Published in final edited form as:

Matern Child Health J. 2020 December ; 24(12): 1429–1437. doi:10.1007/s10995-020-03009-y.

Associations between social network characteristics and loneliness during pregnancy in a sample of predominantly African American, largely publicly-insured women.

Qihan Yu,
Department of Preventive Medicine, University of Southern California

Sara Mazzoni, MD, MPH,
Department of Obstetrics and Gynecology, Division of Maternal-Fetal Medicine

Marie Lauzon, MS,
Cedars-Sinai Medical Center

Alena Borgatti, MA,
Department of Preventive Medicine, University of Alabama at Birmingham

Nenette Caceres, MS,
Research Center for Health Equity, Cedars-Sinai Medical Center

Sydney Miller,
Department of Preventive Medicine, University of Southern California

Gareth Dutton, PhD,
Department of Preventive Medicine, University of Alabama at Birmingham

Sarah-Jeanne Salvy, PhD
Research Center for Health Equity, Cedars-Sinai Medical Center 700 N. San Vicente Blvd., West Hollywood, CA 90069

Abstract

Objectives: Most research evaluating relationships between social network attributes and loneliness have focused on older adult and adolescent networks. The present study examines the relationships between social network size (number of relationships), social network density (whether named relationships are connected to one another) and maternal loneliness during pregnancy.

Methods: Eligible women were enrolled at the time of their dating ultrasound (between 8 and 12 weeks of gestation). Interested women provided written consent and completed demographic, social network and loneliness measures. Participants completed the same surveys in their third

CORRESPONDING AUTHOR Phone: 310-423-6423;, sarah.salvy@cshs.org.

trimester. Mixed-regression models, adjusted for age, race, ethnicity, and insurance type, were used to assess the relationship between social network size, network density, and loneliness.

Results: A total of 94 pregnant women (mean age= 23.77, 70.2% Black, 87.2% public insurance) completed baseline study measures, and 60 participants completed both assessment time points. Completers and non-completers did not differ on key characteristics. Social network density, but not social network size, predicted maternal loneliness (β= −1.27, 95%CI −2.53, −0.01, p= 0.0489) in the first and third trimester.

Conclusions: These findings indicate that pregnant women's social network density may be more intimately related to feelings of loneliness than the objective number of relationships. This knowledge can begin to inform the design of supportive approaches to improve women's health.

Keywords

social networks; loneliness; pregnancy; isolation; network density

Introduction

There is compelling evidence that social relationships are beneficial to physical and emotional health (Christakis & Fowler, 2007; Holt-Lunstad & Smith, 2016; Holt-Lunstad, Smith, & Layton, 2010; Uchino, 2006). Meaningful relationships may be especially critical during pregnancy in providing emotional and instrumental support (Reid & Taylor, 2015). However, changes in lifestyle, daily activities, and pregnancy-related symptoms (e.g., fatigue, nausea) may disrupt or displace social relationships, increasing a pregnant woman's vulnerability to feelings of loneliness (Rokach, 2007). This is concerning because lack of perceived social support during pregnancy is associated with negative maternal and infant outcomes, including lower birthweight, preterm delivery and postpartum depression (Feldman, Dunkel-Schetter, Sandman, & Wadhwa, 2000; Morikawa et al., 2015). Maternal loneliness during pregnancy has also been linked to adverse health outcomes in children, such as respiratory tract infections and depression (Luoma, Korhonen, Puura, & Salmelin, 2019; Schuez-Havupalo et al., 2018), suggesting that a woman's social health may affect the physical and psychosocial health states of her children longitudinally. In contrast, studies suggest that perceived social support can protect against and mitigate prenatal stress and anxiety (Duman & Kocak, 2013; Emmanuel, St John, & Sun, 2012).

An oft-debated question is whether social network size is related to the feeling of loneliness (Green, Richardson, Lago, & Schatten-Jones, 2001; Hawkley et al., 2008; Lee & Ko, 2018). Social network size is operationalized as the total number of individuals (alters) someone lists as part of their social networks, and social isolation is the objective and quantifiable lack of social relationships and paucity of social contacts (Beller & Wagner, 2018; Cornwell & Waite, 2009; De Jong Gierveld, van Tilburg, & Dykstra, 2006; McHugh, Steptoe, Kee, & Lawlor, 2019; Steptoe, Shankar, Demakakos, & Wardle, 2013). By contrast, loneliness is defined as the distressing feeling that accompanies the perception that one's social needs are not being met by the quantity or quality of one's social relationships (Hawkley et al., 2008; Weeks, 1994; Wheeler, Reis, & Nezlek, 1983). The relative independence of social network size and loneliness is supported by the weak correlations between these constructs observed

in a number of studies (McHugh, Kenny, Lawlor, Steptoe, & Kee, 2016). In other words, someone may have a large social network and feel lonely or be objectively socially isolated and not feel lonely.

