**Reproductive Health in the Context of Foreign Direct Investment and Export Production: The Case of China**

By

Kristin Elizabeth King Sznajder

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Doctoral Committee:

Professor Siobán D. Harlow, Chair
Associate Professor Sarah A. Burgard
Professor Mary E. Gallagher
Assistant Professor Min Zhang

**Dedication**

To my husband, Ari, for his unwavering love and support

and to our son, Leon, who motivates me to be someone he can be proud of.

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## List of Abbreviations

| | |
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| EPZ | Export Processing Zone |
| FDI | Foreign Direct Investment |
| GDP | Gross Domestic Product |
| GNP | Gross National Product |
| IMR | Infant Mortality Rate |
| JCQ | Job Content Questionnaire |
| MDG | Millennium Development Goals |
| RTI | Reproductive Tract Infection |
| TEDA | Tianjin Economic-Technological Development Area |
| UTI | Urinary Tract Infection |

**Abstract**

More than half of the world's workers in export processing zones are in China and the majority of those are women. Work environments with high occupational stress, such as production line jobs typical in export processing zones have been associated with adverse reproductive health outcomes. This dissertation analyzes the prevalence of and risk factors associated with pelvic pain and urogenital infection among women working in three electronics factories in Tianjin, China, as well as the association of infant mortality rates with foreign direct investment and indicators of women's employment at China's province and prefecture levels.

A survey designed to examine occupational stress, pelvic pain, and symptoms of urogenital infection was implemented in three electronic factories in the Tianjin Economic-Technological Development Area in 2010 with responses from 744 female factory workers. Infant mortality was evaluated using year 2000 data from the China Census and the China Statistical Yearbook.

Results from the Tianjin survey indicate that nearly one quarter of all factory workers experience job strain, 80.7% any dysmenorrhea, 18.9% often or usually experiencing dysmenorrhea, 15.7% non-cyclic pelvic pain, 26.5% any dyspareunia, and 30.9% any urogenital infection symptom. Survey results suggest associations between occupational

stress, pelvic pain, and urogenital infection symptoms in adjusted analyses. Results from the aggregate China data show that a higher foreign direct investment, higher proportion of the gross domestic product from manufacturing, and lower proportion of exports from total trade are associated with lower infant mortality rates. A higher proportion of women working in manufacturing relative to all women working or to all men and women working in manufacturing was associated with lower infant mortality rates and the effect was modified by gross domestic product and foreign direct investment.

This dissertation provided an initial examination of the associations of aggregate level economic indicators and infant mortality rates, as well as of individual level occupational risk factors and reproductive health outcomes. Future research to better understand the causes for poor reproductive outcomes and public health programs to improve reproductive health among women factory workers in China's export processing zones are crucial to improving the health of China's labor force.

# Chapter 1

# Introduction

## Overview

China has attracted more foreign direct investment (FDI) than any other developing country and is a preferred location for FDI (Gallagher, 2005b; X. Zhang & Zhang, 2003). Increased exportation and FDI in China as in other developing countries has been facilitated by the creation of export processing zones (EPZs). EPZs are areas where goods can be produced and exported without interference from customs and with reduced or no barriers to trade.

Workers in China's EPZs account for more than 70% of all workers in EPZs worldwide or 30 million of the world's 42 million EPZ workers and the majority are women (Fu & Gao, 2007). China began its economic reforms in 1978 just two years after the end of the Cultural Revolution. When it entered the global economy it was without a business class so it relied on FDI to drive economic growth (Gallagher, 2005b). China's dependency on FDI created fierce competition with other countries and within firms in China to attract it. A major competitive advantage for China is its large labor supply willing to work for low wages (International Labour Organization, 2002; McCallum, 2011). Labor costs in China are kept low due to the large labor force coming from rural areas in China and the

expectation that workers work long hours for low wages. Offering low wages for work has been justified by firms arguing that there is increasing competition to attract FDI and by foreign enterprises maintaining that low wages for employees allow them to compete on a global scale (Gallagher, 2005b). Labor contracts were developed to increase the autonomy of firms allowing for increased labor flexibility in terms of working hours, wages, and length of employment. As a result, labor contracts have decreased job security compared to jobs within the former state-run labor assignment system because they are usually short term and easily terminated (Gallagher, 2005b). This situation may be changing due to tightening labor markets and changes to labor legislation to improve job security (Park, Cai, & Du, 2010; H. Wang, Appelbaum, Degiuli, & Lichtenstein, 2009).

Whether FDI and EPZs improve the health status of the population within a country is a point of controversy in the literature. Modernization and Demographic Transition Theorists tend to affirm that FDI and EPZs will improve the health of populations in developing countries through increased wealth, industrialization, education, and urbanization (Shen & Williamson, 1999). Conversely, Dependency Theorists maintain that FDI and EPZs play a role in global division of labor, income inequality, and obstruction of public health measures (Shen & Williamson, 1999). This debate is particularly relevant to women's health as the growing number of EPZs worldwide has created new opportunities for women to work outside the home (Maclean & Sicchia, 2004).

Women comprise of up to 90% of the workers in some EPZs worldwide and are the majority of the workforce in China's foreign invested enterprises (Fu & Gao, 2007; International Labour Organization, 2002, 2007). Women are often selected for jobs with lower wages, long hours, and little opportunity for job advancement (Loewenson, 1999). The preference for women workers is related to beliefs that women workers are more competent, hard-working, and docile than men (Loewenson, 1999). Companies in EPZs often prefer women who are not married because it is assumed they do not have household responsibilities (Loewenson, 1999). The increase in women's employment has narrowed the gap in the proportion of men and women working outside the home and in some cases has narrowed wage differences between men and women, which may increase women's autonomy (Maclean & Sicchia, 2004).

While women are being empowered to improve their lives through gaining formal employment, their quality of life is dependent not only on their financial status and independence, but is also dependent on their health. Chinese labor law provides protection for female employees who are pregnant, menstruating, or nursing (Baker & McKenzie, 2005). However, young working women are nevertheless exposed to occupational health risks such as injury, unsanitary working conditions, discrimination and violence at work, and psychological stress (Maclean & Sicchia, 2004). Furthermore, studies have shown that poor reproductive health is associated with low labor productivity (Burton, Morrison, & Wertheimer, 2003; Reed, Koblinsky, & Mosley, 2000; Sanfillipo & Erb, 2008). If women's health deteriorates, women may not be able or

willing to continue work or to work efficiently and therefore gains made in wealth or autonomy may inadequately balance the associated health costs.

Most of the literature on the reproductive health of female factory workers in China is on migrant women. Female migrants make up the bulk of the production workforce in China's EPZs (Gallagher, 2005b; Lee, 1998) and one third of China's overall migrant population are women of reproductive age (Zheng et al., 2001). For the past 30 years, China has been undergoing the largest human mass migration in history. Increasing economic disparities between rural and urban areas and the development of EPZs have contributed to a rural labor surplus and an urban labor demand, fueling economic labor migration to cities (Hao, 2005). In 2008, the National Bureau of Statistics of China reported 225 million rural to urban migrants in China's mainland, equivalent to 17% of China's total population (NBSC, 2009). Once migrants arrive in urban areas, many find it difficult to assimilate to the urban community and are often marginalized economically, legally, and socially (Biao, 2004). The marginalization experienced by migrants contributes to poor health and lower access to public services (Liang & Ma, 2004).

Migrant women may have less access to healthcare than urban resident women because of government or institutional policies, lack of health insurance, or low levels of knowledge on how and when to access healthcare (Park, Wang, & Cai, 2006). Due to China's household registration system, a method that labels people as living in a rural or urban area, rural to urban migrants in China are not eligible for the same social services as urban residents (Hong et al., 2006; Solinger, 1999). These social services include

healthcare, education and housing. China has been working to improve the situation for migrants and these policies may change in order to attract more migrant workers to move to cities (Cai, 2011).

Once employed as a laborer in a factory, all women workers have similar occupational exposures regardless of migrant status. Occupational stress may play a large role in the health of female factory workers in China. Work environments with high occupational stress, such as low-skilled, production line, and quota-based jobs characteristic of EPZ employment have been associated with adverse reproductive health outcomes (Sioban D. Harlow, 1986; Mozurkewich, Luke, Avni, & Wolf, 2000). Reproductive health is important to consider in this population not only because the work environments employing women are related to poor reproductive health outcomes but also because the population employed in factories are women of reproductive age (Cedillo & Harlow, 1997). The linkage between reproductive health and women's labor force participation has been discussed in popular and academic literature. However, relatively little epidemiologic research has been conducted on the association between women's increasing role in export production-based labor markets and their reproductive health.

China is internationally known for quickly scaling up access to reproductive healthcare due to its remarkable "One Child Policy". The "One Child Policy" has reduced the number of children born in China by offering low-cost or free contraception and demanding fees for having more than the allotted number of children. However, gynecologic morbidity including infection and pain are not integrated into the same national system (Kaufman, 2011). Factory workers in China typically receive all routine

health care through annual exams that their employer is required to offer, although many workers may miss health exams due to high worker turnover. However, a policy has not been formally established on who receives this care and when, which leads to varied healthcare access across employers, hospitals, and regions in China.

This dissertation addresses three major themes in reproductive health research; pelvic pain, urogenital infections, and infant mortality. Chapters 2 and 3 utilize data from an individual level survey conducted among women working in three separate export production factories in Tianjin's EPZ. Chapter 2 evaluates the prevalence of three types of pelvic pain (dysmenorrhea, dyspareunia, non-cyclic pelvic pain) and the associations between pelvic pain and demographic and lifestyle characteristics, as well as occupational stress. Chapter 3 estimates the prevalence of urogenital infection symptoms (abnormal vaginal discharge, genital sores, pain with urination), as well as the associations between demographic and lifestyle characteristics and occupational stress. Chapter 4 utilizes province and prefecture aggregate data from China's 2000 Census and the China Statistical Yearbook for the year 2000 to address the variation in infant mortality rates and the association between infant mortality rates and economic and women's employment indicators.

**Study Justification**

This research project was motivated by numerous predominately qualitative reports, documenting that young women in China's factories have concerns regarding their reproductive health and the evidence suggesting the potential of a higher risk of

reproductive ill-health in this population. This dissertation will examine the impact of occupational stress on the reproductive health of female factory workers in China's export processing zones (EPZs) by assessing the prevalence of reproductive health complaints (pelvic pain and urogenital infections) in female factory workers and by comparing infant mortality rates in China's regions with varying amounts of FDI and proportion of women working in manufacturing.

Chinese women workers and female migrants report painful menstruation and reproductive health, respectively, to be their most important health concerns (Biao, 2004; BSR, 2006; Guan & Jiang, 2002). In a recent assessment of female factory workers in China, five of the top seven health concerns were reproductive in nature (BSR, 2010). Qualitative interviews of women working in EPZs in and outside of China have documented that pain with menstruation, as well as symptoms of vaginal infection are the most frequent reproductive complaints (BSR, 2006; Christiani, Niu, & Xu, 1995; Chung, Yao, & Wan, 2005; GAATW, 2007; Her+Project China, 2010; Manivanh, 2007; Messing, Saurel-Cubizolles, Bourgine, & Kaminski, 1993). Studies in and outside of China have corroborated these concerns by providing evidence that women exposed to occupational stress are at an increased risk for pelvic pain and adverse pregnancy outcomes (Kishi, Kitahara, Masuchi, & Kasai, 2002; Mozurkewich, et al., 2000).

Adverse pregnancy outcomes such as preterm birth and low birth weight are associated with an increased risk of infant mortality as shown in studies completed in Korea and among cohorts from the United States and Canada (Choy, Song, Kim, & Song, 2011;

Kramer et al., 2000). While occupational stress has been shown to increase the risk for adverse pregnancy outcomes that could lead to infant deaths, an increase in individual or country-level wealth may decrease infant mortality (MacDorman et al., 2000; Wagstaff, 2000). Nonetheless, foreign direct investment in China has been found to be associated with increased employment opportunities in labor intensive manufacturing which could lead to increased occupational stress on workers, increased employment of rural migrant workers who have lower access to healthcare compared to non-migrants, as well as increased individual and country-level wealth. Perhaps due to these differing impacts of foreign direct investment, the studies evaluating the association between high levels of foreign direct investment and infant mortality in between country comparisons have been inconclusive (Firebaugh & Beck, 1994; Hong, et al., 2006; Kick, Davis, Burns, & Li, 1995; Meyer, 1996; Shen & Williamson, 1997; Taube & Ogutcu, 2002).

Little data exists examining the risk of urogenital infections related to factory working conditions, however several studies outside China have found a relationship between increased stress and infection (Aiello, Simanek, & Galea, 2008; Godbout & Glaser, 2006; Riddell, 1991). Moreover, females in China hired to work in export production factories are more likely to be never married migrant women, which is a high risk group for reproductive tract infections (RTIs) (Ford Foundation, 2001; Park, et al., 2006; Zheng, et al., 2001).

Early diagnosis and treatment of both pelvic pain and urogenital infection can lead to reduced worker absenteeism, reduced risk for adverse pregnancy outcomes, reduced

vulnerability to other urogenital infections, and early detection of cervical or uterine cancer (Sioban D. Harlow & Campbell, 2000; X.-J. Zhang et al., 2009). Recently, a shortage of low-level workers in China has been documented (Gallagher, 2005a; Park, et al., 2010). Therefore, businesses have a stronger incentive than ever to provide healthy working conditions to employees in order to improve worker health and quality of life and thereby retain employees.

Some companies and non-governmental organizations, especially those in the public eye, have begun to provide their female employees with reproductive health services in response to a documented need for increased attention to the reproductive health of factory workers (Adidas Group, 2007; Her+Project China, 2010; 2005). The proactive solutions undertaken by companies and organizations indicate that epidemiologic research on occupation and reproductive health in these settings is overdue.

The United Nations has recently taken a keen interest in the topic of women's empowerment and gender equity, which has been documented in the United Nations Millennium Development Goals (MDGs) (United Nations, 2010). China has agreed to work towards the MDGs (Briefing Note No. 2, 2005). One of the suggested markers of women's empowerment is an increase in the share of women working in formal non-agricultural settings. The MDG Goal Number Three: Promote Gender Equality and Empower Women. As a sub-point, goal number three aims to increase the share of women in wage employment outside the non-agricultural sector. This dissertation argues

that attending to the health of women working in non-agriculture industries, specifically in export-oriented manufacturing, is critical to achieving MDG Goal Number Three.

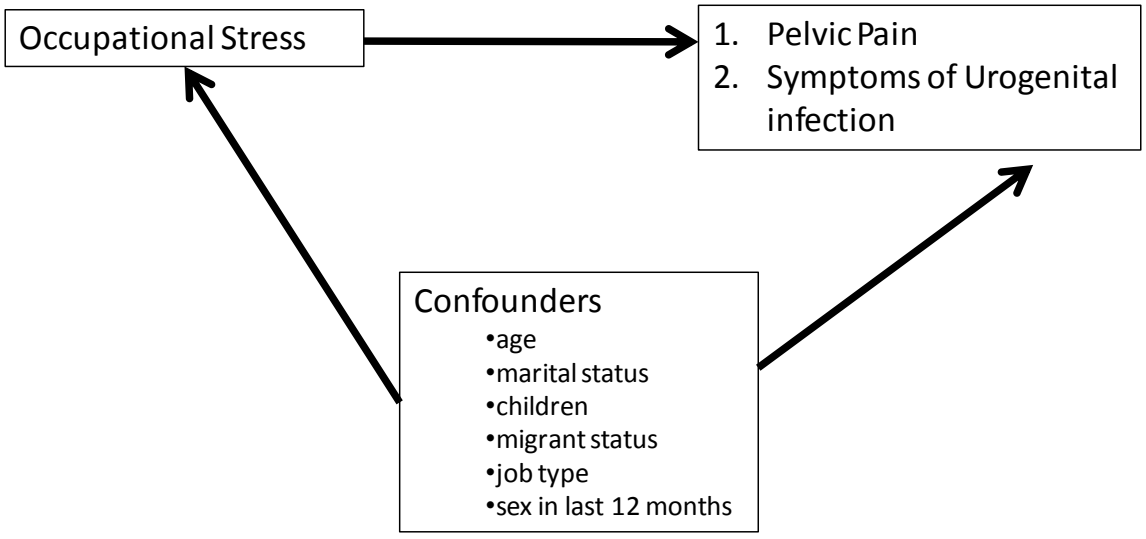
This dissertation research seeks to contribute to the growing literature addressing the reproductive health needs of women working in EPZs and to provide epidemiologic data relevant for China's national health policies. Given the large number of women workers in EPZs and the priority women give to their reproductive health needs, the reproductive health needs of women in EPZs should be recognized. This dissertation will be the first epidemiologic study to document the prevalence of self-reported pelvic pain and urogenital infection symptoms and their relationship to occupational stress among women workers in China's Tianjin Economic-Technological Development Area (TEDA). Additionally, this dissertation will compare infant mortality rates (IMRs) in China's provinces and prefectures and will determine the associations between IMR and FDI. The information gained from this research will help policy-makers better target the specific reproductive health needs and occupational risk factors of Chinese factory working women nationwide. Reproductive health of female factory workers in this economic and social context is a timely topic relevant to China's national reproductive and occupational health policies.

**Specific Aims**

Aim #1: To estimate the prevalence of pelvic pain (dysmenorrhea, dyspareunia, and non-cyclic pain) among women workers in three electronic factories in TEDA and to assess whether prevalence is associated with occupational stress after controlling for age, having children, marital status, job type, or migrant status.

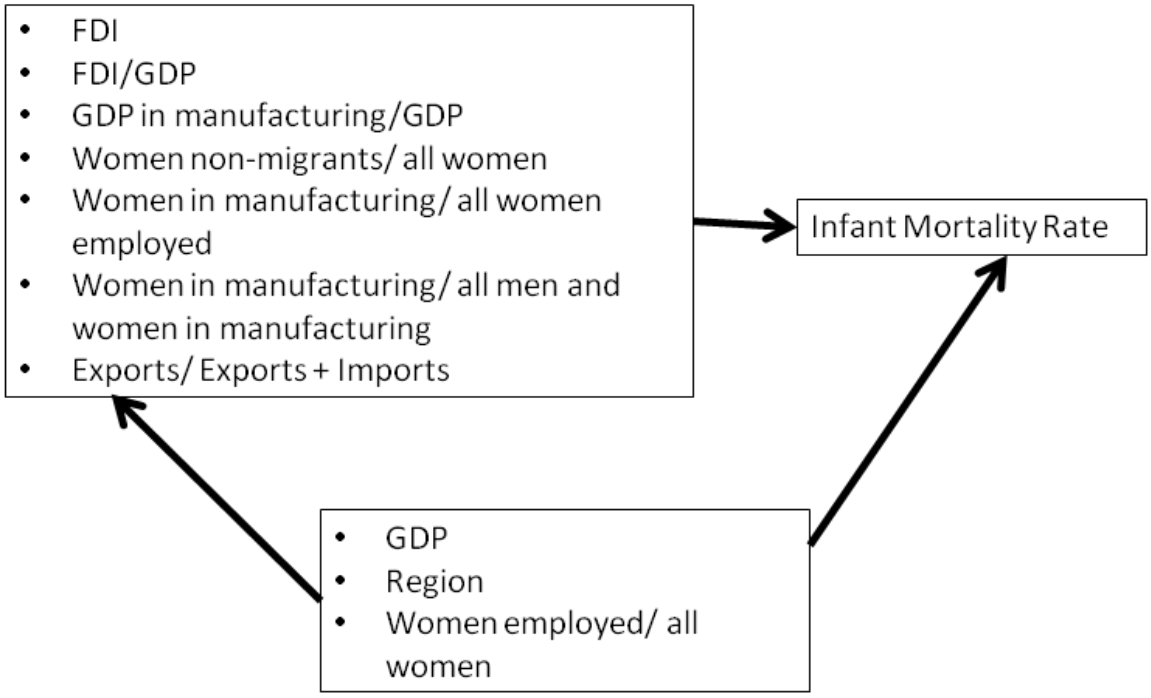
Aim #2: To estimate the prevalence of urogenital infection symptoms (reproductive and urinary tracts) among women workers in three electronic factories in TEDA and to assess whether prevalence is associated with occupational stress after controlling for age, marital status, job type, having sex in the last 12 months, having children, or migrant status.

**Figure 1.1 Directed Acyclic Graph for Aims 1 and 2**



Aim #3: To estimate the infant mortality rate (IMR) in China's provinces and prefectures and to determine associations between foreign direct investment (FDI), the proportion of FDI of gross domestic product (GDP), the proportion of GDP from manufacturing of total GDP, the proportion of female non-migrants of the total female population, the proportion of women employed in manufacturing of all women working and of all people working in manufacturing, the proportion of exports of total trade, and infant mortality rate and to assess whether GDP, region or the proportion of women employed of all women confound the associations or if GDP or FDI modify the associations.

**Figure 1.2. Directed Acyclic Graph for Aim 3**



## Background and Significance

Several studies have recognized the need for policy change to improve access to reproductive healthcare among women workers in China (X. Li et al., 2006; Liang & Ma, 2004; Zheng, et al., 2001). However, the symptoms and outcomes of reproductive ill-health have not yet been quantified and few studies have examined the prevalence of pelvic pain and urogenital infection among female factory workers or the association between economic indicators and infant mortality rates in China.

### *Pelvic Pain*

Pelvic pain, including dysmenorrhea (pain related to menstruation), dyspareunia (pain during or immediately following sexual intercourse), and non-cyclic pelvic pain (pain independent of sex or menstruation) are major reproductive health complaints of women worldwide (Harel, 2006; S. Kennedy, 1997; Laumann, Paik, & Rosen, 1999; Zondervan et al., 2001) and among women factory workers in an EPZ in Guangdong, dysmenorrhea was their primary complaint (BSR, 2006). The overall prevalence of dysmenorrhea among Chinese women laborers is reported to be as high as 44.4% among a population with a mean age of 25 and the risk for dysmenorrhea was more than two times greater among women who reported high levels of stress (L. Wang et al., 2004). The estimated prevalence of dyspareunia among women aged 15 to 34 years old in China was 4.7% and increased with belonging to a minority ethnic group, low education, and early sexual debut (Stones et al., 2006). Dyspareunia has not been linked to occupational stress. Non-cyclic pelvic pain has not been linked to occupational stress, however, it has been found

to be associated with fatigue (Boneva et al., 2011), which could be related to occupational stress.

Women working in China's factories may be at risk for pelvic pain due to persistent occupational stress, a hypothesis substantiated by the finding that dysmenorrhea has been found to be associated with shift work, irregular work, low temperatures, and physical work (Kishi, et al., 2002). This association may be exacerbated by the increased risk for dysmenorrhea among young nulliparous women compared to women who have given birth, and the increased prevalence of reproductive tract infections among Chinese migrant women compared to urban residents found in other studies (Burnett et al., 2005; Ford Foundation, 2001).

Menstrual disorders related to ovulation, cycle length, or amount of menstrual discharge may exacerbate women's experience of pelvic pain. Menstrual disorders have been associated with perceived occupational stress, working overnight, working long hours, working in cold temperatures, and only standing or only sitting – all qualities of work in EPZs (Gold et al., 1995; Hatch, Figa-Talamanca, & Salerno, 1999; Messing, et al., 1993; Mozurkewich, et al., 2000; 1999; Uehata & Saskawa, 1982). This connection between pelvic pain and occupational stress through menstrual disorders is one avenue for the association to manifest.

Past research on pelvic pain in China has not examined dysmenorrhea, dyspareunia, and non-cyclic pelvic pain within the same study nor among both ever and never married

women. Non-cyclic pelvic pain and dyspareunia have also not been examined in an export production factory setting. Chapter 2 of this dissertation examines the prevalence of dysmenorrhea, dyspareunia, non-cyclic pelvic pain among women working in electronics factories in Tianjin, China and the associations between pelvic pain and demographic and lifestyle characteristics, as well as occupational stress.

