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Fear of cancer recurrence across sporadic, familial and hereditary breast cancer: the role of genetic risk and psychosocial factors

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Research Article

Keywords: Fear of cancer recurrence, breast cancer, survivorship, genetic risk, psychosocial factors

Posted Date: June 9th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9306007/v1

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Additional Declarations: No competing interests reported.

Abstract

Background:

Fear of cancer recurrence (FCR) is a common and clinically significant concern among breast cancer survivors; however, the impact of family history and germline mutation positivity remains unclear.

Aim:

To compare FCR across sporadic, familial and hereditary groups and identify predictors.

Methods:

We studied 120 women (< 50 years) treated October 2022–January 2025, classified as sporadic (SBCG), familial/pathogenic germline mutation–negative (FBCG) or hereditary/pathogenic germline mutation–positive (HBCG). FCR was measured with the Turkish Fear of Cancer Recurrence Inventory (FCRI); multivariable linear regression modelled total FCRI score.

Results:

Mean age was 43.7 ± 5.04 years; 32% were SBCG (n = 38), 34% FBCG (n = 41) and 34% HBCG (n = 41). Cronbach's α = 0.880; McDonald's ω = 0.888. Total FCRI differed by group ($p < 0.001$): SBCG median 102 [50–124], FBCG 82 [54–121], HBCG 68 [51–112]. Versus SBCG, FBCG ($\beta = -8.379$; $p = 0.043$) and HBCG ($\beta = -9.776$; $p = 0.029$) had lower FCR. Breast-conserving surgery predicted lower FCR than mastectomy ($\beta = -10.122$; $p = 0.006$), while having ≥ 1 child younger than 14 years ($\beta = 8.438$; $p = 0.026$) and university education ($\beta = 13.290$; $p < 0.001$) predicted higher FCR.

Conclusion:

FCR was highest in sporadic breast cancer and lower in familial/pathogenic germline mutation–negative and hereditary/pathogenic germline mutation–positive disease, suggesting uncertainty may outweigh genetic risk. However, because perceived risk was not measured, this finding remains hypothesis-generating.

What is known about this topic:

- Fear of cancer recurrence (FCR) is a common and clinically significant concern among breast cancer survivors.
- FCR is influenced by psychological and contextual factors beyond objective recurrence risk.
- The role of genetic risk status in shaping FCR remains unclear.

What this paper adds:

- FCR was highest in sporadic breast cancer compared with familial and hereditary groups.

- Perceived uncertainty may be more influential than objective genetic risk in driving FCR.
- Findings highlight the importance of tailored risk communication and integrating FCR assessment into genetic counseling practice.

BACKGROUND

Breast cancer is the most common cancer among women and a leading cause of cancer-related death worldwide (1). Despite advances in surgery, radiotherapy, and systemic treatments that have improved survival, cancer diagnosis and treatment still cause substantial psychosocial distress. Approximately one-third of cancer patients experience depression, anxiety, and impaired quality of life (2). Fear of cancer recurrence (FCR), defined as a persistent concern or worry about cancer returning or progressing, is among the most frequently reported psychosocial problems in women with breast cancer (3). Across cancer types, FCR prevalence has been reported to range from 40% to 90% and is associated with poorer quality of life, reduced treatment adherence, and increased depression and anxiety(4, 5). Clinically meaningful FCR is often operationalized using short screening forms of the FCRI with proposed cut-offs to identify survivors who may require further clinical evaluation (6). The impact of biological risk factors —particularly positive family history and genetic predisposition—on FCR remains unclear. In this study, women with breast cancer who had completed primary treatment were categorized into three groups: sporadic breast cancer group (SBCG), familial breast cancer group (FBCG), and hereditary breast cancer group (HBCG), defined as carriers of a pathogenic germline mutation in breast cancer susceptibility genes. Unlike most previous studies, which have focused on unselected breast cancer samples, we compared FCR across these distinct risk groups and examined the combined contribution of clinical-genetic, sociodemographic, and psychosocial factors. Contemporary cognitive models emphasize that FCR is driven by threat appraisal and intolerance of uncertainty rather than objective recurrence risk alone (7, 8). We aimed to identify predictors of FCR in women with breast cancer. We hypothesized that [1] FCR would be highest in women with hereditary or familial breast cancer, reflecting higher objective risk due to family history and pathogenic germline mutations, and [2] sociodemographic and contextual factors (e.g. younger age, having young children) would also significantly predict FCR beyond clinical-genetic risk status. Because younger age is consistently associated with higher FCR, inclusion was restricted to women younger than 50 years to reduce confounding by life-stage effects (9).