If the social environment of the lonely does not differ *quantitatively* from the social milieu of the non-lonely, is loneliness associated with structural characteristics of the social network? One network attribute susceptible to influence loneliness is network cohesion or density. Social network density refers to the degree to which members of a respondent's social network are themselves interconnected. A network with high-density indicates that each alter in a network is connected to other relationships. By contrast, in a sparse social network, the respondent's relationships are themselves strangers, leaving individuals feeling "alone in a crowd" rather than embedded in an integrated and tightly-knit social web (Cacioppo, Fowler, & Christakis, 2009; Falci & McNeely, 2009). If conflicts occur between individuals in a dense network, social support is maintained because conflicted parties remain connected through shared ties. By contrast, if conflicts occur in a sparse network, the conflicted relationship is likely to disappear in absence of alternative sustaining tie. Perhaps high-density networks provide people with a sense of community, a sense of belonging to a group, which tempers feelings of loneliness. As a group, the social network may also be better able to meet one's social needs.

Simultaneously examining social network size, social network cohesion (density) and loneliness may provide important insights that could not be gained from examining these concepts individually (Newall & Menec, 2019). Most research evaluating these relationships comes from examinations of older adult and adolescent networks. The present study examines the relationship between social network characteristics and loneliness during pregnancy. We were particularly interested in examining whether women's social network size (quantifiable number of relationships) or social network density (whether named relationships are connected to one another) predict loneliness during pregnancy. This knowledge can begin to inform the design of supportive approaches to improve women's and infant health, as interventions aimed at increasing social contacts may differ from those fostering social cohesion among existing ties.

Methods

Participants

Participants were recruited through four obstetric clinics at The University of Alabama at Birmingham (UAB). Patient medical records were reviewed to determine eligibility. Pregnant women between the age of 18 and 40, without a diagnosis of severe mental illness (e.g., schizophrenia) and who were able to communicate in English were considered eligible. Mothers with a previous diagnosis of a psychiatric disorder and those with current depression and/or anxiety were eligible.

Procedures

Eligible women were approached by a female research assistant at the time of their dating ultrasound (between 8 and 12 weeks of gestation). Patients were provided with details about

the study and interested individuals were asked to provide written consent prior to completing their first interview. The first assessment was conducted in a large urban university hospital (University of Alabama at Birmingham Hospital) where dating ultrasounds were conducted. The university hospital serves a large network in which patients most often receive care in suburban neighborhood clinics. Participants completed their second interview in their third trimester or within a month of their scheduled due date. Based on participants' preferences, the second interview occurred at the main hospital or in their neighborhood clinic. As much as possible, follow-up interviews were scheduled to coincide with routine clinic visits in the participant's third trimester. If participants did not have a phone or did not answer calls, research assistants referenced patient electronic health records and were available to complete the second interview following participants' scheduled prenatal appointments. Participants were compensated with a $10 gift card for completing the first interview and a $15 gift card for completing the second interview. All procedures were approved by the University of Alabama at Birmingham Institutional Review Board.

Measures

Social Network Attributes.—Social network characteristics were assessed using egocentric social network methods (Carrington, Scott, & Wasserman, 2006) and EgoWeb software (McCarty, 2002; McCarty, Killworth, & Rennell, 2007). Using standard name generator items (Marsden, 2005; McCarty et al., 2007), participants (egos) were asked to "*list up to 20 individuals whom they considered to be the most important people in their lives, and with whom they had regular contact face-to-face, by phone, or other online communication.*" Participants who initially listed less than 10 alters were prompted to think of other potential relationships they could have omitted. During the second interview, participants completed the same name generating procedure and survey questions, and they were then given the list of alters they generated in their first interview and asked to specify which alters previously listed appeared in their second list as well. Follow-up questions ensued when discrepancies occurred (e.g., "*You previously listed your boyfriend Bob, but I don't see his name on the second list. Is Bob still in your life?*").

Social network size is operationalized as the total number of alters that participants listed in their social networks. Social network density, or connections between alters, was assessed by asking participants whether each alter in their network was connected to other alters. Specifically, the interviewer stated: "*I'm going to give you two of the names of people you listed earlier and ask you to indicate if they know each other*". When participants requested clarification, the interviewer rephrased the question as followed "*Have these people met or have a relationship with each other*". The overall connectivity of their personal network was summarized by a density statistic that represents the proportion of participants' alters that were socially connected (i.e., the number of alter-alter pairs who knew each other) relative to the total number of possible ties among all alters (i.e., the total number of alter-alter pairs). High social network density indicates that one's social network is highly interconnected (everyone knows everyone else), while low social network density characterizes a disconnected social network (non-shared relationships).