*Urogenital Infection*

Urogenital infections including reproductive tract infections (RTIs) and urinary tract infections (UTIs) are important causes of morbidity among women in China (Kaufman, Yan, Wang, & Faulkner, 1999; Stones, et al., 2006; X.-J. Zhang, et al., 2009). The estimated prevalence of RTIs found in studies using clinical examinations of women in China ranges from 17.2% to 76.4% (S. Chen et al., 2002; C. Li et al., 2010; C. Lu et al., 2012; Sun, Cui, Yang, & Han, 2010; X.-J. Zhang, et al., 2009). The lower estimate of 17.2% was among women seeking induced abortions who had an average age of 27.5 and 94% of which were urban residents living in a northeastern coastal city of China (S. Chen, et al., 2002). The higher estimate of 76.4% was among women living in the rural areas in the middle and western regions of China (Sun, et al., 2010). In a recent study among migrant women working in eight factories in southern China, 27.2% of unmarried and 40.2% of married migrant workers had self-reported RTI symptoms (C. Lu, et al., 2012). Factors that have been shown in China to contribute to the likelihood of both having or reporting a RTI are ever having premarital sex, poor sanitary practices, rural to urban migration, low level of reproductive health knowledge, and using an intrauterine device (Y. Chen & Zheng, 2001; Liu, Han, Xiao, Ma, & Chen, 2009; Xia, Liao, He, Choi, &

Mandel, 2004; X.-J. Zhang, et al., 2009). Pain with urination, an indication of infection of the urinary track, is also related to the aforementioned risk factors (Stones, et al., 2006). Among women laborers in China, 8.4% reported pain with urination which increased with age (Stones, et al., 2006). Infrequent bathroom breaks, a common occurrence in factory work within EPZs, could lead to infection of the urinary tract (J. L. Lu, 2008). Stress has been associated with infection in a number of studies (Aiello, et al., 2008; Godbout & Glaser, 2006; Riddell, 1991) pointing to the possibility that stress is related to reproductive and urinary tract infections.

Migrants have been found to be more likely to suffer from an RTI than their urban resident counterparts (Biao, 2004; Burnett, et al., 2005; Ford Foundation, 2001). Hypotheses as to why migrants are at an increased risk are that migrants are continuing poor sanitary practices from the countryside to the city, migrants are engaging in riskier sex, migrants have a low level of reproductive health knowledge, and migrants have lower access to healthcare than urban residents (Biao, 2004; F. Wang, Ping, Zhan, & Shen, 2005; X.-J. Zhang, et al., 2009).

Many of the studies conducted in China have only assessed the prevalence of RTIs among married or ever married women or among high-risk populations such as migrants and sex workers. Although previous research has documented an increase in the prevalence of RTIs among women exposed to stress (Culhane, Rauh, & Goldenberg, 2006; Khawaja, Kaddour, Zurayk, Choueiry, & El-Kak, 2009; Liu, et al., 2009; Prasad, Abraham, Akila, Joseph, & Jacob, 2003), no studies have examined urogenital infection

related 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 (J. L. Lu, 2008). Chapter 3 evaluates the prevalence of urogenital infection symptoms among women working in electronics factories in Tianjin, China as well as the association between urogenital infection symptoms, demographic and lifestyle characteristics, and occupational stress among both married and unmarried women and both migrants and non-migrants.

*Infant Mortality*

Infant mortality rate (IMR), which is death in the first year of life per 1,000 live births, is an accepted and widely used indicator for reproductive health, and more generally, population health and social development (S.D. Harlow, Denman, & Cedillo, 2004; Reidpath & Allotey, 2003; United Nations, 2003). IMR is an indicator of the mother's reproductive health during pregnancy, quality and access to healthcare, socioeconomic conditions, and public health practices (MacDorman, et al.). In countries such as the United States and China, with relatively low IMRs, most infant deaths are neonatal deaths and frequently associated with congenital malformations, premature birth, and low-birthweight (MMWR, 2007). Previous research also identifies several macro-level factors for infant mortality including: world-system dynamics, level of development (i.e. gross national product per capita), national commitment to public health (i.e. health expenditures per capita), human capital (i.e. education or literacy rates), and pollution (Burns, Kentor, & Jorgenson, 2002).

Economic growth is associated with declining infant mortality rates at the national level (Clark, 2011; Wagstaff, 2000). There is evidence that foreign direct investment (FDI) in developing countries may have a beneficial effect on infant survivability in those countries (Firebaugh & Beck, 1994; Meyer, 1996). However, other researchers suggest that dependence on FDI increases child mortality in those countries (Kick, et al., 1995; Shen & Williamson, 1997).

Over the past three decades, since China has opened its doors to the world, the IMR has declined from 49.8 deaths /1000 live births in 1980 to 27.3 deaths/1000 live births in 2000 to 15.8 deaths /1000 live births in 2010 (World Bank, 2011). Declines in infant mortality rates have been found to be attributable to mother's increased access to healthcare, socioeconomic status, and education. However, these gains have not been even throughout China and disparities in income, education, healthcare access have widened (Dollar, 2007). Therefore, it is possible that the infant mortality rates did not decline consistently across China due to variation in socio-economic achievements.

A possible reason that regions with a high IMR do not benefit from high FDI could be a failure to reinvest in areas of high economic growth. A study from Mexico shows that regions with high export production have IMRs higher than the national average (S.D. Harlow, et al., 2004). Harlow's study provides evidence for a lack of reinvestment in areas of economic achievement in the form of poor infrastructure and low levels of healthcare access. Evidence of the lack of reinvestment is also apparent in the ratio of Mexico's growth of share in world manufacturing exports divided by its growth of share

in world manufacturing value added. This ratio for Mexico during 1980-2004 was 0.01, which means that as exports went up in Mexico, the income generated for labor that could be used to increase working wages or improve working conditions did not go up proportionately (Milberg & Amengual, 2008). By contrast, China's value added ratio for the years 1980-2004 was 0.62, which is considerably higher. Therefore, there is some evidence that FDI – for manufacturing benefits the Chinese population in the areas where economic growth in manufacturing is high.

FDI in China is mainly linked to export processing zones (EPZs) where many workers face poor working conditions (Gallagher, 2004). Poor working conditions are a chief concern in EPZs due to the reduced workplace standards used to increase FDI (Hogstedt, Wegman, & Kjellstrom, 2007). Therefore, the strong link between FDI and poor working conditions may precipitate a positive association between FDI and IMR. Evidence from one study from Sri Lanka showed that the stillbirth rate among women working in the Colombo Free Trade Zone was five times the stillbirth rate for women in the general population in that region and the spontaneous abortion rate was four times higher (Hettiarachchy & Schensul, 2001).

Women working in poor conditions distinguished by physically demanding work, fatigue, shift and night work, long hours, long periods of time sitting or standing, and ergonomic risk factors have an increased risk for adverse pregnancy outcomes including preterm birth, low-birthweight, spontaneous abortion, pre-eclampsia, and reduced fecundability (Beaumont et al., 1995; Ceron-Mireles, Harlow, & Sanchez-Carrillo, 1996; Denman,

1991; B. Eskenazi, Bracken, Holford, & Grady, 1988; B Eskenazi et al., 1995; B. Eskenazi, Guendelman, Elkin, & Jasis, 1993; Figa-Talamanca, 2006; Mozurkewich, et al., 2000; 1999; Schenker et al., 1995; Swan et al., 1995; Xu, Dina, Li, & Christiani, 1994). Adverse pregnancy outcomes have been linked to high infant mortality rates (Choy, et al., 2011; Kramer, et al., 2000).

Although infant mortality is an important indicator of reproductive and population health, few studies have evaluated infant mortality trends in the context of FDI. Chapter 4 examines whether IMRs in the year 2000 vary across provinces and prefectures in China and if so, whether areas with high infant mortality rates are associated with higher levels economic indicators related to FDI or higher levels of women employment in the manufacturing industry.

**Overview of Data Sources**

This research used two different approaches to understand the research question of whether women's reproductive health is affected by export production. The first approach used for aims 1 and 2 utilized data collected from three export production factories in Tianjin, China. Few foreign researchers have had access to conduct research in this setting. The individual-level data collected for this research is best to understand the associations between the individual woman's self-reported symptoms of reproductive health and the association with demographic and lifestyle characteristics, as well as occupational stress. The second approach used for aim 3 utilized data compiled from several data sources that report aggregate data at the province and prefecture levels in

China. This data is best to understand any associations between FDI or other economic parameters related to export production and infant mortality rates at the province and prefecture level and provide evidence of economic reinvestment (by proxy of low IMR) into areas of production.

*Study Setting and Data Source for Aims 1 and 2*

Tianjin is one of China's provincial level cities, meaning it is at the same administrative level as a province and therefore has more autonomy and more direct support from China's central government. Tianjin is also one of China's National Cities, cities that are decided nationally to be in charge of leading China's development. With a population greater than 12 million, Tianjin is China's 6th largest city. Tianjin is also one of the top seven destinations for rural migrant workers due to the large number of jobs for low-skilled laborers (Fu & Gao, 2007). Areas of Tianjin have been designated to make up the Tianjin Economic-Technological Development Area (TEDA), one of China's oldest and most established EPZs.

Field work was done in collaboration with the Department of Occupational Health at the Tianjin Centers for Disease Control and Prevention. Surveys were distributed to women working in three electronic factories in Tianjin. Factory 1, a fabrication factory, was established in 1996 and owned through a joint partnership of China and Taiwan. Factory 2, a semiconductor factory, was established in 1996 and owned through a joint partnership of China and the United States. Factory 3, a fabrication factory, was established in 1995 and owned through a joint partnership of China and Japan.

*Study Setting and Data Source for Aim 3*

Data from China's National Census in the year 2000 and the China Statistical Yearbook in year 2000 were used for this dissertation. The China 2000 Census used a short and long form. The short form was distributed to the entire population of China (excluding any non-citizens of China) and the long form was distributed to 9.5% of the country. All data were extracted from the China Data Center housed at the University of Michigan. Additionally, data from a published article on preferential policy was assessed (Demurger, Sachs, Woo, Bao, & Chang, 2002).

In China's recent censuses massive inaccuracies have been documented due to the population's fear of being caught disobeying national policies such as the household registration system and the "One Child Policy" (B. Kennedy, 2001). China's 2000 Census has taken steps to ensure improved accuracy in data collection. To decrease the underreporting of children, families that have children outside of the "One Child Policy" were offered reduced fines if they report all of their children (B. Kennedy, 2001). To decrease the under reporting of migrants, all people were counted if they had lived in the residence for at least 6 months (B. Kennedy, 2001). Lessening penalties for violations of the "One Child Policy" and the household registration system has proved worthwhile and has enumerated urbanization and migration more completely (B. Kennedy, 2001). The China Statistical Yearbook is an annual publication that reflects the economic and social development of China and includes aggregate data at the province and prefecture levels.

**Summary**

Research for this dissertation is a first step towards documenting the reproductive health concerns of women working in China's EPZs and the relationship between infant mortality and FDI. Information provided by this study will help inform interventions that may improve the health of female factory workers. Since there are effective and affordable treatments for both pelvic pain and urogenital infections, offering healthcare to women workers is a feasible intervention and an easy way to improve worker morale and productivity.

Findings from this research will contribute to the growing literature on the reproductive health needs of women working in China's EPZs and by providing epidemiologic data relevant for China's national health policies. This dissertation argues that given the large number of women workers in EPZs and the priority women give to their reproductive health needs, the reproductive health needs of women in EPZs should be recognized. The study in Tianjin (reported in Chapters 2 and 3) will be the first epidemiologic study to document the prevalence of self-reported pelvic pain and urogenital infection symptoms and their relationship to occupational stress and labor productivity among women workers in China's Tianjin Economic-Technological Development Area (TEDA). The study on infant mortality in China (reported in Chapter 4) will be the first in China to examine whether infant mortality occurs at higher rates in areas with more or less FDI using China's 2000 Census and Statistical Yearbook.

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# Chapter 2

## Gynecological Disorders Related to Occupational Stress Among Female Factory Workers in Tianjin, China

### Introduction

Pelvic pain, including pain with menstruation, pain related to sex, and pain independent of menstruation and sex, is reported by a substantial proportion of reproductive age women 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 pelvic pain considered (Garcia-Perez, Harlow, Erdmann, & Denman, 2010; S. Harlow & Park, 1996; Jameison & Steege, 1996; Laumann, Paik, & Rosen, 1999; Zondervan et al., 2001). However, information on the burden of pelvic pain is limited in many countries and scant information is available on the experience of pelvic pain among working women. Young women of reproductive age represent a major proportion of production workers in export industries, and women working in China's export production factories may be at risk for pelvic pain due to persistent occupational stress, as occupational stress has been associated with an increased risk for pelvic pain (Hatch, Figa-Talamanca, & Salerno, 1999; Kishi, Kitahara, Masuchi, & Kasai, 2002).

Occupational stress in factories within China's export production zones (EPZs) is thought to be high due to poor working conditions and low job security motivated by incentives for cheap labor to attract foreign investment (Gallagher, 2005; International Labour Organization, 2002). This recent shift from permanent employment in China's state-owned enterprises to a market-determined employment structure has radically reduced job security, and created large variation in wages and benefits among workers in China's factories (Kuruvilla, Lee, & Gallagher, 2011). These changes have increased employment opportunities in urban areas, especially in EPZs, and have driven China's massive rural to urban labor migration (Hao, 2005).

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 (Biao, 2004; BSR, 2006, 2010; Guan & Jiang, 2002). 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 (F. Wang, Ping, Zhan, & Shen, 2005; Zheng et al., 2001). Although several studies have recognized the need to improve access to reproductive healthcare among women workers in China, relatively few have evaluated the burden of gynecologic morbidity in this economic sector (X. Li et al., 2006; Liang & Ma, 2004; Zheng, et al., 2001).

The prevalence of dysmenorrhea (pain related to menstruation) in China has been reported to be between 44.4% and 56.4%. Chinese female factory laborers at a textile

mill in Anhui Province (mean age = 25) had a prevalence of 44.4% and the prevalence increased more than two fold among women who reported high levels of stress (L. Wang et al., 2004). In another study of over 1,000 female railway workers (mean age = 37), 45.7% of the women had some form of menstrual dysfunction with menstrual pain elevated by stress (Gu et al., 2009). Occupational stress has been associated with dysmenorrhea in some (Christiani, Niu, & Xu, 1995; Laszlo & Kopp, 2009; Nohara, Momoeda, Kubota, & Nakabayashi, 2011; L. Wang, et al., 2004), but not all studies (Gordley, Lemasters, Simpson, & Yiin, 2000). Other studies have reported associations of life stress or life dissatisfaction (Chung, Yao, & Wan, 2005; Gordley, et al., 2000) and fatigue (Cochrane Update, 2010; El-Gilany, Badawi, & El-Fedawy, 2005) with dysmenorrhea. Among university students in China (mean age=20), 56.4% confirmed that they experienced dysmenorrhea, 6.7% of those with dysmenorrhea reported unbearable menstrual pain (Zhou, Yang, & Students Group, 2010). The higher prevalence among female university students, as compared to female factory and railway workers, reflects their younger age. In general young, nulliparous women experience more dysmenorrhea than older women who have had children (Andersch & Milsom, 1982; S.D. Harlow & Campbell, 2004; Ng, Tan, & Wansaicheong, 1992; Widholm, 1979). Young nulliparous women workers in China's factories are likely to have an increased risk for dysmenorrhea given their age, parity, and working conditions. Other important factors that have been shown to be associated with dysmenorrhea include smoking, heavy menstruation, and taking hormonal contraceptives. (Latthe, Mignini, Gray, Hills, & Khan, 2006; Parazzini et al., 1994)

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% (Latthe, Latthe, Say, Gulmezoglu, & Khan, 2006). In China, one study of married women younger than 34 years reported a prevalence of 4.7% with prevalence higher among minority ethnic groups and among women with low education and an early sexual debut (Stones et al., 2006). Another study in China reported the prevalence of dyspareunia to be 20.4% among women over the age of 41 years (Zhao, Wang, Yan, & Dennerstein, 2000). Yet, another more recent study in China found a prevalence of dyspareunia to be 43.0% among women over age 20 accessing care for routine health exams (Zhang, Cheng, Pan, Lei, & Kan, 2011). Smoking has also been found to raise the risk for dyspareunia (Zhang, et al., 2011). 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.

Worldwide estimates of the prevalence of non-cyclic pelvic pain (pain that is independent of sex or menstruation) range from 4% to 43.4%, although little data are available from middle or low income countries (Latthe, Latthe, et al., 2006). A Mexican study reported a prevalence of 6% for non-cyclic pain lasting 6 months or longer with women younger than 35 years, with a history of reproductive tract or urinary tract infections, or a history of fibroids at greater risk for non-cyclic pain (Garcia-Perez, et al., 2010). 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 (Vercellini et al., 2009). One study found that women who

experienced abuse and post traumatic stress disorder more often experienced non-cyclic pelvic pain as compared to other women. We have not identified any studies of non-cyclic pelvic pain in China or studies that examined occupational stress as a predictor for non-cyclic pelvic pain.

This study focuses on the reproductive health of women working in three electronics factories in the Tianjin Economic-Technological Development Area (TEDA), one of China's oldest and most established export processing zones (EPZs). TEDA is located in Tianjin which is one of China's provincial level cities, meaning it is at the same administrative level as a province and therefore has more autonomy and more direct support from China's central government. It is also a coastal city that was opened quite early to foreign direct investment and it is a top destination for rural migrant workers (Fu & Gao, 2007). Twenty-five percent of TEDA is made up of factories in the electronic telecommunications industry, the largest industry in TEDA (TEDA Investment Promotion Bureau, 2011). EPZs are generally structured to rely on contract work and other forms of insecure employment (Sargeson, 1999), which is one potential source of occupational stress facing female factory workers (Hogstedt, Wegman, & Kjellstrom, 2007). 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 (Hogstedt, et al., 2007; Kusago & Tzannatos, 1998; McCallum, 2011). In previous research, the types of poor working conditions and occupational stress 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 (Hatch, et al., 1999; Kishi, et al., 2002).

Women now make up 50-90% of all workers in China's EPZs and 70% of the migrant workers in these EPZs are between the ages of 15-49 with 20% between 25-29 years old (Fu & Gao, 2007; National Statistic Bureau of China, 2001; Ngai, 2004). 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. This preliminary study is the first to describe the prevalence, as well as demographic, lifestyle, and occupational risk factors for three types of pelvic pain among women working in electronic export production factories in Tianjin, China. We hypothesized that occupational stress would increase the risk of each type of pelvic pain and that both occupational stress and pelvic 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 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 and over were asked to participate in the study, surveys were distributed, and informed consent was obtained. All surveys were anonymous. The target population was women between the ages of 18 to 30 years; however all women available at the time of survey distribution were invited to participate. Eighteen is the age of adulthood in China. Thirty was chosen as the upper age limit because women workers are typically in their twenties and pelvic pain is most prevalent among young women (BSR, 2006; Garcia-Perez, et al., 2010).

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), who reported being pregnant in the last 12 months (n=60), or who were missing information on all three of the pelvic 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, working conditions, labor productivity, and access to healthcare. 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 (CHNS, 2009). 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 (Cleland & Harlow, 2003; Zondervan, et al., 2001). The occupational stress questions were from the Chinese Job Content Questionnaire, which was adapted from the Job Content Questionnaire (JCQ) (Karasek et al., 1998; J. Li, Yang, Liu, Xu, & Cho, 2004). Questions on fatigue were selected from the Swedish Occupational Fatigue Inventory (Ahsberg, Kecklund, Akerstedt, & Gamberale, 2000). The survey 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 one U.S. 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 participants' time (Yinan & Yu, 2010).

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 years, 25-29 years, and 30-56 years. Marital status was asked and the options married, single, divorced, widowed, or other. Marital status was dichotomized into never married (single) and ever married (married, divorced, widowed). No one answered with other for marital status. The question, "How many children do you have", was asked with the options none, one, or more than one. This was dichotomized into none and one or more children. If the number of children was missing (N=45), it was coded as 'one or more children'. This was because of the strong relationship between ever married and having children and ever married and missing information on children. The variable on level of education was created by dichotomizing the question, "What is your education level", that had the options 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. Respondents were asked "Do you hold a Tianjin resident card?" with yes or no as the two possible options, yes meaning the respondent was a Tianjin resident. 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. The 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?" and "Have you consumed any beer, white wine, red wine, or rice wine in the past month?" with the possible options for both questions of yes or no. Self-reported health ranking for the respondents was assessed through the question "Generally speaking, how is your health?" with the following options excellent, very good, good, fair, or poor. This variable was

dichotomized as fair or poor and excellent, very good, or good. Hormonal contraception was categorized using the question, "What type(s) of contraception have you used in the past year?" with the following response options categorized into not hormonal (none, withdrawal, condoms, male sterilization, female sterilization/ hysterectomy, intrauterine device, breastfeeding/ no period, and calendar) and hormonal (oral contraception, injections, and ring). The categories of hormonal and not hormonal were then cross-tabulated with the dichotomous variable, sex in the last 12 months, to create a third category of "not sexually active and not on contraception". The question, "In the last 12 months, have you had sexual intercourse?" had either yes or no as possible responses.

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). 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 (N=381). A dichotomous variable was created, ever experienced dyspareunia (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 described as in the Oxfordshire Women's Health Study questionnaire, as pain in the lower abdomen (Zondervan, et al., 2001). Dysmenorrhea was defined in our study as often or usually experiencing dysmenorrhea in contrast dyspareunia and non-cyclic pelvic pain which were dichotomized as ever or never in the last 12 months because it provided a more conservative estimate of dysmenorrhea.

Assessment of occupational stress included measures of job type (production or office), overtime, night work, exhaustion, job security, and a composite score of job strain calculated utilizing questions and assessment from the JCQ and the Swedish Occupational and Fatigue Inventory. 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 other was excluded from analysis. Overtime hours were measured with the question, "In the last 12 months did you work overtime? (yes, no)". Women also indicated whether they had any choice in working 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)". The variable for job security was dichotomized as strongly disagree or disagree and 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)". The indicators for feeling 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 Job Content Questionnaire (JCQ) (Karasek, et al., 1998; J. Li, et al., 2004). 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 (Karasek, et al., 1998). The job demand component was made up of five questions (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; I am free from conflicting demands that others make) each question with a possible answer of strongly disagree, disagree, agree, and strongly agree. The decision latitude component was made up of nine questions (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 question with a possible answer of strongly disagree, disagree, agree, and strongly agree. 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 values for the composite job strain score.

All analyses were conducted in SAS 9.2. The prevalence for each type of pelvic pain was determined. Bivariate and multivariable logistic regression models were used to evaluate associations between demographic, lifestyle, and occupational characteristics and each type of pelvic pain. 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 2.1). Women who worked in production tended to be younger than women working as office staff. Most women were of Han ethnicity (93.4%), 37.0% were never married, and 50.4% 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). Women holding higher than a high school education and women who were Tianjin resident card holders were significantly more likely to hold office positions than production positions.

Only 3.7% of women reported smoking more than 5 cigarettes while 34.3% reported consuming any alcohol in the last month. Office and production staff did not differ in the proportion who smoked but office staff was significantly more likely to report drinking in the last month. Nearly all of 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. The median number of sick days reported among women in this study was three days in the last 12 months and this did not differ by job type.

The median number of months women in our study had worked at their current position was 48 months (range =1- 240 months) and office staff (median = 76 months) were significantly more likely to work at the job longer than production staff (median=36 months). A total of 29.3% women reported working overtime and 44.4% reported working the night shift in the past 12 months (Table 2.2). 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 Job Content Questionnaire (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.

Overall, 80.7% of women had ever experienced dysmenorrhea in the past 12 months and 18.9% reported often or usually experiencing dysmenorrhea (Table 2.3). 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 restricted to those who reported having had sex in the last 12 months, 19.8% reported moderate or severe pain, 25.7% reported pain in the last month, 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 measures of reproductive health were associated with job type.

