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Impact of Lookback Duration on the Performance of a Claims-Based Frailty Proxy in Women With Stage I–III Breast Cancer

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Abstract

Background: Frailty is an important prognostic indicator in older women with breast cancer. The Faurot frailty index, a validated claims-based frailty proxy measure, uses healthcare billing codes during a user-specified ascertainment window to predict frailty. We assessed how the duration of frailty ascertainment affected the ability of the Faurot frailty index to predict one-year mortality in women with stage I–II breast cancer.

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Conflicts of Interest

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Ethics Statement

The Office of Human Research Ethics of the University of North Carolina at Chapel Hill approved this study (#22-0115).

Preliminary results from this work were presented at the American Society of Clinical Oncology (ASCO) Quality Care Symposium in Chicago, IL, in October 2022.

Methods: We included 128 857 women (66+ years) with stage I–III breast cancer in the SEER-Medicare database (2003–2019). The Fautot frailty index was calculated using 3-, 6-, 8-, and 12-month ascertainment windows prior to diagnosis or using all-available lookback. Associations between the Fautot frailty index using each window and one-year all-cause mortality were estimated using Kaplan–Meier curves. Discrimination of one-year mortality risk was assessed using C-statistics.

Results: Five percent of women died during the year following diagnosis. Higher Fautot scores were associated with increased mortality risk for all frailty ascertainment windows. Differences in one-year mortality risk for women with high vs. low Fautot frailty scores were reduced when using all-available lookback (16% vs. 2%, difference = 15%, 95% CI 0.14–0.15) compared to shorter windows (e.g., 8 months: 25% vs. 2%, difference = 23%, 95% CI 0.22–0.24). C-statistics ranged from 0.758 (all-available lookback) to 0.770 (12 months) and were robust in subgroups defined by age, race, ethnicity, region, stage, and cancer subtype.

Conclusions: The Fautot frailty index performed well across 3- to 12-month frailty ascertainment windows in women with breast cancer. Researchers should employ this index to address confounding by frailty in studies of cancer populations.

Summary

- Frailty is an important prognostic factor in older women with stage I–III breast cancer.
- The Fautot frailty index is a Medicare claims-based proxy for frailty based on demographic and healthcare billing codes that has been used to control for confounding by frailty or to assess effect measure modification in pharmacoepidemiologic and health services research using insurance claims data.
- We leveraged the Surveillance, Epidemiology, and End Results-Medicare linked database to assess how the duration of lookback used to ascertain the Fautot frailty index impacted its performance as a predictor of one-year mortality.
- Among 128 857 women (age 66+ years) with newly diagnosed stage I–III breast cancer, we found that 3-, 6-, 8-, and 12-month frailty ascertainment windows performed well as predictors of one-year outcomes overall and in subgroups defined by age, race, ethnicity, region, cancer stage, and subtype.
- Researchers should consider using the Fautot frailty index when designing cancer pharmacoepidemiology and health services research studies and should carefully consider the tradeoffs of using longer vs. shorter frailty ascertainment windows.

Keywords

breast cancer; claims data; frailty; SEER-Medicare; validation

1 | Introduction

Frailty is a dynamic aging-related syndrome characterized by reduced physiological homeostasis and increased risk for adverse health outcomes [1–3]. Frailty is an important prognostic indicator for older women with newly diagnosed breast cancer. Frail women

with breast cancer are more likely to experience treatment toxicities, worse quality of life, and elevated mortality compared with robust women [4, 5]. The gold standard for assessing frailty in routine oncology practice is through comprehensive geriatric assessment, which assesses aging-related domains using self-reported and objective measures [6]. Comprehensive geriatric assessment is recommended by the International Society of Geriatric Oncology (SIOG) for all older patients with cancer and the American Society of Clinical Oncology (ASCO) for all older adults initiating chemotherapy [7, 8]. Despite these recommendations, assessment of frailty in routine oncology practice is underutilized and poorly documented [9–12].

The linked Surveillance, Epidemiology, and End Results (SEER)-Medicare database offers a unique opportunity for conducting pharmacoepidemiologic and health services research in older adults (aged 65 and over) with cancer, including comparative effectiveness and safety studies. Since frailty is a predictor of cancer treatment selection and adverse health outcomes, confounding by frailty is a threat to the validity of pharmacoepidemiologic studies in older adults with cancer. Although gold standard measures of frailty are not available in the SEER-Medicare database, claims-based frailty indices can be used to predict frailty in individuals [13]. The Fautot frailty index is one such measure that predicts frailty based on diagnostic and procedural billing information during a user-specified frailty ascertainment window [14]. It has been used extensively to help address confounding by frailty or to assess effect measure modification in pharmacoepidemiologic studies using the SEER-Medicare data [13, 15–18].

