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Work and Family Stress is Associated with Menstrual Disorders but not with Fibrocystic Changes: Cross-sectional Findings in Chinese Working Women

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Abstract: Work and Family Stress is Associated with Menstrual Disorders but not with Fibrocystic Changes: Cross-sectional Findings in Chinese Working Women: Mei ZHOU, *et al*. School of Public Health, Kunming Medical University, China—Objectives: To explore the separate and combined effects of work and family stress on menstrual disorders and fibrocystic changes in Chinese working women. **Methods:** Data were obtained from a cross-sectional study of 1,642 female railway workers. The Effort-Reward Imbalance Questionnaire and Family Stress Scale were used to measure work stress and family stress, respectively; the menstrual and breast conditions were evaluated by gynecologic interview and a medical examination. Multivariate log-binomial regression was performed to analyze the associations. **Results:** Menstrual disorders were found in 59.3% of female workers, and 54.8% had fibrocystic changes. The risk of menstrual disorders was significantly elevated with respect to work and family stress. The highest risk was found in the group with combined exposure to both work and family stress (RR with 95% CI 1.33 (1.18–1.49)). No significant association between stress and fibrocystic changes was observed. **Conclusions:** Menstrual disorders were associated with stress from work and family life, but not fibrocystic changes, in working women. Tailored intervention measures reducing the burden of stressful psychosocial work and family environment are needed to improve women's reproductive well-being.
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During the past five decades in China, women's participation in the labor market has greatly increased. In 2007, 45% of the national workforce were women. However, following the Confucian tradition, Chinese women are still required to take primary responsibilities for their families, even if they are in full-time employment[1)]. Consequently, as working women, they have the double burden of both work and home, i.e., dual exposure to work and family stress.

The health effects of stress, in particular work stress, have been confirmed by an impressive body of cross-sectional and prospective research. Consistent associations have been observed for cardiovascular diseases[2)], musculoskeletal disorders[3)], and mental illness[4)]. However, less consistent evidence is available on the negative impact of stress on women's reproductive health[5)]. Menstrual disorders are very common in women with high prevalence rates ranging from 30–70%[6)]. Some studies have shown menstrual disorders in association with work stress, negative life events, or general stress perception[7–12)], whereas others have not provided any support for the association[13)]. Another important issue of women's reproductive health is fibrocystic breast conditions, which are relatively common among women particularly between the ages of 20 and 50 (clinically up to 50%) and typically present as any combination of breast pain and tender nodularities in breasts[14)]. Over the years, it has been observed that women with fibrocystic changes (especially proliferative disease without atypia, atypical ductal or lobular hyperplasia) have a greater risk of subsequent development of breast cancer[14)]. In a recent critical review[15)], it was suggested that stress seems not to increase the risk of breast cancer incidence, but whether stress affects the development of fibrocystic breast changes and the progression of breast cancer was not clarified. Sieja investigated the psychological characteristics of women with fibrocystic breast changes and found that women with fibrocystic changes had higher

levels of anxiety, higher sensitivities to stress and higher stress responses than healthy women[16]. However, the work of Price *et al*. found no evidence to support an independent association between psychosocial factors and the development of breast carcinoma[17, 18].

Although the processes by which exposure to psychosocial stress affects women's reproductive health are not yet fully established, several lines of evidence are available. For instance, physiological mechanisms suggest that excessive and prolonged activation of the hypothalamic-pituitary-adrenal axis by stress may alter hormonal profiles, increasing the levels of corticotrophin-releasing hormone and glucocorticoids. Consequently, the synthesis and metabolism of gonadotropin and estrogen are suppressed[19], thereby disrupting women's regular menstrual function. High endogenous concentrations of estrogen are a known risk factor for breast diseases, particularly for breast cancer, and impairment of estrogen synthesis induced by stress may play a role in the null association between stress and breast diseases [15]. In addition, behavioral mechanisms may mediate the association between stress and poor health[20].

To the best of our knowledge, the effect of stress on fibrocystic breast changes has not yet been investigated. Moreover, although there has been some research on the effect of work stress or family stress on reproductive health (such as menstrual function) in working women, no study has investigated the combined effect of double exposure to work and family stress on reproductive health. Therefore, the purpose of the current research was to explore separate and combined effects of work stress and family stress on menstrual disorders and fibrocystic changes in a sample of Chinese female railway workers.

