Gynecologic pain related to occupational stress among female factory workers in Tianjin, China

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Background: Dysmenorrhea, dyspareunia, and non-cyclic pelvic pain are health concerns for factory workers in China and may be increased by occupational stress.
Objectives: To estimate the prevalence and demographic and occupational factors associated with three types of gynecologic pain among female factory workers in Tianjin.
Methods: The study included 651 female workers from three factories in Tianjin, China. Logistic regression models were estimated to determine associations between occupational stress and gynecologic pain.
Results: Occupational stress including high job strain, exhaustion, and stress related to working conditions was a risk factor for gynecologic pain. High job strain and poor job security were associated with an increased risk for dysmenorrhea. Compulsory overtime and exhaustion were associated with increased non-cyclic pelvic pain. Working overtime and exhaustion were associated with increased dyspareunia.
Conclusions: As China's population of female factory workers grows, research on the reproductive health of this population is essential.

Keywords: China, Factory Workers, Occupational health, Gynecologic pain, Reproductive health

Background

Gynecologic pain disorders, including pain with menstruation, pain related to sex, and non-cyclic pelvic pain independent of menstruation and sex, are reported by a substantial proportion of women of reproductive age worldwide, with studies reporting prevalences of 6–90% depending on the demographic, lifestyle, and environmental characteristics of the study participants, as well as the type of gynecologic pain.[1–5] However, information on the burden of gynecologic pain is limited in many countries and scant information is available on the experience of gynecologic pain among women working in export processing zones (EPZs). The population of women working in EPZs is important to consider not only because occupational stress related to EPZ work has been shown to increase the risk of pelvic pain, but also because a large proportion of the population employed in EPZs are women of reproductive age.[6–8] Occupational stress in this paper refers to high job strain, exhaustion, and stress related to working conditions.

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In China, female migrant workers have reported reproductive health to be among their most important health concerns and factory workers have specifically indicated that pain related to menstruation is their most urgent complaint.[9–11] A number of qualitative studies have emphasized that China's female factory workers are concerned about their reproductive health and some studies have quantified the low level of reproductive health knowledge in this population.[12] Qualitative studies of factory workers in South East Asia have shown that women report painful menstruation, pain during sexual intercourse, and lower abdominal pain.[9,13,14] Although several studies have recognized the need to improve access to reproductive healthcare among female workers in China, relatively few have evaluated the burden of gynecologic pain in this economic sector.[12,15,16]

The prevalence of dysmenorrhea (pain related to menstruation) in China has been reported to be between 44.4 and 56.4%.[17–19] Chinese female factory laborers at a textile mill in Anhui Province (mean age=25) had a prevalence of 44.4% with the prevalence more than two fold higher among women who reported high levels of stress.[17] In another study of railway workers (mean age=37), 45.7% of the

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women had some form of menstrual dysfunction with menstrual pain elevated by stress.[18] Occupational stress has been associated with dysmenorrhea in some,[17,20–22] but not all studies.[23,26] In general, young nulliparous women experience more dysmenorrhea than older women who have had children.[25–28] Female workers in China's factories may be likely to have an increased risk for dysmenorrhea given their age, parity, and occupational stress. Other important factors that have been shown to be associated with dysmenorrhea include smoking, heavy menstruation, and taking hormonal contraceptives.[29,30]

Worldwide, estimates of the prevalence of dyspareunia (pain during or immediately following sexual intercourse) range from as low as 1.3% to as high as 45.7%.[30] In China, one study of married women younger than 34 years reported a prevalence of 4.7%[31] while another study reported the prevalence of dyspareunia to be 20.4% among women over age 41 years.[32] A more recent Chinese study found a prevalence of 43% for dyspareunia among women over 20 years of age accessing care for routine health exams.[33] Smoking has also been found to raise the risk for dyspareunia.[33] To date, however, studies of dyspareunia in China are limited and have included only married women. None have examined the association between dyspareunia and working conditions or occupational stress.

Global estimates of the prevalence of non-cyclic pelvic pain (pain that is independent of sex or menstruation) range from 4 to 43.4%, although few data are available from middle or low income countries.[30] A Mexican study reported a prevalence of 6% for non-cyclic pain lasting 6 months or longer among women younger than 35 years, with a history of reproductive tract or urinary tract infections, or a history of fibroids signaling increased risk.[5] Non-cyclic pelvic pain lasting 6 months or longer has been related to reproductive tract disease, urological disease, gastrointestinal and musculoskeletal disorders, as well as psycho-neurological symptoms.[34] Studies have shown that women with non-cyclic pelvic pain have an increased prevalence of physical and/or sexual abuse and post-traumatic stress disorder.[35,36] We have not identified any studies of non-cyclic pelvic pain in China.

This study focuses on dysmenorrhea, dyspareunia, and non-cyclic pelvic pain among women working in three electronics factories in the Tianjin economic-technological development area (TEDA), one of China's oldest and most established EPZs. Tianjin economic-technological development area is located in Tianjin, one of China's provincial level cities. Provincial level cities are at the same administrative level as provinces and therefore have more autonomy and more direct support from China's central government. Tianjin is also a coastal city that opened quite early to foreign direct investment and is a top destination for rural migrant workers.[37] Factories in the electronic telecommunications industry, the largest industry in TEDA, make 25% of TEDA.[38]

