A Longitudinal Analysis of Total Workload and Women's Health After Childbirth

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Objectives: To examine the association of women's postpartum health with total workload (TWL), work and personal factors in the year after childbirth. **Methods:** Employed women from Minneapolis and St Paul, Minnesota, were recruited while hospitalized for childbirth. Longitudinal analyses, using fixed effects regression models, estimated the associations of TWL, job satisfaction and stress, social support, perceived control, breastfeeding and infant characteristics with women's health at 5 weeks, 11 weeks, 6 months, and 12 months postpartum. **Results:** Increased TWL over time was associated with significantly poorer mental health and increased symptoms. **Conclusions:** High TWL–including reduced time for rest, recovery, and sleep–is a risk factor for women's mental health and symptoms 12 months after childbirth. Women's postpartum health was positively associated with social support, which may help to decrease the negative effects of excess work.

There have been drastic changes in labor force participation by new mothers in the United States. Labor force participation rates for mothers of infants (children under the age of 1 year) have increased from 31% in 1976 to 56% in 2008.[1,2] These changes apply to both married and single mothers, as well as first-time and experienced mothers. In 1961–1965, only 17% of new mothers returned to work in the year after childbirth, compared to 64% in 2000–2002.[3]

Despite the increasing presence of women in the workforce, they continue to have more responsibility for domestic work than their male counterparts, as noted in a review on work roles of women in the United States, Sweden, and the Netherlands.[4] This traditional gender role pattern for domestic work has also been observed in several Swedish studies,[5,6] even when men and women are matched for age, education, presence of children in the home, type of job, and full-time employment.[5,7,8]

The association between total workload (TWL), or time spent on paid and unpaid work, and the prevalence of clinical symptoms has not been consistent. While one study of Swedish employees found no short-term association between TWL and physiologic symptoms,[7] other studies have found significant TWL/health relationships.[5,8–11]

One study revealed a TWL/age interaction: older women with high TWL reported the most symptoms, while younger women with high TWL reported the fewest symptoms.[8] Two other reports discussed a work/job strain interaction, where higher levels of domestic responsibilities combined with increased job strain were associated with increased symptoms.[5,9] Symptoms resulting from high TWL have been shown to contribute to increased work absence for women, but not men,[11] a finding important to employers and coworkers.

Reviews of the literature suggest that long work hours are also associated with specific adverse health outcomes, in particular, cardiovascular disease, diabetes, and subjectively reported physical ill health and fatigue,[12] in addition to lower levels of work life balance.[13] Nevertheless, we lack well-controlled, longitudinal studies that investigate the associations between hours of employment, home chores, and family care with mental and physical health throughout the life cycle.

TWL is particularly relevant for mothers who return to work soon after childbirth, as they will also be recovering from pregnancy and childbirth and integrating infant care into their usual daily responsibilities. Many mothers will continue to experience mild to moderate discomforts for several weeks after childbirth (eg, fatigue, breast soreness, cesarean-section, or episiotomy discomfort)[14,15] and some face serious conditions, such as postpartum depression,[16] that may limit daily function for months.

Women's recovery from childbirth and resumption of work and family commitments are likely to be influenced by personal factors such as preexisting health status, the availability of social support from family and friends,[17–19] and work-related factors such as job stress, workplace support, and length of maternity or family leave.[17] Nevertheless, few longitudinal studies have examined these factors in association with women's postpartum health. This study extends previous research by investigating the association of women's postpartum health with TWL and potentially modifiable factors, such as job stress and social support at work and home using panel data collected during the first year after childbirth.

The theory underlying this analysis is a hybrid model of health and workforce participation, adapted from the economic theories of Becker[20] and Grossman[21] and the psychobiological stress model of Frankenhaeuser.[22] The theoretical model assumes that health is determined by genetic endowment, demographic factors, and personal choices. As applied to this study, it emphasizes the dynamics of women's choices to allocate their time between paid work and unpaid work at home. It assumes that the sum of time spent contributing to personal and family responsibilities and time spent in paid employment must equal the total time available (24 hours a day). The theory provides a framework for examining women's choices of time and resources to achieve personal objectives related to postpartum recovery, family care-giving, household responsibilities, and paid employment after childbirth subject to constraints such as time and budget (household income). The theory assumes that factors, such as age and education, will influence health, and economic and social factors, such as wages and employment benefits (paid leave policies, health insurance), influence individual choices.

In Frankenhaeuser's[22] related psychobiological stress model, stress is defined as an imbalance between one's perceived demands and perceived resources. Stress may arise from overstimulation through work overload and too much responsibility, as well as by

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understimulation, due to lack of meaningful activities, or monotonous and repetitive tasks.[23] Nevertheless, an individual's ability to cope with heavy demands or stress may be fostered by situations that balance external demands and personal ability, personal control (the ability to predict and plan), job satisfaction, and social support (including supervisor and coworker support).[23] The application of these theories to this study provides a context for our hypotheses.

We expect women's postpartum health to be associated with the following:

1. Less TWL.[6,13]
2. Breastfeeding, though the direction is unclear. In the early months after childbirth, breastfeeding may have both short-term problems such as breast symptoms, fatigue, and hot flashes[24] and positive consequences such as more rapid weight loss and involution of the uterus.[25]
3. Social support.[17]
4. Perceived control over paid work and domestic activities.[17,22,23]
5. Job satisfaction[21] and lower levels of job stress.[22]
6. Infant's temperament and sleep.[25]
7. Greater time interval from childbirth (eg, up to 12 months postpartum); few studies have examined women's health beyond the early postpartum period.[17,24]

MATERIALS AND METHODS

Design and Sample

This study utilized a prospective cohort design. Women were recruited from three hospitals in the Minneapolis and St Paul metropolitan area in 2001 while hospitalized for childbirth. Sample selection criteria included being at least 18 years of age, English literate, residing in the seven county metropolitan area, giving birth to a singleton infant with no serious complications, having been employed and intending to return to work after childbirth.

Data were collected in person at enrollment and by telephone upon hospital discharge at 5 weeks, 11 weeks, 6 months, and 12 months after delivery. The rationale for collecting data at the selected time periods relates to changes in women's work patterns after childbirth and the potential impact of these changes on health over time.