The original Fautot model was developed in a general population of Medicare beneficiaries using an 8-month frailty ascertainment window. However, different frailty ascertainment windows have been utilized in pharmacoepidemiologic studies in older adults with cancer that use the SEER-Medicare database (e.g., 6 months, 1 year) [13, 15, 16, 18]. We have previously found that the duration of the frailty ascertainment window affects the performance of the Fautot frailty index as a predictor of the Fried frailty phenotype and one-year outcomes relevant to a frail population in a general population of older adults [19]. It is possible that the performance of the Fautot frailty index varies across populations, particularly when the index date for an analysis occurs on the date of an acute medical event, such as a cancer diagnosis or initiation of cancer treatment. In these studies, individuals may have increased healthcare utilization during the pre-index lookback period due to increased encounters with the healthcare system. Different patterns of healthcare utilization can affect the performance of claims-based measures [20].

In this study, we assess the validity of the Fautot frailty index as a predictor of outcomes relevant to a frail population using varying ascertainment windows (3, 6, 8, and 12 months and using all-available lookback) in a population of older women with newly diagnosed stage I–III breast cancer. We also assess its validity as a predictor of one-year mortality in subgroups of breast cancer patients defined by age, race, ethnicity, region, tumor stage, and tumor subtype.

2 | Methods

This was a secondary analysis of the limited SEER-Medicare database. Participants were not contacted and informed consent was not obtained. The Office of Human Research Ethics of the University of North Carolina at Chapel Hill approved this study (#22–0115). All analyses were performed using SAS Version 9.4 (SAS Institute, Cary, NC).

2.1 | Data Source

Our study cohort was drawn from the linked SEER-Medicare database. SEER is a collection of population-based cancer registries that collect tumor and clinical information for approximately half of incident cancers in the USA. SEER was designed to capture a diverse population with respect to race, ethnicity, region, and geography. SEER has been linked to Medicare claims and enrollment data through a collaboration between the National Cancer Institute (NCI) and the Centers for Medicare & Medicaid Services (CMS). Over 95% of adults age 65 years and older with incident cancer living in an SEER area have been successfully linked to Medicare claims and enrollment data [21]. Our study used Medicare claims and enrollment data from January 1, 2003 through December 31, 2019 for incident breast cancer cases diagnosed between January 1, 2004 and December 31, 2017.

2.2 | Study Population

We identified a cohort of women newly diagnosed with primary stage I–III breast cancer between 2004 and 2017, who were at least 66 years of age at diagnosis. Incident breast cancer cases were identified using ICD-O-3 codes (C500–C509) and month and year of diagnosis variables in the SEER registry data. Since only month and year of diagnosis are provided in SEER, we assigned the first of the month of diagnosis as the diagnosis date. Women were required to be continuously enrolled in Medicare fee-for-service (Parts A and B) with no enrollment in a health maintenance organization (i.e., Medicare Advantage/Part C) for at least 365 days prior to the diagnosis date.

2.3 | The Fautot Frailty Index

The Fautot frailty index is a Medicare claims-based algorithm that calculates a predicted probability of frailty using demographic, diagnosis code, or procedure code-based frailty indicators that are assessed during a user-specified frailty ascertainment window [14]. The Fautot frailty index was originally developed and validated as a predictor of dependency in the activities of daily living (ADL) using data linkage between Medicare claims and enrollment data and the Medicare Current Beneficiary Survey (MCBS). Claims-based frailty predictors were determined based on clinical expertise and the final choice of predictors and parameterization was determined based on backwards selection and bootstrapping. The Fautot frailty index was externally validated as a predictor of the frailty phenotype using the Atherosclerosis Risk in Communities (ARIC) cohort with Medicare linkage [22] and in the National Health and Aging Trends Study (NHATS) [19]. It was recently updated for use in the International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM) system and was re-validated as a predictor of mortality, hospitalizations, and SNF admissions [23]. A macro to estimate the Fautot frailty index is available online: <https://sph.unc.edu/epid/harry-guess-research-community/>.

We calculated the predicted probability of frailty on the date of the breast cancer diagnosis using 3-, 6-, 8-, and 12-month frailty ascertainment windows (Figure 1). We also used an “all-available lookback” approach, where the entire history of Medicare fee-for-service continuous enrollment available for each woman prior to the breast cancer diagnosis date was used to estimate the predicted probability of frailty. The earliest availability for claims was January 1, 2003. The predicted probability of frailty was categorized as low (< 0.05), low-medium ($0.05 - < 0.10$), medium ($0.10 - < 0.20$), medium-high ($0.20 - < 0.40$), and high (≥ 0.40) based on cut-points used in prior research [14, 23].

2.4 | Outcomes

We followed women from the date of the breast cancer diagnosis for up to 1 year to assess incident outcomes relevant to a frail population: all-cause mortality, inpatient admission, and skilled nursing facility (SNF) admission. A one-year period was selected based on the strong association between frailty and short-term outcomes. For the analyses of inpatient and SNF admissions, follow-up time was administratively censored at disenrollment from Medicare fee-for-service and death was considered a competing event. For the analysis of one-year mortality, follow-up time was not censored at disenrollment, since Medicare captures vital status information regardless of enrollment status.

