Brief Report

The impact of neighborhood disadvantage on health-related quality of life among African American and White cancer survivors

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Abstract: Following improvements in cancer survival rates quality of life (QOL) has become a key health outcome among cancer survivors. Neighborhood disadvantage has been shown to have a detrimental effect on health outcomes. To date, little is known regarding the influence of neighborhood disadvantage on the health-related QOL of cancer survivors. This study aimed to examine the associations between neighborhood disadvantage and health-related QOL among African American and White cancer survivors. Data were obtained from a retrospective survey study of African American (n=248) and White (n=244) cancer survivors. Physical (PHQOL) and mental health (MHQOL) QOL was measured by the Rand 36-Item Short Form. The neighborhood disadvantage index was created based four components, including prevalence of poverty, mother-only households, home ownership and the prevalence of college educated individuals living in the area. Covariates included demographic characteristics and clinical factors. To adjust the nesting effects of participants living in neighborhoods, a mixed effect linear regression model was conducted to test the association between neighborhood disadvantage and PHQOL and MHQOL after controlling for covariates. Regression results showed that patients living in more disadvantaged neighborhoods reported lower PHQOL than those in more advantaged places (β =–1.21, P=0.020). However, this relationship was not observed for MHQOL outcomes (β =–0.06, P=0.49). Race did not exert an independent influence on observed relationships. Study results contribute to a growing body of research documenting the detrimental effects of neighborhood disadvantage on cancer related outcomes.

Keywords: Neighborhood disadvantage; physical and mental health quality of life; cancer survivors; African Americans

Submitted Feb 06, 2019. Accepted for publication May 23, 2019.
doi: 10.21037/tcr.2019.05.30
View this article at: http://dx.doi.org/10.21037/tcr.2019.05.30

Introduction

Advances in cancer early-detection screening and treatment have contributed to an overall increase in national cancer survivorship rates. Currently, there are an estimated 15.5 million cancer survivors living in the United States (1). Among cancer survivors, quality of life (QOL) represents an important indicator of functioning and well-being. Health-related QOL is defined as the degree to which one's physical, emotional, social, and spiritual well-being are impacted by an illness and its treatment (2,3). Previous evidence-based studies have found that individual sociodemographic (e.g., age, gender, education, race/ethnicity, income, marital status) (2,4-8) and clinical factors (e.g., age at diagnosis, medical comorbidities, time of cancer diagnosis, cancer stage) (4,9,10) are significant predictors of QOL in cancer survivors.

The impact of individual level factors such as demographic and clinical characteristics on health-related quality of life has been well-documented in prior research (11,12).

Beyond individual factors, the neighborhood factors have been showed to have impacts on health-related quality of life in general population (13). Neighborhood disadvantage refers to the lack of economic and social sources in a neighborhood and has been shown to exert a detrimental effect on health outcomes over and above individual level characteristics (14,15). Racial segregation has been found to be associated with differences in socioeconomic status that leads to racial health disparities (16). In the U.S., African American is a population with the highest degree of residential segregation (17). African Americans are more likely to live in disadvantaged neighborhoods that increase the risk of having an adverse psychological condition such as QOL (18). Prior research showed that neighborhood disadvantage is associated with health and health outcomes across the cancer continuum, including cancer incidence, diagnosis, treatment, the survivorship period, and survival rates (19,20). Despite the importance of QOL among cancer survivors, limited research exists that examines the influence of neighborhood disadvantage on QOL outcomes among cancer survivors. Understanding the influence of neighborhood factors on cancer survivorship outcomes has important implications for informing public policy and neighborhood level interventions (21).

The purpose of this study was to: (I) examine the association between neighborhood disadvantage and health-related QOL among a sample of African American and White cancer survivors, and (II) further examined whether any observed associations between neighborhood disadvantage and health-related QOL differed for African American and White cancer survivors.

Methods

Study design and sample

Data for this secondary data analysis study were from a large survey study of the QOL of African American and White breast, prostate and colorectal cancer patients conducted from 1999–2003. In the study, a total of 753 patients meeting eligibility criteria (African American or White, breast, prostate or colorectal cancer diagnosis, and within three years of an initial diagnosis) were identified. Upon telephone interview, 149 cases were found to be ineligible (more than 36 months since diagnosis, other cancer site, deceased, non-English speaking). Of the qualified cases (N=604), 492 (81.5%) completed the interview (44 were not found, 51 refused to participate and 17 started the interview, but did not complete the majority of the questions and were excluded from the analysis; See Manfredi, Kaiser, Matthews & Johnson, 2010 for a full description of study procedures) (22). Therefore, the analytical sample included 492 African American (n=248) and White cancer survivors (n=244). The study protocol was approved by the Institutional Review Boards at the University of Chicago and the University of Illinois at Chicago.

