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ORIGINAL ARTICLE

Rural residence and risk for perinatal depression: a Canadian pilot study

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Abstract Few studies have examined whether rural residence is associated with increased or decreased risk for postpartum depression (PPD). To address this research gap, this pilot study examined rates of depressive symptoms and perceived social support among women living in rural (population <10,000), semi-rural (population 10,000–20,000), and urban (downtown Toronto, population approximately 2.5 million) areas. Women were consecutively recruited at 25–35 weeks gestation from midwifery clinics and hospital-based prenatal care practices in two catchment areas and asked to complete a demographic questionnaire including postal code. On the basis of their responses, rural, semi-rural, and urban mothers were contacted by telephone at 36 weeks gestation (baseline) and 6–8 weeks postpartum (primary outcome). During each assessment, participants completed standardized measures of social connectedness, mental health, and health service utilization, including the Edinburgh Postnatal Depression Scale (EPDS) and the Medical Outcome Study Social Support Scale. A total of 87 participants [N=23 rural (R), N=23 semi-rural (SR), N=41 urban (U)] were recruited into the study. There were no statistically significant differences between groups in mean EPDS scores during pregnancy (U=7.1, SR=5.3, R=5.3, p=0.15) or at 6 weeks postpartum (U=5.3, SR=4.4, R=4.2, p=0.43). The proportion of women with EPDS scores >12 similarly did not differ between groups. There were few statistically significant differences between groups on indicators of social connectedness; however, urban women reported significantly lower scores on measures of social network diversity and social capital than either the semi-rural or rural groups. This pilot study is limited by its small sample size; however, our data do not support the hypothesis that there are clinically important differences in risk for PPD associated with rural residence. Further studies examining potential relationships between indicators of social connectedness and perinatal mental health may be warranted.

Keywords Postnatal depression · Pregnancy · Rural health · Support · Social · Social networks

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Introduction

Approximately 13% of women experience symptoms of depression following delivery, a condition commonly known as PPD (Gaynes et al. 2005; O'Hara and Swain 1996; Pearlstein et al. 2009). Although less well-studied, depression during pregnancy is now understood to be as prevalent as PPD (Bennett et al. 2004; Gaynes et al. 2005; Marcus and Heringhausen 2009). Depression during the perinatal period has been associated with serious negative outcomes for both mother and baby, particularly if untreated (Brand and Brennan 2009).

Few studies have examined whether rural residence is associated with increased or decreased risk for PPD. This is particularly significant in the Canadian context, considering that approximately 30% of the Canadian population lives in rural or remote communities (du Plessis et al. 2001). This was reflected in a recent population-based survey of maternity care in Canada, in which approximately 30% of births occurred outside of a census metropolitan area (Public Health Agency of Canada 2009). However, in a recent review, we identified 19 studies examining a potential relationship between rural residence and risk for PPD; of these, none were conducted in Canada (Villegas et al. 2010). Further, available studies from countries with potentially comparable rural populations (i.e., Australia, New Zealand, and the United States) have provided conflicting prevalence estimates. Significantly lower rates (Astbury et al. 1994) and non-significantly higher rates (Johnstone et al. 2001; Bilszta et al. 2008) of PPD (as variously defined by the authors, typically as an elevated score on a symptom measure) have both been reported. Variable definitions of "rural" may have contributed to these inconsistencies. For example, the only study to report lower rates of PPD compared women with metropolitan to non-metropolitan residences (OR=0.54, 95% CI 0.33–0.90) (Astbury et al. 1994). Additional studies, using small convenience samples, have reported high rates of PPD among rural women (e.g., 19.9% (Reighard and Evans 1995); 23% (Baker et al. 2005; Baker and Oswalt 2008); 58% (Griepsma et al. 1994)) but have not included a non-rural comparison group.

In the general population, data are also mixed regarding a potential relationship between rural residence and depression (Blazer et al. 1994; Carragher et al. 2009; Kessler et al. 1994; Kovess et al. 1987; Neff 1983; Parikh et al. 1996; Romans-Clarkson et al. 1990). For example, Canadian data drawn from the National Population Health Survey (1998–1999) found that rural men and women were significantly less likely to have a major depressive episode than were urban participants (OR=0.80, 95% CI, 0.62, 0.97) (Wang 2004). However, this study defined "rural" as any area that did not meet the definition for urban, potentially masking any differences that could exist between individuals living in rural and semi-rural communities. In a recent Canadian study of depression among older adults, rural residence (population <20,000) was weakly protective against development of depressive symptoms during a 5-year period; however, this protective effect was not statistically significant after adjustment for potentially confounding variables, including sex and self-rated health (St John et al. 2009).