2.5 | Covariates

Demographic, clinical, and cancer characteristics were assessed to describe the study population and to conduct subgroup analyses. Demographic factors included age at diagnosis, race (Asian or Pacific Islander, Black, White, Other), ethnicity (Hispanic, non-Hispanic), and census region (Northeast, West, Midwest, South). Comorbidities were assessed during the year prior to the cancer diagnosis using the Gagne combined comorbidity score [24, 25]. Cancer and metastatic cancer were given weights of 0 when calculating the combined comorbidity score. Cancer characteristics included the American Joint Committee on Cancer (AJCC) stage at diagnosis, tumor size, lymph node involvement, tumor grade, and tumor subtype. Tumor subtype was only assessed in patients diagnosed in 2010 or later, since HER2 status was only reliably captured in the SEER-Medicare database beginning in 2010.

2.6 | Statistical Analysis

2.6.1 | Prediction of One-Year Mortality—We estimated the cumulative incidence of one-year mortality from the date of the breast cancer diagnosis using Kaplan–Meier analyses stratified by low, low-medium, medium, medium-high, and high frailty using each ascertainment window. Differences in one-year cumulative incidence across frailty strata were calculated using the low frailty stratum as the reference group. The discriminative ability of the Fautot index as a predictor of one-year mortality was assessed for each frailty ascertainment window using receiver operating characteristic (ROC) curves and by estimating C-statistics (i.e., area under the ROC curve) [26].

We assessed discrimination of one-year mortality risk within subpopulations defined by age (66–74, 75–84, and 85+), race, Hispanic ethnicity, census region, cancer stage (I, II, III), and cancer subtype (HR+/HER2+, HR+/HER2–, HR–/HER2+, triple negative). Race and

ethnicity were analyzed separately and were conceptualized as distinct social constructs that may affect frailty, risk of adverse health outcomes, and classification of the claims-based measures primarily due to systemic racism and inequitable healthcare access [27]. We were only able to assess performance in Black versus non-Black (i.e., all other races combined) groups due to low sample sizes in some racial subgroups.

2.6.2 | Prediction of One-Year Inpatient and SNF Admissions—Using each frailty ascertainment window, the cumulative incidence of inpatient and SNF admissions was estimated using Aalen-Johansen estimators stratifying by the predicted probability of frailty categories and treating all-cause mortality as a competing event [28]. We estimated 95% CIs using the 2.5th and 97.5th percentiles from 2000 bootstrapped samples.

3 | Results

3.1 | Cohort Characteristics

We identified 128 857 women with stage I–III breast cancer who had at least 365 days of continuous enrollment prior to breast cancer diagnosis. The median age at diagnosis was 75 (interquartile range: 70, 81) years (Table 1). 87% were White, 8% were Black, 4% were Asian or Pacific Islander, and < 1% were another race. 5% were Hispanic. 45% of women had stage I, 42% had stage II, and 13% had stage III cancer at diagnosis.

Median predicted probability of frailty was similar across ascertainment windows (range 0.03–0.04; Table 1). Mean predicted probability of frailty increased with longer ascertainment windows (3 months: 0.06, all-available lookback: 0.13). The proportion of women classified as having low frailty decreased with increasing duration of lookback, while the proportion classified as having high frailty increased (Table 2).

3.2 | Prediction of One-Year Mortality

Five percent of women died within 1 year of diagnosis. Higher predicted probability of frailty was strongly associated with increased one-year mortality risk using each frailty ascertainment window (Figure 2). The difference in one-year cumulative incidence of mortality for individuals with high vs. low frailty was largest using the shortest frailty ascertainment window (28% vs. 2%, difference = 26%, 95% CI 24%–28%) and smallest using the all-available lookback approach (16% vs. 2%, difference = 15%, 95% CI 14%–15%). Discrimination of one-year mortality risk was similar across all frailty ascertainment windows (Figure 3), ranging from 0.758 when using all-available lookback to 0.770 when using a 12-month frailty ascertainment window.

Results from the subgroup analyses are presented in Table 3. The cumulative incidence of one-year mortality differed across subgroups, with older women, Black women, those with higher stage cancer, and those with HR–/HER2+ and triple negative subtypes having a higher cumulative incidence of mortality compared to their counterparts. Across all frailty ascertainment windows, discrimination of one-year mortality risk was similar in subgroups defined by age, race, region, cancer stage, and cancer subtype. Discrimination was good in Hispanic and non-Hispanic subgroups (C-statistics > 0.75), but the C-statistic was lower in non-Hispanic women compared to Hispanic women using all lookback periods.

3.3 | Prediction of One-Year Inpatient and SNF Admissions

Higher predicted probability of frailty was associated with higher incidence of inpatient and SNF admissions using all frailty ascertainment windows (Table 4). For example, when using an 8-month frailty ascertainment window, 35% of women with a low predicted probability of frailty had a hospitalization within 1 year of diagnosis, compared to 66% of women with a high predicted probability of frailty. The cumulative incidence differences suggested that associations between the frailty strata and one-year inpatient and SNF admissions were similar using 3-, 6-, 8-, and 12-month frailty ascertainment windows, as measured by cumulative incidence differences. The cumulative incidence differences were lower when using an all-available lookback approach.

