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The role of social capital in African–American women's use of mammography

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ABSTRACT

Black/African–American women are more likely to get breast cancer at a young age and/or be diagnosed at a late disease stage, pointing to a greater need to promote mammography for Black women at earlier ages than are currently recommended. This study explores how perceived neighborhood social capital, that is, perceptions of how tight-knit a neighborhood is and what power that confers to neighborhood members, relates to use of mammography for Black women in Philadelphia. Living in a community with tight social ties (social cohesion) or that have a collective motivation for community change (collective efficacy) may increase the likelihood that an individual woman in that community will hear health messages from other community members and neighbors (diffusion of information) and will have access to health-related resources that allow them to engage in healthy behaviors. No prior studies have explored the role of social capital in decisions for mammography use. Using multilevel logistic regression, we analyzed self-report of mammography in the past year for 2586, Black women over age 40 across 381 Philadelphia, Pennsylvania USA census tracts. Our study included individual demographic and aggregates of individual-level social capital data from the Public Health Management Corporation's 2004, 2006, and 2008 Community Health Database waves, and 2000 US Census sociodemographic characteristics. Individual perceptions that a Black woman's neighborhood had high social capital, specifically collective efficacy, had a positive and statistically significant association with mammography use (OR = 1.40, CI: 1.05, 1.85). Our findings suggest that an individual woman's perception of greater neighborhood social capital may be related to increased mammography use. Although this analysis could not determine the direction of causality, it suggests that social capital may play a role in cancer preventive screening for African–American women in Philadelphia, which warrants further study.

Introduction

The importance of cancer preventive health behaviors for African–American women

In 2013, breast cancer and prostate cancer were named the top sites for new cancer cases for Blacks/African–Americans (American Cancer Society, 2013). Black/African–American women have a 1 in 9 lifetime risk of developing breast cancer (IR = 118.1/100.000) (American Cancer Society, 2013). While this rate is lower than the lifetime risk for White women, Black women have a 41% higher breast cancer mortality rate than White women (American Cancer Society, 2009; American Cancer Society, 2013; Merkin, Stevenson, & Powe, 2002; Myers et al., 1996; Shen et al., 2007; Smith-Bindman et al., 2006). Reductions in breast cancer mortality rates since 2000 are attributed to increases in mammography use (American Cancer Society, 2013; National Cancer Institute, 2009), yet mortality disparities still exist, largely because Black women are more likely to develop breast cancer at younger ages and be diagnosed at later disease stages based on the age at which screenings are recommended (American Cancer Society, 2013, Surveillance, Epidemiology and End Results (SEER) Program). Tumors diagnosed at younger ages may be more aggressive, and less responsive to treatment, leading to higher mortality rates among Black women who are also more likely to have lower frequency and longer intervals of time between mammograms and follow-up (DeSantis,

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Jemal, & Ward, 2010; Carey et al., 2006; Smith-Bindman et al., 2006; Press, Carrasquillo, Sciacca, & Giardina, 2008). Screening guidelines used to target women starting at age 40, but the most recent recommendations from the US Preventive Services Task Force (USPTF) in 2012 no longer recommend routine screening for women under 50. Black women under the age of 45 are more likely than White women to be diagnosed with breast cancer (Surveillance, Epidemiology, and End Results (SEER) Program), meaning that cancer may have already developed and progressed prior to the first recommended screening at age 50, putting Black women at increasingly higher risk of late-stage detection. Under the most recent guidelines for mammography, Black women would face increased risk of not being diagnosed in a timely manner, perpetuating the disparities in the mortality rate. These facts point to the need for Black women to have routine screening at younger ages than are currently recommended, and to the increasing importance of knowing which social factors encourage or discourage screening.

Neighborhood-level factors, like living in a poor or disadvantaged neighborhood with a high minority health concentration is associated with not receiving cancer screening (Kawachi & Lochner, 1997). Others factors, like urban residence, are associated with higher mammography rates (Anderson & May, 1995; Makuc, Breen, & Freid, 1999; Rakowski, Rimer, & Bryant, 1993), making the context of neighborhoods an important factor to screening. Individual-level factors like low-income, older age, lack of health insurance and less education are each associated with less cancer screening (Hoffman-Goetz, Breen, & Meissner, 1998; Lane, Zapka, Breen, Messina, & Fotheringham, 2000; Mandelblatt et al., 1999; Potosky, Breen, Graubard, & Parsons, 1998). The combination of being poor, living outside of a metropolitan statistical area, and being a Black female is a high-risk profile for not getting a mammogram (Calle, Flanders, Thun, & Martin, 1993). Knowledge of cancer screening (Jepson, Kessler, Portnoy, & Gibbs, 1991; Michielutte & Diseker, 1982; Robinson, Kessler, & Naughton, 1991) and having trust in a personal physician are salient social factors that are linked to increased usage of mammography (O'Malley, Sheppard, Schwartz, & Mandelblatt, 2004). According to one study using the Peters–Belson scale, which is often used for measuring wage discrimination, even if Black women and White women held the same covariate composition (demographic characteristics, physical resources, etc), Black women would still be less likely to be screened. The fact that demographic characteristics and physical resources fail to explain the disparity in screening suggests that other social factors may be at work (Rao, Graubard, Breen, & Gastwirth, 2004), warranting further investigation of what those social factors might be for Black women.

