Association between major discrimination and deficit accumulation in African American cancer survivors: The Detroit Research on Cancer Survivors Study

Jeanne S. Mandelblatt, MD, MPH[1,2], **Julie J. Ruterbusch, MPH**[3,4], **Hayley S. Thompson, PhD**[3,4], **Xingtao Zhou, MS**[1,5,6], **Traci N. Bethea, PhD**[1], **Lucile Adams-Campbell, PhD**[1], **Kristen Purrington, PhD**[3,4], **Ann G. Schwartz, PhD**[3,4]

[1]Department of Oncology, Cancer Prevention and Control Program, Georgetown Lombardi Comprehensive Cancer Center, Washington, District of Columbia, USA

[2]Georgetown Lombardi Institute for Cancer and Aging Research, Georgetown University, Washington, District of Columbia, USA

[3]Department of Oncology, Wayne State University, Detroit, Michigan, USA

[4]Karmanos Cancer Institute, Detroit, Michigan, USA

[5]Department of Biostatistics, Bioinformatics and Biomathematics, Georgetown Lombardi Comprehensive Cancer Center, Georgetown University, Washington, District of Columbia, USA

[6]Office of Minority Health and Health Disparities Research, Georgetown University, Washington, District of Columbia, USA

Abstract

Background: Discrimination can adversely affect health and accelerate aging, but little is known about these relationships in cancer survivors. This study examines associations of discrimination and aging among self-identified African American survivors.

Methods: A population-based sample of 2232 survivors 20–79 years old at diagnosis were enrolled within 5 years of breast (*n* = 787), colorectal (*n* = 227), lung (*n* = 223), or prostate (*n* = 995) cancer between 2017 and 2022. Surveys were completed post-active therapy. A deficit

accumulation index measured aging-related disease and function (score range, 0–1, where <0.20 is robust, 0.20 to <0.35 is pre-frail, and 0.35+ is frail; 0.06 is a large clinically meaningful difference). The discrimination scale assessed ever experiencing major discrimination and seven types of events (score, 0–7). Linear regression tested the association of discrimination and deficit accumulation, controlling for age, time from diagnosis, cancer type, stage and therapy, and sociodemographic variables.

Results: Survivors were an average of 62 years old (SD, 9.6), 63.2% reported ever experiencing major discrimination, with an average of 2.4 (SD, 1.7) types of discrimination events. Only 24.4% had deficit accumulation scores considered robust (mean score, 0.30 [SD, 0.13]). Among those who reported ever experiencing major discrimination, survivors with four to seven types of discrimination events (vs. 0–1) had a large, clinically meaningful increase in adjusted deficits (0.062, $p < .001$) and this pattern was consistent across cancer types.

Conclusion: African American cancer survivors have high deficit accumulated index scores, and experiences of major discrimination were positively associated with these deficits. Future studies are needed to understand the intersectionality between aging, discrimination, and cancer survivorship among diverse populations.

Keywords

African American persons; aging; Black persons; cancer; deficit accumulation; discrimination; disparities; frailty; survivors

INTRODUCTION

There are complex, bidirectional relationships between aging and cancer.[1–4] Aging is a heterogeneous process characterized by accumulated damage to biological systems over the life course, leading to loss of reserve and capacity to respond to challenges, vulnerability to chronic diseases like cancer, and deterioration in function and death.[1] Cancer and its treatments can affect the rate of aging of survivors because they destabilize and damage biological systems while attempting to eradicate the disease, in contrast to treatments for other chronic diseases that stabilize systems (e.g., control blood pressure or blood sugar).[1,3,4]

In noncancer settings, many factors affect aging, health, and health disparities, such as harmful environmental exposures, limits in community resources, socioeconomic opportunity and health care access, and experiencing discrimination.[1,5–9] Factors like discrimination are thought to affect aging via chronic stress, upregulation of stress responses, chronic increases in inflammation, shortening of telomeres, and loss of homeostasis in biological systems.[1,10–19] Thus, it is possible that experiences of discrimination could explain some of the observed racial disparities in cancer outcomes, including poor age-related function and high cancer-specific and all-cause mortality.[18,20]