4 | Discussion

We assessed the performance of the Faurot frailty index as a predictor of one-year outcomes relevant to a frail population (mortality, inpatient, and SNF admissions) in older women with newly diagnosed stage I–III breast cancer. We found that all frailty ascertainment windows evaluated (3-, 6-, 8-, and 12-month and an all-available lookback approach) discriminated mortality risk well. Higher predicted probability of frailty was strongly associated with an increased risk of one-year mortality, inpatient, and SNF admissions across the frailty ascertainment windows. Associations between the frailty strata and one-year outcomes, were slightly reduced using an all-available lookback approach. Discrimination of one-year mortality risk was good in subgroups defined by age, race, ethnicity, census region, cancer stage, and cancer subtype.

We previously evaluated the performance of various frailty ascertainment windows for the Faurot frailty index in a general population of older adults using linkage between NHATS and Medicare claims and enrollment data [19]. Similar to the findings in the current study, this prior work found that discrimination of one-year mortality was good using each ascertainment window and that cumulative incidence differences for one-year mortality, inpatient, and SNF admissions were slightly lower using the all-available lookback approach. The suboptimal performance of the all-available lookback approach as a predictor of one-year outcomes may be due to claims in the more distant past having less predictive significance for outcomes than more recent claims. Importantly, since the Fried frailty phenotype is available in NHATS data [29, 30], our prior work was also able to assess calibration and discrimination of phenotypic frailty and found calibration was best using 6-, 8-, and 12-month windows, and discrimination of phenotypic frailty was best using the all-available lookback approach.

Our prior work in NHATS-Medicare also found that the Faurot frailty index did not perform well in Hispanic individuals, which contradicts the findings from the current study [19]. While the underlying mechanism for this difference is unknown, it may be related to differences in the assessment of ethnicity between the two data sources. For instance, NHATS collects self-reported race and ethnicity information through in-person surveys, while the primary source of SEER-Medicare race and ethnicity data come from extracted medical records [31]. While we hypothesized that differences in diagnostic workup associated with a cancer diagnosis may lead to differences in performance of the Faurot

frailty index in our study population relative to the general population, we did not observe other meaningful differences in the performance of the Fautot frailty index using different frailty ascertainment windows. In addition, while the strength of our study was evaluating performance separately in subgroups defined by race and ethnicity—conceptualized as distinct social constructs rather than biological constructs [27]—we acknowledge that their intersectionality could be meaningful in understanding frailty. Due to sample size constraints, we could not evaluate model performance within these intersections.

SEER-Medicare is a valuable resource for conducting pharmacoepidemiologic and cancer services research in older cancer populations due to its large diverse sample, granular cancer characteristics derived from high quality cancer registries, and long-term healthcare encounter data from the claims. The Fautot frailty index is an effective tool for describing frailty in studies that leverage the SEER-Medicare linked database [13]. Prior studies in cancer populations have used the Fautot frailty index to address confounding by frailty [32, 33], to mimic clinical trial inclusion and exclusion criteria [15], and for population stratification [18].

Our study provides further support of the utility of using the Fautot frailty index in cancer research. Researchers should carefully consider the implications of using different frailty ascertainment durations when designing studies. Using shorter frailty ascertainment windows could enable researchers to shorten continuous enrollment requirements, thus allowing them to retain more individuals in their study samples. However, too short of a window may miss important frailty indicators that are infrequently billed. While our results suggest that 3- to 12-month windows all perform well, choice of the window will vary depending on the clinical context.

4.1 | Limitations

Several limitations have implications for the interpretation of these findings. First, the exact date of diagnosis is not available in SEER, so we assigned the first of the month of diagnosis as the index date. This method ensured that the frailty ascertainment window would not overlap with the period following diagnosis when cancer treatments and care may impact frailty and billing practices. However, this may lead to differential misclassification of frailty between those diagnosed early vs. late in the month. Second, we restricted our sample to women with fee-for-service Medicare coverage and our results may not be generalizable to women covered by Medicare Advantage plans, which are becoming increasingly prevalent [34]. Linkage between SEER and Medicare Advantage encounter data recently became available for research purposes [35]. Third, our study included older women with stage I–III breast cancer and our findings may not be generalizable to men with breast cancer, metastatic breast cancer, or other cancer types. In addition, our analysis of inpatient admissions included any hospitalization and may have included hospitalizations for breast cancer treatment (e.g., surgery). Finally, we only evaluated the performance of the Fautot frailty index, and our findings may not be generalizable to other frailty indices derived from administrative data (e.g., the Kim deficit accumulation claims-based frailty index or frailty indices derived from electronic health records) [36–38]. The optimal duration of lookback will vary across indices due to differences in the data structure, the frequency of health

encounters and assessments, care settings, and differences in the conditions included in the frailty models.

5 | Conclusions

We found that the Faurot frailty index using 3- to 12-month frailty ascertainment windows all performed well and that the choice of frailty ascertainment window had a minimal impact on its validity as a predictor of one-year outcomes in a cohort of older women with stage I–III breast cancer. Researchers should consider using claims-based frailty indices, such as the Faurot frailty index, in studies of older cancer population that leverage the SEER-Medicare database.

