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The trajectory of maternal and paternal fatigue and factors associated with fatigue across the transition to parenthood

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Key words
fathers, fatigue, mothers, parent health and well-being, transition to parenthood.

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Abstract

Background: Fatigue is prevalent in new parents and is associated with poorer functional performance and cognitive functioning. This can be particularly detrimental during the transition to parenthood when parents are adapting to new roles and demands. Examining the course of fatigue and related factors can provide important avenues for intervention and prevention.
Methods: In this longitudinal study, we assessed fatigue and its correlates in 108 mother/father couples. Multilevel modelling examined the prevalence and trajectory of fatigue across the transition to parenthood, as well as factors associated with post-partum fatigue. Parents completed measures of fatigue, prenatal stress, depression and health, and post-natal parental sleep quality, infant sleep duration, and infant negativity.
Results: Mothers' and fathers' fatigue increased following the birth of their infant and remained at high levels. Poor sleep quality, stress, and depression were associated with maternal and paternal fatigue, while infant characteristics were more strongly associated with maternal fatigue. Prenatal depressive symptoms, parental sleep quality, infant sleep duration, and the interaction of gender by prenatal fatigue predicted post-natal fatigue in our model.
Conclusion: Our results highlight the need for health professionals to educate new parents about fatigue and its management beyond the prenatal period. As correlates of fatigue for mothers and fathers differ, we need to expand our understanding of paternal fatigue and develop interventions tailored to their unique experiences.

Key Points

1 Canadian mothers and fathers report high levels of fatigue across the transition to parenthood and would benefit from education on fatigue and its management prenatally and post-natally.
2 The finding that fatigue was associated with mothers' psychological functioning early in the post-partum period and fathers' psychological functioning later in the post-partum period may be related to Canadian paternity leave policies and needs further study.
3 The sources of fatigue may differ for mothers and fathers, and this needs to be taken into account by health professionals for prevention and intervention efforts.

Introduction

Fatigue, defined as "the self-recognized state in which an individual experiences an overwhelming sustained sense of exhaustion and decreased capacity for physical and

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mental work that is not relieved by rest" (Hossain, Reinish, Kayumov, & Bhuiya, 2003, p. 224), is a problem for many people. However, there is reason to believe that it is a particularly significant problem for new parents. There is mounting evidence that levels of fatigue are high among both mothers (Bozoky & Corwin, 2002; Elek, Hudson, & Fleck, 2002; Gay, Lee, & Lee, 2004) and fathers (Elek et al., 2002; Gay et al., 2004) during the transition to parenthood and that fatigue levels remain elevated in the post-partum period (Elek et al., 2002). Moreover, given that fatigue is associated with a number of negative outcomes, including poor decision making (e.g., Hockey, Maule, Clough, & Bdzola, 2000; Mellor & St. John, 2012) and impaired thinking (e.g., Fisher, Feekery, & Rowe-Murray, 2002), it may be particularly problematic for new parents who are required to respond to the multiple changes in lifestyles, relationships, and roles and responsibilities that parenthood brings (Bozoky & Corwin, 2002; Feldman, Sussman, & Zigler, 2004). Finally, if new parents do indeed experience significant problems with fatigue, the consequences may be particularly detrimental because successful adaptation to the role of parent is important not only for their own physical and mental health, but also for the health and development of their infants (Elek et al., 2002). In order to effectively prevent and treat fatigue in first-time parents, it is important to identify factors that predict fatigue in both mothers and fathers.

Despite the attention in the literature to fatigue in parents, there are limitations to our understanding of fatigue in new parents. First, the majority of research on parental fatigue and its correlates is cross-sectional and does not distinguish between first-time and experienced parents (e.g., Bozoky & Corwin, 2002). Second, although there is reason to believe that mothers and fathers of infants differ in their experiences of fatigue (Gay et al., 2004; Nystrom & Orhling, 2004), researchers have focused primarily on the experiences of mothers (Giallo, Rose, Cooklin, & McCormack, 2013). Finally, while researchers have utilised theoretical frameworks that allow for the identification of multiple factors potentially associated with increased fatigue in new parents (Elek et al., 2002; Milligan, Flenniken, & Pugh, 1996; Milligan & Pugh, 1994), there has tended to be a focus on individually based factors (Giallo et al., in press). This is problematic, in that contextual factors, such as characteristics of the family and the infant, may also play a role in parental fatigue (Giallo et al., in press). Employing a guiding theory to identify relevant variables and conceptualise how variables such as parental, familial, and child characteristics may work together to impact fatigue would advance understanding of fatigue have important implications for the development of interventions, and facilitate an easier comparison of research results. In this longitudinal study, we examine factors associated with fatigue in first-time mothers and fathers across the transition to parenthood using the middle-range theory of unpleasant symptoms (TOUS; Lenz, Pugh, Milligan, Gift, & Suppe, 1997).

Physiological, Psychological, and Situational Factors Associated with Fatigue in Parents

TOUS (Lenz et al., 1997), which was designed to provide a theoretical framework to help understand and manage people's experiences of negative health symptoms, can be applied to the study of fatigue in new parents (Elek et al., 2002). This model has three components: the symptom experienced, influencing factors that cause or are related to the experience of that symptom, and the outcomes associated with the symptom experience (Lenz et al., 1997). Intervention studies using this model to reduce fatigue have focused on identifying and targeting the influencing factors (e.g., Milligan et al., 1996). The TOUS model categorises these influencing factors as physiological factors (e.g., functioning of bodily systems), psychological factors (e.g., mental state or mood), and situational factors (e.g., aspects of the social and physical environment).