Occupational stress in factories within China's EPZs is thought to be high owing to poor working conditions and low job security motivated by incentives for cheap labor to attract foreign investment.[39,40] China's recent shift from permanent employment in state-owned enterprises to a market-determined employment structure has reduced job security and created large variation in wages and benefits among workers in China's factories.[41] Export processing zones are generally structured to rely on contract work and other forms of insecure employment,[42] which is one potential source of occupational stress facing female factory workers.[43] Employment in EPZs, such as TEDA, also typically entails working long hours and compulsory overtime for low wages, with increased pressure to work harder and faster creating an environment with high psychological stress.[43–45] In previous research in other societies, the types of poor working conditions and occupational stressors that typify EPZ employment, such as overtime, night work, shift work, and strenuous work, have been linked to dysmenorrhea, dyspareunia, and non-cyclic pelvic pain.[7,8]

Women make up 50–90% of workers in China's EPZs, while 70% of the migrant workers in these EPZs are between the ages of 15–49, and 20% are between 25–29 years old.[37,46,47] The increasing number of women working in China's export production factories and the documented reports of reproductive health concerns among these workers underline the importance of research in this area. The aim of this study was to estimate the prevalence of dysmenorrhea, dyspareunia and non-cyclic pelvic pain among women working in electronic factories in Tianjin, and to examine the association between occupational stress and demographic factors and the risk of these three outcomes. We hypothesized that occupational stress would increase the risk of each type of gynecologic pain and that both occupational stress and pain would be associated with age, having a child, marital status, and migrant status.

Methods

Field work was completed in July and August, 2010 in collaboration with the Department of Occupational Health at the Tianjin Centers for Disease Control and Prevention. The study was approved by the University of Michigan Institutional Review Board and the Tianjin Centers for Disease Control and Prevention.

A cross-sectional survey design was implemented in three electronics factories using a structured

questionnaire. Factories were selected by contacting electronic factories that represented diverse foreign ownership, hire a large number of females, have overtime work, and have a relationship with the Tianjin Centers for Disease Control and Prevention. Three of the four factories approached agreed to take part in the study. Factory 1 was a fabrication factory established in 1996 and owned through a joint partnership between China and Taiwan. Factory 2 was a semiconductor factory established in 1996 and owned through a joint partnership between China and the United States. Factory 3 was a fabrication factory established in 1995 and owned through a joint partnership between China and Japan. At each factory, female workers aged 18 and over were asked to participate in the study; surveys were distributed and informed consent was obtained. All surveys were anonymous.

A total of 744 women workers were approached during work breaks and all agreed to complete the survey. After excluding women who had incomplete age information ($n=24$), reported being pregnant in the last 12 months ($n=60$), or were missing information on all three of the gynecologic pain outcomes ($n=9$), the total number of respondents eligible for this analysis was 651 (87.5%). In the final analytical sample, 12.6% of women were from Factory 1, 37.9% from Factory 2, and 49.5% were from Factory 3. These samples represented 10% of the total female workforce from Factory 1, 18% from Factory 2, and 16% from Factory 3. The remainder of the female workforce in each factory was not available to be surveyed and was not asked to participate.

The structured questionnaire obtained information on demographic characteristics, current reproductive health status, occupational stress, and working conditions. We piloted the questionnaire with 10 female factory workers from a fourth factory to obtain feedback on comprehensibility of the questions. Demographic questions were adapted from the 2006 China Health and Nutrition survey's adult questionnaire.[48] The reproductive health questions, and specifically questions regarding dyspareunia, dysmenorrhea, and non-cyclic pelvic pain were adapted from the Oxfordshire Women's Health Study Questionnaire and from 'Investigating Reproductive Tract Infections and Other Gynaecological Disorders'.[2,49] Occupational stress included questions on job strain and exhaustion. The job strain questions were from the Chinese job content questionnaire, which was adapted from the Job Content Questionnaire (JCQ).[50,51] The Chinese version of the JCQ did not include five questions from the original Karasek JCQ (My job requires lots of physical effort; My job security is good; How steady is your work?; During the past year, how often were you in a situation where you faced job loss or layoff?; Sometimes people permanently lose jobs they want to keep. How likely is it that during the next couple of years you will lose your present job with your employer?).[50,51] The question on exhaustion was selected from the Swedish Occupational Fatigue Inventory (SOFI).[52] The question on job security was selected from the portion of the English version of the JCQ not included in the Chinese version of the JCQ. The remaining questions on working conditions were created based on knowledge from the literature. The survey instrument was written in English, translated into Chinese by a professional Chinese language instructor and back translated by a professional Chinese–English translator. All study participants received a small gift valued at less than 1 US dollar to thank them for their time. The cost of this gift was determined using the minimum wage in Tianjin of about 920 yuan per month and calculating the cost of 30 minutes of the participants' time.[53]

Date of birth (month and year) according to the western calendar was asked in order to calculate age, as age is sometimes calculated in China with the year of birth as year one. Age was then calculated from the date of birth to the date of the survey and categorized into three groups; 18–24, 25–29, and 30–56 years. Marital status was collected with options for married, single, divorced, widowed, or other. Marital status was dichotomized into never married (single) and ever married (married, divorced, widowed). The question "How many children do you have?" was asked with the options none, one, or more than one and subsequently dichotomized (none/one or more). Level of education was categorized by dichotomizing the question "What is your education level?" from response options of no schooling, primary school, middle school, high school/military training/technical training, and educated past high school, into high school education or less and educated past high school. In order to measure migrant status, respondents were asked "Do you hold a Tianjin resident card (yes/no)?". The question "What is your average monthly income including benefits?" had the following six options in the survey: '500 yuan, 501–1000 yuan, 1001–2000 yuan, 2001–3000 yuan, 3001–4000 yuan, and above 4000 yuan'. Responses were dichotomized into 2000 yuan or less and 2001 yuan or more. Respondents were asked, "Have you smoked five cigarettes or more in the past month (yes/no)?" and "Have you consumed any beer, white wine, red wine, or rice wine in the past month (yes/no)?". Self-reported health ranking for the respondents was assessed with the question "Generally speaking, how is your health?" with the options excellent, very good, good, fair, or poor. This variable was dichotomized as fair or poor versus excellent, very good, or good. Hormonal contraception was assessed using the question, "What type(s) of contraception have you used in the past

