^{Loyal}$

Women with at least one prior screening mammogram at LHG before 2018

$Group^{New}$

Women with no previous LHG screening before 2018, regardless of prior imaging at other institutions.

This grouping was designed to explore whether institutional loyalty was associated with better post-crisis adherence.

Follow-Up and Survey

All participants' imaging records were reviewed for follow-up breast imaging at LHG between October 2019 and December 2022. For $Group^{Loyal}$ participants who did not return for follow-up during this period, a structured survey was conducted in September 2024 to determine if they had screened elsewhere or to identify barriers to continued screening. The survey was distributed via WhatsApp, followed by a reminder after two weeks. Non-respondents were contacted by phone by a trained medical secretary. Consent was obtained at the start of each survey interaction.

Data Analysis

Data were anonymized and organized into Excel spreadsheets. Descriptive statistics (means, medians, frequencies) were used to summarize variables. Group comparisons were performed using the Mann-Whitney U test for continuous non-parametric variables and the Chi-square test for categorical variables. A p-value < 0.05 was considered statistically significant.

Ethical Approval

This study was approved by the Institutional Review Board (IRB) of LHG. Waiver of consent was granted for data extraction from PACS. Informed verbal or written consent was obtained for survey participation, with the right to withdraw emphasized to all participants

Results

Study Cohort Selection

Between October 1, 2018, and October 17, 2019, a total of 642 individuals underwent breast imaging (mammography with or without ultrasound) at Lebanese Hospital Geitaoui. After applying inclusion and exclusion criteria, 461 women were retained for final analysis (Figure 1).

A total of 181 subjects were excluded for the following reasons

- 50 had imaging performed outside LHG, with files uploaded for comparison only
- 7 were male
- 118 underwent imaging for non-screening purposes, including: known BC (n = 6), clinical symptoms such as palpable masses or nipple discharge (n = 42), follow-up of previously diagnosed benign lesions (n = 69), and trauma (n = 1)
- 36 were under the age of 40

Some individuals met multiple exclusion criteria, explaining why the total number of excluded cases exceeds 181.

Baseline Characteristics and Group Comparison

Following application of the inclusion and exclusion criteria, 461 women were included in the final analysis. Of these, 247 had a documented history of prior BC screening at LHG (Group^{Loyal}), while 214 had no previous LHG screening records (Group^{New}).

The mean age was comparable between the two groups: 58.7 ± 10.4 years in Group^{Loyal} and 57.1 ± 11.3 years in Group^{New}, with no statistically significant difference (p = 0.07) (Table 1). A family history of BC was reported in 124 out of 461 women (27.0%). This was significantly more common in Group^{Loyal} (78/247, 31.6%) than in Group^{New} (46/214, 21.5%) (p = 0.005) (Table 1).

Baseline BI-RADS distribution differed significantly between groups (p = 0.012, Chi-square test)

Group^{Loyal}

BI-RADS 1–2 in 208/247 (84.2%), BI-RADS 0 in 18/247 (7.3%), BI-RADS 3 in 19/247 (7.7%), and BI-RADS 4–5 in 2/247 (0.8%)

Group^{New}

BI-RADS 1–2 in 149/214 (69.6%), BI-RADS 0 in 27/214 (12.6%), BI-RADS 3 in 29/214 (13.6%), and BI-RADS 4–5 in 9/214 (4.2%)

-In total, 191 out of 461 women (41.4%) had at least one follow-up screening at LHG between 2019 and 2022. Adherence to follow-up was significantly higher in Group^{Loyal} (135/247, 54.6%) than in Group^{New} (56/214, 26.2%) (p < 0.001) (Table 1).

Sociodemographic and Imaging Characteristics of Group^{Loyal} Based on Screening Adherence

Among women in Group^{Loyal} , 135 out of 247 (54.6%) continued BC screening at LHG during the follow-up period (Group$^{Loyal\ -Follow\text{-}Up}$), while 112 (45.4%) did not (Group$^{Loyal\ -No\ Follow\text{-}Up}$). There were no statistically significant differences in age or family history of BC between those who adhered to screening and those who did not.

