REVIEW

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Urban Neighborhood and Residential Factors Associated with Breast Cancer in African American Women: a Systematic Review

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Abstract

Residential characteristics in urban neighborhoods impact health and might be important factors contributing to health disparities, especially in the African American population. The purpose of this systematic review is to understand the relationship between urban neighborhood and residential factors and breast cancer incidence and prognosis in African American women. Using PubMed and Web of Science, the existing literature was reviewed. Observational, cross-sectional, cohort, and prospective studies until February 2017 were examined. Studies including populations of African American women, setting in "urban" areas, and a measure of a neighborhood or residential factor were reviewed. Four parameters related to neighborhood or residential factors were extracted including: neighborhood socioeconomic status (nSES), residential segregation, spatial access to mammography, and residential pollution. Our analysis showed that African American women living in low nSES have greater odds of late stage diagnosis and mortality. Furthermore, African American women living in segregated areas (higher percentage of Blacks) have higher odds of late stage diagnosis and mortality compared to White and Hispanic women living in less segregated areas (lower percentage of Blacks). Late stage diagnosis was also shown to be significantly higher in areas with poor mammography access and areas with higher Black residential segregation. Lastly, residential pollution did not affect breast cancer risk in African American women. Overall, this systematic review provides a qualitative synthesis of major neighborhood and residential factors on breast cancer outcomes in African American women.

Introduction

According to the U.S. Census Bureau, urban areas are densely settled towns or cities with a population of at least 50,000 people, and while 55% of African Americans reside in the Southern region of the USA the other 45% reside in mostly urban areas [1, 2]. A growing body of evidence has demonstrated that a neighborhood's characteristics can influence its residents' health and well-being [3–5]. Moreover, urban areas have been shown to harbor neighborhood characteristics that

negatively influence health [6]. Factors that adversely affect health outcomes include access to resources such as health facilities or public transportation, physical stressors such as toxic chemical exposure from homes or factories, and social stressors such as crime-ridden areas, employment security, and poorly maintained communities [7]. As much as 26% of African American women living in urban areas are of low SES, a factor known to heighten the exposure to negative neighborhood effects. This factor is also associated with health disparities [8–10]. Furthermore, since urban areas are more likely black and low-income compared to their rural counterparts [11], factors that contribute to disparities in urban areas propose differing complexities.

A major health concern for urban African American women is breast cancer. Regrettably, about 1 in 8 US women will develop invasive breast cancer over the course of her lifetime and African American breast cancer patients suffer from higher breast cancer associated mortality rates than any other race despite lower incidence [12]. After accounting for differences in income, past screening rates, and access to care this

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disparity remains unmitigated. African American women are still diagnosed with more advanced breast cancers and have worse survival than White women [13–17]. Deaths due to breast cancer for African American women are heightened, but the reasons for this are unclear [18–20]. Although ethnic differences account for 5–10% of cancer rates, these differences directly result from genetic and epidemiological factors such as the ones discussed above [21].

In addition to SES, many other factors of urbanity effect the risk, incidence, mortality, survival, and diagnosis stage for African American breast cancer patients [22]. Two such factors that are of heightened concerned are residential segregation and pollution, due to their prevalence in every major urban area [23]. Segregation is a systematic form of racial discrimination and greatly contributes to the deficit between health conditions of African Americans compared to their White counterparts [24, 25]. Studies have highlighted issues such as gentrification, access to mammograms, and follow-up care as urban neighborhood and residential stressors that are worsened by segregation [26]. Further, pollutants and other toxicants from water impurities, waste disposal, and air pollution have been shown to have associations with health outcomes. Despite identifying these factors as persistent issues for African Americans in urban areas, there have been no investigations on the interplay of these conditions and breast cancer incidence in urban settings.

While it is known that low SES, residential segregation, and access to mammography are known risk factors of poor breast cancer outcome in African-Americans, it is not fully understood how these factors effect breast cancer outcome in African American women living in urban areas. This review aims to synthesize the findings from literature on associations between nSES, residential pollution, spatial access to mammograms, and residential segregation and breast cancer incidence, risk, mortality, survival, and diagnosis stages among African American women. We aim to determine the relationship between these neighborhood characteristics and breast cancer outcomes in urban settings. Although there is a systematic review on residential segregation and racial disparities in cancer, no review has looked at neighborhood and residential exposures together or with an exclusive concern for the African American population [27]. The findings presented here will help to further understand the mechanisms of breast cancer disparities and inform future investigation into mitigating disparities in urban populations.