year?" with response options categorized into none, not hormonal (withdrawal, condoms, male sterilization, female sterilization/hysterectomy, intrauterine device, breastfeeding/no period, and calendar) and hormonal (oral contraception, injections, and ring). Contraception was then cross-tabulated with the question "In the last 12 months, have you had sexual intercourse (yes/no)?" to create a fourth category of "not sexually active and not on contraception."

Dysmenorrhea was defined as reporting pain with menstruation within the last 12 months. Each woman recorded her experience with dysmenorrhea in response to the following question: "In the last 12 months, how often have you had painful periods? (never, occasionally, often, and usually)." Two dichotomous variables were created: ever experienced dysmenorrhea (never versus other response) and often or usually experienced dysmenorrhea (never or occasionally versus often or usually). For the purpose of analysis, never or occasionally versus often or usually was used owing to the large number of women reporting occasionally experiencing dysmenorrhea and in order to identify associations with more frequent pain with menstruation. Information on the severity of pain ("Is the pain with your period usually mild, moderate, or severe?") and on the time elapsed since the last experience of menstrual pain ("When did you last have a painful period? – in the last month, between one and three months ago, more than three months ago") was collected for those who reported any dysmenorrhea.

Dyspareunia was defined as reporting any pelvic pain during or immediately after sexual intercourse in the last 12 months. Each woman recorded her experience with dyspareunia in response to the following question: "In the last 12 months, how often have you had pelvic pain during or in the 24 hours after sexual intercourse? (never, occasionally, often, and usually)" among women who reported having had sex in the last 12 months. A dichotomous variable was created (never versus other response). Information on the severity of pain ("Typically, is your pelvic pain with intercourse usually mild, moderate, or severe?"), the time elapsed since the last experience of dyspareunia ("When did you last have a pelvic pain with intercourse? – in the last month, between one and three months ago, more than three months ago"), and when the dyspareunia occurred ("At the times you had pelvic pain with sexual intercourse in the last 12 months, when have you felt the pain? – during intercourse, in the 24 hours after intercourse, both during and after intercourse") was collected for those who reported any dyspareunia.

Non-cyclic pelvic pain was defined by women's response to the following question: "In the last 12 months, have you had pelvic pain NOT with periods or intercourse either on or off or constantly? (yes, no)". Among women reporting non-cyclic pelvic pain, information was collected on the severity ("Typically, is your pain not with periods or intercourse usually mild, moderate, or severe?") and on the time elapsed since the last experience of non-cyclic pelvic pain ("When did you last have this pelvic pain? – in the last month, between one and three months ago, more than three months ago") for those who reported any non-cyclic pelvic pain. Pelvic pain in this survey was defined as in the Oxfordshire Women's Health Study Questionnaire, as pain in the lower abdomen. A picture was shown to illustrate the body region that was intended to represent pelvic pain.

Assessment of occupational stress included measures of job type (production or office), overtime, night work, exhaustion, job security, sick days, and a composite score of job strain. Job type was assessed with the question, "What is your position at work?" with the options laborer, manager, office worker, and other. Manager and office worker were combined as office staff and respondents reporting "other" ($n=15$) were excluded from analysis. Overtime hours were measured with the question, "In the last 12 months did you work overtime? (yes, no)". Compulsory overtime was assessed with the question, "Can you choose to work overtime? (yes, no)". Working at night was measured with the question, "In the last 12 months did you work at night? (yes, no)". Job security was assessed with the question "My job security is good. (strongly disagree, disagree, agree, and strongly agree)" and subsequently dichotomized (strongly disagree or disagree versus agree or strongly agree). Exhaustion was measured with a Likert scale question ranging from 0 (no exhaustion) to 10 (very high exhaustion). Sick days were measured with the question "In the last 12 months, during the months you worked, how much time have you taken off work because you didn't feel well? (no time, less than 1 day, 1–2 days, 3–5 days, 6–10 days, 11–30 days, and more than 30 days)." Exhausted and number of sick days were analyzed as continuous variables.

The variable high job strain was derived from the validated Chinese version of the JCQ.[50,51] The composite score for the JCQ was computed according to Karasek's definition of job strain;[50,51] study participants who fell above the sample median on job demands and below the median on decision latitude were defined as having high job strain.[50] The job demand component was made up of five statements (My job requires me to work very fast; My job requires me to work very hard; I am not asked to do an excessive amount of work; I have enough time to get the job done; and I am free from conflicting demands that others make); each with a

possible response of strongly disagree, disagree, agree, and strongly agree. The decision latitude component was made up of nine statements (My job requires that I learn new things; My job involves a lot of repetitive work; My job requires me to be creative; My job allows me to make a lot of decisions on my own; My job requires a high level of skill; On my job, I have very little freedom to decide how I do my work; I get to do a variety of different things on my job; I have a lot of say about what happens on my job; I have an opportunity to develop my own special abilities); each with a possible response of strongly disagree, disagree, agree, and strongly agree. Missing items used to construct the composite job strain score were imputed by substituting the mean response value when only one or two questions in a scale had missing values for that participant. Nineteen individuals with more than two missing items were defined as missing the composite job strain score.[50]

All analyses were conducted in SAS 9.2. The prevalence for each type of gynecologic pain was determined. Bivariate and multivariable logistic regression was used to evaluate associations between demographic and occupational characteristics and each outcome. Crude and adjusted prevalence odds ratios and their 95% confidence intervals were calculated.