Loneliness.—Loneliness was assessed using the UCLA 3-Item Loneliness Scale (Mary Elizabeth Hughes, Linda J. Waite, Louise C. Hawkley, & John T. Cacioppo, 2004; M. E. Hughes, L. J. Waite, L. C. Hawkley, & J. T. Cacioppo, 2004). Participants reported on how often they felt that they "lack companionship", are "left out", and are "isolated from others" (3=often, 2=some of the time, 1=hardly ever or never). Responses to all items were averaged to create a composite loneliness score (range: 3-9) with higher values indicating greater loneliness (Luo, Hawkley, Waite, & Cacioppo, 2012). This scale has been used in previous longitudinal studies (Luo et al., 2012) and shows good internal consistency, as well as concurrent and discriminant validity (M. E. Hughes et al., 2004).

Statistical Analyses

Descriptive statistics of sample characteristics and study variables were calculated. We further compared participants who completed both timepoints and those who only completed the first assessment to evaluate if completers and non-completers differ on key baseline characteristics. Appropriate p-values were calculated either with two-sample t-test or Wilcoxon rank-sum for continuous variables, and either chi-square or fisher's for categorical variables.

Mixed-regression models with random intercept for loneliness and fixed effects for social network size and density were used to assess the relationship between predictors (network size and density) and outcome (loneliness). In mixed-regression models, each participant is included twice, and the use of a subject-specific random intercept acknowledges that different subjects are modeled independently. The random intercept essentially tells the model that it should expect multiple responses (in our case visits) per participant and that these responses will depend on each subject's baseline level. This effectively resolves the non-independence issue stemming from multiple responses by the same participant. The time variable (time 1 vs. time 2) was initially entered in the models using fitting interactions to evaluate whether the relationships between predictors and outcomes differed across timepoints. All models were adjusted for age, race, ethnicity, and insurance type (private vs. public). All statistical analyses were performed using SASv9.4. Statistical significance was established as $p<0.05$.

Results

Of the 94 participants who completed the first interview, 60 completed the second interview (Figure 1). Main reasons for attritions included (1) unable to contact participants until after delivery (no longer eligible for the study); (2) delivered early, (3) miscarriage, (4) transferred care or moved, (5) no-longer interested in participating; (6) did not return calls or attend clinic appointments in their last trimester (Figure 1).

Table 1 summarizes participants' baseline characteristics and descriptive statistics for the overall sample and among participants who completed both assessments (completers) and those who only completed the first assessment (non-completers). Completers did not differ from non-completers on any of the variables of interest at baseline. Participants were relatively young and over two-thirds of the sample was Black/African American (70.2%). A majority of participants had public insurance (87.2%). The range of loneliness scores at

baseline was similar among completers and non-completers (range = 3-8), and mean scores were comparable among completers and non-completers (Table 1). On average, participants reported having nine meaningful relationships (M = 9.08, SD = 3.92, range = 3-20), and fairly dense social networks (M = 0.89, SD = 0.16, range = 0.2-1.0). In other words, on average, 89% of alters listed by participants knew each other. Prototypical high- and low-density social networks are depicted in Figure 2 for illustrative purposes.

Network characteristics by assessment timepoint among participants who completed both assessments (n=60) are shown in Table 2. Assessment timepoint (time) was not a significant predictor of loneliness, and time did not qualify the relationships between social network density and loneliness or between size and loneliness (all $p>0.5$). Social network density and social network size were not significantly correlated at time 1 ($r = -0.1520$, $p = 0.14$) or time 2 ($r = 0.1257$, $p = 0.34$). Social network size was not significantly associated with maternal loneliness ($\beta = 0.017$; 95% CI −0.041, 0.076; $p = 0.5555$). However, social network density was inversely related to maternal loneliness ($\beta = -1.267$; 95% CI −2.527, −0.006; $p < 0.0489$). In other words, participants who reported more interconnected social networks also reported feeling less lonely.