There are some data to suggest that levels of social support and community connectedness may vary depending on one's geographic locale. For example, some researchers have suggested that people in rural communities may be more likely than their urban counterparts to have immediate family close by and to be willing to use family and friends for help and support (Amato 1993). Indeed, in a large population-based survey of Canadians, those living in rural communities reported significantly higher levels of community belonging than did those living in urban areas (Statistics Canada 2005). This is important when considering risk for PPD, since lack of social support has been well established in meta-analyses as one of the strongest risk factors for this condition (Beck 2001; O'Hara and Swain 1996; Robertson et al. 2004). However, many rural women in Canada are geographically isolated from family and others within their own communities as a result of low population density. In addition, there is evidence that relative newcomers to tight-knit rural communities may find them difficult to penetrate and thus perceive limited social support (Bourgeault et al. 2006). Additional research is therefore needed to examine the potential association between various indicators of social connectedness and PPD in Canadian rural communities.

In order to address this research gap, we conducted a longitudinal pilot study. The objectives were: (a) to compare depressive symptomatology during pregnancy and the early postpartum period between three geographically distinct groups of Canadian women: women living in rural communities, women living in small, semi-rural communities, and women living in a major urban center; and (b) to explore the potential relationship between rural residence and various indicators of social connectedness during pregnancy and the postpartum period, in order to examine whether these variables might account for any differences in depressive symptomatology between the three geographic groups.

Methods

Participants

The study sample was composed of three groups of pregnant women: rural, semi-rural, and urban. The rural

group included women living in communities in Grey, Bruce, and Simcoe Counties, Ontario with a population <10,000, consistent with other research on rural health. There is no consensus with regard to how "rural" should be defined; indeed, Statistics Canada analysts have used at least six different definitions in their work and recommend that the definition used be determined on the basis of the research question being asked (du Plessis et al. 2001). However, as a benchmark, du Plessis et al. (2001) recommend the "rural and small town" definition, which refers to the population of communities living outside of the commuting zone of centers with population >10,000. Grey, Bruce, and Simcoe Counties include only three centers with population >10,000: Collingwood (population 17,290), Wasaga Beach (population 15,029), and Owen Sound (population 21,753). Our definition of rural is therefore slightly more inclusive than the Statistics Canada benchmark definition, in that women living outside of these three centers but within commuting distance would be classified as "rural".

Since lower rates of depression have been reported when the definition of "rural" includes non-metropolitan communities, women living in small, "semi-rural" communities were included as a comparison group, in order to determine whether prevalence of depression differed between rural participants and those living in a non-metropolitan, non-rural community. Although Statistics Canada has defined a "non-metropolitan area" as one with population ≥50,000 (du Plessis et al. 2001), we wished to examine the experiences of women living in smaller, non-rural communities, and therefore defined our semi-rural group to include women living in Collingwood and Wasaga Beach, Ontario (populations >10,000 and <20,000). Finally, the urban group included women living in Toronto, a major metropolitan center in Canada of population over 2.5 million. This is consistent with the Statistics Canada definition of a census metropolitan area having an urban core population of ≥100,000 (du Plessis et al. 2001).

Recruitment

Two catchment areas were selected to maximize recruitment of the three populations: (a) Grey Bruce/Simcoe counties in Ontario including a hospital (Collingwood General and Marine Hospital) and a midwifery clinic (Midwives Grey Simcoe); and (b) Toronto, including a teaching hospital (St. Michael's Hospital) and a midwifery clinic (Midwives Collective of Toronto).

Consecutive women attending prenatal care at 25–35 weeks gestation were asked to complete a brief demographic questionnaire including information about place of residence and postal code, as well as a space to provide contact information if interested in learning about the study. Completed questionnaires were retrieved weekly from each recruitment site, and eligible participants who provided contact information were telephoned by a female research coordinator to inform them about the study and ask for consent to participate. Those who consented were mailed consent forms to be signed and returned in an enclosed stamped and self-addressed envelope.