Results

Among the women in the study, 65.1% worked in production. The mean age of women was 28 years (28 ± 5.9), 28.3% were under 25 years old, 41.8% were 25–29 years old, and 29.9% were 30–56 years old (Table 1). Women who worked in production tended to be older than women working as office staff. Women with more than a high school education and women who were Tianjin resident card holders were significantly more likely to hold office positions than production positions. Most women were never married (62.4%) and 49.6% had had at least one child. Production workers were significantly more likely to be single, but just as likely to have children as office workers. Most women had a high school education or less (68.4%) and 72.9% of women were Tianjin resident card holders (non-migrants). Only 3.7% reported smoking more than five cigarettes while 34.3% reported consuming any alcohol in the last month. Office and production staff did not differ in the proportion of who smoked but office staff workers were significantly more likely to report drinking alcohol in the last month. Nearly all the women surveyed (98.3%) reported having medical insurance and few reported current use of hormonal contraception (10.6%). The proportion that had medical insurance or reported current use of hormonal contraception did not differ by job type. A total of 29.3% women reported working overtime and 44.4% reported working the night shift in the past 12 months. Women in production were significantly more likely to work overtime and work at night. Overall, 35.8% reported having concerns regarding their job security, with women in office jobs reporting better job security than women in production jobs. Based on the JCQ, 23.9% of women were found to experience high job strain with significantly more women in production jobs having high job strain compared to women in office jobs.

Table 2 presents the prevalence of menstrual and gynecologic pain complaints. Overall, 80.7% of women had ever experienced dysmenorrhea in the past 12 months and 18.9% reported often or usually experiencing dysmenorrhea. Among those who often or usually experienced dysmenorrhea, 94.3% reported moderate or severe pain and 80.5% reported experiencing pain in the last month. Non-cyclic pelvic pain was reported by 15.7% of the women, 26.7% of whom experienced moderate or severe pain and 36.3% of whom experienced pain in the last month. Among the 381 women who reported having had sex in the past 12 months, 26.5% reported experiencing dyspareunia during this time period (15.5% of the entire sample). Among women reporting dyspareunia in the last 12 months, 19.8% reported moderate or severe pain and 25.7% reported pain in the last month. Among women who experienced dyspareunia, 35.6% experienced pain during sex, 38.6% experienced pain within the 24 hours after sex, and 18.8% experienced pain both during and after sex. A total of 21.4% of women reported irregular periods and 15.5% reported heavy bleeding during menstruation. None of these pain conditions were associated with job type.

Table 3 provides information on the crude associations between demographic, lifestyle, and occupational variables and each of the three gynecologic pain outcomes. All three types of gynecologic pain were associated with an increased risk for having irregular periods and feeling exhausted. Often or usually experiencing dysmenorrhea in the last 12 months was significantly associated with younger age, never being married, not having children, not holding a Tianjin resident card, irregular periods, high noise level, poor job security, high job strain and feeling exhausted. Having any non-cyclic pelvic pain in the last 12 months was significantly associated with being married, having children, irregular periods, working the night shift, compulsory overtime, poor job security, high job strain, and feeling exhausted. Experiencing any dyspareunia in the past 12 months was significantly associated with irregular periods, working overtime in the last 12 months, and feeling exhausted. Notably, women who reported experiencing dysmenorrhea (OR=1.68 (1.09, 2.58)), dyspareunia (OR=1.99 (1.19, 3.30)), or

Table 1 Demographic, lifestyle, and occupational characteristics of all women surveyed in three electronic factories in Tianjin, China

	Total (*N*=651)	Production* (*N*=424)		Office* (*N*=194)		
	%	No.	%	No.	%	*P*-value**
Age						
18–24 years	28.3	160	37.7	14	7.2	<0.01
25–29 years	41.8	169	39.9	93	47.9	
30–56 years	29.9	95	22.4	87	44.9	
Marital status						
Never married	37.0	181	42.7	47	24.2	<0.01
Ever married	62.4	241	56.8	145	74.7	
Information missing	0.6	2	0.5	2	1.1	
Children						
No children	49.6	224	52.8	88	54.6	0.08
1 or more children	50.4	200	47.2	106	45.4	
Education level						
High school education or less	68.4	361	85.1	62	31.9	<0.01
Educated past high school	30.4	58	13.7	129	66.5	
Information missing	1.2	5	1.2	3	1.6	
Holds Tianjin residence card						
Yes	72.9	270	63.7	180	92.8	<0.01
No	24.9	146	34.4	11	5.7	
Information missing	2.2	8	1.9	3	1.5	
Monthly income level						
2000 yuan or less	71.6	379	89.4	65	33.5	<0.01
2001 yuan and more	26.6	39	9.2	124	63.9	
Information missing	1.8	6	1.4	5	2.6	
Smoked in the last month						
Yes	3.7	16	3.8	7	3.6	0.89
No	95.4	402	94.8	187	96.4	
Information missing	0.9	6	1.4	0	0.0	
Drank alcohol in the past month						
Yes	34.3	117	27.6	100	51.6	<0.01
No	63.9	304	71.7	93	47.9	
Information missing	1.8	3	0.7	1	0.5	
Has medical insurance						
Yes	98.3	414	97.7	194	100.0	0.09
No	1.1	6	1.4	0	0.0	
Information missing	0.6	4	0.9	0	0.0	
Uses hormonal contraception						
Yes	10.6	47	11.1	21	10.8	0.78
No	75.3	312	73.6	151	77.8	
Information missing; have had sex in last 12 months	1.4	3	0.7	5	2.6	
Information missing; have not had sex or unknown sex behavior in last 12 months	12.7	62	14.6	17	8.8	
Worked the night shift i n the last 12 months						
Yes	44.4	233	54.9	46	23.7	<0.01
No	52.1	178	42.0	148	76.3	
Information missing	3.5	13	3.1	0	0.0	
Worked overtime in the last 12 months						
Yes	29.3	141	33.3	44	22.7	<0.01
No	67.8	275	64.9	148	76.3	
Information missing	2.9	8	1.8	2	1.0	
Can choose to work overtime						
Yes	57.8	230	54.3	133	68.6	<0.01
No	36.9	171	40.3	58	29.9	
Information missing	5.3	23	5.4	3	1.5	
High noise level						
Yes	47.9	233	54.9	67	34.5	<0.01
No	47.8	169	39.9	125	64.4	
Information missing	4.3	22	5.2	2	1.1	
Poor job security						
Yes	35.8	164	38.7	59	30.4	0.03
No	59.3	238	56.1	129	66.5	
Information missing	4.9	22	5.2	6	3.1	
High job strain						
Yes	23.9	120	28.3	32	16.5	<0.01
No	72.9	288	67.9	162	83.5	