Discussion

To our knowledge, this is the first study to examine the association between social network characteristics and maternal loneliness during pregnancy. It is clear from the data that the number of relationships mothers have during pregnancy is, at best, weakly related to the feeling of loneliness. In other words, women who listed more relationships did not feel less lonely than women who listed fewer important others. These results extend previous findings indicating that the size of one's social network is a poor predictor of loneliness (Hawkley et al., 2008; Peplau, 1982; Pressman et al., 2005). By contrast, pregnant women embedded in dense networks- in which members were interconnected- reported feeling less lonely. These findings are consistent with research in other populations linking social network density and feelings of loneliness (Jones, 1981, 1982; Stokes, 1985). It is possible that these high-density networks provide women with a sense of belonging and community, thereby buffering feelings of loneliness. Dense social networks may further help provide more coordinated support and resources during pregnancy than relationships who are not as interconnected.

Consistent with previous work, network size was not significantly correlated with social network density, suggesting that these network dimensions are relatively independent. It is worth noting however that, in the first trimester, network size was inversely related to density (albeit not significantly), which suggest that larger networks were less interconnected than smaller ones (and vice versa). Although these correlations were not statistically significant, relationships that are not well interconnected in one's social network may conceivably be more effortful to maintain during pregnancy or more promptly abandoned.

This study is not without limitations and these findings should be considered exploratory. Our sample was small, and a sizable number of participants did not complete the second

interview. The limited sample size not only prevents generalization, but also precluded consideration of additional potential confounders in our analyses. Although our analytic models controlled for race, ethnicity, maternal age and insurance, other factors such as maternal depression and overall health likely qualify these findings. The sample was also fairly homogenous, with a majority of participants who were younger, publicly-insured, African American women. Replications with larger samples of women in the US and worldwide are warranted as our findings may not be applicable to other obstetric settings. Finally, loneliness scores were relatively low among mothers surveyed. The finding that dense social network is associated to lower loneliness may not extend to mothers who are very lonely. Nevertheless, the variability in loneliness scores (range = 3-8) and social network density (20% - 100%) were sufficient to detect the previously documented association between network density and loneliness in non-pregnant individuals (Jones, 1981, 1982; Stokes, 1985).

Despite these limitations, our findings provide initial insights on the association between social network interconnectedness and maternal loneliness during pregnancy. This knowledge furthers our understanding of the role of social network attributes on maternal subjective well-being. Efforts to strengthen maternal social networks may include hybrid models of share medical appointment, as well as family systems approaches fostering the involvement of meaningful others in prenatal care.

References

Beller J, & Wagner A (2018). Loneliness, social isolation, their synergistic interaction, and mortality. Health Psychology, 37, 808–813. [PubMed: 30138019]

Cacioppo JT, Fowler JH, & Christakis NA (2009). Alone in the crowd: The structure and spread of loneliness in a large social network. Journal of Personality and Social Psychology, 97, 977–991. [PubMed: 19968414]

Carrington PJ, Scott J, & Wasserman S (2006). Models and Methods in Social Network Analysis. New York, NY: Cambridge University Press.

Christakis NA, & Fowler JH (2007). The spread of obesity in a large social network over 32 years. New England Journal of Medicine, 357, 370–379. [PubMed: 17652652]

Cornwell EY, & Waite LJ (2009). Social disconnectedness, perceived isolation, and health among older adults. Journal of Health and Social Behavior, 50, 31–48. [PubMed: 19413133]

De Jong Gierveld J, van Tilburg TG, & Dykstra PA (2006). Loneliness and social isolation In Perlman D & Vangelisti A (Eds.), The Cambridge handbook of personal relationships (pp. 485–500). Cambridge: Cambridge University Press.

Duman NB, & Kocak C (2013). The effect of social support on state anxiety levels during pregnancy. Social Behavior and Personality, 41, 1153–1163.

Emmanuel E, St John W, & Sun J (2012). Relationship between social support and quality of life in childbearing women during the perinatal period. Journal of Obstetric, Gynecologic & Neonatal Nursing, 41, E62–E70.

Falci C, & McNeely C (2009). Too Many Friends: Social Integration, Network Cohesion and Adolescent Depressive Symptoms. Social Forces, 87, 2031–2061.

Feldman PJ, Dunkel-Schetter C, Sandman CA, & Wadhwa PD (2000). Maternal social support predicts birth weight and fetal growth in human pregnancy. Psychosomatic Medicine, 62, 715–725. [PubMed: 11020102]

Green LR, Richardson DS, Lago T, & Schatten-Jones EC (2001). Network correlates of social and emotional loneliness in young and older adults. Personality and Social Psychology Bulletin, 27, 281–288.

Hawkley LC, Hughes ME, Waite LJ, Masi CM, Thisted RA, & Cacioppo JT (2008). From social structural factors to perceptions of relationship quality and loneliness: the Chicago health, aging, and social relations study. Journal Gerontology, Series B: Psychological Sciences and Social Science, 63, S375–384.