Subjects and Methods

Study subjects

Full-time working women were recruited from the major railway station of the big southwest city of Kunming in China. The study protocol was approved by the Ethical Committee of the Kunming Medical University, and was performed in accordance with the Declaration of Helsinki. Eligibility criteria for inclusion in the study were as follows: women who (i) were between the ages of 20–55 yr, and (ii) had a menstrual period in the past 6 wk, were included; while women who (i) were had used hormonal contraceptives in the past 12 mo, or (ii) had a history of pregnancy or abortion in the past 12 mo, or (iii) had any diagnosed reproductive disease other than menstrual disorders or fibrocystic changes, were excluded. Two thousand one hundred fifty-two eligible women were invited to participate in our study and a total of 1,965 women agreed to participate (response rate: 92.47%). Data for 1,642 women without any missing values were used in our analysis.

Measures

Work stress was measured by the 23-item Effort-Reward Imbalance (ERI) Questionnaire which consists of three scales "effort" (6 items), "reward" (11 items, covering the aspects of salary, promotion prospects, esteem and job security), and "overcommitment" (6 items measuring a personal pattern of coping with work demands)[21, 22]. Following the recent recommendations for improving the measurement accuracy of the questionnaire[23, 24], participants were asked to answer the statements on a 4-point Likert scale (from "strongly disagree" to "strongly agree"). Accordingly, scores of the "effort" scale varied from 6 to 24, scores of the "reward" scale varied from 11 to 44, and scores of overcommitment varied from 6 to 24. The Cronbach's α coefficients of effort, reward, and overcommitment in this study were 0.76, 0.67, and 0.66, respectively. According to a predefined algorithm, the ratio between the two scales "effort" and "reward" (weighted by item numbers) was calculated to quantify the degree of mismatch between high cost and low gain[21]. In our data analysis, work stress was dichotomized into two groups, low and high, by an effort-reward ratio of 1.0.

Family stress was measured by the 5-item Family Stress Scale with a 4-point Likert-scale (from "strongly disagree" to "strongly agree"), including: relationship and conflict with family members, care giving, household workload, and economic burden. Scores of family stress varied from 5 to 20, with higher scores indicating higher family stress, which has been reported to be associated with increased blood pressure and psychosomatic symptoms[25]. The Cronbach's α coefficient of the Family Stress Scale in this study was 0.76. In our data analysis, family stress was dichotomized into two groups, low and high, using the median value.

A comprehensive gynecologic interview and medical examination were performed for all the women. The diagnosis of menstrual disorders was based on an individual interviews conducted by a qualified gynecologic female physician. Three broad categories of menstrual disorders were identified: abnormal cycle length (the interval between menses less than 24 or greater than 35 days), hypermenorrhea (either menses excessive in duration (>7 days) or the amount of menstrual bleeding reported as heavy), and dysmenorrhea (presence of menstrual pain, a condition severe enough to warrant women to cease their daily activities). Women with any of the above menstrual outcomes were classified as having menstrual disorders[6, 8]. A well-established physical method of diagnosing breast diseases is X-ray of the dense tissue content of the breast, standard mammography. However, due to the use of ionizing radiation, mammography is not recommended for younger women. Therefore, an alternative non-imaging, non-invasive technique named near-infrared transillumination breast

Table 1. Sociodemographic, gynecological, and stress characteristics of study subjects (N=1,642)

Characteristics	Menstrual disorders			Fibrocystic changes		
	No	Yes	*p*	No	Yes	*p*
Age (mean ± SD)	36.98 ± 7.16	37.10 ± 7.71	0.7513	36.47 ± 8.12	37.53 ± 6.90	0.0050
Marital status (% of married)	90.28	87.15	0.0035	86.12	90.33	0.0050
Working group (%)						
Train group	27.95	32.99	0.0575	34.77	27.78	0.0001
Station group	20.03	20.45		22.24	18.67	
Supporting & logistic group	52.02	46.56		42.99	53.55	
Age at menarche (mean ± SD)	13.68 ± 1.32	13.65 ± 1.41	0.7354	13.64 ± 1.35	13.68 ± 1.39	0.6070
History of contraception use (%)	63.38	59.40	0.1047	61.05	61.00	0.9831
History of childbirth (%)	74.29	69.27	0.0271	66.98	74.89	0.0004
History of abortion (%)	50.82	43.17	0.0022	43.67	48.44	0.0533
Effort (mean ± SD)	16.10 ± 2.44	16.76 ± 2.52	<0.0001	16.48 ± 2.42	16.50 ± 2.57	0.8312
Reward (mean ± SD)	29.56 ± 2.86	29.05 ± 2.98	0.0006	29.25 ± 2.89	29.26 ± 2.98	0.9880
Overcommitment (mean ± SD)	15.72 ± 2.09	16.08 ± 2.03	0.0005	15.94 ± 2.06	15.94 ± 2.06	0.9634
Effort/Reward ratio (mean ± SD)	1.01 ± 0.21	1.08 ± 0.25	<0.0001	1.05 ± 0.22	1.05 ± 0.25	0.6988
Effort-Reward Imbalance (% of ratio >1.0)	48.58	61.05	<0.0001	56.47	55.56	0.7106
Family stress (mean± SD)	12.21 ± 1.84	12.50 ± 1.77	0.0012	12.28 ± 1.84	12.47 ± 1.77	0.0619