5.1 | Plain Language Summary

Frailty is a condition where older adults become less able to cope with illnesses, injuries, and other health challenges. In older women with breast cancer, frailty is linked to a higher risk of dying. In our study, we measured frailty in 128 857 older women with breast cancer using a tool called the Faurot frailty index. This tool measures frailty based on information from healthcare encounters recorded in Medicare data, such as hospital stays or doctors' appointments. We tested how the length of time used to gather this information affected the tool's ability to predict who might pass away within a year of their breast cancer diagnosis. Shorter timeframes focus more on recent health issues, whereas longer timeframes provide a broader view of a person's medical history. We found that women with higher frailty scores, regardless of the timeframe used, were more likely to die within a year of breast cancer diagnosis. Additionally, the Faurot frailty index worked well across different groups of women, including those of various ages, races, and cancer types. Our study shows that the Faurot frailty index is a useful tool for understanding frailty in older adults with breast cancer.

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Data Availability Statement

This study used data from the Surveillance, Epidemiology, and End Results (SEER) cancer registries with linkage to Medicare enrollment and claims data. SEER-Medicare data are available to researchers through a data use agreement. Additional details on obtaining SEER-Medicare data are available here: <https://healthcaredelivery.cancer.gov/seermedicare/>. The statistical computing code can be made available to other by request.

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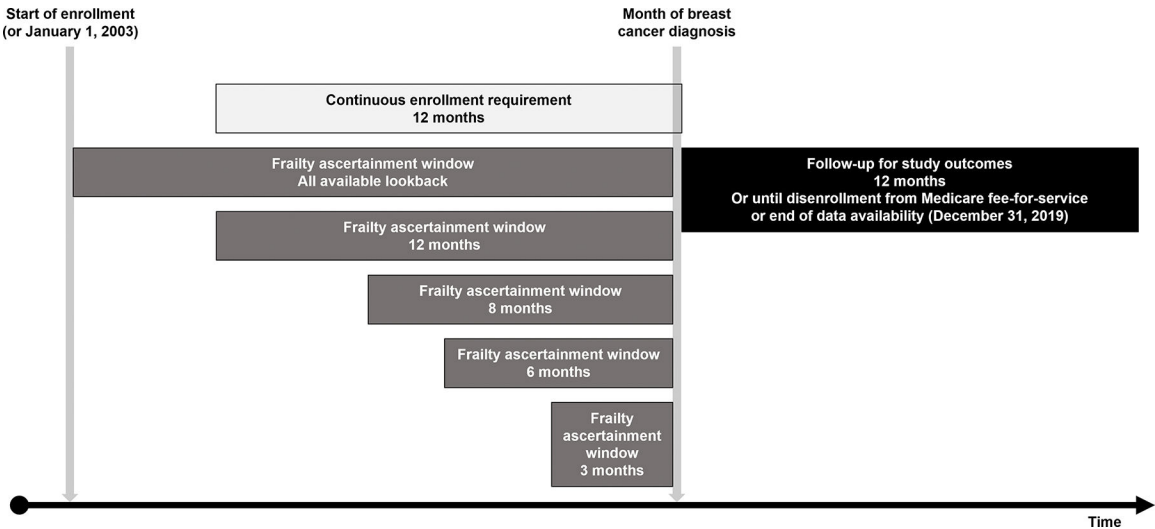


FIGURE 1 |. Study schematic.

