

Sleep problems and depressed mood negatively impact health-related quality of life during pregnancy

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Abstract The objectives of this study were to evaluate and identify determinants of health related quality of life (HRQoL) during pregnancy. Pregnant women ($n=245$) completed questionnaires measuring: HRQoL (Short Form Health Survey SF-36), life stress, social support, sleep, and depressed mood in the third trimester. Demographics and medical variables were also collected. Compared to Canadian normative data, our sample scored significantly poorer on the following HRQoL domains: physical functioning, role limitations due to physical health problems, bodily pain, vitality, and social functioning. Multivariate linear regressions were used to model each of the SF-36 subscales. Experiencing sleep problems emerged as a significant determinant of poorer HRQoL in all domains, with the exception of emotional role. Higher depressed

mood scores was independently associated with lower HRQoL in six of the eight domains, including bodily pain, general health, vitality, social functioning, emotional role, and mental health. Greater pregnancy-related anxiety was independently associated with lower scores on physical functioning and role limitations due to physical health problems. Women experience lower HRQoL during pregnancy, particularly in the physical domains. The importance of identifying and managing modifiable determinants early in pregnancy to enhance maternal health status is discussed.

Keywords Sleep problems · Depression · Health-related quality of life · Pregnancy

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Introduction

Pregnancy is a common event for women of reproductive age and is generally viewed as a joyful occasion. However, it is also a time when considerable physical and emotional changes occur (Sieber et al. 2006). Numerous studies have documented significant elevations in psychological symptoms during pregnancy, including depression and anxiety (Lee et al. 2007; Manber et al. 2008). Even in uncomplicated pregnancies, the physical and emotional changes that accompany pregnancy can alter women's ability to function in their various roles, ultimately impacting their quality of life (Hueston and Kasik-Miller 1998; Mckee et al. 2001). Health care during pregnancy is aimed at optimizing maternal and neonatal health. Thus optimizing women's health-related quality of life (HRQoL) during pregnancy is an important goal given that perceived emotional well-being during pregnancy has been shown to influence maternal postpartum adjustment and birth and neonatal

outcomes (Da Costa et al. 2000; Diego et al. 2004; Glynn et al. 2008; Sutter-Dallay et al. 2004).

HRQoL is a multidimensional concept which refers to an individual's perception of general well-being and extent of role fulfillment across various physical, psychological and social domains (Testa and Simonson 1996). It has become an increasingly important outcome of focus when evaluating the impact of specific conditions. HRQoL questionnaires measure the person's perceptions of daily functioning in various domains including physical, social, mental and emotional well-being. The Medical Outcomes Study Short-Form General Health Survey (SF-36) (Ware and Sherbourne 1992) is a widely used generic HRQoL instrument designed to capture information on each of the HRQoL domains. The SF-36 has been studied in many populations with specific diseases and is considered an appropriate tool to describe HRQoL during pregnancy (Otchet et al. 1999; Jomeen and Martin 2005).

To date only a handful of studies have described HRQoL during pregnancy. Hueston and Kasik Miller (Hueston and Kasik-Miller 1998) described quality of life in 125 women during pregnancy using the SF-36 and found significant declines only for physical domains. A decline in physical functioning was observed as the pregnancy progressed, while role limitation due to physical problems and pain worsened significantly in the first 2 trimesters and stabilized in the final trimester. In a Canadian sample of 393 pregnant women during the third trimester, Otchet et al. (1999) found that in addition to declines in physical functioning, mental domains were also significantly reduced, including role limitation due to emotional problems, vitality, and social functioning compared to community norms for nonpregnant women. Similar decreases in physical functioning and vitality during pregnancy have been reported in a large ($n=1809$) study (Haas et al. 2004). The few studies conducted to date suggest that pregnancy is associated with significant impairments in HRQoL particularly in the physical domains and the declines seem to be more profound as the pregnancy progresses to the third trimester. However, the extent to which HRQoL is diminished by the third trimester remains unclear as the study by Otchet and colleagues conducted in Canada compared SF-36 scores from their sample of pregnant women in the third trimester to normative data from the United States. Hopman et al. (2000) have since shown a pattern of higher scores across the SF-36 domains in a large Canadian sample compared to those obtained in the United States.