Table 1 Continued

	Total (*N*=651)		Production* (*N*=424)		Office* (*N*=194)		
	%		No.	%	No.	%	*P*-value**
Information missing	3.2		16	3.8	0	0	
Health rating							
Fair or poor	25.0		109	25.7	47	24.2	0.65
Excellent, very good, good	73.0		305	71.9	144	74.2	
Information missing	2.0		10	2.4	3	1.6	
	Mean		No.	Mean	No.	Mean	*t*-test
Number of Sick Days Taken	2.6		408	2.5	192	2.7	0.05
Exhausted	5.6		411	5.8	194	5.3	0.04

*33 missing information on job type.
**Missing information not included in analysis,

non-cyclic pelvic pain (OR=2.35 (1.48, 3.73)) were all more likely to report a fair or poor overall health rating. Furthermore, women who experienced non-cyclic pelvic pain were more likely (OR=1.28 (1.09, 1.51)) to utilize more sick days than women who did not report non-cyclic pelvic pain. Smoking and alcohol use were not associated with any type of gynecologic pain in this population.

Table 2 Prevalence of menstrual complaints and gynecologic pain for all women surveyed in three electronic factories in Tianjin, China (*N*=651)

	No.	%	No.	%
Irregular periods				
No	498	76.5		
Yes	139	21.4		
Information missing	14	2.2		
Heavy periods				
No	537	82.5		
Yes	101	15.5		
Information missing	13	2.0		
Often or usually dysmenorrhea				
No	518	79.6		
Yes	123	18.9		
Mild			6	4.9
Moderate			80	65.0
Severe pain			36	29.3
Missing severity data			7	5.6
Have had pain in the last month			99	80.5
Information missing	10	1.5		
Non-cyclic pelvic pain				
No	414	63.6		
Yes	102	15.7		
Mild			62	60.8
Moderate			23	22.6
Severe pain			4	3.9
Missing severity data			13	12.8
Have had pain in the last month			37	36.3
Information missing	135	20.7		
Dyspareunia				
Never had sex	212	32.6		
No pain	206	31.6		
Yes	101	15.5		
Mild			76	75.2
Moderate			19	18.8
Severe pain			1	1.0
Missing severity data			5	5.0
Have had pain in the last month			26	25.7
Information missing	132	20.3		

Given correlations between age, children, and marital status, we ascertained that the effects of age and marital status were confounded by having children. Therefore, subsequent analyses adjust for having had a child. After adjusting for having children, none of the other demographic variables remained associated with any of the three types of gynecologic pain. Results from the analyses adjusting only for having had a child are reported in Table 4.

Table 5 shows the three separate multivariable models and illustrates the three outcomes and all variables included. In the multivariable analysis, not having children (OR=3.49 (2.19, 5.57)), poor job security (OR=1.68 (1.08, 2.63)), and high job strain (OR=1.74 (1.07, 2.82)) were significantly associated with an increased risk for often or usually experiencing dysmenorrhea. Not having children (OR=0.56 (0.34, 0.91)) and compulsory overtime (OR=1.84 (1.11, 3.06)) significantly increased the risk for non-cyclic pelvic pain, while feeling exhausted (OR=1.09 (1.00, 1.19)) was associated with a borderline significant increase in the risk for non-cyclic pelvic pain. In the multivariable analysis for dyspareunia, working overtime (OR=1.97 (1.14, 3.04)) and feeling exhausted (OR=1.11 (1.01, 1.21)) were significantly associated with an increased risk in dyspareunia. No interactions were present in the above models or between job type and variables included in the multivariable analysis. Analyses using pain severity in lieu of pain frequency produced similar results, although job security was no longer significantly associated with dysmenorrhea.