There are virtually no studies of the relationships between discrimination and aging in the setting of cancer survivorship.[18] This gap is exacerbated by the continued under-representation of racial and ethnic minorities in cancer research,[21] difficulties measuring aging in oncology settings, and observations that levels of frailty, which are thought to

reflect aging, are not always clinically apparent.[22–24] Frailty is generally measured using one of two types of indices—phenotypic, focused on objective assessments of system failure (e.g., loss of muscle strength)[25] and deficit accumulation, focused on comorbidities and self-reported functional problems.[23,26,27] Both approaches predict mortality in general populations.[23] Deficit accumulation indices are useful because they can readily be constructed from survey and/or clinical data and predict multiple survivorship outcomes, including chemotherapy toxicity, medication adherence and hospitalizations,[28,29] cognitive decline,[30] quality of life, and all-cause mortality.[22,28–31] Deficit accumulation indices are also useful because they are constructed using standardized scaling, facilitating comparisons across studies.[23,26]

In this cross-sectional study, we tested associations between perceived discrimination and deficit accumulation among self-identified Black or African American breast, lung, prostate, and colorectal cancer survivors who were within 5 years post-diagnosis and had completed active treatment. Survivors were part of the Detroit Research on Cancer Survivors (ROCS) Study, a population-based cohort of self-identified Black or African American adult cancer survivors (hereinafter referred to as African American survivors).[32,33] We hypothesized that African American cancer survivors who reported high levels of discrimination would have greater deficit accumulation (i.e., greater frailty) than those reporting lower levels of discrimination. The results are intended to support future studies of multilevel factors affecting aging in cancer survivors from racial minority groups and target testing of interventions to increase racial equity in cancer health outcomes.

MATERIALS AND METHODS

The Detroit ROCS Study has previously been described in detail elsewhere.[33] Briefly, African American adults 20–79 years old at diagnosis of a first primary invasive breast, colorectal, lung, prostate, endometrial, or other cancers among individuals ages 20 years and older residing within the metropolitan Detroit area (Wayne, Macomb, and Oakland counties) were identified from the Metropolitan Detroit Cancer Surveillance System cancer registry. Potentially eligible survivors were contacted and 40% consented and completed assessments. The study protocol was reviewed and approved by the institutional review board at Wayne State University (050417M1F).

Study population

For this secondary analysis, we included African American survivors with breast, colorectal, prostate, and lung cancer who were enrolled from September 2017 to April 2022 and were post-active treatment. We focused on these four cancers because they represent the majority of the cancer burden in African American adults, have racial disparities in cancer and all-cause survival and generally affect older age groups where deficit accumulation is most common.

There were 5067 African American survivors enrolled in ROCS by June 2022 and 4631 had data entry and final eligibility confirmation at that time. Among this sample, we excluded participants with other cancers ($n = 421$), those still in active treatment ($n = 911$), those enrolled more than 5 years from diagnosis ($n = 300$), and those enrolled in a

hospital recruitment-based pilot before surveys measured discrimination ($n = 662$). Among the remaining eligible sample of 2337 persons, we excluded 105 (4.5%) participants who were missing sufficient data for calculation of a deficit accumulation index score, for a final analytic sample of 2232 survivors (Figure 1). The 105 survivors with insufficient data to estimate a deficit accumulation index score were similar to the final analytic sample except that they included more persons in lower education categories (high school or general equivalency diploma, 49% vs. 35%; $p = .013$). The survivors enrolled via hospital-based recruitment excluded due to missing discrimination data had higher deficits accumulation scores than the population-based analytic sample (mean, 0.339 [SD, 0.134] vs. 0.305 [SD, 0.133]; $p < .001$).

Data collection

Participants completed an online (16%), written (57%), or phone survey (27%). The survey included data on self-reported sociodemographics, whether active therapy was complete (except for long-term hormonal treatments), self-reported comorbidities, quality of life (FACT G[34] and Patient-Reported Outcomes Measurement Information System [PROMIS] depression and anxiety scales),[35] perceived discrimination,[36,37] and other data.[33,38] Participants received a $25 gift card for completion of the questionnaire. Clinical data (i.e., date of diagnosis, cancer site, and stage) were extracted from the registry. Treatment data about surgery, radiotherapy, and systemic therapies were self-reported.