The TOUS model has been used to study childbearing fatigue (Milligan et al., 1996; Milligan & Pugh, 1994), maternal fatigue (Elek et al., 2002; Rychnovsky, 2007), and paternal fatigue (Elek et al., 2002). As well, in support of this model, other researchers have identified individual factors within the three categories associated with parental fatigue. In terms of physiological factors, fatigue is associated with poor sleep quality in mothers during the post-partum period (Gay et al., 2004; Giallo et al., in press; Rychnovsky, 2007). Gay et al. (2004) found a significant association between poor sleep quality and higher levels of paternal fatigue during the post-partum period, while Cooklin, Giallo, and Rose (2012) found it to be associated with paternal fatigue in fathers of children under age 6. Sleep quality has been identified as the most significant predictor of maternal fatigue during the post-partum period, and sleep disruption has been identified as the most commonly reported contributing factor to fatigue by both mothers and fathers of young children (Giallo et al., 2013). Parent age has been found to be differentially associated with fatigue for mothers (Giallo et al., in press; Lee & Zaffke, 1999) and fathers (Elek et al., 2002). Younger mothers report higher levels of fatigue than older mothers at 3 months post-partum (Giallo et al., in press), but older maternal age predicts the persistence of fatigue across the post-partum period (Giallo et al., in press). Younger fathers report higher levels of fatigue than older

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fathers (Elek et al., 2002). Finally, while there is evidence that prenatal health is associated with post-partum fatigue in mothers (Lee & Zaffke, 1999), no studies were found that focused on fathers. As fatigue is often associated with medical conditions (Nijrolder, van der Horst, & van der Windt, 2008), we would expect poor health in the prenatal period to be associated with fatigue in the post-partum period for both parents.

Most researchers examining the role of psychological factors in parental fatigue have focused on depression (Bozoky & Corwin, 2002; Elek et al., 2002). There is a strong body of evidence that fatigue is associated with concurrent maternal depression in both the prenatal and post-partum periods (Bozoky & Corwin, 2002; Elek et al., 2002). However, the role prenatal depression plays in post-partum fatigue is less clear. There is evidence that other psychological factors, such as levels of parenting stress, are associated with fatigue in mothers and fathers of children under the age of 5 (Cooklin et al., 2012). As the transition to parenthood has been identified as a time of stressful change for many new parents (Cowan & Cowan, 1995), it is important to examine the relationship between stress levels and fatigue in this population.

Few studies have included situational factors in their studies of parental fatigue. Of those, the focus has been on family variables such as income (Elek et al., 2002) with lower income found to be associated with both maternal and paternal post-partum fatigue. There may also be aspects of the marital relationship associated with fatigue. For example, Doss, Rhoades, Stanley, and Markman (2009) found that having a first child more quickly following marriage to be associated with a decline in fathers', but not mothers', marital satisfaction. Thus, parents who have been together for a shorter period of time before their child's birth may still be negotiating ways of dealing with stress and therefore may be at greater risk for fatigue. As the biggest change to the family during the transition to parenthood is the addition of the infant, it seems likely that infant variables such as temperament and sleep patterns would be associated with parent fatigue. In the few studies that examined the associations between child variables and maternal fatigue, Rychnovsky (2007) found infant negativity to be associated with maternal fatigue early in the post-partum period, but Giallo et al. (in press) did not find this association later in the post-partum period. Giallo, Rose, and Vittorino (2011) found infant sleep problems to be associated with maternal fatigue, but the relationship between infant sleep patterns, such as the length of time they sleep during the night without waking, and fatigue has received less attention. Finally, no published studies were found that assessed the relationships between fatigue and infant characteristics for fathers.

In sum, there are limitations to our understanding of fatigue in new parents. As most studies have focused on parent characteristics, we know little about the associations of other variables, such as family and child characteristics and fatigue across the transition to parenthood. We also know less about the experiences of fatigue in fathers (Giallo et al., 2013). The present study was designed to assess fatigue in first-time mothers and fathers and to answer the following two research questions: (1) What is the trajectory of fatigue in mothers and fathers across the first 6 months of the transition to parenthood? 2) Which psychological factors (stress and depressive symptoms), physical factors (age, prenatal health, prenatal fatigue, and post-partum sleep quality), and situational factors (family income, duration of the parental relationship, infant negativity, and infant sleep duration) are associated with maternal and paternal fatigue during the first 6 months of the transition to parenthood? More specifically, we hypothesised that:

Hypothesis 1: Both mothers and fathers will report an increase in levels of fatigue following the birth of their baby, and their levels of fatigue will remain elevated during the first 6 months post-partum. However, mothers will report higher levels of fatigue than fathers both prenatally and in the post-partum period.

Hypothesis 2: Physical, psychological, and situational factors identified by the TOUS model will be associated with elevated post-partum fatigue for mothers and fathers. More specifically, physical factors (i.e., poorer prenatal health, higher levels of prenatal fatigue, older age, and poorer post-partum sleep quality), psychological factors (i.e., higher levels of prenatal depression and stress), and situational factors (i.e., lower family income, shorter parental relationship, infant negativity, and shorter infant sleep duration) will be associated with elevated fatigue for both parents.