MATERIAL–METHODS

This single-center cross-sectional study was conducted at the at a tertiary surgical oncology center. A total of 120 women with breast cancer who underwent surgery between October 2022 and January 2025 were included. The sample size was calculated using G*Power (version 3.1.9.7), assuming a two-sided $\alpha = 0.05$, 80% power ($1-\beta = 0.80$), and a moderate effect size, indicating that at least 120 patients were required. Patients were categorized into three groups according to family history and genetic status: sporadic breast cancer group (SBCG), familial breast cancer group (FBCG; women with a positive family history of breast cancer but no pathogenic germline mutation in breast cancer susceptibility genes), and

hereditary breast cancer group (HBCG; carriers of a pathogenic germline mutation in breast cancer susceptibility genes). Family history positivity was defined as the presence of breast cancer in at least one first- or second-degree relative; participants in the familial and hereditary groups received standardized genetic counseling.

FCR was assessed at the end of primary treatment, after completion of surgery and indicated adjuvant systemic and/or radiation therapy. Fear of cancer recurrence was measured using the validated Turkish version of the Fear of Cancer Recurrence Inventory (FCRI) (10). The total FCRI score ranges from 0 to 168, with higher scores indicating greater fear of recurrence. All items were scored according to the original instructions, and a total FCR score was calculated for each patient. Internal consistency was evaluated using Cronbach's alpha (α) and McDonald's omega (ω) coefficients. The total FCRI score was selected as the primary outcome to capture overall FCR burden; because the primary aim was between-group comparison rather than clinical prevalence estimation, no categorical FCR cut-off analysis was performed.

Demographic, clinicopathological, and treatment-related data were obtained from medical records. Comorbidity was defined as the presence of any chronic medical condition (e.g., hypertension, diabetes). Monthly household income was classified as low, moderate, or high. Tumor-related variables included hormone receptor status, HER2 status, tumor stage, nodal status. Treatment-related variables included type of surgery, adjuvant chemotherapy, and adjuvant radiotherapy.

Statistical analyses were performed using jamovi software (version 2.3.28). Continuous variables were expressed as mean ± standard deviation or median (minimum–maximum), as appropriate, and categorical variables as frequencies and percentages. The total FCR score was treated as a continuous variable. Normality of its distribution was assessed with the Shapiro–Wilk test and was not met; therefore, non-parametric methods were used. Comparisons between two groups were performed with the Mann–Whitney U test, and comparisons among three or more groups with the Kruskal–Wallis test. When statistically significant differences were detected ($p < 0.05$), post-hoc pairwise comparisons were conducted using the Dwass–Steel–Critchlow–Fligner (DSCF) method. Associations between continuous variables and FCR scores were evaluated using Spearman's rho correlation. Variables that were statistically significant in univariate analyses were entered into a multivariable linear regression model, with total FCR score as the continuous outcome. Although the FCR score was not normally distributed, linear regression was applied as the dependent variable was continuous. Linear regression models are generally robust to moderate deviations from normality, particularly in samples of this size. A p value < 0.05 was considered statistically significant.

The study was approved by the institutional ethics committee (approval number and date withheld for blinded review) and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants, and patients who did not provide consent were excluded.