Methods

Study Selection Criteria

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis statement was used to aide in the search protocol of this review [28]. Eligible studies included in the review met the following criteria—*study design*: cohort studies, prospective studies, observational studies, case-control studies, cross-sectional studies; *population*: studies included adult women of African American race; *outcome*: breast cancer incidence/risk, stage at diagnosis, survival and mortality; and *exposure*: assessed a neighborhood or residential factor. Studies that were excluded include articles written in languages other than English, review papers, non-peer reviewed articles such as conference proceedings or abstracts, studies exclusively focused on rural areas, assessment of individual SES, and male breast cancer.

Search Strategy

The keyword search was performed in PubMed and Web of Science. The search algorithm included all possible combinations of keywords, with wildcard character, from the following groups: [10] "breast cancer," (2) "breast cancer outcomes," (3) "African American," and (4) "residential/ neighborhood characteristics." Furthermore, Boolean terms "OR" and "AND," Medical Subject Headings (Mesh), and truncation "*" were used. A detailed search algorithm for both search databases is available in Appendix 1. Title and abstract screening was conducted based on the search criteria. Eligible articles were extracted for full text review. A cited reference search (i.e., forward reference search) and a reference list search (i.e., backward reference search) based on the articles meeting the study selection criteria that were identified from keyword search was conducted. Articles identified through forward/backward reference search were further screened and evaluated using the same study selection criteria. Reference search was repeated on all newly identified articles until no additional relevant article was found. The authors jointly determined the inclusion/exclusion of all articles retrieved in full text and discrepancies were resolved through discussion.

Data Extraction

A standardized data extraction form was adopted to abstract the following data from studies: author(s), publication year, study design, urban area, sample size of African American women, age, public data set used, length of study, neighborhood or residential factor, and cancer outcome. A total of four parameters for residential and neighborhood factors were identified through the data extraction process. These parameters included residential or neighborhood socioeconomic status (nSES), residential racial segregation or composition, spatial access to mammography, and residential pollution. For the residential pollution parameter, two levels were identified: residential magnetic field exposure and trihalomethane levels in public water. For this review, at least two studies that

assessed the same cancer outcomes with the quantitative measure that enables a meta-analysis are lacking. Thus, a narrative synthesis of the studies was conducted.

Study Quality Assessment

Study quality criteria were adopted from the 2014 NIH Quality Assessment Tool for Observational, Cohort, and Cross-Sectional studies with the following criteria. (1) Was the research question or objective in this paper clearly stated? (2) Was the study population clearly specified? (3) Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study pre-specified and applied uniformly to all participants? (4) Was a sample size justification, power description, or variance and effect estimates provided? (5) For the analysis in this paper, were the neighborhood or residential factor measured prior to the breast cancer outcome being measured? (6) Was the time frame sufficient so that one could reasonably expect to see an association between neighborhood or residential factor and breast cancer outcome if it existed? (7) Did the study examine different levels of the neighborhood or residential factor as related to the breast cancer outcome? (8) Were the neighborhood or residential factors clearly defined, valid, reliable, and implemented consistently across all study participants? (9) Were the cancer outcome measures clearly defined, valid, reliable, and implemented consistently across all study participants? (10) Were the outcome assessors blinded to the exposure status of participants? (11) Were key potential confounding variables measured and adjusted statistically for their impact on relationship between neighborhood or residential factor and breast cancer outcome? The authors of this review independently scored each study based on these 11 criteria, with disagreement resolved through discussion. Scores for each criterion were either 0 or 1, depending on if the criterion were met or unmet, not reported, or not applicable. The possible total study score ranges between 0 and 11. Study quality assessment helped to determine the strength of the study but not used for inclusion of studies.
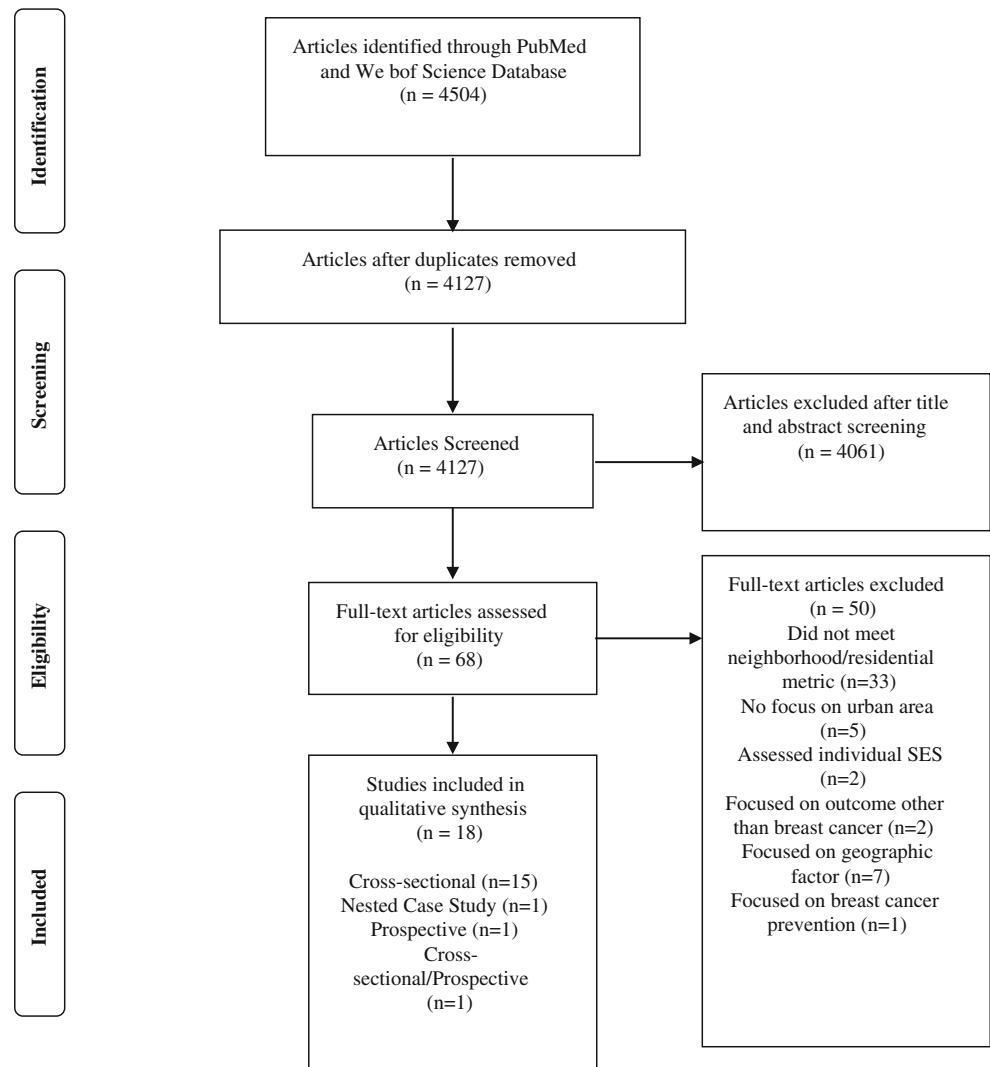
Results