Baseline BI-RADS distribution also showed no significant difference between the two subgroups (p = 0.093, Chi-square test) (Table 2).

BI-RADS Evolution and Malignancy Detection During Follow-Up (2019–2022)

Changes in BI-RADS categories between baseline and follow-up screenings were analysed for the entire cohort (N = 461), as shown in Table 3. A statistically significant difference in BI-RADS evolution was observed between Group^{Loyal} and Group^{New} (p < 0.001, Chi-square test).

Among the 9 women who showed an increase in BI-RADS category during follow-up, only one was diagnosed with malignancy. This case was confirmed as infiltrative ductal carcinoma by biopsy.

Reported Barriers to Continued Screening in Non-Adherent Group^{Loyal} *Participants*

To explore reasons for discontinuation, all women in Group$^{Loyal\ -No\ Follow\text{-}Up}$ (n = 112) were contacted. An initial WhatsApp message was sent twice, yielding two responses. Follow-up phone calls resulted in 42 additional responses, for a total of 44 responses and a response rate of 39.3% (44/112). Results are presented in Figure 2.

Among respondents, 21/44 (47.7%) indicated that their decision to discontinue screening was influenced by at least one component of the triple shock crisis namely the COVID-19 pandemic, the economic collapse, or the Beirut Port explosion. Seven participants reported being impacted by all three crises.

The remaining 23/44 (52.3%) cited reasons unrelated to these external events, most commonly the perception that further screening was unnecessary following previously normal mammograms (4/44, 9.1%).

Imaging Characteristics of Group$^{Loyal\ -Follow\text{-}Up}$

Among participants in Group$^{Loyal\ -Follow\text{-}Up}$ (n = 135), the majority had a baseline BI-RADS classification of 1–2 (112/135, 83%), followed by BI-RADS 3 (15/135, 11.1%), BI-RADS 0 (7/135, 5.1%), and BI-RADS 4–5 (1/135, 0.9%). The median follow-up duration per participant was 3 years, with an interquartile range (IQR) of 1 year (Table 4).

Table 1. Baseline Characteristics of the Study Population

		Screening population (N=461)	Group^{Loyal} (N=247)	Group^{New} (N=214)	P value
Age					0.078
Mean ± SD		57.9± 10.8	58.7± 10.4	57.1± 11.3	
Median (IQR)		57 (17)	58 (17)	56 (17)	
Range [min-max]		[40-91]	[40-88]	[40-91]	
Positive family history for BC		124 (26.9%)	78 (31.6%)	46 (21.5%)	0.0057
Baseline BI-RADS	0	45 (9.8%)	18 (7.3%)	27 (12.6%)	0.012
(US+MG)	1-2	357 (77.4%)	208 (84.2%)	149 (69.6%)	
(2018-2019)	3	48 (10.4%)	19 (7.7%)	29 (13.6%)	
	4-5	11 (2.4%)	2 (0.8%)	9 (4.2%)	
Subjects who continued screening at LHG after (2019-2022)		191/461 (41.40%)	135/247 (54.70%)	56/214 (26.20%)	<0.001

BIRADS, Breast Imaging Report and Data System; Group^{Loyal}, patients with previous screening at LHG; Group^{New}, patients with no previous screening at LHG; IQR, interquartile range; LHG, Lebanese Hospital Geitaoui. MG, mammogram; US: ultrasound.