Among 2736 women giving birth at study hospitals during the enrollment period, 1157 were eligible to participate. Of those eligible, 817 enrolled in the study (response rate: 71%). Of the 1579 women excluded, 581 (37%) were ineligible because of sample selection criteria (eg, county of residence and neonatal complications) and 998 (63%) did not meet employment-related eligibility criteria. Sample characteristics included 77% married, 78% white, 11% Asian, 9% African American, and 1% Native American. Additional details regarding sample characteristics are provided in a previous report.[24] Of the 817 women who enrolled in the study, 716 (88% of enrolled women) completed an interview, on average, at 5 weeks, 638 (78%) at 11 weeks, 603 (74%) at 6 months, and 554 (68%) at 12 months after childbirth.

Procedures

After approvals were given by the institutional review boards for Protection of Human Subjects in Research, perinatal nurses enrolled mothers in the study. Nurses reviewed the hospital's birth log and charts to identify all women that delivered during the study enrollment period and conducted in-person interviews before discharge. Demographics and health information were collected from hospital records. Information on women's health, employment, and job characteristics were collected by computer-assisted telephone interviews.

Measures

Health Outcome Measures

Health outcome measures, which include the SF-12 and symptoms score, were assessed at 5 weeks, 11 weeks, 6 months, and 12 months postpartum. The SF-12 (Version 2), is a 12-item measure of general health, which includes the physical component summary and mental component summary scores. The physical component summary score includes items that measure physical function, bodily pain, general health, and role limitations due to physical health; the mental component summary score includes mental health, social function, vitality, and role limitations due to emotional health.[26] Because the SF-12 is standardized and norm-based, scores above and below 50 are above and below the average, respectively, in the general US population, and higher scores denote better health.[26]

Symptoms Score. The 28-item symptoms score, described in an earlier paper,[24] assesses the presence of symptoms potentially associated with childbirth and the first postpartum year, including acne, rash, hair loss, headaches, runny or stuffy nose, sore throat, cough or cold, bronchitis or pneumonia treated by a physician or other health care provider, asthma, sinus trouble, high blood pressure treated by a physician or other health care provider, irregular heart beats, decreased appetite, diarrhea or stomach flu, abdominal pain including indigestion, hemorrhoids, constipation, back or neck pain, numbness or tingling of hands, breast discomfort, nipple irritation, breast infection or mastitis treated with antibiotics, decreased desire for sex, uterine infection treated with antibiotics, fever above 38°C (100°F), hot flashes, fatigue, and dizziness.

Independent Variables

The independent variables included work-related and personal factors that were measured at all four time periods.

Work-Related Factors

TWL Adapted from Mårdberg et al,[27] it was defined as the total daily hours spent on paid work and unpaid duties (travel to and from paid work and day care, domestic chores, running errands outside of the home, yard work, and family care, including infant care). Not included in TWL was time spent sleeping, performing personal care, or participating in leisure activities. TWL was measured by the recall method given the time constraints of the study population and the need to minimize respondent burden. Women reported their time (in increments of one-half or 1 hour) for their most recent workday, if working for pay, and their most recent day, if they were on leave from their workplace. Even if they were on leave from work, women were asked about their time spent working at their usual paid work activities. Face validity of the TWL measure was assessed by interdisciplinary experts on the research team, and content validity was evaluated in a pilot study with mothers at a day care center; appropriate modifications followed. Reliability for two components of TWL—hours of sleep and paid work—was verified by comparing responses on the TWL scale with those from questions located elsewhere in the survey, and there were no significant differences.

A substudy comparing three data collection methods for the TWL measure—diaries, worksheets, and computer-assisted telephone interviews—was also conducted at 12 months postpartum to assess the tradeoffs in precision of TWL data with participant burden and response rates. Fifty randomly selected women were mailed diaries, the most precise data collection method with the most participant burden. Another 50 randomly selected women were mailed TWL worksheets (intermediate level of precision and participant burden), and the remaining women were interviewed by computer-assisted telephone interviews (same precision as the worksheet and least respondent burden). Data on TWL for the three groups were compared to assess the magnitude and direction of any bias. Women in the computer-assisted telephone interview group reported

higher average workloads (mean: 15.25 hours, SD: 1.64) compared to women using the mailed worksheet (mean: 14.73 hours, SD: 1.1) or mailed diary (mean: 13.7, SD: 1.71; F = 17.46, $P = 0.000$). Given these findings, a sensitivity analysis of the data relative to the measures of TWL was conducted as described later in the Analytic Plan.

Perceived Control. Taken from Mårdberg et al,[27] this item asked: "How much control have you had over the time and effort spent caring for family, doing home chores or paid work?" (Responses: 1 = none/very little control, 2 = some control, 3 = a lot of control, 4 = complete control.)

Supervisor and Coworker Support. Taken from Bond et al,[28] items asked: "My supervisor has been helpful to me when I have had to take care of personal or family matters," and "My coworkers have been supportive of me when I had to take care of personal or family matters." (Responses: 1 = strongly disagree to 4 = strongly agree were collapsed into a dichotomous score where 1 = agree and 0 = disagree).

Job Stress. Taken from Mårdberg et al,[27] items asked: "How often do you have too much to do?" and "How often do you experience stress from your job?" (Responses: 1 = never, 2 = rarely, 3 = sometimes, 4 = usually, 5 = almost always.) A summary score was computed. The alpha reliability ranged from 0.75 to 0.77 across the four time periods.

Job Satisfaction. Taken from Quinn and Staines,[29] this item asked: "In general, how satisfied are you with your job (even if you are on leave)?" (Responses: 1 = very dissatisfied to 4 = very satisfied; these were collapsed into a categorical measure, where 1 = satisfied and 0 = dissatisfied.)

Personal Factors

Available Social Support. Taken from Sherbourne and Stewart,[30] scale items asked: "How often are the following kinds of support available to you, if needed: someone to (1) confide in or talk about your problems, (2) get together with for relaxation, (3) help with daily chores if you are sick, (4) turn to for suggestions about how to handle personal problems, and (5) someone to love and make you feel wanted." (Responses: 1 = none of the time; 5 = all of the time; range: 5–25; alpha reliability: 0.82 at 5 weeks postpartum and 0.85 at 12 months postpartum.)

