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Urogenital infection symptoms and occupational stress among women working in export production factories in Tianjin, China

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ABSTRACT

Objective: To assess the prevalence of urogenital infection symptoms and their association with occupational stress among women working in export production factories in China. **Methods:** Six hundred and thirty-eight women workers in three factories in Tianjin, China were surveyed. Information was collected on women's demographic characteristics, levels of occupational stress, and urogenital infection symptoms. Data were analyzed using multiple logistic regression. **Results:** Among the 638 women who provided information on urogenital symptoms, 30.9% reported at least one symptom: 27.9% reported abnormal discharge, 2.4% reported genital sores, and 6.3% reported pain with urination. Feeling exhausted was associated with an increased risk for reporting genital sores [*OR*=1.35 (1.05, 1.73)] and pain with urination [*OR*=1.21 (1.06, 1.39)], while reporting low job security was significantly associated with reporting at least one symptom of urogenital infection [*OR*=1.51 (1.03, 2.20)]. **Conclusions:** Many women working in China's export factories report symptoms of urogenital infection. Occupational stress may be linked to an increased risk for urogenital infection. Focused efforts are needed to improve accessibility to reproductive health services for women working in China's export production factories.

1. Introduction

Urogenital infections including reproductive tract infections (RTIs) and urinary tract infections (UTIs) are important causes of morbidity among women in China[1-3] although studies among disparate Chinese populations report a wide range of prevalence estimates. The estimated prevalence of RTIs in studies using clinical examinations ranges from 17.2% to 76.4% with the higher estimates in studies of women living in rural China[1, 4-7]. In China's general population, 8.4% reported pain with urination with a higher prevalence at older ages[3, 8]. Few studies provide information on RTIs or UTIs in China's factory worker population. One study of China's women workers shows that 27.2% of unmarried migrant workers and 40.2% of married migrant workers reported symptoms of RTIs.

RTIs can lead to pelvic inflammatory disease, infertility, ectopic pregnancy, premature labor, low birth weight babies, chronic pain, and increased vulnerability to human immunodeficiency virus (HIV) and other sexually transmitted infections (STIs) [1, 9]. A number of risk factors have been identified that contribute to an increased prevalence of RTIs among Chinese women, such as ever having premarital sex, poor sanitary practices, low level of reproductive health knowledge, using an intrauterine device, rural to urban migration, and stress[1, 10-13]. Risk factors for pain with urination, an indication of an UTI, include early sexual debut, low level of education, working in agricultural and manual low-skilled occupations, and

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infrequent bathroom breaks[3, 14].

Export processing zones (EPZs) employ a large number of low-skilled laborers and offer jobs which often demand long hours, overtime, night work, and poor job security -- conditions conducive to high levels of stress. Several studies have documented an increase in the prevalence of RTIs among women exposed to stress[11, 15-17]. However, no studies have examined RTIs and UTIs or their relation to stress from working in China's EPZs, even though symptoms of RTIs and UTIs have both been reported to be concerns in this population[14].

The objective of this study was to assess the prevalence of self-reported urogenital infection symptoms (abnormal vaginal discharge, pain with urination, and genital sores) and the association between urogenital infection symptoms and demographic, lifestyle, and occupational risk-factors among women working in three electronics factories in the Tianjin Economic-Technological and Development Area (TEDA) in northeastern China.

2. Materials and methods

Field work for this study 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.

This study was completed in Tianjin, China. Tianjin is one of China's provincial level cities, placing it at the same administrative level as a province and giving it more autonomy than cities within provinces. Tianjin is located on China's northeastern coast and opened to foreign direct investment relatively early. The Tianjin Economic-Technological Area (TEDA) was created in 1984 and is one of China's oldest EPZs.

A cross-sectional survey design was implemented in three electronics factories in TEDA using a structured questionnaire. Factories were selected by contacting electronic factories with relationships to 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 of China and Taiwan. Factory 2 was a semiconductor factory established in 1996 and owned through a joint partnership of China and the United States. Factory 3 was a fabrication factory established in 1995 and owned through a joint partnership of China and Japan. At each factory, women workers aged 18 years and over who were available at the day and time of the study were asked to participate, informed consent was obtained, and the survey was immediately completed. All surveys were anonymous.