In order to be eligible to participate in the study, women must have had telephone access. Women less than 16 years of age and those who were not sufficiently fluent in English or Spanish to understand the consent form and study materials were excluded from the study. Women who did not deliver a healthy term infant (i.e., in cases where the infant required hospital admission at birth) were excluded from the study at follow-up.

Recruitment at the rural sites ran from December 2007 until August 2008, while at the Toronto sites, it ran from February 2008 to January 2009. From the 1,039 questionnaires distributed to all sites, 705 (68%) were returned with contact information, after removal of duplicates. Recruitment in rural sites occurred until approximately 20 rural and 20 semi-rural women provided informed consent; therefore, a large proportion of women who returned questionnaires with contact information were not followed up by the research coordinator since their study group was already full. A total of 135 women were screened eligible and asked to consent to participate; of these, 119 (88%) consented. From the 119 who agreed to participate, 25 (18%) became ineligible to participate (primarily as a result of delivering the infant prior to the time at which the researcher was able to make contact for the first assessment), and 7 (6%) withdrew before the first assessment. A total of 87 women (73% of eligible consenting women) provided baseline data, of whom 70 (80%) also completed the postpartum assessment. The main reasons for not completing the postpartum assessments were participant's lack of time or inability to contact participants within 10 weeks postpartum. One participant's postpartum assessment data were lost due to a computer malfunction. The final sample for analysis was therefore composed of 23 rural women, 23 semi-rural women, and 41 urban women who completed the baseline assessment, and 19 rural, 20 semi-rural, and 30 urban women who completed the primary outcome assessment.

Data collection

All participants gave written informed consent to participate, and the research was approved by the local Institutional Review Board. Participants were all telephoned by the same female research coordinator at approximately 36 weeks gestation (mean=37.4; range 32–40 weeks) to complete the baseline assessment. Follow-up data were

collected by telephone by the same research coordinator at approximately 6 weeks postpartum (mean=7.1; range 5.9–10.1 weeks). Prior to each assessment, participants were mailed a copy of the questionnaire package to facilitate the interview.

Instruments

A demographic questionnaire was constructed to collect basic sociodemographic information such as income, employment status, race/ethnicity and education, as well as reproductive history including history of miscarriage or pregnancy termination, planning, type of delivery, and complications with current pregnancy. Information was updated at the follow-up assessment.

The Edinburgh Postnatal Depression Scale (EPDS) (Cox et al. 1987) is a 10-item self-report screening tool for perinatal depression that was administered at both assessment points. Scores range from 0 to 30, with higher scores indicating greater severity of depression. A cut-off score of >12 has been previously validated against diagnostic instruments to indicate probable clinical depression with sensitivity and specificity of 86% and 78%, respectively (Cox et al. 1987; Eberhard-Gran et al. 2001). The EPDS has been validated for use with modified optimum cut-off scores during pregnancy (Murray and Cox 1990), in fathers (Matthey et al. 2001), and in a number of ethnocultural communities (O'Hara 1994).

In order to provide a detailed examination of social connectedness, several inter-related constructs were assessed, including perceived social support, social conflict, size and diversity of social networks, social capital, and sense of community. To measure social support, the Medical Outcome Study Social Support Survey (MOS) (Sherbourne and Stewart 1991) was administered during both assessments. This is a brief self-report measure of availability of tangible, affectionate, positive social interaction, and emotional/informational support, with high internal consistency and good test–retest reliability (McDowell and Newell 1996). Scores range from 0 to 100, with higher scores indicating greater levels of social support. The MOS Social Support Survey has previously been used in a perinatal population (Ross et al. 2004).

The Social Conflict Scale (SCS) (Schuster et al. 1990) is a 20-item scale which was administered at both assessments in order to assess frequency of supportive and negative interactions with spouse/partner, relatives, and friends. Scores on each component index range from 0 to 1, with higher scores indicating more frequent supportive or negative interactions, depending on the index. Negative interactions are included since data indicate that they may be more predictive of depressed mood than supportive interactions (Schuster et al. 1990). To our knowledge, negative social interactions have not previously been investigated in perinatal women.