A flow chart was constructed to choose eligible papers for this review (Fig. 1). Initially, 4127 unduplicated articles were identified through keyword search and 4061 articles were excluded after title and abstract screening. The remaining 68 articles went through full text review and 50 were excluded because they did not meet the selection criteria as listed in Fig. 1. The remaining 18 articles were included in the review. Table 1 shows the basic characteristics of each of the studies. Several study designs examined neighborhood and residential

factors. The largest number were cross-sectional studies (N = 15), followed by nested case control (N = 1), prospective (N = 1), and prospective/cross-sectional (N = 1). Secondary data analysis was conducted on all the included studies. Datasets included Surveillance, Epidemiology, and End Results (SEER), state cancer registries, local hospitals, and US Census. SEER is a program initiated through the National Cancer Institute which provides information on cancer statistics in an effort to reduce the cancer burden among the US population [29]. A cancer registry is a standardized collection of data. Highly trained cancer registrars transfer hospital information from the patient's medical record to the registry's computer software using standardized codes [30]. Thus, the data in the studies represented large sample sizes, contained similar demographic information, and controlled for confounders in their statistical analysis. A number of urban areas were evaluated including Atlanta, Detroit, San Francisco, Chicago, St Louis, New York City, Los Angeles, Seattle, and urban New Jersey and Texas. The average length of the studies was about 8 years. The combined total number of African American participants sampled from the studies was 93,670. The age of participants ranged between 19 and 91 years of age.

Residential and Neighborhood SES

Table 2 demonstrates the factors evaluated, outcomes, and results of each study. Ten studies examined nSES and its association with late stage diagnosis, mortality, and survival. Barrett et al. studied the relationship between upward neighborhood SES (a betterment in the neighborhood's economy, a change measured by concentrated disadvantage, concentrated affluence, and concentrated immigration) and the probability of distant metastasis at diagnosis in breast cancer [31]. Interestingly, this study showed that African American women who experience a residential area socioeconomic upward change were significantly associated with higher probabilities of distant metastasis at diagnosis of breast cancer (OR = 1.24; 95% CI = 1.03, 1.48; p = 0.022). Four studies illustrated significant associations between low nSES and high-poverty rates with greater odds of late stage diagnosis in African American women [18, 19, 32, 33]. Flores et al. and Merkin et al. both showed no significant associations with nSES and breast cancer staging [34, 35]. Cheng et al. showed nonlinear positive association between low nSES and mortality in African American women when examining years 1994–1995 and 1996–2007 [36]. Lian et al. illustrated African American women with non-metastatic invasive breast cancer had higher risk in both breast cancer mortality (HR = 1.87, 95% CI = 1.43–2.45) and non-breast cancer mortality (HR = 2.79, 95% CI = 1.93–4.04) when associated to census-tract-level