A total of 744 women workers were approached during work breaks and all agreed to complete the survey. After removing women who had incomplete age information (n=24), those missing information on all three of the urogenital outcomes (n=24), and those who reported being pregnant in the last twelve months (n=58), the total number of respondents eligible for this analysis was 638 (85.8%). In the final analytical sample, 13% of women were drawn from Factory 1, 38% of women were drawn from Factory 2, and 49% of women were drawn from Factory 3. These samples represented 10% of the total female workforce from Factory 1, 17% from Factory 2, and 19% from Factory 3. Details of our data collection and instrument have been published previously[18]. 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 Economic, Population, Nutrition and Health Survey's Adult Questionnaire[19]. The reproductive health questions were adapted from the Oxfordshire Women's Health Study questionnaire and from the chapter, "The Value of the Imperfect: The Contribution of Interview Surveys to the Study of Gynaecological Ill Health " in the book, Investigating Reproductive Tract Infections and Other Gynaecological Disorders[20, 21]. The occupational stress questions included questions on job strain and exhaustion. The job strain questions were adapted from the Karasek Job Content Questionnaire (JCQ)[22]. The question on exhaustion was selected from the Swedish Occupational Fatigue Inventory (SOFI)[23]. 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 was written in English and translated to Chinese by a professional Chinese language instructor and back translated by a professional Chinese-English translator.

Date of birth (month and year) according to the western calendar was asked in order to calculate age. Age was then calculated from the date of birth to the date of the survey and categorized into three groups; 18-24 years, 25-29 years, 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). Level of education was created 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, 501-1 000 yuan, 1001-2 000 yuan, 2 001-3 000 yuan, 3001-4 000 yuan, and above 4 000 yuan. Responses were dichotomized into 2 000 yuan or less and 2 001 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".

Vaginal discharge with an abnormal color was defined in response to the following question: "In the last 12 months, did you experience vaginal discharge with an abnormal color?", with the options yes or no. Vaginal discharge with an abnormal smell was defined in response to the following question: "In the last 12 months, did you experience an unusual smell with your vaginal discharge?" with the options yes or no. Abnormal vaginal discharge was defined as present if women reported either vaginal discharge with an abnormal color or vaginal discharge with an abnormal smell. Information on genital sores was ascertained by the following question, "In the last 12 months, did you experience pain or sores in your genital area?", with the options yes or no. Information on pain with urination was ascertained by with the following question, "In the last 12 months, did you experience pain or burning when urinating?", with the options yes or no. An indicator variable of at least one symptom was positive if women reported any abnormal discharge, genital sores, or pain with urination.

Women were defined as having dysmenorrhea if they reported often or usually having painful periods in the past 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)". A dichotomous variable was created (never or occasionally versus often or usually). Dyspareunia was defined as reporting occasionally, often, or usually having pain during sexual intercourse or in the 24 hours after sexual intercourse. 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 reponse). Non-cyclic pelvic pain was defined as having pelvic pain not with periods or intercourse either on or off or constantly. Each woman recorded her experience with non-cyclic pelvic pain in 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)".

Occupational stress variables included job type (production or office), working overtime more than 3 days in average week (yes, no), working nights more than 3 nights in the average week work, poor job security, exhaustion, 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)" and "If yes, how many times did you work overtime on average each week? (one, two, three, or four or more)". A dichotomous variable was created (one, two, or three versus four or more). Working at night was measured with the question, "In the last 12 months did you work at night? (yes, no)" and "If yes, how many times did you work at night on average each week? (one, two, three, or four or more)". A dichotomous variable was created (one, two, or three versus four or more). Poor job security was assessed with the question "My job security is good. (strongly disagree, disagree, agree, and strongly agree)" and was dichotomized as strongly disagree or disagree and agree or strongly agree. Exhaustion was measured with by asking respondents to rate their level of exhaustion from zero if they were not exhausted to ten if they were extremely exhausted. 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)". Feeling exhausted and number of sick days were analyzed as continuous variables.