Table 2. Age, Family History, and Baseline BI-RADS Among Women Loyal to Screening at LHG, by Continuation of Screening Post-2019

		Group^{Loyal-}(N=247)	Group$^{Loyal-follow-up}$ (N=135)	Group$^{Loyal-no\ follow-up}$ (N=112)	P value
Age					0.339
Mean ± SD		58.7± 10.4	58±9.7	59.5±11.1	
Median (IQR)		58 (17)	57 (16)	59.5 (17.75)	
Range [min-max]		[40-88]	[40-82]	[40-88]	
Positive family history for BC		78 (31.6%)	47 (35.1%)	31 (27.7%)	0.355
Baseline	0	18 (7.3%)	7 (5.2%)	11 (9.8 %)	0.093
BI-RADS	1-2	208 (84.2%)	112 (83%)	96 (85.7 %)	
(US+MG)	3	19 (7.7%)	15 (11.1 %)	4 (3.5 %)	
(2018-2019)	4-5	2 (0.8%)	1 (0.7%)	1 (0.9%)	

BIRADS, Breast Imaging Report and Data System; IQR, interquartile range; LHG, Lebanese Hospital Geitaoui; MG, mammogram; US, ultrasound.

Table 3. Change in BI-RADS Category during 3-Year Follow-up

	Group^{Loyal}(N=247)	Group^{New}(N=214)	Total (N=461)	P value
No Change	112 (45%)	41 (19%)	153 (33%)	< 0.001
Increase	7 (3%)	2 (1%)	9 (2%)	
Decrease	16 (6.5%)	13 (6%)	29 (6%)	
No Follow-up	112 (45.5%)	158 (74%)	270 (59%)	

BIRADS, Breast Imaging Report and Data System; IQR, interquartile range; LHG, Lebanese Hospital Geitaoui; MG, mammogram; US: ultrasound.

At the most recent screening, BI-RADS 1–2 remained the most frequent category (117/135, 86.6%), followed by BI-RADS 0 (8/135, 5.9%), BI-RADS 3 (8/135, 5.9%), and BI-RADS 4–5 (2/135, 1.5%) (Table 4).

Histopathologic Correlation and Biopsy Outcomes At Baseline

Twelve cases required histopathologic correlation; biopsy was performed in nine.

BI-RADS 0

One biopsy revealed benign fibrous mastosis.

BI-RADS 1–3

No biopsies were performed.

BI-RADS 4–5

Biopsy was recommended in 11 cases and performed in 8 (6 at LHG, 2 externally). Of the LHG biopsies, 4 were malignant (1 lobular, 3 ductal carcinoma) and 2 benign (fibroadenoma). This yields a cancer detection rate of 8.6 per 1,000 women. The 2 external cases likely represented malignancies, as both were followed by mastectomy.

At Follow-Up

Two biopsies were performed: one benign (fibrous dysplasia), one malignant (infiltrative ductal carcinoma)

Discussion

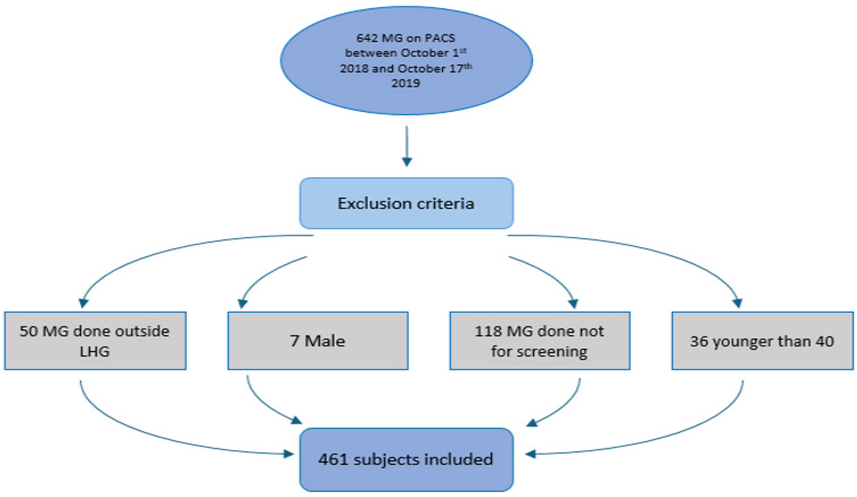

Figure 1. Flowchart Explaining the Process of Selection of the Study Population. MG, mammogram; LHG, Lebanese Hospital Geitaoui. To note that some files were excluded due to the presence of concomitant exclusion criteria which explains that the sum is >181