Method

Participants and Procedures

This study was part of a longitudinal investigation into the transition to parenting and received approval from the University of Regina Research Ethics Board and the Regina Qu'Appelle Health Region Research Ethics Board. Cohabiting mother–father couples expecting their first child were recruited from prenatal education classes, a community baby shower, and local media in a mid-sized western Canadian city. As an incentive to participate, a draw for a $50.00 gift certificate to a popular children's store was conducted at each of the four time periods. Participants were recruited through prenatal classes,

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community baby showers/exhibits, and through flyers posted in physicians' offices. Interested parents were asked to provide a contact number to receive more information about the study and were contacted by telephone by research assistants. One hundred and sixty-one couples who expressed interest in participating in this study were contacted by telephone. One couple could not be reached, and 37 couples did not wish to participate in the study. The remaining 123 interested participants received a consent form and questionnaire packet in the mail. Of those, two couples did not complete the questionnaires, and three couples had babies that arrived early. Thus, 118 couples began the study at time 1. There were four data collection points: time 1, the third trimester of pregnancy; time 2, 1 month post-partum; Time 3, 3 months post-partum; and time 4, 6 months post-partum. Couples were interviewed in their homes at each of the time periods, and questionnaires were collected by the research assistants following these interviews. Of the 118 couples who participated at time 1, 107 remained at time 4. Ten couples that were missing fatigue data from two or more time points were excluded. Thus, the data for 108 couples were used. An attrition analysis was conducted to compare participants who were excluded from the study to those who were included for all variables that were measured at time 1. Those who were excluded had a shorter relationship with their partner (mean (*M*) = 35.8 months, standard deviation (*SD*) = 28.8) than the participants who were included (*M* = 58.5 months, *SD* = 35.3*)*; there was no other difference between the groups.

Mothers ranged in age from 17 to 42 years, with an average age of 29 years (*SD* = 4.6), while fathers ranged in age from 16 to 50 years, with an average age of 30.7 years (*SD* = 5.7). Couples had been living together for an average of 58.5 months (*SD* = 35.3), and the majority were legally married (80.6%). Participants were well educated (76.4% reported some post-secondary education), 70.4% had an average combined income over $CDN60 000 CDN, and they were predominantly Caucasian (92.1%). Although the majority of the mothers were employed at time 1 (*n* = 93; 86.1%), none was working outside of the home during the course of this study. However, all of the fathers were engaged in paid employment during the study period.

Participants were mailed a questionnaire package that mothers and fathers were asked to complete independently. Fatigue levels were assessed at the four time periods—prenatally, 1 month, 3 months, and 6 months post-partum. Prenatally, parents individually completed measures of depressive symptoms, general stress, and general health. At 1 month post-partum, each parent completed a questionnaire battery assessing parental sleep quality, infant negativity, and infant sleep duration.

Measures

Demographics

Participants provided information on their age, ethnicity, level of education, level of family income, marital status, and the length of their relationship with their partner.

Depressive symptoms

The Center for Epidemiologic Studies—Depression Scale (CES-D) was used to measure parents' depressive symptoms during the prenatal visit. The CES-D includes 20 items responded to on a four-point scale. Total scores may range from 0 to 60, and higher scores indicate greater symptomatology. Clinical utility and high internal consistency have been demonstrated previously for this measure (Radloff, 1977). The internal consistency was $\alpha = .88$.

Stress

Stress during the prenatal period was measured using the Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983). The PSS is a 14-item measure of global perceived stress. Participants are asked to rate the frequency of statements as they have taken place in the last month on a five-point scale (i.e., "In the last month, how often have you felt nervous and 'stressed'?"). Internal reliability was $\alpha = .85$.

Fatigue

The Visual Analog Scale for Fatigue (VAS-F) was used to assess fatigue levels (Lee, Hicks, & Nino-Murcia, 1991). Participants are presented with a series of 13 100-mm lines anchored by statements on either side that represent different aspects of fatigue (i.e., "Not at all sleepy" versus "Extremely sleepy"). By making a vertical mark on the line, participants are asked to assess their current fatigue levels in regards to the two anchor statements. The instrument is scored by measuring the distance of the vertical mark along each 100-mm line. A mean fatigue score is generated by averaging responses for each of the 13 items. The VAS-F has been shown to have good reliability and validity (Lee et al., 1991). Participants completed this measure once during the third trimester of pregnancy. For the three post-partum time periods, participants completed the VAS-F in the evening of two successive days. Average fatigue scores across the two evenings are used in the current analysis. Internal consistency was $\alpha = .95$ at time 1 and $\alpha = .96$ for times 2, 3, and 4.

Parental sleep quality

Parental sleep quality was assessed at 1 month post-partum using the sleep quality subscale of the General

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Sleep Disturbance Scale (Lee, 1992). This subscale consists of seven items that query the frequency in the last week (i.e., from 0 to 7) participants experienced differing aspects of sleep quality. Items include "waking up during sleep" and "having difficulty getting to sleep." Higher scores on this scale indicate poor sleep quality. Lee (1992) reported an internal consistency of $\alpha = .88$. In this study, internal consistency was $\alpha = .76$.

General health

General health was measured prenatally using a single question: "In general, would you say your health is . . ." Participants made their selection on a five-point Likert scale from excellent to poor. Higher scores are indicative of poorer health.

Infant negativity

Infant negativity was assessed at 1 month post-partum using the Infant Characteristics Questionnaire (Bates, Freeland, & Lounsbury, 1979). This 24-item measure is rated on a seven-point scale relating to the parents' perceptions of their infant. Overall scores on the six-item fussy/difficult subscale (e.g., "How easy or difficult is it for you to calm or soothe your baby when he/she is upset?") were used in this study to assess infant negativity. Bates et al. (1979) reported an internal consistency of this scale of $\alpha = .82$. The internal consistency in this study was $\alpha = .82$.