Breastfeeding. This item asked, "Which of the following are you feeding your baby: breast milk, formula, milk (cow or soy), other?" Any breastfeeding was scored 1.

Infant Sleep Problems and Irritable Behavior. These items asked: "Has your baby had problems sleeping (eg, on an average night, your baby is awake 2 or more hours per night)?" and "Has your baby had fussy, irritable behavior that lasts for at least 2 days or had colic?" ("yes" = 1).

Control Variables

These measures were time-invariant and included the following demographic factors. Age, delivery type, infant gender, and number of children were abstracted from the medical record. Race was adapted from the US Census 2000.[31] Marital status, poverty status in the year before childbirth, and highest educational degree were all adapted from the National Health Interview Survey.[32] Health-related control variables included the level of maternal preconception health and was adapted from the SF-12.[26] Maternal occupation was initially coded by categories used by the US Census[33] and subsequently collapsed into three levels: professional, clerical, and blue collar/service.

Analytic Plan

Women's postpartum health is a function of two types of variables:

1) Time invariant variables (do not vary over time for the same woman) include: demographic factors, family size, income in the year before childbirth, preconception and prenatal health, delivery characteristics, occupation, race, marital status and number of children, and unobserved variables such as genetic endowment for health.
2) Time varying variables (vary over time for the same woman) include: TWL, work-related factors such as job stress and job satisfaction, perceived control at work and home, and personal factors, such as social support, breastfeeding, and infant irritability and sleep problems.

The primary focus of this article is on the time varying variables measured at four time periods. Unobserved time invariant variables that affect both the independent variables of interest and the woman's postpartum health outcomes could result in biased coefficient estimates. This problem was addressed by estimating a regression equation with a fixed effect for each woman. Inclusion of a fixed effect for each woman controls for both measured and unmeasured time invariant covariates[34] (eg, age, race, highest educational degree) and omitted variables that are constant over time. In addition, each woman serves as her own control.

The empirical model for testing the association of TWL and work-related and non-work-related factors with women's health outcomes in the first year after childbirth was a fixed effects panel regression written as follows: $Y_{it} = \gamma_0 + \gamma_1 X_{it} + \gamma_2 T_t + \mu_i + \delta_{it}$. Y_{it} is the health status score (mental health, physical health or postpartum symptoms) for the ith individual at time t (ie, at 5 weeks, 11 weeks, 6 months, and 12 months). X_{it} represents TWL and other characteristics for the ith individual at time t. T_t represents dummy variables that capture time-specific effects on the health outcome scores, which are common to all individuals. μ_i represents individual fixed effects, and δ_{it} is the unobserved error term for this equation. To control for time series autocorrelation, standard errors were adjusted for clustering at the individual level by using an arbitrary variance–covariance matrix as recommended by Bertrand et al.[35] The models estimated the relation between the time varying variables (TWL, supervisor support, coworker support, perceived job stress, job satisfaction, perceived control, available social support, breastfeeding, infant sleep problems, and infant fussy behavior) and health outcomes across four time periods.

To evaluate the potential effect of measurement error on the study findings, sensitivity analyses were conducted with TWL. Data from a substudy on TWL measures (see "Work-Related Factors") provided alternative estimates that were used in the sensitivity analysis; the mean values of TWL at 12 months were the following: 13.7 for the diary, 14.73 for the worksheet, and 15.25 for the computer-assisted telephone interviews or CATI. Using the diary as the gold criterion for TWL measurement, the estimates from worksheets or interviews were adjusted accordingly. For example, women who completed the worksheet had their TWL estimates adjusted by a constant reflecting the difference between the mean value for the worksheet and diary (−1.09 hours). Fixed effects panel regressions were run for all three health outcome models (mental health, physical health, and symptoms) with the adjusted TWL values, and the results were compared with the original fixed effects regression results.

Data analyses were conducted using the xtreg command for fixed effects program in STATA (StataCorp LP, College Station, TX), which uses all observations from all time periods. To estimate attrition over time, a series of logistic regressions were run with response status at each time period as the outcome variable and demographic characteristics (age, marital status, education, income, race, occupation, and parity) as the independent variables. Attrition did not differ by demographics at 11 weeks postpartum; however, by 6 and 12 months postpartum, respondents were slightly more likely

to be in a professional occupation (vs blue collar/service or clerical) and to be married or partnered than nonrespondents.

RESULTS

Participants' Characteristics

Participants were, on average, 30 years of age; 73% were married, 46% were college graduates, 86% were white, and 78% reported their preconception health as "very good or excellent." Occupational classifications included 47% professional, 39% clerical, and 14% blue collar or service workers. Among 567 married or partnered women, 96% had husbands or partners who were employed, on average, 42 hours per week. All women had health insurance coverage. Approximately 10% of women met state threshold values for poverty in the year before childbirth. Nearly half (46%) of participants were first-time mothers, 36% had 2 children, 13% had 3 children, and 6% had 4 to 6 children. Eighty-one percent of women breastfed in the hospital immediately after childbirth; this declined to 67% at 5 weeks and 14% at 12 months. A more detailed account of participants' characteristics is published elsewhere.[24]

Health Outcomes

Women's health outcomes improved from 5 weeks to 12 months postpartum, by 4 points on physical health, and by 1.7 points on mental health (Table 1). When participants' 5 week scores were compared with national norms for women aged 25 to 34 years,[26] our participants scored slightly worse on physical health (mean: 51.4 vs 52.7 (SD: 7.2, 9.13); $z = -3.9$; $P < 0.001$), and slightly better on mental health (mean: 49.6 vs 47.2 (SD: 7.9, 12.1); $z = 4.9$; $P < 0.001$).

Overall, symptoms declined with time, from an average of 6.1 symptoms at 5 weeks to 3.6 symptoms at 12 months postpartum (Table 2). Fatigue was the most frequent symptom at 5 and 11 weeks postpartum experienced by 64% and 39% of women, respectively, and remained a relatively common experience for women at 6 months (39%) and 12 months (28%) after childbirth. Nevertheless, respiratory symptoms were an exception to the overall declining trend. Symptoms such as a runny and stuffy nose, sore throat, cough and cold, and sinus problems increased from 5 weeks to 6 months postpartum and then declined at 12 months postpartum close to levels at 5 weeks postpartum.