While it is apparent that social factors play a role in cancer preventive screening, there is little research that has attempted to disentangle which factors are the most salient for Black women, and whether or not neighborhood-level or individual-level factors matter more. Understanding the modifiable neighborhood social factors, like social capital, that contribute to whether or not a Black women woman will undergo cancer preventive screening can help identify the roots of the racial/ethnic cancer disparities.

The mechanism linking social capital and health

The concept of social capital grows from the observation that social relationships can create a form of capital that can have positive effects on multiple outcomes, including health (Hanifan, 1916; Kawachi, Kennedy, & Glass, 1999; Putnam, 1993, 1995). Social capital may be considered the ecological analog to individually-based social support, and is considered to be a social determinant of health and health behaviors. It is distinguished from social support because social support relates to interpersonal relationships among individuals, while social capital is about resources embedded within groups, making it a collective-level construct. Social capital is based on properties of groups and the space of interactions that exist among group members like expectations of reciprocity, trust, capacity for information flow, and norms and sanctions; it is distinguished from human capital, which represents the formal education and experiences of an individual (Coleman, 1988, 1990; Kawachi, Subramanian, & Kim, 2007a; Kawachi, Subramanian, & Kim, 2007b, 294 pp.).

Social capital indicators cover five main areas that are properties of groups that can be perceived by individuals: social engagement, neighborliness, social networks, social support, and perception of the local area (Morgan & Swann, 2004). These indicators are often used in survey data, and at both individual-level and community level-units of analysis. Inclusive of these indicators, measures of community-level social capital focus on collective efficacy, social cohesion, and social participation. Collective efficacy refers to the collective willingness of residents to intervene on behalf of the common good, and largely depends on mutual trust and solidarity among residents (Kawachi et al., 2007a; Sampson, Raudenbush, & Earls 1997). Social cohesion measures how tight-knit the group is, while social participation measures how active the group is. It is important to measure both individual-level perceptions and community-level perceptions of social capital, as they represent different characteristics of the group. An individual perception is in part a function of that individual's personality, but when perceptions are aggregated to the community-level, the characteristics of that entire community may be different. As a crude example, one member of a community may not choose to participate in community events, but that is entirely different from whether or not the community offers opportunities to participate. Tools such as multilevel modeling help determine whether community-level social capital (contextual effect) influences individual health over and above perceptions at the individual-level (compositional effect). Contextual influences refer to the influences of the collective that are exerted on the individual (Kawachi & Berkman, 2001), while compositional effects are the influences that the individual contributes to the collective. It is important to measure both compositional and contextual components of social capital, as each has been found to have different associations with health (Kawachi et al., 2007a).

Although social capital has been conceptualized and measured in different ways – e.g. using measures of trust, norms of reciprocity, and sense of belonging – the fundamental premise is that social relationships create a form of capital that can affect health. Social capital measures these constructs as properties of a group or population and would, for example, involve the amount of social support across a group's members, rather than between two group members. Public health researchers have offered the following suggested mechanisms by which social capital may be related to health and health behaviors: (1) diffusion of information sharing messages about health-promoting and preventive behaviors; (2) maintenance of health behavioral norms or deterrence of risky behaviors through informal social control; (3) promotion of access to services; (4) effective support or other psychosocial pathways that act directly or indirectly; and (5) empowerment to engage political policies that impact community health (Berkman & Kawachi, 2000; Kawachi & Berkman, 2001; Kawachi et al., 2007a). While mechanisms 1 and 2 reflect influences on individuals, mechanisms 3–5 suggests that social capital has benefits for the health of the community over and above impacts on the individual.

Health behaviors have been less studied in relationship to social capital than health outcomes, despite that the same mechanisms may be at work (Lindstrom, 2007). Although no studies have explicitly attempted to use social capital to explain cancer

preventive behavior (Brody et al., 2007), they are plausibly linked. A review of social capital's links to health-related behaviors like drug and alcohol use, physical activity, diet and sexual behavior has shown that social capital may influence behavior through norms and values, communication channels and information diffusion, and psychosocial stress mechanisms. Further, the influence of geographic area and environment may vary according to the behavior (Lindstrom, 2007), so investigators cannot assume that social capital has the same effect across all preventive behaviors at all geographic locations, so each behavior should be studied independently. That is to say, social capital may influence cancer preventive behaviors, but its influence may or may not mimic the ways in which social capital influences other health behaviors, which is why it deserves specific attention.

