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Quantifying the Influence of Psychosocial Characteristics, Supportive Care Needs and Quality of Life on Breast Cancer Survival

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ABSTRACT

Objective: To identify the contribution of psychosocial characteristics, supportive care needs, or quality of life on breast cancer survival outcomes.

Methods: This study used data from a population-based longitudinal study involving women diagnosed with invasive breast cancer (n = 3326, response rate = 71%) in Queensland, Australia, 2010–2013, and followed up to 2020. Flexible parametric survival models were used to identify which factors were associated with survival outcomes. Model fit was assessed using D and R_D^2 statistics.

Results: Unmet physical and daily living needs, social support, age, stage at diagnosis, tumour grade, clinical subtype and mode of detection explained 39% of survival variability (R_D^2 0.39; 95% CI 0.33–0.44), with a Harrell's C statistic of 0.84 (95% CI 0.81–0.86). Unmet physical and daily living needs and social support, which fall under the categories of supportive care needs and psychosocial characteristics respectively, were identified as key factors that predict breast cancer survival, explaining 3% of survival variability. When compared to women who had less unmet physical needs and adequate social support (5-year survival: 96.6%, 95% CI 92%–99%), those who had more unmet physical needs and limited social support had poorer breast cancer-specific survival (5-year survival: 86.8%, 95% CI 72%–95%).

Conclusion: The study found that unmet physical and daily living needs and social support play a marginal but significant role in influencing breast cancer outcomes. The findings enhance the current literature regarding the impact of psychosocial characteristics and supportive care needs on breast cancer survival and suggest that integrating psychosocial support and interventions alongside medical treatment may further improve the survival outcomes for women diagnosed with breast cancer.

1 | Introduction

Breast cancer is one of the main causes of cancer death globally with Australia having one of the highest incidence rates of breast cancer [1]. Once a diagnosis has been made, statistical models that predict breast cancer prognosis (i.e., prognostic models) provide important guidance to patients and clinicians for making decisions on treatment choices [2]. The prognostic factors included in these breast-cancer prognostic models are typically clinical and demographic in nature and the exact prognostic factors used can vary depending on the specific model [2–6]. Examples include PREDICT v3.0, which integrates pathological factors [3]; the Nottingham Prognostic Index (NPI), which uses histological grade alongside classical clinical markers [4]; and the Breast Cancer Outcomes Study (BCOS) prognostic model, which included a set of clinical factors, including detection method, to enhance the model's precision [5]. While clinical factors are well-established predictors, incorporating other factors such as psychosocial characteristics, supportive care needs, or quality of life (PSQ) factors could enhance the understanding of breast cancer prognosis and provide more accuracy to existing prognostic models.

Psychosocial characteristics like depression, anxiety, and social support along with supportive care needs are consistently studied for their impact on breast cancer survival as these factors not only affect quality of life but may also complicate treatment compliance and influence breast cancer patient outcomes post-diagnosis [7–11]. For instance, unmet 'physical and daily living' supportive care needs, which refers to coping with cancer-related symptoms and how treatment impacts day-to-day life, have been associated with poorer clinical outcomes [12].

The study aims to build on a previously published prognostic model, the BCOS prognostic model, which included age at diagnosis, mode of detection, tumour stage, and grade [5], to quantify the additional variation in breast cancer survival that could be explained by PSQ factors.

2 | Methods

Ethics approval for the study was obtained from the Human Research Ethics Committee of Griffith University, Australia (PSY/C4/09/HREC).

2.1 | Study Cohort

The study uses data from the BCOS cohort, a population-based longitudinal study involving women (n = 3326, response rate = 71%) between the ages of 20 and 79 who were diagnosed with invasive breast cancer in Queensland, Australia, from 31 March 2010 to 30 June 2013. All but 3 (n = 3323) consented to their data being used for follow-up purposes. Full details of data collection methods, along with sample size and power calculations, have been published previously [9]. To summarise, information on individual participants was collected through a Computer Assisted Telephone Interview (CATI) and self-administered questionnaire (SAQ) about 4–6 months post-diagnosis. Variables including socio-demographics, medical history, pathways to diagnosis, treatment pathways and psychosocial outcomes were collected through CATI and SAQ. Interview data were linked with participant's medical records and Queensland Cancer Registry data.

Death information up to 31 December 2020, was obtained by the Queensland Cancer Register using internal linkage with the Queensland Register of Births, Deaths, and Marriages, and external linkage with the National Death Index by the Australian Institute of Health and Welfare.

