Social Support Needs of Minority Breast Cancer Patients: Significance of Racial Homogeneity and Kin Composition of Social Networks

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Abstract

Social support from family and friends assists breast cancer patients navigate a life crisis, but more needs to be understood about specific social network characteristics that can benefit breast cancer patients. To address this need, the primary aim of this study was to identify social network factors that facilitate or reduce social support. Given racially patterned gaps in social support among breast cancer patients, a secondary goal was to identify network characteristics that are linked to gaps in support. We examined these research questions using data from a sample of 915 breast cancer patients (NHWhite=373; NHBlack=377; Hispanic=165) and 4,021 of their network members. To improve on prior research, we collected detailed social network data using a personal-network measurement tool and assessed needed and received support on five support components. Study findings identified specific network characteristics that facilitate these social support components. Network size was associated with increased practical, informational, emotional, and spiritual support. Network density was associated with increased practical support. Racial homogeneity in networks were associated with reduced informational support while a higher number of daughters in support networks was associated with increased emotional support. Compared to NHWhite patients, NHBlack patients were more likely to experience inadequate practical and financial support. Additionally, compared to NHWhite patients, Hispanic patients were more likely to experience inadequate informational and emotional support. The study found that network density, racial homogeneity, and gender composition of NHWhite, NHBlack and Hispanic social networks contributed to the racially patterned disparities in social support. Findings in this study could inform interventions aimed at increasing social support through greater mobilization of existing network ties as well as policy-driven, formal community building initiatives aimed at replicating benefits of naturally occurring networks.

Keywords

Social Support; Social Networks; Breast Cancer; Racial/Ethnic Disparities

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ABSTRACT

Social support from family and friends assists breast cancer patients navigate a life crisis, but more needs to be understood about specific social network characteristics that can benefit breast cancer patients. To address this need, the primary aim of this study was to identify social network factors that facilitate or reduce social support. Given racially patterned gaps in social support among breast cancer patients, a secondary goal was to identify network characteristics that are linked to gaps in support. We examined these research questions using data from a sample of 915 breast cancer patients (NHWhite=373; NHBlack=377; Hispanic=165) and 4,021 of their network members. To improve on prior research, we collected detailed social network data using a personal-network measurement tool and assessed needed and received support on five support components. Study findings identified specific network characteristics that facilitate these social support components. Network size was associated with increased practical, informational, emotional, and spiritual support. Network density was associated with increased practical support. Racial homogeneity in networks were associated with reduced informational support while a higher number of daughters in support networks was associated with increased emotional support. Compared to NHWhite patients, NHBlack patients were more likely to experience inadequate practical and financial support. Additionally, compared to NHWhite patients, Hispanic patients were more likely to experience inadequate informational and emotional support. The study found that network density, racial homogeneity, and gender composition of NHWhite, NHBlack and Hispanic social networks contributed to the racially patterned disparities in social support. Findings in this study could inform interventions aimed at increasing social support through greater

mobilization of existing network ties as well as policy-driven, formal community building initiatives aimed at replicating benefits of naturally occurring networks.

Keywords: Social Support; Social Networks; Breast Cancer; Racial/Ethnic Disparities

INTRODUCTION

Social support following a breast cancer diagnosis is associated with better health-related quality of life (Leung, et al. 2014; Arora, et al. 2006; Thompson, et al. 2013; Galvan, et al. 2009; Tejeda, et al. 2017) and increased survival (Beasley, et al. 2010; Chou, et al. 2010; Kroenke, et al. 2017; Kroenke, et al. 2006; Reynolds, et al. 1994; Vijayasiri, et al. 2018; Waxler-Morrison, et al. 1991). While the patient's network of family and friends usually provide this vital support, little is known about specific network characteristics that facilitate it. The current study aims to identify these network characteristics using detailed personal network data gathered from a racially diverse sample of breast cancer patients.

Defined as the resources that people within an individual's social network provide, social support is a multidimensional concept that includes five types of support. According to most definitions, instrumental social support includes *practical support*, *financial support*, and *informational support*. Psychological support includes *emotional* and *spiritual support* (Helgeson, 2003; Thoits, 2011; Thoits, 1986; Cohen & Wills, 1985). *Practical support* has been found to be most useful for improving survival (Pinquart, et al. 2007; Vijayasiri, et al. 2018) while *emotional and spiritual support* have been found to be associated with better quality of life among cancer survivors (Helgeson & Cohen, 1996; Manning-Walsh, 2005; Kroenke, et al. 2013). Despite the evident benefits of social support, cancer patients often report receiving inadequate or inconsistent support (Peters-Golden, 1982; Arora, et al.2007; Pearce, et al. 2012; Steptoe, et al. 2013).

Initiatives to improve social support resources among breast cancer patients could be more effective if informed by an adequate knowledge of *social network characteristics* that promote or constrain social support. But studies that have focused on breast cancer patients' personal networks have considered a narrow set of network characteristics including network size (Bloom, et al. 2001) and relative benefits of kin vs. friendship networks (Lopez-Class, et al. 2012; Jutagir, et al. 2016). As a result, little is known about the relative contributions of differing network forms to address the five dimensions of support needs. Scholars have acknowledged the need to include other network measures such as proximity of support sources, frequency of contact with network members, and closeness or intensity of relationships (Jutagir, et al. 2016). Evidence also suggests that a single social network metric may not have the same impact on all five support dimensions. Thus, normative influences associated with dense networks can promote tangible help (Berkman, et al. 2000; Miguel & Gugerty, 2005) but on the other hand, sparse networks can promote the flow and quality of information (Villalonga-Olives & Kawachi, 2015; Scholmerich, et al. 2016; McPherson, et al. 2001; Granovetter, 1983).