Time Spent on Work, Sleep, and Leisure Activities

Total average daily workload significantly increased from 14.4 hours (SD: 2.5) at 5 weeks postpartum to an average of 15.1 hours (SD: 1.7) at 12 months postpartum ($t_{\text{paired}} = -6.46$, *df*: 555, $P = 0.000$; 95% CI [confidence interval], -0.99 to -0.53). An important contributor to the increasing workload was employment: mean paid work time averaged across all participants increased from 0.61 hours/day (SD: 1.96) at 5 weeks postpartum to 7.61 hours/day (SD: 2.2) at 12 months postpartum. Represented in this overall increase in paid work over time was a steady increase in the number or percent (%) of women returning to the paid work force: 51 (7%) at 5 weeks, 331 (49%) at 11 weeks, 563 (93%) at 6 months, and 539 (97%) at 12 months–and an increase in average daily paid work time for women back at work from 6.76 (SD: 2.5) hours at 5 weeks to 7.8 (SD: 1.92) hours at 12 months (Table 3).

While paid work time increased from 5 weeks to 12 months postpartum, family care-giving (including infant care) declined significantly from 10.49 hours/day (SD: 3.28) to 4.06 hours/day (SD: 2.18) ($t_{\text{paired}} = 41.6$, *df*: 553, $P = 0.000$; 95% CI, 6.12 to 6.73). Leisure activities also declined significantly from 1.49 hours/day (SD: 1.59) to 0.71 hours/day (SD: 1.05) over the same time period ($t_{\text{paired}} = 10.5$, *df*: 553, $P = 0.000$; 95% CI, 0.68 to 0.99). Average hours of sleep increased slightly, but significantly, from a low of 6.6 hours/night (SD: 1.53) at 5 weeks postpartum to a high of 6.93 hours/night (SD: 1.34) at 11 weeks postpartum, and a similar

TABLE 1. Descriptive Statistics for Health Outcome and Independent Variables by Time

Study Variables	5 Wk ($n = 716$)	11 Wk ($n = 638$)	6 Mo ($n = 603$)	12 Mo ($n = 554$)
Continuous variables*				
Health outcome variables (theoretical scores)				
Mental component summary score (0–100)	49.42 (7.58)	50.43 (7.33)	50.42 (7.47)	51.08 (7.51)
Physical component summary score (0–100)	51.37 (7.2)	55.79 (5.16)	55.16 (5.85)	55.41 (5.69)
All symptoms (including breast symptoms)† (0–28)	6.11 (3.46)	4.17 (3.19)	4.65 (3.39)	3.62 (3.28)
Symptoms (excluding breast symptoms)‡ (0–25)	4.95 (3.07)	3.8 (2.93)	4.49 (3.26)	3.5 (3.15)
Independent variables				
Total workload (0–24 hours)	14.44 (2.48)	14.36 (2.46)	15.05 (1.97)	15.09 (1.66)
Perceived control (1–5)	3.26 (0.99)	3.58 (0.86)	3.66 (0.93)	3.79 (0.83)
Available social support (5–25)	20.68 (3.68)	20.94 (3.75)	21.16 (3.76)	21.25 (3.82)
Supervisor support (1–4)	3.61 (0.76)	3.68 (0.63)	3.65 (0.65)	3.61 (0.69)
Coworker support (1–4)	3.86 (0.43)	3.79 (0.49)	3.76 (0.52)	3.72 (0.58)
Perceived job stress (1–8)	4.2 (2.01)	3.97(2.01)	3.97(2.06)	4.09(2.11)
Discrete variables§				
Breastfeeding (0–1)	480 (67.0)	340 (53.3)	230 (38.1)	75 (13.5)
Infant sleep problems (0–1)	120 (16.8)	57 (8.9)	129 (21.4)	117 (21.1)
Fussy infant behavior (0–1)	109 (15.2)	102 (16.0)	103 (17.1)	208 (37.5)
Job satisfaction (0–1)	620 (86.6)	563 (88.2)	530 (87.9)	490 (88.4)

*Values are mean (standard deviation).

†Symptoms were measured two ways. The first measure included all symptoms identified in the text of the paper and the maximum summary score was 28 symptoms. This measure was used for descriptive purposes.

‡The second measure included all symptoms identified in the text of the paper, but excluded symptoms specific to breastfeeding (eg, breast discomfort, nipple irritation, and mastitis). Thus the maximum summary score for this measure was 25. This second measure was the variable used for multivariate analyses because breastfeeding was an independent variable in the model.

§Values are frequency (frequency percentages).

TABLE 2. Participants' Symptoms by Time*

Variable	6 Wk ($n = 716$)	11 Wk ($n = 638$)	6 Mo ($n = 603$)	12 Mo ($n = 554$)
Total symptoms, mean (SD)	6.11 (3.46)	4.17 (3.19)	4.65 (3.39)	3.62 (3.28)
General and other				
Fatigue	457 (63.8)	227 (38.7)	280 (39.1)	203 (28.4)
Back or neck pain	310 (43.3)	242 (33.8)	244 (34.1)	189 (2.4)
Dizziness	104 (14.5)	69 (9.6)	72 (10.1)	52 (7.3)
Hot flashes	85 (11.9)	38 (5.3)	42 (5.9)	28 (3.9)
Fever > 100°F	51 (7.1)	27 (3.8)	29 (4.1)	25 (3.5)
Neurologic				
Hand numbness or tingling	102 (14.2)	62 (8.7)	64 (8.9)	54 (7.5)
Headaches	355 (49.6)	270 (37.7)	301 (42)	277 (38.7)
Gynecologic and breast				
Decreased desire for sex	375 (52.4)	237 (33.1)	170 (23.7)	107 (14.9)
Breast symptoms (>1)†	492 (68.7)	155 (24.3)	69 (11.4)	44 (7.9)
Uterine infection treated with antibiotics	19 (2.7)	10 (1.4)	10 (1.4)	6 (0.8)
Cardiovascular				
Irregular heart beat	15 (2.1)	11 (1.5)	11 (1.5)	10 (1.4)
High blood pressure treated by doctor	13 (1.8)	6 (0.8)	2 (0.3)	4 (0.6)
Respiratory symptoms (>1)‡	291 (40.6)	305 (47.8)	386 (64)	283 (51.1)
Skin and hair				
Acne	129 (18)	108 (15.1)	104 (14.5)	110 (15.4)
Hair loss	34 (5)	65 (9.1)	212 (29.6)	39 (5.4)
Excessive sweating	165 (23)	48 (6.7)	37 (5.2)	25 (3.5)
Rash	53 (7.4)	36 (5)	28 (3.9)	25 (3.5)
Gastrointestinal				
Constipation	196 (27.4)	84 (12.2)	59 (8.2)	29 (4.1)
Abdominal pain (heartburn, cramps)	149 (20.8)	87 (12.2)	100 (14)	67 (9.4)
Hemorrhoids	169 (23.6)	80 (11.2)	57 (8)	38 (5.3)
Decreased appetite	224 (31.3)	78 (10.9)	56 (7.8)	58 (8.1)
Diarrhea or stomach flu	54 (7.5)	44 (6.1)	64 (8.9)	59 (8.2)