The variable high job strain was derived from the Chinese version of the Job Content Questionnaire (JCQ)[22, 24]. The

composite score for the JCQ was computed according to Karasek's job strain calculation; 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[21]. Missing items used to construct the composite job strain score were imputed by substituting the mean for each variable when only one or two questions had missing values for that participant. The nineteen individuals who had more than two items with missing values were defined as having missing information for the composite job strain score.

SAS 9.2 was used to conduct the analyses. The prevalence and 95 percent confidence interval of each urogenital symptom were determined. Bivariate and multiple logistic regression were used to evaluate associations between occupational, lifestyle, and demographic characteristics and each outcome. Crude and adjusted prevalence odds ratios and their 95% confidence intervals were calculated. Variables were included in the multivariable analysis if they were associated with urogenital infection in the bivariate analysis. As being married, not having children, and having sex in the last 12 months were highly correlated with one another, only having sex in the last 12 months, the variable most strongly associated with symptoms of urogenital infections, was included in the multivariable models, and is presented here.

3. Results

The mean age of women in this study was 28+5.8 (Mean+ SD) with 28.4% between 18 and 24 years, 42.0% between 25 and 29 years and 29.6% over 30 years. The majority of women (61.9%) were ever married and 49.4%% of women had at least one child. Most women had a high school education or less (68.2%) and 72.1% had an income of less than 2 001 yuan (approximately $317 USD). Most women in the study sample (73.1%) were urban residents of Tianjin (non-migrants). Most women did not smoke more than 5 cigarettes (95.3%) or drink any alcohol (64.1%) in the past month. Slightly more than half of the participants reported having had sex in the last 12 months (58.5%); most of whom had not used hormonal contraception (83.7%), but had used a condom at their last sexual encounter (45.6%). In total, 24.8% of the respondents reported their overall health as fair or poor.

More than two thirds (65.4%) of the women in this sample worked production jobs in the factories. A total of 16.9% reported working overtime and 33.7% reported working nights on average three or more days each week over the past 12 months. Almost one quarter (24.0%) of study participants reported high job strain and 35.7% reported job insecurity.

The percent of women who reported having at least one urogenital infection symptom was 30.9% (Table 1): 27.9% reported having abnormal discharge, 2.4% genital sores, and 6.3% pain with urination. Symptoms of urogenital infection were associated with other indicators of poor health status. Each symptom was associated with approximately a 2 to 3-fold greater likelihood of reporting a fair or poor overall health rating (Table 2) and with a 3 to 10-fold increase in the odds of reporting both dyspareunia (among women reporting having had sex in the past 12 months) and non-cyclic pelvic pain. Dysmenorrhea was not associated with reporting urogenital infection symptoms

Table 1

Prevalence and 95 % confidence intervals of urogenital symptoms among female factory workers in Tianjin, China (*n*=638).

Symptoms	No.	Percent	95% Confidence interval
Abnormal vaginal discharge color / smell	178	27.9	(0.24, 0.31)
Genital sores	15	2.4	(0.01, 0.14)
Pain with urination	40	6.3	(0.04, 0.80)
At least one symptom	197	30.9	(0.27, 0.34)

Table 2

Associations of urogenital infection symptoms with self-reported health and gynecologic pain conditions among female factory workers in Tianjin, China (*n*=638).