To assess network diversity, the Social Network Index (SNI) (Cohen et al. 2000) was administered at the baseline assessment. The SNI is a 12-item scale to assess participation in 12 types of social relationships (including with family members, neighbors, and members of community organizations). Raw scores ranging from 0 to 12 were converted to percentage scores, with higher scores indicating greater levels of network diversity. SNI scores have previously been associated with increased positive affect (Cohen et al. 2000), reduced anxiety in response to a stressful experience (Bolger and Eckenrode 1991), and reduced susceptibility to the common cold (Cohen et al. 1997).

The Sense of Community Index (SCI) (Perkins et al. 1990) was administered at baseline to assess community belonging. In their seminal work, McMillan and Chavis (1986) defined sense of community as "a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be together." The SCI, a 12-item scale, is the most widely used and well-validated measure of sense of community (Obst and White 2004). Raw scores ranging from 0 to 12 were converted to percentage scores, with higher scores indicating greater levels of sense of community.

To assess social capital, the Social Capital Questionnaire (SCQ) (Onyx and Bullen 2000), as modified for telephone administration by O'Brien et al. (2004), was administered at the baseline assessment. Social capital is defined as the level of resources of a community or group, such as trust between citizens and norms of reciprocity (Berkman et al. 2000). The SCQ instrument is one of the few social capital measurement tools for which any psychometric data are available, and the only one to include all of the theoretical dimensions of social capital (i.e., cognitive, structural, bonding, and bridging) (Harpham et al. 2002). This instrument has been used to identify differences in social capital between urban and rural communities (Onyx and Bullen 2000) and between volunteers and marginalized women (Onyx and Bullen 2001). As in the modification of O'Brien et al. (2004), we administered 34 of the original 36 items which were considered appropriate for a North American context. Each item is scored from 1 to 4, with higher scores indicating greater levels of social capital. Total scores are calculated by summing the items; since >15% of our sample did not provide data for the "work connections" items due to their current employment status, these four items were excluded in calculating the total scores. As such, the potential range for our total scores was from 0 to 120. As recommended by Bullen and Onyx (2005), where participants were missing data on less than two items, the missing responses were replaced by mean values for that item. One participant did

not provide data on more than two items and so was excluded from analyses with the total scale and subscales for which data were missing. Subscale scores (as defined by Bullen and Onyx 2005) were calculated by summing the scores of the appropriate items. Because the subscales were composed of varying numbers of items, we converted subscale scores to percentage scores for comparability.

Data analysis

Demographic characteristics and reproductive history were analyzed using frequencies and descriptive statistics. Group comparisons were examined using chi-square analyses or Fisher's exact test (depending on expected cell counts) for categorical outcome variables and one-way ANOVA for continuous outcome variables. Post hoc tests were computed for continuous variables showing significant differences between groups. Pearson correlations were used to examine potential associations between indicators of social connectedness and EPDS scores. All analyses were computed using the statistical package SPSS version 17.0.1.

Results

Sociodemographic characteristics and reproductive history

Selected demographic characteristics of participants are provided in Table 1. There were no significant differences in age, education, relationship status, employment status, or household income between groups. However, race/ethnicity ($p=0.04$) and language spoken at home ($p=0.02$) differed significantly between groups, with more women from the urban group identifying a race/ethnicity other than Caucasian and speaking a language at home other than English. However, in bivariate analyses, neither race/ethnicity ($p>0.4$) nor language spoken at home ($p>0.1$) were significantly associated with EPDS scores; as such, neither variable was entered as a covariate in subsequent analyses.

Table 2 shows reproductive history for participants. There were no significant differences between groups in history of pregnancy termination, planning of current pregnancy, or complications during current pregnancy. Type of delivery ($p<0.01$) differed significantly between groups, with more women from the urban group reporting delivery by cesarean section. Further, the groups differed significantly in reports of past miscarriage or pregnancy loss ($p<0.05$), with fewer rural women reporting pregnancy loss than women in the other two groups. Again, type of delivery ($p>0.06$) and history of pregnancy loss ($p>0.26$) were not associated with EPDS scores in bivariate analyses.