Much less is known about the factors associated with greater declines in HRQoL during pregnancy. Physiological changes that occur in pregnancy likely contribute to the declines in physical health status. Hueston et al. (1998) found a negative correlation between gestational age and multiple physical HRQoL dimensions, supporting the view

that physical changes during pregnancy contribute to the declines. However, HRQoL in other patient populations has been shown to be multidetermined with demographic, medical and psychosocial factors each contributing. Lower income has been associated with poorer health status during pregnancy (Haas et al. 2004; Otchet et al. 1999). Depressed mood during pregnancy has in a number of studies also been shown to negatively impact multiple HRQoL domains (Mckee et al. 2001; Nicholson et al. 2006; Setse et al. 2008). Interestingly other factors such as sleep problems and stress, both of which are known to be elevated during pregnancy (Da Costa et al. 1999; Lee 1998; Lee et al. 2000) have yet to be examined in relation to HRQoL in this population.

HRQoL is a central element in the biopsychosocial model (Engel 1977) which can be influenced by sociodemographic, medical, behavioural and psychosocial factors. Importantly, the few studies conducted to date on HRQoL during pregnancy have not assessed all of these variables simultaneously. Moreover, multivariate statistical analyses have not generally been applied to delineate the relative contribution of these factors to specific HRQoL domains during pregnancy.

The goals of the present study were to (a) evaluate HRQoL in women during the third trimester of pregnancy compared to age-appropriate norms for Canadian women, and (b) delineate factors associated with HRQoL during pregnancy. We were guided by the biopsychosocial model (Engel 1977) tailored to women during pregnancy, which included examining the potential contribution of demographic (age, income) pregnancy-related variables (parity, pregnancy complications), behavioural (sleep problems) and psychosocial (pregnancy-related anxiety, depression, life stress, social support) variables on HRQoL.

Materials and methods

Participants

Pregnant women in the third trimester (28–40 weeks) were recruited at the offices of their obstetrician/gynaecologist whom were affiliated with the McGill University Health Centre and at an ultrasound department at the Jewish General Hospital (JGH) in Montreal, Canada. All eligible pregnant women were invited to participate in an ongoing prospective study examining adjustment during pregnancy and the postpartum. No financial compensation was offered to women for their participation. At the time of recruitment eligible women who indicated their interest in participating were asked the language (English or French) that they preferred to complete the questionnaire battery. The present analyses focused on the baseline data prior to delivery. The

study was approved by the McGill University Faculty of Medicine Institutional Review Board and the Research Ethics Committee of the JGH.

Measures

The Medical Outcomes Study Short-Form-36 was used to assess HRQoL (Ware and Sherbourne 1992). The SF-36 is a psychometrically sound and widely used measure comprised of 36 items measuring 8 aspects of health and well-being: physical functioning, role limitations due to physical health, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems, and mental health. Scores vary from 0–100, with higher scores indicating better health status. The SF-36 has been widely used and has been established as a reliable and valid questionnaire for assessing HRQoL in different populations (Ware et al. 1993). While the SF-36 has been commonly used during pregnancy (Hueston and Kasik-Miller 1998; Otchet et al. 1999), only one study has examined its psychometric properties during this period (Jomeen and Martin 2005). This validation study with women in their first trimester, found support for using the SF-36 as an eight subscale measure to explore specific and separate domains of HRQoL (Jomeen and Martin 2005).

The Edinburgh Postnatal Depression Scale (EPDS), a widely used 10-item scale developed for use in the postpartum and validated for use during pregnancy, was administered to measure depressive symptomatology during pregnancy (Cox et al. 1987; Murray and Cox 1990). Items inquire about mother's mood in the past 7 days and are rated on a 4-point scale. Somatic symptoms likely to occur during this period are not included. A cutoff point of 10 has been shown to have a sensitivity of 84% to 100% and a specificity of 76% to 88% when compared to a diagnosis of minor and major depression using a psychiatric interview such as the Structured Clinical Interview for the DSM-III-R (Harris et al. 1989; Murray and Carothers 1990; Zerkowitz and Milet 1995).