Causes of deaths were coded and classified according to the International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD10) [13]. Deaths caused by breast cancer were defined by an ICD-10 code of C50.

Questionnaires used for measuring psychosocial characteristics, supportive care needs and quality of life include.

2.1.1 | Psychosocial Characteristics

Brief Symptom Inventory (BSI-18): An 18-item tool measuring psychological distress through anxiety, depression, and somatization subscales. A Global Severity Index (GSI) *T*-score was also generated for each patient by combining their raw subscales scores. GSI *T*-scores ≥ 48 suggest significant psychological morbidity ('Cases'), while scores < 48 indicate lesser morbidity ('Non-cases') [14, 15].

Social Constraints Scale (SCS): A 15-item tool assessing perceived constraints or restrictions that a patient feels in their social environment when discussing traumatic experiences or serious illnesses [16].

Constructed Meaning Scale (CMS): An 11-item scale examining how patients construct meaning from their disease, with negative meaning construction linked to higher emotional distress [17].

ENRICHD Social Support Instrument (ESSI): A 7-item self-report survey of social support, with scores under or equal to 18 indicating lower perceived support levels. It measures three attributes of social support: emotional, instrumental and informational [18, 19].

2.1.2 | Supportive Care Needs

Supportive Care Needs Survey Short Form 34 (SCNS-SF34): A 34-item tool assessing support needs in five domains, 'psychological', 'health systems and information', 'patient care and support', 'physical and daily living', and 'sexuality' needs, among cancer patients [20]. Higher scores indicate a greater unmet need, each domain was analysed separately.

2.1.3 | Quality of Life

Functional Assessment of Cancer Therapy-Breast (FACT-B): A 37-item questionnaire evaluating quality of life across five domains, incorporating physical and emotional well-being, including breast cancer-specific concerns [13].

Scores from each questionnaire or its subscales were aggregated for analysis, with totals calculated as per the respective manual instructions. These scores are termed 'Measured PSQ factors' throughout the study. Additionally, broader psychosocial characteristics and quality of life factors such as the Remoteness Index of Australia used by the Australian Bureau of Statistics (ABS) [21], ethnic background, pre-cancer depression diagnosis, educational level, pre-diagnosis household income, marital and indigenous status, non-English home language, and area-level disadvantage were evaluated and are referred to as 'General PSQ factors' in the study. Further details on instruments and factors used can be found in Supporting Information S1: Appendices 2 and 3.

2.2 | Statistical Analysis

Breast cancer-specific survival was the outcome of interest. Other events, including death from conditions other than breast cancer, were censored at date of death. Those who were not recorded as dying by 31 December 2020 were censored at this date.

Using the BCOS prognostic model published in 2022 as a foundation, core prognostic variables for the model included age at diagnosis, mode of detection, tumour stage, and grade [5]. These core prognostic variables were retained in the model throughout the study for their prognostic relevance and were also used to guide selection of PSQ factors.

Over 20 PSQ factors were included in the initial analysis based on priori knowledge or evidence presented within the scientific literature [10, 11]. PSQ factors that demonstrated a significant association with breast cancer survival after adjusting for the core prognostic variables (age at diagnosis, mode of detection, tumour stage, and grade) were evaluated for inclusion in the extended model.

Flexible parametric survival or Royston–Parmar (RP) models [22] incorporating multivariate fractional polynomials (MFP) [23] were used for guiding variable selection for the extended model. RP models use natural cubic splines to adopt a smooth curve for the baseline cumulative hazard function, allowing more flexibility for predictions and is ideal for prognostic models [22, 24]. Bayes information criterion (BIC) statistic was used to determine degrees of freedom for the cubic spline function and scale with the RP model, which for the data, was 2 degrees of freedom with a baseline spline function on the probit scale.

Variable selection for the extended model involved a backward elimination strategy, maintaining only variables with statistical significance ($p < 0.05$) [5] with 'Age at diagnosis' being deliberately retained in the model using restricted cubic splines with two internal knots and was centred at age 60.

Optimal cut-off points analysis [25] was also conducted for measured PSQ factors that were included in the extended model, either for prediction purposes or for the improvement of discrimination or interpretation. Optimal cut-off points for measured PSQ factors were estimated from RP model analysis after adjusting for core prognostic variables. The minimum *p*-value method was used to select the optimal cut-point where the cut point with the lowest *p* value and Bonferroni adjusted $p < 0.20$ was selected [25].