In the present study, we isolate the cancer preventive behavior of mammography use among Black women in Philadelphia and explore the role of social capital in this context. In the case of mammography use for Black women, living in a community with tight social ties (social cohesion) may increase the likelihood that an individual woman in that community will hear health messages from other community members and neighbors (diffusion of information). A woman who lives in a community that has high collective motivation for community change (collective efficacy) may have greater access to health-related resources that might allow her to engage in preventive behaviors. But in order for her to be motivated to utilize preventive services, there must be both access and positive community of support; simply having access is not enough. Past studies have findings that support the notion that having access to screening alone does not fully explain differences in timing and usage of cancer screening (Blustein, 1995; Burns et al., 1996; Kiefe, McKay, Halevy, & Brody, 1994; Makuc, Freid, & Parsons, 1994). To that end, social capital mechanisms may be an important accessory to getting Black women to use available mammography services.

Social capital and health behaviors for African–Americans

Although social capital has been examined in a growing number of studies, few have directly addressed its relevance on the health and health behaviors of Black populations (Hart, 1997; Hutchinson, Long, Montagnet, & Armstrong, 2006). Specifically examining social capital within the Black population is important because neighborhood factors such as social capital may operate on Blacks differently than other racial/ethnic groups due to the institutionalized and persistent forms of oppression that Blacks faced for centuries in the U.S. (Gee, 2002; LeClere, Rogers, & Peters, 1997). Institutional, structural, and individual racial discrimination toward African–Americans as a vestige of US slavery has been foundational to the social and economic inequalities in work, wealth, income, education, housing, and overall standard of living which underlie disparities in health (Krieger, 2000, 211–216; Jones, 2000, 1212–1215). Throughout history, African–Americans have had to adapt to social exclusion from mainstream culture, leading to the formation of African–American mutual benefit associations, fraternities, sororities, African American women's clubs, community-based organizations, churches, mosques, schools, and businesses which continue to serve as a form of formal community and collective efficacy building to overcome institutional racism (Fairclough, 2002; Jalata, 2002, 86–116). These representations of social capital rise to importance, especially because other representations of social capital may not apply to African–Americans due the legacy of institutional racism. For example, voting is often used a measure of social capital, but voting may not be a good indicator of social capital for Blacks in America due to the structural barriers to voting, as well as a history of being intentionally turned away from voting booths, and subsequent disenfranchisement with the voting system.

Examining social capital within the Black population is important, because studies of other health outcomes show that social capital may act differently on health for African–Americans than for other racial/ethnic groups (Kawachi, Kennedy, & Glass, 1999; Kim, Subramanian, & Kawachi, 2006; Mitchell & LaGory, 2002). For example, the positive association between bonding social capital (resources that are available to members of a group who are similar to each other with respect to social position and identity) and self-rated health is weaker for African–American women than those of other races (Kawachi et al., 1999; Kim et al., 2006). As a contrasting example, research by Mitchell and LaGory has shown that among African–American women living in impoverished areas with high residential segregation, mental distress increases with higher bonding social capital, whereas the presence of bridging social capital (bonds between persons which cut across social class and racial lines) was protective against mental distress (Mitchell & LaGory, 2002). These findings point to a gap in our understanding of the relationship between social capital and health for African–Americans, and by extension a gap in our understanding of the relationship between social capital and health behaviors for African–Americans.

Methods

Research design

This study used the Public Health Management Corporation's data (years 2004, 2006, and 2008) and US Census Data (2000). For the social capital variables, we combined data from the 2004, 2006 and 2008 Southeastern Pennsylvania Household Health Survey (SPHHS) data set administered by the Public Health Management Corporation (Design and Implementation of the 2004 Southeastern Pennsylvania Household Survey, 2004 Household Health Survey Documentation, Public Health Management Corporation). The survey is a Random Digit Dialing (RDD) telephone survey of individuals 18 years of age and older from a probability sample of households in the five major counties of the Greater Philadelphia Metropolitan Area.

In 2004, a total of 4415 households in Philadelphia County were enrolled between June and September with a response rate of 27%; in, 2006, there were 4193 Philadelphia households represented with a response rate of 24%; and the 2008 survey had data from 4394 Philadelphia County households, with a response rate of 25%. The characteristics of the sample across time are intentionally kept similar by retaining the sampling frame (e.g., oversampling minority populations), so the data were similar across all waves of the data. As a sensitivity analysis, we compared the means and variances of each variable from the PHMC data set across each of the three data points. We found that the samples from each wave were not statistically different from one another with regards to age, income, education, poverty, health insurance, or mean social capital scores; thus, combining the data should increase the number of responses without creating any forms of bias. Additionally, combining the data helped account for any neighborhood-level social factors like poverty, captured in the 2000 US Census Data.