Research on social networks of breast cancer patients to date has provided valuable knowledge that could inform policy. Thus, larger networks were found to be associated with greater instrumental and emotional support (Bloom, et al. 2001). Reynolds, et al. (1994) found that, following a breast cancer diagnosis, friends were a more useful source of informational

support than family members, but that family members were a more important source of emotional support than friends. While minority breast cancer patients report worse psychological and emotional well-being and poorer physical functioning than white patients (Reynolds, et al. 1994), women of color and women with lower education also report less helpful support (Arora, et al. 2007). Though minority breast cancer patients report greater unmet support needs, study samples (Arora, et al. 2007; Bloom, et al. 2001) have not had sufficient representation of minority patients to adequately examine disparities in social support between NHWhite, NHBlack, and Hispanic patients.

Using cross-sectional data from a newly diagnosed, racially diverse sample of breast cancer patients, we examined how structural, compositional, and functional metrics of patients' social networks are associated with social support needs. We also examined the presence of a racial/ethnic gap in social support and identified network mediators of racial/ethnic disparities in social support. Empirical answers to these questions could inform policies aimed at addressing unmet social support needs among all cancer patients.

METHODS

Sample

With the assistance of the Illinois State Cancer Registry, during 2005 to 2008, the Breast Cancer Care in Chicago (BCCC) study invited 1754 newly diagnosed breast cancer patients who were identified using rapid case ascertainment to participate. Eligible patients were female Chicago residents, between ages 30–79, when diagnosed. Patients provided written informed consent and participated in a computer-assisted personal interview. The consent process and interview took approximately 90 minutes. Subject recruitment was stratified with the intention of obtaining specific numbers of NHWhite, NHBlack and Hispanic participants. In all, 989 patients (411 NHBlack, 397 NHWhite, and 181 Hispanic) participated in the interview representing a 56.4% response rate among those approached. As part of the consent process patients were asked for permission to access their medical records. Medically abstracted data were obtained for 863 consenting patients. Patients were also asked to provide up to five names of members of their social support networks and to assist in contacting them. A total of 4021 network members were identified by 975 patients.

Measures

Social Support. Social support consists of five subtypes including practical, financial, informational, emotional, and spiritual support (Langford, et al. 1997; Kuuppelomäki, 2002). In assessing social support, studies have made a distinction between perceived availability of social support, received social support, and perceived adequacy of social support (Gallant, 2013; Tejeda, et al. 2017; Thompson, et al. 2013). The matching hypothesis (Cohen & McKay, 1984) suggests that social support is beneficial when the amount and quality of support received matches the amount and quality of support needed. The primary goal of the current study is to identify network sources of social support. Given this goal, and the fact that network characteristics are correlated with assessment of patient support needs as well as the generation and coordination of support resources (Rockenbaugh & Sakdapolrak, 2017; Miguel & Gugrty, 2005), we used *perceived adequacy of social support* as the measure of social support. For each of the five support subtypes, *perceived adequacy of social support* is measured in BCCC data with two indicators: amount of

support *needed* and the amount of actual support *received*. For example, for practical support, the BCCC survey asked, "Since you were diagnosed with breast cancer how much assistance with practical or everyday matters have you needed?" and "Since you were diagnosed with breast cancer, how much practical help or support have you received, from anyone?". There were four response options: None, A Little, Some, and A Great Deal. For each subtype, perceived adequacy of support was assessed as the difference between actual support received and support needed. Scores on *perceived adequacy of social support* ranges from -3 to 3. Positive values indicate adequate support, zero equals exactly meeting support needs, and negative numbers equal inadequate support.

Social Network Characteristics. Network data for each patient was obtained using a personal-network measurement tool consisting of a name generator, name interpreter, and a name inter-relator (Marsdon, 1990). The name generator asked "People look to others for various sorts of help such as companionship, prayer, information, baby-sitting, and money when they have serious health problems. Since your breast cancer diagnosis, who are the people who have provided you with the most important help? "Patients were asked to nominate as many as five of their most helpful friends or relatives. While the survey also collected information on the number of additional friends and relatives who may have provided important help to the patient, the current analysis focused only on the five network members who provided the 'most important help'. For each member of the patient's *network*, defined here as friends and relatives who provided the 'most important help', the name interpreter collected information on demographics, residential location, and details on his/her relationship with the patient. The name inter-relater asked about the relationship among all possible pairs of network members within each patient's network. Network characteristics were calculated for each individual patient. *Network size* is the number of friends and relatives "who provided the most important help" to the patient since diagnosis and could range from 0 to 5. The *Network density* of a patient's personal network was measured by summing existing ties between network members and dividing by the maximum number of possible ties. *Geographic proximity* of the network is the average distance between place of residence of network members and patient. Driving distance between the patient's residence and residences of her network members was calculated using the OD Cost Matrix Network Analyst tool in ArcGIS Version 10.1 (ESRI, 2014). *Race/Ethnic homogeneity* of the network was calculated as the proportion of network members of the same race/ethnicity as the patient. The *proportion of daughters* in the network was calculated by dividing the number of daughters in the network by the network size. Two indicators assessed relationship strength: average *Communication Frequency* with network members and the average number of years the patient has known network members. We also measured whether the patient was *married or cohabiting* based on whether the patient had a spouse or partner.

Health and Clinical Factors. *Stage at diagnosis* of breast cancer was abstracted from the surgical pathology report in the patient's medical record and was identified using the American Joint Commission on Cancer staging system (Edge & Compton, 2010). Stages 0, 1 were defined as early stage and 2, 3, and 4 as late stage. Measures of *Adjuvant therapy* including radiation, chemotherapy, and hormone therapy were based the medical record abstraction and supplemented by self-report. Each treatment type was a binary variable coded as `1' if the treatment was given and `0' otherwise. *Type of Surgery* received by the patient was defined as either mastectomy,

lumpectomy, or 'no surgery' with each coded as `1' or `0'. The study also included *Time since Diagnosis* as a covariate based on evidence that social support received by breast cancer patients tends to decrease over time (Arora, et al. 2001).

The study also measured demographic factors as covariates. These included self-reported age, socio-economic status (a composite measure of standardized education and household income), marital status, and whether the patient's household was a Spanish-speaking household. Participation in a formal support group was also included as a covariate.