*Values are *n* (%) unless otherwise indicated.
†Breastfeeding symptoms included breast discomfort, nipple irritation, and mastitis.
‡Respiratory symptoms included sore throat, cough, cold, runny/stuffy nose, sinus trouble, asthma, and pneumonia.

6.9 hours at 12 months postpartum ($t_{\text{paired}} = -3.2$, *df*: 553, $P = 0.001$; 95% CI, −0.39 to −0.09). Meanwhile, the number of awakenings per night dropped from a mean of 2.6 (SD: 1.1) at 5 weeks to a mean of 1.06 (SD: 1.04) at 12 months postpartum.

Relationship of Mothers' TWL to Health

Mothers' mental health and symptoms were related to TWL (first hypothesis, Tables 4 and 5). As TWL increased, mothers' mental health scores worsened and the number of symptoms increased. Mothers' physical health was not significantly associated with TWL in contrast to the study hypothesis.

Relationship of Mothers' Health to Work and Social Variables

Mothers' mental health was positively related to available social support from family and friends (third hypothesis) and perceived control over work and home activities across time (fourth hypothesis); mental health was *inversely* related to infant sleep problems and fussy infant behavior across time (sixth hypothesis; Table 4).

Maternal symptoms increased in association with less social support (third hypothesis), infant sleep problems (sixth hypothesis), and less perceived control across time (fourth hypothesis; Table 5).

Similar to our previous report of health outcomes over time (under "Health Outcomes"), multivariate results showed that mental health and symptoms improved over time (Tables 4 and 5); however, there was a slight, but statistically significant increase in total symptoms between 11 weeks and 6 months postpartum, from an average of 4.2 to 4.7 symptoms, respectively ($t = 3.7$, *df*: 570; $P = 0.000$; 95% CI: −0.697 to −0.210). Physical health also steadily improved over time, with significant improvements seen at each time interval. The results for each time period relative to 5 weeks postpartum were as follows: 11 weeks: $\beta = 4.44$, $P = 0.000$; 95% CI, 3.885 to 4.987; 6 months: $\beta = 3.91$, $P = 0.000$; 95% CI, 3.274 to 4.551; and 12 months: $\beta = 4.24$, $P = 0.000$; 95% CI, 3.421 to 5.059.

Sensitivity Analyses on TWL Estimates

When original values of TWL were compared with those using diary-based adjustments for TWL, there were no significant differences. The fixed effects regression coefficients, standard errors, *t* tests, and CIs for the TWL estimates and covariates in the models were remarkably similar (results not shown here).

DISCUSSION

The total daily workload for these mothers increased a small, but statistically significant amount over the first year after childbirth while the allocation of their time to daily tasks varied with increasingly more time spent on paid employment and less time spent on family care-giving, leisure, and domestic chores. When compared

TABLE 3. Descriptive Statistics for Time Spent by Mothers on Daily Work and Personal and Leisure Activities (mean hours/day)

	Timing of Measurement			
Daily Activities*	**5 Wk Postpartum ($n = 716$)**	**11 Wk Postpartum ($n = 638$)**	**6 Mo Postpartum ($n = 603$)**	**12 Mo Postpartum ($n = 554$)**
Employment (all women)	0.61 (1.96)	3.95 (4.05)	7.40 (2.53)	7.61 (2.23)
Employment (only for women working)†	6.76 (2.53)	7.71 (1.99)	7.89 (1.74)	7.80 (1.92)
Travel to/from work	0.08 (0.33)	0.37 (0.38)	0.89 (0.59)	0.93 (0.74)
Sleep	6.6 (1.53)	6.93 (1.34)	6.80 (1.33)	6.88 (1.21)
Personal care	1.47 (0.89)	1.49 (0.75)	1.37 (0.65)	1.32 (0.66)
Housework	2.01 (1.42)	1.84 (1.42)	1.45 (1.12)	1.44 (1.12)
Errands	1.17 (1.31)	0.80 (1.08)	0.57 (0.91)	0.58 (0.74)
Yard work	0.13 (0.41)	0.13 (0.42)	0.03 (0.29)	0.11 (0.43)
Care of the baby and other family members	10.49 (3.28)	7.24 (3.37)	4.68 (2.41)	4.06 (2.18)
Leisure	1.49 (1.59)	1.22 (1.65)	0.78 (1.16)	0.71 (1.05)
Other	0.01 (0.17)	0.00 (0.00)	0.00 (0.00)	0.16 (0.44)
Total workload‡	14.44 (2.48)	14.36 (2.46)	15.05 (1.97)	15.09 (1.66)

*Each activity has a theoretical range of response from 0 to 24 hours, as the question was " . . . I am going to read you a list of activities. For each one, please tell me how much time you spent on that activity using whole or half hours. How much time in that [reference] 24 hours did you spend on. . . .[each activity was read, eg, Employment, or work for pay; Travel to and from work and day care; sleep; Personal care; Housework; Errands outside of the house; Yard work; Care of the baby and other family members; Leisure; Other].

†Percentage of total women at work includes 7% at 5 weeks, 46% at 11 weeks, 87% at 6 months, and 92% at 12 months postpartum.