Measures

We were interested in testing the associations of deficit accumulation and discrimination scores. Our deficit accumulation index[22,23,26,27,39] included 25 items capturing cardiovascular, metabolic, and other comorbidities, polypharmacy, activity level (e.g., time spent in bed),[40] social support (based on marital status and social well-being)[34] nutritional status (body mass index and unintentional weight loss), physical, emotional and functional well-being, depression,[35] anxiety,[35] and fatigue[38] (see Table S1). Each deficit item received a score from 0 to 1, where 0 represented absence of the deficit and 1 indicates that the item was present and/or the most severe deficit level. For continuous items, we used a range of scores based on established cutpoint or quartiles, where 0.25–0.75 indicated mild to moderate deficits. Items with interval five-point Likert scales (from never to all the time) were scored as 0, 0.25, 0.5, 0.75, and 1. Item scores are summed and divided by the total number of items available, resulting in a final score ranging from 0 to 1. A higher score indicated greater deficit accumulation. All participants included in our sample had 90% of items required for scoring.[26] The continuous deficit accumulation index score was our primary outcome. A difference in score of 0.02 is considered a small clinically meaningful difference and 0.06 a large difference.[41] We also report categorical scores that have previously been identified with risk of hospitalization and mortality (robust, 0 to <0.2; pre-frail, 0.2 to <0.35; or frail, 0.35).[23,26]

We used a well-validated seven-item[42] scale to measure experiences of major discrimination.[43–45] Participants were asked if they ever personally experienced discrimination (yes/no). Among those who experienced discrimination, seven experiences of major discrimination were queried, including being unfairly fired or denied a promotion; not

being hired for a job; unfairly stopped, searched, questioned, physically threatened or abused by the police; unfairly discouraged by a teacher or advisor from continuing education; unfairly receiving worse medical care than other people; unfairly prevented from moving into a neighborhood because the landlord or a realtor refused to sell or rent a house or apartment; and moved into a neighborhood where neighbors made life difficult. The overall score was a sum of experiences of discrimination ranging from 0 to 7. A score of zero among those who had indicated they had experienced discrimination was included to reflect the fact that the context for their perceived discrimination may not have been captured in the included items.[11]

We also considered covariates that could be potential confounders of the association between deficit accumulation and discrimination, including age, cancer type, treatment, cancer stage, time from diagnosis, gender, education, employment, income, and insurance at the time of study enrollment.

Analysis

We described the unadjusted distribution of continuous deficit accumulation scores for the overall sample of survivors and survivors by cancer type (breast, colorectal, lung, and prostate). Next, we tested bivariate associations between categories of deficit accumulation scores (robust, 0 to <0.2; pre-frail, 0.2 to <0.35; or frail, ≥0.35) and covariates using χ^2 or the Cochran-Armitage trend test as applicable; two-sided p values ≤0.05 were considered statistically significant. In secondary analyses, we also examined unadjusted continuous score distributions separately for each of the four cancer types.

For our primary analysis, we used linear regression models to test the associations of perceived discrimination (number of major discriminatory events among those reported ever having experienced discrimination) with the outcome of continuous deficit accumulation scores, considering age, education, insurance and income level, self-identified sex (for site-specific analyses of lung and colorectal cancer), time from diagnosis, and cancer type and treatment. The number of discrimination events was grouped into 0–1, 2–3, and 4–7 based on sample distributions; results were unchanged using the continuous scores from 0 to 7. In secondary analyses, we repeated the regression models separately for each cancer type to determine if the magnitude of association between major discrimination and deficit accumulation varied across cancer type. Finally, we conducted secondary analyses to test the association of ever versus never reporting discrimination and deficit accumulation scores. Model fit was assessed using R^2 values. All analyses were conducted using SAS Version 9.4 (SAS Institute Inc, Cary, North Carolina) and graphs were drawn using R software.

RESULTS

African American cancer survivors in this study were an average of 21 months (SD, 14) from diagnosis and most had breast (35.3%) or prostate cancer (44.6%) (Table 1). Two-thirds of the survivors had their cancers diagnosed at local stages. The mean age at enrollment was 62 years (range, 23–84): breast cancer, 60 years (28–84); colorectal cancer, 61 years (23–80); lung cancer, 65 years (39–83); and prostate cancer, 64 years (42–81). Two-thirds of these African American cancer survivors reported ever experiencing major

discrimination. Among those reporting discrimination, the mean number of types of events was 2.4 (SD, 1.7), with 24.2% reporting four to seven types of events (Table 2).

Deficit accumulation

The majority of survivors had unadjusted deficit accumulation scores in the pre-frail (42.7%) or frail category (32.9%); only 24.4% had scores in the robust score range (Table 1 and Figure 2), with a mean deficit accumulation score of 0.30 (SD, 0.13). The proportion of survivors with scores in the frail category did not differ by disease stage ($p = .705$), although there were small numbers with distant disease. Deficit scores did vary somewhat across cancer types, with the smallest proportion in the frail category among colorectal and prostate cancer survivors (27.3% and 29.0%, respectively) and the highest rates among breast (35.2%) and lung cancer survivors (47.5%, $p = .001$) (Table 1 and Figure S1).