Discussion

Female factory workers have reported reproductive health to be one of their main health concerns. However, little quantitative research has addressed the prevalence or risk factors for reproductive health complaints among this population in China. This preliminary study evaluated an important aspect of reproductive health among female factory workers,

Table 3 Unadjusted associations with gynecologic pain among female factory workers in Tianjin, China *N*=651

	Often or usually dysmenorrhea				Non-cyclic pelvic pain				Dyspareunia (*N*=381)			
	No.	%	OR	CI	No.	%	OR	CI	No.	%	OR	CI
Age												
18–24	52	42.3	2.69	(1.58, 4.59)	23	22.6	0.79	(0.44, 1.40)	9	8.9	1.34 (0.53, 3.37)	–
25–29	47	38.2	1.45	(0.85, 2.46)	42	41.2	0.82	(0.49, 1.34)	48	47.5	0.86 (0.52, 1.41)	–
30–56	24	19.5	–	–	37	36.2	–	–	44	43.6	–	–
Marital status												
Never married	72	58.5	2.88	(1.93, 4.31)	24	23.8	0.54	(0.33, 0.89)	8	7.9	1.26	(0.50, 3.14)
Ever married	51	41.5	–	–	77	76.2	–	–	93	92.1	–	–
Children												
No children	91	26.0	3.39	(2.19, 5.27)	38	37.3	0.58	(0.37, 0.91)	24	23.8	0.88	(0.50, 1.53)
1 or more children	32	73.0	–	–	64	62.7	–	–	77	76.2	–	–
Education level												
High school education or less	31	25.4	0.71	(0.46, 1.12)	28	27.7	0.74	(0.46, 1.19)	32	32.0	1.02	(0.61, 1.71)
Educated past high school	91	74.6	–	–	73	72.3	–	–	68	68.0	–	–
Tianjin resident												
Yes	75	60.9	0.44	(0.29, 0.67)	76	74.5	0.77	(0.47, 1.28)	88	87.1	1.00	(0.49, 2.04)
No	48	39.1	–	–	26	25.5	–	–	13	12.9	–	–
Monthly income level												
2000 yuan or less	87	72.5	0.99	(0.63, 1.54)	75	75.8	1.19	(0.72, 1.98)	69	69.7	0.93 (0.55, 1.58)	
2001 yuan or more	33	27.5	–	–	24	24.2	–	–	30	30.3	–	–
Drank alcohol in the past month												
Yes	45	36.6	1.09	(0.73, 1.65)	45	44.6	1.52	(0.97, 2.36)	49	49.0	1.48	(0.92, 2.41)
No	78	63.4	–	–	56	55.4	–	–	51	51.0	–	–
Uses hormonal contraception												
Yes	9	9.3	0.69	(0.33, 1.45)	16	16.2	1.34	(0.72, 2.48)	23	23.0	1.49	(0.83, 2.70)
No	88	90.7	–	–	83	83.8	–	–	77	77.0	–	–
Irregular periods												
Yes	39	31.9	1.93	(1.25, 2.99)	37	37.0	2.71	(1.68, 4.37)	33	33.7	2.41	(1.38, 4.19)
No	83	68.1	–	–	63	63.0	–	–	65	66.3	–	–
Heavy periods												
Yes	26	21.1	1.56	(0.95, 2.57)	23	22.8	1.57	(0.92, 2.69)	17	17.2	0.98	(0.52, 1.86)
No	97	78.9	–	–	78	77.2	–	–	82	82.3	–	–
Job type												
Production	86	74.8	1.45	(0.92, 2.30)	69	69.0	1.18	(0.74, 1.89)	55	55.6	0.68	(0.42, 1.12)
Office	29	25.2	–	–	31	31.0	–	–	44	44.4	–	–
Worked the night shift in the last 12 months												
Yes	63	52.5	1.37	(0.92, 2.05)	55	55.0	1.58	(1.01, 2.46)	50	49.5	1.32	(0.82, 2.14)
No	57	47.5	–	–	45	45.0	–	–	51	50.5	–	–
Worked overtime in the last 12 months												
Yes	41	33.9	1.24	(0.81, 1.89)	29	29.0	0.94	(0.58, 1.51)	39	39.0	2.14	(1.27, 3.59)
No	80	66.1	–	–	71	71.0	–	–	61	61.0	–	–
Compulsory overtime												
Yes	51	43.2	1.24	(0.83, 1.86)	47	49.0	1.85	(1.18, 2.90)	44	44.9	1.44	(0.89, 2.33)
No	67	56.8	–	–	49	51.0	–	–	54	55.1	–	–
High noise level												
Yes	70	59.3	1.60	(1.07, 2.40)	45	45.9	0.95	(0.61, 1.48)	43	45.3	1.30	(0.79, 2.14)
No	48	40.7	–	–	53	54.1	–	–	52	55.8	–	–
Poor job security												
Yes	60	51.3	1.73	(1.15, 2.60)	46	46.9	1.65	(1.05, 2.58)	38	40.0	1.21	(0.73, 2.00)
No	57	48.7	–	–	52	53.1	–	–	57	60.0	–	–
High job strain												
Yes	44	36.7	2.02	(1.32, 3.09)	29	28.7	1.21	(0.75, 1.97)	27	27.6	1.28	(0.74, 2.23)
No	76	63.3	–	–	72	71.3	–	–	71	72.4	–	–