Depression

Depression data are presented in Table 3. There were no significant differences in the prenatal mean EPDS scores among rural (mean 5.35, SD 3.52), semi-rural (mean 5.35, SD 4.18), and urban (mean 7.07, SD 4.29) participants ($p=$

Table 1 Selected demographic characteristics of participants stratified by place of residence

	Rural $N=23$ n (%)	Semi-rural $N=23$ n (%)	Urban $N=41$ n (%)	Chi-square test[a] χ^2 (df)	p
Race/ethnicity				5.96 (2)	0.04
Caucasian/White	19 (83)	22 (96)	29 (71)		
Other	4 (17)	1 (4)	12 (29)		
Primary language				7.42 (2)	0.02
English	20 (87)	23 (100)	31 (76)		
Other	3 (13)	0 (0)	10 (24)		
Education				0.65 (2)	0.79
Post-secondary	17 (74)	19 (83)	33 (81)		
No post-secondary	6 (26)	4 (17)	8 (19)		
Household income (CAD)				3.01 (2)	0.22
Less than 80,000	14 (61)	9 (43)	16 (46)		
≥80,000	7 (39)	12 (57)	19 (54)		
Employment status				0.40 (2)	0.82
Full-time paid work	11 (48)	12 (54)	19 (46)		
Other	12 (52)	10 (46)	22 (54)		
Relationship status				1.70 (2)	0.45
Married/living with partner	22 (96)	21 (91)	33 (85)		
Single/separated/divorced	1 (4)	2 (9)	6 (15)		
	Mean (SD)	Mean (SD)	Mean (SD)	F (df)	p
Age	29.9 (6.0)	31.3 (6.4)	29.6 (6.2)	0.56 (2, 84)	0.57

[a] Fisher's exact test is reported where >20% of cells had expected counts <5

Table 2 Reproductive history of participants stratified by place of residence

	Rural N=23 N (%)	Semi-rural N=23 N (%)	Urban N=41 N (%)	Chi-square test[a] χ^2 (*df*)	p
Miscarriage history	2 (9)	7 (30)	17 (42)	7.56 (2)	0.02
Abortion history	3 (13)	4 (17)	5 (12)	0.49 (2)	0.92
Planned pregnancy	20 (87)	17 (74)	28 (68)	2.73 (2)	0.26
Complications	2 (9)	9 (39)	12 (29)	5.80 (2)	0.06
Type of delivery				8.80 (2)	<0.01
Vaginal	19 (100)	16 (80)	20 (67)		
C-section	0 (0)	4 (20)	10 (73)		

[a] Fisher's exact test is reported where >20% of cells had expected counts <5

0.15). Similarly, there were no significant differences at the 6-week postpartum assessment (rural mean 4.21, SD 3.36, semi-rural mean 4.40, SD 3.28, and urban mean 5.33, SD 3.24, p=0.44).

The number of participants with significant depressive symptoms (EPDS>12) similarly did not differ significantly between groups. At the prenatal assessment, 3 (7%) urban women, 2 (9%) semi-rural women, and 0 (0%) rural women reported EPDS>12 (p=0.59). At 6 weeks postpartum, 2 (7%) urban women, 0 (0%) semi-rural women, and 1 (5%) rural woman reported EPDS>12 (p=0.62).

Social connectedness

Measures of social connectedness are reported in Table 4. Overall, there were no statistically significant differences between groups in perceived social support (MOS), social conflict (SCS), or sense of community (SCI). However, there was a statistically significant difference in social network diversity (p<0.01), wherein SNI scores were significantly lower in urban women than either the rural or semi-rural groups (p=0.001). Similarly, there were significant differences between groups in reported social capital (p<0.05), where SCQ scores were again lowest among the urban women, relative to both the semi-rural (p<0.01) and urban groups (p<0.05). Two of the subscales of the SCQ were similarly statistically different between groups, with lowest scores among the urban women: "trust and safety" (p=0.001) and "neighborhood connections" (p<0.05). All remaining social support scales and subscales did not differ significantly between groups.