Stressful life events were assessed using the modified *Life Stress Event Scale* (Hurst et al. 1978). This questionnaire lists 10 major life events that could have occurred in the past 6 months. The questionnaire shows good internal consistency (Cronbach alpha=0.87) (Hurst et al. 1978) and has been used in previous studies to examine life change stress in the postpartum (e.g., Lenz et al. 1986).

The *MOS social support survey* (Sherbourne and Stewart 1991) was administered to assess social support. This seven item scale measures perceived support from one's social network by using a five point scale ranging from "Not at all" to "Always" (0–4). Good internal consistency (Cronbach alpha 0.88) has been demonstrated for this measure (Sherbourne and Stewart 1991).

Sleep problems were measured by an item on the Prime-MD Patient Health Questionnaire: "Trouble falling or staying asleep, or sleeping too much" (Spitzer et al. 1999). Respondents are asked if they were bothered by the problem over a 2 week timeframe. The response choices are "not at all", "several days", "more than half the days" and "nearly every day" and scores range from 0 to 3.

Pregnancy-related anxiety and partner support during the pregnancy was assessed with a 5-point Likert scale. Sociodemographic (i.e. age, parity, income, education, marital and employment status) and gestational complications were also obtained.

Procedures

Consenting participants were mailed the questionnaire battery along with a pre-addressed stamped envelope. Women were instructed to complete the questionnaires and return them promptly by mail. Reminder phone calls were made to participants whose questionnaires had not been received within 2 weeks of mailing.

Statistical analyses

Descriptive statistics including means, medians, and standard deviations were calculated for all the variables. The variable pertaining to how supportive women felt their partner was of the pregnancy was negatively skewed. Several transformation were computed to reduce skewness but did not result in considerable improvements toward normality. Therefore, given the extent to which this variable deviated from normality, it was not included in the multiple regression analyses.

Single sample t-tests were computed to compare means on the SF-36 dimensions and summary scores obtained in our sample of women to normative means of Canadian women aged between 25–34 years (Hopman et al. 2000).

A Pearson correlation matrix was computed with all the variables to examine the bivariate correlations between the outcome variables (SF-36 subscales) and each potential predictor variable. The pattern of inter-correlations among the possible predictor variables was also examined to determine the extent of multicollinearity among predictors.

A series of multiple stepwise linear regression analyses were conducted to identify independent determinants of each SF-36 subscale. Demographic (age, marital status, educational level, income, occupational status), medical (parity, gestational weeks, number of nonpregnancy related medical conditions, and pregnancy complications), behavioural (sleep problems) and psychosocial (social support, life events, depression, pregnancy-related anxiety) factors

were considered as potential independent variables. Variable selection was based on theoretical relevance, pattern of univariate association with each of the SF-36 subscale scores and other potential predictor variables, and the assumptions underlying multiple regression analysis. Each model was then constructed with forced entry of age, household income, parity, weeks gestation and EPDS scores followed by the remaining demographic, behavioural and remaining psychosocial predictor variables using both forward and backward stepwise selection strategy, with a $p < 0.05$ needed for entry and a $p < 0.10$ for retaining a variable in the model. Each model yielded a subset of independent determinants associated with each of the SF-36 subscales. Statistical analyses were performed using the statistical software SPSS version 12.0.

Results

Sample characteristics

Of the 380 participants who agreed to participate in this study, 253 (66.6%) returned their self-report questionnaires. After reviewing each questionnaire package, 13 participants had incomplete data and were not used in the present analyses. Of the 131 women who failed to return their questionnaires, 12 were no longer interested and/or had no time to participate, 18 delivered prior to completing the questionnaires, three felt too ill to return the questionnaires, one discontinued because the fetus died and the remainder never responded to our reminder phone calls.