RESULTS

A total of 120 patients were included. The FCRI showed excellent internal consistency (Cronbach's α = 0.880; McDonald's ω = 0.888). The mean age was 43.7 ± 5.04 years (median 45, range 28–50). Patients were distributed as 32% sporadic (SBCG, n = 38), 34% familial (FBCG, n = 41), and 34% hereditary (HBCG, n = 41). Comorbidities were present in 37% (n = 44). Overall, 46% (n = 55) were employed and 54% (n = 65) unemployed. Monthly household income was low in 73% (n = 88), moderate in 23% (n = 27), and high in 4% (n = 5). Most patients were married (75%, n = 90), while 14% (n = 17) were single and 11% (n = 13) widowed. Hormone receptor status was positive in 78% (n = 93), and HER2 was positive in 26% (n = 31). Adjuvant chemotherapy and radiotherapy were administered to 85% (n = 102) and 89% (n = 107), respectively. Regarding tumor characteristics, 24% (n = 29) were T1, 71% (n = 85) T2, and 5% (n = 6) T3. Clinical nodal stage was N0 in 53% (n = 64), N1 in 38% (n = 45), N2 in 6% (n = 7), and N3 in 3% (n = 4). Breast-conserving surgery was performed in 52% (n = 62), and 48% (n = 58) underwent mastectomy, including both simple mastectomy (SM) and nipple-sparing mastectomy (NSM). The mean FCR score was 84.7 ± 19.6 (median 86, range 50–124). A family history of cancer-related mortality was reported in 37% (n = 43). Overall, 46% (n = 55) had at least one child younger than 14 years, and 37.5% (n = 45) were university graduates. (Table 1)

Table 1
Baseline clinicopathological and sociodemographic characteristics of the study population

Variables	n = 120 (%)	Variables	n = 120 (%)
Age	43.7 ± 5.04	Adjuvant Chemotherapy	102
Mean	45(28–50)	Yes	18
Median		No	
Comorbidity	44 (37)	Adjuvant RT	107
Yes	76 (63)	Yes	13
No		No	
Occupation	55 (46)	Family History	38 (32)
Employed	65 (54)	Sporadic Breast Cancer	41 (34)
Unemployed		Familial Breast Cancer (non-BRCA)	41 (34)
		BRCA Mutation–Positive Breast Cancer	
Monthly household income	88 (73)	T stage	29 (24)
Low	27 (23)	T1	85 (71)
Middle	5 (4)	T2	6 (5)
High		T3	
Marital status	17 (14)	Clinic N stage	64 (53)
Single	90 (75)	N0	45 (38)
Married	13 (11)	N1	7 (6)
Widowed		N2	4 (3)
		N3	
Hormone Receptor Status	27 (22)	M stage	116 (97)
Negative	93 (78)	M0	4 (3)
Positive		M1	
Her2 Status	89 (74)	Operation	62 (52)
Negative	31 (26)	BCS	58 (48)
Positive		Mastectomy	
Fear of Cancer Recurrence score	84.7 ± 19.6	Number of children	19 (16)
		0	20 (17)

Variables	n = 120 (%)	Variables	n = 120 (%)
Mean Median	86 (50–124)	1 ≥ 2	81 (67)
Family History of Mortality	43 (37)	Having a child under the age of 14	55 (46)
Yes	77 (63)	Yes	65 (54)
No		No	
University Graduate	45 (38)		
Yes	75 (62)		
No			

In univariable analyses, age was negatively correlated with FCR (Spearman's rho = − 0.247; p = 0.024), whereas number of children was not associated with FCR (p = 0.317). FCR scores differed significantly across family history/genetic risk categories (p < 0.001), with the highest scores in the SBCG. FCR was also significantly associated with educational level (p < 0.001), surgical approach (breast-conserving surgery vs mastectomy; p < 0.001), monthly household income (p = 0.005), family history of cancer-related mortality (p = 0.009), and having a child younger than 14 years (p = 0.002). No significant associations were observed with tumor stage, nodal status, receptor status, adjuvant treatments, comorbidity, employment, or marital status (all p > 0.05). (Table 2)