Differences were determined by Student's *t*-test or the chi-square test.

spectroscopy (TIBS) was used in our study. TIBS is a promising new tool for risk assessment of breast diseases with clinically relevant accuracy, particularly for younger women. It provides optical information relating to tissue chromophores (such as water, lipid and haemoglobin content) which is highly consistent with conventional mammography in identifying breast tissue density. Fibrocystic changes were identified by abnormally high parenchymal density.[26)]

Information on age, age at menarche, marital status, reproductive history (including contraception use, childbirth, and abortion) and working group were collected by standardized questionnaire.

Statistical analysis

First, descriptive statistics were generated. Means and standard deviations (SDs) were calculated for continuous variables, and relative frequencies for categorical variables. Next, we performed the *t*-test (for continuous variables) or the Chi-square test (for categorical variables) to compare the differences between the groups with presence or absence of menstrual disorders or fibrocystic changes. Finally, log-binomial regression models were applied due to the presence of common outcome variables (prevalence > 10%) to estimate relative risks (RRs) and 95% confidence intervals (CIs)[27)] separately for work stress and family stress, adjusting for age, age at menarche, marital status, working group, history of contraception, history of childbirth, and history of abortion. To test the combined effect of two exposures—work stress and family stress, a composite variable was constructed. The dichotomized exposure variables—work stress and family stress—were combined in the following way: low work stress—low family stress, low work stress—high family stress, high work stress - low family stress, and high work stress - high family stress. All calculations were performed with the statistical program SAS 9.2.

Results

Data for 1,642 women with a mean age of 37.0 yr were used in the statistical analysis. The mean age at menarche for this population was 13.7 yr. Most of the women (88.4%) were married, 61.0% had a history of contraception use, 71.3% had a history of childbirth, 46.3% women had a history of abortion (including 5.4% spontaneous abortion and 43.5% induced abortion, which is allowed in China due to the national policy of "one child in one family"), 30.9% worked on trains, 20.3% were station workers, and 48.8% served in support and logistics.

The prevalence rates of menstrual disorders and fibrocystic changes in this study sample were 59.3% and 54.8%, respectively. Comparative data on age, marital status, working group, age at menarche, history of contraception use, childbirth and abortion, and the key measures of the ERI model and family stress between groups with and without reproductive disorders are presented in Table 1. Women who had menstrual disorders reported significantly higher effort, overcommitment, effort-reward imbalance, family stress, and significantly lower reward than those who did not.

Table 2. Associations between separate and combined work and family stress and menstrual disorders and fibrocystic changes (RRs and 95% CIs)

Stress	Menstrual disorders (RRs and 95% CI)		Fibrocystic changes (RRs and 95% CI)	
	Model I	Model II	Model I	Model II
Work stress				
Low (effort/reward ratio ≤1.0)	1.00	1.00	1.00	1.00
High (effort/reward ratio >1.0)	1.22 (1.11–1.33)***	1.23 (1.13–1.35)***	0.98 (0.89–1.07)	1.00 (0.91–1.10)
Family stress				
Low (≤median)	1.00	1.00	1.00	1.00
High (>median)	1.12 (1.04–1.22)**	1.13 (1.05–1.22)**	1.08 (0.99–1.18)	1.07 (0.98–1.16)
Combined stress				
Low work stress-Low family stress	1.00	1.00	1.00	1.00
Low work stress-High family stress	1.07 (0.97–1.18)	1.06 (0.97–1.17)	1.04 (0.91–1.19)	1.02 (0.90–1.16)
High work stress-Low family stress	1.18 (1.04–1.34)*	1.19 (1.05–1.35)**	1.02 (0.89–1.17)	1.06 (0.92–1.21)
High work stress-High family stress	1.31 (1.16–1.47)***	1.33 (1.18–1.49)***	1.06 (0.93–1.19)	1.06 (0.94–1.20)

Model I: no adjustment. Model II: adjustment for age, age at menarche, marital status, working group, history of contraception, history of childbirth, history of abortion, and overcommitment. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

In relation to fibrocystic changes, no significant association was observed.

The results of the log-binomial regression analyses are shown in Table 2. After adjusting for socio-demographic and gynecological factors, RRs of menstrual disorders and fibrocystic changes are presented separately by work stress and family stress. No significant associations between overcommitment and the two reproductive health indicators were observed; therefore, the results are not shown. The RRs of work stress in terms of effort-reward imbalance and family stress were significantly elevated with respect to menstrual disorders in the fully adjusted models. Again, no significant association between stress and fibrocystic changes was found. RRs of menstrual disorders were found to be the highest in the group with combined work and family stress. No significant association in case of fibrocystic changes was found.