The characteristics of the 245 participants included in the final study sample are shown in Table 1. The mean age of the sample was 31.8 (SD=4.4) years, ranging from 19 to 44 years and 95.6% were married or living with a partner. Of the 98% who responded to questions about racial identity, the majority identified themselves as White (75.9%), followed by Asian (7.5%), Black (6.2%), Middle Eastern (5%), South or Latin American (2.5%) and Other (2.5%). Forty-eight percent of the participants were primiparous and 54.4% were employed at study entry. At study entry, the mean number of gestational weeks was 32.5 weeks (SD=2.9). In terms of health status prior to pregnancy, 12% reported suffering from a medical problem (i.e. asthma, thyroid problem). Twenty-nine percent of the women reported at least one pregnancy complication (i.e., high blood pressure, gestational diabetes) during their current pregnancy. The mean EPDS score was 7.2 (SD=4.5), ranging from 0–22, with 28.6% ($n=70$) obtaining a score of 10 or greater. Twenty-seven percent reported a sleep problem “more than half the days” or “nearly every day”.

Table 1 Demographic characteristics

Characteristic	Mean (SD)
Age (years)	31.8 (4.4)
Education	15.9 (2.2)
Income*	5.1 (2.0)
Marital Status	
Married/cohabiting	237 (95.6%)
Single/divorced	11 (4.4%)
Work Status	
Employed	135 (54.4%)
Not working	113 (45.6%)
Parity	
Primiparous	119 (48%)
Gestational Weeks	32.5 (2.9)
Prior Medical Problems	29 (12%)
Pregnancy Complications	73 (29%)
Sleep Problems	1.0 (.99)
Pregnancy related anxiety	2.5 (.96)
Partner Support	4.40 (.86)
Social Support	22.6 (1.1)
EPDS	7.2 (4.5)
Life stress	3.6 (4.1)

*Income scale 1–8 e.g., 4=\$41,000–\$60,000; 5=\$61,000–\$80,000

Health-related quality of life

The results comparing the scores on the SF-36 dimensions obtained in this sample of women during the third trimester of pregnancy to normative means reported for Canadian women between 25–34 years of age (Hopman et al. 2000) are presented in Table 2. Pregnant women in their third trimester scored significantly lower on 5 of the 8 SF-36 dimensions including physical function, role limitation due to physical health, bodily pain, vitality, and social function compared to age-appropriate normative means. In 5 of the 8 HRQoL domains, large reductions in scores were observed ranging from 9.5 (social functioning) to 46.7 (role limitations due to physical health). Reductions greater than 5 points have previously been shown to be clinically significant (Hays and Morales 2001; Ware et al. 1993). The scores for general health, role limitation due to emotional health and mental health in our pregnant sample of women in their third trimester were similar to the normative means reported by Hopman et al. (2000).

Univariate associations between predictor variables and health-related quality of life

Among the demographic variables, the most consistent correlates of the various HRQoL dimensions were income

Table 2 Mean (SD) SF-36 scores for women in the third trimester of pregnancy compared to Canadian normative means

	Pregnant women in 3rd trimester (n=245)	Normative means*	p
Physical Function	56.7 (23.1)	90.9 (14.8)	<0.0001
Role limitation due to physical health	37.0 (39.0)	83.7 (31.4)	<0.0001
Bodily pain	61.7 (20.4)	75.0 (21.6)	<0.0001
General Health	78.1 (17.7)	77.9 (15.5)	0.995
Vitality	49.5 (18.9)	61.2 (17.3)	<0.0001
Social Function	74.2 (24.6)	83.7 (21.3)	<0.0001
Role limitation due to emotional health	75.2 (37.6)	77.6 (35.3)	0.305
Mental Health	74.5 (15.4)	74.1 (16.3)	0.658

*Canadian Normative means for women between 25–34 years old (Hopman et al. 2000).

and marital status (Table 3). Having a higher household income was significantly correlated with higher scores on role physical, general health, social functioning, role emotional and mental health. Being married or cohabiting was significantly correlated with all the SF-36 subscales, with the exception of bodily pain.

Regarding the medical variables, parity was only correlated with bodily pain, vitality and social functioning, indicating that multiparity was associated with lower scores on these subscales. Having experienced a pregnancy complication in the current pregnancy was significantly correlated with lower scores on physical functioning,

bodily pain, general health and social functioning. The psychosocial variables were consistently correlated with the various HRQoL domains. Higher pregnancy anxiety, sleep problems, and higher depression scores were significantly correlated with lower scores across all the SF-36 subscales.