Study measures

Demographic and clinical factors

Demographics included: race, education, gender, income, health insurance status, and employment status. Clinical factors were measured by age at diagnosis in years, cancer site, cancer stage at diagnosis, current treatment status, time since diagnosis and the presence of medical comorbidities.

Neighborhood disadvantage index

We created the neighborhood disadvantage index (NDI) based on the methods established by Ross and Mirowsky [2001] (14). The NDI consisting of four components is calculated at the zip code level (n=237 zip codes), including: (I) the prevalence of poverty: the percentage of households with incomes below the federal poverty threshold; (II) mother-only households: the percentage of female-headed households with children; (III) home ownership: the percentage of housing units that are owner occupied; and (IV) college educated residents: the percentage of adults over the age of 24 with college degrees. The index was calculated by dividing the prevalence of poverty, mother-only households, home ownership and college educated residents by ten, adding poor and mother-only households, subtracting home ownership and college educated residents, and dividing by four (the alpha reliability of the index is 0.78). A large and positive NDI value shows more disadvantaged neighborhood. A unit increase in the scale is equivalent to an increase of 10 percentage points in the prevalence of poor households, of mother-only households, of non-owner occupied units, and of adults without a college degree (14).

Quality of Life

The Medical Outcomes Study 36-Item Short Form Health Survey (SF-36) was used to measure QOL (23). The SF-36 encompasses two components, including (1) physical health quality of life (PHQOL) that measures physical functioning, role limitations due to physical problems, bodily pain, and general health; and (2) mental health quality of life

(MHQOL) that measures energy/vitality, social functioning, role limitations due to emotional problems, and mental health. Both QOL summary scores range from 0 to 100, with a higher score indicating better QOL. In the current sample, the internal consistency as measured by Cronbach's alpha was 0.81 for the physical health summary scale and 0.78 for the mental health summary scale.

Data analysis

Descriptive statistics were used to describe the characteristics of study sample. Bivariate analyses (Chi-Square test and Mann-Whitney U test) were performed to examine differences in demographic characteristics, clinical factors, QOL, and neighborhood disadvantage between the African American and White samples. For the multivariate analysis, in order to account for clustering of observations within neighborhood, mixed effect linear regression models with a random intercept were used to assess the association between neighborhood disadvantage (NDI) and quality of life (i.e., PHQOL and MHQOL) after adjusting for demographic characteristics and clinical factors. However, two demographic factors including income and education variables were excluded from the model due to a potential collinearity issue (between NDI scores and individual education and income variables) that had a significant impact on QOL. Furthermore, the normal Q-Q plots of NDI showed an acceptable distribution for normal distribution. The mixed effect linear model used in this study has been approved to be robust to violations of some of their assumptions such as "random effects and/or residual errors might not be normally distributed" (24). All the analyses were performed using SAS version 9.4, a statistical software package.

Results

Sample characteristics and neighborhood disadvantage

In *Table 1*, study participants were primarily African American (50.4%), female (61.4%), insured (88.6%), unemployed (56.1%), and had at least some college education or above (56.9%). Nearly half of the sample (49.9%) had been diagnosed with breast cancer, following by prostate cancer (28.8%) and colorectal cancer (21.2%). The majority of participants were diagnosed at age 50 years or older (80.7%), were not currently in treatment (80.0%), had been diagnosed less than 2 years (82.1%), and reported having at least one medical comorbidity (58.7%). Mean QOL scores for the sample were 46.02 (SD =11.13) for PHQOL and 52.62 (SD =9.44) for MHQOL. As shown in *Table 1*, African Americans significantly differed from White cancer survivors on several key demographic characteristics (lower income level, more likely to be uninsured and unemployed), clinical factors (younger age at diagnosis and higher likelihood of having a medical comorbidity) and poorer PHQOL (mean =44.5<47.5) and MHQOL (mean =51.6<53.7) outcomes. *Table 2* shows that, compared with Whites, African Americans resided in more disadvantaged neighborhoods with a larger median NDI value (−0.2 *vs.* −1.6). Specially, African Americans resided in neighborhoods with a significantly higher median percentage of households below federal poverty threshold (16.4% *vs.* 5.1%, P<0.0001) and female-headed households with children (48.5% *vs.* 30.1%, P<0.0001), and with a significantly lower median percentage of housing units that are owner occupied (61.5% *vs.* 76.7%, P<0.0001) and adults over the age of 24 with college degrees (13.5% *vs.* 24.0%, P<0.0001) compared with Whites.