Infant sleep duration

Participants were asked to track over an average 24-hr period the amount of time their infant slept at 1 month post-partum. This tracking took the form of a chart made up of four 6-hr time rulers corresponding to the morning (6:00 a.m. to noon), afternoon (noon to 6:00 p.m.), evening (6:00 p.m. to midnight), and night (midnight to 6:00 a.m.). Each time ruler was labelled hourly and further demarcated by 5-min intervals. Parents completed this measure independently. We calculated the average number of hours in a row in the evening that the infant slept.

Results

Analyses

Preliminary analyses (descriptive statistics and correlations) were computed, then three-level hierarchical linear models (Raudenbush & Bryk, 2002) were conducted using HLM 7.01 software (Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2011) to examine the associations among parental fatigue, physical and psychological factors (parental characteristics), and situational factors (characteristics of the family and the infant). This technique allowed for an examination of change in fatigue for each parent over the course of three post-partum time points (at 1, 3, and 6 months; level 1). The repeated measures of fatigue at level 1 are nested within individual parents (level 2; measures include physical and psychological factors such as parental age, health, depression, and stress), which are nested within the family (level 3; measures assess family and child characteristics including family income, length of parental relationship, infant negativity, and infant sleep duration). Determining statistical power for multilevel models is complex but is strongly influenced by total sample size at each level (Dedrick et al., 2009); our sample of 108 couples was adequate for the model being tested (Maas & Hox, 2005). The time variable was centred around the initial post-partum data collection so that baseline fatigue is 1 month after the birth of the child.

First we estimated a fully unconditional model (level 1 with no level 2 or 3 predictors). This model provides evidence that there is sufficient variance explained to proceed with a test of conditional models. Second, we estimated a level 1 time only model (no level 2 or 3 predictors), with random intercepts and coefficients to determine if the starting point (intercept) and rate of change (slope) in post-partum fatigue randomly varied across parents, as well as the overall trajectory of parental fatigue. A quadratic factor was not estimated because a preliminary examination of the data suggested that parental fatigue tended to follow a linear trajectory.

The third step was to specify a two-level model to explain variability in parental fatigue as a function of individual parental characteristics. Finally, we estimated the three-level model to explain variability in parental fatigue as a function of family characteristics (i.e., couple and child). Because there were a large number of level 2 and level 3 variables, inclusion of variables in the level 2 and 3 models was based on (1) theoretical importance and (2) the use of an iterative process examining the statistical significance of the predictors and changes in overall model fit (Raudenbush & Bryk, 2002).

All continuous level 2 and 3 predictors were grand-mean centred; dichotomous predictors were not centred. Full maximum likelihood estimation was used for all models, and the reported results were based on the robust standard errors. Changes in model fit were assessed by an examination of pseudo R^2 and the statistical significance of the changes in the deviance statistics (Luo & Azen, 2013; Raudenbush & Bryk, 2002). Pseudo R^2 provides the amount of variance accounted for by adding new predictors to the model. Changes in the deviance statistic assesses model fit as a function of model

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complexity with progressively smaller values for deviance suggesting better model fit.

Missing Data

There were minimal missing data. For the longitudinal fatigue data, HLM allows for incomplete data so that parents who were missing only one time point could be included in the analyses. Because the amount of data missing for level 2 and 3 predictors was relatively small (0–3.2%), mean substitution was used to maintain sample size.

Descriptive Statistics

The *M*, *SD*, and results of dependent *t*-tests comparing mothers and fathers for all predictor and outcome measures are presented in Table 1. Mothers reported more fatigue than fathers prenatally and at 1 and 6 months post-partum. Fathers were older than mothers and reported worse health. Mothers, as compared with fathers, reported more stress, depression, and poorer sleep quality than fathers prior to the birth of their children. Finally, fathers rated their infants as more negative than mothers.

Correlations between all predictor and outcome measures for mothers and fathers separately are presented in Table 2. An examination of the correlations suggests that many of the relationships among variables are similar for mothers and fathers. There was no evidence of multicollinearity suggesting our measures are assessing unique constructs. For mothers and fathers, post-partum fatigue was positively related to stress, depression, and general sleep quality. To examine differences between the correlations for mothers and fathers, r-to-z transformations were computed (Cohen & Cohen, 1983; see Table 2). The relationship between fatigue, health, and depression was generally stronger for fathers than it was for mothers. For example, fathers' post-partum fatigue at 6 months was moderately related to prenatal depression ($r = .38$) compared with the smaller relationship for mothers ($r = .16$); fathers' 6-month post-partum fatigue was related to their prenatal health with more fatigue related to poorer health ($r = .23$), but there was no such relationship for mothers ($r = .00$). Furthermore, age seems to be more strongly related to stress and depression levels for mothers than for fathers, such that mothers' younger age was related to significantly more stress ($r = -.24$) and depression ($r = -.35$). For fathers, age was unrelated to stress ($r = .01$) and depression ($r = .02$).