We obtained summary demographic data on characteristics of Philadelphia residents for each of the 381 census tracts from the 2000 US Census. Census tract level information was chosen as a proxy for neighborhoods in this analysis because the census tract was the smallest unit of analysis available across all of the variables (except for those used for the individual-level analysis). Census tract boundaries are designed to be homogeneous with respect to population characteristics, economic status, and living conditions

and are sensitive to physical changes in street layout that may constrain or broaden where tract residents go. Census tracts are more stable boundaries than zip codes, which permits easier statistical comparisons when looking at data from different points in time (Blocker et al., 2006; Krieger et al., 2003). Although Philadelphia residents may not use census tracts to define their neighborhoods, in an analysis of social capital, which depends on neighborhood spatial layout and physical barriers to social interaction, census tracts may be an appropriate substitute.

Measures

Dependent variable

The dependent variable was asked in each wave of the PHMC data. The survey administrator asked, "About how long has it been since you last had a mammogram?" and later coded the answer based on whether or not the respondent had the screening test done in the recommended time. This question was only asked to females age 40 or older. We recorded the outcome so that "0" represented not having had the test in the past year, while "1" represented having had the test in the past year. We used one year as the cut-off because at the time of the analysis, guidelines suggested that women over 40 should receive annual mammograms.

Independent variables

Individual-level predictors (Level 1). The PHMC data set provided the age (continuous), health insurance status, income (categorical), education level and whether the respondent was below the 200% federal poverty level. Health insurance status was coded as yes or no. Income was captured in 19 categories based on the distribution of Philadelphia annual salaries ranging from "1 = Less than $10,400" through "19 = $250,000 or over." Income was treated as a continuous variable in regression models. For ease of interpretation, we calculated the midpoint of each income category and used the midpoint values in our results tables.

We collapsed education from four categories to a yes or no item for whether or not the respondent had graduated from high school or not. This enabled us to compare an analogous census-level graduation rate, which was the only available census-level education variable.

We used the 200% poverty line as measure of poverty because it was inclusive of Philadelphia's eligibility standards for social services, which are reserved for residents who are anywhere from 125% to 175% below the poverty level. Philadelphia's social service standards may be the best available metric for understanding the degree of financial distress that a resident feels, which may influence their health outcomes and behaviors. Using 200% poverty is a common standard across research studies on neighborhood social determinants of health.

We created dummy variables to account for time in the model, based on whether the individual-level demographic variables were from the 2004, 2006 or 2008 wave of the PHMC data.

Community-level predictors (Level 2)

Population demographics

The 2000 US Census provided raw counts of population demographics for each census tracts. The Census provided raw counts which allowed us to calculate the percentage of high school graduates, residents below the 200% poverty line, and the average age per tract.

Social capital

The PHMC data allowed us to include measures of social capital based on social cohesion, collective efficacy and social participation. We felt that in this exploratory study, we should not limit the ways in which social capital might surface in Philadelphia communities.

An oblique (promax) rotated principal components factor analysis suggested that we use a four-measure composite score to represent social cohesion (alpha = 0.76). There were three social capital questions pertaining to social cohesion:

1. To determine feelings of belongingness: "Please tell me if you strongly agree, agree, disagree, or strongly disagree with the following statement: I feel that I belong and am a part of my neighborhood"
2. To determine interpersonal trust: "Please tell me if you strongly agree, agree, disagree, or strongly disagree with the following statement: Most people in my neighborhood can be trusted"
3. To determine neighborliness: "Please rate how likely people in your neighborhood are willing to help their neighbors with routine activities such as picking up their trash cans, or helping to shovel snow. Would you say that most people in your neighborhood are always, often, sometimes, rarely, or never willing to help their neighbors?"

All variables were reverse scored so that higher numbers represented high social cohesion. The community satisfaction item loaded on the social cohesion factor as well, but was later separated because it only appeared in one wave of the PHMC data, and if kept, would not have allowed us to combine the three waves of data. The resulting three-item composite social cohesion score had a Cronbach's alpha of 0.71.

Collective efficacy was represented by the yes–no item, "Have people in your neighborhood ever worked together to improve the neighborhood?" Starting with the 2006 wave, the question added the prompt, "For example, through a neighborhood watch, creating a community garden, building a community playground, or participating in a block party?"

Social participation was measured by dichotomizing the response to the item, "How many local groups or organizations in your neighborhood do you currently participate in, such as social, political, religious, school-related, or athletic organizations?" Responses were recoded as 0 or none and 1 for any participation at all.

This data was collected at the individual level, but since social capital is inherently an area-level measure, we aggregated social capital measures to have one average value per census tract. We did this by summing the individual values and dividing by the number of respondents in that tract; we assigned that value as the average for that tract. Individual-level data from all races were included since members from each race within a census tract would be expected to contribute to the overall social capital.

To account for the compositional effects of social capital (that is, the contribution of social capital as measured by individual-level data) and avoid multicollinearity across levels, we used group-mean centered variables along with the aggregated social capital variables.