Fig. 1 Study selection flow chart. Flow chart followed during selection of articles to be included in the review. "n" represents the number of articles

Identification

Articles identified through PubMed and We bof Science Database
(n = 4504)

Articles after duplicates removed
(n = 4127)

Screening

Articles Screened
(n = 4127)

Articles excluded after title and abstract screening
(n = 4061)

Eligibility

Full-text articles assessed for eligibility
(n = 68)

Full-text articles excluded
(n = 50)
Did not meet neighborhood/residential metric (n=33)
No focus on urban area (n=5)
Assessed individual SES (n=2)
Focused on outcome other than breast cancer (n=2)
Focused on geographic factor (n=7)
Focused on breast cancer prevention (n=1)

Included

Studies included in qualitative synthesis
(n = 18)

Cross-sectional (n=15)
Nested Case Study (n=1)
Prospective (n=1)
Cross-sectional/Prospective (n=1)

socioeconomic deprivation index [37]. The index is further described in previous literature [37]. Lastly, Shariff-Marco et al. illustrated that all-cause survival was significantly worse for African American women living in low SES neighborhoods, specifically when they were highly educated and had low nSES (HR = 1.61, p-trend = 0.03) [20]. However, breast cancer-specific mortality showed no associations with nSES.

Residential Segregation and Neighborhood Racial Composition

Six studies illustrated the associations between residential segregation or neighborhood racial composition and breast cancer mortality, survival, and stage at diagnosis [38–42]. One of the six studies also looked at residential segregation as a factor and analyzed spatial access to mammograms as a factor, which will be discussed later. Pruitt et al. and Russell et al. analyzed mortality and

residential segregation, respectively [39, 40]. Pruitt et al. showed that compared with Whites, African American women were more than twice as likely to die from breast cancer when living in segregated areas (HR, 2.14; 95% CI, 2.02–2.26) [39]. Also this study showed that higher black segregation (HR, 1.66; 95% CI, 1.56–1.77) and higher Hispanic segregation (HR, 2.52; 95% CI = 2.29–2.77) were associated with higher all-cause mortality [39]. Russell et al. showed that Black women consistently had significantly higher breast cancer mortality associated to residential segregation, even after controlling for stage, surgery status, age at diagnosis, and percent of census tract residents living in poverty ($p < 0.001$) [40]. Furthermore, results indicate that census tract residential racial composition has a small but significant relationship with breast cancer mortality such that for each 10% increase in tract percent Black residents, women experience a 7% increased risk of mortality (HR = 1.07, 95% CI = 1.05–1.08) [40]. Russell et al. analyzed neighborhood

Table 1   Basic characteristics of studies

First author (year)	Dataset	Study design	Urban area	Length of study	Sample size*	Age (mean ± SD)
Barrett et al. (2008)	Illinois State Cancer Registry 1990 and 2000 US Census	Cross-sectional	Chicago	1990–2000	4820	62.43 ± 1-4.48
Barry (2012)	SEER	Cross-sectional	San Francisco, Atlanta, and Detroit	1990–2000	1810	60 ± 14
Cheng (2015)	California Breast Cancer Survivorship Consortium 1990 & 2000 US Census	Prospective cross-sectional	Urban California	1994–1995 1996–2007	1719	NR
Dai (2010)	Michigan Cancer Surveillance Program	Cross-sectional	Detroit	1998–2002	12,413	NR
Echeverria (2009)	New Jersey State Cancer Registry	Cross-sectional	Urban New Jersey	1994–2004	1167	59.8 ± 31.1
Flores (2013)	California Cancer Registry and 2000 US Census	Cross-sectional	Urban California	1990–2000	1227	52 ± 12
Haas (2008)	SEER	Cross-sectional	Detroit, Atlanta, Seattle	1992–2002	NR	NR
Lian (2015)	2000 US Census, Alvin J Siteman Cancer Center, and Washington University School of Medicine	Prospective	St Louis	1999–2010	812	53.5
London (2003)	Multiethnic Cohort Study and SEER	Nested Case Control	Los Angeles	1995–2001	19,132	59.5 ± 14.5
Mandelblatt (1995)	New York State Department of Health Tumor Registry	Cross-sectional	New York City	1980–1985	3055	64 ± 14.15
Marcus (1998)	North Carolina Central Registry	Cross-sectional	Urban North Carolina	1990–1992	1046	59.5 ± 24.5
Marcus (1998)	North Carolina Central Registry	Cross-sectional	Urban North Carolina	1990–1992	1046	59.5 ± 24.5
McLafferty (2011)	Illinois State Cancer Registry	Cross-sectional	Chicago Chicago Suburbs Illinois Metropolitans	1988–1992 1998–2002	9210	NR
Merkin (2002)	New York State Cancer Registry	Cross-sectional	New York City	1986–1995	6993	NR
Pruitt (2015)	Texas Cancer Registry	Cross-sectional	Urban Texas	1995–2009	11,253	64 ± 10.29
Russell (2011)	Georgia Comprehensive Cancer Registry	Cross-sectional	Metropolitan and micropolitan Georgia	1999–2003	4779	40–85
Russell (2012)	Georgia Comprehensive Cancer Registry	Cross-sectional	Metropolitan Georgia	1999–2009	3481	40–85
Shariff-Marco (2014)	San Francisco Bay Area Breast Cancer Study and Northern California Breast Cancer Family Registry	Cross-sectional	Urban California	1995–1999	993	19–79
Warner (2010)	California Cancer Registry and 2000 US Census	Cross-sectional	Metropolitan California	1996–2004	10,030	NR