Is discrimination associated with deficit accumulation index score?

Among those who reported ever experiencing discrimination, as the number of types of major discrimination events increased, the adjusted deficit accumulation scores increased, with those who reported four to seven types of major discrimination events having a large clinically meaningful increase in deficits, controlling for covariates (0.062 higher than those reporting 0–1 types of major discrimination events, $p < .001$) (Figure 3 and Table 3).

Several sociodemographic factors were also independently associated with deficit accumulation, including sex (β 0.46 [SD, 0.015] for females vs. males; $p = .003$) and education level (β 0.034 for <high school vs. graduate degree; $p = .044$), but age was not significantly associated with adjusted deficit scores after considering other covariates. Among clinical variables, cancer type or time from diagnosis was not related to adjusted deficit accumulation scores and receipt of radiation therapy (vs. not) was the only treatment modality independently associated with a small clinically meaningful increase in deficit accumulation (β 0.023 [SD0.007], $p < .001$) (Table 3).

The pattern of adjusted associations between level of perceived discrimination and deficit accumulation scores was consistent across survivors with all four cancer types (Supplement Table 2). The magnitude of effects of discrimination ranged from small (breast and colorectal cancer) to large (lung and prostate cancer) clinically meaningful increases in deficit accumulation scores among those reporting four to seven (vs. 0-1) types of discrimination events, and these relationships were statistically significant for all cancer types except the type with the smallest sample size (colorectal cancer) (Table S2). The independent effects of radiotherapy on deficit accumulation score seen in the all cancer model was mainly driven by effects among breast and prostate cancer survivors (Table S2); other treatment modalities were not related to deficit accumulation. Finally, in models considering ever (vs. never) reporting any discrimination, discrimination was also significantly associated with adjusted deficit accumulation score ($p = .041$) (Table S3).

DISCUSSION

This is the first study to examine the relationship between deficit accumulation, a measure of aging, and perceived discrimination in African American survivors of breast, colorectal,

lung, and prostate cancer. We found that two-thirds of African American survivors had deficit accumulation scores in the pre-frail and frail range. More than 60% of these African American cancer survivors also reported experiencing major discrimination. There was a large clinically meaningful association of reporting more types of major discrimination events and greater deficit accumulation. Finally, socioeconomic indicators and receipt of radiation therapy were also independent predictors of deficit accumulation.

There is limited data on deficit accumulation in adult cancer survivors,[46] and even less information among African American survivors.[20] The average deficit accumulation index scores among the African American cancer survivors in our study were close to a frail range, with two-thirds having scores in the pre-frail and frail categories. These rates are higher than those reported in other analyses of largely White cancer survivors and general populations of adults. For example, studies of predominantly White breast cancer survivors with similar age distributions as our sample reported that only 5% of women have deficit accumulation scores in the frail range,[46-48] compared to 35.2% in our population. In one study of gastrointestinal cancer survivors, African American survivors were significantly more likely to have scores in the frail range than White survivors, independent of covariates.[20] In the general US population, phenotypic frailty rates in African American adults ages 65 and older were 22.9%,[49] lower than the 35.2% rate seen in our cancer survivors with an average age of 62 using a deficits accumulation index, suggesting possible interactions of aging and cancer.

There are many studies linking discrimination and health,[6,8,15,16,50] but fewer that have examined how discrimination affects aging or biomarkers of aging processes,[51-53] and only one small, inconclusive study of discrimination and an aging marker in breast cancer survivors.[18] In addition to a relative paucity of data, the relationships between experiences of discrimination, aging and health outcomes are not straightforward. There are reports that low income, passive coping styles, internalized racism, and medical mistrust can exacerbate the negative effects of discrimination on health among African American individuals.[18,54] These relationships have not been studied in the context of aging and cancer survivorship and will be important to consider in future studies.

Beyond discrimination, socioeconomic indicators were independent predictors of deficit accumulation. This result is not unexpected because African American adults in the general population consistently have higher levels of frailty than White adults, and these differences are not explained by socioeconomic factors.[49,55] It will be important to study other social determinants of health to illuminate relationships between different factors in their effects on deficit accumulation. Cancer and its therapies can also increase accumulation of aging-related deficits.[3,56-58] We found that radiotherapy was independently associated with deficit accumulation, largely due to effects among breast and prostate cancer survivors. We did not find an effect for chemotherapy, but this modality was only used by 28.3% of survivors compared to 54.0% receiving radiotherapy. Further examination of the effects of specific modalities and agents on aging of African American cancer survivors is warranted.