Analysis Plan

Descriptive statistics were generated for social support sub-types, network metrics, patient demographics, and treatment factors overall and stratified by race/ethnicity. To better understand the five social support dimensions, we generated additional descriptive statistics for each social support subtype. These included the correlations between needed and received support and percentage of patients reporting inadequate support overall and by race/ethnicity. Using bivariate linear regression, we examined unadjusted associations between each covariate and each of the five social support subtypes. We also assessed multivariate regression models for the five social support outcomes. While the primary aim of the study was to identify network characteristics that promote social support, a secondary goal was to determine whether racial/ethnic minority patients received less support than NHWhite patients and to determine the relative contribution of network factors compared to socio-economic and health factors to any racial gap in social support. For support dimensions that had a racial/ethnic gap, we determined the mediating role of social network, demographic, and treatment factors using structural mediation modeling (SEM) in Mplus 8.2. Using SEM that allows the simultaneous estimation of several regression models, we estimated the following associations: (1) the direct path from race/ethnicity to perceived adequacy of social support, (2) the path between race/ethnicity and mediators, and (3) the path between each mediator and perceived adequacy of social support. The latter two paths provide information on factors underlying a racial/ethnic gap in support that are potential targets for policy interventions.

Based on general guidelines for selecting mediators (MacKinnon, et al. 2002), all social network, demographic, and treatment covariates that were assumed to be a consequence of patient race/ethnicity and a subsequent cause of social support were considered potential mediators. These were included as mediators in an initial set of mediation models. Then a set of nested mediation models were estimated that included only significant mediation paths from the initial models. All analyses were weighted by race/ethnicity to bring the sample back to its correct proportional representation in the population.

Missing Data

Full information maximum likelihood estimation (Enders & Bandalos, 2001) in MPlus 8.2 was used to account for missing data for variables missing for over 3% of the initial sample (N=989), including stage at diagnosis (13% missing), network racial/ethnic composition (29%), duration of relationships (28%), and network density (7%). Variables missing 3% or less included spatial proximity to network members, proportion of daughters in the network, frequency of communication with network members, and treatment factors. Observations missing on any of these variables were excluded from the analysis, resulting in an analytic sample of 915 patients.

RESULTS

Descriptive Statistics

Sample Characteristics. The analysis sample of 915 patients consisted of 373 (41%) NHWhites, 377 (41%) NHBlacks, and 165 (18%) Hispanics. Of the 165 Hispanic patients, 68% reported they spoke Spanish at home. The mean age of the sample was 58 years and 40% reported having a spouse or cohabiting partner (Table 1). Thirty patients (3%) in the initial sample (N=989) reported zero network members. They were excluded from the current analysis as they were missing social support outcomes. In the analytic sample, while 4% of patients reported one network member, patients on average reported 4.2 social network members. On average, about a third (37%) of the support providers were non-kin (including friends, co-workers, spiritual leaders, and neighbors) while two-thirds (63%) of the support providers were family members.

With regard to social support outcomes, a zero score on the 'adequacy of social support' measure indicated that the amount of support received by the patient equaled the amount of support needed, while a positive score on the same measure indicated that support received exceeded patient needs. On average, patients reported positive scores for all support adequacy measures except financial support. This was true for the overall sample as well as for each race/ethnicity group (Table 1).

Table 1. Unmet Social Support, Demographic and Clinical Factors, and Social Network Characteristics by Race/Ethnicity (N=915)[a]

	Range	Overall	NHWhite (N=373)	NHBlack (N=377)	Hispanic (N=165)
Social Support Needed	0-3				
Practical		1.24	1.23	1.29	1.59**
Financial		1.10	0.78	1.44***	1.58***
Informational		1.78	1.95	1.70***	1.95
Emotional		1.96	2.10	1.91**	2.19
Spiritual		2.04	1.76	2.31***	2.30***
Social Support Received	0-3				
Practical		1.71	1.79	1.65*	2.04*
Financial		0.90	0.77	0.99*	1.39***
Informational		2.28	2.48	2.17***	2.19***
Emotional		2.69	2.81	2.62***	2.62**
Spiritual		2.28	1.98	2.56***	2.44***
Adequate Social Support					
Practical	-3 - 3	0.46	0.56	0.36***	0.45
Financial	-3 - 3	-0.19	-0.01	-0.45***	-0.18
Informational	-3 - 3	0.49	0.53	0.46	0.24**
Emotional	-3 - 2	0.73	0.71	0.71	0.44**
Spiritual	-3 - 3	0.24	0.22	0.26	0.14
Demographic Factors					
Age (years)	26-97	58.54	55.75	56.78	54.25
SES Score	-3.3-2.2	0.01	0.52	-0.22***	-0.6***
Married (%)		40	49	29***	56~
Speaks Spanish at Home (%)		9	--	--	68
Health/Clinical					

Time since Diagnosis (weeks)	5.6-67.4	17.52	16.61	17.83*	18.76**
% with Late Stage Cancer		43	36	49***	55***
% had no Surgery		10	7	15***	11
% had Lumpectomy		61	66	54	59
% had Mastectomy		29	28	31***	30
% Radiation Therapy Initiated		59	63	54**	59
% Chemotherapy Initiated		42	36	52***	56***
% Hormone Therapy Initiated		46	50	37***	51
Formal Support Sources					
Participated in Support Group (%)	0 - 10	7	7	10~	7.1
Social Network Factors					
Number of Network Members	1 - 5	4.17	4.27	4.13	4.18
Mean Network Density	0 - 10	5.37	3.67	6.53***	6.52***
Mean Spatial Proximity of Network (10 miles)	0 - 73	12.03	17.29	9.76***	6.92***
Proportion of Daughters	0-1	0.18	0.11	0.20***	0.21***
Proportion Same Race/Ethnicity	0-1	0.90	0.90	0.93	0.86
Communication Frequency	1-6	2.08	2.42	1.86***	1.77***
Years Known	0.1-51	15.09	14.08	15.30	11.63~