residential racial composition and mortality and survival time. This study showed that there are elevated risks for breast cancer-specific mortality among African American women in segregated metropolitan statistical areas (MSAs) (HR = 2.20, 95% CI 1.09, 4.45) compared to White women [41]. Furthermore, Warner and Gomez studied showed higher odds of distant stage disease among Black women living in low percent Black neighborhoods within the most segregated metropolitan regions as measured by the isolation index, compared to Black women living in low percentage Black neighborhoods within the least segregated regions (OR = 2.11 (95% CI: 1.05–4.27) [42]. The data showed that when African American women who lived in a neighborhood with greater than or equal to 20% Black residents was associated with lower breast cancer-specific (HR = 0.86 (95% CI 0.76–0.97)) and all-cause (HR = 0.90 (95% CI 0.82–0.99)) mortality. This study also showed that when White

Table 2 Studies examining associations of neighborhood and/or residential factors and breast cancer outcomes

First author (year)	Factor	Outcome	Results
Barrett (2008)	Neighborhood SES change	Probability of distant metastasis at diagnosis	Greater odds of distant breast metastasis was associated with upward neighborhood SES change
Barry (2012)	Residential poverty	Late stage diagnosis	Greater odds of being diagnosed in high-poverty areas
Cheng (2015)	Neighborhood SES	Mortality	Nonlinear positive association between neighborhood SES and mortality
Dai (2010)	Residential segregation and spatial access to healthcare	Variation in late stage diagnosis	Late stage cancer diagnosis was significantly higher in areas with poor mammography access and areas with higher Black residential segregation
Echeverria (2009)	Neighborhood index	Staging risk	Odds of late stage diagnosis were high in African American women by a marginal significance when compared to neighborhood index
Flores (2013)	Neighborhood SES	Changes in stage at diagnosis	No significant differences observed in percent change stage of diagnosis and income level
Haas (2008)	Residential segregation	Diagnosis of early versus late stage cancer	For combination of low and high segregation and low and high income the odds of early stage diagnosis were lower in Black women compared to White women
Lian (2015)	Census-tract-level socioeconomicdeprivation index	All-cause death and breast cancer-specific death	African American women with non-metastatic invasive breast cancer had higher risk in both breast cancer and non-breast cancer mortality
London (2003)*	Eesidential magnetic field exposure	Incidence	Breast cancer risk was not appreciably associated with broadband magnetic field measurements
Mandelblatt (1995)	Neighborhood SES	Stage at diagnosis	African American women were 34% more likely to be diagnosed at late stage than White women before controlling for area SES
Marcus (1998)*	Trihalomethane levels	Incidence	Rate ratios suggest little risk to breast cancer incidence when exposed to differing levels of trihalomethane
McLafferty (2011)	Neighborhood SES	Late stage risk	Odds of late stage diagnosis were roughly 20% higher for Black breast cancer patients living in suburban areas and other metropolitan areas compared to women of similar age who live in socioeconomically similar communities in Chicago
Merkin (2002)	Residential area SES	Advance stage	No significant differences observed neighborhood SES and advance stage breast cancer but individual characteristics were significant for Black women
Pruitt (2015)	Residential segregation	Mortality	Higher Black segregation and higher Hispanic segregation were associated with higher all-cause mortality
Russell (2011)	Residential segregation	Breast cancer and all-cause mortality	Black women had high breast cancer mortality when living in segregated areas
Russell (2012)	Neighborhood residential racial composition	Mortality and survival time	Elevated risk for breast cancer-specific mortality among Blacks in segregated metropolitan areas
Shariff-Marco (2014)	Neighborhood SES	Survival	All-cause survival was show to be significantly worse in Black women living in low SES neighborhoods regardless of education
Warner (2010)	Neighborhood racial composition and residential segregation	Stage at diagnosis and all-cause mortality	Higher odds of distant stage among Black women living in low % Black neighborhoods within the most segregated metropolitan regions

*Studied showed no eff

women lived in high percentage Black areas, they had higher percentages of mortality rates compared to other White women supporting the idea that the environmental conditions associated with lower SES contributes to death due to breast cancer rather than the race itself [42]. Lastly, Haas et al. analyzed residential segregation and early versus late stage diagnosis. The study showed that for combinations of low and high segregation and low and high

income, the odds of *early stage* diagnosis was lower in Black women compared to White women [38].