Symptoms		Fair or poor health rating				Often or usually dysmenorrhea				Pain with sex (*n*=373)				Non-cyclic pelvic pain			
		No.	%	*OR*	*CI*	No.	%	*OR*	*CI*	No.	%	*OR*	*CI*	No.	%	*OR*	*CI*
Abnormal vaginal discharge color/Smell	Yes	58	33.9	1.83	(1.24, 2.67)	39	22.2	1.29	(0.84, 1.98)	58	49.2	3.03	(1.84, 4.99)	52	33.9	3.12	(1.99, 4.89)
	No	99	21.9	–	–	82	18.1	–	–	48	23.8	–	–	50	14.2	–	–
Genital sores	Yes	8	53.3	3.35	(1.19, 9.39)	6	40.0	2.74	(0.95, 7.85)	10	83.3	8.41	(1.75, 40.42)	10	71.4	10.90	(3.34, 35.58)
	No	139	25.5	–	–	108	19.6	–	–	92	31.9	–	–	86	18.7	–	–
Pain with Urination	Yes	17	42.5	2.30	(1.19, 4.44)	12	30.0	1.84	(0.90, 3.74)	20	57.1	2.86	(1.36, 5.98)	20	52.6	5.71	(2.88, 11.35)
	No	125	24.3	–	–	98	18.9	–	–	77	29.4	–	–	70	16.3	–	–
At Least One Symptom	Yes	65	34.2	1.91	(1.31, 2.79)	45	23.1	1.40	(0.93, 2.12)	63	47.7	2.91	(1.77, 4.77)	62	36.5	4.26	(2.71, 6.72)
	No	93	21.4	–	–	77	17.6	–	–	43	22.9	–	–	40	11.9	–	–

Table 3 presents the unadjusted odds ratios for having urogenital symptoms by demographic, lifestyle and work characteristics. Age was not associated with any of the urogenital infection symptoms. The odds of reporting any urogenital infection symptoms were elevated for Tianjin residents (non-migrants), although the confidence interval included one. Women who reported having had sex in the last 12 months were significantly more likely to report abnormal vaginal discharge [*OR*=2.44(1.62, 3.67)], pain with urination [*OR*=3.91 (1.50, 10.17)], and at least one of the three urogenital infection symptoms [(*OR*=2.55 (1.71, 3.79)]. The odds ratio for reporting genital sores among women who

Table 3

Unadjusted odds ratios for urogenital infection symptoms by demographic, lifestyle and work characteristics among female factory workers in Tianjin, China (*n*=638).