[a] The table compared the characteristics of NHWhite patients with the characteristics of NHBlack and Hispanic patients. For continuous variables statistics reported are means and for binary variables statistics reported are percentages; P-values for continuous variables are based on OLS regression and P-values for binary variables are based on logistic regression; ~p<.1; *p<.05; **p<.01; ***p<.001

Correlations between Support Needed and Support Received. Table 2 showed correlations between support needed and support received for each of the five support dimensions as well as correlations among the five support needed measures. For all support dimensions except emotional support, support received had moderately strong, positive correlations with needed support (correlations between 0.30 - 0.58) for all three race/ethnicity groups. NHWhites however had somewhat stronger correlations between received and needed support for these four support measures than NHBlacks and Hispanics. Emotional support received had a weak, positive correlation (correlations between 0.13-0.19) with needed support across the three race/ethnicity groups. In Table 2, support needs were positively correlated across all five support dimensions (correlations ranged between 0.06 - 0.53), indicating that patients who report need for greater support in one social support dimension needed greater support in the other four, while patients who reported need for less support in one support dimension needed less support in the other four.

Table 2. Correlations Between Patient Need and Received Support for Five Dimensions of Social Support (N=915)

Patient Need	Correlation with Received Support[a]	Correlation with Patient Need[b]			
		Practical	Financial	Informa-tional	Emotional
		Overall (N=915)			
Practical	0.49	1			
Financial	0.45	0.32	1		
Informational	0.35	0.28	0.17	1	
Emotional	0.19	0.36	0.23	0.39	1
Spiritual	0.54	0.23	0.27	0.23	0.36
		NHWhite (N=373)			
Practical	0.57				
Financial	0.58	0.25			
Informational	0.41	0.22	0.06		
Emotional	0.13	0.42	0.22	0.31	
Spiritual	0.59	0.17	0.21	0.21	0.30
		NHBlack (N=377)			
Practical	0.46				
Financial	0.34	0.31			
Informational	0.30	0.32	0.22		
Emotional	0.21	0.32	0.22	0.42	
Spiritual	0.51	0.24	0.17	0.28	0.41
		Hispanic (N=165)			
Practical	0.39				
Financial	0.33	0.46			
Informational	0.33	0.31	0.43		
Emotional	0.19	0.34	0.39	0.44	
Spiritual	0.32	0.29	0.36	0.33	0.53

[a] Correlation between support needed and support received for each of the five dimensions of support.

[b] Cross correlations between patient need variables.

Race/Ethnicity Differences in Adequacy of Social Support. Table 3 presents percentages for the five support adequacy measures. Patients who reported a support adequacy score between -3 and -1 are coded as receiving 'inadequate' support. While on average patient support needs were met, Table 3 also shows there is a segment of patients who reported unmet support needs. Overall, 11 % reported inadequate practical support; 25% of patients reported inadequate financial support, and 12% reported inadequate informational support. Seven percent of patients and 11% of patients also reported inadequate emotional and spiritual support respectively. For all support measures except spiritual support, NHBlack and Hispanic patients were more likely than NHWhite patients to report inadequate support. Higher percentages of NHWhite and Hispanic patients reported inadequate spiritual support than NHBlack patients.

Table 3. Percentage of patients reporting inadequate Social Support by domain and race/ethnicity (N=915)[a]

	N	Practical	Financial	Informational	Emotional	Spiritual
Overall	915	11	25	12	7	11
NHWhite	373	7	15	9	5	14
NHBlack	377	14	35	14	9	8
Hispanic	165	13	32	21	12	18

a. Adequacy of Support scores between -3 and -1 were treated as inadequate support.

Bivariate Results

Table 4 shows the unadjusted, bivariate associations between race/ethnicity, network factors, and demographic and health factors and the five social support dimensions. Several race/ethnicity patterned differences were observed in levels of adequate social support. Thus, NHBlacks were more likely to report inadequate practical and financial support than NHWhites, while Hispanics were more likely to report inadequate emotional and informational support than NHWhites. Several network measures were also associated with adequacy of social support; for example, network size was associated with four of the social support components while all other network measures were associated with at least one support component.

Table 4. Unadjusted Associations between Adequate Social Support and Social Network, Demographic, and Clinical Factors (N=915)[a]

	Practical Support	Financial Support	Informa-tional Support	Emotional Support	Spiritual Support
Race/Ethnicity (Ref: NHWhite)					
NHBlack	-0.242*	-0.479***	-0.071	-0.005	0.044
Hispanic	-0.130	-0.217	-0.318**	-0.313**	-0.135
Demographic Factors					
Mean Age (years)	0.005	0.004	0.013***	0.02***	0.007**
Mean SES Score	0.126**	0.336***	0.098*	0.053	0.082~
Married	0.080	0.295***	0.100	-0.051	0.044
Speaks Spanish at Home	0.005	-0.027	-0.326**	-0.365**	-0.317*
Health/Clinical					
Time since Diagnosis (days)	-0.001	-0.001	-0.002***	-0.001*	-0.001~
Late Stage Cancer	-0.164*	-0.031	-0.074~	-0.137~	0.091
No Surgery	-0.163	-0.406*	0.040	-0.230*	-0.101
Lumpectomy	0.095	0.159~	0.042	0.203**	0.069
Mastectomy	-0.036	-0.001	-0.066	-0.131	-0.034
Radiation Therapy Initiated	-0.104	-0.012	0.006	-0.005	-0.010
Chemotherapy Initiated	-0.081	-0.051	-0.055	-0.277***	-0.036
Hormone Therapy Initiated	0.117	0.155~	0.083	0.128~	0.063
Formal Support Sources					

Participated in Support Group	0.054	-0.152	-0.184	0.388***	-0.118
Social Network Factors					
Number of Network Members	0.165***	0.078*	0.093**	0.035	0.058~
Network Density	0.006	-0.037**	0.001	0.004	0.007
Proximity of Network (10 miles)	0.010	0.052*	-0.002	-0.003	-0.028~
Proportion of Daughters	-0.051	-0.248	0.171	0.456**	0.074
Proportion Same Race/Ethnicity	-0.14	-0.128	-0.301~	-0.062	-0.201
Communication Frequency	0.054	0.147**	0.036	0.016	-0.002
Years Known	0.002	-0.001	0.008*	0.016**	0.005

[a] Reported coefficients are unstandardized slope coefficients.