When we examined comorbidity (Table 2.4) among women with no missing information on dysmenorrhea and non-cyclic pelvic pain (13.0%) often or usually experienced dysmenorrhea only, 15.6% reported only experiencing non-cyclic pelvic pain and 4.5% reported experiencing both types of pelvic pain with a total of 33.1% experiencing at least one type of pelvic pain. Among the subset of women who had had sex and did not have missing information on any type of pelvic pain, 6.3% reported only dysmenorrhea, 10.7% reported only non-cyclic pain, 16.2% reported dyspareunia only, 1.1% reported experiencing dysmenorrhea and non-cyclic pelvic pain, 2.9% reported dysmenorrhea and dyspareunia, 12.6% reported dyspareunia and non-cyclic pelvic pain and 3.3% reported all three conditions with 53.1% reporting at least one type of pelvic pain.

Table 2.5 provides information on the crude associations between demographic and occupational variables and each of the three pelvic pain outcomes. All three types of pelvic pain were associated with 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, loud noise, job insecurity, as well as having high job strain. Non-cyclic pelvic pain in the last 12 months was significantly associated with not being married, not having children, working the night shift, not having the ability to choose whether to work overtime, having insecure employment, and having high job strain. Experiencing any dyspareunia in the past 12 months was significantly associated with working overtime in the last 12 months.

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 type of pelvic pain. Results from the children-adjusted analysis are reported in Table 2.6.

In the multivariable analysis (Table 2.7), 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 dysmenorrhea. Analyses using pain severity (dichotomized as mild and moderate or severe when period was reported occurring occasionally, often, or usually) in lieu of pain frequency produced similar results although job security was no longer significantly associated with dysmenorrhea. In the multivariable analysis for non-cyclic pelvic pain, not having children (OR=0.56 (0.34, 0.91)), having the choice to work overtime (OR=0.54 (0.33, 0.90)), and feeling exhausted (OR=1.09 (1.00, 1.19)) remained significant. 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)) remained associated with this outcome. No interactions were present between variables in the models above.

Notably, women who reported experiencing dysmenorrhea (OR=1.68 (1.09, 2.58)), dyspareunia (OR=1.99 (1.19, 3.30)), or 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 significantly more likely (OR=1.28 (1.09, 1.51) to utilize more sick days with the majority of women reporting they took off 1-2 days in the last year.

**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 in among female factory workers in China. This preliminary study evaluated an important aspect of reproductive health among female factory workers, the burden of pelvic pain. We found that pelvic pain is a common condition with 33.1% of women reporting experiencing dysmenorrhea or non-cyclic pelvic pain and 53.1% of women who have had sex in the past year reporting experiencing dysmenorrhea, non-cyclic pelvic pain, or dyspareunia. Occupational stress was associated with increased odds of pelvic pain with high job strain and job insecurity associated with dysmenorrhea, working overtime and feeling exhausted with dyspareunia, and compulsory overtime and feeling exhausted with non-cyclic pelvic pain.

Notably, pelvic pain was strongly associated with self-reported health status and non-cyclic pelvic pain appeared to affect productivity through an increased absenteeism.

In total, four-fifths of the women surveyed reported experiencing dysmenorrhea in the past year with nearly one-fifth reporting they experienced menstrual pain often or usually. Previous research from China reported the prevalence of any dysmenorrhea to be between 44.4% and 56.4%. Our research reports a prevalence of women reporting any dysmenorrhea (80.7%). The difference could be because of differences in the way the question was asked, differences in the population studied, differences in the stress level of the population studied or the different age distributions. Past studies have identified younger age as a major predictor for dysmenorrhea (Burnett et al., 2005; Weissman, Hartz, Hansen, & Johnson, 2004). In a review of menstrual disorders in developing countries, dysmenorrhea was found to affect up to 50% of adult women and roughly 75% of adolescent women (S.D. Harlow & Campbell, 2004). Our study found that age was confounded by parity with nulliparous women being at the greatest risk for dysmenorrhea independent of age. One longitudinal study corroborates our finding that nulliparity predicts dysmenorrhea independently of age (Sundell, Milson, & Andersch, 1990).

Two occupational variables, job insecurity and high job strain, were associated with risk of dysmenorrhea consistent with the previous findings that high job strain is associated with dysmenorrhea (Christiani, et al., 1995; Laszlo & Kopp, 2009; Nohara, et al., 2011; L. Wang, et al., 2004). 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 the prevalence reported in two other Chinese studies (Stones, et al., 2006; Zhao, et al., 2000), is lower than the prevalence reported in a recent study among women receiving routine healthcare in China (Zhang, et al., 2011), and within the range documented in Latthe's review of 54 publications (Latthe, Latthe, et al., 2006) (age range for all studies: 15-96). Two job characteristics - working overtime and feeling exhausted - were associated with reporting dyspareunia. One possible explanation for these associations is suggested by a paper examining gender-based violence in Mexico's maquiladoras. In that study working the night shift was associated with an increased risk for domestic violence, and these authors hypothesized that risk of violence might reflect increased stress on the relationship and partner jealousy (Bustillos-Dominguez, Sanin-Aguirre, Valdez-Santiago, & Harlow, 2006). Domestic violence per se has not been found to be a risk factor for dyspareunia (Chowdhary & Patel, 2008; John, Johnson, Kukreja, Found, & Lindow, 2004); however, experience of current or past abuse and stress associated with these experiences has been identified as a risk factor for dyspareunia (Jameison & Steege, 1997; Meana, Binik, Khalife, & Cohen, 1997).

Over 15% of women in this study reported non-cyclic pelvic pain. This percentage falls within the range of Latthe's review article (Latthe, Latthe, et al., 2006), but is higher than the prevalence reported in the community-based study in Mexico (Garcia-Perez, et al.,

2010). Feeling exhausted, a marker of fatigue, was associated with having non-cyclic pain in this study and has been found to be associated with non-cyclic pelvic pain among women with chronic fatigue syndrome (Boneva et al., 2011). 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 (Bustillos-Dominguez, et al., 2006) which may result in increased non-cyclic pelvic pain (Jameison & Steege, 1997). We have not identified other studies that have examined occupational risk factors for non-cyclic pelvic pain.

This preliminary study has identified demographic, lifestyle, and occupational risk factors for three major types of pelvic 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 cause of pelvic pain. It is possible that pelvic pain contributes to occupational stress, if pain results in more negative responses to occupational the occupational environment. Study participants may have misunderstood or misinterpreted the survey questions, as some of the questions in the survey instrument were not previously validated in a Chinese setting. We did however conduct a pilot study to assess comprehension and used previously validated translations where available. Although this is one of the larger studies completed within export production factories to date, the relatively small sample size may have underpowered our results. Some data on reproductive health were missing and although missing data did not differ significantly by demographic factors, it is possible that women with reproductive health concerns did

not answer the survey questions on reproductive morbidity leading to underestimated pelvic pain results. Data collection within the factories, may have led to underreporting of their migrant status, adverse working conditions or health complaints. However, data collection was anonymous and women were encouraged to answer truthfully. If underreporting occurred it would mean our results are a conservative estimate of the association between migrant status or occupational stress and pelvic pain in this population. Women who experienced extreme pelvic pain may have left work and therefore our study may not have captured more extreme outcomes. Furthermore, 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 are not generalizable to other factories in TEDA or elsewhere. .

Further research should include women from factories in EPZs throughout China to assess regional differences with regards to potential differences in policies and worker populations. Additionally, this study focused on work-related stress; however other aspects of life stress likely also play a role in pelvic pain. Future research should incorporate a more comprehensive stress battery. 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 differing work 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 pelvic pain, as the background of the women would be similar before the decision to migrate.

This study illustrates the importance of offering reproductive healthcare to all women working in factories, as risk for any type of pelvic pain did not increase with age. Addressing reproductive health complaints can be important as failure to address such complaints may affect worker productivity, although non-cyclic pelvic pain was the only type of pelvic pain in this study to be significantly associated with work absenteeism. It is possible that non-cyclic pelvic pain is more alarming than dysmenorrhea or dyspareunia and therefore women do not report to work.

Harlow and Campbell have previously argued that improving services that provide care for menstrual complaints is an excellent and relatively easy method for improving women's overall reproductive health status (Sioban D. Harlow & Campbell, 2000). One simple step is to not only increase reproductive healthcare services among women 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 through clinics onsite or through women shift or dormitory leaders. Improving working conditions by reducing occupational stress through eliminating compulsory overtime, offering job contracts with more security, lowering occupational demands and increasing opportunities for workers to make decisions might also improve reproductive outcomes among both office and production staff. Reducing occupational stress, encouraging women to seek healthcare for pelvic pain and providing easy access to reproductive healthcare as well as 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 and maintaining factory productivity.

In summary, this study documents a high prevalence of reproductive health complaints among women factory workers in China and is the first study to examine occupational stress as it relates to three main types of pelvic pain among women working 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, close attention to the reproductive health needs of women working in these zones is warranted.

**Table 2.1. Demographic and Lifestyle Characteristics for All Women Surveyed in Three Electronic Factories in Tianjin, China (N=651)**

| | Total | | Production* | | Office* | | |
|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | p-value |
| Age | | | | | | | |
| 18-24 years | 184 | 28.3 | 160 | 37.7 | 14 | 7.2 | <0.01 |
| 25-29 years | 272 | 41.8 | 169 | 39.9 | 93 | 47.9 | |
| 30-56 years | 195 | 29.9 | 95 | 22.4 | 87 | 44.9 | |
| Marital Status | | | | | | | |
| Never Married | 241 | 37.0 | 181 | 42.7 | 47 | 24.2 | <0.01 |
| Ever Married | 406 | 62.4 | 241 | 56.8 | 145 | 74.7 | |
| Missing | 4 | 0.6 | 2 | 0.5 | 2 | 1 | |
| Children | | | | | | | |
| No Children | 328 | 49.6 | 224 | 52.8 | 88 | 54.6 | 0.08 |
| 1 or more Children | 323 | 50.4 | 200 | 47.2 | 106 | 45.4 | |
| Education Level | | | | | | | |
| High School Education or Less | 445 | 68.4 | 361 | 85.1 | 62 | 31.9 | <0.01 |
| Educated past high school | 198 | 30.4 | 58 | 13.7 | 129 | 66.5 | |
| Missing | 8 | 1.2 | 5 | 1.2 | 3 | 1.6 | |
| Holds Tianjin Residence Card | | | | | | | |
| Yes | 475 | 72.9 | 270 | 63.7 | 180 | 92.8 | <0.01 |
| No | 162 | 24.9 | 146 | 34.4 | 11 | 5.7 | |
| Missing | 14 | 2.2 | 8 | 1.9 | 3 | 1.6 | |
| Monthly Income Level | | | | | | | |
| 2000 元 or less | 466 | 71.6 | 379 | 89.4 | 65 | 33.5 | <0.01 |
| 2001 元 and more | 173 | 26.6 | 39 | 9.2 | 124 | 63.9 | |
| Missing | 12 | 1.8 | 6 | 1.4 | 5 | 2.6 | |
| Drank alcohol in the past month | | | | | | | |
| Yes | 223 | 34.3 | 117 | 27.6 | 100 | 51.6 | <0.01 |
| No | 416 | 63.9 | 304 | 71.7 | 93 | 47.9 | |
| Missing | 12 | 1.8 | 3 | 0.7 | 1 | 0.5 | |
| Uses Hormonal Contraception | | | | | | | |
| Yes | 69 | 10.6 | 47 | 11.1 | 21 | 10.8 | 0.78 |
| No | 490 | 75.3 | 312 | 73.6 | 151 | 77.8 | |
| Missing have had sex in last 12 months | 9 | 1.4 | 3 | 0.7 | 5 | 2.6 | |
| Missing have not had sex or unknown sex behavior in last 12 months | 83 | 12.7 | 62 | 14.6 | 17 | 8.8 | |

*33 missing information on job type

**Table 2.2. Occupational Characteristics and Working Conditions for All Women Surveyed in Three Electronic Factories in Tianjin, China (N=651)**

| | Total | | Production* | | Office* | | |
|---|---|---|---|---|---|---|---|
| | **No.** | **%** | **No.** | **%** | **No.** | **%** | **p-value** |
| Worked the night shift in the last 12 months | | | | | | | |
| Yes | 289 | 44.4 | 233 | 54.9 | 46 | 23.7 | <0.01 |
| No | 339 | 52.1 | 178 | 41.9 | 148 | 76.3 | |
| Missing | 23 | 3.5 | 13 | 3.1 | 0 | 0 | |
| Worked overtime in the last 12 months | | | | | | | |
| Yes | 191 | 29.3 | 141 | 33.3 | 44 | 22.7 | <0.01 |
| No | 441 | 67.7 | 275 | 64.9 | 148 | 76.3 | |
| Missing | 19 | 2.9 | 8 | 1.9 | 2 | 1.0 | |
| Can choose to work overtime | | | | | | | |
| Yes | 376 | 57.8 | 230 | 54.3 | 133 | 68.6 | <0.01 |
| No | 240 | 36.9 | 171 | 40.3 | 58 | 29.9 | |
| Missing | 35 | 5.4 | 23 | 5.4 | 3 | 1.6 | |
| High Noise level | | | | | | | |
| Yes | 312 | 47.9 | 233 | 54.9 | 67 | 34.5 | <0.01 |
| No | 311 | 47.8 | 169 | 39.9 | 125 | 64.4 | |
| Missing | 28 | 4.3 | 22 | 5.2 | 2 | 1.0 | |
| Poor Job Security | | | | | | | |
| Yes | 233 | 35.8 | 164 | 38.7 | 59 | 30.4 | <0.03 |
| No | 386 | 59.3 | 238 | 56.1 | 129 | 66.5 | |
| Missing | 32 | 4.9 | 22 | 5.2 | 6 | 3.1 | |
| High Job Strain | | | | | | | |
| Yes | 156 | 23.9 | 120 | 28.3 | 32 | 16.5 | <0.01 |
| No | 475 | 72.9 | 288 | 67.9 | 162 | 83.5 | |
| Missing | 20 | 3.1 | 16 | 3.8 | 0 | 0 | |
| | **No.** | **Mean** | **No.** | **Mean** | **No.** | **Mean** | **t-test** |
| Exhausted | 636 | 5.56 | 411 | 5.77 | 194 | 5.25 | 0.04 |

*33 missing information on job type

**Table 2.3 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 | | |
| Missing | 14 | 2.2 | | |
| Heavy Periods | | | | |
| No | 537 | 82.5 | | |
| Yes | 101 | 15.5 | | |
| Missing | 13 | 2.0 | | |
| Often or Usually had Menstrual pain | | | | |
| 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 |
| 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 |
| Missing | 135 | 20.7 | | |
| Pain with sex | | | | |
| 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 |
| Missing | 132 | 20.3 | | |

**Table 2.4. Percentage distribution of women, by number and type of pelvic pain condition**

| | Total Population (N=507) % | Population that had sex in last 12 months (N=271) % |
|---|---|---|
| One Condition | | |
| Dysmenorrhea | 13.0 | 6.3 |
| Non-Cyclic Pelvic Pain | 15.6 | 10.7 |
| Dyspareunia | -- | 16.2 |
| Two Conditions | | |
| Dysmenorrhea and Non-Cyclic Pelvic Pain | 4.5 | 1.1 |
| Dysmenorrhea and Dyspareunia | -- | 2.9 |
| Dyspareunia and Non-Cyclic Pelvic Pain | -- | 12.6 |
| All Three Conditions | -- | 3.3 |
| At least one condition | 33.1 | 53.1 |
| No Condition | 66.9 | 46.9 |

**Table 2.5. Unadjusted Associations with Pelvic Pain Among Female Factory workers in Tianjin, China (N=651)**

| | Often or Usually Dysmenorrhea | | | | Non-cyclic Pelvic Pain | | | | Any 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 元 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 元 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 | -- | -- |
| Can choose to work overtime | | | | | | | | | | | | |
| Yes | 67 | 56.8 | 0.81 | (0.54, 1.21) | 49 | 51.0 | **0.54** | **(0.35, 0.85)** | 54 | 55.1 | 0.63 | (0.38, 1.03) |
| No | 51 | 43.2 | -- | -- | 47 | 49.0 | -- | -- | 44 | 44.9 | -- | -- |
| 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 | -- | -- |
| Exhausted | | | **1.11** | **(1.03, 1.19)** | | | **1.13** | **(1.05, 1.22)** | | | **1.14** | **(1.05, 1.25)** |

**Table 2.6. Children-Adjusted Reproductive and Occupational Associations with Pelvic Pain Among Female Factory workers in Tianjin, China (N=651)**

| | Often or Usually Dysmenorrhea | | | | Non-cyclic Pelvic Pain | | | | Any 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 | -- | -- |
| Can choose to work overtime | | | | | | | | | | | | |
| Yes | 67 | 56.8 | 0.87 | (0.57, 1.33) | 49 | 51.0 | **0.51** | **(0.32, 0.80)** | 54 | 55.1 | 0.62 | (0.38, 1.02) |
| No | 51 | 43.2 | -- | -- | 47 | 49.0 | -- | -- | 44 | 44.9 | -- | -- |
| 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 | -- | -- |
| Exhausted | | | **1.11** | **(1.03, 1.20)** | | | **1.13** | **(1.05, 1.23)** | | | **1.14** | **(1.04, 1.26)** |

**Table 2.7. Multivariate Associations with Pelvic Pain Among Female Factory workers in Tianjin, China (N=651)**

| | Often or Usually Dysmenorrhea | | Non-cyclic Pelvic Pain | | Any Dyspareunia | |
|---|---|---|---|---|---|---|
| | **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)** |
| Can choose to work overtime | -- | -- | **0.54** | **(0.33, 0.90)** | -- | -- |
| 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

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# Chapter 3

# Urogenital Infection Related to Occupational Stress Among Female Factory Workers in Tianjin, China

## Introduction

Urogenital infections including reproductive tract infections (RTIs) and urinary tract infections (UTIs) are major causes of morbidity among women in China (Kaufman, Yan, Wang, & Faulkner, 1999; Stones et al., 2006; Zhang et al., 2009) and 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% (S. Chen et al., 2002; C. Li et al., 2010; Sun, Cui, Yang, & Han, 2010; Yongjun et al., 2009; Zhang, et al., 2009). Among China's women workers, 27.2% of unmarried migrant workers and 40.2% of married migrant workers reported symptoms of RTIs, while 8.4% of the general population reported pain with urination with a higher prevalence in older ages (C. Lu et al., 2012; Stones, et al., 2006).

RTIs can lead to pelvic inflammatory disease, infertility, ectopic pregnancy, premature labor, low birth weight babies, chronic pain, and increased vulnerability to HIV and other

STIs (Population Council; Zhang, et al., 2009). 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 (Y. Chen & Zheng, 2001; Lan, 2004; Liu, Han, Xiao, Ma, & Chen, 2009; Xia, Liao, He, Choi, & Mandel, 2004; Zhang, et al., 2009). 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 infrequent bathroom breaks (J. L. Lu, 2008; Stones, et al., 2006).

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 (Culhane, Rauh, & Goldenberg, 2006; Khawaja, Kaddour, Zurayk, Choueiry, & El-Kak, 2009; Liu, et al., 2009; Prasad, Abraham, Akila, Joseph, & Jacob, 2003). However, no studies have examined RTIs and UTIs related 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 (J. L. Lu, 2008).

This preliminary study assessed 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. We hypothesized that occupational stress would increase the risk of urogenital symptoms and that the association would be confounded by migrant status.

**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, meaning it is at the same administrative level as a province and holds 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. At each location, eligible women workers were asked to participate in the study, informed consent was obtained, and the survey was immediately completed. All surveys were anonymous. The target population was women between the ages of 18 to 30 years; however women up to age 56 participated and all women that participated were included in the analysis.

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. 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, and occupational stress. 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 (CHNS, 2009). 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* (Cleland & Harlow, 2003; Zondervan et al., 2001). The occupational stress questions were adapted from the Karasek Job Content Questionnaire (JCQ) (Karasek et al., 1998). 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, 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 years, 25-29 years, and 30-56 years. Marital status was asked and the options married, single, divorced, widowed, or other. Marital status was dichotomized into never married (single) and ever married (married, divorced, widowed). No one answered with other for marital status. The question, "How many children do you have", was asked with the options none, one, or more than one. This was dichotomized into none and one or more children. If the number of children was missing (N=44), it was coded as 'one or more children'. This was because of the strong relationship between ever married and having children and ever married and missing information on children. The variable on level of education was created by dichotomizing the question, "What is

your education level", that had the options 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. Respondents were asked "Do you hold a Tianjin resident card?" with yes or no as the two possible options, yes meaning that the respondent was a Tianjin resident. 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. The 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?" and "Have you consumed any beer, white wine, red wine, or rice wine in the past month?" with the possible options for both questions of yes or no. Self-reported health ranking for the respondents was assessed through the question "Generally speaking, how is your health?" with the following options excellent, very good, good, fair, or poor. This variable was dichotomized as fair or poor and excellent, very good, or good. The question, "In the last 12 months, have you had sexual intercourse?" had either yes or no as possible responses. Hormonal contraception was categorized using the question, "What type(s) of contraception have you used in the past year?" with the following response options categorized into not hormonal (none, withdrawal, condoms, male sterilization, female sterilization/ hysterectomy, intrauterine device, breastfeeding/ no period, and calendar) and hormonal (oral contraception, injections, and ring). The categories of hormonal and not hormonal were then cross-tabulated with the dichotomous variable, sex in the last 12 months, to create a third category of "not sexually active and not on contraception". The variable condom at last sex was taken from the survey

question, “Did you use a condom the last time you had sex?” yes or no. This variable was also cross-tabulated with the variable sex in the last 12 months to create a third category of not sexually active in the last 12 months.

Our measure of abnormal vaginal discharge combined the women who reported vaginal discharge with an abnormal color with those who reported vaginal discharge with an abnormal smell. These variables were combined in order to measure any type of abnormal vaginal discharge. 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. Genital sores was documented with the following question, “In the last 12 months, did you experience pain or sores in your genital area?”, with the options yes or no. Pain with urination was documented with the following question, “In the last 12 months, did you experience pain or burning when urinating?”, with the options yes or no. Abnormal discharge, genital sores, and pain with urination were combined to create an indicator of ‘at least one symptom’.

Dysmenorrhea was assessed with the question, “In the last 12 months, how often have you had painful periods?” with response options never, occasionally, often, or usually. This was dichotomized into never or occasionally and often or usually. Dyspareunia (pain during or immediately after sexual intercourse) was assessed with the question, “In the

last 12 months, how often have you had pelvic pain during or in the 24 hours after sexual intercourse?" with response options never, occasionally, often, or usually. This was dichotomized into never and occasionally, often or usually and for associations with this variable the population was restricted to those that self-reported having had sex in the last 12 months. Non-cyclic pelvic pain was assessed with the question, "In the last 12 months, have you had pelvic pain NOT with periods or intercourse either on or off or constantly?" with response options yes or no. Pelvic pain in this survey was described as in the Oxfordshire Women's Health Study questionnaire, as pain in the lower abdomen (Zondervan, et al., 2001). Dysmenorrhea was defined in our study as often or usually experiencing dysmenorrhea in contrast dyspareunia and non-cyclic pelvic pain which were dichotomized as ever or never in the last 12 months because it provided a more conservative estimate of dysmenorrhea.

Occupational exposure variables included job type (production = 1 or office = 0), overtime, night work, exhaustion, sick days, poor job security, and a composite score of job strain calculated utilizing questions from the JCQ. 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 other was 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, more than three). Overtime hours were measured by the number of days the participant worked overtime and was dichotomized as more or less than three times per week. 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, more than three). Working at night was also measured as working nights more or less than three times per week. 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)”. The indicators for 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) (Karasek, et al., 1998; J. Li, Yang, Liu, Xu, & Cho, 2004). 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 (Karasek, et al., 1998). The job demand component was made up of five questions (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; I am free from conflicting demands that others make) each question with a possible answer of strongly disagree, disagree, agree, and strongly agree. The decision latitude was made up of nine questions

(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 question with a possible answer of strongly disagree, disagree, agree, and strongly agree. 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 values for the composite job strain score.

SAS 9.2 was used to conduct the analyses. The prevalence of each urogenital symptom was determined. Bivariate and multivariable logistic regression was 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 and were not highly correlated with other variables.