Table 2
Univariate Analysis of Factors Associated with Fear of Cancer Recurrence Score

Variables **n = 120 (%)**	**n**	**Fear of Cancer Recurrence Score** **(Mean)**	**median**	**p value**
Age	120	43.7 ± 5.04	45(28–50)	0.024*
Number of children	19	73.8 ± 16.7	73 (50–102)	0.317
0	20	98.3 16	102 (70–124)	
1	81	83.3 ± 18.8	81 (51–121)	
≥ 2				
Family History	38	98.7 ± 17.7	102 (50–124)	< 0.001*
Sporadic Breast Cancer	41	83.6 ± 15.9	82 (54–121)	
Familial Breast Cancer (non-BRCA)	41	72.8 ± 16.1	68 (51–112)	
Hereditary Breast Cancer				
Comorbidity	44	87.9 ± 21.9	89.5 (51–124)	0.128
Yes	76	82.8 ± 18		
No			84.5 (50–121)	
University Graduate	45	93.7 ± 20	97 (51–124)	< 0.001*
Yes	75	78.7 ± 16.2	76 (50–121)	
No				
Occupation	55	87.7 ± 22	89 (50–124)	0.113
Employed	65	82.1 ± 16.9	82 (51–107)	
Unemployed				
Monthly household income	88	84 ± 19.8	86 (50–124)	0.005*
Low	27	82.3 ± 17.5	81 (51–112)	
Middle	5	109 ± 2.19	111 (107–111)	
High				

Variables n = 120 (%)	n	Fear of Cancer Recurrence Score (Mean)	median	p value
Marital status	17	86.8 ± 26	89 (50–124)	0.858
Single	90	84.4 ± 18.8	83 (51–121)	
Married	13	83.8 ± 15.9	90 (51–97)	
Widowed				
Hormone Receptor Status	27	80 ± 21.7	73 (50–124)	0.126
Negative	93	86 ± 18.8	86 (51–121)	
Positive				
Her2 Status	89	86.4 ± 20.5	86 (51–124)	0.097
Negative	31	78.8 ± 16	76 (50–107)	
Positive				
Adjuvant Chemotherapy	102	84.9 ± 20.1	86 (50–124)	0.803
Yes	18	83.5 ± 14.8	79.8 (51–118)	
No				
Adjuvant RT	107	85.7 ± 19.7	86 (50–124)	0.093
Yes	13	76.7 ± 17.4	72 (51–102)	
No				
T stage	29	82.3 ± 23.9	78 (51–121)	0.636
T1	85	85.1 ± 18.2	86 (50–124)	
T2	6	89.8 ± 17.2	89 (71–107)	
T3				
Clinic N stage	64	84.7 ± 20.9	87.5 (50–124)	0.983
N0	45	82.8 ± 15.5	78 (51–112)	
N1	7	86.1 ± 27.8	100 (56–111)	
N2	4	103 ± 20.8	103 (85–121)	
N3				
Operation	62	78.3 ± 16.7	75 (51–112)	< 0.001*
BCS	58	91.5 ± 20.2	96.5 (50–124)	

Variables n = 120 (%)	n	Fear of Cancer Recurrence Score (Mean)	median	p value
Mastectomy (SM or NSM)				
Family History of Mortality	44	91.9 ± 17.3	92 (54–124)	0.009*
Yes	76	80.6 ± 19.7	76 (50–124)	
No				
Having a child under the age of 14	55	90.2 ± 17.3	97 (64–118)	0.002*
Yes	65	79.3 ± 19.6	78 (50–124)	
No				

In multivariable linear regression, using the SBCG as reference, both FBCG (β = −8.379; p = 0.043) and HBCG (β = −9.776; p = 0.029) were independently associated with lower FCR scores. Breast-conserving surgery was associated with lower FCR compared with mastectomy (β = −10.122; p = 0.006). Having a child younger than 14 years (β = 8.438; p = 0.026) and university education (β = 13.290; p < 0.001) were independently associated with higher FCR. Age, income level, and HER2 status were not independent predictors. (Table 3)