Although both mothers' and fathers' post-partum fatigue was related to depression and sleep quality, mothers' fatigue seems to be more strongly related to characteristics of the child than that of fathers. For example, for mothers the relationship between 3-month

Table 1 Descriptive statistics for predictor and outcome measures comparing parents

Measures	*n*	Mothers	Fathers	*t*
		M (*SD*)	*M* (*SD*)	
Outcome				
Fatigue—1 month	104	55.94 (18.43)	50.78 (15.03)	2.71**
Fatigue—3 months	104	52.02 (19.62)	48.93 (18.42)	1.39
Fatigue—6 months	104	56.49 (19.35)	50.64 (17.66)	2.58*
Level 2 predictors				
Prenatal fatigue[a]	106	43.89 (16.19)	32.39 (19.18)	5.43***
Age[a]	107	28.96 (4.65)	31.37 (8.60)	–3.45*
Education[a]	108	3.25 (.95)	3.18 (1.09)	.53
Health[a]	107	2.20 (.85)	2.47 (.83)	–2.62**
Stress[a]	107	22.52 (6.77)	20.60 (6.71)	2.47*
Depression[a]	107	13.07 (8.32)	9.28 (7.30)	4.52***
Parental sleep quality[b]	104	26.92 (8.34)	22.04 (8.63)	4.42***
Level 3 predictors				
Family income[ac]	105	4.09 (1.22)	4.09 (1.22)	—
Length of relationship[ac]	108	58.55 (35.39)	58.55 (35.39)	—
Infant negativity[b]	105	20.71 (5.21)	21.91 (4.84)	–2.55*
Infant sleep[b]	107	3.96 (1.35)	3.86 (1.47)	.82

****$p < .10$; ***$p < .001$; **$p < .01$; *$p < .05$.

[a]Assessed prenatal. [b]Assessed 1 month post-partum. [c]Parent's score identical.

Notes. Education: 1 = less than high school, 6 = doctoral degree; health: 1 = excellent, 5 = poor; total family income: 1 = <$20 000, 5 = > 80 000; length of relationship: months; infant sleep: hours in a row.

M, mean; *SD*, standard deviation.

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Table 2 Correlations between predictor and outcome measures for mothers and fathers

	1	2	3	4	5	6	7	8	9	10	11	12	13
Fatigue—1 month	—	.43***	.33***	.18****	.13	.09	.19*	.18****	.18****	−.09	.13	.28**	−.27**
Fatigue—3 months	.54***	—	.60***	.28**	.10	.01	.13	.14	.25*	−.06	.00	.25**	.18****
Fatigue—6 months	.54***	.59***	—	.18****	.11	.00	.14	.16****	.28**	−.14	.04	.06	−.04
Prenatal fatigue	.38***	.42***	.41***	—	−.20****	.32***	.33***	.53***	.24**	−.17****	−.24*	.07	−.02
Age	.13	−.03	.03	.07	—	−.12	−.24*	.35***	.10	.52***	.50***	−.02	−.17****
Health	.21*	.23*	.23*	.24*	.10	—	.32***	.41***	.12	−.24*	−.06	.01	.19*
Stress	.14	.14	.28**	.27**	.01	.31***	—	.69***	.23*	−.25**	−.14	.09	.12
Depression	.18****	.20*	.38***	.42***	.02	.31***	.61***	—	.28**	−.34***	−.26**	.06	.13
Parental sleep	.27**	.24*	.27**	.25*	.20*	.13	.01	.13	—	.03	.00	.08	.06
Family income	.08	−.02	−.03	−.08	.23*	−.22*	−.22*	−.21*	.08	—	.24**	.04	−.14
Relationship length	−.02	.02	.05	−.11	.18****	−.01	−.08	−.08	.00	.24**	—	−.04	−.08
Infant negativity	.11	.03	.17****	.06	.06	.14	.09	.10	.18****	.02	−.10	—	−.18****
Infant sleep	−.07	−.08	−.06	−.01	.13	.08	.05	.03	−.20*	−.14	−.08	−.06	—

****$p < .10$; ***$p < .001$; **$p < .01$; *$p < .05$.

Notes. Correlations between variables for mothers are above the diagonal and correlations between variables for fathers are in italics below the diagonal. Correlations that differed between mothers and fathers on r-to-z transformations are shown in bold.

post-partum fatigue and infant negativity was moderate ($r = .25$) whereas there was no relationship between the infant negativity and fathers' 3-month post-partum fatigue ($r = .03$).

Hierarchical Linear Model

We initially examined the fully unconditional model (level 1 with no level 2 or 3 predictors) to estimate the variance across parents and families with no predictors. An examination of the interclass correlation coefficients indicated that 49.57% of the variability in post-partum fatigue is due to between parent variability, with 24.38% of this variability due to between family variability. Individual parents showed statistically significant variability with respect to the intercept (i.e., initial fatigue at 1 month post-partum). There was also statistically significant variability across families suggesting variability in intercepts that has the potential to be explained by both the level 2 and level 3 predictors (see Table 3). Second, we estimated the level 1 time only model, which adds time as the only predictor (no level 2 or level 3 predictors), with random intercepts and coefficients to determine if the starting point (intercept) and rate of change (slope) in post-partum fatigue randomly varied across parents, as well as the overall trajectory of parental fatigue. The effect of fatigue across time was not statistically significant, suggesting a relatively flat overall trajectory for parental fatigue. However, in addition to variability in parents and families with respect to baseline fatigue, this model also indicated that there was statistically significant variability with respect to the slope for individual parents (i.e., change in the fatigue over the post-partum period). The model improved on the fully unconditional model (deviance = 5335.91, parameters = 7, $\chi^2 = 9.57$, degrees of freedom (df) = 1, $p < .05$) with pseudo $R^2 = .2402$, suggesting that about 24% of variation in fatigue across parents is accounted for by time.