**Results**

The mean age of women in this study was 28 (SD=$\pm$5.8) with 28.4% between 18 and 24 years, 42.0% between 25 and 29 years and 29.6% over 30 years (Table 3.1). The majority of women (61.9%) were ever married and 50.6% of all women in the survey never had

children. Most women had a high school education or less (68.2%) and 72.1% had an income of less than 2001 yuan (approximately $317 USD). Most women in the study sample, 73.1%, were urban residents of Tianjin (non-migrants). Most women in this study sample did not smoke more than 5 cigarettes (95.3%) or drink any alcohol (64.1%) in the past month. The majority of women in the sample had sex in the last 12 months (58.5%); and among those most had not used hormonal contraception, but most did use a condom at their last sexual encounter. 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 (Table 3.2). Some women (16.9%) reported working overtime on average three or more days each week over the past 12 months 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 in our sample that reported having at least one of the urogenital infection symptoms was 30.9% (Table 3.3). Among women in our study, 27.9% reported having abnormal discharge, 2.4% genital sores, and 6.3% pain with urination. Each symptom was associated with greater likelihood of reporting a fair or poor overall health rating. Dysmenorrhea was not associated with urogenital infection symptoms; however both dyspareunia and non-cyclic pelvic pain were associated with all urogenital infection symptoms (Table 3.4).

Age was not associated with any of the urogenital infection symptoms studied (Table 3.5). Never being married and not having any children were associated with reduced odds of abnormal vaginal discharge and of reporting at least one urogenital infection symptom. 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, pain with urination, and at least one of the three urogenital infection symptoms. The odds ratio for reporting genital sores among women who reported having sex in the last 12 months was also elevated; however it was not statistically significant. The variables never married, not having children, and having sex in the last 12 months were all highly correlated with one another, thus only having sex in the last 12 months, the variable most strongly associated with symptoms of urogenital infections, was controlled for in the multivariable analysis.

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 significantly more likely to report having genital sores and pain with urination. The odds ratio for women reporting abnormal vaginal discharge and at least one urogenital infection symptom was elevated but not significant. High job strain is associated with pain with urination. 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 found to be associated with abnormal

vaginal discharge and reporting at least one urogenital infection symptom. Feeling exhausted increased the odds of reporting at least one urogenital infection symptom, pain with urination, and genital sores. The odds of having abnormal vaginal discharge increased with feeling exhausted although the confidence interval included one. Being required to work overtime was associated with reporting at least one urogenital symptom and with each symptom separately, although associations with individual symptoms were not statistically significant. Notably, women who reported abnormal discharge, pain with urination, and at least one of the three urogenital infection symptoms were more likely to take off days of work due to illness than women who did not report these symptoms.

In the multivariable analysis, assessing abnormal vaginal discharge; sex in the last 12 months (OR=2.40 (1.58, 3.65)) remained significant (Table 3.7) while poor job security and high job strain no longer showed a significant association (although the direction of the association remained the same as in the bivariate analysis). In the analysis assessing genital sores, feeling exhausted remained significant (OR=1.35 (1.05, 1.73)) and working the night shift showed an increased odds but was not significant. Pain with urination was associated with sex in the last 12 months (OR=3.83 (1.46, 10.08)) and feeling exhausted (OR=1.21 (1.06, 1.39)), while reporting high job strain showed an increased odds but was not statistically significant. Reporting at least one urogenital infection symptom was associated with sex in the last 12 months (OR=2.53 (1.68, 3.79)) and poor job security (OR=1.51 (1.03, 2.20)), while high job strain showed an increased odds although not statistically significant.

**Discussion**

To our knowledge, this is the first study to examine the relationship between occupational stress and symptoms of urogenital infections in an EPZ in China. This research shows a high prevalence of symptoms of urogenital infections among women working in factories in a Tianjin EPZ and suggests there is an association between abnormal vaginal discharge, pain with urination, and genital sores and 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. This study of women workers in three electronic factories in Tianjin, China found a prevalence of 30.9% for reporting at least one of the urogenital infection symptoms assessed (abnormal discharge, pain with urination, or genital sores). In our sample, 27.9% reported abnormal vaginal discharge, 2.4% reported genital sores, and 6.3% reported pain with urination. The prevalence reported in this study is most likely an underestimate of 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%) (C. Lu, et al., 2012). This difference could be due to differences in the population studied, as no non-migrant women or women over the age of 30 were included in Lu's sample and women in our study had a higher average level of education. The prevalence of pain with urination in our study was slightly less than the prevalence of 8.4% found in China's general population, which again could be due to differences in the population studied (Stones, et al., 2006).

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 urogenital infection symptoms and stress.

All symptoms of urogenital infections in our study were associated with dyspareunia and non-cyclic pelvic pain. Notably, reporting urogenital infection symptoms was associated with increased work absenteeism. Women who report 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.

Sex in the last 12 months was the key demographic risk factor for abnormal vaginal discharge, pain with urination, and at least one urogenital infection symptom. No demographic or lifestyle characteristics were associated with genital sores. None of the symptoms of urogenital infection 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 2001 yuan, which is below the average reported monthly salary of 3000 yuan – 4000 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 (3749 yuan) in the year 2010 (2010; 2012). The low income in our sample could lead to additional stress outside of the occupational stress documented in this study.

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 little association between the complaint of abnormal vaginal discharge and certain urogenital infections based on clinical examination (Patel et al., 2005). Additionally as some of the occupational stress survey questions and the self-reporting of urogenital infection symptoms have a degree of subjectivity; it is possible that responses could be globally negative or positive. However, the survey results allow us to understand the subjective element of reproductive ill-health (Cleland & Harlow, 2003). The subjective experience of urogenital infection is important due to the consequences of feeling ill, missed work days, and reduced sexual activity (Cleland & Harlow, 2003). Furthermore, 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 are not generalizable to other factories in TEDA or elsewhere. Because data collection occurred at factories, it is possible that women underreported their migrant status occupational stress, as well as urogenital symptoms in order to appear healthy. However, data collection was anonymous and women were encouraged to

answer truthfully. If underreporting occurred it would mean our results are a conservative estimate of the association between migrant status or occupational stress and urogenital infection in this population. 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 determine the prevalence of urogenital infections, but survey measures should still be incorporated in order to understand the social and occupational implications of self-reported poor reproductive health.

Due to our relatively small sample size, there is a decreased power to observe associations between urogenital infection symptoms and demographic and occupational risk factors, especially genital sores leading to some non-significant findings. Nevertheless our study did document risk. Despite our efforts to pilot the study instrument and remove or clarify poorly understood items, it is still possible that study participants misunderstood or misinterpreted the survey questions. Due to the cross-sectional study design, we were not able to assess the directionality of the associations. Moreover, our study also did not evaluate stress outside the workplace or other risk factors such as sanitary practices and stigma. Lastly, as the population in this study all worked in electronics companies in the Tianjin EPZ; all study participants may have experienced relatively high levels of occupational stress which may have led to an underestimation of the effect of occupational stress. Research comparing women working inside and outside of EPZs or between several different industries within the EPZs in China would improve the generalizablity of this study.

Even though our population consists of a small percentage of the previously documented demographic and lifestyle risk factors for urogenital infections among Chinese women such as migrant, not married, poor healthcare access, and young age; almost one third of the population reported symptoms of urogenital infections. This research suggests that women of all ages and regardless of marital status need universal access to reproductive healthcare, as no difference between age, marital status and any urogenital infection symptom was found.

Our research also suggests that working overtime, working at night, and job strain are associated with the prevalence of urogenital infection symptoms. This is especially important because 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 are more likely to describe their health as fair or poor. 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. Due to this growing population and the evidence of a clear unmet need in reproductive healthcare, it is imperative that the reproductive health needs of women working in China's factories are addressed.

**Table 3.1 Demographic and Lifestyle Characteristics for Female Factory Workers in Tianjin, China (N=638)**

| | No. | % |
|---|---|---|
| Age | | |
| 18-24 years | 181 | 28.4 |
| 25-29 years | 268 | 42.0 |
| 30-56 years | 189 | 29.6 |
| Marital Status | | |
| Never Married | 239 | 37.5 |
| Ever Married | 395 | 61.9 |
| Missing | 4 | 0.6 |
| Children | | |
| No Children | 323 | 50.6 |
| 1 or more Children | 315 | 49.4 |
| Education Level | | |
| Educated past high school | 195 | 30.6 |
| High School Education or Less | 435 | 68.2 |
| Missing | 8 | 1.3 |
| Holds Tianjin Residence Card | | |
| Yes | 466 | 73.1 |
| No | 159 | 24.9 |
| Missing | 13 | 2.0 |
| Monthly Income Level | | |
| 2000 元 or less | 460 | 72.1 |
| 2001 元 and more | 167 | 26.2 |
| Missing | 11 | 1.7 |
| Smoked more than 5 cigarettes in the past month | | |
| Yes | 24 | 3.8 |
| No | 608 | 95.3 |
| Missing | 6 | 0.9 |
| Consumed any alcohol in the past month | | |
| Yes | 221 | 34.6 |
| No | 409 | 64.1 |
| Missing | 8 | 1.3 |
| Health Rating | | |
| Fair, Poor | 158 | 24.8 |
| Excellent, Very Good, Good | 467 | 73.2 |
| Missing | 13 | 2.0 |
| Had sex in last 12 months | | |
| Yes | 373 | 58.5 |
| No | 212 | 33.2 |
| Missing | 53 | 8.3 |
| Uses Hormonal Contraception | | |
| No Sex | 206 | 32.3 |
| Yes | 68 | 10.6 |
| No | 311 | 48.8 |
| Missing | 53 | 8.3 |
| Condom at last sex | | |
| No Sex | 203 | 31.8 |
| Yes | 192 | 30.1 |
| No | 163 | 25.6 |
| Missing | 80 | 12.5 |

**Table 3.2. Occupational Characteristics For Female Factory Workers in Tianjin, China (N=638)**

| | No. | % |
|---|---|---|
| Job Type | | |
| Production Staff | 417 | 65.4 |
| Office Staff | 192 | 30.1 |
| Missing | 29 | 4.5 |
| Worked the overtime in the last 12 months at least 3 days | | |
| Yes | 108 | 16.9 |
| No | 520 | 81.5 |
| Missing | 10 | 1.6 |
| Worked the night shift in the last 12 months at least 3 nights | | |
| Yes | 215 | 33.7 |
| No | 386 | 60.5 |
| Missing | 37 | 5.8 |
| High Job Strain | | |
| Yes | 153 | 24.0 |
| No | 466 | 73.0 |
| Missing | 19 | 3.0 |
| Poor Job Security | | |
| Yes | 228 | 35.7 |
| No | 380 | 59.6 |
| Missing | 30 | 4.7 |

**Table 3.3. Urogenital Symptoms Among Female Factory Workers in Tianjin, China (N=638)**

| | No. | % |
|---|---|---|
| Vaginal Discharge / Abnormal Smell | | |
| Yes | 178 | 27.9 |
| No | 457 | 71.6 |
| Missing | 3 | 0.5 |
| Genital Sores | | |
| Yes | 15 | 2.4 |
| No | 556 | 87.2 |
| Missing | 67 | 10.5 |
| Pain with Urination | | |
| Yes | 40 | 6.3 |
| No | 523 | 81.9 |
| Missing | 75 | 11.8 |
| At Least One Symptom | | |
| Yes | 197 | 30.9 |
| No | 441 | 69.1 |

**Table 3.4. Consequences of Urogenital Infection Symptoms Among Female Factory workers in Tianjin, China (N=638)**

| | Fair or Poor health rating | | | | Often or Usually Dysmenorrhea | | | | Pain with Sex | | | | Non-Cyclic Pelvic Pain | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **No.** | **%** | **OR** | **CI** | **No.** | **%** | **OR** | **CI** | **No.** | **%** | **OR** | **CI** | **No.** | **%** | **OR** | **CI** |
| Abnormal Vaginal Discharge | | | | | | | | | | | | | | | | |
| Yes | 58 | 33.9 | **1.83** | **(1.24, 2.67)** | 39 | 22.2 | 1.29 | (0.84, 1.98) | 58 | 49.2 | **3.10** | **(1.91, 5.04)** | 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 | 2.74 | (0.95, 7.85) | 10 | 83.3 | **10.65** | **(2.29, 49.60)** | 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 | **3.20** | **(1.56, 6.58)** | 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 | 1.4 | (0.93, 2.12) | 63 | 47.7 | **3.08** | **(1.90, 4.99)** | 62 | 36.5 | **4.26** | **(2.71, 6.72)** |
| No | 93 | 21.4 | -- | -- | 77 | 17.6 | -- | -- | 43 | 22.9 | -- | -- | 40 | 11.9 | -- | -- |

**Table 3.5. Unadjusted Associations of Demographic and Lifestyle Characteristics with Urogenital Infection Symptoms Among Female Factory workers in Tianjin, China (N=638)**

| | Vaginal Discharge and/or Abnormal 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 Married | 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 Married | 124 | 31.6 | -- | -- | 11 | 3.1 | -- | -- | 30 | 8.4 | -- | -- | 136 | 34.4 | -- | -- |
| Children | | | | | | | | | | | | | | | | |
| No Children | 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 Children | 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 | -- | -- |

**Table 3.6. Unadjusted Associations of Occupational Characteristics with Urogenital Infection Symptoms Among Female Factory workers in Tianjin, China (N=638)**

| | Vaginal Discharge and/or Abnormal Smell | | | | Genital Sores | | | | Pain with Urination | | | | At least one symptom | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **No.** | **%** | **OR** | **CI** | **No.** | **%** | **OR** | **CI** | **No.** | **%** | **OR** | **CI** | **No.** | **%** | **OR** | **CI** |
| 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 the last 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)** |
| Exhausted | -- | -- | 1.06 | (0.99, 1.13) | -- | -- | **1.47** | **(1.15, 1.88)** | -- | -- | **1.22** | **(1.08, 1.39)** | -- | -- | **1.09** | **(1.02, 1.15)** |

**Table 3.7. Multivariate Associations with Urogenital Infection Symptoms Among Female Factory workers in Tianjin, China (N=638 )**

| | Abnormal Vaginal Discharge | | 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)** | -- | -- |

-- not included in model

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# Chapter 4

# Foreign Direct Investment and Infant Mortality in China's Provinces and Prefectures

## Introduction

China opened its doors to the world three decades ago through economic reforms which encouraged private businesses, foreign investment and trade liberalization. Since that time, China's gross domestic product (GDP) has grown at an inflation-adjusted average annual rate of eight percent over the last 25 years and China became the world's second largest economy and the world's largest exporter (Curran, Funke, & Wang, 2007; Flanders, 2011; Hutzler, 2005; The Associated Press, 2010). In the early 2000s, more than half of China's exports were through foreign invested enterprises and the majority were from manufacturing ("Birth, Migrating Population, Key to Fifth Census," 2000; K. Liu & Daly, 2011). While China's economy surged, the officially reported infant mortality rate (IMR: number of deaths in the first year of life per 1000 live births) declined from 49.8 deaths /1000 live births in 1980 to 27.3 deaths/1000 live births in 2000 to 15.8 deaths /1000 live births in 2010 (World Bank, 2011). The IMR, is an accepted and widely used indicator for reproductive health, and more generally an indicator for population health and social development (Harlow, Denman, & Cedillo,

2004; Reidpath & Allotey, 2003; United Nations, 2003). Declines in the IMR are associated with improved maternal health during pregnancy and increased socioeconomic status including higher income, better access to quality healthcare, and more education (MacDorman et al., 2000). Macro-level indicators for IMR declines include a high level of development (i.e. gross national product per capita), national commitment to public health (i.e. health expenditures per capita), and high education and literacy rates. The association between IMRs and foreign direct investment (FDI) is not established. This paper aims to assess associations between FDI and China's IMR.

Generally, economic growth is associated with declining IMRs as has been shown in studies comparing national IMRs across countries (Clark, 2011; Wagstaff, 2000). However, whether FDI is associated with lower IMRs is a point of controversy in the literature. Some studies comparing national level IMRs have found evidence that FDI in developing countries may have a beneficial effect on infant survivability in those countries (Firebaugh & Beck, 1994; Meyer, 1996). Other researchers have found that country level IMRs increase in areas with high levels of FDI (Kick, Davis, Burns, & Li, 1995; Shandra, Nobles, London, & Williamson, 2004; Shen & Williamson, 2001). A study from Mexico shows that some states with high export production have IMRs higher than the national average (Harlow, et al., 2004). A study in Sri Lanka's Colombo export processing zone reported that the stillbirth rate among women working in the Colombo Free Trade Zone was five times the stillbirth rate for women in the general population and the spontaneous abortion rate was four times higher (Hettiarachchy & Schensul, 2001).

Although the methodologies utilized in the above mentioned studies differ, these inconsistent findings could also be attributable to variations in the characteristics of the countries studied. For example, level of GDP may mask the association between FDI and IMR or other factors that vary across nations may drive the observed associations, including factors such as the chief industrial sector where FDI is prominent, the proportion of FDI involved in export production, or the availability and accessibility of healthcare. The majority of FDI to China in the year 2000 was invested in the manufacturing industry (Davies, 2010; K. Liu & Daly, 2011). Research has shown that a large proportion of GDP allocated to the manufacturing industry results in a positive influence on economic growth at China's county and city levels, while in areas with GDP dependent on agricultural industries there is a negative impact on economic growth (Curran, et al., 2007). FDI in China is mainly linked to export production in export processing zones (EPZs) (Gallagher, 2004). Further, in 1998, 44% of China's total exports were by foreign affiliates and that percentage was higher in the manufacturing industry (State Statistical Bureau, 1999). Finally, FDI has propelled millions of rural people to migrate to China's urban industrial centers. China's migrant population is not eligible for the same social services as urban residents and therefore infant mortality may be higher in areas with higher migrant populations (Hong et al., 2006; Park, Wang, & Cai, 2006; Solinger, 1999).

EPZs in China take on many different names with slightly different policies. However, for this paper all areas with special incentives to attract FDI will be referred to as EPZs. Both manufacturing and export production factories are locations where many women

work and are exposed to poor working conditions. Although increased female employment may result in improved health through increased financial independence and autonomy (Maclean & Sicchia, 2004), poor working conditions in EPZs may lead to a net decrease in overall health. Poor working conditions for women working in manufacturing in EPZS is an important concern due to the reduced workplace standards used to attract FDI, such as limits on unionization, compulsory overtime, lack of safely equipment, and low wages (Hogstedt, Wegman, & Kjellstrom, 2007; Milberg & Amengual, 2008). Women working in poor conditions distinguished by physically demanding work, fatigue, shift and night work, long hours, long periods of time sitting or standing, and ergonomic risk factors typically found in FDI funded industries in China have an increased risk for adverse pregnancy outcomes including preterm birth, low-birthweight, spontaneous abortion, pre-eclampsia, and reduced fecundability (Beaumont et al., 1995; Ceron-Mireles, Harlow, & Sanchez-Carrillo, 1996; Denman, 1991; B. Eskenazi, Bracken, Holford, & Grady, 1988; B Eskenazi et al., 1995; B. Eskenazi, Guendelman, Elkin, & Jasis, 1993; Figa-Talamanca, 2006; Mozurkewich, Luke, Avni, & Wolf, 2000; Saxena, 1999; Schenker et al., 1995; Swan et al., 1995; Xu, Dina, Li, & Christiani, 1994). Adverse pregnancy outcomes have been linked to high infant mortality rates (Choy, Song, Kim, & Song, 2011; Kramer et al., 2000) and adverse pregnancy outcomes comprise a large proportion of all infant deaths in China (MMWR, 2007). Therefore, women working in manufacturing in China's EPZs may be more likely to have adverse pregnancy outcomes due to occupational exposures including experiencing more infant mortality. Other risk factors for infant mortality such as poor infant nutrition and infection are dependent on healthcare access, education level, income, living

arrangements, and whether the infant is breastfed. Alternatively, increased income through EPZ work may decrease infant mortality.

Although the GDP and IMR in China have been steadily improving, there is evidence that these gains have not been uniform throughout China and that disparities have widened (Demurger, Sachs, Woo, Bao, & Chang, 2002; Dollar, 2007; S. Fan, Kanbur, & Zhang, 2009; Kanbur & Zhang, 1999; Y. Liu, Hsiao, & Eggleston, 1999; Unel & Zebregs, 2006; Y. Wang et al., 2012). China's development is marked by the rapidly growing rate of economic inequality, quantified by the Gini coefficient rising from 28.2% in 1980 to 37.2% in 2000 (Kanbur & Zhang, 1999). The World Bank stated that since 1980, China's inequality has been rising more quickly than any other country (C. Fan & Sun, 2008). Specifically, the eastern provinces have realized such high economic growth that they have met or exceeded the richest provinces before the economic reforms, while the landlocked provinces have made much smaller gains (Unel & Zebregs, 2006). Several studies have described regional inequalities in economic growth, especially along the "three economic belts" categorized as eastern, central, and western, which were defined as part of China's Seventh 5-year plan to organize economic growth (Bao, Chang, Sachs, & Woo, 2002; C. Fan & Sun, 2008; Wen, 2007). In 1997, the GDP of the western region was only 71% as high as the national gross domestic product GDP, while the central region was 82% as high and the eastern region was 159% as high (Curran, et al., 2007). From 1978 to 1999, the western region accounted 3% of China's total FDI inflows, the central region accounted for 9% and the eastern region accounted for 88% of total FDI inflows (Taube & Ogutcu, 2002).

These regional inequalities are largely due to the preferential economic policies that fostered FDI to eastern areas and created export processing zones (EPZs), which increased GDP growth in the recipient provinces (Demurger, et al., 2002; Unel & Zebregs, 2006; Wei, Liu, Parker, & Vaidya, 1999; Wen, 2007; Zebregs, 2003). These preferential policies were part of a larger national plan to open China to a market economy gradually by first allowing foreign investment in the eastern provinces followed by the central and lastly western provinces. FDI in eastern areas began in 1978, while FDI in the central and western areas was not actively encouraged until 2000.

Studies have also emphasized the regional disparities apparent in the IMRs across China with year 2000 estimates for IMR at 26.8 in the central region and 13.6 in the eastern region (S. Fan, et al., 2009; Y. Wang, et al., 2012), which was further supported by another study that showed IMRs were 3-5 times higher in western provinces than eastern provinces (Gong & Brixi, 2005). Other authors show that income inequalities are associated with increased mortality (Kawachi & Kennedy, 1997; Mayer & Sarin, 2005). Although the economic and IMR disparities are evident across China's regions, little epidemiologic research has assessed the relationship between China's economy and IMR.

This paper describes the relationship between economic indicators and IMR at the province and prefecture levels in China in the year 2000. We hypothesize that lower IMRs are associated with higher GDP, higher FDI, a lower proportion of women non-migrants, and a higher proportion of women working in manufacturing. We also hypothesize that FDI and GDP will modify the association between the proportion of

women working in manufacturing and IMR, as employment in manufacturing may benefit women differently in areas with higher FDI or GDP. This paper aims to add to the literature on women's health, infant mortality and FDI in developing countries. Research in this area is increasingly important given the Millennium Development Goal to increase the proportion of women in wage employment outside the agricultural sector and as the growing number of EPZs worldwide create more opportunities for women to work outside the home (Maclean & Sicchia, 2004).

**Methods**

This study analyzes data from the China 2000 Census and China Statistical Yearbook for the year 2000 for all China's 31 provinces (including autonomous regions) and 334 prefectures (including autonomous prefectures) except in the case of missing data. No data were missing at the province level. Prefectures with missing data were removed from the analyses that included the missing variables. Fifty-five prefectures were missing data on GDP (8 from the central region, 2 from the eastern region and 45 from the western region). Sixty-seven prefectures were missing data on FDI (11 from the central region, 2 from the eastern region and 54 from the western region). For the purposes of this study, the municipalities of Beijing, Shanghai, Tianjin, and Chongqing are considered provinces in the province level analysis and prefectures in the prefecture level analysis. Direct units, which are counties under the direct authority of the province and exist only in Hubei and Xinjiang were not included in any analysis because of the potential for unmeasured confounders regarding differential policies. Also, the data for

direct units were combined into one variable for each province, which did not allow for measurement between each direct unit.