Multivariate Results

In unadjusted bivariate regression models, NHBlacks were more likely to report inadequate practical support than NHWhites. In regression models that adjusted for demographic, health, and network characteristics (see Table 5), the NHBlack difference was reduced in magnitude but remained marginally significant. In the adjusted model both network size and network density were associated with greater likelihood of adequate practical support. In unadjusted models, NHBlacks were more likely to report inadequate financial support than NHWhites. In the adjusted model, the NHBlack effect on financial support reduced in size and was no longer statistically significant. While in unadjusted models several network factors including network size, network density, proximity of the network and communication frequency were associated with adequacy of financial support, in adjusted models none of the social network factors showed significant associations with adequacy of financial support.

With regard to unmet informational support, in bivariate analysis Hispanics reported greater inadequate support compared to NHWhites but in fully adjusted models, no race/ethnic differences were observed in levels of unmet support. As expected, network size was positively associated with adequate informational support while a higher proportion of network members of the same race/ethnicity as patient was negatively associated with adequate informational support.

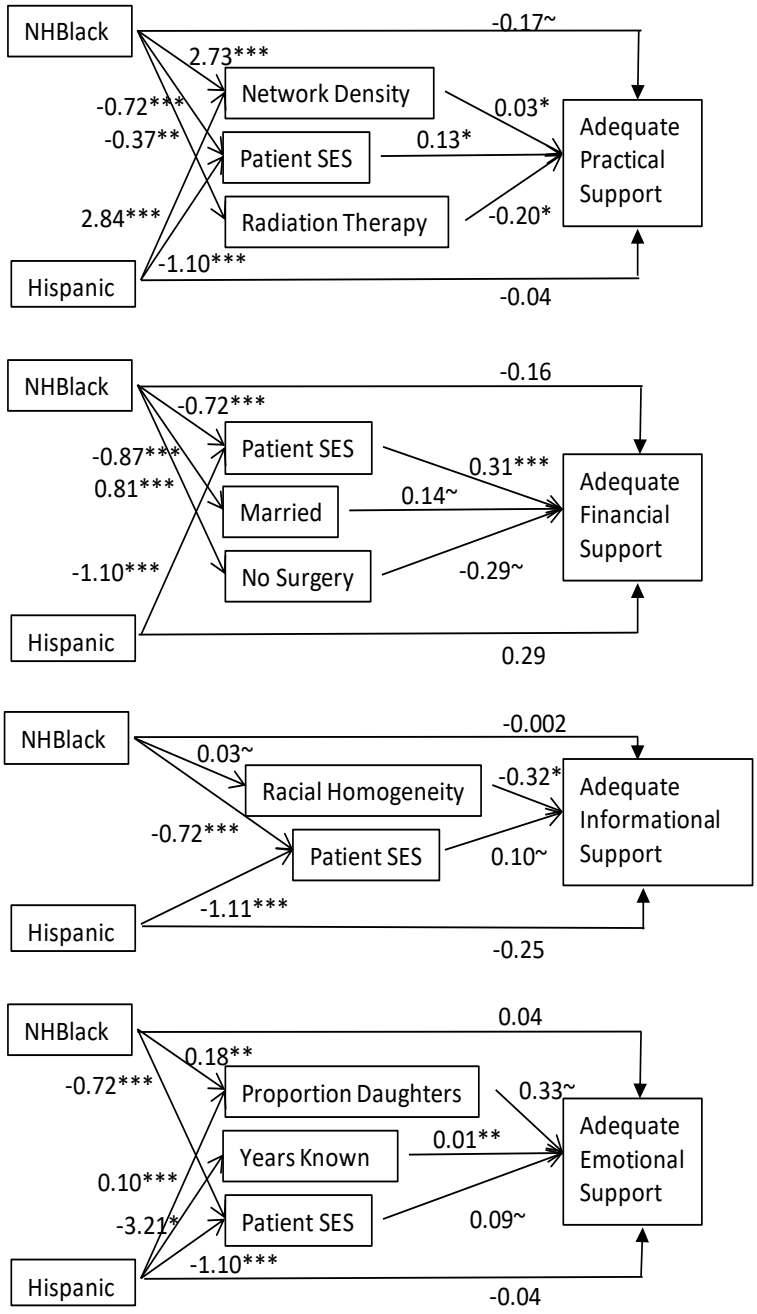
Table 5. Multivariate Associations between Adequate Social Support and Social Network, Demographic, and Clinical Factors in a Sample of Recently Diagnosed Breast Cancer Patients (N=915)[a]