Statistical analysis

Preliminary analysis

As a preliminary analysis, we inspected the distributions of the continuous individual- and community-level predictor variables (aggregated to the tract level, when appropriate) for normality using histograms. For data that appeared non-normal, we created a scatterplot to explore the variable's association with each outcome. The scatterplot suggested transformations to linearity, which we explored using the ladder of powers. However, transformation to linearity did not help with linearity, and were later abandoned since the estimates achieved through transformation were no better than those for untransformed variables

We calculated the means and standard deviations for individual-level variables and compositional social capital variables. We performed two-sample *t*-tests to and chi-square tests to determine whether individuals who had undergone screening were demographically different from those without a diagnosis, at a significance of $p < 0.05$.

Multilevel analysis

Prior to the multilevel analysis, we performed Pearson's correlations and examined univariate associations between the outcome and each predictor variable. Using MLwIN 2.11 (Rasbash, Charlton, Browne, Healy, & Cameron, 2009), we generated two-level variance component models with random intercepts. Level-2 was census tracts and level-1 was individuals. The models were estimated with each dichotomous outcome using the binomial logit function, and were based on a first-order marginal quasi-likelihood approximation (MQL) of the second-order Taylor linearization procedure, and estimated under iterative generalized least squares (IGLS) assumptions.

Because we used aggregated social capital variables, we needed to reduce collinearity of the individual-level variables and its aggregated counterparts. In preparation for modeling, we calculated average values at the census tract level for each of the social capital variables, which we considered to be the "contextual" component of social capital. Previous research in multilevel modeling (Subramanian, Lochner, & Kawachi, 2003) highlights the importance of distinguishing compositional effects from contextual effects, since individual-level factors may confound the community-level social interactions and the development of social capital. We calculated group-mean centered social capital variables by subtracting the average value for the individual social capital from the average value for the aggregated social capital variable, for each individual, giving us the "compositional" component of social capital. Conceptually, using the group-mean centered approach is a way to disentangle the contribution of the individual perceptions of social capital from the community-level characteristics of social capital by subtracting the social capital score at the individual-level from the community-level mean score.

Next we examined the bivariate associations between each predictor and the outcome using logistic regression in an IGLS model. Then, we began building the model. The baseline model (null model) contained no predictor variables. Subsequent models separately included time, individual-level covariates, census tract analogs to the individual-level covariates, contextual social capital variables, and compositional social capital variables. The constant had both fixed and random components while the remaining predictors were entered as fixed effects. The final model would be expressed as:
where

$$\begin{aligned}\text{logit}(MAMTIME_{ij}) &= \ln\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \beta_0 x_{0ij} + \beta_1(YR04)_{ij} + \beta_2(YR06)_{ij} + \beta_3(AGE)_{ij} + \beta_4(INSURED)_{ij} + \beta_5(INCOME)_{ij} \\ &+ \beta_6(POVERTY)_{ij} + \beta_7(HIGHSCHOOL)_{ij} + \beta_8(COMP-COHESION)_{ij} + \beta_9(COMP-COLLECTIVE\ EFFICACY)_{ij} \\ &+ \beta_{10}(COMP-PARTICIPATION)_{ij} + \alpha_1(AVGAGE)_j x_{0ij} + \alpha_2(PCTPOV)_j x_{0ij} + \alpha_5(COLLECTIVE\ EFFICACY)_j x_{0ij} \\ &+ \alpha_6(PARTICIPATION)_j x_{0ij} + \left(\mu_{0j}x_{0ij} + \mu_{1j}x_{1ij} + \ldots\mu_{11j}x_{11ij}\right)\end{aligned}$$

$$\mu_{0j} \sim N\left(0, \sigma^2_{\mu 0}\right) \quad \varepsilon_{ij}, z_{ij}, z_{ij} = \sqrt{\frac{\hat{\pi}_{ij}\left(1-\hat{\pi}_{ij}\right)}{n_{ij}}}, \quad \sigma^2_{\varepsilon} = 1 \quad \textit{if binomial}$$

$$\text{var}(y|\pi) = \frac{\pi(1-\pi)}{n}$$

assuming the response variable, "MAMTIME" comes from binomial distributions with a denominator for each cell that is equal to 1, and an underlying proportion.

For each parameter, we exponentiated the coefficient estimates, standard errors and 95% confidence intervals to get odds ratios and we assessed significance at $p < 0.05$. The level-1 odds ratios represented the model's fixed effects, that is, the differences between individuals within each tract. The level-2 odds ratio represented the model's random effects, that is, the differences between census tracts and across individuals.

Table 1
Demographic characteristics of respondents.