*Measurement*

Demographic and mortality data including the total population, number of non-migrants, number of women working, number of women working in manufacturing, number of all people working in manufacturing, and the number of births and deaths were taken from the China 2000 Census. All data from the China 2000 Census is collected using self-report. Economic data including foreign capital actually utilized (FDI), gross domestic product (GDP), and value of exports were compiled from the China Statistical Yearbook for the year 2000. FDI was listed in US Dollars and converted to yuan at the exchange rate for the year 2000 (8.27 yuan to 1 USD). Data on preferential policy was taken from the publication in the China Economic Review by Demurger and colleagues in the year 2002 (Demurger, et al., 2002). The division for all provinces as eastern, central, or western was taken from the China Monthly Statistical Yearbook for the year 2000 and is used instead of the more general distinction of rural/urban, as region is a standard grouping of provinces in China research and as region and rural/urban are highly correlated in our data. Unless otherwise indicated, all data for this analysis were obtained from the China Data Center which includes data from the China 2000 Census and the China Statistical Yearbook for the year 2000 at the University of Michigan.

*Infant mortality rate* (IMR) was calculated by dividing the number of total population deaths of those aged zero between November 1, 1999 and October 31, 2000 by all live births between November 1, 1999 and October 31, 2000.

*Demographic Data*

The proportion of women non-migrants was calculated by dividing the number of women non-migrants by the total population of women for each province and prefecture. The proportion of women employed was calculated by dividing the number of women employed by the total population of women between the ages of 15 and 64 for each province and prefecture[1]. Employment in the census was described as any employment including agricultural work. The proportion of women working in manufacturing of all women employed was calculated by dividing the number of women working in manufacturing by the total number of women employed for each province and prefecture. The proportion of women working in manufacturing of all people in manufacturing was calculated by dividing the number of women working in manufacturing by the total number of men and women working in manufacturing for each province and prefecture.

[1] The denominator was multiplied by 9.5 percent because the numerator of all women employed was taken from the long form of the census which was conducted on 9.5 percent of the population and the denominator was from the short form given to the entire population.

*Economic Data*

Data on economic activity included foreign capital actually utilized (FDI), gross domestic product (GDP), GDP from manufacturing (listed as industry in the China Statistical Yearbook), the total value of exports and the total value of exports and imports. The total value of exports was divided by the total value of exports and imports to create an indicator of the level of export production. FDI was divided by GDP to create an indicator of FDI in relation to GDP. GDP from manufacturing was divided by GDP to create an indicator of the amount of GDP related to manufacturing. Lastly, the variable, preferential policy described in detail by Demurger and colleagues, provided an average ranking for each province for economic zones from 0-3 with 0 being no zone and 3 being the most open zones. The ranking was provided for every year and changed when a new zone was established in that province between 1978-1998 (Demurger, et al., 2002).

*Statistical Analysis*

All analyses were conducted in SAS 9.2. Bivariate linear regression models and linear regression models adjusting for GDP, region, and female employment rate were built to determine associations between the infant mortality rate (IMR) at China's province or prefecture levels and the economic variables of interest. For all analyses at the prefecture level, linear mixed models were used to account for clustering by province. Plots were constructed to visualize associations at the province level. Provinces with high leverage that may have influenced the results were considered in the plots and when an influential case was identified by a cooks distance greater than one, the plots are presented with and without the case. Multicollinearity was considered in each model.

*Data Quality*

China's 2000 Census was deemed a success because it was the first Chinese census that used both a short form for basic information and a long form sent to a randomly selected 9.5 percent of the population for detailed questions. The government had also ensured the population that census data would not be used to punish individuals for violations including having more children than the birth control policy specifies or residing in an area without proper registration (C. Fan, 2002; Kennedy, 2001; Zhang, Li, & Cui, 2005). Specifically, migrants who lived in one place outside their legal area of residence for more than six months in the year 2000 were designated in their area of current residence in the census regardless of whether they were officially registered, which ended up counting millions of rural migrants missed in previous censuses. Also, the Chinese government encouraged parents to register all of their children by offering reduced fines for children outside the "One Child Policy" (Kennedy, 2001).

However, there are still some data quality concerns. Although the China 2000 Census implemented measures to reduce undercounting of infant births or deaths, the possibility of underreporting due to fears regarding the "One Child Policy" in China remains. Through data quality checks, it was estimated that there is a 1.81% under-enumeration, most of which is among children ages 0-9 (Zhang, et al., 2005). Also, migrants who did not live in any one location for more than six months may have been completely missed in the census (Kennedy, 2001) and some researchers suggest that the 2000 census largely undercounts migrants (Anderson, 2004; Lavely, 2001). Undercounting is likely related to the difficulty of enumerating populations that lived in nonresidential places and places

with restricted access, which may include areas where migrants are more likely to live and factories (Treiman, Lu, & Qi, 2009). Lastly, concern has been reported regarding possible underreporting of non-agricultural employment in rural areas because the survey administration for the China 2000 Census may have influenced rural respondents to report all household members as agricultural workers (Banister, 2004).

Data from the China Statistical Yearbook is the most widely used source of official statistics on China (Zhou & Ma, 2005). The quality and integrity of GDP data in China has been called into question by new evidence of potential falsification or exaggeration of the data (Meng & Wang, 2000; Rawski, 2001). However, these claims were contested by other authors following further data investigation (Holz, 2003; Klein & Ozmucur, 2002/2003; Mehrotra & Paakkonen, 2011).

With both the China Census and the China Statistical Yearbook, there are inconsistencies in enumeration criteria, territorial boundaries, and variable definitions across time (Zhou & Ma, 2005). Due to this concern and issues with data availability, this study employs a cross-sectional design for the year 2000.

**Results**

Within China's 31 provinces; 12 provinces and 115 prefectures are in the eastern region, 9 provinces and 117 prefectures are in the central region, and 10 provinces and 105 prefectures are in the western region. Demographic and economic data vary across regions. Table 4.1 shows the province level data stratified by region. From this data it is

evident that the eastern region has the lowest average IMR (12.44/1000) followed by the central region (22.04/1000) and then the western region (35.15/1000). Eastern provinces have the lowest proportion of women non-migrants (81.7%) and the highest proportions of women working in manufacturing of all women employed (20.0%) and of all people in manufacturing (44.2%) compared to both central and western regions. The western region has the highest employment rate for women (80.1%) followed by the eastern region (71.3%) and then the central region (68.9%). Absolute values of FDI, GDP and GDP from manufacturing range from 0.05 to 0.73 per 1000 population, 4.83 to 14.04 per 1000 population, and 1.49 to 5.81 per 1000 population respectively and are higher in the eastern provinces, followed by central provinces, and then by western provinces. However, the FDI as a proportion of GDP is highest in the central region (7.6%), followed by eastern (5.2%), and then followed by western (1.0%). The proportion of GDP from manufacturing is only slightly higher in the eastern provinces (39.5%) compared to the central provinces (38.2%) and both are higher than the western provinces (30.7%). The ratio of exports to total imports and exports ranges from 60.1% to 65.7% with the largest ratio in the western region followed by the central and the eastern provinces. Lastly, the preferential policy described in Demurger and colleagues shows the eastern provinces with more preferential policies followed by the central provinces and lastly the western provinces (Demurger, et al., 2002).

The associations between IMR and demographic and economic indicators at the province level are reported in Table 4.2 and depicted graphically in figures 4.1-4.20. GDP per 1000 population had a statistically significant negative association with IMR ($\beta$=-1.44,

p<0.01), while both central (β=9.59, p=0.05) and western (β=22.70, p<0.01) regions had a positive association when the eastern region was the referent group. When GDP per 1000 population and region were in the model together, all estimates were diminished although the decline in IMR with GDP remained significant (β=-0.89, p=0.04), and the elevated IMR in the western region remained significant (β=14.41, p=0.02). A higher proportion of women non-migrants was positively associated with a higher IMR in the bivariate analysis. A higher proportion of women working in manufacturing of all women working and a higher proportion of women working in manufacturing of all people working in manufacturing were both associated with a lower IMR. Higher FDI per 1000 population and a higher proportion of FDI of GDP and GDP from manufacturing of total GDP were associated with lower IMRs. A higher value of exports of the total value of exports and imports was associated with higher IMR and after stratifying by region, this association only remained in the eastern region. A higher preferential policy score was associated with lower IMRs. A higher proportion of women employed was positively associated with a higher IMR. None of these economic of employment indicators (except the proportion of women employed) remained statistically significant after adjusting for GDP or GDP and region, but the direction of the effects remained the same. The proportion of women employed remained positively and significantly associated with a higher IMR after adjusting for GDP per 1000 population, region, and GDP per 1000 population and region. After adjusting for proportion of women employed, only GDP from manufacturing of total GDP and preferential policy remained statistically associated with higher IMRs.

Prefecture level results were calculated with log base 10 transformed IMR in order to increase the normality of the residuals in our multivariable models and reported in Table 4.3. In this analysis, the direction of the effects mirrored those in the province level analysis but statistical power was increased given the greater sample size. Having a higher GDP had a significant association with lower IMR ($\beta$=-0.02, p-value<0.01) while both central ($\beta$=0.22, p-value=0.02) and western ($\beta$=0.43, p-value<0.01) regions had a positive association when the eastern region was the referent group. When GDP per 1000 population and region were in the model together, GDP remained significant ($\beta$=-0.02, p<0.01) and the central region ($\beta$=-0.03, p=0.75) and the western region ($\beta$=0.09, p=0.29) were no longer significant. Adjusting for GDP per 1000 population attenuated but did not eliminate the association between a higher proportion of women non-migrants of all women in the prefecture or a higher proportion of women employed and a higher IMR or the associations between a higher proportion of women working in manufacturing of all women employed, women working in manufacturing of all people in manufacturing, or FDI per 1000 population and a lower IMR. After adjusting for the proportion of women employed, the effects of all parameters remained significant.

The association between the proportion of women working in manufacturing of all women working and log base 10 transformed IMR was modified by prefecture level GDP, dichotomized at the median (GDP = 6.19 per 1000 population) ($\beta$= 1.79, p-value<0.01) and by FDI dichotomized at the median (FDI = 0.07 per 1000 population) ($\beta$=0.89, p-value<0.01) (Table 4.4). Thus in prefectures with a GDP equal or below the median or FDI equal or below the median, a higher proportion of women working in manufacturing

was associated with a larger reduction in the IMR than in provinces with a GDP or FDI above the median.

**Discussion**

Infant mortality rates (IMRs) have declined throughout the world due to improvements in basic maternal and child healthcare (Schell, Reilly, Rosling, Peterson, & Ekstrom, 2007; The World Bank, 2011). Although China's IMR has declined in recent years, China is among the top five countries with the largest number of infant deaths ("Child deaths: Unicef says global mortality rates fall," 2012). This paper has examined the relationship of FDI, GDP, and women working in manufacturing with IMR at the province and prefecture levels in the year 2000. At both the province and prefecture levels, a higher GDP or higher FDI was associated with lower IMRs and where the proportion of FDI from GDP or GDP from manufacturing from GDP was greater the IMR was lower. This study also showed that while a higher proportion of women working in manufacturing of all people working in manufacturing or of all women employed in the province were both associated with lower IMRs, the effect was strongest in areas with lower GDP and lower FDI.

Our findings are consistent with existing research on industrializing countries in East Asia that assert FDI has improved economic growth and the population's living standards (Shen & Williamson, 1997). Cross-national research has also illustrated that economic development (GDP or gross national product) was the most important predictor of low IMRs (Clark, 2011; Meyer, 1996). In a study using data from The Population Atlas of

China collected in 1981-2, an association between high per capita income and low IMR was documented (Bradshaw & Fraser, 1989). Additionally, research has shown higher levels of FDI to be associated with lower IMRs (Meyer, 1996). This study found that in addition to higher GDP; higher FDI, higher FDI as a proportion of GDP, and the higher proportion of GDP from manufacturing were all associated with lower IMRs. Higher GDP had a strong association with lower IMRs and confounded our results, which suggests two alternative theories; that places with a higher GDP result in healthy populations or places with healthy populations result in a higher GDP (Alsan, Bloom, & Canning, 2006).

Our results show that a higher proportion of exports from total trade was associated with higher infant mortality and when stratified by region this effect only remained in the eastern region. In the year 2000, the eastern region received the vast majority of FDI and exported the most goods ("Birth, Migrating Population, Key to Fifth Census," 2000; K. Liu & Daly, 2011). This finding suggests an association between export production and IMRs, which needs to be further studied.

Several studies have documented that IMRs are greater in rural areas than in urban areas (Y. Liu, Rao, Evans, Chen, & Hsiao, 2001) and that IMRs are higher among infants whose parents work in the agricultural sector compared to infants whose parents were laborers or civil servants (Weng & Wang, 1993). Besides differing types of occupational exposures, another possible explanation is that 10% of the rural population live more than 30 minutes from emergency obstetric care (Gong & Brixi, 2005). Our data show that the

IMRs in the western region were higher than that of the central region, which was higher than that of the eastern region. The western region is the most rural with a large proportion of people working in agriculture followed by the central region and then the eastern region. Furthermore, our data suggest that moving from agricultural work to manufacturing jobs has a beneficial impact on survival of infants.

At the prefecture level, a higher proportion of women working in manufacturing relative either to all women working or to all people working in manufacturing was associated with lower IMRs for that area even after controlling for GDP, region, and the female employment rate. This finding is corroborated by previous research based on data from The Population Atlas of China collected in 1981-2. That study showed industrial employment to be associated with lower infant mortality (Bradshaw & Fraser, 1989). On the other hand, a higher proportion of females working of all females of working age (15-64) was associated with higher IMRs, which suggests that the majority of women are employed in sectors with worse conditions than manufacturing. The observed interaction between GDP and the proportion of women working in manufacturing of all women working indicates that in areas where the GDP is lower, manufacturing jobs may be one of the better jobs while in areas with higher GDP, manufacturing jobs may be one of the least desirable (Banister, 2004; Knight & Yueh, 2004). In other words, in areas with lower GDP, the population of women working in manufacturing may have a larger income, superior healthcare access, or better social services compared to women working in other sectors of the economy (Banister, 2004). As GDP and FDI independently modified the association between a higher proportion of women working in

manufacturing and lower IMRs; transitioning from working in the agricultural sector to the industrial sector points to a beneficial impact.

The finding that IMR was higher when the proportion of women who were non-migrants in the province was higher was unexpected. This finding could reflect the salmon bias, i.e. that pregnant migrant women, especially those with complications, return home for childbirth. In that situation, if the woman was surveyed for the census in her home, the infant death and occupation would be counted in her hometown meaning misclassifying the place of these.. This is true for some migrants, however, research has shown that other migrant women stay in cities and elect to pay more for healthcare in hospitals or receive care from midwives at a lower cost (F. Wang, Ping, Zhan, & Shen, 2005). Conversely, this finding may also suggest that the proportion of female non-migrants is higher in prefectures where there are less work opportunities and therefore less wealth and lower IMRs.

The "One Child Policy", may distort the findings, because the policy provides incentives to reduce fertility, such as availability of contraception to married women, and fees for having more children than allowed. Contraceptive prevalence is associated with a reduction in IMR among married women of reproductive age (Shen & Williamson, 2001). However, the "One Child Policy" is a national policy and therefore does not explain the variation in IMRs across China.

In Mexico, states with higher FDI had higher IMRs than other states (Harlow, et al., 2004). The difference from the experience of Mexico and our findings in China could be because the proportion of China's growth of share in world manufacturing value added from 1980 – 2004 relative to its growth of share in world manufacturing exports from 1980-2004 was 0.62, a relatively high proportion whereas in Mexico the proportion is 0.01. This means that as exports went up in China and in Mexico, the value added (income generated for labor or other primary factors) that could be used to increase working wages or improve working conditions both went up considerably in China and did not go up proportionately in Mexico (Milberg & Amengual, 2008). Additionally, in 1994, China implemented the tax sharing system which designated certain taxes to go to the central government and others to the local government while only the value added tax (VAT) is shared between the local (25%) and central (75%) governments (Wong, 2000). The tax sharing system also allows for rebates from the central government to the local government (Wong, 2000). Therefore, FDI has a positive impact on the economic growth of China's provinces (Huang, 2009).

This study has several limitations. It was not possible to obtain data on all prefectures in China. Most of the missing data were from the western region and in prefectures in areas of China considered to be autonomous regions or areas with high levels of minority groups. Furthermore, data quality may fluctuate by region due to differing regions have more or less resources for data collection. If infant births were undercounted, IMR would be overestimated and if infant deaths were undercounted IMR would be underestimated. However, most likely infant deaths and births would be undercounted in equal

proportions and therefore our estimates of IMR are most likely close to the truth. Again, it is possible that migrant women in China have either the infant death or occupation misclassified if the death occurred in a different place from where she worked, but both the infant death and occupation were counted in the same place. Also, migrants may have been undercounted in the census, especially among migrants living in factories, which may mean that the results presented in this paper are a conservative estimate of the proportion of manufacturing workers of all workers in China. However, there is no suggestion that this bias in the estimate of manufacturing workers would differ across areas of China. Data on exports and imports were not available at the prefecture level. As this is a cross-sectional ecologic study, causation cannot be ascertained and associations reported in this study may not be true at the individual level. This paper was not able to assess the infant mortality associated with working conditions. EPZ factories have varied working conditions and that variation may not be directly related to FDI. Working conditions are not easily measured at the aggregate level. Additionally, state owned or domestic private enterprises may have poor working conditions or may have worse working conditions compared to EPZ factories due to market competition.

As the world becomes more interdependent, it is imperative to better understand the relationship between foreign investment and health. Our data show that higher FDI is associated with lower IMRs, which suggests the possibility that FDI improves the population's health. Our data also show that a higher proportion of women working in manufacturing is associated with lower IMRs and that the association is strongest in areas with low GDP and with low FDI, which suggests that moving from agricultural work to

manufacturing work has the largest impact on lowering IMRs. However, it is not clear through this study whether the women working in manufacturing benefit from the level of FDI at the individual level. Future research needs to assess the ways occupational stress is linked to infant mortality outcomes at the level of the individual worker and how this is counterbalanced by increased individual incomes and local economic development.