Determinants of health-related QoL

Table 4 shows the final multiple regression models to identify determinants of each HRQoL domain. The results of the final models showed that the identified predictors

Table 3 Univariate relationships between predictor variables and HRQoL (Pearson’s r)

SF-36 Subscales	Physical function	Role limit physical	Bodily pain	General health	Vitality	Social function	Role limit emotional	Mental health
Age	-.15*	-.06	.04	.07	.03	.04	.09	.08
Education (yrs)	.07	-.01	.08	.24***	.10	.05	.10	.04
Income	.02	.14*	.05	.24***	.07	.15*	.21**	.19**
Work Status	.02	.17**	.04	.13*	-.02	.07	.09	.05
Marital Status	-.14*	-.13*	-.09	-.18**	-.14*	-.19**	-.17**	-.20**
Parity	-.05	-.09	-.14*	-.12	-.17**	-.15*	-.01	-.10
Gestational Weeks	-.06	-.12	-.05	.01	-.01	-.06	-.01	.01
Prior Medical Problems	-.004	-.01	.01	-.13*	.03	-.04	.01	.04
Pregnancy Complications	-.27***	-.12	-.14*	-.13*	-.03	-.23***	-.01	-.01
Pregnancy-related anxiety	-.24***	-.22***	-.21**	-.26***	-.20**	-.26***	-.18**	-.32***
Partner support	-.07	.03	-.06	.11	.16*	.06	.16*	.32***
Social Support	.005	.19**	.06	.20**	.17**	.21**	.29***	.41***
Sleep Problems	-.23***	-.27***	-.38***	-.31***	-.35***	-.39***	-.26***	-.40***
EPDS	-.19**	-.20**	-.22**	-.39***	-.45***	-.41***	-.53***	-.71***
Life Events	-.11	-.21**	-.13*	-.13*	-.23***	-.30***	-.31***	-.46***

*p<.05, **p<.01, *** p<.001

Table 4 Final multivariate regression models for SF-36 domains during the third trimester of pregnancy

SF-36 Subscales	Determinants	Beta†	p-value
<i>Physical Functioning</i> R ² =0.18	Age	-0.17	0.006
	Complicated pregnancy	-0.22	<0.0001
	Sleep problems	-0.17	0.007
	Pregnancy-related anxiety	-0.14	0.038
<i>Role Physical</i> R ² =0.18	Occupational status	0.13	0.043
	Sleep problems	-0.19	0.002
	Life events	-0.14	0.033
	Pregnancy-related anxiety	-0.17	0.009
<i>Bodily Pain</i> R ² =0.16	Sleep problems	-0.35	<0.0001
	EPDS	-0.13	0.039
<i>General Health</i> R ² =0.27	Education	0.18	0.003
	Previous medical problem	-0.15	0.006
	Sleep problems	-0.21	<0.0001
	EPDS	-0.28	<0.0001
<i>Vitality</i> R ² =0.26	Sleep problems	-0.25	<0.0001
	EPDS	-0.40	<0.0001
<i>Social Functioning</i> R ² =0.31	Complicated pregnancy	-0.20	<0.0001
	Sleep problems	-0.26	<0.0001
	EPDS	-0.27	<0.0001
	Life Events	-0.12	0.044
	EPDS	-0.50	<0.0001
<i>Role Emotional</i> R ² =0.30	Sleep problems	-0.20	<0.0001
	EPDS	-0.59	<0.0001
	Life events	-0.17	0.001
<i>Mental Health</i> R ² =0.58	Sleep problems	-0.20	<0.0001
	EPDS	-0.59	<0.0001

† Standardized Beta coefficients and p-values given for the final model. Age, household income, parity, weeks gestation and EPDS were forced into all the models.

explained between 16–58% of the variance in the various HRQoL domains. Sleep problems was a significant predictor of poorer HRQoL in all dimensions, except for role emotional. Depressed mood was a significant independent determinant of 6 of the 8 HRQoL dimensions including: bodily pain, general health, vitality, social functioning, role emotional, and mental health. Greater pregnancy-related anxiety was a significant determinant of poorer physical functioning and role physical. The experience of greater life events in the past year was a significant predictor of poorer role physical, social functioning and mental health scores. Having had at least one gestational complication emerged as a significant determinant of physical functioning and social functioning. Age, occupational status, educational level, and a prior medical problem were each related to only one of the eight SF-36 subscales in the final models.