Table 3 Continued

	Often or usually dysmenorrhea				Non-cyclic pelvic pain				Dyspareunia (*N*=381)			
	No.	%	OR	CI	No.	%	OR	CI	No.	%	OR	CI
Health rating												
Fair or poor	41	33.6	1.68	(1.09, 2.58)	41	40.6	2.35	(1.48, 3.73)	42	39.6	1.99	(1.19, 3.30)
Excellent, very good, good	81	66.4	–	–	60	59.4	–	–	64	60.4	–	–
Number of sick days taken			1.06	(0.91, 1.23)			1.28	(1.09, 1.51)			1.09	(0.92, 1.31)
Exhausted			1.11	(1.03, 1.19)			1.13	(1.05, 1.22)			1.14	(1.05, 1.25)

the prevalence of gynecologic pain. We found that gynecologic pain is a common condition with 33.1% of women reporting at least one of the three conditions studied here and 53.1% of women who have had sex in the past year reporting at least one condition. Occupational stress was associated with increased odds of gynecologic pain. High job strain and job insecurity were associated with dysmenorrhea, compulsory overtime and exhaustion were associated with increased non-cyclic pelvic pain, and working overtime and feeling exhausted were associated with dyspareunia. Notably, gynecologic pain was strongly associated with self-reported health status and non-cyclic pelvic pain appeared to affect

Table 4 Adjusted* reproductive and occupational associations with gynecologic pain among female factory workers in Tianjin, China (*N*=651)

	Often or usually dysmenorrhea				Non-cyclic pelvic pain				Dyspareunia (*N*=381)			
	No.	%	OR	CI	No.	%	OR	CI	No.	%	OR	CI
Irregular periods												
Yes	39	31.9	1.98	(1.27, 3.12)	37	37.0	2.76	(1.70, 4.48)	33	33.7	2.43	(1.39, 4.23)
No	83	68.1	–	–	63	63.0	–	–	65	66.3	–	–
Heavy periods												
Yes	26	21.1	1.83	(1.09, 3.08)	23	22.8	1.49	(0.87, 2.56)	17	17.2	0.98	(0.52, 1.85)
No	97	78.9	–	–	78	77.2	–	–	82	82.3	–	–
Job type												
Production staff	86	74.8	1.35	(0.84, 2.16)	69	69.0	1.24	(0.77, 2.00)	55	55.6	0.67	(0.41, 1.10)
Office staff	29	25.2	–	–	31	31.0	–	–	44	44.4	–	–
Worked the night shift in the last 12 months												
Yes	63	52.5	1.36	(0.90, 2.05)	55	55.0	1.59	(1.02, 2.48)	50	49.5	1.32	(0.82, 2.14)
No	57	47.5	–	–	45	45.0	–	–	51	50.5	–	–
Worked overtime in the last 12 months												
Yes	41	33.9	1.11	(0.72, 1.71)	29	29.0	0.99	(0.61, 1.60)	39	39.0	2.20	(1.30, 3.72)
No	80	66.1	–	–	71	71.0	–	–	61	61.0	–	–
Compulsory overtime												
Yes	51	43.2	1.15	(0.75, 1.74)	47	49.0	1.98	(1.25, 3.13)	44	44.9	1.45	(0.89, 2.35)
No	67	56.8	–	–	49	51.0	–	–	54	55.1	–	–
High noise level												
Yes	70	59.3	1.38	(0.91, 2.11)	45	45.9	1.01	(0.65, 1.58)	43	45.3	1.30	(0.79, 2.13)
No	48	40.7	–	–	53	54.1	–	–	52	55.8	–	–
Poor job security												
Yes	60	51.3	1.91	(1.26, 2.91)	46	46.9	1.64	(1.04, 2.57)	38	40.0	1.21	(0.73, 2.00)
No	57	48.7	–	–	52	53.1	–	–	57	60.0	–	–
High job strain												
Yes	44	36.7	2.07	(1.34, 3.22)	29	28.7	1.24	(0.76, 2.02)	27	27.6	1.28	(0.74, 2.22)
No	76	63.3	–	–	72	71.3	–	–	71	72.4	–	–
Health rating												
Fair or poor	41	33.6	1.95	(1.24, 3.05)	41	40.6	2.25	(1.41, 3.58)	42	39.6	1.98	(1.19, 3.28)
Excellent, very good, good	81	66.4	–	–	60	59.4	–	–	64	60.4	–	–
Number of sick days taken			1.08	(0.93, 1.26)			1.29	(1.09, 1.51)			1.10	(0.92, 1.31)
Exhausted			1.11	(1.03, 1.20)			1.13	(1.05, 1.23)			1.14	(1.04, 1.26)

*Associations are adjusted for ever having a child.

Table 5 Multivariable associations with gynecologic pain among female factory workers in Tianjin, China (*N*=651)

	Often or usually dysmenorrhea		Non-cyclic pelvic pain		Dyspareunia (*N*=381)	
	OR	CI	OR	CI	OR	CI
Not having children	3.49	(2.19, 5.57)	0.56	(0.34, 0.91)	0.80	(0.45, 1.44)
Worked overtime in the last 12 months	–	–	0.80	(0.46, 1.39)	1.97	(1.14, 3.04)
Compulsory overtime	–	–	1.84	(1.11, 3.06)	–	–
Poor job security	1.68	(1.08, 2.63)	1.27	(0.77, 2.09)	–	–
High job strain	1.74	(1.07, 2.82)	–	–	–	–
Exhausted	1.07	(0.98, 1.16)	1.09	(1.00, 1.19)	1.11	(1.01, 1.21)

–: not included in model.

productivity through an association with more sick days taken. Smoking and alcohol use were not associated with any type of gynecologic pain nor did smoking or alcohol confound the associations between occupational stress and any type of gynecologic pain.