**Figure 4.1. The Association Between the Proportion of Women who are Non-Migrants of all Women and IMR**

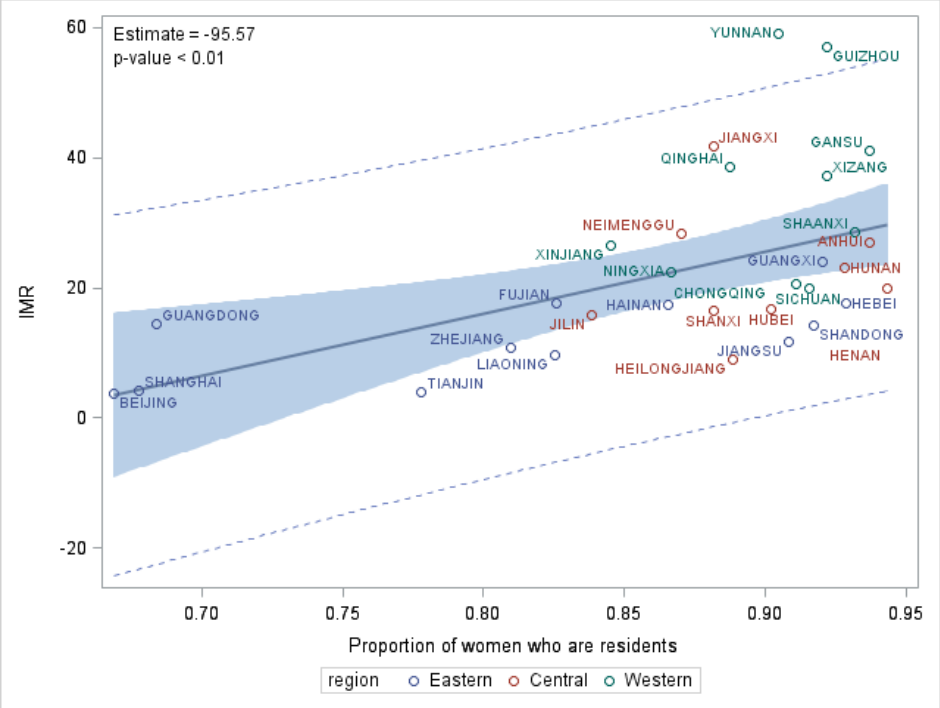


**Figure 4.2. The Association Between the Proportion of Women who are Non-Migrants of all Women and IMR by Region**

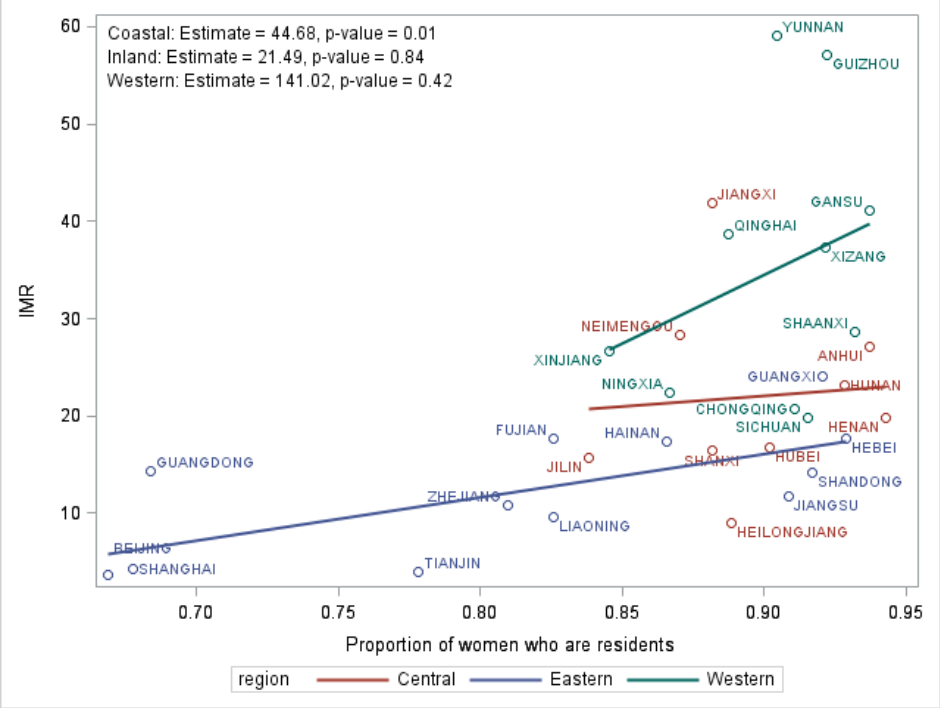

**Figure 4.3. The Association Between the Proportion of Women in Manufacturing of All Women Employed and IMR**

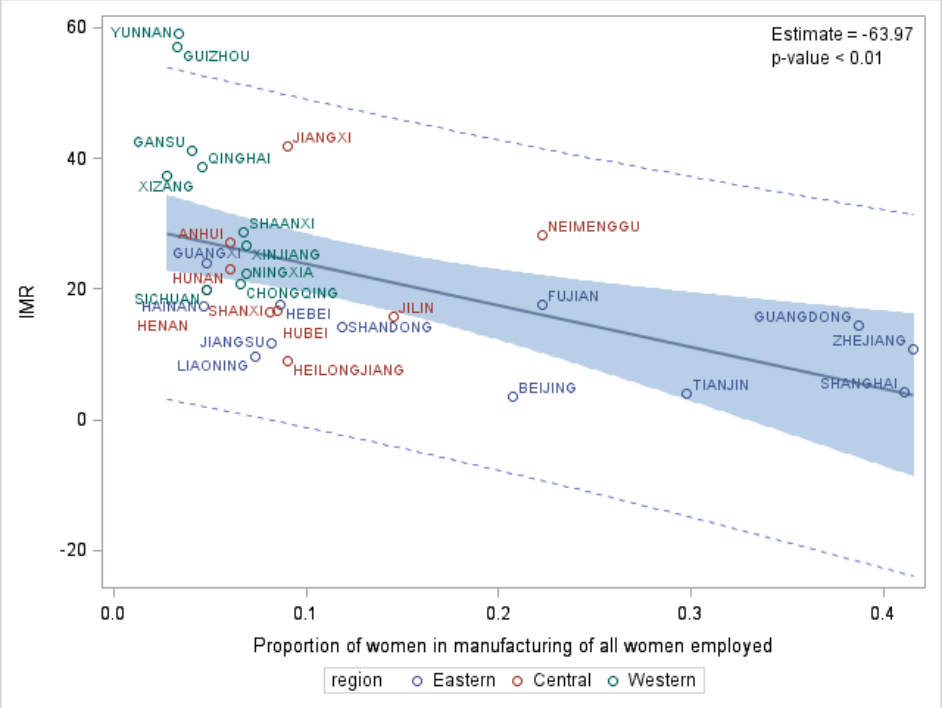


**Figure 4.4. The Association Between the Proportion of Women in Manufacturing of All Women Employed and IMR by Region**

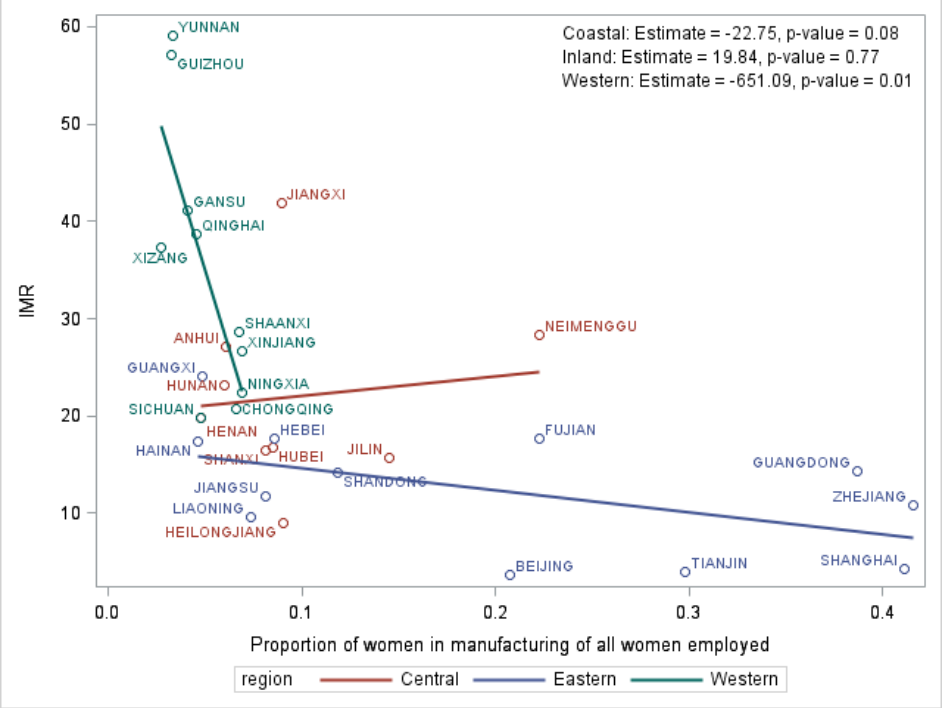

**Figure 4.5. The Association Between the Proportion of Women in Manufacturing of All People in Manufacturing and IMR**

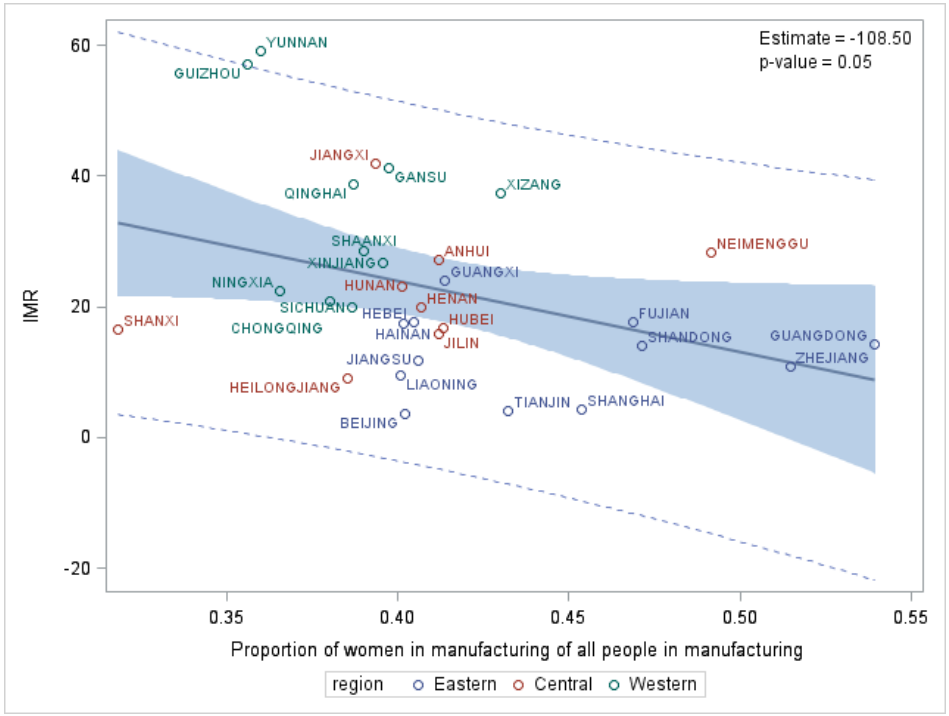


**Figure 4.6. The Association Between the Proportion of Women in Manufacturing of All People in Manufacturing and IMR by Region**