This study has many strengths, including use of data from the Detroit ROCS Study, the largest investigation of multilevel determinants of cancer outcomes exclusively conducted

in an African American population. Inclusion of survivors who were post-active treatment and within 5 years from diagnosis allowed recovery and reduced the amount of informative missing data. Longer-term cohort studies that include data from before and after cancer diagnosis, prospective studies that enroll survivors at cancer diagnosis with concurrent noncancer controls and preclinical models will be useful to better understand the interactions of chronic life stressors, stress biology, and cancer on aging-related outcomes.

There are also several caveats that should be considered in evaluating our results. First, because aging was not an initial study focus, the number of items available for the deficit accumulation index were adequate, but fewer than used in some other studies.[46] The smaller number of items means that certain aspects of aging may not have been fully captured (e.g., instrumental activities of daily living or vision and hearing impairments), making the index potentially less sensitive than indices having more items and likely biasing results toward the null. Furthermore, we did not have data on specific biomarkers of aging processes that might illuminate the pathways between experiences of discrimination and frailty and other cancer survivorship outcomes. This will be an important next step.[18] Second, although the items in our measure of major discrimination has been used over decades and predicts mental and physical health outcomes,[7,45,50,52,59] it may not reflect all types of discrimination in current society. A simple count of the types of major discriminatory events may also not capture more subtle aspects of discrimination or the effects of item framing or unwillingness to report unfair events.[11] Additionally, our discrimination measure only ascertained if an event occurred, but not the frequency of the experience or when it occurred relative to cancer diagnosis and treatment. This is likely to have under-estimated our observed effect of discrimination on deficits. It will be important to obtain more nuanced data on the dose and timing of discriminatory events in future studies. It is also possible that the emotional, social, and biological impacts of discrimination affect aging differently in cancer versus noncancer groups. To the extent that we may have under-ascertained discrimination or its impact, this would have led to measurement error that should have biased the observed association of discrimination and deficit accumulation toward the null. We also did not specifically assess different dimensions of discrimination, including internalized discrimination, interpersonal versus institutional discrimination and discrimination due to race versus other causes (e.g., weight, disability, and national origin). There is only very limited data on these dimensions in cancer survivors. Moving forward, it will be important to evaluate the impact of multiple discrimination dimensions to better understand mechanisms and identify intervention strategies. Earlier studies of the impact of racism on health suggest that structural discrimination will affect socioeconomic opportunity and access to and quality of cancer care, whereas experiences of discrimination and coping strategies like internalization have been observed in general populations to affect allostatic load, stress, gene expression and inflammatory responses.[14–16,18,59] Finally, this was a cross-sectional analysis, and we did not have baseline deficit accumulation data from the time of diagnosis, limiting conclusions about causal relationships.

Overall, the results of this study illustrate that the experience of major discrimination is related to aging as measured by deficit accumulation, and this association is not explained by socioeconomic status. With the largest projected increases in the number of cancer survivors occurring among racial and/or ethnic minority groups,[1,4,60] we urgently need

transdisciplinary collaborations to study multilevel factors to identify pathways to achieving greater cancer health equity.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

ACKNOWLEDGMENTS

DATA AVAILABILITY STATEMENT

The Detroit Research on Cancer Survivors Study (ROCS) data are available for sharing following the National Institutes of Health requirements and Findability, Accessibility, Interoperability, Reproducibility (FAIR) principles for data access. Data access is via requests described at https://detroitrocs.org/dnn/For-Researchers/Data-Requests. The deficit accumulation index used in this study is included in Table S1. The SAS code and data for the analyses included in the article are available on request within the constraints of the Detroit ROCS institutional review board requirements.

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FIGURE 1.
CONSORT diagram for analytic sample of self-identified African American breast, colorectal, lung and prostate cancer survivors 20–79 years old at diagnosis.

FIGURE 2.

Distribution of unadjusted deficit accumulation index scores among self-identified African American breast, colorectal, lung, and prostate cancer survivors 20–79 years old at diagnosis. Deficit accumulation scores range from 0 to 1, with scores between 0 to <0.20 considered robust; 0.20 to <0.35 considered pre-frail; and 0.35+ considered frail.