The continuous versions of measured PSQ factors were utilised in the extended model and the categorical versions of the same factors using cut-off points were used for predictive purposes to make survival probability comparisons and to illustrate the prognostic value of the PSQ factors chosen for the extended model.

The missing data for PSQ factors ranged from 9% to 13% for different variables (Supporting Information S1: Appendix 4), with a total of 30% of respondents having at least one missing variable. The core prognostic variables from the BCOS prognostic model also had varying levels of missing data with clinical subtype having the highest level of missing observations at 20%, further information on missing values for prognostic factors can be found in Supporting Information S1: Appendix 1.

As complete-case analysis would introduce potential bias, missing data was handled using multiple imputation by chained equation (MICE) with the assumption of missing data being missing at random [26]. Based on the proportion of the incomplete cases, 30 imputations were performed on the data and any continuous variables that needed to be categorised, were done post-imputation and across all the 30 imputed datasets to ensure accurate and comparable results.

2.3 | Discrimination and Explained Variation

The Royston and Sauerbrei's *D* statistic was used to evaluate the discrimination of the extended model and the contribution of PSQ factors, indicating its effectiveness at predicting patient outcomes [27]. The associated R_D^2 statistic, ranging from 0 to 1, was used to measure how much variation in survival times the model could explain, with 1 meaning total explanation of variance in the data [27].

The Harrell's *C* statistic, similar to the area under the receiver operating characteristic (ROC) curve, was used to measure the extended model's discriminatory ability, rating its accuracy in ranking survival probabilities for pairs of individuals. A *C*-statistic of 0.5 equates to random chance, while 1 denotes perfect discrimination [28, 29].

The extended prognostic model was used to estimate survival probabilities up to 5 years following breast-cancer diagnosis based on two combinations of prognostic factors, 'low risk' (screening-detected, stage 1, low grade, luminal A) and 'high risk' (symptom-detected, stage 3–4, high grade, triple negative). These two types of hypothetical groups then would use differing combinations of any significant PSQ factors included in the extended model.

All data management and statistical analysis were conducted using Stata/SE version 17 (StataCorp LLC, Texas, USA). Graphs and figures were generated using Stata/SE version 17 [30].

3 | Results

The median follow-up time was 8.8 years (range 0.9–10.8 years). During the follow-up period, 220 out of 3323 women died of breast cancer. Twelve measured PSQfactors with significant evidence of association with breast cancer-specific survival after adjustment for age at diagnosis, tumour stage and grade, and mode of detection were initially identified (Table 1). Women who died from breast cancer tended to exhibit higher scores on the SCS, SCNS-SF34, and BSI-18 metrics, which indicates greater unmet needs, higher social constraints, and elevated psychological distress, than women who did not die of breast cancer (Table 1). Conversely, women who died from breast cancer typically scored lower on the FACT-B metrics and ESSI scores, indicating a lower quality of life and social support (Table 1).

3.1 | Extended Model

The 'SCNS Physical & daily living Summation Score' (hereafter referred to as 'Unmet physical & daily living needs') in a linear form, and the 'ESSI Score' (hereafter referred to as 'Social support score') in a transformed state (using a reciprocal square transformation) were selected to be included in the extended model, in addition to variables in the BCOS prognostic model which included age, stage at diagnosis, tumour grade, clinical subtype, and mode of detection. No time-dependent regression coefficients of significant impact were found from either PSQ factor.

The extended model explained 39% of the variability in breast cancer survival (R^2_D 0.39; 95% CI 0.33, 0.44) with a D statistic of 1.26 (95% CI 1.11, 1.41) (Table 2). This provided a marginal but significant improvement when compared to the original prognostic model which has 36% variability (R^2_D 0.36; 95% CI 0.30, 0.42) and a D statistic of 1.20 (95% CI 1.05, 1.34). The Harrell's C statistic for the extended model was 0.84 (95% CI 0.81, 0.86).

Based on the Physical & daily living domain of the SCNS-SF34 instrument, women who died from breast cancer reported a higher proportion of moderate to high needs in managing pain (13% vs. 10%), tiredness (27% vs. 19%), feeling unwell (14% vs. 7%), work around the home (18% vs. 12%), and not being able to do things that they used to do (23% vs. 16%) compared to those who survived or died from other causes (Supporting Information S1: Appendices 5 and 6). Similarly, the prevalences of having lower social support were higher among women who died from breast cancer (Table 3).

3.2 | Extended Model Parameter Estimates

Table 4 presents the final parameter estimates from the original and extended prognostic models, where a one-unit change in a covariate result is a one-beta change in risk on the probit (inverse normal probability) scale. Interpretation of the probit

TABLE 1 | Mean with standard division for continuous PSQ factors[a] between women who did not die from breast cancer versus women who died from breast cancer.