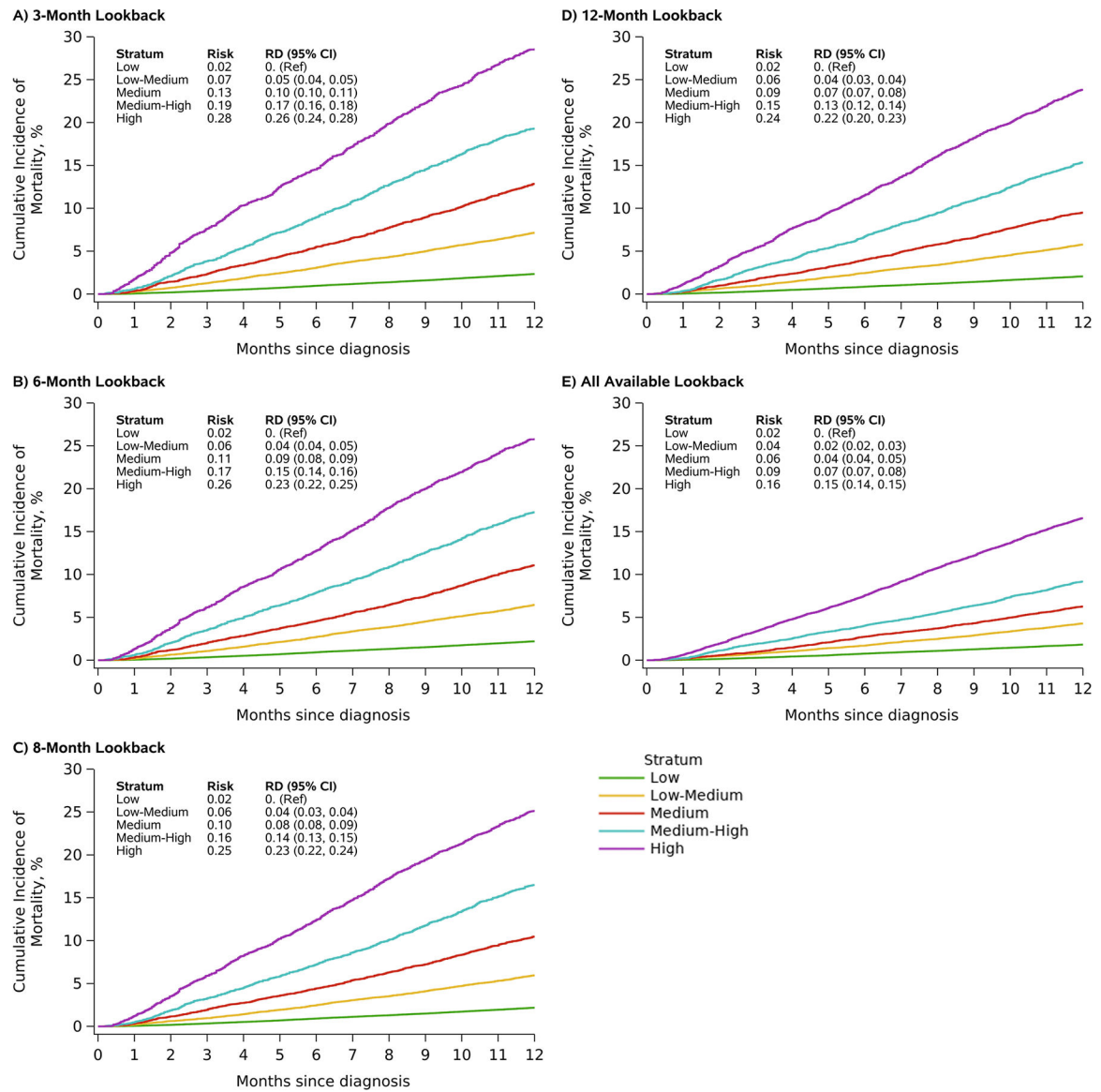


FIGURE 2 |.

One-year all-cause mortality stratified by the Faurot frailty index using varying frailty ascertainment windows, among women aged 66 and older with stage I–III breast cancer in the SEER-Medicare database (2003–2019).