Parameters	Abnormal vaginal discharge color/ Smell				Genital sores				Pain with urination				At least one symptom			
	No.	%	*OR*	*CI*	No.	%	*OR*	*CI*	No.	%	*OR*	*CI*	No.	%	*OR*	*CI*
Age																
18–24	43	24.0	0.68	(0.43, 1.07)	3	1.9	0.54	(0.13, 2.21)	9	5.9	0.77	(0.32, 1.84)	49	27.1	0.69	(0.44, 1.08)
25–29	75	27.9	0.83	(0.55, 1.25)	6	2.5	0.70	(0.22, 2.21)	18	7.6	1.00	(0.48, 2.10)	82	30.6	0.82	(0.55, 1.22)
30–56	60	31.9	–	–	6	3.5	–	–	13	7.6	–	–	66	34.9	–	–
Marital status																
Never	53	22.3	0.62	(0.43, 0.90)	4	1.9	0.63	(0.19, 1.99)	10	4.9	0.57	(0.27, 1.19)	60	25.1	0.64	(0.45, 0.91)
Ever	124	31.6	–	–	11	3.1	–	–	30	8.4	–	–	136	34.4	–	–
Children																
None	75	23.3	0.62	(0.44, 0.88)	5	1.8	0.51	(0.17, 1.51)	15	5.5	0.61	(0.31, 1.18)	83	25.7	0.61	(0.43, 0.86)
1 or more	103	32.9	–	–	10	3.4	–	–	25	8.7	–	–	114	36.2	–	–
Education level																
Educated past high school	55	28.2	1.01	(0.69, 1.47)	5	2.8	1.09	(0.38, 3.24)	10	5.7	0.69	(0.33, 1.46)	63	32.3	1.09	(0.76, 1.58)
High school education or less	121	28.0	–	–	10	2.6	–	–	30	7.9	–	–	132	30.3	–	–
Holds Tianjin residence card																
Yes	138	29.7	1.37	(0.90, 2.08)	13	3.1	2.08	(0.46, 9.35)	35	8.3	2.24	(0.86, 5.85)	153	32.8	1.41	(0.94, 2.11)
No	37	23.6	–	–	2	1.5	–	–	5	3.9	–	–	41	25.8	–	–
Drank alcohol in the past month																
Yes	68	30.9	1.27	(0.89, 1.82)	7	3.5	1.59	(0.57, 4.46)	20	9.9	1.84	(0.96, 3.50)	76	34.4	1.31	(0.92, 1.86)
No	106	26.0	–	–	8	2.2	–	–	20	5.7	–	–	117	28.6	–	–
Had sex in the last 12 months																
Yes	130	34.9	2.44	(1.62, 3.67)	11	3.1	1.99	(0.55, 7.18)	34	9.7	3.91	(1.50, 10.17)	144	38.6	2.55	(1.71, 3.79)
No	38	18.0	–	–	3	1.6	–	–	5	2.7	–	–	42	19.8	–	–
Used Condom at last sex																
Yes	65	33.9	0.96	(0.63, 1.47)	6	3.4	0.94	(0.29, 2.98)	20	11.2	1.39	(0.68, 2.86)	71	36.9	0.94	(0.62, 1.43)
No	63	34.8	–	–	6	3.6	–	–	14	8.3	–	–	70	38.5	–	–
Job type																
Production staff	109	26.3	0.83	(0.57, 1.21)	8	2.1	0.61	(0.21, 1.78)	22	5.9	0.58	(0.30, 1.13)	121	29.0	0.82	(0.57, 1.18)
Office staff	58	30.2	–	–	6	3.5	–	–	17	9.9	–	–	64	33.3	–	–
Worked the overtime in thelast 12 months at least 3 days																
Yes	37	34.6	1.47	(0.94, 2.29)	7	6.9	4.24	(1.49, 11.96)	13	13.3	2.43	(1.21, 4.90)	40	37.0	1.41	(0.91, 2.18)
No	137	26.5	–	–	8	1.7	–	–	27	5.9	–	–	153	29.4	–	–
Worked the night shift in the last 12 months at least 3 nights																
Yes	67	31.3	1.25	(0.87, 1.80)	10	5.1	4.58	(1.42, 14.81)	19	10.3	1.96	(1.01, 3.79)	76	35.4	1.34	(0.94, 1.91)
No	103	26.8	–	–	4	1.2	–	–	19	5.5	–	–	112	29.0	–	–
High Job strain																
Yes	52	34.2	1.47	(0.99, 2.19)	3	2.1	0.73	(0.20, 2.63)	15	10.9	1.97	(1.00, 3.88)	57	37.3	1.46	(0.99, 2.14)
No	121	26.1	–	–	12	2.9	–	–	24	5.8	–	–	135	28.9	–	–
Poor Job Security																
Yes	75	33.0	1.47	(1.02, 2.11)	7	3.3	1.39	(0.49, 3.91)	16	7.7	1.13	(0.58, 2.19)	84	36.8	1.53	(1.08, 2.17)
No	95	25.1	–	–	8	2.4	–	–	23	6.9	–	–	105	27.6	–	–
Number of sick days used	–	–	1.23	(1.07, 1.40)	–	–	1.28	(0.89, 1.82)	–	–	1.33	(1.06, 1.68)	–	–	1.25	(1.10, 1.43)

reported having sex in the last 12 months was also elevated; however it was not statistically significant.

Women who reported working on average three days or more of overtime per week in the last year and those working on average three or more night shifts per week over the last year were 2 to 4.5 times more likely to report having genital sores and pain with urination. The odds ratios for women reporting abnormal vaginal discharge and at least one urogenital infection symptom were elevated but not significant. High job strain was associated with pain with urination (*OR*=1.97 (1.00, 3.88)). Furthermore, high job strain showed evidence of a relationship with both abnormal vaginal discharge and at least one urogenital infection symptom, although the confidence intervals included one. Genital sores were not associated with job strain. Poor job security was associated with abnormal vaginal discharge [*OR*=1.47 (1.02, 2.11)] and reporting at least one urogenital infection symptom [*OR*=1.53 (1.08, 2.17)]. Notably, women who reported abnormal discharge [*OR*=1.23 (1.07, 1.40)], pain with urination [*OR*=1.33 (1.06, 1.68)], and at least one of the three urogenital infection symptoms [*OR*=1.25 (1.10, 1.43)] were more likely to take off days of work due to illness than women who did not report these symptoms. Feeling exhausted increased the odds of reporting at least one urogenital infection symptom [*OR*=1.09 (1.02, 1.15)], pain with urination [*OR*=1.22 (1.08, 1.39)], and genital sores [*OR*=1.47 (1.15, 1.88)]. The odds of having abnormal vaginal discharge increased with feeling exhausted although the confidence interval included one.