	Died from breast cancer		
	No (n = 3103) Mean ± SD	**Yes (n = 220) Mean ± SD**	***p* value[b]**
Psychosocial characteristics			
BSI-18 depression T score	49.72 ± 10.43	53.2 ± 11.51	< 0.01
BSI-18 anxiety T score	45.66 ± 10.14	48.79 ± 11.38	0.05
ESSI social support score	28.01 ± 5.30	27.52 ± 6.02	0.01
Social constraints scale total (SCS)	1.69 ± 0.72	1.85 ± 0.77	0.04
Supportive care needs			
SCNS physical and daily living summation score	9.91 ± 4.80	11.59 ± 5.11	0.01
SCNS psychological summation score	20.40 ± 9.42	23.24 ± 9.81	0.03
SCNS health systems summation score	19.26 ± 8.23	21.43 ± 8.92	0.03
SCNS patient care summation score	7.93 ± 3.39	8.80 ± 3.63	0.02
Quality of life			
Fact-B total score	107.8 ± 20.5	100.59 ± 22.43	0.02
Fact-B emotional wellbeing	19.95 ± 3.79	18.42 ± 4.67	0.02
Fact-B social/family wellbeing	21.23 ± 5.94	20.80 ± 6.08	0.02
Fact-B functional wellbeing	20.12 ± 6.00	18.48 ± 6.32	0.03

[a]Numbers of women with missing values for each PSQ factor were presented in Supporting Information S1: Appendix 4.
[b]p values were based on flexible parametric survival models adjusting for age at diagnosis, tumour stage and grade, mode of detection. These models were generated while using the censoring conditions listed in methods.

TABLE 2 | Prognostic model discrimination (D), explained variation (R_D^2) statistic and goodness of fit (Harrell's C-statistic) of included PSQ factors from Table 1.

Type of model	D (95% CI)	R_D^2 (95% CI)	Harrell's C statistic (95% CI)
BCOS prognostic model	1.20 (1.05, 1.34)	0.36 (0.30, 0.42)	0.83 (0.81, 0.85)
BCOS model with only 'social support score (transformed)'	1.23 (1.09, 1.38)	0.37 (0.32, 0.43)	0. 83 (0.81, 0.86)
BCOS model with only 'unmet physical and daily living needs'	1.24 (1.09, 1.39)	0.38 (0.32, 0.43)	0. 83 (0.81, 0.86)
Extended BCOS model with 'social support score (transformed)' and 'unmet physical & daily living needs'	1.26 (1.11, 1.41)	0.39 (0.33, 0.44)	0. 84 (0.81, 0.86)

TABLE 3 | Included instrument prevalence of items in cohort between women who did not die from breast cancer versus women who died from breast cancer.

	Prevalence of moderate-to-high need[a]		
	Died from breast cancer		Overall
SCNS-SF34 physical & daily living domain	No (n = 3103) n (%)	Yes (n = 220) n (%)	(N = 3323) N (%)
Pain	321 (10%)	30 (13%)	351 (11%)
Lack of energy/tiredness	583 (19%)	60 (27%)	643 (19%)
Feeling unwell	218 (7%)	31 (14%)	249 (7%)
Work around the home	359 (12%)	40 (18%)	399 (12%)
Not being able to do the things you used to	495 (16%)	50 (23%)	545 (16%)
	Prevalence of low social support[b]		
	Died from breast cancer		**Overall**
ESSI items	**No (n = 3103) n (%)**	**Yes (n = 220) n (%)**	**(N = 3323) N (%)**
Is there someone available to whom you can count on to listen to you when you need to talk? (Item 1)	195 (6%)	17 (7%)	212 (6%)
Is there someone available to you to give you good advice about a problem? (Item 2)	237 (8%)	24 (11%)	261 (8%)
Is there someone available to you who shows you love and affection? (Item 3)	162 (5%)	17 (8%)	179 (5%)
Is there someone available to help you with daily chores? (Item 4)	646 (21%)	46 (21%)	692 (21%)
Can you count on anyone to provide you with emotional support (talking over problems or helping you make a difficult decision)? (Item 5)	226 (7%)	17 (8%)	243 (7%)
Do you have as much contact as you would like with someone you feel close to, someone in whom you can trust and confide? (Item 6)	281 (9%)	29 (13%)	310 (9%)
Are you currently married or living with a partner? (Item 7)[c]	1038 (33%)	79 (36%)	1117 (34%)