‡Total daily workload was measured as 24 hours minus time spent in sleep, personal care, and leisure activities.

TABLE 4. Fixed Effects Panel Regression of the Determinants of Mental Health*

Mental Health	**Coefficient**	**Robust SE**	***t***	***P* >|t|**	**95% CI**
Total workload	−0.3038	0.0655	−4.64	0.000	−0.4323 to −0.1752
Breastfeeding	−0.2818	0.4066	−0.69	0.489	1.0801 to 0.5165
Perceived control	0.8867	0.2060	4.30	0.000	0.4823 to 1.2911
Social support	0.3973	0.0789	5.04	0.000	0.2424 to 0.5522
Supervisor support	−0.1325	0.2767	−0.48	0.632	−0.6757 to 0.4107
Coworker support	0.5632	0.3369	1.67	0.095	−0.0983 to 1.2247
Infant sleep problems	−0.8966	0.3878	−2.31	0.021	−1.6579 to −0.1353
Fussy infant	−0.8042	0.3776	−2.13	0.034	−1.5456 to −0.0628
Perceived job stress	−0.0732	0.1050	−0.70	0.486	−0.2793 to 0.1328
Job satisfaction	0.4637	0.5350	0.87	0.386	−0.5867 to 1.5142
Time period					
5 wk (reference)					
11 wk	0.4514	0.2800	1.61	0.107	−0.0983 to 1.0012
6 mo	0.6377	0.3477	1.83	0.067	−0.0448 to 1.3202
12 mo	1.1223	0.4336	2.59	0.010	0.2711 to 1.9735
Constant	41.4135	2.3308	17.77	0.000	36.8376 to 45.9896

R-squared within = 0.0817
R-squared between = 0.3289
R-squared overall = 0.2348
*General mental health was measured by the Short Form (SF) 12, version 2. Mental Components Summary score.

with employed US adult women with children less than 6 years old,[36] mothers in our sample reported more family care (4.1 hours vs 2.2 hours per day), more paid work (7.6 hours vs 4.4 hours per day), less leisure time (0.7 hours vs 3.3 hours per day), and less sleep (6.9 hours vs 8.3 hours per day) at 12 months postpartum. The differences in family care may, in part, reflect the constant demands associated with an infant relative to the less time intensive needs of children aged 2 to 5 years, while the differences in paid work may reflect the study sample. Nevertheless, the net effect of 3 fewer hours per day of leisure and 1.4 fewer hours per day of sleep for these new mothers is not trivial. The TWL for study participants shows limited time for rest to recuperate from childbirth and adapt to the needs of an infant, and the demands of employment, family and personal commitments.

Multivariate findings revealed that TWL was associated with postpartum symptoms and poorer mental health, consistent with our study hypotheses and results from two Swedish studies showing increased symptoms for women with long hours of domestic work coupled with high-strain paid work.[5,8] In an earlier study, investigators found that women with access to any paid leave (eg, sick leave,

TABLE 5. Fixed Effects Panel Regression of the Determinants of Maternal Symptoms*

Maternal Symptoms	Coefficient	Robust SE	*t*	*P* > |t|	95% CI
Total workload	0.0701	0.0273	2.57	0.010	0.0165 to 0.1236
Breastfeeding (1 = yes)	0.2891	0.1629	1.77	0.076	−0.3077 to 0.6089
Perceived control	−0.2619	0.0777	−3.37	0.001	−0.4145 to −0.1094
Social support	−0.0853	0.0250	−3.42	0.001	−0.1343 to −0.0363
Supervisor support	−0.0988	0.0971	−1.02	0.309	−0.2894 to 0.0917
Coworker support	−0.0846	0.1257	−0.67	0.501	−0.3315 to 0.1623
Infant sleep problems	0.3358	0.1574	2.13	0.033	0.0268 to 0.6448
Fussy infant	0.2149	0.1411	1.52	0.128	−0.0621 to 0.4919
Perceived job stress	0.0617	0.0399	1.55	0.122	−0.0166 to 0.1401
Job satisfaction	−0.0346	0.1818	−0.19	0.849	−0.3915 to 0.3223
Time period					
5 wk (reference)					
11 wk	−0.9427	0.1117	−8.44	0.000	−1.1619 to −0.7235
6 mo	−0.2731	0.1367	−2.00	0.046	−0.5415 to −0.0047
12 mo	−1.2337	0.1825	−6.76	0.000	−1.5921 to −0.8753
Constant	6.7291	0.8571	7.85	0.000	5.0465 to 8.4118

R-squared within = 0.1227
R-squared between = 0.1664
R-squared overall = 0.1416
*The maternal symptom measure used in the multivariate analysis was a summary score, excluding the three items specific to breast symptoms.

vacation leave, or disability leave) had, on average, leaves that were 4 weeks longer than those of women without paid leave benefits;[37] leaves longer than 12 weeks were associated with better health.[38] Human resources personnel and health care providers could assist women with reconciling work and family life by advocating strategies to reduce maternal workload such as intermittent Family and Medical Leave, paid leave benefits, and flexible work arrangements. Intermittent Family and Medical Leave, which allows individuals to return to work on a gradual, part-time basis over a longer time period, must be certified by a health care provider as necessary for the mother's serious health condition (as defined in the Family and Medical Leave Act regulations)[39] related to childbirth and distinct from time for infant bonding.[17] In contrast to the findings of an association between increasing maternal TWL and increased symptoms, as well as poorer mental health, significant associations between TWL and physical health were not found. It may be that physical health outcomes associated with mild or moderate, but chronic mental stress, may only be evident over many years.

Women's mental health, physical health, and symptoms all improved over time, though certain symptoms, such as fatigue, back or neck pain, headaches, and respiratory symptoms were relatively prevalent for several months. Fatigue was the most prevalent symptom through 11 weeks postpartum, consistent with other studies.[40–43] Postpartum fatigue, which can be profound and relentless, may be caused by recovery from childbirth, childcare responsibilities, reduced sleep, and anemia. Gay et al[42] report that women's postpartum sleep disturbance scores are comparable to those of women working permanent night or rotating shifts who are known to have significant sleep disturbance. Furthermore, people with disturbed sleep seem to exhibit the same physiological changes as those under stress, such as increased levels of cortisol, heart rate, body temperature, and oxygen consumption.[43] Infant sleep patterns and maternal fatigue have been shown to be strongly associated with the onset of maternal depressive symptoms[40–41,44–46] suggesting that postpartum fatigue, while important in its own right, may lead to other more serious health problems. For women who experience relentless fatigue, health care providers should explore additional leave from work or strategies aimed at encouraging rest and quiet time to prevent postpartum depression.