The influence of neighborhood disadvantage on physical health

Multivariate results in *Table 3* shows that cancer survivors residing in neighborhoods with higher levels of disadvantage reported lower PHQOL scores than those residing in more advantaged neighborhoods (β =−1.21, P=0.0203). Additional correlates of lower PHQOL scores included being female, unemployed, having later stage disease (i.e., Stage III and IV), less time since diagnosis (<2 years), and being diagnosed with a separate comorbid medical condition. Among Whites, within group analyses suggest a similar pattern of demographic and clinical correlates of PHQOL as was observed in the combined sample. However, none of the clinical (except medical comorbidities) or demographic variables tested were independently associated with PHQOL outcomes among African Americans. There was a marginally significant trend for the independent effect of neighborhood disadvantage on PHQOL within African American cancer survivors (P=0.059) but not White cancer survivors (P=0.1642).

The influence of neighborhood disadvantage on mental health quality of life

Unlike PHQOL, multivariate results showed that

Table 1 Characteristics of study participants

Variables	Overall (n=492)	African American (n=248)	White American (n=244)	P value[a]
Demographic factors				
Education				0.126
≤ High school/GED	210 (43.1)	109 (51.9)	101(48.1)	
Some college	130 (26.7)	73 (56.2)	57 (43.8)	
≥ College degree	147 (30.2)	65 (44.2)	82 (55.8)	
Gender				0.377
Female	302 (61.4)	157 (52.0)	145 (48.0)	
Male	190 (38.6)	91 (47.9)	99 (52.1)	
Income				<0.0001[†]
<$30,000	174 (37.3)	115 (66.1)	59 (33.9)	
$30,000–$50,000	142 (30.4)	62 (43.7)	80 (56.3)	
>$50,000	151 (32.3)	64 (42.4)	87 (57.6)	
Health insurance status				0.0022[†]
Uninsured	56 (11.4)	39 (69.6)	17 (30.4)	
Insured	436 (88.6)	209 (47.9)	227 (52.1)	
Employment status				0.034*
Employed	213 (43.9)	96 (45.1)	117 (54.9)	
Unemployed	272 (56.1)	149 (54.8)	123 (45.2)	
Clinical factors				
Age at diagnosis (years)				0.0280*
26–49	95 (19.3)	56 (58.9)	39 (41.1)	
50–64	207 (42.1)	111 (53.6)	96 (46.4)	
65–74	129 (26.2)	58 (45.0)	71 (55.0)	
75+	61 (12.4)	23 (37.7)	38 (62.3)	
Cancer site				0.127
Colorectal	101 (21.2)	42 (41.6)	59 (58.4)	
Breast	237 (49.9)	127 (53.6)	110 (46.4)	
Prostate	137 (28.8)	70 (51.1)	67 (48.9)	
Currently in treatment				0.136
Yes	98 (20.0)	56 (57.1)	42 (42.9)	
No	392 (80.0)	191 (48.7)	201 (51.3)	
Cancer stage at diagnosis				0.49
Stage I and II	171 (34.7)	86 (50.3)	85 (49.7)	
Stage III and IV	45 (9.2)	19 (42.2)	26 (57.8)	
Unknown	276 (56.1)	143 (51.8)	133 (48.2)	

Table 1 (*continued*)

Table 1 (*continued*)

Variables	Overall (n=492)	African American (n=248)	White American (n=244)	P value[a]
Time since diagnosis (months)				0.798
≤12 months	89 (18.1)	41 (46.1)	48 (53.9)	
13 to 18 months	144 (29.3)	76 (52.8)	68 (47.2)	
19 to 24 months	171 (34.7)	86 (50.3)	85 (49.7)	
>24 months	88 (17.9)	45 (51.1)	43 (48.9)	
Medical comorbidities				0.0015[†]
Yes	289 (58.7)	163 (56.4)	126 (43.6)	
No	203 (41.3)	85 (41.9)	118 (58.1)	
Quality of life				
Physical health QOL	46.02±11.13	44.53±10.89	47.54±11.20	0.0026[†]
Mental health QOL	52.62±9.44	51.58±9.97	53.67±8.76	0.0135*

[a], P value was obtained from Chi-Square test and Mann-Whitney U test. *, P<0.05; [†], P<0.01. Sample sizes vary due to missing data.