	Total respondents for mammogram ($N = 2586$)	No mammogram in recommended time ($n = 815$)	Mammogram in recommended time ($n = 1771$)	*p*-Value
Mean age (SD)	58 (12)	57 (13)	59 (12)	0.004
HS grad	2170	673	1497	0.24
(%)	(84.2%)	(82.98%)	(84.8%)	
Have health insurance	2380	696	1684	<0.001
(%)	(92.0%)	(85.4%)	(95.1%)	
Mean income category midpoint	$27,300	$24,700	$27,300	<0.001
(Range)	($14,000–$54,500)	($10,400–$42,500)	($14,000–$54,500)	
Less than 200% poverty	1275	467	808	<0.001
(%)	(49.4%)	(57.4%)	(45.7%)	
Mean social cohesion score (SD)*	9.35 (2.19)	9.14 (2.31)	9.44 (2.13)	<0.004
Collective efficacy = Yes (%)**	1892 (76.7%)	555 (71.2%)	1337 (79.2%)	<0.001
Social participation = yes (%)***	1241 (48.5%)	354 (43.8%)	887 (50.6%)	<0.001

*$n = 2093$; **$n = 2468$, ***$n = 2561$.

Results

Respondents who had mammograms within the past year ($n = 1771$) represented 68.5% of the study sample. Compared to those who had not had one in that recommended time ($n = 815$), respondents who had mammography were significantly different on nearly every demographic measure, with education as the exception (Table 1). Those who had a mammogram were significantly older by an average of two years (average = 59), were more likely to have health insurance, have higher income, and were less likely to be in poverty. The mean social capital score for all respondents was 9.35 (SD = 2.19) on a scale of 3–13, with 76.7% of individuals reporting that their neighborhood demonstrated collective efficacy, and 48.5% participating in at least one community event. Women who had a mammogram had significantly higher perceptions of social cohesion in their neighborhoods ($p < 0.004$), were significantly more likely to report collective efficacy in their neighborhoods ($p < 0.001$), and were significantly more likely to have participated in a community event ($p < 0.001$).

Accordingly, in bivariate associations in multilevel analysis (Table 2, Bivariate), older age (OR = 1.01), having health insurance (OR = 3.32), and having higher income (OR = 1.05) were associated with a likelihood of having had a mammogram. Being in poverty decreased the likelihood of having a mammogram by a factor of at least 0.4 (OR = 0.62).

When controlling for time and other individual-level variables, the factors age, health insurance, and poverty remained statistically significant (Model III). In the final model, which controlled for individual-level and community-level factors, the factors age, health insurance, and poverty remained significant predictors of mammography (Table 2, Model VI). Each year of age was associated with a 1% increase in the likelihood of having a mammogram (OR = 1.01). A woman with health insurance was over twice as likely to have had a mammogram (OR = 2.28) compared to a woman who did not have health insurance, while a woman in poverty had a 30% less likelihood of a mammogram (OR = 0.68) of one above the poverty line. Additionally, individual perception of collective efficacy (compositional) was the only social capital-related variable that was statistically related to mammography in the final model. Each unit increase in compositional collective efficacy was associated with a 1.4 times greater likelihood of having had a mammogram in the past year. No community-level social capital variables were associated with mammography.

Discussion

We sought to answer the question of whether or not measures of social capital predict use of mammography for Black females in Philadelphia, net of individual-level characteristics (age, socioeconomic position). Our findings suggest that individual perceptions of

Table 2
Multilevel regression models for the log odds of mammogram in past year.

Log odds for mammogram (95% CI)	Bivariate	Model I – Null model	Model II + Time	Model III + Individual	Model IV + Compositional	Model V + Census Tract	Model VI + Social capital
Leve -1 Variables (Individual)							
Constant	**2.17*** (2.00, 2.36)**	**2.17*** (2.00, 2.36)**	**2.32*** (2.03, 2.68)**	**0.42* (0.19, 0.91)**	0.60 (0.25, 1.46)	2.28 (0.32, 16.00)	4.50 (0.29, 69.76)
Year 2004	0.94 (0.79, 1.13)		0.90 (0.73, 1.10)	0.91 (0.72, 1.14)	0.90 (0.69, 1.16)	0.90 (0.69, 1.16)	0.90 (0.69, 1.16)
Year 2006	0.95 (0.79, 1.13)		0.90 (0.74, 1.10)	0.93 (0.74, 1.17)	0.88 (0.68, 1.14)	0.88 (0.68, 1.14)	0.88 (0.68, 1.14)
Age (continuous)	**1.01** (1.00, 1.02)**			**1.01* (1.00, 1.02)**	**1.01** (1.00, 1.02)**	**1.01** (1.00, 1.02)**	**1.01** (1.00, 1.02)**
Health insurance	**3.32*** (2.48, 4.44)**			**2.78*** (1.99, 3.89)**	**2.32*** (1.60, 3.37)**	**2.31*** (1.59, 3.46)**	**2.29*** (1.57, 3.33)**
Income (categorical)	**1.05*** (1.03, 1.06)**			1.02 (0.98, 1.05)	1.01 (0.98, 1.05)	1.01 (0.98, 1.05)	1.01 (0.98, 1.05)
Below 200% poverty	**0.62*** (0.53, 0.74)**			**0.70* (0.51, 0.98)**	**0.68* (0.47, 0.98)**	**0.68* (0.47, 0.98)**	**0.68* (0.47, 0.98)**
High school graduate	**1.14 (0.91, 1.43)**			1.21 (0.91, 1.59)	0.91 (0.65, 1.28)	0.93 (0.66, 1.31)	0.93 (0.66, 1.31)
Compositional social cohesion	**1.06** (1.02, 1.11)**				1.00 (0.95, 1.06)	1.00 (0.95, 1.06)	1.00 (0.95, 1.06)
Compositional collective efficacy	**1.50*** (1.22, 1.83)**				**1.40* (1.06, 1.85)**	**1.39* (1.05, 1.84)**	**1.40* (1.05, 1.85)**
Compositional Social Participation	**1.10* (1.02, 1.12)**				1.05 (0.96, 1.15)	1.05 (0.96, 1.15)	1.05 (0.96, 1.15)
Level-2 Variables (Ecological)							
Median Age	1.00 (0.99, 1.02)					1.00 (0.97, 1.02)	1.00 (0.97, 1.02)
Percent Below 200% Poverty	1.00 (0.99, 1.00)					0.99 (0.98, 1.00)	1.00 (0.97, 1.02)
Percent high school graduates	1.00 (0.99, 1.00)					0.99 (0.97, 1.00)	0.99 (0.97, 1.00)
Social cohesion	1.07 (0.93, 1.22)						0.93 (0.74, 1.17)
Collective efficacy	1.00 (1.00, 1.00)						1.00 (1.00, 1.00)
Community participation	1.30 (0.93, 1.81)						1.17 (0.73, 1.88)
Level-2 Variance (Random effect)	–	1.00 (1.00, 1.00)	1.00 (1.07, 0.94)	1.01 (1.08, 0.98)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)