FIGURE 3.

Association between number of perceived major discrimination events among persons reporting ever experiencing discrimination and unadjusted deficit accumulation score category among self-identified African American breast, colorectal, lung, and prostate cancer survivors 20–79 years old at diagnosis (n = 1378; 485 repo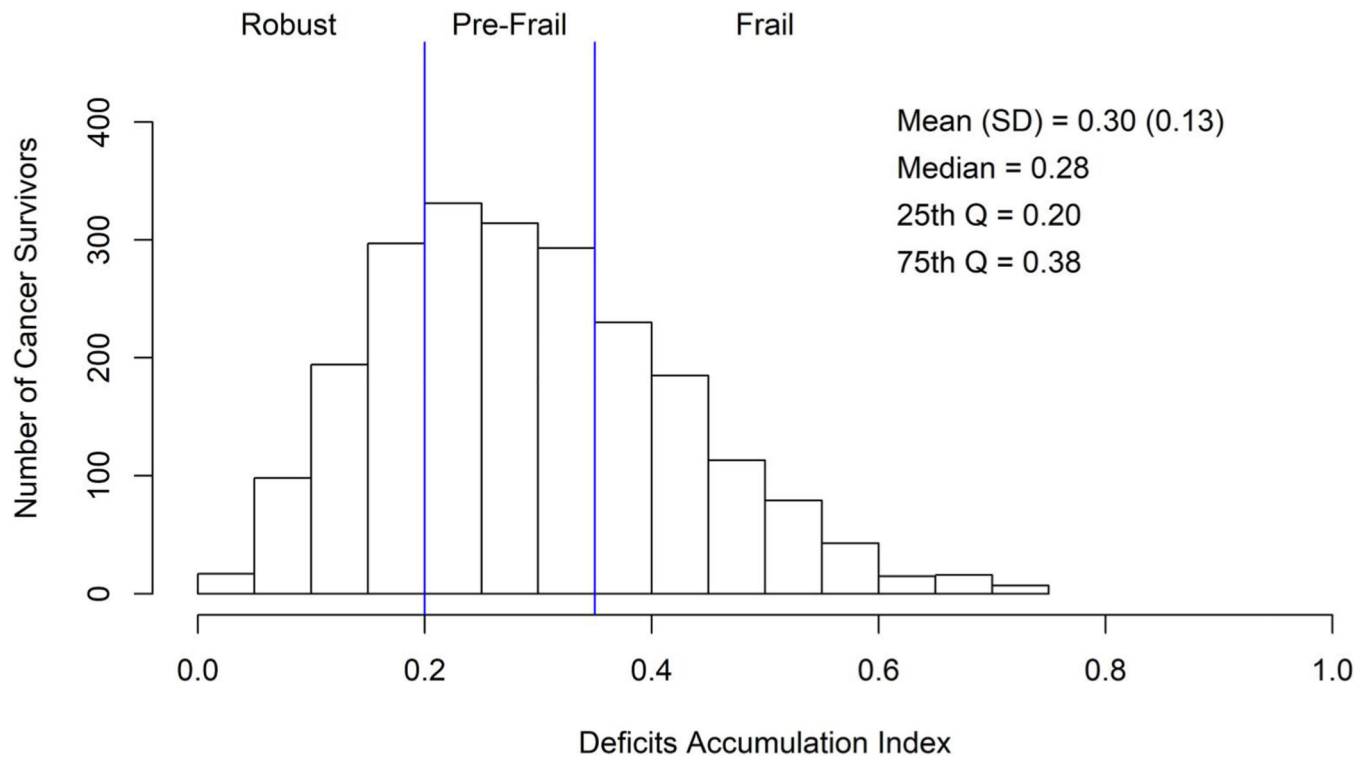rting 0–1, 560 reporting 2–3, and 333 reporting 4–7 discrimination events). Zero discrimination events among those reported ever experiencing discrimination reflects that their specific experience was not included in the items included on the scale

TABLE 1

Characteristics of self-identified African American breast, colorectal, lung, and prostate cancer survivors by deficit accumulation score category