Holt-Lunstad J, & Smith TB (2016). Loneliness and social isolation as risk factors for CVD: implications for evidence-based patient care and scientific inquiry. Heart, 102, 987–989. [PubMed: 27091845]

Holt-Lunstad J, Smith TB, & Layton JB (2010). Social relationships and mortality risk: a meta-analytic review. PLoS Med, 7, e1000316. [PubMed: 20668659]

Hughes ME, Waite LJ, Hawkley LC, & Cacioppo JT (2004). A Short Scale for Measuring Loneliness in Large Surveys. Research on Aging, 26, 655–672. [PubMed: 18504506]

Hughes ME, Waite LJ, Hawkley LC, & Cacioppo JT (2004). A short scale for measuring loneliness in large surveys: results from two population-based studies. Research on Aging, 655–672. [PubMed: 18504506]

Jones WH (1981). Loneliness and social contact. Journal of Social Psychology, 113, 295–296.

Jones WH (1982). Loneliness and social behavior In Peplau LA & Perlman D (Eds.), Loneliness: A sourcebook of current theory, research and therapy (pp. 238–254). New York: Wiley.

Lee Y, & Ko Y.-g. (2018). Feeling lonely when not socially isolated: Social isolation moderates the association between loneliness and daily social interaction. Journal of Social and Personal Relationships, 35, 1340–1355.

Luo Y, Hawkley LC, Waite LJ, & Cacioppo JT (2012). Loneliness, health, and mortality in old age: a national longitudinal study. Social Science and Medicine, 74, 907–914. [PubMed: 22326307]

Luoma I, Korhonen M, Puura K, & Salmelin RK (2019). Maternal loneliness: concurrent and longitudinal associations with depressive symptoms and child adjustment. Psychology of Health and Medicine, 24, 667–679.

Marsden P (2005). Recent Developments in Network Measurement Ω In Carrington PJ, Scott J, & Wasserman S (Eds.), Models and Methods in Social Network Analysis (pp. 8–30): Cambridge University Press.

McCarty C (2002). Structure in personal networks. Journal of Social Structure, 3, 20.

McCarty C, Killworth PD, & Rennell J (2007). Impact of methods for reducing respondent burden on personal network structural measures. Social Networks, 29, 300–315.

McHugh PJE, Kenny RA, Lawlor BA, Steptoe A, & Kee F (2016). The discrepancy between social isolation and loneliness as a clinically meaningful metric: findings from the Irish and English longitudinal studies of ageing (TILDA and ELSA). International Journal of Geriatric Psychiatry, 3, 664–674.

McHugh PJE, Steptoe A, Kee F, & Lawlor B (2019). Loneliness and social engagement in older adults: A bivariate dual change score analysis. Psychology of Aging, 34, 152–162.

Morikawa M, Okada T, Ando M, Aleksic B, Kunimoto S, Nakamura Y, … Hayakawa N (2015). Relationship between social support during pregnancy and postpartum depressive state: a prospective cohort study. Scientific Reports, 5, 10520. [PubMed: 26022720]

Newall N, & Menec VH (2019). Loneliness and social isolation of older adults: Why it is important to examine these social aspects together. . Journal of Social and Personal Relationships, 36, 925–939.

Peplau LA (1982). Loneliness: A sourcebook of current theory, research, and therapy (Vol. 36): John Wiley & Sons Inc.

Pressman SD, Cohen S, Miller GE, Barkin A, Rabin BS, & Treanor JJ (2005). Loneliness, social network size, and immune response to influenza vaccination in college freshmen. Health Psychology, 24, 297–306. [PubMed: 15898866]

Reid KM, & Taylor MG (2015). Social support, stress, and maternal postpartum depression: A comparison of supportive relationships. Social Science Research, 54, 246–262. [PubMed: 26463547]

Rokach A (2007). Self-perception of the antecedents of loneliness among new mothers and pregnant women. Psychological Reports, 100, 231–243. [PubMed: 17451030]

Schuez-Havupalo L, Lahti E, Junttila N, Toivonen L, Aromaa M, Rautava P, … Raiha H (2018). Parents' depression and loneliness during pregnancy and respiratory infections in the offspring: A prospective birth cohort study. PLoS One, 13, e0203650. [PubMed: 30192872]

Steptoe A, Shankar A, Demakakos P, & Wardle J (2013). Social isolation, loneliness, and all-cause mortality in older men and women. Proceedings of the National Academy of Science, 110, 5797–5801.