[a]Moderate-to-high need classified as scoring 4 or 5 on the specified item.
[b]Low social support classified as scoring 1 or 2 on the specified item.
[c]Women that answer 'yes' are given a score of 4, answering 'no' gives a score of 2 for this item.

regression coefficients, especially in a medical context, is not as straightforward as interpreting linear or logit regression coefficients. However, we can interpret these coefficients in a general sense where a positive beta coefficient indicates that, when compared to the reference group of a categorical variable, or with one unit increase in a continuous covariate, the predicted probability of breast cancer-specific death increases. Conversely, a negative beta coefficient implies a lower probability of breast cancer-specific death when compared to the reference group or with one unit increase of the continuous covariate [29].

The extended model has shown that patients that have more unmet physical needs (unmet physical & daily living needs, beta coefficient = 0.025, 95% CI = 0.009, 0.041, p = 0.002) and less social support (transformed Social support score, beta coefficient = 0.802, 95% CI = 0.319, 1.286, p = 0.001) have a higher risk of breast-cancer death. Based on the variable selection process, the model included 'Social support' using its reciprocal square transformation of $(X/10)^{-2}$, where X represents the Social Support Score. Therefore, a higher transformed Social Support Score in Table 4 indicates a lower original Social Support Score.

TABLE 4 | The multivariable parameter estimates of the extended BCOS model compared with the original BCOS model.

Variable	Extended BCOS model: Beta coefficient[a] [95% confidence interval]	Extended BCOS model: *p* value	Original BCOS model: Beta coefficient[a] [95% confidence interval]	Original BCOS model: *p* value
Age at diagnosis (spline, 3 df)				
Coefficient 1	0.096 [0.023, 0.168]	0.009	0.092 [0.021, 0.163]	0.012
Coefficient 2	−0.052 [−0.117, 0.013]	0.115	−0.057 [−0.121, 0.008]	0.084
Coefficient 3	0.059 [−0.013, 0.130]	0.107	0.047 [−0.223, 0.118]	0.182
Subtype				
Luminal A (ER+ PR+ HER2−)	0.000	—	0.000	
Luminal B HER2 −ve (ER+ PR− HER2−)	0.305 [0.019, 0.591]	0.036	0.278 [−0.006, 0.561]	0.069
Luminal B HER2 +ve (ER+ PR+ HER2+)	−0.211 [−0.507, 0.086]	0.163	−0.186 [−0.477, 0.106]	0.211
HER2+ (ER− PR− HER2+)	−0.080 [−0.438, 0.277]	0.659	−0.077 [−0.432, 0.279]	0.673
Triple negative (ER− PR− HER2−)	0.340 [0.089, 0.590]	0.008	0.337 [0.087, 0.586]	0.009
Stage at diagnosis				
Stage I	0.000	—	0.000	
Stage IIA/IIB	0.369 [0.162, 0.576]	< 0.001	0.379 [0.176, 0.582]	< 0.001
Stage IIIA/IIIB/IV	1.238 [1.013, 1.462]	< 0.001	1.230 [1.009, 1.450]	< 0.001
Tumour grade				
Low	0.000	—	0.000	—
Intermediate	0.329 [0.002, 0.657]	0.048	0.300 [−0.015, 0.616]	0.062
High	0.687 [0.345, 1.029]	< 0.001	0.641 [0.311, 0.971]	< 0.001
Mode of detection				
Screening	0.000	—	0.000	—
Symptoms	0.468 [0.284, 0.653]	< 0.001	0.495 [0.312, 0.678]	< 0.001
Unmet physical and daily living needs (linear)				
Coefficient 1	0.025 [0.009, 0.041]	0.002	Not included	—
Social support score (transformed)[b]				
Coefficient 1	0.802 [0.319, 1.286]	0.001	Not included	—

[a]A one-unit change in a covariate result in a one-beta change in risk on the probit (inverse normal probability) scale. A positive beta coefficient means that an increase in covariate raises the predicted probability of death from breast cancer. A negative beta coefficient means that an increase in covariate decreases the predicted probability of death from breast cancer. A beta coefficient of zero indicates the reference group.
[b]A reciprocal square transformation was applied, specifically $(x/10)^{-2}$ as recommended from *mfpmi* in stata. Therefore, a higher transformed social support score indicates a lower original social support score.