Bivariate analyses examined potential correlations between social connectedness variables and EPDS scores (see Table 5). In the total sample, there were statistically significant correlations between prenatal EPDS scores and most indicators of prenatal social connectedness, including total MOS scores (p=0.005), SCS negative partner interaction scores (p<0.005), and SCQ scores (p<0.05). Similarly, postpartum EPDS scores were significantly correlated with most of the indicators of postpartum social connectedness, including total MOS scores (p=0.001), SNI scores (p=0.01), and SCS negative partner interaction scores (p<0.001), although there were no significant correlations with the SCQ or its subscales. Finally, several indicators of prenatal social connectedness were significantly associated with postpartum EPDS scores, including total MOS scores (p=0.01) and SCS negative partner interactions scores (p<0.005).

Discussion

To our knowledge, this is the first published study to examine risk for perinatal depression among rural women in Canada. Overall, we found no statistically significant

Table 3 Edinburgh Postnatal Depression Scale (EPDS) scores stratified by place of residence

	Rural N (%)	Semi-rural N (%)	Urban N (%)	Chi-square test Fisher's	p
EPDS prenatal, mean (SD)				1.87	0.59
0–12	23 (100)	21 (91)	38 (93)		
≥13	0 (0)	2 (9)	3 (7)		
EPDS postpartum, mean (SD)				1.27	0.62
0–12	18 (95)	20 (100)	28 (93)		
≥13	1 (5)	0 (0)	2 (7)		
	Mean (SD)	Mean (SD)	Mean (SD)	F (*df*)	p
Prenatal EPDS	5.35 (3.5)	5.35 (4.2)	7.07 (4.3)	1.95 (2, 84)	0.15
Postpartum EPDS	4.21 (3.4)	4.40 (3.3)	5.33 (3.2)	0.84 (2, 66)	0.44

Table 4 Indicators of social connectedness stratified by place of residence

	Rural	Semi-rural	Urban	ANOVA	
	Mean (SD)	Mean (SD)	Mean (SD)	*F* (*df*)	*p* value
Prenatal indicators					
No. family and friends	8.8 (4.1)	10.0 (7.9)	7.3 (6.2)	1.40 (2, 83)	0.25
MOS tangible	76.6 (19.0)	86.1 (15.3)	76.1 (20.1)	2.34 (2, 84)	0.10
MOS affectionate	95.7 (9.0)	90.6 (16.5)	86.2 (20.8)	2.24 (2, 84)	0.11
MOS positive interaction	83.4 (17.6)	84.8 (18.4)	75.0 (22.2)	2.24 (2, 84)	0.11
MOS info/emotional	84.9 (13.6)	88.9 (13.2)	79.1 (18.4)	2.98 (2, 84)	0.06
MOS total	84.6 (12.8)	87.7 (11.9)	82.5 (15.0)	3.03 (2, 84)	0.05
Supportive partner	0.63 (0.00)	0.61 (0.05)	0.60 (0.07)	1.07 (2, 77)	0.35
Partner-negative interaction	0.86 (0.09)	0.80 (0.11)	0.85 (0.08)	2.71 (2, 77)	0.07
Supportive friends	1.00 (0.00)	1.00 (0.00)	0.96 (0.16)	1.70 (2, 82)	0.19
Friends-negative interaction	0.80 (0.13)	083 (0.13)	0.85 (0.13)	1.18 (2, 82)	0.31
Supportive relatives	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	n/a (2, 84)	n/a
Relatives-negative interaction	0.91 (0.09)	0.87 (0.14)	0.91 (0.11)	0.78 (2, 84)	0.46
Social network diversity	56.5 (14.4)	60.9 (14.3)	47.6 (14.2)	7.11 (2, 84)	0.001
Sense of community	60.5 (15.5)	62.0 (12.0)	55.5 (13.0)	2.04 (2, 84)	0.14
Social capital	88.9 (8.16)	90.0 (8.70)	83.3 (10.4)	4.60 (2, 83)	0.01
Participation in local community	42.2 (14.4)	47.1 (15.6)	40.2 (12.7)	1.79 (2, 84)	0.17
Productivity in social context	80.1 (12.3)	84.2 (9.10)	81.3 (11.5)	0.84 (2, 83)	0.44
Trust and safety	84.6 (11.7)	85.0 (12.3)	72.4 (17.2)	7.65 (2, 84)	0.001
Neighborhood connections	71.3 (15.5)	68.1 (14.4)	60.5 (18.1)	3.59 (2, 84)	0.03
Family and friends	80.4 (13.9)	80.1 (13.5)	79.5 (13.9)	0.35 (2, 84)	0.97
Tolerance of diversity	89.4 (9.98)	92.0 (11.0)	90.7 (14.7)	0.23 (2, 83)	0.80
Value of life	89.7 (12.9)	84.8 (16.8)	81.7 (14.5)	2.14 (2, 84)	0.12
Work connections	83.3 (18.5)	88.3 (11.3)	82.8 (19.7)	0.66 (2, 55)	0.52
Postnatal indicators					
No. family and friends	9.6 (7.3)	7.4 (2.9)	7.6 (5.8)	0.83 (2, 84)	0.44
MOS tangible	77.2 (20.5)	85.4 (20.6)	70.5 (24.4)	2.57 (2, 62)	0.08
MOS affectionate	94.1 (11.7)	92.5 (14.9)	90.5 (13.3)	0.40 (2, 62)	0.67
MOS positive interaction	82.4 (19.4)	84.9 (18.4)	72.4 (24.3)	2.27 (2, 62)	0.11
MOS info/emotional	84.0 (18.6)	88.7 (15.3)	80.8 (18.1)	1.15 (2, 62)	0.32
MOS total	83.8 (16.7)	87.8 (16.0)	78.4 (17.5)	1.83 (2, 62)	0.17
Supportive partner	0.45 (0.15)	0.38 (0.21)	0.45 (0.15)	1.13 (2, 62)	0.33
Partner-negative interaction	0.26 (0.14)	0.30 (0.22)	0.32 (0.16)	0.69 (2, 62)	0.51
Supportive friends	0.96 (0.11)	0.93 (0.18)	0.88 (0.22)	1.40 (2, 65)	0.25
Friends-negative interaction	0.15 (0.17)	0.12 (0.15)	0.19 (0.14)	1.48 (2, 65)	0.24
Supportive relatives	0.95 (0.14)	0.96 (0.09)	0.96 (0.10)	0.09 (2, 65)	0.92
Relatives-negative interaction	0.28 (0.18)	0.22 (0.20)	0.30 (0.22)	0.81 (2, 65)	0.45