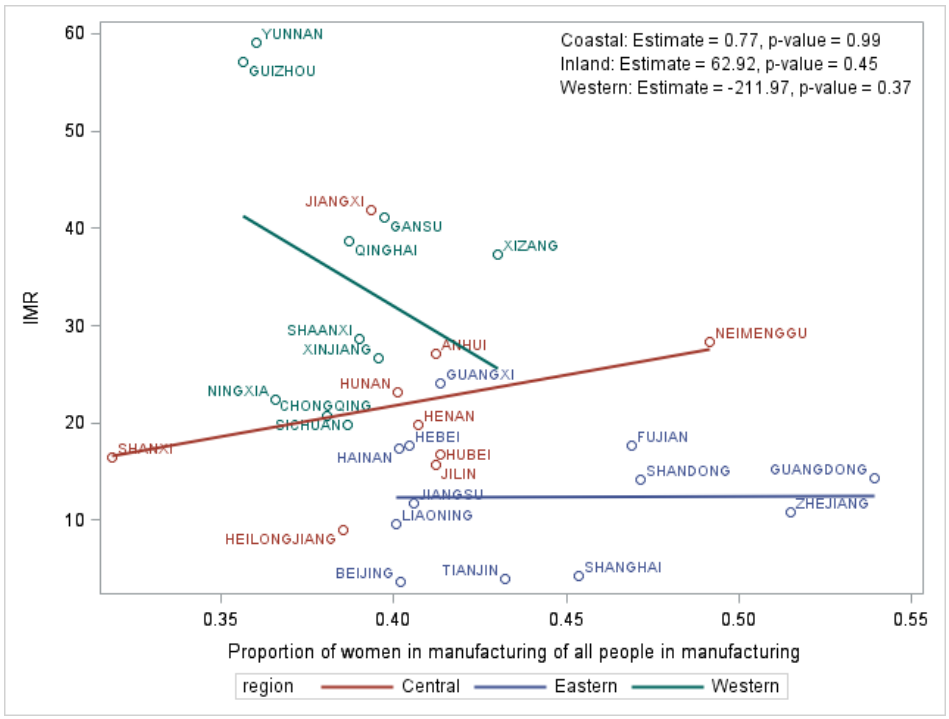

**Figure 4.7. The Association Between the FDI per 1000 Population and IMR**

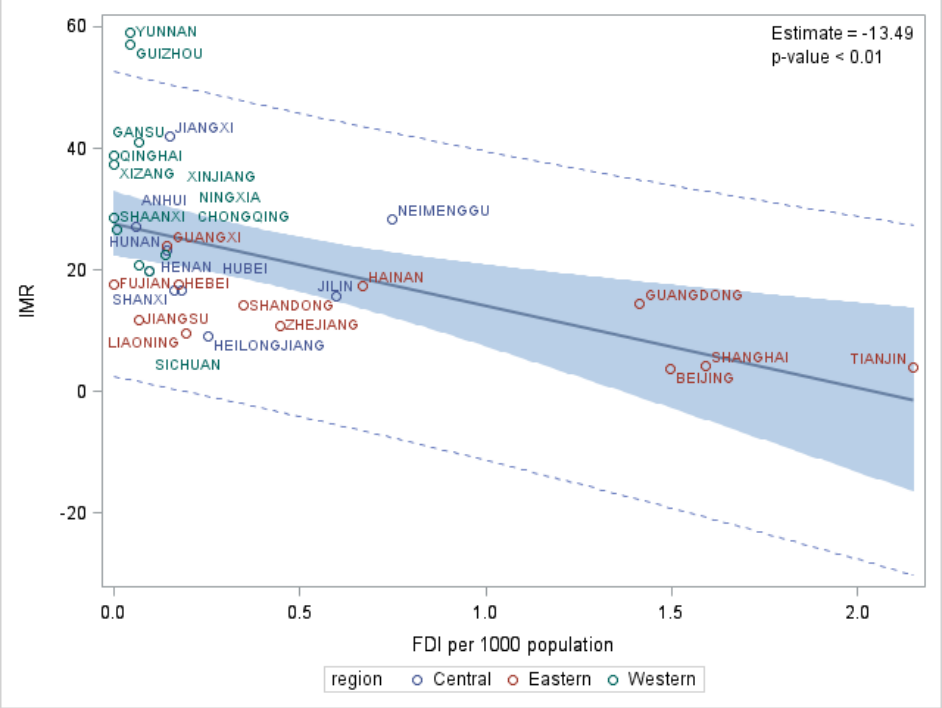


**Figure 4.8. The Association Between the FDI per 1000 Population and IMR by Region**

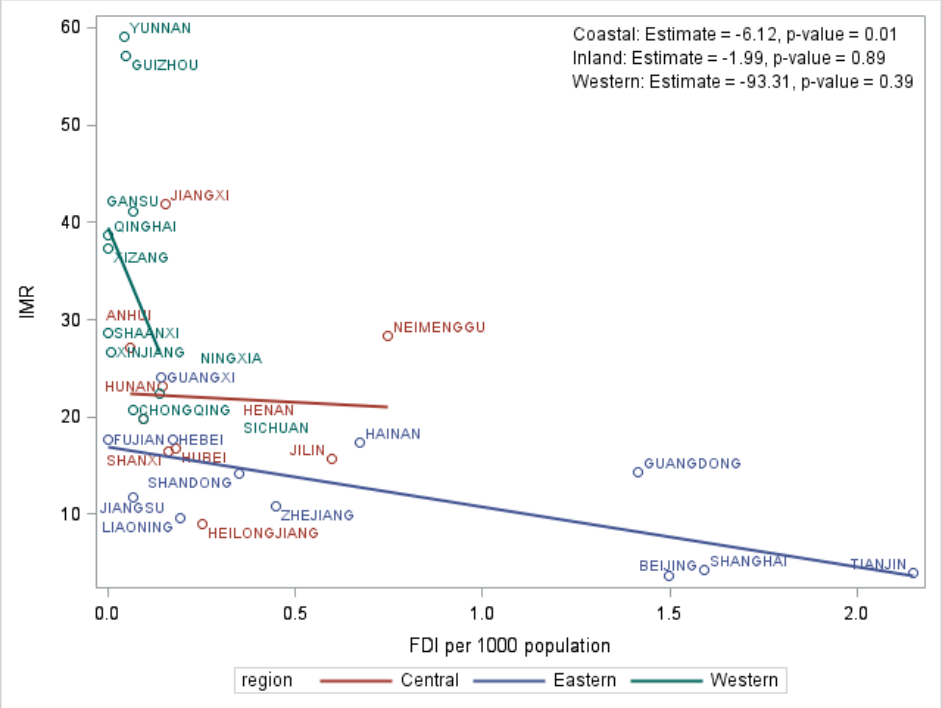

**Figure 4.9. The Association Between the Proportion of FDI of GDP and IMR**

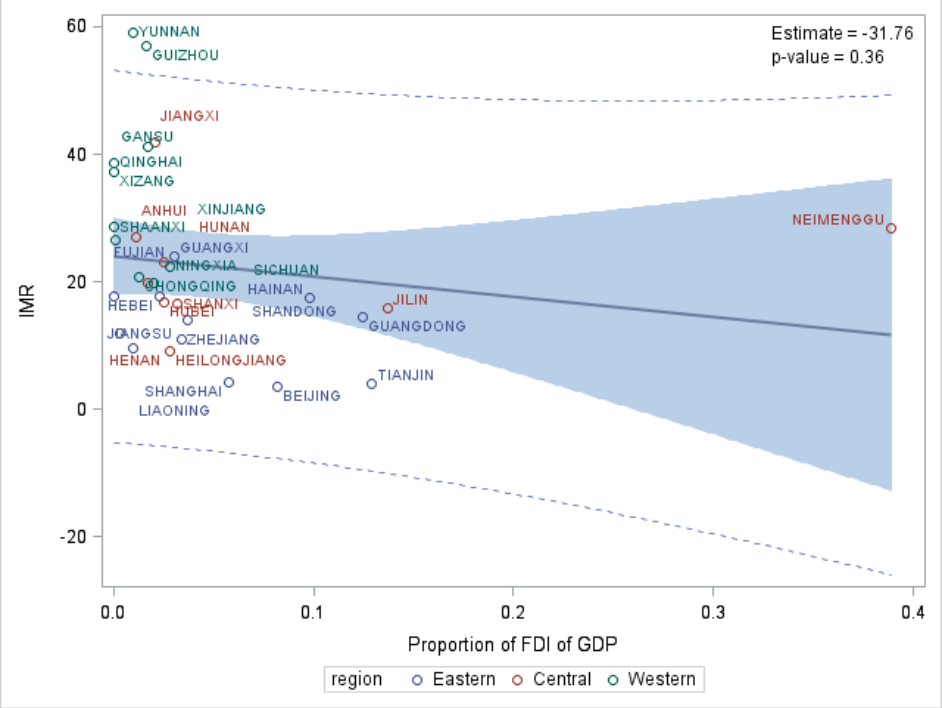


**Figure 4.10. The Association Between the Proportion of FDI of GDP and IMR by Region**

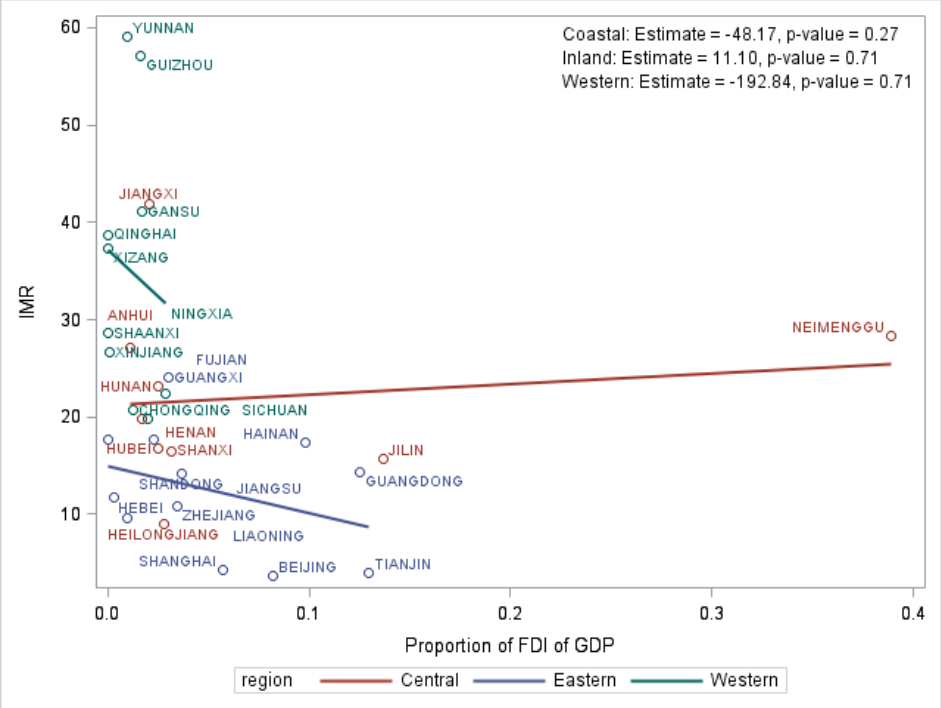

**Figure 4.11. The Association Between the Proportion of FDI of GDP and IMR without Neimenggu**

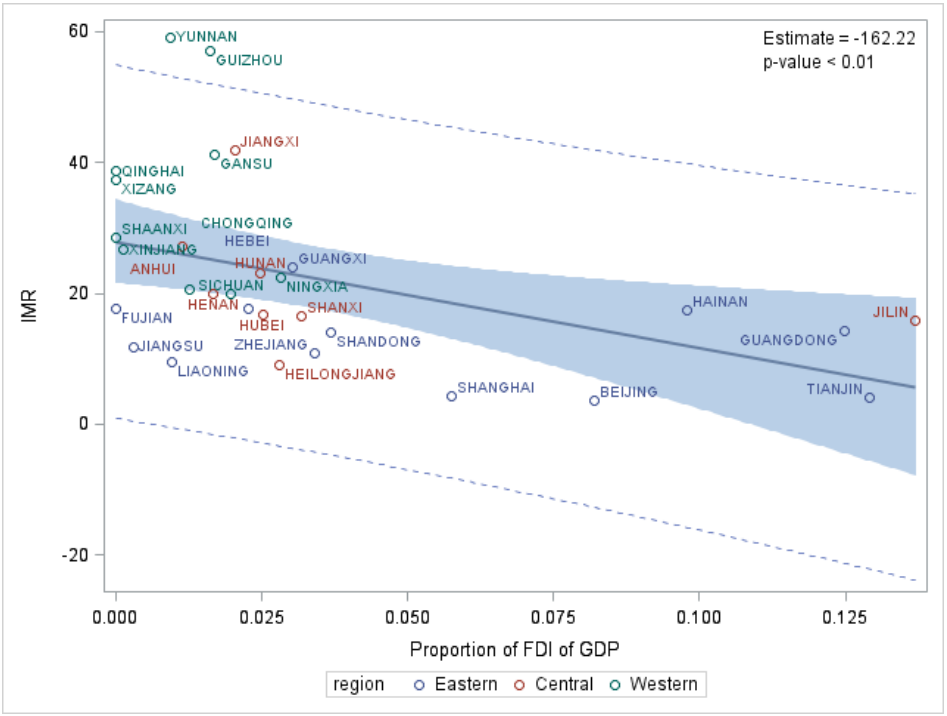


**Figure 4.12. The Association Between the Proportion of FDI of GDP and IMR without Neimenggu by Region**

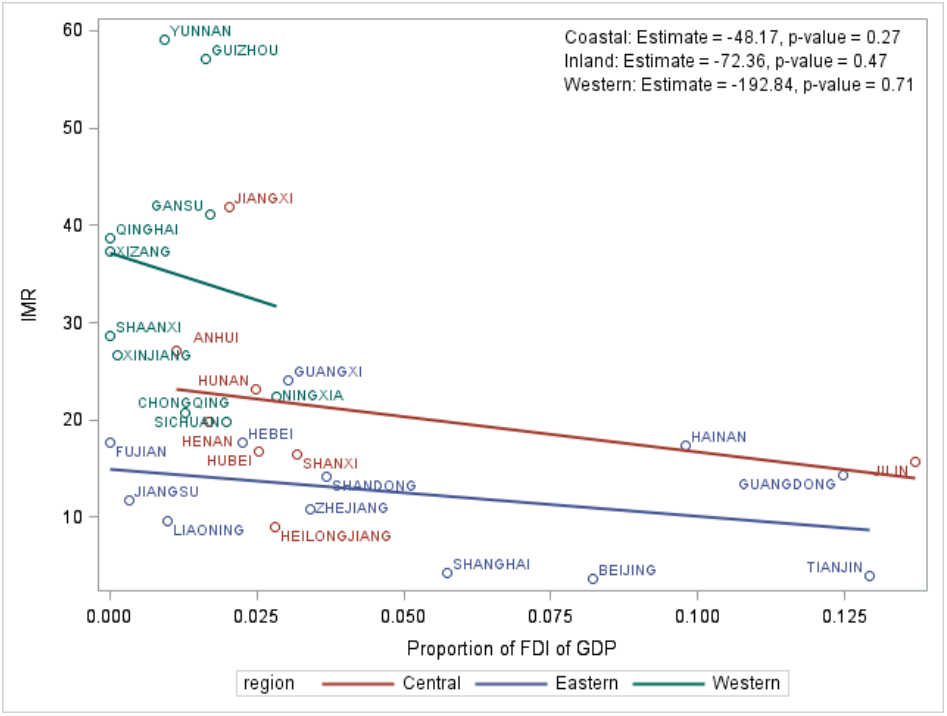

**Figure 4.13. The Association Between the Proportion of GDP from Manufacturing of GDP and IMR**

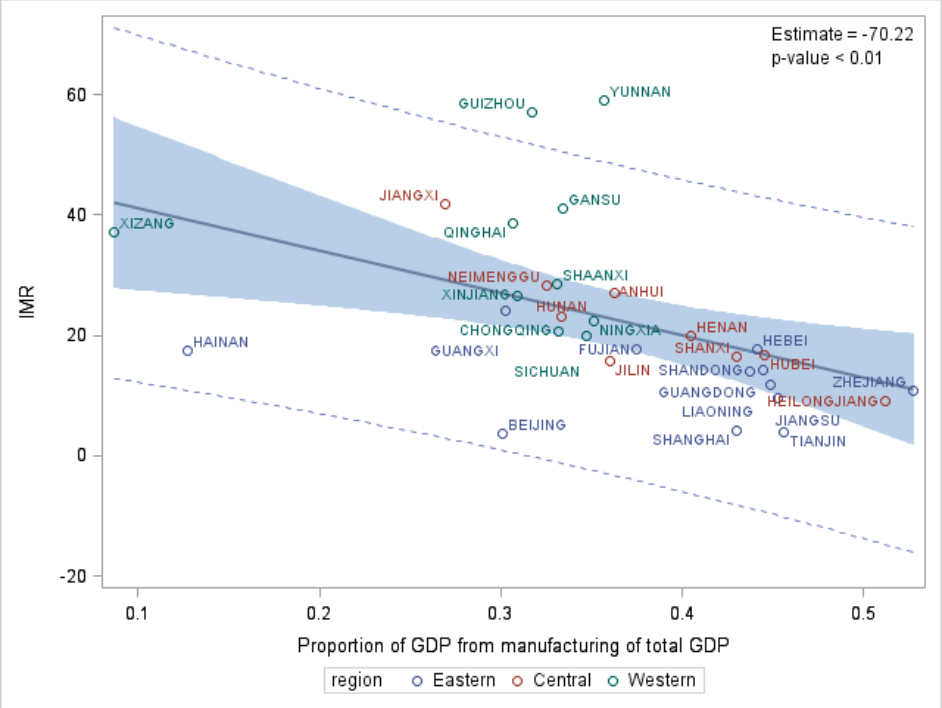


**Figure 4.14. The Association Between the Proportion of GDP from Manufacturing of GDP and IMR by Region**

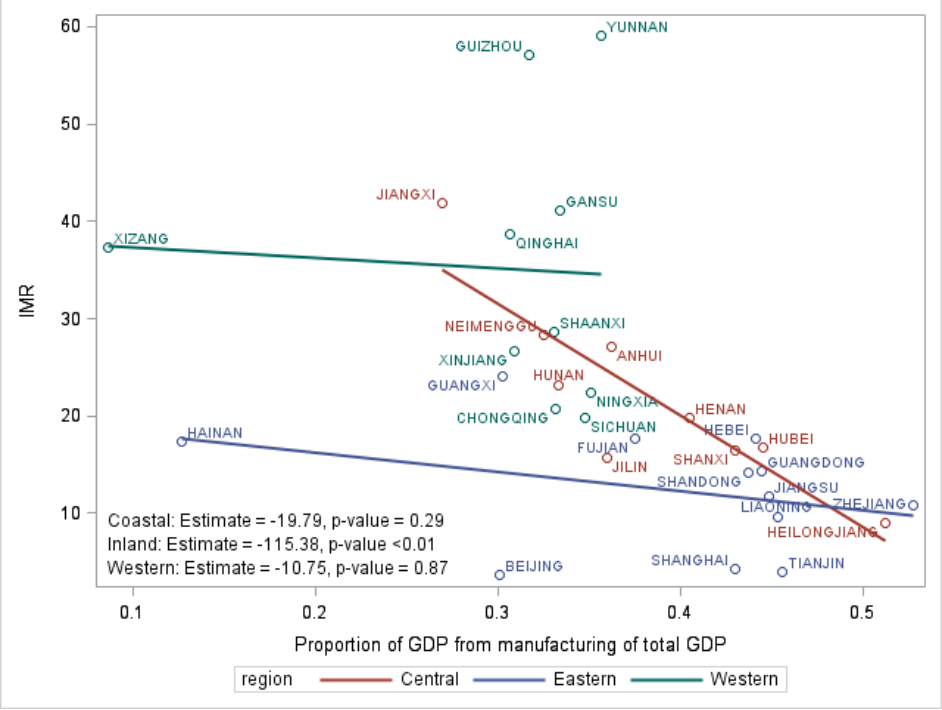

**Figure 4.15. The Association Between the Proportion of Exports of Total Exports and Imports and IMR**

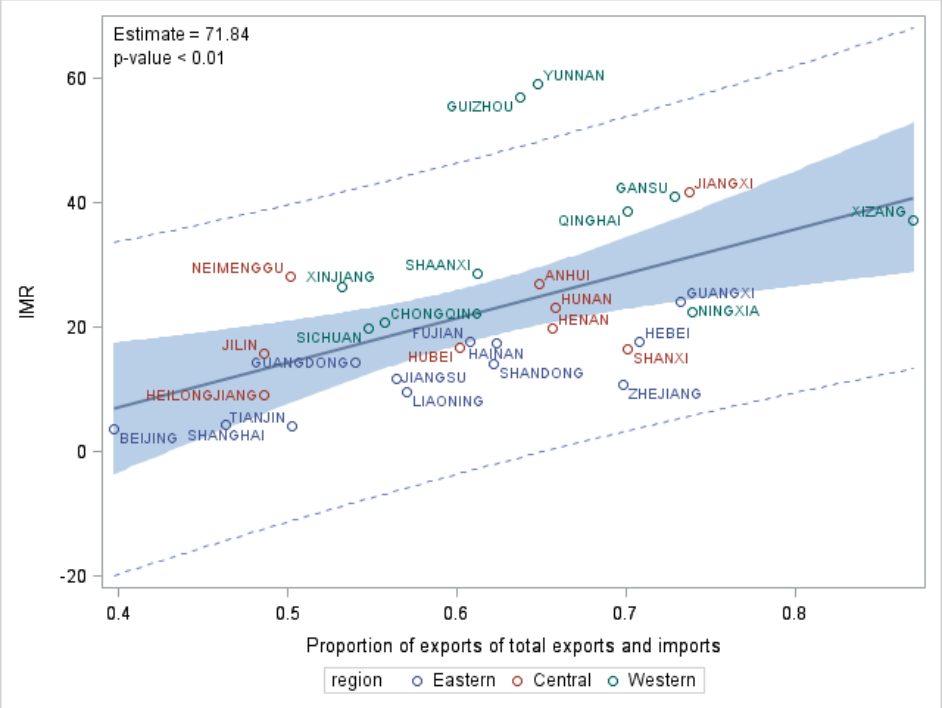


**Figure 4.16. The Association Between the Proportion of Exports of Total Exports and Imports and IMR by Region**

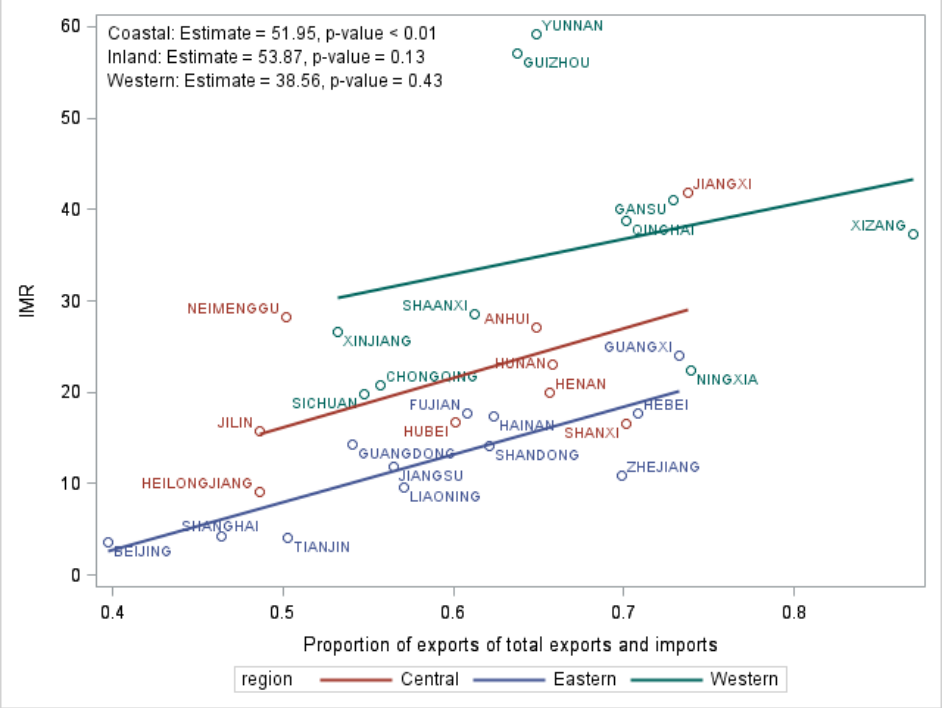

**Figure 4.17. The Association Between the Preferential Policy and IMR**

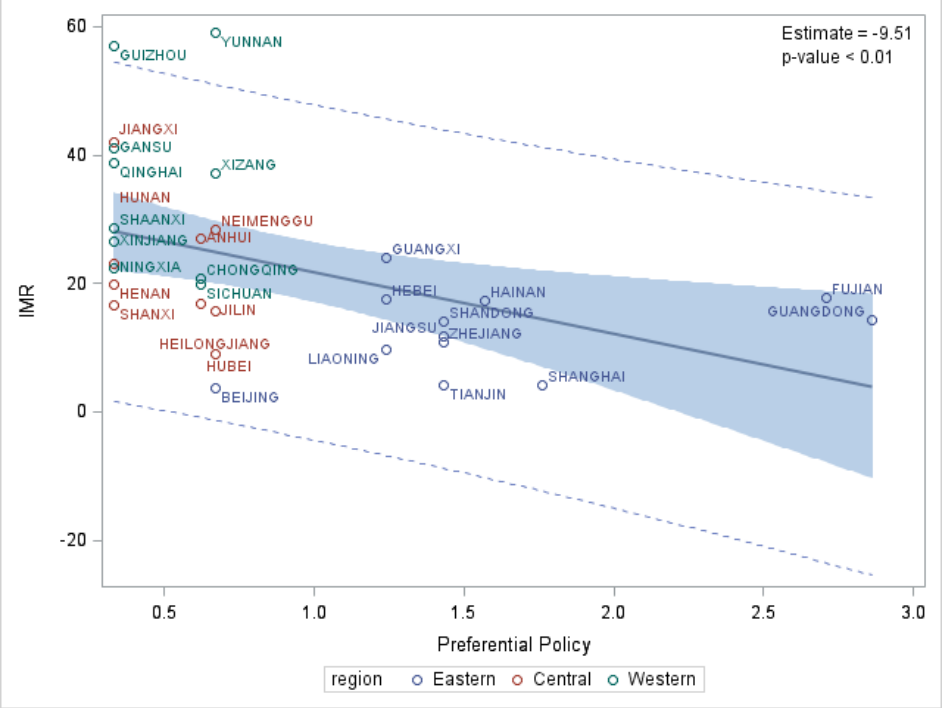


**Figure 4.18. The Association Between the Preferential Policy and IMR by Region**

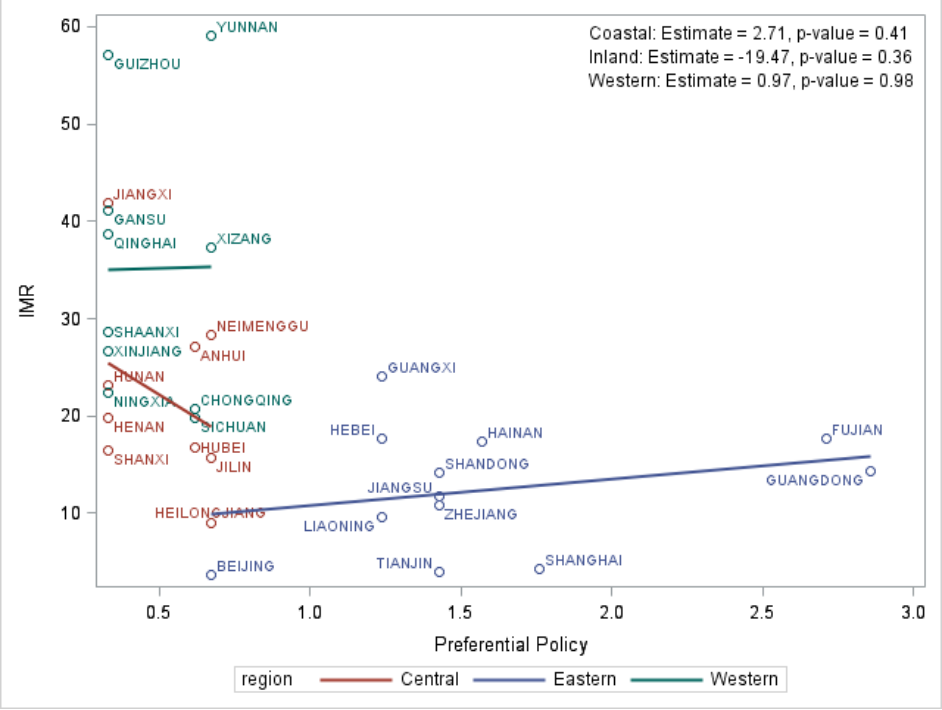

**Figure 4.19. The Association Between the Proportion of Women Employed of All Women Age 15-64**

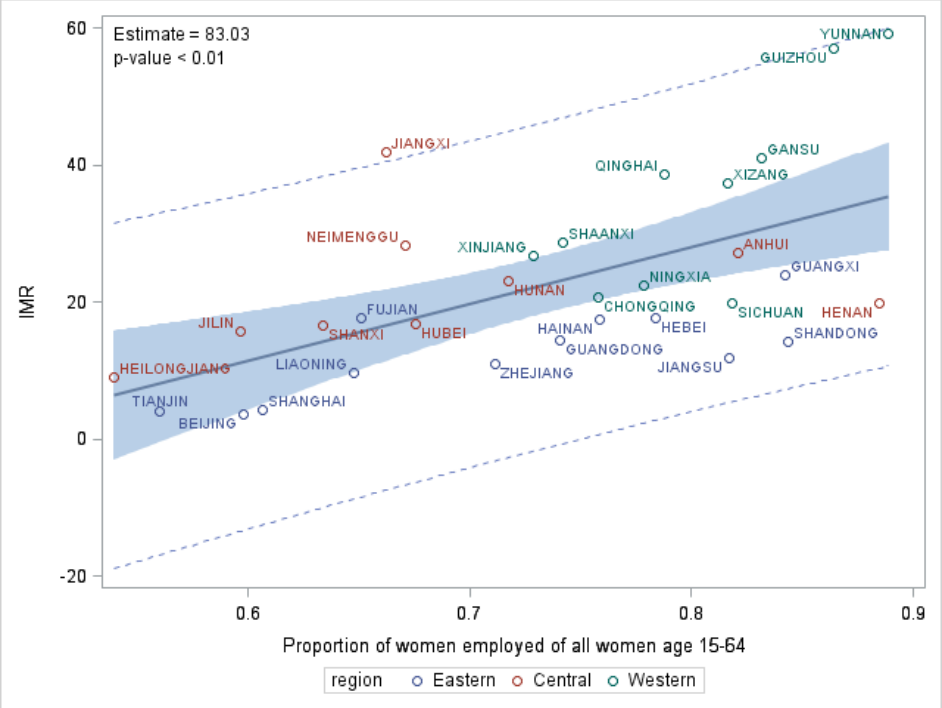


**Figure 4.20. The Association Between the Proportion of Women Employed of All Women Age 15-64 by Region**

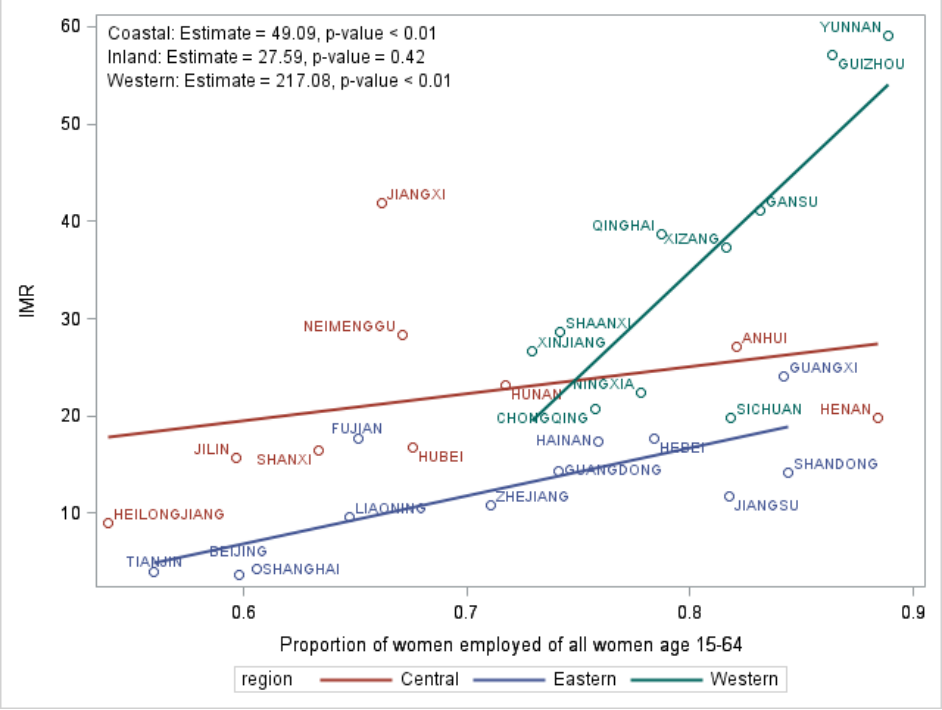

**Table 4.1 Province Level Information**

| | IMR | Women non-migrants / All women | All women employed / All women aged 15-64 | Women in manufacturing / All women employed | Women in manufacturing / All people in manufacturing | FDI 元 per 1000 population | GDP 元 per 1000 population | GDP from manufacturing 元 per 1000 population | FDI / GDP | GDP from manufacturing / Total GDP | Exports / Exports and imports | Average Preferential Policy from 1978 - 1998 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Eastern Region** | | | | | | | | | | | | |
| Beijing | 3.65 | 66.9% | 59.8% | 20.8% | 40.2% | 1.50 | 18.26 | 5.49 | 8.2% | 30.1% | 39.7% | 0.670 |
| Fujian | 17.64 | 82.6% | 65.1% | 22.3% | 46.9% | 0.00 | 11.50 | 4.31 | 0.0% | 37.5% | 60.8% | 2.710 |
| Guangdong | 14.36 | 68.4% | 74.1% | 38.7% | 53.9% | 1.41 | 11.34 | 5.04 | 12.5% | 44.5% | 54.0% | 2.860 |
| Guangxi | 24.02 | 92.1% | 84.2% | 4.8% | 41.4% | 0.14 | 4.67 | 1.41 | 3.0% | 30.2% | 73.2% | 1.240 |
| Hainan | 17.38 | 86.6% | 75.9% | 4.7% | 40.2% | 0.67 | 6.85 | 0.87 | 9.8% | 12.7% | 62.3% | 1.570 |
| Hebei | 17.63 | 92.9% | 78.4% | 8.6% | 40.5% | 0.17 | 7.63 | 3.37 | 2.3% | 44.2% | 70.8% | 1.240 |
| Jiangsu | 11.81 | 90.8% | 81.7% | 8.2% | 40.6% | 0.07 | 21.24 | 9.53 | 0.3% | 44.8% | 56.5% | 1.430 |
| Liaoning | 9.57 | 82.6% | 64.8% | 7.3% | 40.1% | 0.19 | 20.02 | 9.07 | 1.0% | 45.3% | 57.0% | 1.240 |
| Shandong | 14.11 | 91.7% | 84.4% | 11.9% | 47.1% | 0.35 | 9.49 | 4.15 | 3.7% | 43.8% | 62.1% | 1.430 |
| Shanghai | 4.24 | 67.8% | 60.6% | 41.1% | 45.4% | 1.59 | 27.74 | 11.93 | 5.7% | 43.0% | 46.3% | 1.760 |
| Tianjin | 4.04 | 77.8% | 56.0% | 29.8% | 43.2% | 2.15 | 16.64 | 7.59 | 12.9% | 45.6% | 50.3% | 1.430 |
| Zhejiang | 10.87 | 80.9% | 71.1% | 41.6% | 51.5% | 0.45 | 13.14 | 6.93 | 3.4% | 52.7% | 69.9% | 1.430 |
| Average | *12.44* | *81.7%* | 71.3% | *20.0%* | *44.2%* | *0.73* | *14.04* | *5.81* | *5.2%* | *39.5%* | *58.6%* | *1.584* |
| | | | | | | | | | | | | |
| **Central Region** | | | | | | | | | | | | |
| Anhui | 27.09 | 93.7% | 82.1% | 6.1% | 41.2% | 0.06 | 5.15 | 1.87 | 1.1% | 36.2% | 64.9% | 0.620 |
| Heilongjiang | 9.04 | 88.8% | 53.9% | 9.0% | 38.5% | 0.25 | 8.97 | 4.59 | 2.8% | 51.2% | 48.6% | 0.670 |
| Henan | 19.89 | 94.3% | 88.4% | 4.8% | 40.7% | 0.09 | 5.63 | 2.28 | 1.7% | 40.5% | 65.6% | 0.330 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hubei | 16.75 | 90.2% | 67.6% | 8.5% | 41.3% | 0.18 | 7.19 | 3.20 | 2.5% | 44.5% | 60.1% | 0.620 |
| Hunan | 23.10 | 92.8% | 71.8% | 6.0% | 40.1% | 0.14 | 5.83 | 1.95 | 2.5% | 33.3% | 65.8% | 0.330 |
| Jianxi | 41.88 | 88.2% | 66.2% | 9.0% | 39.4% | 0.15 | 7.47 | 2.01 | 2.0% | 26.9% | 73.7% | 0.330 |
| Jilin | 15.77 | 83.8% | 59.7% | 14.5% | 41.2% | 0.60 | 4.35 | 1.57 | 13.7% | 36.0% | 48.6% | 0.670 |
| Neimonggu | 28.29 | 87.0% | 67.1% | 22.3% | 49.2% | 0.75 | 1.92 | 0.62 | 38.9% | 32.5% | 50.2% | 0.670 |
| Shanxi | 16.52 | 88.1% | 63.4% | 8.1% | 31.8% | 0.16 | 5.06 | 2.18 | 3.2% | 43.0% | 70.1% | 0.330 |
| *Average* | *22.04* | *89.7%* | *68.9%* | *9.8%* | *40.4%* | *0.27* | *5.73* | *2.25* | *7.6%* | *38.2%* | *60.9%* | *0.508* |
| | | | | | | | | | | | | |
| **Western Region** | | | | | | | | | | | | |
| Chongqing | 20.71 | 91.1% | 75.8% | 6.6% | 38.0% | 0.07 | 5.21 | 1.73 | 1.3% | 33.2% | 55.7% | 0.620 |
| Gansu | 41.11 | 93.7% | 83.2% | 4.1% | 39.7% | 0.07 | 3.91 | 1.31 | 1.7% | 33.4% | 72.9% | 0.330 |
| Guizhou | 57.06 | 92.2% | 86.4% | 3.3% | 35.6% | 0.05 | 2.82 | 0.89 | 1.6% | 31.7% | 63.7% | 0.330 |
| Niangxia | 22.47 | 86.7% | 77.8% | 6.9% | 36.6% | 0.14 | 4.83 | 1.70 | 2.8% | 35.1% | 73.9% | 0.330 |
| Qinghai | 38.69 | 88.7% | 78.8% | 4.6% | 38.7% | 0.00 | 5.45 | 1.67 | 0.0% | 30.6% | 70.1% | 0.330 |
| Shaanxi | 28.61 | 93.2% | 74.2% | 6.8% | 39.0% | 0.00 | 4.69 | 1.55 | 0.0% | 33.1% | 61.2% | 0.330 |
| Sichuan | 19.81 | 91.5% | 81.8% | 4.8% | 38.6% | 0.10 | 4.87 | 1.69 | 2.0% | 34.8% | 54.8% | 0.620 |
| Xianjiang | 26.63 | 84.5% | 72.3% | 6.9% | 39.6% | 0.01 | 7.39 | 2.29 | 0.1% | 30.9% | 53.2% | 0.330 |
| Xizang | 37.25 | 92.2% | 81.7% | 2.8% | 43.0% | 0.00 | 4.47 | 0.39 | 0.0% | 8.7% | 87.0% | 0.670 |
| Yunnan | 59.13 | 90.5% | 88.9% | 3.3% | 36.0% | 0.04 | 4.62 | 1.65 | 0.9% | 35.7% | 64.8% | 0.670 |
| *Average* | *35.15* | *90.4%* | *80.1%* | *5.0%* | *38.5%* | *0.05* | *4.83* | *1.49* | *1.0%* | *30.7%* | *65.7%* | *0.456* |

**Table 4.2. Province Level Linear Models Bivariate and Adjusted for GDP per 1000 people and Region with the outcome IMR**

| | Main Effect | | After Adjusting for GDP | | After Adjusting for Region | | After Adjusting for GDP and Region | | After Adjusting for Women employed / All women aged 15-64 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | B | p-value | β | p-value | β | p-value | β | p-value | β | p-value |
| **Women non-migrants/ All women** | 95.57 | <0.01 | 30.08 | 0.41 | 49.03 | 0.09 | 24.4 | 0.46 | 48.39 | 0.16 |
| **Women in manufacturing / All women employed** | -1272.78 | <0.01 | -550.65 | 0.22 | -415.43 | 0.34 | -223.65 | 0.60 | -37.11 | 0.08 |
| **Women in manufacturing / All people in manufacturing** | -108.50 | 0.05 | -54.40 | 0.24 | 2.66 | 0.96 | -8.94 | 0.85 | -86.08 | 0.06 |
| **FDI 元 per 1000 population** | -13.47 | <0.01 | -6.43 | 0.15 | -6.09 | 0.14 | -3.74 | 0.36 | -7.63 | 0.09 |
| **FDI / GDP** | -31.76 | 0.36 | -38.04 | 0.16 | 0.49 | 0.99 | -10.34 | 0.69 | 6.11 | 0.84 |
| **GDP from manufacturing / Total GDP** | -70.22 | <0.01 | -37.95 | 0.10 | -35.75 | 0.10 | -23.62 | 0.28 | -49.89 | 0.03 |
| **Exports / Exports and imports** | 71.84 | <0.01 | 39.55 | 0.08 | 47.78 | 0.01 | 37.38 | 0.07 | 39.03 | 0.11 |
| **Average Preferential Policy from 1978 - 1998** | -9.51 | <0.01 | -3.57 | 0.32 | 1.53 | 0.76 | 0.49 | 0.92 | -7.65 | 0.01 |
| **Women employed / All women aged 15-64** | 83.03 | <0.01 | 54.29 | 0.01 | 58.59 | <0.01 | 48.09 | 0.04 | -- | -- |

**Table 4.3. Prefecture Level Linear Models Bivariate and Adjusted for Province level variable and GDP and prefecture level GDP per 1000 people and Region with the outcome log(10) IMR**

| | Main Effect | | After Adjusting for GDP | | After Adjusting for Region | | After Adjusting for GDP and Region | | After Adjusting for Women employed / All women aged 15-64 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | β | p-value | β | p-value | β | p-value | β | p-value | β | p-value |
| **Women non-migrants/ All women** | 1.01 | <0.01 | 0.50 | <0.01 | 1.00 | <0.01 | 0.50 | <0.01 | 0.86 | <0.01 |
| **Women in manufacturing / All women employed** | -1.18 | <0.01 | -0.81 | <0.01 | -1.17 | <0.01 | -0.81 | <0.01 | -1.06 | <0.01 |
| **Women in manufacturing / All people in manufacturing** | -1.37 | <0.01 | -1.15 | <0.01 | -1.33 | <0.01 | -1.16 | <0.01 | -1.42 | <0.01 |
| **FDI 元 per 1000 people** | -0.14 | <0.01 | -0.06 | 0.02 | -0.14 | <0.01 | -0.06 | 0.02 | -0.14 | <0.01 |
| **FDI / GDP** | -1.44 | <0.01 | -0.57 | 0.09 | -1.23 | <0.01 | -0.61 | 0.08 | -1.36 | <0.01 |
| **GDP from manufacturing / Total GDP** | -0.53 | <0.01 | -0.02 | 0.86 | -0.54 | <0.01 | -0.04 | 0.76 | -0.46 | <0.01 |
| **Women employed / All women aged 15-64** | 0.74 | <0.01 | 0.44 | <0.01 | 0.74 | <0.01 | 0.44 | <0.01 | -- | -- |

**Table 4.4 Prefecture level interaction model with outcome log10 (IMR)**

| | GDP | | FDI | | Women in manufacturing / All women employed | | Interaction | |
|---|---|---|---|---|---|---|---|---|
| | β | p-value | β | p-value | β | p-value | β | p-value |
| **Women in manufacturing / All women employed * GDP 元 per 1000 people*** | -0.21 | <0.01 | -- | -- | -2.69 | <0.01 | 1.79 | <0.01 |
| **Women in manufacturing / All women employed * FDI 元 per 1000 people^** | -0.07 | 0.01 | -0.06 | 0.11 | -1.86 | <0.01 | 0.89 | <0.01 |

-- not included in model
*Adjusted for province level GDP, province level proportion of women in manufacturing and region
^Adjusted for province level GDP, province level proportion of women in manufacturing, region, and province level FDI

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# Chapter 5

# Discussion

## Overview

China's economic success over the past three decades has been largely due to its abundant and low-cost labor force, which attracts much of China's foreign direct investment (FDI) and drives export production (Gallagher, 2005). Although China has attracted more FDI than any other developing country (Gallagher, 2005; Zhang & Zhang, 2003) and its gross domestic product (GDP) has grown at an astonishing average annual rate of 8% over the last 25 years (Hutzler, 2005), little epidemiological research has been done to assess whether China's labor force has reaped the economic benefits from increased FDI and export production which it has helped create.