Stokes JP (1985). The relation of social network and individual difference variables to loneliness. Journal of Personality and Social Psychology, 48, 981.

Uchino BN (2006). Social Support and Health: A Review of Physiological Processes Potentially Underlying Links to Disease Outcomes. Journal of Behavioral Medicine, 29, 377–387. [PubMed: 16758315]

Weeks DJ (1994). A review of loneliness concepts, with particular reference to old age. .International Journal of Geriatric Psychiatry, 9, 345–355.

Wheeler L, Reis H, & Nezlek J (1983). Loneliness, social interaction, and sex roles. Journal of Personality and Social Psychology, 45, 943–953. [PubMed: 6631669]

Significance

What is already known on this subject?

Social relationships are beneficial to physical and emotional health. Perceived lack of social support during pregnancy is associated with negative maternal and infant outcomes.

What this study adds?

Social network density, but not network size, is a predictor of loneliness during pregnancy. Interventions fostering increased social cohesion among existing relationships may be more beneficial to prevent maternal loneliness than approaches aiming at developing new relationships.

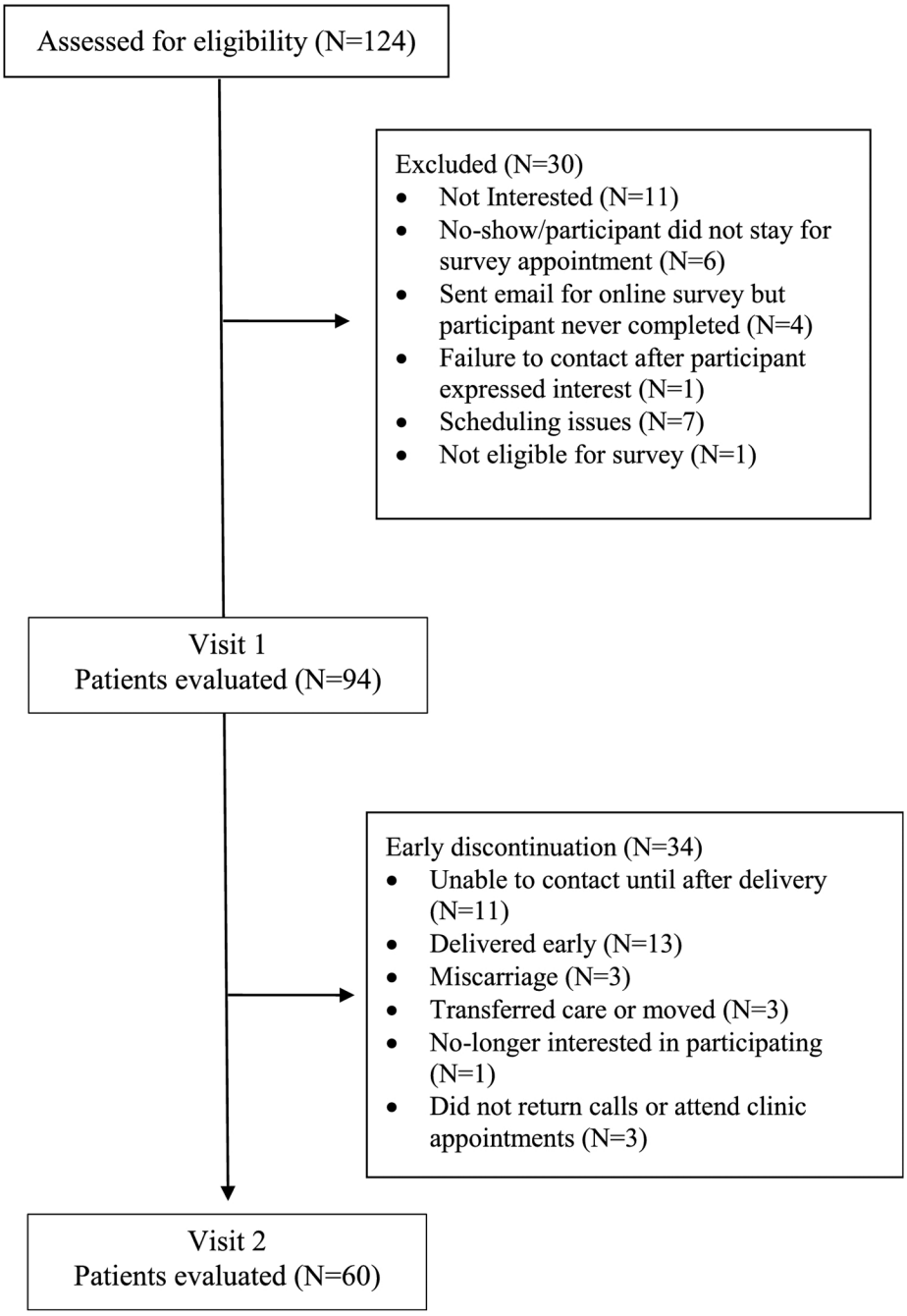

Figure 1.
Participant Flow Diagram

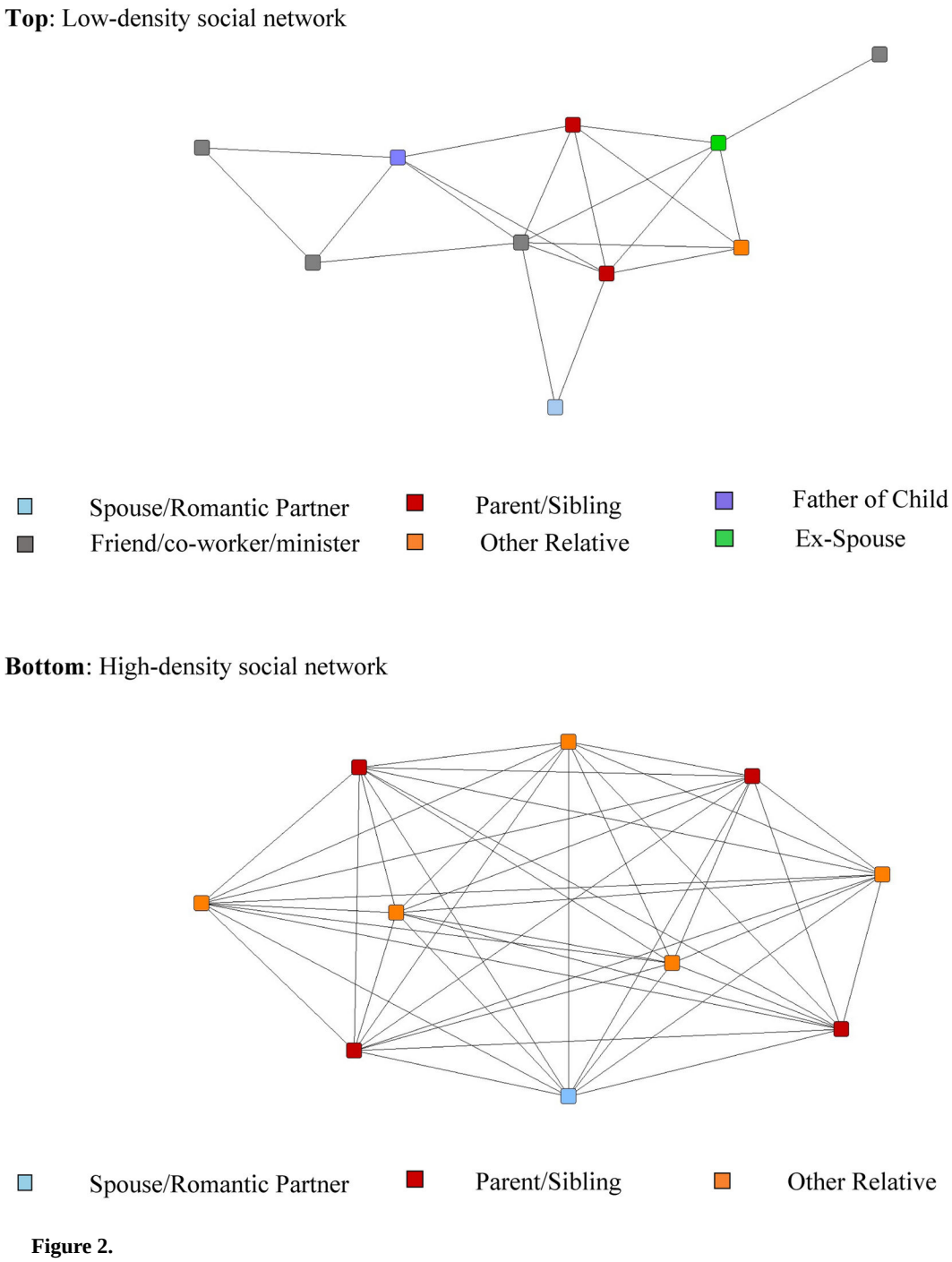

Figure 2.

Examples of low- (top) and high- (bottom) density social networks. In a sparse social network, the degree of interconnectedness among a mother's social contacts is low (few people known each other). In a high-density network, the mother has a high number of ties who have relationships with each other.