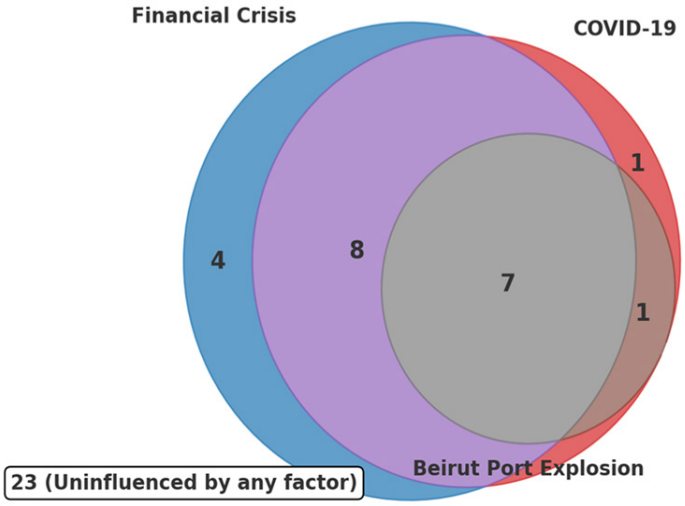

Figure 2. Venn Diagram Showing the Factors Affecting Screening Adherence in the Loyal Group as Reported by Women who Participated in the Survey (N=44).

Table 4. Characteristics of the Subgroup that Remained Loyal to Screening at the Institution Group$^{Loyal\text{-}follow\text{-}up}$: Baseline BI-RADS, years of follow-up, and BI-RADS on last screening.

		Continued screening (N=135)
Baseline	0	7 (5.1%)
BI-RADS	1-2	112 (83%)
(US+MG)	3	15 (11.1%)
(2018-2019)	4-5	1 (0.9%)
Years of follow-up	Mean ± SD	2.3 ±0.78
	Median (IQR)	3 (1)
	Range [min-max]	[1-3]
BI-RADS on last screening (US+MG) (2020-2023)	0	8 (5.9%)
	1-2	117 (86.6%)
	3	8 (5.9%)
	4-5	2 (1.5%)

BIRADS, Breast Imaging Report and Data System; IQR, interquartile range; LHG, Lebanese Hospital Geitaoui. MG, mammogram; US, ultrasound.

This study aimed to evaluate adherence to breast cancer (BC) screening at Lebanese Hospital Geitaoui (LHG) following the onset of Lebanon's compounded national crises namely the financial collapse, the COVID-19 pandemic, and the Beirut Port explosion collectively referred to as the "triple shock crisis." By analyzing pre-crisis screening data and tracking post-crisis follow-up, we were able to assess screening behavior, patient characteristics, and imaging outcomes over time.

Rate of adherence to breast cancer screening after the triple shock crisis

In our study, 41% of women continued screening at our institution, with significantly higher adherence observed among those loyal to the center prior to 2018 (Group^{Loyal}). This difference may be attributed to factors such as continuity of care, access to previous medical records, and established relationships with healthcare providers.

Difference in sociodemographic factors between Group^{Loyal} *and Group^{New}*

Group^{Loyal} participants had a higher incidence of positive family history, suggesting increased vigilance due to genetic predisposition [3]. However, no significant differences were found within Group^{Loyal} between those who continued screening and those who didn't in terms of age, family history and baseline BI-RADS, unlike international findings where older age correlated with higher adherence [4], suggesting cultural or systemic differences in Lebanon.

Impact of the triple shock crisis on screening adherence

Calls to Group$^{Loyal\ -no\ follow\text{-}up}$ *participants revealed three main barriers:*

1. COVID-19 pandemic

Fear of exposure, reduced health services, and travel restrictions all contributed to reduced screening. Global studies support these findings, showing drops in mammogram attendance and more advanced cancer presentations [5-8].

2. Beirut Port Explosion

This disaster further strained the healthcare system, but this study is the first to assess its impact on BC screening.

3. Economic constraints

The national screening campaign was halted after 2019 due to financial crisis [2]. Emigration of healthcare workers and the cost of services further reduced access.