3.3 | Predicted Breast Cancer-Specific Survival

Optimal cut-off analysis suggested that unmet physical & daily living needs ≥ 19 points (more unmet physical needs) was associated with poorer breast cancer-specific survival compared to unmet physical & daily living needs < 19 points (less unmet physical needs). For 'Social support score', optimal cut-off analysis suggested that social support score ≥ 18 (adequate social support) was associated with better breast cancer-specific survival compared to social support score < 18 (limited social support). (See details in Supporting Information S1: Appendices 7 and 8).

To demonstrate the model and how PSQ factors affect patients' survival, five 'low risk' and five 'high risk' hypothetical 55-year-old patients with varying combinations of 'unmet physical & daily living needs' and 'Social support score' were generated (Table 5, Figures 1 and 2). Two patients, one 'low risk' and one 'high risk', were assigned 'BCOS Model' indicating that they were generated based on the BCOS model which did not incorporate PSQ factors and acted as a baseline for the rest of the hypothetical patients. This allowed for a comparison between the predictive capacity of the BCOS model and the extended model that included PSQ factors.

The results suggested that patients with less unmet physical needs and/or adequate social support had higher predicted survival compared to those with more unmet physical needs and limited social support for both 'low risk' and 'high risk' patients. For example, when compared to the 'low risk' patient which has

TABLE 5 | Predicted 1- and 5-year breast cancer-specific survival of 10 hypothetical patients.

Patient number	Age at diagnosis (years)	Stage at diagnosis	Mode of detection	Grade	Clinical subtype[a]	Unmet physical & daily living needs	Social support score	Predicted breast cancer-specific survival (95% CI)	
								One-year survival (%)	Five-year survival (%)
1	55	1	Screening	Low	Luminal A like	Less unmet physical needs	Adequate social support	99.7% (99.1, 99.9)	96.6% (91.9, 98.8)
2	55	1	Screening	Low	Luminal A like	(BCOS model)	(BCOS model)	99.6% (99.0, 99.9)	96.2% (91.3, 98.6)
3	55	1	Screening	Low	Luminal A like	Less unmet physical needs	Limited Social support	99.1% (97.5, 99.8)	93.2% (83.9, 97.7)
4	55	1	Screening	Low	Luminal A like	More unmet physical needs	Adequate social support	99.0% (97.3, 99.7)	92.6% (83.2, 97.3)
5	55	1	Screening	Low	Luminal A like	More unmet physical needs	Limited Social support	97.8% (93.9, 99.3)	86.8% (72.0, 95.1)
6	55	3–4	Symptoms	High	Triple negative	Less unmet physical needs	Adequate social support	51.2% (41.3, 61.0)	19.3% (10.9, 30.9)
7	55	3–4	Symptoms	High	Triple negative	(BCOS model)	(BCOS model)	48.6% (38.9, 58.4)	17.8% (9.9, 28.7)
8	55	3–4	Symptoms	High	Triple negative	Less unmet physical needs	Limited Social support	38.3% (24.3, 53.9)	11.6% (4.7, 23.8)
9	55	3–4	Symptoms	High	Triple negative	More unmet physical needs	Adequate social support	36.5% (25.4, 48.9)	10.7% (4.9, 20.5)
10	55	3–4	Symptoms	High	Triple negative	More unmet physical needs	Limited Social support	25.0% (13.7, 40.1)	5.8% (1.9, 14.3)

[a]Luminal A like: ER+ PR+ HER2−; Triple negative: ER− PR− HER2−.

less unmet physical needs and adequate social support (Patient 1), the 'high risk' patient with more unmet physical needs and limited social support (Patient 5) had poorer survival, with a 5-year survival predicted as 86.8% (95% CI 72.0%, 95.1%) versus 96.6% (95% CI 91.9%, 98.8%), although the confidence intervals overlapped.

4 | Discussion

This study identified specific PSQ factors that explained some, albeit a marginal amount, of the previously unexplained variation of breast cancer survival. Specifically, higher levels of 'unmet physical & daily living needs' and lower levels of 'social support' were associated with poorer survival. Compared with the previously published prognostic model [5], this extended prognostic model explained an additional 3% of the survival variance (39% in total), with an improvement in discrimination and predictive ability when compared to the original prognostic model.

The addition of these two factors, although marginal at 3%, has variance contributions comparable to BCOS prognostic model factors like clinical subtype and age at diagnosis [5]. Integrating these factors provides a more comprehensive understanding of breast cancer survival while clarifying the role of psychosocial characteristics and supportive care needs in breast cancer survival. To the best of our knowledge, no published prognostic models for breast cancer have considered self-report measures, a point reinforced by a systematic review in 2019 that found none of the 58 reviewed models considered PSQ factors [2].