Bold font indicates a statistically significant result at $p < 0.05$. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

high collective efficacy may be related to mammography screening for African–American women in Philadelphia, which warrants further investigation. Each unit increase in a female's perceptions that her neighborhood had collective efficacy was associated with a 40% greater likelihood that she would have had a mammogram in the past year. As single-item measures of social capital, these estimates may be downwardly biased (Kawachi et al., 2007b, 294 pp.), which may mean that the actual effect of social capital is even greater than our study shows. In other multi-level studies that included both individual-level and community-level odds ratios for social capital and health outcomes, the inclusion of individual-level social capital indicators attenuated the odds ratios, thus our effect sizes may be a lower bound estimate, which would make the actual effect even larger (Kawachi et al., 2007b, 294 pp.). Residents who had participated in a preventive screening had higher income, were more likely to be insured, and less likely to be in poverty compared to those who had not had screening, which is consistent with other studies (Hoffman-Goetz et al., 1998; Lane et al., 2000; Mandelblatt et al., 1999; Potosky et al., 1998). Altogether, our findings could provide preliminary support on what social factors are favorable toward the use of mammography.

The individual-level perception of collective efficacy was statistically robust for mammograms while the community-level measure of collective efficacy was not. This discrepancy between analogous individual-level and community-level contextual factors underscores that individual-level factors seem to be of primary importance to mammography for Black females in Philadelphia. An individual's perception of collective efficacy has components that reflect ways in which community members gather together and interact. Our findings suggest that actual representations of collective efficacy may be less important than an individual's perceptions of whether or not their neighbors would come together for collective action.

In contrast, our findings did not show a significant relationship between mammography use and the other individual-level social cohesion or social participation variables in the final model, though they were significant in bivariate associations. This may suggest that diffusion of information due to having a close-knit neighborhood or having opportunities for individuals to participate in community events may simply not be enough to encourage a preventive behavior like mammography, which requires access to health resources and the ability to overcome elements of community disadvantage. Rather, when examining the usage of mammography, which requires securing access to resources and services and deliberate action, collective efficacy would be implicated as its definition includes motivation to advocate for resources and take action.

Women living in areas of high collective efficacy may be more likely to hear messages about screening. Because of the requisite working together and depth of interaction implied in collective efficacy, residents living in neighborhoods with high collective efficacy may have increased contact with their neighbors. Diffusion of information is believed to operate on individual health and thus our finding that individual perceptions of social capital, but not contextual measures, further supports that diffusion of information could be the mechanism at work for mammography use among African–American women. Increased contact may offer more opportunities to be exposed to the diffusion of information mechanism. Thus, they may be more likely to have health messages reinforced through social networks for sharing messages about health-promoting and preventive behaviors. Depending on where the diffusion of information mechanism operates, our findings may suggest the need for culturally-relevant strategies for increasing adoption of cancer preventive screening by Blacks/African–Americans. Residents who live in areas with high social capital may be recipients of diffusion of health information because of dense social networks. Our findings support that using familiar social networks could be an effective tool for encouraging mammography use by Black women in Philadelphia.