In total, 80.7% of the women surveyed reported experiencing any dysmenorrhea in the past year with 18.9% reporting they experienced menstrual pain often or usually. Previous research reported the prevalence of any dysmenorrhea to be between 44.4 and 56.4%, however prevalence is sensitive to the age of the population studied and the precise wording of questions about menstrual pain (e.g., ever having versus usually having pain). Past studies have identified younger age as a major determinant of dysmenorrhea prevalence.[54,55] We found that age was confounded by parity with nulliparous women being at greatest risk for dysmenorrhea independent of age. One longitudinal study corroborates this finding that nulliparity predicts dysmenorrhea independent of age.[56]

We found that job insecurity and high job strain were associated with increased risk of dysmenorrhea, consistent with previous studies.[17,20–20] Gynecologic pain in pregnancy has also been reported to be associated with high job strain (as defined by Karasek).[57] Feeling exhausted was associated with dysmenorrhea in bivariate models and represents a possible alternative marker of occupational stress that should be explored in future studies.

The prevalence of dyspareunia found in our study (16.6%) falls between that reported in two other Chinese studies[31,32] and within the range documented in Latthe's review of 54 publications[30] (age range for all studies: 15–96). Two job characteristics, working overtime and feeling exhausted, were associated with a higher likelihood of reporting dyspareunia in our results. Data from maquiladora workers in Northern Mexico suggest that working the night shift is associated with an increased risk of domestic violence[58] and current or past abuse has been identified as a risk factor for dyspareunia.[59–62] It is possible that women who work the night shift in China also experience domestic violence, which may lead to dyspareunia. Research studies examining factory work, domestic violence and dyspareunia in China are needed.

Over 15% of women in this study reported having non-cyclic pelvic pain in the last 12 months. This percentage falls within the range of Latthe's review article,[30] but is higher than the prevalence reported in a community-based study in Northern Mexico that included women working in Mexico's maquiladoras.[5] Feeling exhausted, a marker of fatigue, was associated with non-cyclic pelvic pain in this study. Similarly, a strong association between chronic fatigue syndrome and a history of pelvic pain unrelated to menstrual periods has been documented.[63] We found that being required to work overtime was associated with reporting non-cyclic pelvic pain. Compulsory overtime may be an additional marker of occupational stress, which warrants further investigation. Compulsory overtime may result in domestic violence,[58] which may result in sexual abuse that could be associated with increased non-cyclic pelvic pain.[62] We have not identified other studies that have examined occupational risk factors for non-cyclic pelvic pain, so discussion of these mechanisms is speculative.

This preliminary study has identified demographic and occupational risk factors for three major types of gynecologic pain: dysmenorrhea, dyspareunia, and non-cyclic pelvic pain among women who work in export production in China. As this study was cross-sectional, it is not possible to determine the causal nature of these relationships. Gynecologic pain could lead to increased occupational stress, especially if pain interfered with women's ability to meet production quotas. Another possible limitation is that study participants may have misunderstood or misinterpreted some survey questions, as not all questions in the survey instrument had been previously validated in a Chinese setting. We did conduct a pilot study to assess comprehension, improving the likelihood that the questions were understood.

Although this is one of the larger studies completed in export production factories to date, the relatively small sample size may have underpowered our results. Some data on reproductive health was missing and

although missing data did not differ significantly by demographic factors, it is possible that women with reproductive health concerns were less likely to answer survey questions on reproductive morbidity, leading to an underestimation of pain prevalence and of associations reported here. As data collection occurred within factories, it is possible that women did not report their migrant status or underreported their occupational stress and gynecologic pain. However, data collection was anonymous and women were encouraged to answer truthfully. If underreporting occurred, our results would be a conservative estimate of the association between occupational stress and gynecologic pain in this population. Women who experienced extreme pain may have stopped working and therefore our study may not have captured more extreme cases. Furthermore, as factories were selected by the Tianjin Centers for Disease Control and Prevention, it is possible that working conditions are better than in other factories, limiting the generalizability of our results.

Further research should include women from factories in EPZs throughout China to assess the impact of regional differences in policies and worker populations. Additionally, this study focused on occupational stress; however other aspects of life stress likely also play a role in gynecologic pain. Future research should incorporate a more comprehensive set of questions about stress. Finally, the population in this study all worked in electronics companies in an EPZ; therefore all study participants may have experienced similar levels of occupational stress resulting in an underestimate of the risks associated with occupational stress. Research comparing women working inside and outside of EPZs would lead to improved information on potential health disparities related to different working conditions in EPZ and non-EPZ factories. Research comparing rural migrant women workers in EPZs with their counterparts in rural areas who did not migrate would better assess the impact of migration and working conditions on pain. Future research is also needed to better assess potential policy changes and public health interventions that could improve the reproductive health of women working in China's EPZ factories.

This study illustrates the importance of offering reproductive health services to all women working in factories, regardless of age or marital. Addressing reproductive health complaints can be important to increasing worker productivity, particularly for non-cyclic pelvic pain. Harlow and Campbell have previously argued that improving services by providing care for menstrual complaints is an excellent and relatively easy method for improving women's overall reproductive health status.[64] One simple step is to not only to increase reproductive healthcare services among female workers in China's factories, but to offer birth control pills and pain relief medication to women who suffer from menstrual pain and/or heavy menstruation. Reducing occupational stress, encouraging women to seek health care for gynecologic pain, and providing easy access to reproductive health care and reproductive health education for women of all ages and positions within the factory are important steps to improving women's health in China's EPZs.

In summary, this study documenting a high prevalence of reproductive health complaints among women factory workers in China is the first to examine occupational stress as it relates to three main types of gynecologic pain among female factory workers in China's export production factories that depend on foreign investment. As Chinese women's waged employment increases in the manufacturing industries in EPZs and as job security remains unstable or continues to decline and overtime work continues to be widespread, especially among factories with foreign investment, close attention to the reproductive health needs of women working in these zones is warranted.

Conflict of Interest

The authors declare no conflicts of interest.

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