Spatial Access to Healthcare and Residential Segregation

Access to healthcare is a crucial factor in breast cancer detection and survival. Individuals must have access to facilities which

perform mammogram testing to be diagnosed and patients need to be able to correspond with their physicians upon diagnosis. Dai's studies illustrated that late stage cancer diagnosis was significantly higher in areas with poor mammography access ($R = -0.38$, $p = 0.001$) and areas with higher Black residential segregation ($R = 0.74$, $p = 0.001$) [43]. This analysis was coupled with the understanding of residential segregation to conclude that when living an area with socioeconomic deprivation, due to limited mammography access, and sociocultural barriers, African American women have increased likelihood of being diagnosed with late stage breast cancer [43, 44].

Residential Pollution and Breast Cancer Incidence

There are few studies on the relationship between environmental pollutants and breast cancer outcomes. Environmental pollutants encompass a variety of characteristics but here we focus at residential pollutants. Two studies [45, 46] looked at residential pollutants, specifically residential magnetic field exposure and trihalomethane levels in public drinking water. The results showed that neither, magnetic field exposure or trihalomethane levels, had effects on breast cancer incidence in African American women (OR = 1.02; 95% CI = 0.89, 1.16) and (OR = 1.2; 95% CI = 0.8, 1.8), respectively. The odds ratio of trihalomethane levels was at the highest parts per billion (ppb) ≥ 80; however, there was still little or no effect shown on breast cancer incidence [46]. Each study examined the exposure at least 8 years after the pollutants were exposed.

Study Quality

Table 3 reports results of study quality assessment. Studies included in the review on average scored 8.8 out of 11 and ranged between 7 and 11. The distribution of qualification differed substantially across criteria. All 18 studies included in the review clearly described their research question and objective, had similarity among populations and inclusion and exclusion criteria, clearly defined neighborhood and residential factors, and confounded variables in their analysis [18, 20, 31–46]. In contrast, all but two studies [19, 38] clearly defined the study population, in addition, only one study [45] blinded assessors for outcome variables. Since 17 of the papers were cross-sectional, the neighborhood or residential exposures could not be defined and measured before the breast cancer outcome, thus only one study [45] was able to assess and report this.

Discussion

The study systematically reviewed and qualitatively synthesized the current evidence on the association of urban neighborhood and residential factors and breast cancer in African American women. The main conclusion from our analysis is that, we are lacking carefully designed studies specifically focusing on breast cancer disparities in African American women due to urban residential and neighborhood factors.

Table 3 Study quality assessment

Criterion	Mean	Standard deviation
Q1 Was the research question or objective in this paper clearly stated?	1	0
Q2 Was the study population clearly specified and defined?	0.9	0.3
Q3 Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study pre-specified and applied uniformly to all participants?	1	0
Q4 Was a sample size justification, power description, or variance and effect estimates provided?	0.9	0.2
Q5 For the analyses in this paper, were the neighborhood or residential factors measured prior to the breast cancer outcome(s) being measured?	0.2	0.4
Q6 Was the timeframe sufficient so that one could reasonably expect to see an association between neighborhood or residential factors and breast cancer outcome if it existed?	0.9	0.2
Q7 For neighborhood or residential factors that can vary in amount or level, did the study examine different levels as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?	0.9	0.3
Q8 Were the neighborhood or residential factors clearly defined, valid, reliable, and implemented consistently across all study participants?	1	0
Q9 Were the breast cancer outcome measures clearly defined, valid, reliable, and implemented consistently across all study participants?	0.9	0.2
Q10 Were the outcome assessors blinded to the exposure status of participants?	0.1	0.2
Q11 Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between neighborhood or residential factors and breast cancer outcome(s)?	1	0
Total score	**8.8**	**1.8**

Note: Criterion yes = 1, all others (no, not reported, cannot determine, not applicable) = 0