Table 2 Neighborhood characteristics of study participants

Components[a]	African American (n=248)	White American (n=244)	P[b]
Poverty			
% of households below federal poverty threshold	16.4 (15.7)	5.1 (5.2)	<0.0001[†]
Mother-only households			
% of female-headed households with children	48.5 (18.5)	30.1 (12.7)	<0.0001[†]
Home ownership			
% of housing units that are owner occupied	61.5 (30.6)	76.7 (20.4)	<0.0001[†]
College educated residents			
% of adults over the age of 24 with college degrees	13.5 (14.6)	24.0 (20.5)	<0.0001[†]
Neighborhood disadvantage index (NDI)	−0.2 (1.6)	−1.6 (1.0)	<0.0001[†]

[a], Percentage of each zip-code level component was calculated based on n=237 zip codes; [b], Mann-Whitney U test was used to examine the significance of % NDI components by race. [†], P<0.01.

neighborhood disadvantage was not an independent predictor of MHQOL scores in either the overall sample (P=0.9469) or in models examining African American (P=0.5817) and White cancer survivors separately (P=0.3282) (*Table 4*). In the combined sample, employment and age at diagnosis were the significant predictors of MHQOL scores. Compared to individuals who were employed, unemployed cancer survivors reported statistically significant lower levels of MHQOL (P=0.011). Individuals who were older at the time of diagnosis reported better MHQOL outcomes compared to younger participants (P=0.005). Among Whites, within group analyses suggest a similar pattern of demographic and clinical correlates of MHQOL as was observed in the combined sample. However, none of the clinical or demographic variables tested were independently associated with MHQOL outcomes among African Americans.

Discussion

Consistent with the extant literature on neighborhood disadvantage and chronic illness outcomes (25-28),

Table 3 The influence of neighborhood disadvantage on physical health quality of life

Variables	Overall (N=492)			African American (n=248)			White American (n=244)		
	β	SE	P value	β	SE	P value	β	SE	P value
Demographic factors									
Race (ref: White)									
African American	0.12	1.18	0.9193	N/A			N/A		
Gender (ref: Female)									
Male	5.94	1.98	0.0031†	3.26	3.08	0.2922	6.92	2.58	0.0092†
Health Insurance (ref: Insured)									
Uninsured	–3.04	1.55	0.0508	–2.49	1.92	0.1970	–1.81	2.76	0.5147
Employment status (ref: Employed)									
Unemployed	–3.76	1.10	0.0008†	–2.86	1.56	0.0695	–4.46	1.64	0.0084†
Clinical factors									
Age at diagnosis (years)	0.00	0.05	0.9763	0.01	0.07	0.8294	–0.00	0.07	0.9919
Cancer site (ref: Prostate)									
Colorectal	0.78	1.70	0.6450	–1.84	2.67	0.4915	2.52	2.20	0.2563
Breast	2.49	2.28	0.2761	–1.30	3.46	0.7073	4.94	3.08	0.1130
Cancer stage at diagnosis (ref: Stage I and II)									
Stage III and IV	–3.59	1.73	0.0392*	–4.98	2.66	0.0638	–1.96	2.28	0.3924
Unknown	–1.38	1.07	0.1986	1.20	1.50	0.4250	–3.42	1.55	0.0307*
Currently in treatment (ref: Yes)									
No	1.56	1.18	0.1888	0.39	1.68	0.8142	3.35	1.69	0.0517
Time since diagnosis (ref: >24 months)									
≤12 months	–5.89	1.59	0.0003†	–2.08	2.42	0.3921	–7.62	2.12	0.0006†
13 to 18 months	–4.56	1.42	0.0015†	–2.97	2.07	0.1535	–4.63	1.95	0.0200*
19 to 24 months	–2.81	1.38	0.0436*	–0.62	2.06	0.7644	–2.36	1.89	0.2178
Medical comorbidities (ref: Yes)									
No	5.46	1.02	<0.0001†	6.10	1.48	<0.0001**	4.44	1.43	0.0028†
Neighborhood disadvantage index	–1.21	0.52	0.0203*	–1.23	0.64	0.0590	–1.35	0.96	0.1642