Based on these findings, the level 2 and 3 models retained the fixed effect of time and allowed for random variability in parent and family intercepts, as well as random variability in parent slope (see Table 3). The next series of models was run to consider hypotheses regarding the relationship between post-partum fatigue (intercept and slope) and individual parental characteristics (level 2 predictors). Each potential level 2 predictor was entered individually with the random intercept and random slope allowed to vary across individuals to allow for different initial levels of fatigue as well as different trajectories of fatigue during the post-partum period. The following variables were considered as potential level 2 predictors: parent's gender and age, prenatal fatigue,

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Table 3 Hierarchical linear modelling analyses for association between parental characteristics, family characteristics, and parent fatigue

Fixed effects	Fully unconditional model			Time only model			Final level 2 model			Final full model		
	Coefficient	*SE*	*t*	Coefficient	*SE*	*t*	Coefficient	*SE*	*t*	Coefficient	*SE*	*t*
Average intercept, β_{00}	52.52	1.18	44.44***	52.70	1.32	39.75***	52.21	1.43	36.40***	52.19	1.34	38.87***
Average slope (Time), β_{10}				−.08	.27	−.30	−.07	.26	−.28	−.08	.27	−.28
Level 2												
Parent gender, β_{01}							.96	1.45	.66	1.00	1.47	.68
Depression, β_{02}							.19	.11	1.71****	.21	.11	1.99*
Gender × fatigue, β_{03}							.22	.06	3.59***	.22	.06	3.56***
Parental sleep, β_{04}							.36	.10	3.46***	.34	.10	3.26***
Level 3												
Infant sleep, β_{10}										−1.59	.82	−1.96*
Random effects	Variance	*df*	χ^2	Variance	*df*	χ^2	Variance	*df*	χ^2	Variance	*df*	χ^2
Parent intercept, π_{00}	83.35	108	266.35***	63.33	108	213.55***	49.34	104	208.96***	47.64	104	207.67***
Parent slope, π_{10}				3.33	215	287.53***	3.16	215	285.63***	3.18	215	285.83***
Family intercept, μ_{00}	80.67	107	232.27***	83.87	107	244.59***	65.20	107	236.03***	60.88	106	227.66***

****$p < .10$; ***$p < .001$; **$p < .01$; *$p < .05$.
df, degrees of freedom; *SE*, standard error.

health, stress, depression, and parental sleep quality at the post-partum baseline.

Mothers reported significantly more post-partum fatigue than fathers (coefficient = –4.70, standard error (*SE*) = 1.50, $p = .002$). Age was unrelated to post-partum fatigue (coefficient = .01, $SE = .14$, $p > .05$). The effect of prenatal fatigue was statistically significant with those reporting more prenatal fatigue also reporting more post-partum fatigue (coefficient = .30, $SE = .05$, $p < .001$). Health was a marginally significant predictor of post-partum fatigue (coefficient = 1.84, $SE = 1.06$, $p = .086$). Higher levels of prenatal stress (coefficient = .04, $SE = .14$, $p = .001$) and prenatal depression (coefficient = .46, $SE = .11$, $p < .001$), as well as poorer initial post-partum parental sleep quality (coefficient = .51, $SE = .10$, $p = .001$) were related to higher levels of post-partum fatigue.

Because an examination of the average level of fatigue suggested that fathers had less fatigue than mothers prior to the birth of the child, presumably because of the fatigue related to pregnancy, a gender by time variable was included, which reflects the change in fatigue experienced by males and females between the prenatal and post-partum periods. As can be seen in Fig. 1, fathers were less fatigued than mothers prior to the birth of the child but then reported being consistently more fatigued

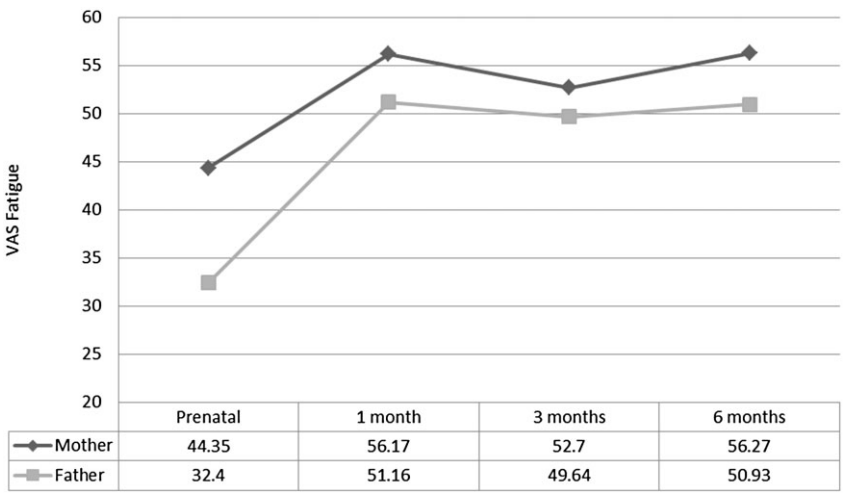

Figure 1 The interaction of gender and time (change from prenatal to post-partum).

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and much closer to mothers' levels of fatigue at the three post-partum time points (coefficient = .32, $SE = .06$, $p < .001$).