Table 3
Multivariable Linear Regression Analysis of Factors Associated with Fear of Cancer Recurrence Score

			95% Confidence Interval				
Predictor	**Estimate**	**SE**	**Lower**	**Upper**	**t**	**p**	**Stand. Estimate**
Intercept	99.796	16.805	66.49	133.099	5.939	< .001	
Age	-0.402	0.373	-1.14	0.339	-1.075	0.285	-0.105
Family History (Sporadic / Familial Breast Cancer/Brca+):							
Familial– Sporadic	-8.379	4.092	-16.49	-0.269	-2.048	0.043	-0.435
Brca+ – Sporadic	-9.776	4.424	-18.54	-1.009	-2.210	0.029	-0.507
Monthly household income:							
Middle – Low	2.766	3.709	-4.58	10.116	0.746	0.457	0.144
High – Low	2.794	8.506	-14.06	19.652	0.328	0.743	0.145
Her2 Status							
Negative-positive	5.255	3.521	-1.72	12.233	1.492	0.138	0.273
Operation							
Bcs-Mastectomy(SM or SNM)	-10.122	3.638	-17.33	-2.912	-2.782	0.006	-0.525
Having a child under the age of 14							
Yes-No	8.438	3.747	1.01	15.864	2.252	0.026	0.438
University Graduate:							
Yes-No	13.290	3.120	7.11	19.473	4.260	< .001	0.690
Represents reference level							

DISCUSSION

In this study, we examined the association between fear of cancer recurrence (FCR) and family history/genetic status in women with breast cancer and found that FCR levels were significantly higher in the sporadic breast cancer group (SBCG) than in the familial (FBCG) and hereditary (HBCG) groups. University education and having at least one child younger than 14 years were independently associated with higher FCR. While several studies, including Vachon's, have linked lower educational attainment to

higher FCR, university graduates in our cohort reported greater FCR, suggesting that the education–FCR relationship may depend on illness perceptions, information exposure, and cognitive appraisal processes (11, 12). Overall, our findings indicate that FCR is driven not only by biological recurrence risk but also by cognitive and psychosocial factors (7, 13).

According to the cognitive model proposed by Lee-Jones et al., FCR is a multidimensional construct shaped by appraisals of cancer threat and by internal (bodily sensations) and external triggers (follow-up visits, imaging), rather than a simple fear response (14). This framework supports the notion that the higher FCR levels observed in the SBCG cannot be adequately explained by objective risk alone and likely reflect differences in threat appraisal and perceived uncertainty.

Among the instruments used to assess FCR, the Cancer Worry Scale and the Fear of Cancer Recurrence Inventory (FCRI) are the most prominent. The Cancer Worry Scale has been widely used in hereditary cancer syndromes such as familial adenomatous polyposis, Li-Fraumeni syndrome, and von Hippel–Lindau disease (15–17). The FCRI, developed by Simard and Savard, is a multidimensional measure covering triggers, severity, psychological distress, and functional impairment (18). Use of the validated Turkish version of the FCRI and the excellent internal consistency observed in our sample support the reliability of our findings (10). Screening instruments such as the FCRI short form have also been evaluated for identifying clinical levels of FCR in survivorship settings (6).

Predictors of high FCR reported in the literature include younger age, female sex, lower educational level, shorter time since diagnosis, presence of metastasis, and greater treatment intensity (4). Younger age has frequently been associated with higher FCR, often attributed to unmet life goals, ongoing career development, and responsibility for dependent children (9, 19). To reduce the confounding effect of age-related psychosocial factors and focus more directly on sporadic, familial, and hereditary risk, we restricted inclusion to women younger than 50 years. In contrast to previous work, younger age was not associated with higher FCR in our cohort, which we attribute to age homogenization across the groups. However, having at least one child younger than 14 years was positively associated with FCR, in line with prior studies. The BRBC study emphasized that FCR is strongly shaped by family-related contextual variables such as the presence of young children (20). Our finding that child age < 14 years predicted higher FCR further underscores the central role of caregiving responsibilities in the phenomenology of recurrence fear. In addition, perceived risk and worry are known to be influenced by cognitive and psychological variables, which may interact with education and family context (21–23).