	Practical Support	Financial Support	Informational Support	Emotional Support	Spiritual Support
Race/Ethnicity (Ref: NHWhite)					
NHBlack	-0.161~	-0.156	0.005	0.039	0.091
Hispanic	-0.033	0.286	-0.248	-0.043	0.324*
Demographic Factors					
Age (years)	0.009*	0.010*	0.015***	0.014***	0.008**
SES Score	0.130*	0.312***	0.101~	0.086~	0.113*
Married	0.039	0.142~	0.131	-0.031	0.058
Speaks Spanish at Home	0.018	-0.091	-0.011	-0.207	-0.532**
Health/Clinical					
Time since Diagnosis (weeks)	-0.005	-0.006	-0.013*	-0.007~	-0.006~
Late Stage Cancer	-0.181	0.017	-0.091	0.059	0.178~
Surgery type (Ref: Mastectomy)					
No Surgery	-0.025	-0.294~	0.099	-0.062	-0.056
Lumpectomy	0.130	0.088	0.023	0.184*	0.125
Radiation Therapy Initiated	-0.202*	-0.150	-0.017	-0.129	-0.075
Chemotherapy Initiated	0.114	0.132	0.152	-0.084	-0.040
Hormone Therapy Initiated	0.113	0.126	0.097	0.080	0.075
Formal Support Sources					
Participated in Support Group	0.115	-0.109	-0.055	-0.213*	-0.043
Social Network Factors					
Number of Network Members	0.158***	0.048	0.101**	0.063*	0.069*
Network Density	0.030*	-0.002	0.010	-0.007	0.012
Proximity of Network (10 miles)	0.001	0.002	-0.002	-0.002	-0.004*
Proportion of Daughters	-0.075	-0.059	0.056	0.316~	-0.030
Proportion Same Race/Ethnicity	-0.158	-0.121	-0.359*	-0.107	-0.218
Communication Frequency	-0.010	-0.005	0.002	-0.003	-0.017
Years Known	-0.002	-0.002	0.004	0.012**	0.001

[a] Reported coefficients are unstandardized regression slopes.

In unadjusted models, Hispanics reported greater levels of inadequate emotional support than NHWhites. In fully adjusted models, no race/ethnic differences were observed in levels of emotional support. In these adjusted models, network size, proportion of daughters in the network, and relationship duration were positively associated with adequate emotional support. Participation in a support group however was associated with inadequate support. Regarding spiritual support, no race/ethnic differences in adequacy of support were observed in unadjusted models. In adjusted models, Hispanics were more likely to report adequate spiritual support than

Figure 1. Mediators Between Race/Ethnicity and Social Support



NHWhites. Spanish speakers were more likely to report inadequate spiritual support than non-Spanish speakers. Several network factors were associated with adequate spiritual support; network size was associated with greater likelihood of adequate support, but surprisingly, proximity was associated with inadequate support.

Some of the demographic, health and clinical covariates were also associated with support adequacy measures. In fully adjusted models, higher SES and older age were associated with greater likelihood of adequate support for all five support outcomes. Time from diagnosis to interview date was associated with greater likelihood of inadequate informational, emotional, and spiritual support. Cancer stage was associated with just one support dimension; thus, patients with late-stage cancer were more likely to report adequate spiritual support than patients with early-stage cancer. Several of the treatment factors were associated with support dimensions. Thus, patients who had already started radiation therapy at the time of the interview were more likely to report inadequate practical support than patients who had not yet started radiation therapy. Patients who had a mastectomy were more likely to report inadequate emotional support than patients who had a lumpectomy while no difference in adequacy of emotional support was observed between patients who had no surgery and patients who had a mastectomy. Patients who had no surgery were more likely to report inadequate financial support than patients who had a mastectomy.

In addition to assessing social network determinants of perceived adequacy of social support, this study also aimed to determine the extent to which social network, socio-economic, and health factors accounted for racial/ethnic differences in support needs. Figure 1 presents the results of mediation analysis assessing this for the four social support sub-types which (see Table 4) had a racial/ethnic gap. The analysis identified several social network factors and patient SES as the key mediators between race/ethnicity and adequate social support. Several of these mediators contribute to the lower social support reported by minority women while some mediators help minority patients garner greater social support. Both NHBlack and Hispanic patients report lower SES than NHWhite patients and low SES was associated with inadequate practical, financial, informational, and emotional support. Among network factors, network density, racial homogeneity, proportion of daughters, relationship duration, and marital status mediated the association between race/ethnicity and social support. Thus, NHBlack patients were less likely to be married than NHWhite patients and being unmarried was positively associated with inadequate practical support. Similarly, social networks of NHBlack patients tended to show greater racial homogeneity than the networks of NHWhite patients, and greater racial homogeneity was associated with inadequate informational support. Social network relationships of Hispanics tended to be of shorter duration than that of NHWhites, and relationships of shorter duration was associated with patients reporting a greater likelihood of unmet emotional needs. Network density and the proportion of daughters in patients' networks on the other hand helped minority women garner greater social support. Thus, networks of NHBlack and Hispanic patients tended to be denser than the networks of NHWhite patients, and dense networks were associated with greater likelihood of adequate practical support. Similarly, networks of minority women tended to have a higher proportion of daughters than the networks of NHWhite women, and a higher proportion of daughters was positively associated with adequate emotional support.

DISCUSSION

While the benefits of social support for breast cancer patients including improved quality of life and survival are well documented, there has been less attention on network sources of social support. Interventions involving social support have generally used two approaches: using and manipulating existing social networks to garner greater social support and generating new social

ties, often using peer support groups (Gallant, 2013). A deeper understanding of social network sources of support can inform both intervention approaches. To address the knowledge gap in the literature, one goal of this study was to broaden understanding of social network factors that are related to social support resources of breast cancer patients. Another goal was to identify factors that might be related to the racial/ethnic gap in social support among breast cancer patients. The study findings confirmed that several network factors are associated with adequacy of social support experienced by all breast cancer patients regardless of race/ethnicity. The study also confirmed a gap in social support between NHWhite and minority breast cancer patients and identified several social network, demographic, and health related mediators associated with this race/ethnicity gap in support.

Network Sources of Social Support

Prior breast cancer research suggests an association between larger networks and greater social support. Thus, Bloom 2001 found that larger networks were related to greater availability of emotional support and instrumental support (Bloom's measure of instrumental support combined practical and financial support). The study by Kroenke et al. (2013) also found provisional evidence of an association between larger networks and a broad measure of social support. While the current study improved on prior methodologies by using a more nuanced measure of social support as well as controls for additional network factors such as density and racial/ethnic heterogeneity of networks, findings in this study are consistent with prior research findings. This study found network size to be related to increased levels of practical, informational, emotional and spiritual support, thus providing cumulative evidence that larger networks benefit breast cancer patients. While 90% of the patients in the initial BCCC sample reported two or more support-providing network members, three percent of the patients reported zero support givers and seven percent reported only one support giver, confirming evidence in prior literature of a segment of socially isolated breast cancer patients (Kroenke, et al. 2006). For these patients, generating new social ties often using peer support groups will be more useful than attempts at using and manipulating existing social networks to garner greater social support (Gallant, 2013). Given mounting evidence that larger networks lead to higher levels of support, it is vital to understand the support needs of the socially isolated breast cancer patient population. It is important that future research investigate the support needs of socially isolated breast cancer patients which is an urgent public health concern.