differences in either mean EPDS scores or in the proportion of our sample scoring above the recommended cut-off score to identify clinical depression, associated with place of residence. Although the small sample size of this pilot study limits our statistical power to detect significant differences between groups, a power analysis indicates that the present sample should be nearly sufficient to identify a clinically meaningful difference in EPDS scores (specifically, to detect a moderate effect size of $f^2=0.15$, approximately 23 participants per group would be required). Further, the effect size detected in this pilot study was small, suggesting that any statistically significant difference between groups that might be identified with a larger sample would be unlikely to have clinically significance.

The lack of significant difference in risk for PPD among rural, semi-rural, and urban women is consistent with some previous studies comparing rural and urban women, also finding non-significant differences in the rates of PPD between the groups (Bilszta et al. 2008; Johnstone et al. 2001). Similarly, some studies of the general population

Table 5 Correlations between indicators of social support and depression

	Pearson correlations	
	Prenatal EPDS *N*=87	Postpartum EPDS *N*=69
Prenatal indicators		
No. of friends/family	0.06	0.10
MOS tangible	−0.14	−0.28*
MOS affectionate	−0.30**	−0.12
MOS positive interaction	−0.29**	−0.25*
MOS information/emotional	−0.27*	−0.30*
MOS total	−0.30**	−0.31**
Supportive partner	0.02	−0.07
Partner-negative interaction	0.34**	0.37**
Supportive friends	−0.01	−0.13
Friends-negative interaction	0.08	0.27*
Supportive relatives	N/A	N/A
Relatives-negative interaction	0.19	0.35**
Social network diversity	−0.21	−0.30*
Sense of community index	−0.15	−0.18
Social capital	−0.26*	−0.04
Participation in local community	−0.02	0.23
Productivity in social context	−0.16	0.21
Trust and safety	−0.34**	−0.22
Neighbourhood connections	−0.06	−0.10
Family and friends	−0.22*	0.00
Tolerance of diversity	−0.07	−0.12
Value of life	−0.34**	−0.06
Work connections	−0.15	−0.07
Postpartum indicators		
MOS tangible		−0.49**
MOS affectionate		−0.28*
MOS positive interaction		−0.33**
MOS information/emotional		−0.29*
MOS total		−0.39**
Supportive partner		−0.42**
Partner-negative interaction		0.48**
Supportive friends		−0.27*
Friends-negative interaction		0.26*
Supportive relatives		0.13
Relatives-negative interaction		0.44**