Discussion

The present study demonstrated significant impairments in the HRQoL of women during the third trimester of pregnancy. We found that, compared to normative means from a large sample of age appropriate Canadian women, pregnant women in their third trimester showed worse

functioning in five of the eight SF-36 subscales including physical function, role limitation due to physical health, bodily pain, vitality, and social function. In addition to sociodemographic and medical factors, modifiable behavioural and psychosocial factors were associated with poorer HRQoL in the third trimester.

Our results are consistent with an earlier study by Otchet et al. (1999) who also showed diminished scores along the same SF-36 dimensions including physical functioning, role limitation due to physical health, bodily pain, vitality and social functioning in women during the third trimester compared to normative data from the United States. Similar to Otchet et al. we did not find significantly lower scores in general health, role limitation due to emotional functioning and mental health. The mean scores on physical functioning and bodily pain obtained in our sample of pregnant women were similar to other studies of patients with chronic medical conditions such as cardiovascular disease, diabetes and cancer (Sprangers et al. 2000), while the means for role limitation due to physical functioning and vitality were even lower compared to these other patient populations. In contrast, pregnant women in their third trimester were comparable to nonpregnant Canadian women on general health, role limitation due to emotional problems and mental health. The finding that the mental health was not

significantly different from nonpregnant norms requires cautious interpretation. While a similar pattern of findings have been reported by Otchet et al. (1999) that study also found increased psychological distress including elevated scores on somatization and hostility subscales as assessed by the Brief Symptom Inventory (BSI). Otchet et al. argue that the BSI may be more comprehensive for assessing mental health status during pregnancy compared to the SF-36 which primarily taps symptoms of anxiety and depression. Similarly, the rate of depression in the third trimester found in the present study (28.6%) is consistent with other studies which have reported prevalence rates between 25% and 30% in the last trimester (Haas et al. 2005; Setse et al. 2008). These findings provide further evidence for the observation that while the prevalence of depression during the first trimester of pregnancy is similar to that observed in the general female population, it nearly doubles in the second and third trimester of pregnancy (Bennett et al. 2004).

Similar to other studies, sociodemographic factors were either unrelated or only weakly related to HRQoL during pregnancy (Hueston and Kasik-Miller 1998). The experience of sleep problems during the third trimester of pregnancy emerged as an important determinant in the multivariate models of poorer scores in 7 of the 8 HRQoL domains measured by the SF-36. Sleep problems appears to impact *both* physical and mental health domains on the SF-36. While to our knowledge this is the first study to link sleep problems with poorer HRQoL during pregnancy, this link has previously been shown among depressed women in the postpartum (Da Costa et al. 2006) and in other populations (LeBlanc et al. 2007; Leger et al. 2001). Sleep problems during pregnancy are often viewed as a normal part of pregnancy and while still not completely understood result from hormonal and mechanical changes (Santiago et al. 2001). Disruptions in sleep appear as early as 11–12 weeks of gestation, intensify in the third trimester and persist into the postpartum period (Lee 1998; Lee et al. 2000). Prior studies have found that the experience of sleep problems during pregnancy is associated with an increased risk of depression both during the pregnancy and in the postpartum (Skouteris et al. 2008; Wolfson et al. 2003). Clinically, the findings underscore the importance of assessing and monitoring sleep problems throughout the pregnancy and intervening accordingly to alleviate these symptoms and improve the HRQoL of pregnant women.