The multivariable analysis is presented in Table 4. Adjusting for sexual activity in the past 12 months attenuated most associations. For abnormal vaginal discharge; sex in the last 12 months increased odds over two-fold [*OR*=2.40 (1.58, 3.65)] while poor job security and high job strain were associated with a non-significant elevation in the odds ratio. For genital sores, feeling exhausted remained significant [*OR*=1.35 (1.05, 1.73)] and working the night shift showed an increased but non-significant odds ratio. For pain with urination, having sexual activity in the last 12 months was associated with nearly a three-fold increase in odds [*OR*=3.83 (1.46, 10.08)], feeling exhausted slightly increased the odds [*OR*=1.21 (1.06, 1.39)], while reporting high job strain showed an increased but not statistically significant increase in the odds. For reporting at least one urogenital infection symptom, sex in the last 12 months was associated with a 2.5 fold increase in the odds [*OR*=2.53 (1.68, 3.79)] and poor job security with a 50 percent increase in the odds [*OR*=1.51 (1.03, 2.20)], while high job strain again showed an increased but not statistically significant odds.

Table 4

Adjusted odds ratios for urogenital infection dymptoms among female factory workers in Tianjin, China (*n*=638).

Parameters	Abnormal Vaginal discharge color/smell		Genital sores		Pain with urination		At least one symptom	
	OR	*CI*	*OR*	*CI*	*OR*	*CI*	*OR*	*CI*
Sex in the last 12 months	2.40	(1.58, 3.65)	–	–	3.83	(1.46, 10.08)	2.53	(1.68, 3.79)
High Job strain	1.37	(0.89, 2.11)	–	–	1.57	(0.75, 3.27)	1.36	(0.89, 2.07)
Poor Job security	1.41	(0.96, 2.08)	–	–	–	–	1.51	(1.03, 2.20)
Worked the night shift in the last 12 months at least 3 nights	–	–	3.09	(0.91, 10.45)	–	–	–	–
Exhausted	–	–	1.35	(1.05, 1.73)	1.21	(1.06, 1.39)	–	–

4. Discussion

To our knowledge, this is the first study to examine the relationship between occupational stress and symptoms of urogenital infections in an export processing zone (EPZ) in China. We documented a high prevalence of self-reported symptoms of urogenital infections among women working in three factories in a Tianjin EPZ and provide preliminary evidence that women have an increased odds of abnormal vaginal discharge, pain with urination, and genital sores when exposed to occupational stressors such as working overtime, working at night, and self-reported job strain regardless of the women's age, marital status, or migrant status. In this study of women workers in three electronic factories in Tianjin, China nearly one-third reported at least one of the urogenital infection symptoms assessed (abnormal discharge, pain with urination, or genital sores). As would be expected, sex in the last 12 months was the key demographic risk factor for reporting urogenital symptom; however, several work characteristics indicative of occupational stress were also associated with elevated odds of reporting at least one symptom, pain with urination and genital sores.

In our sample, 27.9% reported abnormal vaginal discharge, 2.4% reported genital sores, and 6.3% reported pain with urination. Although, the prevalence reported in this study may underestimate urogenital infections in this population since it is based on self-report and urogenital infections are frequently asymptomatic, the prevalence of abnormal vaginal discharge found in our study was similar to the prevalence of self-reported RTI symptoms reported among migrant unmarried women in Guangzhou (27.2%)[8]. The prevalence of pain with urination in our study was slightly less than the prevalence of 8.4% found in China's general population[3]. Data on these

conditions remain limited in China and warrant further study.