Discussion

The purpose of this study was to investigate the separate and combined effects of work and family stress, measured by theory-based instruments, on women's reproductive health—menstrual disorders and fibrocystic changes—in a large sample of the Chinese railway workforce. We found consistent associations between menstrual disorders and both work and family stress even after adjustment for demographic and gynecological confounding factors. Moreover, a combined exposure to high work stress and high family stress was observed to be associated with menstrual disorders, though no association between stress and fibrocystic changes was found. Similar results were observed by examining the associations between stress and three types of menstrual disorders (abnormal cycle length, hypermenorrhea, and dysmenorrhea), and the associations between stress and different level of fibrocystic changes (mild, moderate, and severe) (data not shown).

Our results are in the line with previous studies on menstrual disorders. A US study indicated that stressful work (high demand in combination with low control) was related to short menstrual cycle length in a group of healthy, working, premenopausal women[7]; while another study among US military personnel found that life event stress was significantly associated with abnormal menstrual cycle length, hypermenorrhea, and dysmenorrhea[8]. Using prospective data from a group of predominantly white, well-educated US women, Barsom *et al*. showed that changes in levels of stress due to critical life events were related to changes in the length of the menstrual cycle intervals and duration of bleeding[9]. A Hungarian nation-wide survey also revealed an imbalance between effort and reward and overcommitment at work were associated with painful menstruation[10]. In a Chinese prospective study, perceived stress was confirmed as risk factor of dysmenorrhea among women working in cotton textile mills[11, 12]. Unfortunately, all these studies examined only the separate effect of stress (work stress, or negative life events, or general stress perception) on menstrual disorders.

Concerning breast diseases, a number of studies have been conducted on stress and breast cancer[15, 28]. Results based on large prospective cohort studies with long-term follow-up (the US Nurses' Health Study, the Finnish Twin Cohort Study, the Copenhagen City Heart Study, and the Danish Nurse Cohort Study, 6,000–70,000 participants, 8–21-year follow-up), suggest work stress, self-perceived stress, and stress from caregiving do not appear to increase breast cancer risk[29–33], while findings from Finland

indicate stressful life events increase the risk[34]. Studies on stress and fibrocystic changes are limited. A Polish study found that women with fibrocystic changes had higher levels of anxiety, higher sensitivities to stress and increased stress responses[16], whereas an Australian study observed no differences between normal women, benign breast diseases and breast carcinoma subjects, with respect to a number of psychosocial factors (such as life event stressors, social support, defense style, locus of control of behavior, emotional expression and control, self-esteem, anxiety, and depression)[17, 18]. However, both studies were based on relatively small sample sizes and did not include measurements on stressful working conditions. Additionally, it should be mentioned that the overall level of work stress in terms of effort-reward imbalance in both groups (with presence or absence of reproductive disorders) of our study sample was significantly higher than reported in previous studies of women working in different occupations in Europe[21].

To the best of our knowledge this is the first study testing the separate and combined effects of work and family stress, measured by theory-based instruments, on women's reproductive health with a large study sample. Despite these merits, several limitations must be taken into consideration in the interpretation of our findings. First, due to cross-sectional study design, neither the stability of stress over time nor the direction of its association with women's reproductive health was examined. Second, we were not able to take into account all potential confounders for the association between stress and women's reproductive health, such as indicators of socioeconomic position (education and income), BMI, family history of reproductive diseases, lifestyle factors or physical health[5, 6, 14, 15, 35]. Third, some working conditions such as work hours, shift work, and job control, were not examined in our study, and they may also be important for employed women' reproductive health[5]. These limitations could be compensated by several methodological strengths. First, stress was measured with theory-based instruments. Moreover, for measurement of the Effort-Reward Imbalance, the recommended 4-Likert score procedure of response categories was applied[23, 24]. Second, outcome measures were based on detailed clinical interview and medical examination so that common method variance could be avoided.

In conclusion, this study provides scientific evidence of elevated risk of menstrual disorders due to combined exposure to work and family stress. Importantly, stress seems not be a risk factor of fibrocystic changes, which might be an early stage of breast cancer. If confirmed by prospective evidence, our results call for tailored intervention measures to reduce the burden of stressful psychosocial work and family environment on working women. Practical measures should focus on, raising awareness of stress recognition among working women; improving career prospects (continuous training, appropriate remuneration, and harmonious interpersonal relations); and offering services by the organization (work-family balance arrangements, flexible work schedule, and coping education). Such measures are an important prerequisite for improving women's reproductive well-being.

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