Level 2 predictors that were statistically significant were considered for inclusion in the final level 2 model (Raudenbush & Bryk, 2002). Because the levels of prenatal stress and depression were highly related, prenatal depression was selected for inclusion in the final model based on a consideration of deviance statistics and variance accounted for by each of the variables. Thus, the final level 2 model included gender, the gender by time interaction, prenatal depression, and parental sleep quality at 1 month post*partum as the predictors of fatigue across parents (see Table 3). The effect of prenatal fatigue alone was not included in the level 2 model because inclusion of this measure accounted for much of the variability in post-partum fatigue (i.e., those that were initially fatigued remained fatigued) but eliminated our ability to see the contributions of gender, depression, and sleep quality. Parent gender is no longer significant, and parent's level of prenatal depression is only marginally significant. The parent gender by time interaction, as well as parental sleep quality at 1 month after the birth of the child contributed to prediction of fatigue in this model. The model improved on the time only model (deviance = 5291.72, parameters = 11, χ^2 =44.19, $df = 4$, $p < .001$) with pseudo $R^2 = .2204$ suggesting that an additional 22% of the between parent variability in fatigue is accounted for by the level 2 predictors.

Finally, a series of models was run to consider hypotheses regarding the relationship between post-partum fatigue (intercept and slope) and family characteristics (i.e., family income, length of parental relationship, infant negativity, and infant sleep). Each potential level 3 predictor was entered individually to the final level 2 model described above. Family income, infant negativity, and length of parental relationship were not retained in the level 3 model.

The final full model included gender, the gender by time interaction, prenatal depression, and parental sleep quality at post-partum baseline as level 2 predictors and the number of hours the infant sleeps in a row as the only level 3 predictor (see Table 3). Parent gender remained non-significant, but the gender by time interaction, prenatal depression, and parental sleep quality were all statistically significant. This model improved on the level 2 model (deviance = 5287.60, parameters = 12, $\chi^2 = 4.12$, $df = 1$, $p < .05$) with pseudo $R^2 = .0350$ suggesting that infant's sleep predicts an additional 3.5% of variability in fatigue between parents. Furthermore, the inclusion of level 2 and 3 predictors improved on the time only model with Pseudo $R^2 = .2453$, suggesting that these variables accounts for 24.5% of variability in fatigue across families.

Discussion

Through our focus on first-time mothers and fathers, and our use of the TOUS model, we extend research on fatigue in mothers and fathers across the transition to parenthood. Consistent with our expectations, levels of maternal and paternal fatigue increased following the birth of their infant and then remained relatively consistent over the next 6 months. Mothers tended to be more fatigued than fathers at each time point. However, the gender by time interaction reflected the large increase in fatigue reported by fathers between the prenatal and initial post-partum period. Thus, the gap between mothers' and fathers' ratings of fatigue narrowed substantially following the birth of the child. Furthermore, our finding of a flat trajectory of fatigue, with mothers and fathers reporting high levels of fatigue throughout the post-partum period, supports the claim that fatigue continues to be an issue for parents beyond the initial transition period. Given the negative consequences of fatigue for parents' physical and mental health, as well as the health and development of their infants (Elek et al., 2002), these findings highlight the necessity to inform expectant parents about the detrimental aspects of fatigue and provide assistance and strategies for managing it.

Our findings also revealed significant variability in levels of fatigue in mothers and fathers, which highlights the need to identify and target factors associated with fatigue for prevention and intervention purposes. Employing the TOUS model provided us with the theoretical framework necessary to identify and examine potential physical, psychological, and situational factors associated with increased fatigue in mothers and fathers. In terms of physical factors, consistent with prior research (Gay et al., 2004), poor sleep quality at 1 month post-partum was associated with fatigue in mothers and fathers across the post-partum period. However, while both parents reported poor sleep quality, it may be that the source of poor sleep differs for mothers and fathers. We expected that shorter duration of infant sleep would be associated with poorer parental sleep quality, but that was only true for fathers. For the mothers, poor sleep quality was associated with higher levels of stress and depressive symptoms. This suggests that helping mothers manage stress and depressive symptoms may be more beneficial to improving their sleep quality then focusing on infant sleep patterns. Given the bidirectional relationship between maternal mood and sleep (Park, Meltzer-Brody, & Stickgold, 2013), improving mothers' sleep may also increase their mood and decrease their stress.

We found higher levels of prenatal fatigue to be associated with higher levels of post-partum fatigue for both

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mothers and fathers. Thus, assessing levels of fatigue during the prenatal period can help identify mothers and fathers who are at risk for elevated fatigue in the post-partum period. Our finding that poorer health during the prenatal period was related to fatigue for fathers only may reflect differences in the types of poor health experienced in the prenatal period. Mothers' reports may be largely based on issues surrounding pregnancy, which are resolved with birth, while fathers are likely to be reporting more chronic health issues. Contrary to expectations, age was not associated with post-partum fatigue for either mothers or fathers. However, younger mothers reported higher levels of stress and depressive symptoms than older mothers.

In terms of psychological correlates of fatigue, while prenatal levels of stress were associated with fatigue for mothers and fathers, the timing of this association differed. For mothers, stress was associated with fatigue when their infants were 1 month old. For fathers, stress was associated with fatigue when their infants were 6 months of age. A similar pattern emerged for prenatal depressive symptoms, which were associated with mothers' and fathers' fatigue during the first 3 months but more strongly related to fathers' fatigue at 6 months. Perhaps this increase in the relationship between psychological functioning and fatigue for fathers reflects increasing work–family conflict as the infant gets older. Steinberg, Kruckman, and Steinberg (2000) found Canadian fathers whose wives were on parental leave reported feeling stress from both work and family domains. Future research should focus on the role that work–family conflict may play in parents' psychological health during the post-partum period. These findings also highlight the importance of assessing and addressing depressive symptoms and stress levels in parents beyond the first few months of parenthood.