The prevalence of germline (BRCA1/2. PALB2) mutations among women with breast cancer has been reported to range from 2.7% to 7.8%. In mutation carriers, local recurrence rates are higher after breast-conserving surgery (BCS) and lower after simple or nipple-sparing mastectomy (24, 25). Although prophylactic mastectomy and salpingo-oophorectomy substantially reduce recurrence risk, they do not eliminate it (26).). In our cohort, 52% of women underwent breast-conserving surgery and 48% underwent mastectomy; among those having mastectomy, approximately half had simple mastectomy and half nipple-sparing mastectomy, which may influence body image but was not analysed separately in

relation to FCR. Differences in body image disturbance and treatment symbolism between mastectomy and breast-conserving approaches may partially explain this finding (27, 28). Few studies have specifically evaluated FCR in women with pathogenic germline mutations. One study reported higher rates of clinical FCR among germline mutation carriers compared with non-carriers, and only partial reduction in FCR after prophylactic mastectomy and salpingo-oophorectomy (26). These findings suggest that FCR is linked not only to statistical recurrence risk but also to risk perception and cognitive processing. A novel cognitive processing formulation also highlights intolerance of uncertainty as a mechanism maintaining persistent FCR over time (7, 29).

In our study, FCR levels were lower in the HBCG and FBCG than in the SBCG, partially diverging from the limited literature. One possible explanation is that many women in the FBCG and HBCG have relatives who previously underwent breast cancer treatment, providing a concrete example of disease trajectory and reducing uncertainty—one of the main drivers of FCR. Clearly defined genetic risk and access to structured genetic counseling in the HBCG may also reduce perceived ambiguity and indirectly lower FCR(30).

Furthermore, in the FBCG, the proportion of patients who had experienced cancer-related death of a first-degree relative was markedly higher than in the HBCG (FBCG: FCRI ≈ 82 vs HBCG: FCRI ≈ 68). Although we did not detect a statistically significant association between cancer-related death in the family and FCR, the relatively higher FCR in the FBCG (n = 30) compared with the HBCG (n = 13) may reflect the impact of repeated exposure to cancer-related loss on perceived unpredictability and threat. Larger studies are needed to clarify the relationship between family bereavement and FCR. Importantly, perceived risk was not directly measured; therefore, interpretations regarding uncertainty versus objective genetic risk remain inferential. These findings have direct implications for genetic counseling practice. The higher FCR observed in sporadic cases suggests that perceived uncertainty, rather than objective genetic risk, may drive psychological burden, highlighting the importance of individualized risk communication and structured counseling interventions.

Although FCR is one of the most frequently reported concerns among cancer survivors, it is also considered one of the most challenging psychosocial problems to manage. Prophylactic surgeries and available psychosocial interventions often lead to only partial reductions in FCR, and evidence for the effectiveness of cognitive-behavioural approaches remains mixed (22, 26). Together with our findings, this underscores the need for individualized, multidimensional management strategies that integrate genetic risk information, family context, and cognitive–emotional processes. Screening for clinical levels of FCR has been proposed as a step toward matching patients to appropriate intensity of survivorship support (21–23, 30).

A major strength of this study is the comparative evaluation of FCR across SBCG, FBCG, and HBCG, using a validated multidimensional measure and adjusting for key sociodemographic and clinical covariates in multivariable analyses. These findings may help identify patients at increased risk of fear of cancer recurrence in routine oncology practice. However, the single-center, cross-sectional design limits

causal inference and generalizability, and assessment of FCR at a single time point precludes evaluation of temporal changes. Although the sample size was adequate for the primary analyses, it limited power for subgroup and interaction analyses. Future longitudinal and intervention studies integrating genetic counseling with targeted psychosocial support may help clarify causal pathways and inform tailored FCR interventions for different risk groups. Another limitation is the absence of concurrent measures of depression, anxiety and quality of life, which are known correlates of FCR. The definition of family history (≥ 1 first- or second-degree relative) did not account for the number of affected relatives or degree of clustering, which may have introduced heterogeneity within the familial group.