	All cases		Robust (<0.20)		Pre-frail (0.20 to <0.35)		Frail (0.35+)		
	No.	Col %	No.	Row %	No.	Row %	No.	Row %	p *
Total	2232	100	544	24.4	954	42.7	734	32.9	
Demographics									
Sex									.001
Male	1200	53.8	309	25.8	538	44.8	353	29.4	
Female	1032	46.2	235	22.8	416	40.3	381	36.9	
Age at enrollment, years									<.001
<50	216	9.7	71	32.9	87	40.3	58	26.9	
50–59	565	25.3	168	29.7	228	40.4	169	29.9	
60–69	918	41.1	213	23.2	389	42.4	316	34.4	
70+	533	23.9	92	17.3	250	46.9	191	35.8	
Mean (std)	62 (9.6)		60 (9.7)		63 (9.8)		64 (8.9)		
Range	23–84		30–83		23–84		32–82		
Education									<.001
Less than high school	190	8.6	25	13.2	73	38.4	92	48.4	
High school or GED	577	26.2	116	20.1	244	42.3	217	37.6	
Some college	871	39.6	205	23.5	381	43.7	285	32.7	
4-year degree	251	11.4	80	31.9	106	42.2	65	25.9	
Graduate/professional degree	313	14.2	112	35.8	137	43.8	64	20.4	
Employment status									<.001
Employed (full, part time)	710	31.9	306	43.1	308	43.4	96	13.5	
Unemployed or disability	574	25.8	51	8.9	208	36.2	315	54.9	
Retired	859	38.6	163	19.0	403	46.9	293	34.1	
Other	85	3.8	23	27.1%	33	38.8	29	34.1	
Income (household)									<.001
<$20,000	737	35.6	100	13.6	281	38.1	356	48.3	
$20,000–39,999	456	22.0	99	21.7	195	42.8	162	35.5	
$40,000–59,999	339	16.4	102	30.1	149	44.0	88	26.0	

	All cases		Robust (<0.20)		Pre-frail (0.20 to <0.35)		Frail (0.35+)		p*
	No.	Col %	No.	Row %	No.	Row %	No.	Row %	
$60,000–79,999	210	10.1	68	32.4	107	51.0	35	16.7	
$80,000	327	15.8	131	40.1	151	46.2	45	13.8	<.001
Insurance at enrollment									
Medicare only	432	19.4	81	18.8	190	44.0	161	37.3	
Medicare plus private	424	19.0	79	18.6	188	44.3	157	37.0	
Medicare plus Medicaid	291	13.1	33	11.3	93	32.0	165	56.7	
Medicaid alone	352	15.8	63	17.9	145	41.2	144	40.9	
Private insurance or VA	703	31.6	279	39.7	323	45.9	101	14.4	
Other	25	1.1	8	32.0	11	44.0	6	24.0	<.001
Cancer characteristics									
Cancer site									
Breast	787	35.3	195	24.8	315	40.0	277	35.2	
Colorectal	227	10.2	70	30.8	95	41.9	62	27.3	
Lung	223	10.0	26	11.7	91	40.8	106	47.5	
Prostate	995	44.6	253	25.4	453	45.5	289	29.0	<.001
SEER summary stage									
Local	1513	68.3	368	24.3	639	42.2	506	33.4	
Regional	608	27.5	153	25.2	263	43.3	192	31.6	
Distant	93	4.2	18	19.4	44	47.3	31	33.3	.705
Treatments received									
Surgery									
Yes	1470	66.3	384	26.1	612	41.6	474	32.2	
No	748	33.7	156	20.9	337	45.1	255	34.1	.023
Chemotherapy									
Yes	627	28.3	147	23.4	270	43.1	210	33.5	
No	1591	71.7	395	24.8	678	42.6	518	32.6	.782
Radiation									
Yes	1199	54.0	261	21.8	501	41.8	437	36.4	
No	1023	46.0	282	27.6	448	43.8	293	28.6	<.001
Hormone therapy									.365

	All cases		Robust (<0.20)		Pre-frail (0.20 to <0.35)		Frail (0.35+)		p *
	No.	Col %	No.	Row %	No.	Row %	No.	Row %	
Yes	438	19.9	106	24.2	176	40.2	156	35.6	
No	1768	80.1	436	24.7	763	43.2	569	32.2	.226
Immunotherapy									
Yes	76	3.5	13	17.1	33	43.4	30	39.5	
No	2100	96.5	524	25.0	896	42.7	680	32.4	.288
Time from diagnosis to enrollment									
2–12 months	817	36.6	182	22.3	352	43.1	283	34.6	
13–24 months	669	30.0	177	26.5	289	43.2	203	30.3	
25–60 months	746	33.4	185	24.8	313	42.0	248	33.2	
Mean (std)	21 (14)		21 (14)		21 (14)		21 (14)		
Median	16		17		16		15		
Diagnosis year									.647
2014–2016	813	36.4	201	24.7	346	42.6	266	32.7	
2017–2018	805	36.1	207	25.7	338	42.0	260	32.3	
2019–2021	614	27.5	136	22.1	270	44.0	208	33.9	

Note: Not reported or unknown values omitted from the table; other insurance includes those who reported no insurance (<1% of the sample). The last date of diagnosis was December 31, 2021, or earlier and the last enrollment and survey completion date was in 2022.