In terms of situational factors, we examined the associations between family-based and infant-based factors and parental fatigue. Contrary to expectations, neither family income nor length of couple relationship was associated with fatigue. While prior studies have found a relationship between lower income and fatigue (Elek et al., 2002), the lack of association in our study may be due in part to the characteristics of our sample. Overall, our parents' reported moderate or high family incomes (Findlay & Kohen, 2012). We had expected that couples who had their first child more quickly in the relationship would be more fatigued, as the transition to parenthood in general may be more difficult for these couples. However, it may be more useful to study other characteristics, such as the quality of the marital relationship and their association with fatigue. While we expected infant characteristics to be associated with fatigue in mothers and fathers, this was only partially true. Infant negativity was associated with mothers' fatigue during the first 3 months post-partum, but related to fathers' fatigue only at 6 months and then only marginally. Contrary to our expectations, infant sleep duration was associated with maternal, but not paternal, fatigue during the first 3 months. Considering additional variables such as amount of involvement fathers have with their infants may help clarify these findings.

Our use of multilevel modelling allowed us to examine which physiological, psychological, and situational correlates predict persistent fatigue in mothers and fathers during the first 6 months post-partum. In our final hierarchical model, prenatal depression, parental sleep quality, the gender by time interaction, and infant sleep duration were significant predictors of parental fatigue. These findings provide further evidence of key areas for potential interventions with parents. Recognising that both mothers and fathers experience elevated fatigue across the post-partum period that tends to be exacerbated for individuals with pre-existing fatigue, depressive symptoms, and poor sleep quality should be considered as part of prenatal screening. Between-family characteristics tended to be less related to parental fatigue than hypothesised, although having a child that sleeps fewer hours in a row contributed to the prediction of mothers' post-partum fatigue in our final model. However, infant sleep duration in this study may be impacting mothers' fatigue through its association with other factors, such as levels of stress and depressive symptoms.

While fatigue levels in both mothers and fathers remained elevated during the first 6 months post-partum, it may be that the reasons why mothers and fathers remain fatigued in the post-partum period differ. One situational factor that should be considered in studies of Canadian parents is parental leave. In Canada, the Unemployment Insurance Act provides 35 weeks of paid parental leave after the birth of a child. Even though men are eligible, only 9% of employed Canadian fathers take parental leave after the birth of a child (Beaupré & Cloutier, 2007). Thus, the majority of employed fathers in Canada continue to work outside the home over the transition to parenthood, while the majority of employed mothers do not (Beaupré & Cloutier, 2007). This was true in our study, where all of the mothers who had been employed prenatally were receiving parental benefits and not working outside of the home. While contemporary fathers are more involved in the caretaking of children than their fathers had been, mothers are still responsible for the majority of childcare responsibilities, particularly with respect to infant care (Loutzenhiser, Sevigny, & Thompson, 2010). This may be particularly true in families where mothers are taking parental leave and be

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associated with mothers' high levels of fatigue. Fathers' fatigue, however, may be associated with their attempts to balance the demands of paid employment with their role as parents (Giallo et al., 2013). It may be that fathers are struggling with meeting the multiple demands of paid employment and new parenthood, and high fatigue levels are a consequence. Future research should examine the role that parental leave and employment status and division of labour plays in post-partum fatigue in mothers and fathers.

Limitations

The present study expands our understanding of fatigue in first-time mothers and fathers across the transition to parenthood and identifies physical, psychological, and situational factors associated with fatigue that can be targeted for prevention and intervention purposes. However, there are some limitations to this study that must also be noted. First, our participants were predominately well-functioning, Caucasian couples with moderate to high levels of income where fathers were employed and the majority of mothers were on parental leave. It is not known how our findings would generalise to more ethnically diverse populations with differing socio-economic status. Future research with a more diverse set of parents is necessary. Second, although the present study included variables that have been identified as important in the literature, future research could consider additional variables likely to be associated with fatigue such as parental relationship quality, work–family conflict, social support, and stressful life events. Third, while our use of HLM allowed us to examine the correlates of fatigue within families, our sample size was not large enough to assess the complex nature of the relationship between gender and child characteristics. Furthermore, future research should consider how changes in situational characteristics over the post-partum period relate to changes in fatigue as parents adjust to their new infant. This would allow for clearer causal interpretations than were possible in the present study (e.g., do changes in stress or infant sleep lead to changes in fatigue?). Finally, reliance on self-report measures is potentially problematic; future studies should consider the inclusion of clinical assessments for variables such as parental depression, health, and infant negativity.

Conclusions and Implications for Future Research

In sum, Canadian mothers and fathers are experiencing high levels of fatigue following the birth of their first child, and they remain fatigued at 6 months post-partum. Moreover, post-partum fatigue is a particular problem for parents reporting high levels of fatigue during the prenatal period. Taken together, these findings highlight the need for health professionals to educate expectant parents on fatigue and work on the development of interventions to reduce it during the post-partum period. Our results also highlight that while there are similarities in first-time mothers' and fathers' experiences of fatigue during the transition to parenthood, important differences are also present. In particular, mothers' poorer psychological functioning was associated with fatigue early in the post-partum period, while for fathers this association was apparent only at 6 months. This suggests that sources of fatigue in mothers and fathers may differ, and, consequently, interventions to help parents manage fatigue need to reflect these differences. Finally, our results indicate that the TOUS model is a useful theoretical framework for studying parental fatigue. While in this study we focused on only one component of the model (influencing factors), future research should include a more thorough examination of the nature of fatigue itself (e.g., duration and intensity) as well as the relationships among the fatigue, influencing factors, and functional outcomes (e.g., parenting behaviours).

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