These findings highlight how Lebanon's compounded crises have disrupted screening behaviors and emphasize the urgent need for both systemic and individual-level interventions to improve adherence.

Interestingly, 52% of respondents cited personal reasons for discontinuing screening, with several believing further imaging was unnecessary after previously normal results. This highlights a gap in health literacy, reinforcing findings from other Lebanese studies which showed

that higher education and healthcare backgrounds are associated with better screening adherence. Addressing misconceptions about the importance of regular screening even after normal results remains a critical area for intervention.

Recent studies in Lebanon using validated tools such as the Breast Cancer Screening Beliefs Questionnaire (BCSBQ) and the Champion Health Belief Model Scale (CHBMS) have shown that women with higher education levels or healthcare backgrounds are more likely to adhere to screening recommendations [9]. These variables were not assessed in our study but may help explain some of the observed differences in screening behavior.

BI-RADS distribution at baseline

Our BI-RADS distribution resembled national patterns, with most falling into BI-RADS 0–2 (87%). $Group^{Loyal}$ had more benign findings, while $Group^{New}$ had more suspicious or inconclusive results. This supports the role of regular screening in early detection and reducing diagnostic uncertainty [10, 11].

BI-RADS evolution and malignancy detection (2019–2022)

Several cases shifted from BI-RADS 1 to BI-RADS 2 during follow-up, reflecting evolving but benign changes. BI-RADS 3 cases that remained stable were downgraded over 48 months, aligning with established guidelines [12]. Nine new cases with BI-RADS 3/4 emerged, one of which was confirmed as infiltrative ductal carcinoma, emphasizing the importance of close monitoring.

Biopsy results and cancer detection

At baseline, biopsy was performed in nine women, confirming malignancy in four cases (three infiltrative ductal carcinomas and one infiltrative lobular carcinoma). This corresponds to a cancer detection rate of 8.6 per 1,000 screened women comparable to detection rates reported during national screening campaigns in Lebanon (5.55/1,000) and internationally (7.6/1,000 in the U.S.) [10, 13].

Two additional subjects who underwent biopsy outside LHG and returned for follow-up after mastectomy likely represent further undiagnosed malignancies within the cohort. During follow-up, two more biopsies were performed, one of which revealed a second case of infiltrative ductal carcinoma.

Among the confirmed cancers, only one case was metastatic, highlighting the importance of early detection through screening in improving prognosis and potentially reducing treatment intensity.

Strengths and Limitations

This study provides timely insight into BC screening adherence in Lebanon following the compounded national crises of financial collapse, the COVID-19 pandemic, and the Beirut Port explosion. Its strengths include a clearly defined cohort with meaningful stratification based on prior screening history, integration of radiologic, histopathologic, and patient-reported data, and objective imaging outcomes with biopsy correlation. It is also the first to explore patient-reported barriers to screening during this crisis period, highlighting systemic and individual-level challenges.

However, the single-center design may limit generalizability. Key sociodemographic variables such as education and income were not assessed, restricting analysis of health literacy and access factors. The modest survey response rate introduces potential recall and response bias. External biopsy results were not always available, and inferred malignancies may affect cancer detection estimates. Lastly, the analysis was limited to follow-up through 2022, and ongoing trends remain to be studied.

In conclusion, this study demonstrates a significant decline in BC screening adherence at our institution following national crises in Lebanon, with lower follow-up rates among women without prior imaging at LHG. Continued screening was associated with stable BI-RADS classifications and early-stage cancer detection, reinforcing the critical role of radiologists in maintaining screening continuity during healthcare disruptions. Future efforts should focus on improving access, patient communication, and service resilience in low-resource and crisis-prone settings.

Author Contribution Statement

All authors contributed equally in this study.

Acknowledgements

Author Disclaimer

This manuscript includes content generated and refined with the assistance of ChatGPT, a language model developed by OpenAI, used under human supervision to support language clarity, structure, and editing. All scientific content, interpretations, and conclusions were developed, reviewed, and approved by the authors.

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