Our findings may support a strategy that unites residents toward a goal for collective action, or creates opportunities for residents to engage socially. These increased opportunities to strengthen social bonds may allow residents to form social resources to advocate for their own cancer preventive resources. It may be that certain areas with high social capital get more targeted prevention messages because of their social fabric and ability to command attention for resources (LaVeist, 1993). Neighborhoods with high collective efficacy may have the means to engage political action to ensure their accessibility to cancer preventive screening. Still, there may be an insurmountable lack of access to key physical resources, like access to health care, which could stymie advocacy efforts no matter how strong the social resources are. It could otherwise be that residents who have the motivation to seek out screening may be more attracted to living in neighborhoods that are already high in social capital.

It is entirely possible that many of these strategies are already in use, which may explain why the rates for cancer screening in our sample were higher than national estimates for Blacks/African–Americans. Our rates may also be higher than average because we used a sample of individuals from an urban area which is associated with higher mammography rates (Anderson & May, 1995; Makuc et al., 1999; Rakowski et al., 1993), and Black women are believed to over-report mammography use (American Cancer Society, 2013; Cronin et al., 2009). If social capital mechanisms are at work, then urban residence might promote social capital mechanisms since cities have a geographical density that might make diffusion of information more likely or more extensive than in suburban areas. Given our cross-sectional study design, gaging the direction of causality is difficult; however, we can safely say that social capital does have some association with cancer screening, and this association deserves further exploration.

Limitations

Limitations to this study involve the quality of the secondary data sources used. The response rate to the PHMC questions was low at fewer than 30%, but this is a typical and acceptable rate for community random-digit dialing surveys. Low response rates can become problematic when selection bias is introduced because those who choose not to respond or do not respond may be fundamentally different from those who agree to take the survey. However, PHMC's response rates fall within the range of response rates of other well-used and respected community surveys that use random-digit dialing (Behavioral Risk Factor Surveillance System, 2009; California Health Interview Survey, 2009; Lee, Brown, Grant, Belin, & Brick, 2009). Unlike some other community surveys, PHMC includes cellular phone-only users, to omit some selection bias associated with random-digit dialing techniques.

There were limited measures of social capital. Social capital was only measured based on perceptions of a participant's neighborhood, and not on a participant's kinship networks or other social networks. There were no purely ecological measures and no primary source representations of social capital (e.g., voting block representation, number of permits for community events). However, measurement of social capital tends to be critiqued because researchers have been relegated to using proxy indicators (e.g. the number of community events held) which could either be precursors or consequences of social capital, raising problems of endogeneity. However, these were the indicators available to us and, to our knowledge, are the only survey-based indicators of social capital in Philadelphia. Similar to this one, many studies use data

aggregated from individuals, rather than purely ecological measures. In that sense, our study's measures are acceptable and typical given the state of the field of social capital measurement. As an additional strength of this analysis, our study included three indicators of social capital – social cohesion, collective efficacy, and social participation – while most others include only one indicator of social capital (Kawachi et al., 2007a). Using multiple indicators enabled us to account for multiple dimensions of the social capital construct, leading to a more refined view of which specific social capital mechanisms may be at work.

Mammography is represented as a single self-reported item, which may not be the most valid way to measure these behaviors. Self-report lacks medical records or other supporting documentation from a health professional, for validation. We could not ascertain whether or not asking about cancer-preventive behaviors would be a sensitive topic for this population, but if it is a sensitive topic, that could increase the likelihood of either denying or falsely endorsing mammography use. In fact, because it is a question about a health – promoting behavior, respondents may have felt that responding affirmatively may have increased their desirability, which might also explain why the rates were higher than national averages.

The CHDB questionnaire no longer gathers data on cancer diagnosis (it did in previous waves, but not after 2002) so we could not distinguish those who already had cancer and for whom these are diagnostic (rather than preventive) actions. Those who had undergone cancer screening may have done so because of a cancer diagnosis. In which case, screening is diagnostic and not preventive. Those who engage cancer testing for diagnostic purposes may be more likely to get routine screening than those who do so as a voluntary preventive action. If there were a large number of respondents who already had cancer at the time of the questionnaire, these respondents may be more likely to seek out support groups or other sorts of social networks around cancer itself, which may inflate reports of collective efficacy or social participation, thus confounding our results.

All of our data were cross-sectional, making it difficult to determine the direction of causality for the relationship between our independent variables and dependent variable. We cannot verify empirically whether social capital causes residents to seek out cancer preventive screening, or whether those who are likely to pursue preventive screening seek out neighborhoods that are high in social capital. Although we had access to multiple waves of data, there was not sufficient variation between waves of data to permit longitudinal analysis. Nevertheless, the associations are important for laying a foundation to explore causality in the future.

Conclusion

Our findings suggest that an individual woman's perception of social capital, specifically collective efficacy, may be related to her choice for mammography use, in a sample of Black women in Philadelphia. Given the salience of individual perceptions of social capital, it is likely that a diffusion of information could be at work in increasing the likelihood of usage of mammography. As the first study to explore the relationship between social capital and mammography using multilevel modeling, further investigation could help elucidate the mechanisms through which social capital and cancer screening operate. This understanding could inform effective strategies for encouraging routine screening for African–American women.

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