*, P<0.05; †, P<0.01; N/A, not applicable.

neighborhood disadvantage was associated with QOL outcomes among our sample of African American and White cancer survivors. Specifically, cancer survivors, regardless of race, who resided in a more disadvantaged neighborhood (i.e., higher prevalence of poor households, of mother-only households, of non-owner occupied units, and of adults without a college degree) reported significantly lower PHQOL scores than those residing in more advantaged neighborhoods.

In bivariate analyses, African Americans were much more likely than Whites to reside in disadvantaged neighborhoods. However, in multivariate analyses controlling for demographic and clinical factors, race was not an independent predictor of PHQOL in the overall model. In the multivariate models examining each racial group separately, among African Americans there was

Table 4 The influence of neighborhood disadvantage on mental health quality of life

Variables	Overall (N=492)			African American (n=248)			White American (n=244)		
	β	SE	P value	β	SE	P value	β	SE	P value
Demographic factors									
Race (ref: White)									
African American	–0.91	1.12	0.4186		N/A			N/A	
Gender (ref: Female)									
Male	1.05	1.90	0.5815	1.73	3.13	0.5812	0.38	2.44	0.8781
Health Insurance (ref: Insured)									
Uninsured	–2.71	1.48	0.0679	–2.59	1.96	0.1887	–3.68	2.62	0.1645
Employment status (ref: Employed)									
Unemployed	–2.70	1.06	0.0115*	–2.31	1.58	0.1469	–3.33	1.49	0.0292*
Clinical factors									
Age at diagnosis (years)	0.13	0.05	0.0053†	0.08	0.078	0.2237	0.18	0.06	0.0071†
Cancer site (ref: Prostate)									
Colorectal	0.29	1.62	0.8581	1.37	2.71	0.6151	–1.07	2.06	0.6049
Breast	1.00	2.18	0.6456	2.19	3.52	0.5350	–0.32	2.87	0.9122
Cancer stage at diagnosis (ref: Stage I and II)									
Stage III and IV	1.52	1.65	0.3577	1.02	2.70	0.7075	2.07	2.12	0.3391
Unknown	0.04	1.02	0.9680	–0.88	1.52	0.5649	0.55	1.46	0.7066
Currently in treatment (ref: Yes)									
No	–0.96	1.13	0.3998	–1.89	1.70	0.2707	–0.29	1.60	0.8582
Time since diagnosis (ref: >24 months)									
≤12 months	0.18	1.52	0.9065	–1.19	2.46	0.6285	0.51	2.00	0.7980
13 to 18 months	1.73	1.35	0.2018	2.54	2.10	0.2287	0.57	1.84	0.7568
19 to 24 months	1.08	1.32	0.4135	0.70	2.09	0.7400	1.07	1.77	0.5481
Medical comorbidities (ref: Yes)									
No	0.64	0.98	0.5121	1.70	1.50	0.2584	–0.29	1.33	0.8305
Neighborhood disadvantage index	–0.03	0.49	0.9469	–0.37	0.66	0.5817	0.78	0.80	0.3282

*, P<0.05; †, P<0.01; N/A, not applicable.

an independent but marginally-significant trend toward lower rates of PHQOL among individuals residing in neighborhoods with higher rates of disadvantage; however, this same relationship was not observed among White cancer survivors. In general, African Americans are much more likely to live in a segregated and economically disadvantaged neighborhood compared to Whites (29). This is especially true in Chicago and the greater metropolitan area (30). Additional research is needed in populations with more variation in neighborhood disadvantages scores to better understand potential interactions between race, neighborhood disadvantage and PHQOL.