Abbreviations: GED, general equivalency diploma; SEER, Surveillance, Epidemiology, and End Results; Std, standard deviation; VA, Veteran's Administration.

*
p values are χ^2 tests, tests for trend, or t-tests.

TABLE 2

Perceived major discrimination among self-identified African American breast, colorectal, lung, and prostate cancer survivors by unadjusted deficit accumulation score category

	All cases		Robust (0 to <0.20)		Pre-frail (0.2 to <0.35)		Frail (0.35+)		
	No.	Col %	No.	Row %	No.	Row %	No.	Row %	p *
Perceived discrimination									.570
Ever	1378	63.2	345	25.0	584	42.4	449	31.5	
Never	803	36.8	186	23.2	355	44.2	262	32.6	
Perceived discrimination count (among those who reported ever)									<.001
0–1	485	35.2	148	30.5	215	44.3	122	25.2	
2–3	560	40.6	144	25.7	243	43.4	173	30.9	
4–7	333	24.2	53	15.9	126	37.8	154	46.2	
Mean (std)	2.4 (1.7)		2.0 (1.5)		2.3 (1.5)		2.8 (1.8)		
Median	2		2		2		3		

Abbreviation: Std, standard deviation.

*
p values calculated from Cochran-Armitage trend test, Mantel-Haenszel χ^2, or ANOVA (as applicable); 51 people missing data on discrimination.

TABLE 3

Adjusted associations of continuous deficit accumulation scores and number of perceived discrimination events and among African American cancer survivors reporting ever experiencing personal discrimination ($n = 1257$)

	β	SE	Lower confidence limit	Upper confidence limit	p
Perceived discrimination (count of major discrimination events)					
0–1	Ref	—	—	—	—
2–3	0.025	0.007	0.010	0.040	.001
4–7	0.062	0.009	0.045	0.079	<.001
Sex					
Male	Ref	—	—	—	—
Female	0.046	0.015	0.016	0.076	.003
Age group at enrollment[a]	0.003	0.005	−0.006	0.013	.471
Education					
<High school	0.034	0.017	0.001	0.067	.044
High school or GED	0.014	0.012	−0.009	0.037	.228
Some college	0.019	0.010	−0.001	0.038	.058
4-year degree	0.007	0.012	−0.016	0.030	.534
Graduate/professional degree	Ref	—	—	—	—
Employment status					
Employed (full or part time)	Ref	—	—	—	—
Unemployed or disability	0.108	0.010	0.088	0.129	<.001
Retired	0.045	0.010	0.026	0.064	<.001
Other	0.026	0.018	−0.010	0.061	.152
Income (household)	−0.011	0.003	−0.017	−0.006	<.001
Insurance at enrollment					
Medicare only	0.016	0.011	−0.005	0.038	.126
Medicare plus private	0.024	0.011	0.003	0.045	.024
Medicare plus Medicaid	0.052	0.013	0.027	0.078	<.001
Medicaid alone	−0.001	0.012	−0.025	0.023	.942
Private insurance or VA	Ref	—	—	—	—
Cancer site					

	β	SE	Lower confidence limit	Upper confidence limit	p
Female breast	-0.017	0.017	-0.051	0.016	.314
Colorectal	-0.022	0.013	-0.048	0.005	.107
Lung	0.005	0.014	-0.024	0.033	.753
Prostate	Ref	—	—	—	—
Radiation therapy (vs. none)	0.023	0.007	0.009	0.037	.001
Time from diagnosis	0.000	0.000	-0.001	0.000	.640
Model fit, R^2	0.286				

Abbreviations: GED, general equivalency diploma; SE, standard error; VA, Veteran's Administration.

[a] See age groups in Table 1. Other insurance set to missing (<1%). A total of 121 persons missing one of more model covariates. R^2 (from 0 to 1) indicates the percent of variance in deficit accumulation scores explained by the model covariates. Here, 28.6% of the variability in deficit accumulation scores was explained by the model covariates.