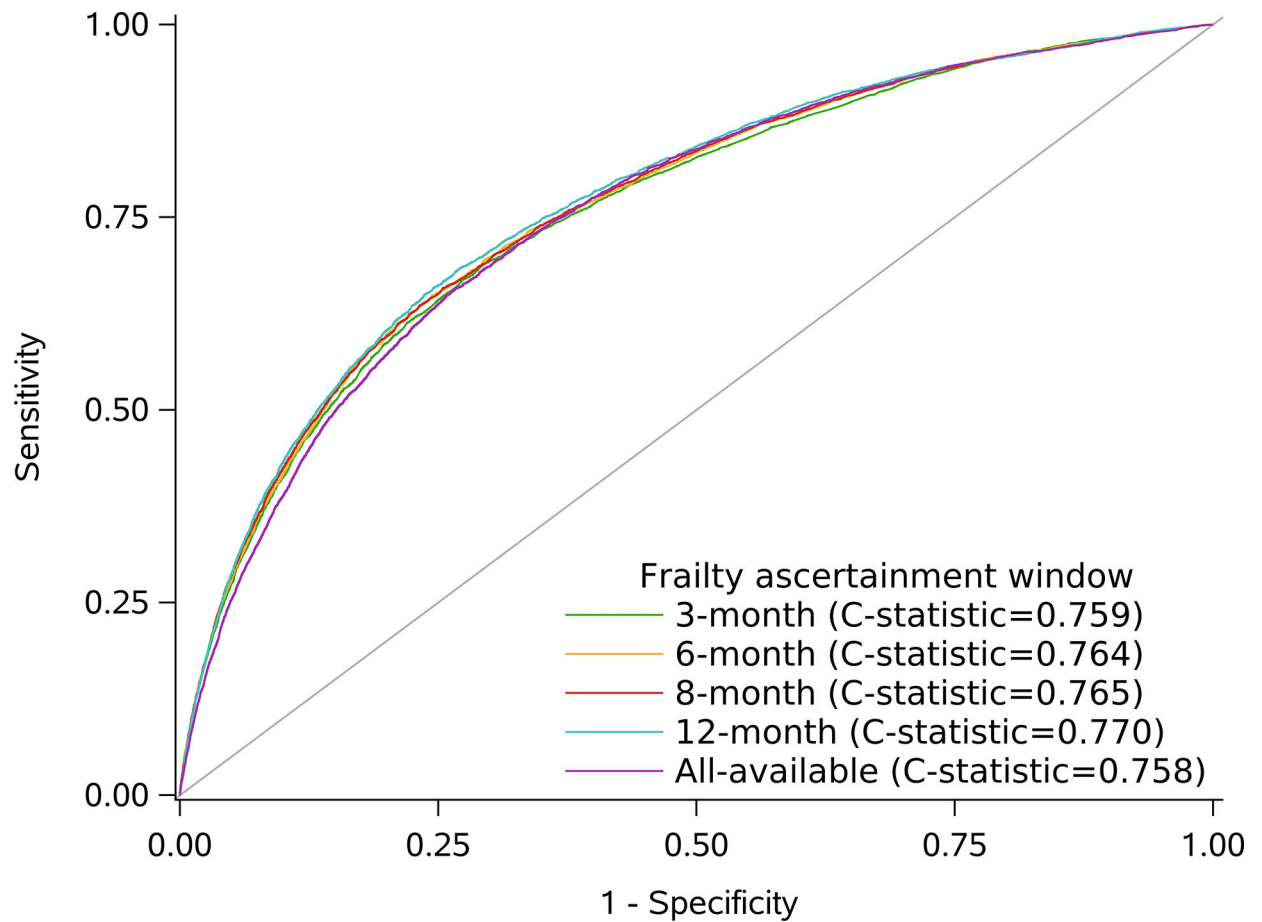


FIGURE 3 |.

Receiver operating characteristic curve assessing discrimination of one-year all-cause mortality risk for the Fautot frailty index using varying frailty ascertainment windows in women aged 66 and older with stage I–III breast cancer in the SEER-Medicare database (2003–2019). SEER = Surveillance, Epidemiology, and End Results.

Table 1.

Baseline characteristics for women aged 66 and older with stage I-III breast cancer in the SEER-Medicare database (2003–2019)

Characteristic	N=128,857	
Demographics		
Age on index date, median (IQR)	75	(70, 81)
Mean (SD)	75.8	(7.2)
Race, n (%)		
White	112,326	(87.4)
Black	10,062	(7.8)
Asian or Pacific Islander	5,637	(4.4)
Other	443	(0.3)
Missing	389	
Ethnicity, n (%)		
Hispanic	6,555	(5.1)
Non-Hispanic	122,302	(94.9)
Region, n (%)		
Northeast	26,509	(20.6)
West	56,026	(43.5)
Midwest	23,907	(18.6)
South	22,415	(17.4)
Gagne Combined Comorbidity Score, ^a n (%)		
<0	28,395	(22.0)
0	42,090	(32.7)
1	21,178	(16.4)
2	12,941	(10.0)
≥3	24,253	(18.8)
Cancer characteristics		
Stage, n (%)		
I	58,022	(45.0)
II	53,780	(41.7)
III	17,055	(13.2)
Tumor size, n (%)		
T1	70,537	(54.9)
T2	45,057	(35.1)
T3	7,022	(5.5)
T4	5,907	(4.6)
Missing	334	
Lymph node involvement, n (%)		
N0	89,591	(69.7)
N1	28,227	(22.0)
N2	6,848	(5.3)

Characteristic	N=128,857	
N3	3,780	(2.9)
Missing	411	
Tumor grade, n (%)		
Well differentiated	29,920	(24.4)
Moderately differentiated	57,900	(47.3)
Poorly differentiated	34,028	(27.8)
Undifferentiated	534	(0.4)
Missing	6,475	
Subtype, ^b n (%)		
HR+/HER2+	7,029	(7.7)
HR+/HER2-	73,286	(80.2)
HR-/HER2+	2,737	(3.0)
HR-/HER2-	8,271	(9.1)
Missing	37,534	
Predicted probability of frailty		
Median, (IQR)		
3-month frailty ascertainment window	0.03	(0.02, 0.05)
6-month frailty ascertainment window	0.03	(0.02, 0.06)
8-month frailty ascertainment window	0.03	(0.02, 0.06)
12-month frailty ascertainment window	0.03	(0.02, 0.06)
All available lookback	0.04	(0.02, 0.11)
Mean (SD)		
3-month frailty ascertainment window	0.06	(0.10)
6-month frailty ascertainment window	0.07	(0.12)
8-month frailty ascertainment window	0.07	(0.13)
12-month frailty ascertainment window	0.08	(0.14)
All available lookback	0.13	(0.22)

Abbreviations: HER2=human epidermal growth factor receptor 2; HR=hormone receptor; IQR=interquartile range; SD=standard deviation; SEER=Surveillance, Epidemiology, and End Results.

^aCancer and metastatic cancer were given a weight of 0 when calculating the Gagne combined comorbidity score. The combined comorbidity score can be less than 0, since two of the conditions included in the score (hypertension and HIV/AIDS) have weights <0 based on their associations with 1-year mortality in the original study.

^bCancer subtype is only available in SEER-Medicare after 2010.

Table 2.