While self-report measures such as the ESSI and SCNS-SF34 are widely used and validated, their typical use in studies focussing on patient palliative care, survivorship or quality of life [8, 9, 12, 31, 32] limits the ability to compare our results with existing evidence. Nevertheless, a lack of social support has long been

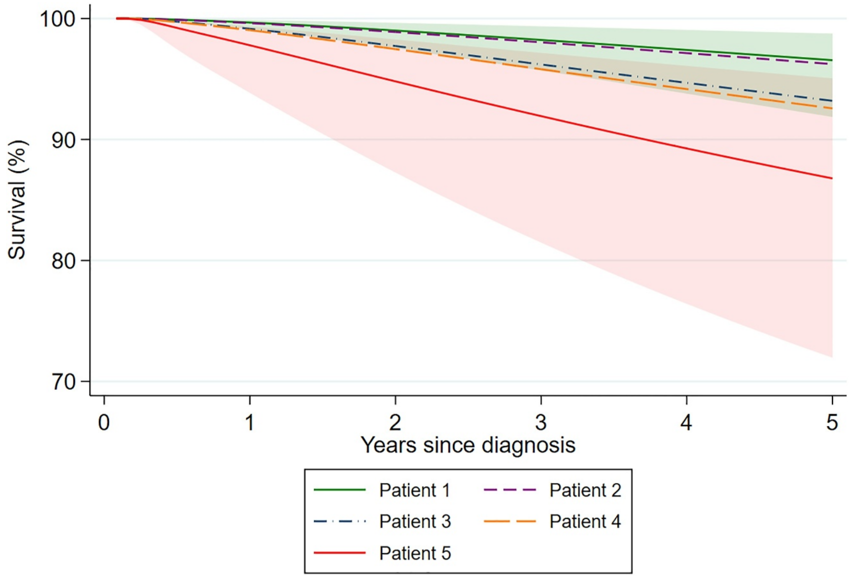

FIGURE 1 | Predicted breast cancer-specific survival for hypothetical patients 1–5.

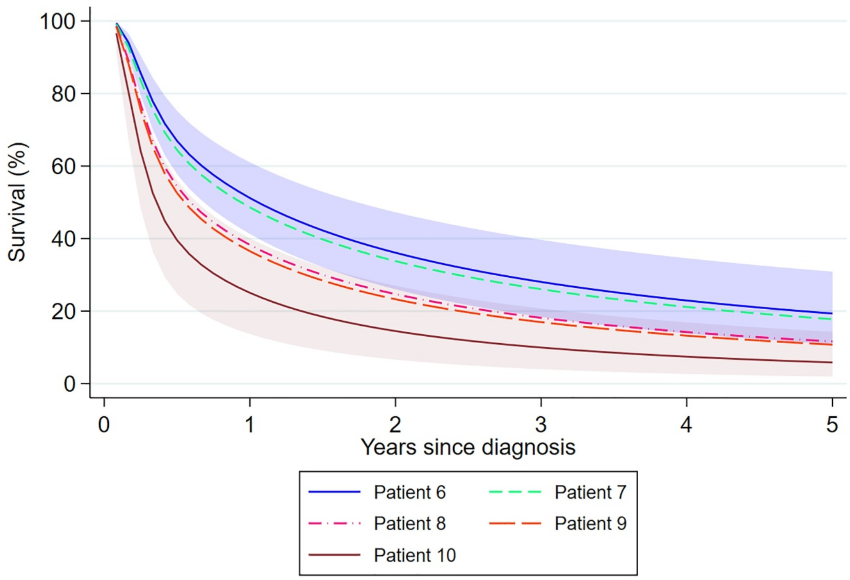

FIGURE 2 | Predicted breast cancer-specific survival for hypothetical patients 6–10.

recognised as a detrimental factor influencing disease outcomes across various medical conditions [33]. Studies that have examined social support and breast cancer survival reported that breast cancer patients with higher levels of social support had better breast cancer survival when compared to patients with less social support [34, 35]. This is consistent with our findings that higher social support (as shown by a higher ESSI score) positively impacts breast cancer survival, highlighting the importance of developing effective interventions to ensure all women diagnosed with breast cancer have sufficient social support and identify early those women who have lower levels of support. Social isolation and perceived loneliness can exacerbate stress and lead to adverse physical responses such as inflammation and weakened immune function. The negative association between social support and survival revealed here may reflect the way in which these responses can hinder recovery and worsen disease progression [36].