Total global score between 0 and 11

African American Women Living in Low nSES Have Greater Odds of Late Stage Diagnosis and Mortality Several studies showed significant associations between low nSES and late stage breast cancer diagnosis and mortality in African American women. Previous literature has shown that living in areas with low nSES, regardless of race, has overall negative impacts on health outcomes [7]. African American women often live in low-income neighborhoods in urban areas because of affordability. Literature has also shown that nSES is a better measure for studying population health outcomes as oppose to individual SES, since nSES considers the built environment or components that contribute to the neighborhood's environment. A study for example, illustrated that some high SES individuals live in low SES neighborhoods and vice versa [47]. Interestingly, the characteristics of the individuals living in low SES neighborhoods with high SES were White men with low body mass index (BMI), while low SES individuals living in high SES neighborhoods were Black women with high BMIs. This example justifies the need to differentiate individual and neighborhood SES [47]. Gentrification or "upward" change in nSES has also shown to have overall negative health outcomes [48, 49]. This is enlightening because an increase in overall nSES should result in better health of residents. However, Barret et al. pointed out that "long standing residents of neighborhoods" experiencing this change, are more prone to distant metastasis at breast cancer diagnosis [31].

African American Women Living in Segregated Areas Have Higher Odds of Late Stage Diagnosis and Mortality A previous review on residential segregation shows similar results of the negative impacts of segregation on late stage diagnosis and mortality of breast cancer [27]. Williams [50] also suggests that residential segregation has an impact on SES and educational opportunities, thus residential segregation and SES are associated, which further complicates breast cancer staging and mortality [50]. Historically, residential segregation stems from Whites wanting social distance from Blacks, during the 1950s. However, these trends have not seemed to dissipate resulting in disparities within minority populations [50]. Residential segregation can be seen in almost every urban area; with Blacks almost always living in the poverty-stricken areas with little resources. Conversely, the resources that they have are usually for example, public health departments, which sometimes lack doctors and utilize nurse practitioners [50].

Late Stage Diagnosis Significantly Higher in Areas with Poor Mammography Access and Areas with Higher Black Residential Segregation Only one study in this review illustrated the association of mammography access and residential segregation on late stage diagnosis of breast cancer [43]. This study was alarming because it showed that Detroit has a mammography access problem that directly correlates with its higher percentage of Black neighborhoods. Even with

resources such as state mandated health departments, there is still a problem with diagnosing breast cancer in African American women in urban areas. Russell [40] also highlighted that African American women are less likely to have tumors removed compared to Caucasian women, which is mainly due to lack of specialists on hand at health departments or access to primary care physicians.

Residential Pollution Has no Effect on Breast Cancer Risk Residential pollution showed no significant association on breast cancer risk in this review. In general, previous literature has cited pollution as a concern when it comes to breast cancer risk and incidence [51]. A review on environmental pollutants and breast cancer suggested that there is an association between industrial development and breast cancer outcomes [52]. Endocrine disruptors such as Bisphenol-A (BPA) were an anticipated pollutant we had hoped to see in the literature since found in some household products such as plastic goods. More importantly, it was anticipated to see some association between BPA-products and breast cancer risk and incidence in African American women. However, our database search brought about no articles related to these types of pollutants. The reason for this may have been due to the combinations of words used during the literature search or lack of research to address the impact of these exposures on breast cancer outcomes in this population. In addition, the latency period for these chemicals to manifest any carcinogenic activity might be longer. Future research is needed to address these questions in this population.

Strengths and Limitations

The construction of a meta-analysis could not be developed in this review because of the measured factors of nSES and the use of multiple residential segregation isolation indices. These findings indicate that more studies are needed to answer the question of the role that residential characteristics play in breast cancer outcomes in urban African American women. Furthermore, with a focus on epidemiological studies causal relationships cannot be established between neighborhood and residential factors on breast cancer risk, stage at diagnosis, late stage diagnosis, survival, and mortality. However, epidemiological studies do allow us to better understand factors that may contribute to breast cancer disparities in African American women and to develop experimental designs to test these hypotheses. Epidemiological studies also allow us to bring forth issues on health policy. In 2012, the National Cancer Institute's Epidemiology and Genomics Research Program, proposed a plan to tackle gaps in research discoveries and clinical and public health practice [53]. This initiative would serve to use the knowledge of epidemiological studies to further study cancer epidemiology in clinical trials and to

support health policy initiatives. Health policy change is a targeted goal with the development of this review. Furthermore, by understanding these factors molecular biologists can take them into consideration when testing experimental designs for targeted, individualized medicine is a secondary goal. Underrepresented groups alike can benefit from this review because these experiments can be generalized to other populations.

Conclusion

This review provides a qualitative synthesis of major neighborhood and residential factors on breast cancer risk, stage at diagnosis, mortality and survival. Focusing on African American women is important since they face greater disparities in breast cancer late stage diagnosis, mortality and survival. By understanding reasons for health disparities in this population, disparities in other populations with similar health outcomes can be addressed better.