Proportion of women aged 66 and older with stage I-III breast cancer classified as having low, low-medium, medium, medium-high, and high frailty using varying frailty in the SEER-Medicare database (2003–2019)

Lookback window	Proportion in each frailty group (%)				
	Low	Low-medium	Medium	Medium-high	High
3-month	74%	15%	6%	3%	2%
6-month	72%	15%	7%	4%	3%
8-month	71%	15%	7%	4%	3%
12-month	70%	14%	7%	4%	4%
All available lookback	59%	14%	9%	7%	11%

Performance of the Fautrot frailty index using varying frailty ascertainment windows as a predictor of one-year all-cause mortality among women aged 66 and older with stage I-III breast cancer in the SEER-Medicare database (2003–2019), overall and in subgroups

Table 3.

	One-year all-cause mortality (%)	Discrimination of one-year all-cause mortality (C-statistic)				
		3 months	6 months	8 months	12 months	AAL
Overall	4.6	0.76	0.76	0.77	0.77	0.76
Age						
66–74	2.3	0.70	0.71	0.71	0.72	0.71
75–84	4.7	0.70	0.71	0.71	0.72	0.70
85+	12.5	0.69	0.69	0.69	0.69	0.68
Race						
Asian or Pacific Islander	3.1	0.75	0.77	0.77	0.77	0.77
Black	7.0	0.75	0.76	0.76	0.77	0.75
White	4.5	0.76	0.77	0.77	0.77	0.76
Ethnicity						
Hispanic	3.4	0.78	0.79	0.80	0.80	0.79
Non-Hispanic	4.7	0.76	0.76	0.76	0.77	0.76
Census region						
Northeast	4.4	0.77	0.78	0.78	0.78	0.76
Midwest	5.7	0.75	0.75	0.75	0.76	0.75
South	5.7	0.77	0.77	0.77	0.78	0.76
West	3.9	0.75	0.76	0.76	0.77	0.76
Cancer stage						
I	2.0	0.73	0.74	0.74	0.75	0.74
II	5.3	0.75	0.76	0.76	0.76	0.76
III	11.6	0.72	0.73	0.73	0.74	0.73
Cancer subtype ^a						
HR+/HER2+	4.3	0.73	0.74	0.74	0.74	0.74
HR+/HER2–	2.9	0.76	0.77	0.77	0.78	0.77
HR–/HER2+	6.6	0.75	0.74	0.74	0.75	0.75
Triple negative	7.5	0.73	0.74	0.74	0.76	0.75

Abbreviations: AAL=all-available lookback; C-statistic=area under the receiver operating characteristic curve; CI=confidence interval; FFI=Faurot frailty index m=month; HER2=human epidermal growth factor receptor 2; HR=hormone receptor; SEER=Surveillance, Epidemiology, and End Results.

^aTumor subtype was only assessed in patients diagnosed in 2010 or later, since HER2 status was only reliably captured in the SEER-Medicare database beginning in 2010.

Cumulative incidence and cumulative incidence differences of one-year inpatient and SNF admissions, by predicted probability of frailty strata, among women aged 66 and older with stage I-III breast cancer in the SEER-Medicare database (2003–2019)

Table 4.

	One-year cumulative incidence (%)				Difference in one-year cumulative incidence compared to low frailty group as reference (95% CI)				
	Low	Low-medium	Medium	Medium-high	High	Low-medium	Medium	Medium-high	High
Inpatient admission									
3-month	36%	47%	54%	60%	66%	11% (11%, 12%)	18% (17%, 19%)	24% (22%, 25%)	30% (28%, 32%)
6-month	36%	47%	53%	58%	66%	11% (11%, 12%)	17% (16%, 19%)	23% (21%, 24%)	31% (29%, 32%)
8-month	35%	46%	53%	58%	66%	11% (10%, 12%)	17% (16%, 18%)	22% (21%, 24%)	30% (29%, 32%)
12-month	35%	46%	52%	57%	65%	11% (10%, 12%)	17% (16%, 18%)	22% (21%, 24%)	30% (28%, 31%)
All available lookback	34%	42%	46%	50%	58%	8% (7%, 9%)	12% (11%, 13%)	16% (15%, 17%)	24% (23%, 25%)
SNF admission									
3-month	4%	12%	19%	28%	32%	7% (7%, 8%)	15% (14%, 16%)	24% (22%, 25%)	28% (26%, 30%)
6-month	4%	11%	17%	26%	31%	7% (6%, 7%)	13% (12%, 14%)	22% (20%, 23%)	28% (26%, 29%)
8-month	4%	10%	16%	24%	31%	7% (6%, 7%)	13% (12%, 13%)	21% (20%, 22%)	27% (26%, 29%)
12-month	4%	10%	16%	23%	30%	6% (6%, 7%)	12% (12%, 13%)	19% (18%, 20%)	26% (25%, 27%)
All available lookback	3%	7%	11%	15%	24%	4% (4%, 5%)	8% (8%, 9%)	12% (12%, 13%)	21% (20%, 22%)

Abbreviations: CI=confidence interval; SEER=Surveillance, Epidemiology, and End Results; SNF=skilled nursing facility.