This study also found that patients who belonged to higher density networks were more likely to report adequate practical support than patients who belonged to sparse networks. We did not test the underlying mechanisms of this association, but, arguably the normative controls and the capacity for increased coordination (Rockenbaugh & Sakdapolrak, 2017; Miguel & Gugerty, 2005) generally associated with dense networks facilitated fulfillment of patients' practical support needs. Additionally, in the study sample, networks of NHBlack and Hispanic patients tended to be denser compared to networks of NHWhite patients, which may have implications for the ability of minority patients to meet their support needs, a point further discussed below.

The importance of emotional support for managing breast cancer and other chronic illnesses is well established (Kroenke, et al. 2006; Pearce, et al. 2012). Results in this study suggest that networks consisting of a higher proportion of daughters may better meet breast cancer patients' emotional support needs. This finding is consistent with research in health and elder care (Gatuso

& Bevan, 2000; Thomeer, et al. 2013; Thomeer, et al. 2015) that have documented the importance of emotion work, defined as intentional activities done to promote another's well-being. This research found that, in families and in formal sectors such as hospitals and nursing homes, females do most of the emotion work (Erickson, 2005; Rao, 2017). Our finding that a higher proportion of daughters and relationships of longer duration help in meeting patients' emotional support needs together with research findings from emotion work provide insights into desirable caregiver qualities. This knowledge can inform public health efforts to supplement emotional support needs of breast cancer patients.

Social network literature posits that while information flows more efficiently *within* dense co-ethnic networks, heterogeneous and sparse networks facilitate the flow of new and non-redundant information *into* a network (Larson & Lewis, 2016; Putnam, 2001; Villalonga-Olives & Kawachi, 2016). New information rarely enters racially homogenous and often segregated networks, with the result that the health information circulating within such networks can be one-sided, incomplete, or outdated (Scholmerich, et al. 2016). Current findings are compatible with these predicted trends; in the current study, racially/ethnically homogeneous networks are associated with patients reporting a higher likelihood of inadequate informational support. This is concerning given the high degree of homophily (or individuals' tendency to form ties with similar others) in tie formation. Reflecting findings in the general social network literature of widespread race/ethnic homogeneity of social network ties in the U.S. (Wimmer & Lewis, 2010), social network ties of all race/ethnicity groups in this study sample were extremely homogenous with over 90% of the network membership consisting of persons of the same race/ethnicity as the patient. Again, reflecting trends in the general population (Mollica, et al. 2003), networks of NHBlack and Hispanic patients were found to be even more racially homogeneous than networks of NHWhite patients. A major barrier to formation of heterogeneous social networks, especially for NHBlacks, is residential segregation (DiPrete, et al. 2011). One possible avenue for reducing this information deficit is provided by research findings on civic participation. This research suggests that increasing participation in voluntary associations among members of segregated communities could help build more racially diverse networks that could bring an information advantage (Glanville, 2016).

Though there is reason to believe that treatment type may have implications for meeting patient support needs, in our study surgery type and adjuvant therapy received by the patient showed no clear association with adequacy of social support received. One explanation for this finding could be that the association between treatment factors and social support is bidirectional in that support availability may influence patients' treatment decisions and continued adherence to recommended treatment regimens. On the other hand, the severity of the surgery or adjuvant therapy may also influence the patient need for support and receipt of support. Many studies have found a correlation between low social support and treatment discontinuation among cancer patients (Dhotre, et al. 2016; Nonzee, et al. 2015; Reyes, et al. 2016; Huiart, et al. 2012). Several other studies have examined the correlation between treatment severity and social support by assessing levels of social support after treatment initiation, but the findings have been inconsistent. Thus, one study found that breast cancer patients who had two or more adjuvant therapies engaged in greater social support seeking behaviors (Maunsell, et al. 2009). Thompson et al. (2013) found no association between surgery type and social support 4-6 months after surgery, while Spatuzzi

et al. (2016), who assessed perceived social support after surgery, found that patients who had a lumpectomy reported greater perceived support than patients who had a mastectomy. Cross-sectional data that assessed social support received by patients between diagnosis and interview date in the current study could only test whether the treatment factors in the study were correlated with this measure of social support. A thorough understanding of the complex association between social support and treatment factors is warranted given the salience of initiation of recommended treatment and treatment completion for good prognosis on the one hand (Wells, et al. 2015) and the need to track patient support needs resulting from physical side effects and disruptions to daily activities following treatment on the other. Future research should investigate this complex association and possible bidirectionality between social support and treatment factors using longitudinal data with social support measurements before and during treatment.

Socioeconomic status (SES) is a key determinant of many health outcomes including obesity, heart disease, depression, and chronic obstructive pulmonary disease (COPD) (Everson, et al. 2002; Eisner, et al. 2010), leading to a clear socio-economic gradient in health. Given the primacy of SES for health and most other life outcomes, it is not surprising that in the current study patient SES was correlated with social support; thus, breast cancer patients with lower SES reported greater unmet need for all five social support components than patients with higher SES. This finding is consistent with findings based on general population samples indicating that lower SES individuals report lower social support than individuals with higher SES (Turner & Marino, 1994; Mickelson, et al. 2003). While we did not include SES of social network members in estimated models, based on homophily we could assume that network members of low SES patients shared the patient's deprived economic status (McPherson, et al. 2001). One theoretical perspective on the effect of SES on social support suggests that economic deprivation leads to less interaction between network members and increased conflict leading to lower social support while a competing perspective suggests that economic deprivation results in increased mobilization of social support (Roschelle, 1997). While social network ties may function as adaptive tools for overcoming challenges associated with structural barriers of economic deprivation or immigrant status (Martinez, et al. 2004; Zhou, 2005), this study confirms that social network processes cannot fully overcome the influences of foundational elements of social structure such as SES, and that marginalized, low SES groups may need additional institutional assistance.