Appendix 1

Search Algorithm

Web of Science:

Options: Advance Search, Does not include conference proceedings, Only English, and Peer-Reviewed Articles

TS = ((Residence Characteristic* OR Domestic characteristic* OR Residential Selection* OR Neighborhood characteristic* OR Place of Birth OR Birth Place OR living arrangement* OR arrangement of living OR communit* OR vicinity OR zone OR quarter OR region OR district OR hood* OR ghetto* OR projects OR PJ's OR PJs OR home* OR dwelling* OR apartment* OR low-income OR low income OR low SES OR low socioeconomic* OR public housing OR section 8 OR housing project* OR high crime OR high crime area OR urban* OR urban core* OR city OR inner-cit* OR town OR poverty OR poverty-stricken* OR need* OR want OR disfavored OR impoverished OR destitute OR badly off OR deficient OR hard up OR inferior OR indigent OR poor OR lack OR unfortunate OR dispar* OR underprivileged OR underrepresented OR deprived OR disadvantaged OR scarcity OR scarce OR rundown OR paucity OR metropolitan OR metropolis OR low resources OR Standard of Living OR land tenure OR municipalities OR poverty area OR racial segregation OR residential segregation OR neighborhood racial composition OR environment) AND (effect* OR impact* OR predict* OR result* OR consequence* OR significanc*) AND (breast cancer OR breast neoplasm OR breast neoplasms OR breast carcinoma OR breast tumor OR breast tumors OR

cancer of the breast OR mammary cancer OR mammary cancers OR neoplasm of breast OR cancer of breast OR mammary carcinoma OR mammary neoplasm OR luminal A breast cancer* OR basal breast cancer* OR breast cancer subtype* OR breast cancer outcome* OR breast cancer mortality OR breast cancer survival OR breast cancer death) AND (African American* OR African American OR black* OR Afro-American* OR African-American* OR Negro* OR Negro American*))

PubMed:

("breast cancer" OR "breast neoplasm" OR "breast neoplasms" OR "breast carcinoma" OR "breast tumor" OR "breast tumors" OR "cancer of the breast" OR "mammary cancer" OR "mammary cancers" OR "neoplasm of breast" OR "cancer of breast" OR "mammary carcinoma" OR "mammary neoplasm" OR "luminal A breast cancer" OR "basal breast cancer" OR "breast cancer subtype" OR "breast cancer outcome" OR "breast cancer outcomes" OR "breast cancer mortality" OR "breast cancer survival" OR "breast cancer death" OR Breast cancer[MeSH]) AND ("African American" OR "African Americans" OR "black" OR "blacks" OR "Afro-American" OR "Afro-Americans" OR "African-American" OR "African-Americans" OR "Negro*" OR "Negro American*" OR African American[MeSH]) AND ("residence characteristics" OR "residence characteristic" OR "neighborhood characteristic" OR "neighborhood characteristics" OR "community" OR "communities" OR "domestic characteristic" OR "domestic characteristics" OR "residential selection" OR "residential selections" OR "place of birth" OR "birth place" OR "living arrangements" OR "living arrangement" OR "arrangement of living" OR "community" OR "communities" OR "vicinity" OR "zone" OR "quarter" OR "region" OR "district" OR "hood" OR "hoods" OR "ghetto" OR "ghettos" OR "projects" OR "PJ's" OR "PJs" OR "home" OR "hometown" OR "dwelling" "dwellings" OR "apartment" OR "apartments" OR "apartment complex" OR "apartment complexes" OR "low-income" OR "low income" OR "low SES" OR "low socioeconomic" OR "low socioeconomic status" OR "public housing" OR "section 8" OR "housing project" OR "housing projects" OR "housing authority" OR "housing authorities" OR "gain territories" OR "high crime" OR "high crime area" OR "urban" OR "urban core" OR "city" OR "inner-city" OR "inner cities" OR "town" OR "poverty" OR "poverty-stricken" OR "poverty stricken" OR "needy" OR "need" OR "want" OR "disfavored" OR "impoverished" OR "destitute" OR "badly off" OR "deficient" OR "hard up" OR "inferior" OR "indigent" OR "poor" OR "lack" OR "unfortunate" OR "disparity" OR "disparities" OR "underprivileged" OR "underrepresented" OR "deprived" OR "disadvantaged" OR "scarcity" OR "scarce" OR "rundown" OR "paucity" OR "metropolitan" OR "metropolis" OR "low resources" OR "Standard of Living" OR "land tenure" OR "municipalities" OR "poverty area" OR "racial segregation" OR

"residential segregation" OR "neighborhood racial composition" OR "environment factors" OR Residence Characteristics[MeSH]) AND ("effect" OR "effects" OR "impacts" OR "impact" OR "predict" OR "prediction" OR "prediction" OR "predicts" OR "result" OR "results" OR "consequence" OR "consequences" OR "significance" OR "significant")

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