Maternal sleep loss and fatigue are related to infants' sleep and disposition problems. Study results showed that infants' irritable behavior and sleep problems were negatively associated with maternal health, consistent with our hypotheses. The proportion of mothers reporting infant sleep problems increased from 9% to 21% between 11 weeks and 6 months postpartum and remained at 21% through 12 months postpartum. Irritable infant behavior peaked at 12 months postpartum with more than a two-fold increase in mothers reporting problems between 6 months and 12 months postpartum. New mothers may need education on techniques for caring for irritable infants and facilitating their sleep. Such education could be offered by health care providers, experienced mothers, and workplace-based parenting support groups and could be the focus of future intervention research.

Available social support from friends and family and perceived control were also related to postpartum health, consistent with our hypotheses and the literature.[17–19,38] Interestingly, supervisor and coworker support were not related to health outcomes. Health care providers may want to explore potential sources of social support with new mothers and encourage them to ask for needed help with infant cares and home chores. For example, in open-ended questions about sources of social support, the women in this study described the importance of contributions by husbands and partners, their mothers, and older children in the family.

Study limitations include the somewhat homogeneous sample, the potential for measurement error, use of a relatively simple measure of TWL, and little evaluation of fathers' contributions to infant care and relief of mothers' TWL. The study's sampling frame was restricted to mothers from the seven-county metropolitan Minneapolis and St Paul, Minnesota, and may not readily apply to women in other parts of the United States or other countries given variations in women's labor force participation, hours of paid work, and health insurance coverage. Fathers' contribution to mothers' health was evaluated through the measures of marital/partnered status and available social support, but future studies could more explicitly incorporate fathers' contributions to care-giving and home

chores to reduce the TWL of mothers in the short-term and contribute to maternal well-being in the long-term.

Strengths of the study include the use of several strategies to reduce measurement error: survey questions that were taken from established, validated instruments, and a sensitivity analyses for our measure of TWL, the key independent variable, which showed that even when the estimates were adjusted for precision of the data collection instrument, the results of the fixed effects regressions were unchanged.

This study makes an important contribution to the literature on the health of working women by prospectively evaluating TWL and health status at key times throughout the first year after childbirth in a cohort of employed mothers. The model of health and workforce participation applied to this sample reveals that several potentially modifiable factors, such as TWL, available social support, perceived control over work and home activities, and infant care-giving, influence maternal postpartum health. These factors are relevant to occupational health practice and could be the focus of future workplace intervention studies.

CONCLUSION

Mothers in this sample had heavy workloads with very limited sleep and personal time. Given the association of maternal TWL with symptoms and poorer mental health, it appears that mothers' postpartum work responsibilities and conflicting role demands may increase their risk for poor health outcomes. Although not studied here, it is possible that high maternal TWLs, including reduced time for rest and recovery, put mothers at risk for long-term physical health problems—this warrants investigation. On the contrary, women's postpartum health was positively associated with social support, so the presence of such support may help to blunt the negative effects of excess work. Therefore, health care providers and employers should consider exploring with new mothers options to enhance social support and promote a better balance between postpartum work and rest. Future studies are needed to assess the role of fathers in assisting with care-giving and home chores, and the use of intermittent Family and Medical Leave benefits, flexible work arrangements, paid leave benefits, and other supportive measures that may contribute to maternal rest and alleviate excessive TWLs. Health care providers, working in collaboration with human resource personnel and top managers, are in key roles to influence workplace policies to promote mothers' recovery from childbirth and successful resumption of work roles.