Beyond neighborhood factors, demographic and clinical factors were also found to be independently associated with PHQOL. In terms of demographic factors, male respondents reported higher PHQOL compared to female

respondents. This finding is consistent with a prior study of cancer patients where male patients maintained overall strength and PHQOL to a larger degree than female cancer patients (31). In addition, individuals who were unemployed reported lower PHQOL compared to those who were employed. This finding has also been reported in the literature for breast cancer patients (32). Clinical factors associated with lower PHQOL scores were also consistent with the extant literature and included later stage disease (stages III and IV), being within 24 months since the time of initial diagnosis, and the presence of a medical comorbidity. In analyses examining African Americans and Whites separately, the patterns of results for Whites were very consistent with those for the overall sample. However, only having an additional comorbid medical disorder was statistically and independently associated with PHQOL among African Americans suggesting additional but unmeasured factors may play a role in this population.

Unlike PHQOL, we did not observe an independent influence of neighborhood disadvantage on MHQOL. One explanation may be that the neighborhood disadvantage index used in this study was more correlated with economic disadvantage (14) rather than being reflective of other neighborhood components such as informal social control, social cohesion and social relationships that may result in poor mental health outcomes (e.g., depression or anxiety) (33,34). For example, one study showed that higher neighborhood deprivation (measured by percentage of low income households, percentage of persons receiving assistance benefits, and the percentage of owner occupied houses) was only associated with lower mental health related quality of life among people with low social relations (i.e., few personal contacts or low social need fulfillment). Future studies will be required to examine the role of social control, social cohesion or social relations on the association between neighborhood disadvantage and health-related quality of life among cancer survivors.

Similar to PHQOL, demographic and clinical factors were also found to correlate with MHQOL. Specifically, unemployment status was negatively associated with MHQOL while older age at cancer diagnosis was positively associated with MHQOL. This same pattern of result was observed in the model conducted among White cancer survivors only; however, none of the demographic or clinical factors included in the model were independently associated with MHQOL among African Americans. Additional research is needed to better understand the factors associated with MHQOL among African American cancer survivors including social support, coping style, and spirituality (2).

Several study limitations should be noted. First, the cross-sectional study design utilized in this study increases the possibility of misclassifying neighborhoods regarding the timing of influence vis-a-vis the critical exposure window for the relevant outcomes (20). Second, clinical data such as stage of cancer at diagnosis were based on self-report and potentially subject to recall bias. Lastly, White cancer patients were recruited from the Illinois counties where African American cancer patients were mainly recruited. Therefore, White patients in the study is not representative of those who resided in more affluent suburban counties or in some rural areas. Further, the potential of lacking variations between neighborhoods may be considered due to limited number of counties in the Illinois State.

People living in a more disadvantaged neighborhood are more likely to experience stress associated with disorder, crime, and danger that can erode health (14). Our study results contribute to a growing body of research documenting the detrimental effects of neighborhood disadvantage on cancer related outcomes, especially on quality of life. In addition, neighborhood disadvantage can be measured in multiple ways. More research is warranted to determine the influence of other aspects of neighborhood disadvantage (e.g., neighborhood cohesion and disorder, residential segregation, neighborhood environment and resources) on health outcomes and the potential interactive effects of race/ethnicity on neighborhood disadvantage and QOL. Finally, targeted interventions can be developed not only based on individual demographic and clinical factors but also in the neighborhood texts in which cancer survivors live to promote health status and outcomes.

Acknowledgments

We thank the Illinois State Cancer Registry for their cooperation with this study. This paper is dedicated to the loving memory of Rita Ann Matthews - cancer survivor, life-long and proud Appalachian resident, and mother.
Funding: This research was supported by a grant from the National Cancer Institute, Bethesda, MD (1R01CA775-01A1: Matthews, A.K., PI).

Footnote

Provenance and Peer Review: This article was commissioned

by the Guest Editors (Hui-Yi Lin, Tung-Sung Tseng) for the series "Population Science in Cancer" published in *Translational Cancer Research*. The article has undergone external peer review.

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/tcr.2019.05.30). The series "Population Science in Cancer" was commissioned by the editorial office without any funding or sponsorship. The authors have no other conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Informed consent was waived due to the retrospective nature of the study. The study protocol was approved by the Institutional Review Boards at the University of Chicago and the University of Illinois at Chicago.

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Cite this article as: Li CC, Matthews AK, Asthana A, Shah RC. The impact of neighborhood disadvantage on health-related quality of life among African American and White cancer survivors. Transl Cancer Res 2019;8(Suppl 4):S313-S322. doi: 10.21037/tcr.2019.05.30