The presence of depressive symptoms emerged as an important determinant of poorer functioning in 6 of the 8 HRQoL domains. Two other studies earlier in pregnancy have also shown worse HRQoL across all domains with the exception of physical functioning (Mckee et al. 2001; Nicholson et al. 2006). Setse et al. (2008) found depressive symptomatology during the third trimester of pregnancy to be significantly related to worse functioning across both

physical and mental health domains. Clearly, these findings provide evidence that depressive symptoms are associated with diminished health status during pregnancy. Given the cross-sectional nature of this study it is important to note that decreased HRQoL may contribute to increased depressive symptomatology or that they may each maintain the other over time (Orr et al. 2007). However, prior studies have shown that depression precedes the onset of poorer health status (Brink et al. 2005; Dunlop et al. 2005; van den Brink et al. 2005). Moreover, Setse et al. (2008) have recently shown improvements in certain domains of HRQoL in women whose depression improved from one trimester to the other compared to those who remained or became depressed. These findings provide support for the importance of regular screening and treatment of depression during pregnancy.

Pregnancy-related anxiety emerged as an independent determinant of 2 HRQoL domains, both tapping physical dimensions. There is research to support that pregnancy-specific stress may be a stronger determinant of adverse birth outcomes compared to stress related to other sources (Lobel et al. 2008; Roesch et al. 2004). The impact of pregnancy-related anxiety on HRQoL and adverse birth outcomes may be a result of engaging in more unhealthy behaviours such as inactivity, smoking, use of alcohol and other substance and poor nutrition (Lobel et al. 2008).

Our findings must be considered in view of several limitations. As previously mentioned, this study was cross-sectional and therefore no cause-effect relationships can be inferred for some of the observed relationships. Sleep problems were assessed using a single-item self-report question. We acknowledge that a single item does not precisely characterize the nature and severity of the sleep problem (insomnia, daytime sleepiness). Moreover, the subjective responses on the self-report sleep item may not reflect objective physiologic sleep measures. While polysomnography (PSG) is considered the gold standard for assessing sleep-wake parameters, it is not suitable for screening large community samples due to the effort, cost, and difficulty in capturing the features of sleep problems which can be highly variable from night-to-night (Buysse et al. 2006). Moreover, sleep difficulties involves a subjective perception of poor sleep which may not be reflected by objective PSG assessment. Others have also used a single-item sleep question in epidemiological studies and suggest that it can have reasonable utility for the purposes of screening (Kravitz et al. 2003; Kuppermann et al. 1995). Certainly our consistent findings between sleep problems and poorer HRQoL is in accordance with other studies showing similar relationships using validated sleep measures (LeBlanc et al. 2007; Leger et al. 2001). This study did not concurrently collect HRQoL data from a nonpregnant sample. While HRQoL in our sample was compared to

Canadian norms for women in a similar age group, the Hopman et al (2000) normative data was published 9 years ago. A further limitation is that the majority of our sample was well educated, of middle socioeconomic status, and were recruited from university affiliated clinics and hence may not be entirely generalizable. Future studies across socioeconomic class and various geographical settings are needed to untangle the relative contribution of these factors to HRQoL during pregnancy. While we included a comprehensive assessment of psychosocial variables using well validated scales, we did not include other potentially important variables such as exercise and pregnancy-related symptoms which have both been previously shown to influence HRQoL (Da Costa et al. 2006; Lacasse et al. 2008).

Conclusions

In summary, diminished HRQoL, particularly in the physical domains, is experienced by pregnant women in their third trimester. The experience of sleep problems and depressed mood each contributed independently to various HRQoL domains. Health care providers should not dismiss sleep problems and depression as part of the normal pregnancy experience. These findings further highlight the importance of continuously assessing and providing appropriate treatment for sleep problems and depressive symptoms over the course of pregnancy in order to optimize the HRQoL of pregnant women. Previous studies have shown sleep problems, elevated depressive symptoms and poorer maternal health status to be associated with negative pregnancy outcomes including preterm delivery (Beebe and Lee 2007; Field et al. 2008; Li et al. 2009). Future studies are needed to prospectively examine whether the identification and treatment of these symptoms in early pregnancy positively impacts pregnancy outcomes and HRQoL later in pregnancy and throughout the postpartum.

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