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REFERENCES

1. Dye J. *Fertility of American Women, June 2004*. Current Population Reports, P20–555. Washington, DC: US Census Bureau; 2005:7.
2. US Bureau of Labor Statistics.Employment Characteristics of Families 2009. Available at: http://www.bls.gov/news.release/famee.nr0.htm. Accessed March 21, 2010.
3. Johnson T. *Maternity Leave and Employment Patterns: 2001–2003*. Current Population Reports, P70–113. Washington, DC: US Census Bureau; 2007:18.
4. Gjerdingen D, McGovern P, Bekker M, Lundberg U, Willemsen T. Women's work roles and their impact on health, well-being and career: comparisons between the United States, Sweden, and the Netherlands. *Women Health.* 2000;31:1–20.
5. Krantz G, Ostergren P. Double exposure: the combined impact of domestic responsibilities and job strain on common symptoms in employed Swedish women. *Eur J Public Health.* 2001;11:413–419.
6. Lundberg U, Mårdberg B, Frankenhaeuser M. The total workload of male and female white collar workers as related to age, occupation level, and number of children. *Scand J Psychol.* 1994;35:315–327.
7. Berntsson L, Lundberg U, Krantz G. Gender differences in work-home interplay and symptom perception among Swedish white-collar employee. *J Epidemiol Community Health.* 2006;60:1070–1076.
8. Lindfors P, Berntsson L, Lundberg U. Total workload as related to psychological well-being and symptoms in full-time employed female and male white-collar workers. *Int J Behav Med.* 2006;13:131–137.
9. Krantz G, Berntsson L, Lundberg U. Total workload, work stress and perceived symptoms in Swedish male and female white-collar employees. *Eur J Public Health.* 2005;15:209–214.
10. Nordenmark M. Balancing work and family demands: do increasing demands increase strain? A longitudinal study. *Scand J Public Health.* 2004;32: 450–455.
11. Voss M, Floderus B, Diderichsen F. How do job characteristics, family situation, domestic work and lifestyle factors relate to sickness absence? A study based on Sweden Post. *JOEM.* 2004;46:1134–1143.
12. Van Der Hulst M. Long work hours and health. *Scand J Work Environ Health.* 2003;29:171–188.
13. Albertson K, Rafnsdottir G, Girmsmo A, Tomasson K, Kauppinen K. Workhours and worklife balance. *SJWEH Suppl.* 2008;5:14–21.
14. Brown S, Lumley J. Maternal health after childbirth. *Br J Obstet Gynaecol.* 1998;105:156–161.
15. Ansara D, Cohen M, Gallop R, Kung R, Schei B. Predictors of women's physical health problems after childbirth. *J Psychosom Obstet Gynaecol.* 2005;26:115–125.
16. Stowe Z, Hostetter A, Newport D. The onset of postpartum depression: implications for clinical screening in obstetrical and primary care. *Am J Obstet Gynecol.* 2005;192:522–526.
17. McGovern P, Dowd B, Gjerdingen D, et al. Mothers' health and work-related factors at eleven weeks postpartum. *Ann Fam Med.* 2007;5:519–527.
18. Fisher J, Feekery C, Rowe-Murphy H. Nature, severity and correlates of psychological distress in women admitted to a private mother-baby unit. *J Paediatr Child Health.* 2002;38:140–145.
19. Gjerdingen D, Center B. First-time parents' prenatal to postpartum changes in health, and the relation of postpartum health to work and partner characteristics. *J Am Board Fam Pract.* 2003;16:304–311.
20. Becker G. A theory of the allocation of time. *Econ J.* 1965;75:493–517.
21. Grossman M. *The Demand for Health: A Theoretical and Empirical Investigation.* New York, NY: Columbia University Press and the National Bureau of Economic Research; 1972:119.
22. Frankenhaeuser M. A biopsychological approach to work life issues. *Int J Health Services.* 1989;19:747–758.
23. Lundberg U, Parr D. Neuroendocrine influences on the health of diverse populations. In: Eisler RM, Hersen M, eds. *Handbook of Gender, Culture and Health.* Philadelphia, PA: Lawrence Erlbaum and Assoc, Inc; 2000:21–24.
24. McGovern P, Dowd B, Gjerdingen D, Gross C, Kenny S, Ukestad L. The postpartum health of employed mothers 5 weeks after childbirth. *Ann Fam Med.* 2006;4:159–167.
25. American College of Nurse-Mdwives. *Benefits of Breastfeeding.* 2007. Available at: http://www.gotmom.org. Accessed October 10, 2010.
26. Ware J, Kosinski M, Turner-Bowker D, Gandek B. *How to Score Version 2 of the SF-12 Health Survey.* Boston, MA: QualityMetrics Inc and the Health Assessment Lab; 2002:19–29, 39–43, 73–103.
27. Mårdberg B, Lundberg U, Frankenhaeuser M. The total workload of parents employed in white-collar jobs: construction of a questionnaire and scoring system. *Scand J Psychol.* 1991;32:233–239.
28. Bond J, Galinsky E, Lord M, Staines G, Brown K. *Beyond the Parental Leave Debate: the Impact of Laws in four States*. New York, NY: Families and Work Institute; 1991.
29. Quinn R, Staines G. *The 1977 Quality Employment Survey*. Ann Arbor, MI: Survey Research Center, Institute for Social Research; 1979.
30. Sherbourne C, Stewart A. The MOS social support survey. *Soc Sci Med.* 1991;32:233–239.
31. US Census Bureau. *Overview of Race and Hispanic Origin, Census 2000*, C2KBR/01–1. Washington, DC: US Census Bureau; 2001.
32. US Census Bureau. *Educational Differences in Health Status and Health Care. Data from the National Health Interview Survey, US, 1989*. Vital and Health Statistics. Series 10, No 179, DHHS Pub NO (PHS) 91–1507. Washington, DC: US Census Bureau; 1991.
33. US Census Bureau. *Alphabetic Index of Industries and Occupations, 1990. Census of Population and Housing.* Washington, DC: US Department of Commerce, Bureau of the Census; 1992.

34. Allison P. Fixed Effects Regression Methods in SAS (Paper 184–31). *Proceedings of the 31st Annual SAS Users Group International Conference*. Cary, NC: SAS Institute, Inc; 2006.
35. Bertrand M, Duflo E, Mullainathan S. How much should we trust differences-in-differences estimates? *Q J Econ.* 2004;114:249–275.
36. US Department of Labor, Bureau of Labor Statistics. *American Time Use Survey–2008 Results.* Time spent in primary activities for the civilian population 18 years and over by employment status, presence and age of youngest household child, and sex, 2008 annual averages, Table 8. Economic News Release. Available at: http://www.bls.gov/tus./ Accessed October 10, 2010.
37. McGovern P, Dowd B, Gjerdingen D, Moscovice I, Kochevar L, Murphy S. *The Determinants of time off work after childbirth*. *J Health Polit Policy Law*. 2000;25:527–564.
38. McGovern P, Dowd B, Gjerdingen D, Moscovice I, Kochevar L, Lohman W. Time off work and the postpartum health of employed women. *Med Care*. 1997;35:507–521.
39. The Family and Medical Leave Act. 1993;29 C.F.R.:825.100.
40. Corwin E, Brownstead J, Barton N, Heckard S, Morin K. The impact of fatigue on the development of postpartum depression. *J Obstet Gynecol Neonatal Nurs*. 2005;34:577–586.
41. Dennis C, Ross L. Relationships among infant sleep patterns, maternal fatigue and development of depressive symptomatology. *Birth*. 2005;32: 187–193.
42. Gay L, Lee K, Lee S. Sleep patterns and fatigue in new mothers and fathers. *Biol Res Nurs*. 2004;5:311–318.
43. Åkerstedt T. Psychosocial stress and impaired sleep. *Scand J Work Environ Health*. 2006;32:493–501.
44. Groer M, Davis M, Casey K, Short B, Smith K, Groer S. Neuroendocrine and immune relationship in postpartum fatigue. *Am J Matern Child Nurs*. 2005;30:133–138.
45. Lee K, Zaffke M. Longitudinal Changes in Fatigue. *J Obstet Gynecol Neonatal Nurs*. 1998;28:183–191.
46. Bozoky I, Corwin E. Fatigue as a predictor of postpartum depression. *J Obstet Gynecol Neonatal Nurs*. 2001;31:436–443.