IMPLICATIONS

These findings highlight the importance of integrating routine FCR screening into genetic counseling and survivorship care. In particular, the elevated FCR observed in sporadic cases underscores the need for tailored risk communication strategies addressing uncertainty, as well as risk-stratified psychosocial support, especially for patients with young children.

LIMITATIONS

This single-center cross-sectional study limits causal inference and generalizability. FCR was assessed at one time point, and perceived recurrence risk was not directly measured. Psychological variables such as anxiety and depression were not assessed, which may influence FCR. Larger longitudinal studies are warranted.

CONCLUSION

This study demonstrates that fear of cancer recurrence (FCR) in women with breast cancer is shaped not only by biological recurrence risk but also by demographic and psychosocial factors. Higher FCR in the sporadic breast cancer group (SBCG) compared with the familial (FBCG) and hereditary (HBCG) groups suggests that perceived uncertainty and cognitive appraisal may be more influential than objective risk alone. Furthermore, university education and having at least one child younger than 14 years were independently associated with higher FCR, underscoring the role of individual life context and caregiving responsibilities. These findings highlight the need for systematic assessment of FCR during clinical follow-up and for individualized psychosocial support strategies targeting high-risk subgroups, including women in the SBCG and mothers of young children. However, because perceived risk was not directly assessed, conclusions regarding uncertainty versus objective risk should be interpreted cautiously. Routine screening using brief FCR measures and stepped-care psychosocial interventions may help optimize survivorship care delivery. Integrating genetic risk communication with structured psychosocial assessment may be essential for optimizing long-term survivorship outcomes.

ABBREVIATIONS

BCS – Breast-conserving surgery

BRCA – Breast cancer gene (BRCA1/BRCA2)

CI – Confidence interval

DSCF – Dwass–Steel–Critchlow–Fligner

FBCG – Familial / BRCA-negative breast cancer group

FCR – Fear of cancer recurrence

FCRI – Fear of Cancer Recurrence Inventory

HBCG – Hereditary / BRCA-positive breast cancer group

HER2 – Human epidermal growth factor receptor 2

NSM – Nipple-sparing mastectomy

SM – Simple mastectomy

SBCG – Sporadic breast cancer group

T – Tumor (TNM staging)

DECLARATIONS

Author Contributions

Author contributions are reported using initials to ensure anonymization during peer review. Full author details are provided in the separately uploaded title page.

O.C. and E.T. carried out the investigation.

O.C. and L.D. conceptualized the study.

O.C. performed data curation.

O.C., E.T., and L.D. reviewed and edited the manuscript.

O.C., L.D., and F.S. developed the methodology.

O.C. wrote the original draft of the manuscript.

F.S. conducted the formal analysis.

All authors approved the final manuscript.

Conflict of Interest

The authors declare no conflicts of interest.

Ethics Statement

The study was approved by the institutional ethics committee (approval number and date withheld for blinded review) and conducted in accordance with the Declaration of Helsinki.

Patient Consent

Written informed consent was obtained from all participants, and individuals who did not provide consent were excluded.

AI Statement

No generative artificial intelligence tools were used in the design, analysis, or interpretation of the study. AI was used only for language editing without altering scientific content.

Conflict of Interest:

The authors declare no conflicts of interest.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Author Contribution

Author Contributions:O.C. and E.T. carried out the investigation. O.C. and L.D. conceptualized the study. O.C. performed data curation. O.C., E.T., and L.D. reviewed and edited the manuscript. O.C., L.D., and F.S. developed the methodology. O.C. wrote the original draft of the manuscript. F.S. conducted the formal analysis. All authors approved the final manuscript.

Acknowledgements

The authors thank the patients who participated in this study.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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