Reporting of urogenital infection symptoms was associated with working conditions. Working overtime for more than three days a week in the past year and working the night shift for more than three nights a week in the past year were associated with an increased risk of genital sores and pain with urination. Job strain was associated with increased pain with urination and a statistically non-significant increase in risk was also observed for abnormal vaginal discharge and having at least one urogenital infection symptom. Feeling exhausted was associated with all urogenital infection symptoms although the association with abnormal discharge was not statistically significant. These findings are consistent with an association between risk of urogenital infection symptoms and stress.

Studies have shown that stress disrupts communication between the nervous and immune systems[25] Consequences of stress-induced immune dysregulation include hormonal changes that increase the rate of disease progression, reactivation of infection, as well as slow wound healing and prolonged infectious episodes[25-27], In a meta-analysis of stress-related immune system dysfunction, chronic stress was found to be associated with the suppression of both cellular and humoral immunity, while stressors lasting just minutes were associated with adaptive up-regulation of natural immunity and down-regulation of some functions of specific immunity. Stressors lasting a brief time were associated with suppression of cellular immunity, but not humoral immunity[26, 28]. Female factory workers most likely experience all three types of stress, but our study has most approximated chronic stress. The associations we found between chronic occupational stressors and increased risk for urogenital infection could be due to occupational stressors modifying the immune response.

Urogenital symptoms are important to address in their own right, but also because they are associated with other gynecologic morbidities and lost wages. All symptoms of urogenital infections in our study were associated with dyspareunia and non-cyclic pelvic pain as well as with work absenteeism. Women who reported at least one of the urogenital infection symptoms, abnormal discharge, or pain with urination were more likely to take days off work due to illness than women without these symptoms.

None of the symptoms of urogenital infection that we assessed were associated with migrant status. This finding is contrary to previous research which states that migrant status is a major risk factor for RTIs. However, over 90% of women in our study population had health insurance through their employer; therefore access to healthcare was similar for migrant and non-migrant women in our sample. Notably, more than 70% of women had an income of less than 2 001 yuan, which is below the average reported monthly salary of 3 000 yuan - 4 000 yuan for factory workers in other Tianjin electronics factories according to a report by China Labor Watch and the median income of all workers in Tianjin (3 749 yuan) in the year 2010[29, 30]. Possibly, income and health insurance are more important to healthcare access than migrant status.

This paper has some limitations. Self-report was used to assess urogenital infection symptoms instead of clinical exams due to the difficulty in accessing this population of female factory workers. Past research has shown a low correlation between the complaint of abnormal vaginal discharge and certain urogenital infections based on clinical examination[31]. However, the survey results allow us to understand the subjective element of reproductive ill-health[21]. The subjective experience of urogenital infection is important due to the consequences of feeling ill, missed work days, and reduced sexual activity[21]. As factories were selected by the Tianjin Centers for Disease Control and Prevention, it is possible that the factory conditions are better than in other factories and therefore our results may not be generalizable. Women who experienced more severe symptoms of urogenital infection may have left work and therefore our study may not have captured more extreme outcomes. Future research in this area could utilize clinical exams to confirm the prevalence of urogenital infections. Moreover, our study also did not evaluate stress outside the workplace or other risk factors such as sanitary practices and stigma.

In summary, this study provides further evidence of the burden of urogenital infection among working women in China and suggests that working overtime, working at night, and job strain may be associated with the risk of having urogenital infection symptoms. Women who report abnormal discharge and pain with urination are more likely to take days off work due to illness and women reporting any or all of the three urogenital infection symptoms in this study were more likely to describe their health as fair or poor. Increased attention to these issues is needed to improve women's health and reduce the potential for lost wages. Reducing occupational stress among female factory workers could decrease the prevalence of urogenital infections in this population and, given the association with days taken off work, may reduce worker absenteeism.

As China continues to grow economically, the worker population will increase and with it the number of female factory workers with reproductive health concerns. Given this growing population and the evidence of a clear unmet need for reproductive healthcare, it is imperative that the reproductive health needs of women working in China's factories be addressed.

Conflict of interest statement

The authors state that they do not have a conflict of interest.

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