The SCNS-SF34 manual defines 'physical and daily living' needs as a patient's needs related to coping with cancer physical symptoms, treatment and how it affects their day-to-day life, and the extent to which the health care services available to them are meeting these needs [20]. Unmet supportive care needs in cancer patient cohorts have been shown to be associated with more severe anxiety and depression, poorer quality of life, and poorer clinical outcomes [10, 31, 37]. It has also been shown that supporting the physical needs of patients may influence breast cancer survival positively [38]. This coincides with our findings which clarifies current knowledge.

The impact of psychosocial characteristics and supportive care needs on breast cancer survival outcomes has shown a dose-related effects even after adjusting for typical prognostic factors, as less social support and more unmet physical and daily living needs were associated with worse survival. These effects were consistent for both 'low risk' and 'high risk' patients.

It was difficult to compare the overall performance of our extended prognostic model to other models since a systematic review [2] found that most breast cancer prognostic models do not examine overall model performance. However, when comparing the discrimination of our model (C-index) to a widely recognised model like PREDICT v3, our findings indicate around the same discriminatory ability of being within the 0.8–0.9 range [3].

4.1 | Clinical Implications

The results showed that 'social support' and 'unmet physical and daily living needs' have a marginal yet statistically significant effect on breast cancer-specific survival, indicating that multidisciplinary care involving psychosocial characteristics and supportive care needs can contribute to improved breast cancer survival. The dose-related effects observed in the hypothetical patient scenarios also provide rationale that the results are not purely statistically significant and demonstrate a substantial difference in survival outcomes between patients that are considered 'high risk' and 'low risk'.

From a clinical perspective, this highlights the need for healthcare providers to adopt a patient-centred approach to survivorship care that includes psychosocial assessments and interventions from the point of diagnosis. By incorporating formal methods to capture patient-reported outcomes within electronic medical records, providers can more effectively address these aspects early in the care process.

Our findings also extend current knowledge, further highlighting the importance of patient-centred survivorship care commencing as soon as possible after a cancer diagnosis. A survivorship care framework that emphasises personal agency, along with health promotion and advocacy; shared management vigilance; care coordination; and evidence-based survivorship interventions provides a pathway to tailor care to need [39].

4.2 | Strengths and Limitations of the Study

The primary strength of this study is its large sample size. This advantage enables the detection of subtle influences of PSQ factors, which may be missed in smaller cohorts due to limited statistical power. This strength is particularly relevant, given the marginal impact demonstrated by these factors on survival outcomes and the inconsistent findings in the literature.

Along with the limitations highlighted in the development of the previous BCOS prognostic model [5], this study has some unique limitations. Firstly, like all studies involving the interpretation of instrument measurements, especially variables obtained from psychological metrics or screening measures, this study might contain measurement error due to the complexity of these variables and their interrelated nature. Secondly, unlike some other prognostic models such as the PREDICT model, our extended model has yet to be externally validated and further testing on other datasets is necessary. Given these limitations, we recommend that future studies examine these specific measured PSQ factors regarding breast cancer-specific survival to consolidate the findings further.

5 | Conclusion

To extend an existing prognostic model for breast cancer survival by incorporating PSQ factors, we demonstrated that both psychosocial characteristics and supportive care needs have marginal but significant prognostic value for determining breast cancer-specific survival.

Our findings highlighted the prognostic importance of unmet 'physical and daily living needs' and 'perceived social support' among women diagnosed with breast cancer and so underscored the potential of personalised multidisciplinary care that addresses these psychosocial and supportive care aspects to improve survival outcomes. Further validation of these findings in other cohorts will increase the evidence base to motivate the development of relevant interventions.

Author Contributions

Study conception and design: Peter Baade, Kou Kou. Data analysis and interpretation: Kieran Arasu, Kou Kou. Manuscript drafting or critique: Kieran Arasu, Kou Kou, Peter Baade, Belinda Goodwin, Suzanne Chambers, Jeff Dunn, Chris Pyke. All authors have read and approved the final manuscript.

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Ethics Statement

Ethics approval for this study was granted by the Griffith University Human Research Ethics Committee (Ref. No: PSY/C4/09/HREC).

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data utilised in this study comprises confidential patient information and in adherence to ethical guidelines, cannot be shared with third parties. Access to the data is restricted to authorised personnel only, and all analyses have been conducted in compliance with institutional and regulatory requirements to ensure the protection of patient privacy. However, the modelled estimations derived from this data are available upon reasonable request.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.