Table 1.

Participants' baseline characteristics and descriptive statistics for the overall sample and among participants who completed both assessments (completers) and those who only completed the first assessment (non-completers).

Data are mean ± SD or *n* (%) Overall (n=94) Completers (n=60) Non-completers (n=34) p-value [*]

Demographics				
Age	23.77 ± 4.42	24.2 ± 4.8	23.1 ± 3.6	0.4833
Public insurance	82 (87.2%)	53 (88.3%)	29 (85.3%)	0.5884
Race and Ethnicity				
Black	66 (70.2%)	40 (66.7%)	26 (76.5%)	0.6536
White	20 (21.3%)	14 (23.3%)	6 (17.6%)	
Other	8 (8.5%)	6 (10%)	2 (5.9%)	
Relationship Status				
Married or living partner	46 (48.9%)	31 (51.7%)	16 (47.1%)	0.6323
Partner (not living together)	31 (33.0%)	20 (33.3%)	11 (32.4%)	
Separated or divorced	3 (3.19%)	2 (3.3%)	1 (2.9%)	
Single	13 (13.8%)	7 (11.7%)	6 (17.6%)	
Mental Health				
Prior psychiatric diagnosis	23 (24.5%)	14 (23.3%)	9 (26.5%)	0.7339
Depression	13 (13.8%)	7 (11.7%)	6 (17.6%)	0.5360
Anxiety	12 (12.8%)	9 (15.0%)	3 (8.8%)	0.5265
Loneliness	4.0 ± 1.5	4.1 ± 1.6	4.0 ± 1.4	0.5807
Network characteristics				
Network size	9.08 ± 3.92	9.3 ± 3.5	9.4 ± 3.9	0.8423
Network density	0.89 ± 0.16	0.9 ± 0.1	0.9 ± 0.2	0.9837
Female	497 (61.7%)	321 (62.0%)	176 (61.3%)	0.8569
Frequency of contact				
≤1-3 times per month	103 (13.0%)	61 (12.0%)	42 (14.7%)	0.4472
1-3 times per week	200 (25.2%)	129 (25.3%)	71 (24.8%)	
Daily or almost daily	492 (61.9%)	319 (62.7%)	173 (60.5%)	
Relationship closeness				
Not very / somewhat close	131 (16.3%)	91 (17.6%)	40 (13.9%)	0.0920
Very / extremely close	675 (83.7%)	427 (82.4%)	248 (86.1%)	
Relationship type				
Other relatives	210 (24.1%)	135 (23.9%)	75 (24.4%)	0.1610
Sibling	174 (19.7%)	124 (22.0%)	50 (16.3%)	
Parents or stepparents	142 (16.3%)	93 (16.5%)	49 (16.0%)	
Friends	124 (24.7%	71 (12.6%)	53 (17.3%)	
Spouse or partner	78 (8.9%)	51 (9.0%)	27 (8.8%)	

Demographics				
In-laws	61 (7.0%)	43 (7.6%)	18 (5.9%)	
Ex-spouse (current / previous child father)	16 (1.8%)	5 (0.9%)	11 (3.6%)	
Minister, priest or clergy	4 (0.5%)	2 (0.4%)	2 (0.7%)	

* p-values were calculated with two-sample t-test or Wilcoxon rank-sum for continuous variables, and chi-square or fisher's for categorical variables.

Table 2.

Network characteristics by assessment timepoint among participants who completed both assessments (n=60).

Data are n (%)	**Time 1**	**Time 2**
Network size	9.28 ± 3.46	8.67 ± 4.35
Network density	0.87 ± 0.17	0.92 ± 0.14
Female	321 (62.0%)	280 (60.5%)
Frequency of contact		
≤1-3 times per month	61 (12.0%)	56 (12.1%)
1-3 times per week	129 (25.3%)	123 (26.6%)
Daily or almost daily	319 (62.7%)	284 (61.3%)
Relationship closeness		
Not very or somewhat close	91 (17.6%)	68 (14.7%)
Very or extremely close	427 (82.4%)	395 (85.3%)
Relationship type		
Other relatives	135 (23.9%)	118 (22.4%)
Sibling	124 (22.0%)	106 (20.2%)
Parents/stepparents	93 (16.5%)	86 (16.3%)
Friends	71 (12.6%)	78 (14.8%)
Spouse/partner	51 (9.0%)	54 (10.3%)
In-laws	43 (7.6%)	35 (6.7%)
Ex-spouse (current / previous child father)	3 (0.5%)	3 (0.6%)
Minister, priest or clergy	2 (0.4%)	2 (0.4%)