Regarding all five support components, our findings indicated that older women were more likely to report adequate support than younger women. Previous findings on the association between age and social support have been inconsistent (Antonucci & Akiyama, 1987). In one study younger women reported greater social support than older women (Sammarco, 2009) while Turner & Marino (1994) found that social support increased with age to a point then started to decline. Further research is needed to clarify the association between age and social support, especially given evidence that social networks tend to constrict with increasing age (Arling, 1987; Boyle, et al. 2010; Fishcer, 1982).

In this study adequacy of financial support did not depend on the structural and functional characteristics of the social network. It did, however, depend on patient demographics and in large part on patient SES. Probably adequacy of financial support also depends on the average SES of the network, but this was not examined in the current study.

Racial/Ethnic Gap in Social Support

The current study revealed several racial/ethnic disparities in social support. On average, NHBlack patients reported greater unmet practical and financial support compared to NHWhite patients and Hispanic patients reported greater unmet emotional and informational need than NHWhite patients. Most prior breast cancer research points to a social support gap between minority women and white women (Arora, et al. 2007; Moadel, et al. 2006). Thus, in one study, in unadjusted models, NHBlack and Hispanic cancer patients reported greater practical, emotional, and informational need than NHWhite patients (Moadel, et al. 2006). Arora et al. (2017) also found that women of color received less helpful support following a breast cancer diagnosis than white women. However, findings have not been consistent. Thus, in one study white women reported lower perceived social support than African American women (Thompson, et al. 2013) and another study suggested that there was no difference in instrumental and emotional support among White and non-White breast cancer patients (Bloom, et al. 2001). Some of these studies did not undertake a comparison of social support differences between NHWhite, NHBlack, and Hispanic groups separately although there is reason to expect that such differences exist. The current study also adds new knowledge to the existing findings on social support, as it identifies social network and other factors that are instrumental in increasing or reducing social support for ethnic minority patients. These are possible intervention foci for boosting social support resources for minority breast cancer patients.

In our study, NHBlack and Hispanic breast cancer patients reported having denser and more interconnected networks than NHWhite patients, and greater network density was in turn associated with greater likelihood of adequate practical support. Study results also indicated that support networks of NHBlacks and Hispanics consisted of a higher number of adult daughters compared to support networks of NHWhites, and that this helped both NHBlack and Hispanic patients to meet their emotional support needs more effectively. Many studies have shown that social networks of NHBlacks and Hispanics are more likely to consist of family members than networks of NHWhite patients (Ajrouch, et al. 2001; Nguyen, 2016). The fact that social networks of minorities consist of dense, kin and extended family networks allows the pooling of economic resources and the distribution of household and care giving responsibilities (Nguyen, et al. 2016). These characteristics of collectivism and group loyalty found in extended kin networks have often been described as a form of adaptive strategy that allow vulnerable groups to overcome structural challenges (Kim & McKenry, 1998).

Our study also revealed a few racial/ethnic differences in patient's informational support needs. NHBlacks had lower information need than NHWhites while no difference in information need was observed between Hispanics and NHWhites. In public health literature, health literacy is described as an individual's capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions (Rikard, et al. 2016; Jeppesen, et al. 2009). Our findings on informational support needs are unexpected given the strong evidence that NHBlacks and both native born and foreign-born Hispanics have low health literacy compared to NHWhites (Rikard, et al. 2016). However, lower health literacy among patients is also correlated with lower *health information seeking behaviors* (Morris, et al. 2013; Sheih, et al. 2010) and possibly with lower expectations about health information. This could be a possible explanation for the low health information need observed among NHBlack patients. While heterogeneous networks are considered to have an information advantage relative to homogenous networks, social

networks in the US reflect high racial/ethnic homogeneity with networks of minorities showing even greater racial/ethnic homogeneity than networks of NHWhites. Our study also found that social networks of NHBlack patients were more racially homogenous than networks of NHWhites, and that this extreme homogeneity contributed to the greater unmet informational support needs reported by NHBlack patients compared to NHWhite patients.

The current study also confirmed that, in addition to social network factors, patient SES played a significant mediating role in the racial/ethnic gap in social support. Thus, both NHBlack and Hispanic patients reported lower SES than NHWhite patients and lower SES was associated with greater unmet practical, emotional, and informational support.

Several limitations of the current study should be noted. The study examined how patient SES might be correlated with social support resources. However, while low SES and problems of residential segregation and neighborhood safety often associated with low SES can also affect social network formation, this study did not explore these additional linkages. One methodological limitation of the study was that in assessing patients' social networks, patients were asked to think of people who provided help with companionship, prayer, information, baby-sitting, and money. This may have restricted patient responses. The study focused on social support from family and friends including co-workers, spiritual leaders, and neighbors. While physicians, nurses, and patient navigators could be a significant source of support for cancer patients (Dakof & Taylor, 1990), the current study did not collect data on these factors.

CONCLUSION

The current study identified key network metrics that either promote or reduce social support for breast cancer patients. Size of breast cancer patients' social networks had a positive effect on almost all support components while network density, racial/ethnic heterogeneity, proportion of daughters, and duration of relationships had positive effects on some of the support components. Knowledge regarding social network sources of support is useful for public health policy experts, especially when addressing the concerns of socially isolated individuals. At the same time, findings in this study highlight the primacy of macro-social conditions of economic inequality and residential segregation as challenges to health promotion, factors that social network resources can only partially overcome.

FOOTNOTES

Conflicts of interest: The authors declare that they have no conflict of interest.

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