*$p<0.05$, **$p<0.01$

have also shown that rates of depression did not differ between rural and urban residents (Neff 1983; Romans-Clarkson et al. 1990), including one epidemiological study conducted in Ontario (Parikh et al. 1996) and one U.S. study comparing individuals from metropolitan areas, smaller cities, and rural areas in the U.S. (Blazer et al. 1994).

In contrast, there were some important differences between groups in indicators of social connectedness. Specifically, both social network diversity and social capital differed significantly between groups, whereby urban women had the lowest levels of both variables. Minimal data exist comparing social capital and social network diversity in rural and urban areas. Previous studies assessing social capital have reported significantly higher levels of networks, participation in civic and social participation, cohesion, and perceived safety among rural individuals (Peterson 2009; Quine and Morrell 2008; Romans et al. 1992; Ziersch et al. 2009). However, these studies have not included semi-rural group comparison groups in order to

assist in determining whether urban residence is associated with lower than average levels of social capital or whether rural residence is associated with higher than average levels. Our finding that urban women typically reported lower levels of various indicators of social capital compared to both rural and semi-rural women suggests that urban residence in particular is associated with this finding. Additional research examining these issues would be worthwhile.

Social network diversity, along with other indicators of social connectedness, was also significantly associated with EPDS scores when examined in the entire sample. Although the association between perceived social support and symptoms of PPD has been well established in meta-analyses (Beck 2001; Robertson et al. 2004), we were unable to identify any studies which have examined potential associations between community-level indicators of social connectedness, such as social networks or social capital and PPD. Our study therefore indicates an important area for future research.

Several methodological limitations of this work must be noted. As mentioned above, the primary limitation of our study is the small sample size per group; however, our power analysis indicates that this sample would have been sufficient to detect a clinically meaningful difference between groups. With a larger sample size, it is possible that variables which differentiated our three groups (in particular, race/ethnicity and language spoken at home) may have been associated with EPDS scores and therefore emerged as important covariates. A study with an adequate sample to control for these variables may have yielded different findings. Further, although our sample was consecutively recruited, the proportion of women who chose to provide contact information on our screening form was relatively low. However, there were no significant differences in age or relationship status between women who provided contact information and those who did not. Since no depression data were collected on our screening forms, we are unable to determine whether there may be systematic differences in mental health status between those women who do and do not provide contact information. It is possible that women with higher risk for developing PPD were less likely to provide contact information, resulting in an underestimation of severity of depression in our sample; or, conversely, that women at lower risk for developing depression were less likely to provide contact information, resulting in an overestimation. However, there is no reason to suggest that any such participation bias would differ according to place of residence, suggesting that the patterns of differences observed between groups would be unaffected.

Our study was limited to women who delivered healthy, full-term infants, since preterm birth is an established risk factor for PPD (Vigod et al. 2010). Although little research has explored specific birth outcomes among rural women, there is some evidence that women living in rural communities may be a lower risk for preterm birth (Hillemeier et al. 2007). Research examining the potential inter-relationships among preterm birth, rural residence, and depression may therefore be warranted.

Finally, it is important to acknowledge the limited scope of this study: we assessed depressive symptoms using the EPDS, which does not provide a depressive diagnosis, and limited our analysis to symptoms of depression, to the exclusion of other common comorbid conditions, including anxiety. Additional research of a broader scope may be warranted.

The findings of this study await replication in a larger sample of rural, semi-rural, and urban women. However, if confirmed, they may have important implications for service provision in these communities. In particular, low levels of social support, network diversity, and social capital may act as modifiable markers for identifying women at risk for PPD, regardless of one's geographic location. Finally, an association between indicators of social capital and perinatal mental health may have theoretical implications for this field of study, as it suggests a need to move away from an individualized conceptualization of perinatal depression to a model that considers the social and community context of a new mother's distress. In turn, community-level interventions may be worthy of study.

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