FDI in China is mostly invested into export processing zones (EPZs) which many have argued take advantage of workers by exposing them to unsafe working conditions with poor job security and low compensation (Hogstedt, Wegman, & Kjellstrom, 2007; Sargeson, 1999). These exposures, specifically fatigue, overtime, shift and night work, long hours, long periods of time sitting or standing, and ergonomic risk factors increase the risk for adverse reproductive health conditions including pelvic pain, urogenital

infection, and adverse pregnancy outcomes (Beaumont et al., 1995; Ceron-Mireles, Harlow, & Sanchez-Carrillo, 1996; Denman, 1991; B. Eskenazi, Bracken, Holford, & Grady, 1988; B Eskenazi et al., 1995; B. Eskenazi, Guendelman, Elkin, & Jasis, 1993; Figa-Talamanca, 2006; Hatch, Figa-Talamanca, & Salerno, 1999; Kishi, Kitahara, Masuchi, & Kasai, 2002; Lu, 2008; Messing, Saurel-Cubizolles, Bourgine, & Kaminski, 1993; Mozurkewich, Luke, Avni, & Wolf, 2000; Saxena, 1999; Schenker et al., 1995; Swan et al., 1995; Xu, Dina, Li, & Christiani, 1994).

While most previous research on women working in export production has focused on ergonomic, chemical, and injury risk factors, this dissertation examined the impact of occupational stress. This study defined occupational stress as working overtime, working at night, feeling exhausted, and by the Karasek model of job strain (defined by psychological demands and low decision latitude) (Karasek et al., 1998). Specifically, this dissertation added to the current literature on pelvic pain and urogenital infections as they relate to occupational stress and documented the prevalence of pelvic pain, urogenital infections, and occupational stress using data collected in three electronic factories in Tianjin Economic-Technological Development Area (TEDA). Our results documented a substantial prevalence of pelvic pain and urogenital infections and showed that occupational stress is associated with poor reproductive health outcomes among women working in TEDA. This dissertation also assessed the relationship between FDI, GDP, women's employment indicators, and infant mortality among women in China using China's 2000 Census and Statistical Yearbook. Our results demonstrated an

association between lower infant mortality and higher FDI. Major findings of each chapter are summarized below.

**Major Findings**

Chapter 2 identified demographic, lifestyle and occupational risk factors for three major types of pelvic pain including dysmenorrhea, dyspareunia, and non-cyclic pelvic pain among women working in three electronic factories in TEDA. The study showed that one-third of all women surveyed reported suffering from dysmenorrhea or non-cyclic pelvic pain and among women that reported having sex in the last 12 months two-thirds reported suffering from dysmenorrhea, non-cyclic pelvic pain, or dyspareunia. Slightly less than one-fifth of women reported experiencing dysmenorrhea often or usually and the occupational risk factors were found to be high job strain and poor job security. The prevalence of dyspareunia in our study was 16.6% and the occupational risk factors were working overtime and feeling exhausted. The prevalence of non-cyclic pelvic pain reported by women in our study was 15.7% and the occupational risk factors were compulsory overtime and feeling exhausted. Not having children significantly increased the odds of reporting dysmenorrhea and significantly reduced the odds of experiencing non-cyclic pelvic pain. All types of pelvic pain were associated with fair or poor self-reported health status. Non-cyclic pelvic pain was associated with an increase in worker absenteeism.

Chapter 3 identified demographic, lifestyle, and occupational risk factors for symptoms of urogenital infection including abnormal vaginal discharge, genital sores, and pain with urination among women working in three electronic factories in TEDA. The prevalence of women that reported at least one urogenital symptom was 30.9%, including 27.9% that reported abnormal discharge, 2.4% that reported genital sores, and 6.3% that reported pain with urination. The main risk factor for abnormal vaginal discharge was sex in the last 12 months; however, job strain and poor job security increased the risk non-significantly. Risk factors for genital sores were 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. Risk factors for pain with urination were sex in the last 12 months, job strain, 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. Abnormal vaginal discharge, genital sores, and pain with urination were all associated with increased odds for dyspareunia and non-cyclic pelvic pain. Finally, women who reported abnormal discharge, pain with urination, or at least one urogenital symptom were more likely to take days off work due to illness than women without these symptoms.

Chapter 4 documented associations between economic indicators and infant mortality in China's provinces and prefectures for the year 2000. IMR was highest in the western region followed by the central region and then the eastern region whereas GDP was highest in the eastern region followed by the central region and then the western region. This study found that a higher GDP, a higher FDI, a higher FDI as a proportion of GDP,

and a higher proportion of GDP from manufacturing from total GDP were all associated with lower IMRs. A higher proportion of women working in manufacturing relative either to all women working or to all people working in manufacturing was associated with lower IMRs at the prefecture level even after controlling for GDP, region, and female employment rate with the effect strongest in areas with lower GDP and lower FDI.

**Strengths and Limitations**

The major strength of Chapters 2 and 3 were the uniqueness and comprehensiveness of the data. Very few epidemiologic studies have been able to distribute surveys to women inside export production factories in China. This study builds on previous research that showed poor working conditions and a high prevalence of reproductive health concerns among female factory workers interviewed in the community. To our knowledge, this is the first study to examine the relationship between occupational stress, pelvic pain and urogenital infections among female workers in an EPZ in China.

The limitations for Chapters 2 and 3 are the relatively small sample size, the cross-sectional nature of the study, and the subjectivity of self-reported data. Since causation cannot be established due to cross-sectional data, it is possible that women who have reproductive health problems are more likely to report occupational stress. The population for this study may have experienced similar levels of occupational stress as they all worked in electronics companies in TEDA, therefore the amount of variation in

occupational stress may have been insufficient to detect all associations with reproductive health. As all study participants reported relatively high levels of occupational stress the effect of occupational stress may have been underestimated. Not all questions in the survey instrument were previously validated in a Chinese setting; however, we completed pilot testing and removed or reworded questions that were flagged by the pilot study participants. Furthermore, as all three factories where surveys were distributed had a good relationship with the Tianjin Centers for Disease Control and Prevention and were foreign invested, those factories may have had better working conditions than others due to routine inspections by the Tianjin Centers for Disease Control and Prevention and international labor standards that must be upheld; therefore our estimates of occupational stress may be underestimated. It is also possible that the factories where data were collected are not representative of all factories in TEDA because they were selected by the Tianjin Centers for Disease Control and Prevention and may therefore be the factories with the best working conditions in the area, which limits the generalizability of the study. Lastly, women working in factories who experienced severe reproductive morbidity may have left their jobs in the factory. Therefore, this study may have underestimated the prevalence of pelvic pain and urogenital infections and the associations with occupational stress, as those with severe morbidity were not include in the study.

The research reported in Chapter 4 is the first to use China's 2000 Census and Statistical Yearbook data to document associations between economic indicators and IMR at the

province and prefecture levels in China. Not all economic data were available in some of China's prefectures and most of the missing data were from the western or autonomous regions. It is possible that infant births, infant deaths, and the migrant population were undercounted in the China 2000 census which would lead to underestimates of prevalence and more conservative estimates of associations. As this study was cross-sectional, the possibility of reverse causation must be acknowledged. Past literature also has shown that healthier populations attract FDI (Alsan, Bloom, & Canning, 2006). Furthermore, since this study was ecologic, associations reported in this study may not be true at the individual level. Due to the household registration system which limits access to healthcare among migrant workers, many migrants may return home for childbirth, especially women with complicated pregnancies. This means that the infant death may occur in a different place than the occupation, but the infant death and occupation would be recorded in the same place. Therefore, this study may underestimate correlations between infant mortality and working in manufacturing due to the possibility of misclassification among migrant workers.

**Future Research Directions**

This dissertation provides evidence that women working in China's EPZs have reproductive health concerns and would benefit from increased reproductive healthcare. Research comparing women working in manufacturing inside and outside EPZs would add information regarding the differences in health outcomes and healthcare access between factories with different investment policies and working conditions. Research

comparing occupational stress and reproductive health outcomes between factories with differing ownership (ie. state owned enterprises, wholly foreign owned enterprises, joint venture companies) would provide insight regarding the association of ownership type and health. Additionally, research comparing migrant women factory workers in EPZs with women in rural areas who never migrated would facilitate a better understanding of the interrelationships between migration, and working conditions and reproductive health.

Future research should incorporate a more comprehensive stress battery including stressors from outside the workplace, as well as include clinical exams to add a clinical diagnosis to reproductive health complaints. Lastly, conducting longitudinal studies would improve the understanding of causal pathways regarding associations identified in this dissertation.

This dissertation shows an association between high FDI and low IMRs; however, whether the women working in manufacturing benefit from the level of FDI at the individual level is still unclear. Future research needs to assess the association of occupational stress among women working in foreign invested enterprises and IMR at the level of the individual worker.

**Implications for Public Health Practice**

The results from this dissertation indicate that although increases in GDP and FDI reduce levels of infant mortality at the province and prefecture level, there is a high prevalence of self-reported reproductive health concerns among women working in export production factories and that the reproductive health of factory workers may be associated with occupational stress. Increased reproductive healthcare for China's female factory workers is past due. This dissertation supports past research that has shown that female factory workers are concerned about their reproductive health. Expanding reproductive healthcare access by encouraging women to seek healthcare for reproductive health concerns, providing reproductive healthcare education, incorporating reproductive healthcare for all women regardless of age or marital status into annual health exams currently required at factories, and by offering simple public health measures such as access to birth control pills and pain relief medication, condoms, and over the counter medication for urogenital infections would improve workers reproductive health. Our study also indicates that improving working conditions may improve the reproductive health of women factory workers. Further research to understand whether these conditions are risk markers or risk factors is needed.

Although little epidemiological research has been done to assess the reproductive health of women factory workers involved in export production, foreign enterprises and non-governmental organizations have already taken notice of the reproductive health complaints of workers in and outside of China (Adidas Group, 2007; Her+Project China,

2010, 2012; Institute of Population and Labor Economics and the Chinese Academy of Social Sciences on behalf of the China Youth Reproductive Health Program, 2005). International pressure on high-profile companies has prompted improvements in working conditions in their factories in EPZs (Hogstedt, et al., 2007). Implementing reproductive health programs in China's factories improves worker morale, productivity, and retention, as well as reduces worker absenteeism (Her+Project China, 2012). The challenge ahead lies in increasing reproductive health programs to all women factory workers in all EPZs in China.

**Conclusions**

A considerable proportion of China's population suffers from illnesses related to hazardous living and working conditions and occupational hazards are an emerging as an important health threat to the Chinese population (Gong & Brixi, 2005). Currently, there is insufficient epidemiologic research addressing the prevalence of and risk factors for poor reproductive health outcomes among women working in export production factories in China. This preliminary study evaluated the burden of pelvic pain and urogenital infection in this population, provided evidence for a negative association between FDI and infant mortality and suggests that the move from working in agriculture to manufacturing may be beneficial to the survivability of infants. Future research is necessary to better understand and corroborate these associations.

The Report of the World Commission on the Social Dimension of Globalization states that the global economy is currently "ethically unacceptable and politically unstable" (World Commission on the Social Dimension of Globalization, 2004). Specifically, the report found that in China while globalization stimulated economic growth and offered employment to millions of people, it increased regional disparities and pressures for a cheaper, more flexible labor force (World Commission on the Social Dimension of Globalization, 2004). These pressures to remain competitive in the global market have come at a cost of poor working conditions. In recent years, China's workforce has gained an improved awareness of their rights and power as a collective force and has demonstrated this through labor strikes. Ensuring a healthy female labor force through reproductive health programs makes business sense as it increases worker retention, improves productivity, and reduces absenteeism. Enhancing the quality of the labor force through the promotion of its health and education has been recognized to be one of the important government policies to reduce regional disparities and ensure future economic growth in China (Fleisher, Li, & Zhao, 2010; Gong & Brixi, 2005; Wang & Yao, 2001).

As China continues to grow economically, increases in its female labor force in the manufacturing industry in EPZs are likely. Since female factory workers have reported reproductive health to be one of their main health concerns and studies have documented a high prevalence of poor reproductive health outcomes and an unmet need for reproductive health services in that population, the implementation of reproductive health

programs for female factory workers is crucial to ensure the health of China's factory workers.

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# Appendices

**Appendix A**
**Consent and Survey in English**

**Reproductive Morbidity among Female Workers in Tianjin, China**

Principal Investigator: Kristin King, PhD Candidate, University of Michigan
Co-investigators: Wang Yanrang, Liu Jing, Han Cheng, Tianjin CDC
Faculty Advisor: Sioban Harlow, PhD, Professor of Epidemiology, University of Michigan

Hello, you are invited to participate in a research study on the reproductive health to female workers. The Tianjin CDC is conducting this investigation in order to provide better health services for women in Tianjin. The information we learn from this study will be very important to the prevention and treatment of female reproductive morbidity. If you agree to be part of this research study, you will be asked to complete the survey. It should take about 20 minutes of your time. Although you may not directly benefit from being in this study, the information you provide will help researchers and policy makers understand the reproductive health needs of female workers in China. Some questions in the survey are sensitive and may make you feel uncomfortable or embarrassed. Please try to answer all questions since the information we gain is important to the well-being of women. You may refuse to answer any question. The information you provide in the survey is voluntary and confidential. We will not collect information that could identify you. All the information we collect will be kept in a secure location and will only be seen by staff working on this study. We plan to publish the results we collect and we will not include any information that could identify you. The data collected in this survey will also be used for a student's dissertation for her graduate degree in epidemiology and will be completely anonymous. Your decision to participate will not affect your employment. You will receive a small gift for your participation.

If you have questions at a later time, you may contact Kristin King at 022-15022670593, Dr. Sioban Harlow at harlow@isr.umich.edu, or the Tianjin CDC at 022-24333499. If you have questions about your rights as a research participant, please contact the University of Michigan Institutional Review Board at irbhsbs@umich.edu.

If you agree to participate please continue with the survey. You may keep this page for your reference

Thank you for your cooperation! Please turn the page to begin the survey and mark your answers with a checkmark.

**Section 1: Demographics**

1. What is your Date of Birth according to the western calendar? ____year ____month
2. What is your ethnicity?
   (1) Han (2) Other (Specify) _____
3. What city and province were you born in? ____province ____city
4. Where is your family from originally? ____province ____city
5. What is your marital status?
   (1) Single (2) Married (3) Divorced (4) Widowed (5) Other (Specify) _____
6. How many children do you have? (1) 0 (2) 1 (3) More than 1
7. What is your education level?
   (1) No Schooling (2) Primary School (3) Middle School
   (4) High School / Military Training/ Technical Training (5) Educated past high school
8. What is your average monthly income including benefits?
   (1) 0-500 元 (2) 501-1000 元 (3) 1001-2000 元 (4) 2001-3000 元
   (5) 3001-4000 元 (6) Above 4000 元
9. What kind of house do you live in now?
   (1) Apartment (2) One-story house (3) Underground (4)Dormitory at Work (5) Other Specify)_____
10. Who do you live with? Please mark all that apply.
    (1) I live alone(2) Spouse (3) Boyfriend (4) Parents (5)Child(ren) (6) Relatives
    (7) Co-workers (8) Fellow Villagers (9) Friends (10) Other (Specify) _____
11. Generally speaking, how is your health?
    (1) Excellent (2) Very good (3) Good (4) Fair (5)Poor
12. What do you do when you are sick? Please mark all that apply.
    (1) Nothing (2) Self-treatment (3) Ask friends for advice (4) Big Hospital (5) Community Clinic
    (6) Licensed Clinic (7) Unlicensed/ Private Clinic (8) Drug Store (9) Sanitary Medical Station
    (10) Other (Specify) _____
13. Where have you accessed health care in Tianjin? Please mark all that apply.
    (1) Big Hospital (2) Community Clinic (3) Licensed Clinic (4) Unlicensed/ Private Clinic (5) Drug Store
    (6) Sanitary Medical Station (7) Have not accessed care in Tianjin (8) Other (Specify) _____

14. What health care facilities are located near your work or place of residence? Please mark all that apply.
    (1) Big Hospital (2) Community Clinic (3) Licensed Clinic (4) Unlicensed/ Private Clinic (5) Drug Store
    (6) Sanitary Medical Station (7) Other (Specify) _____
15. How far is it to the nearest medical institution from your place of residence? _____km
16. How far is it to the nearest medical institution from your workplace? _____km
17. Do you have medical insurance?
    (1) Yes (2) No
18. Which of the following types of medical insurance do you have?
    (1) Commercial Insurance (2) Social Medical Insurance (3) Free Medical Insurance
    (4) Other (Specify) _____
19. Have you smoked more than 5 cigarettes in the past month?
    (1) Yes (2) No
20. Have you consumed any beer, white wine, red wine, or rice wine in the past month?
    (1) Yes (2) No
21. How many friends do you have in Tianjin now?
    (1) 0 (2) 1-10 (3) 11-20 (4) more than 20
22. Do you hold a Tianjin residence card?
    (1) Yes (2) No
23. Up to now, how many months or years have you been in Tianjin? ____years ____months (00) I am from Tianjin
24. How many people did you know in Tianjin before you moved?
    (1) 0 (2) 1-10 (3) 11-20 (4) more than 20 (00) I am from Tianjin

**Section 2: Basic Working Situation**

25. How many different employers have you had in the past twelve months?
    (1) 1 (2) 2 (3) 3 or more
26. Where are you currently employed?
    (1) Electronic Factory (2) Textile Factory (3) Automotive Plant (4) Chemical Plant
    (5) Food/Beverage Production (6) Machinery Factory (7) Other (Specify) _____
27. What is your position at work?
    (1) Laborer (2) Manager (3) Office Worker (4) Other (Specify) _____

28. What is your specific job at work? Please Specify_____
29. How long have you been in your current position with this employer? _____years _____months
30. In the last month, how many hours were you scheduled work on average every day?_____ hours
31. In the last month, how many hours did you actually work on average every day? _____ hours
32. How many days do you work each week on average?_____ days
33. In the last 12 months, did you work overtime?
    (1) Yes (2) No
34. If yes, how many times did you work overtime on average each week?
    (1) 1 (2) 2 (3) more than 4
35. In the last 12 months, have you worked at night?
    (1) Yes (2) No
36. If yes, how many times did you work at night on average each week?
    (1) 1 (2) 2 (3) 3 (4) more than 4
37. Can you choose not to work overtime?
    (1) Yes (2) No
38. How many breaks (including eating and small breaks) do you get during your working shift?
    _____number of breaks to eat _____ number of other breaks
39. Can you use the bathroom at your convenience? (1) Yes (2) No
40. What is the length of your contract?
    (1) 3 months (2) 6 months (3) 1 year and above
41. How satisfied are you with your job?
    (1) Very Satisfied (2) Satisfied (3) Just OK (4) Not Satisfied (5) Very Dissatisfied
42. In the last 12 months, during the months you worked, how often has your health decreased your ability to work?
    (1) Always (2) Mostly (3) Sometimes (4) Rarely (5) Never
43. In the last 12 months, during the months you worked, how much time have you taken off work because you didn't feel well?
    (1) No time (2) Less than 1 day (2) 1-2 days (3) 3-5 days (4) 6-10 days (5) 11-30 days
    (6) More than 30 days
44. Are you expected to meet a certain quota during your work day? (1) Yes (2) No
45. In the last 12 months, during the months you worked, how many days did you not meet quota days because of your poor health?_____ days
46. How steady is your work?

(1) Regular and Steady (2) Seasonal (3) Frequent Layoffs (4) Other_____

47. Sometimes people permanently lose jobs they would like to keep. How likely is it that during the next couple of years you will lose your present job with your employer?
(1) Not likely at all (2) Not too likely (3) Somewhat likely (4) Very likely
（5）Don't Know

| **Job Content Questionnaire** | | | | |
|---|---|---|---|---|
| | **1. Strongly Disagree** | **2. Disagree** | **3. Agree** | **4. Strongly Agree** |
| **48. My job requires that I learn new things** | | | | |
| **49. My job involves a lot of repetitive work** | | | | |
| **50. My job requires me to be creative** | | | | |
| **51. My job allows me to make a lot of decisions on my own** | | | | |
| **52. My job requires a high level of skill** | | | | |
| **53. On my job, I have very little freedom to decide how I do my work** | | | | |
| **54. I get to do a variety of different things on my job** | | | | |
| **55. I have a lot of say about what happens on my job** | | | | |
| **56. I have an opportunity to develop my own special abilities** | | | | |
| **57. My job requires me to work very fast** | | | | |
| **58. My job requires me to work very hard** | | | | |
| **59. I am not asked to do an excessive amount of work** | | | | |
| **60. I have enough time to get the job done** | | | | |
| **61. I am free from conflicting demands that others make** | | | | |

| | | | | |
|---|---|---|---|---|
| **62. People I work with are competent in doing their jobs** | | | | |
| **63. People I work with take a personal interest in me** | | | | |
| **64. People I work with are friendly** | | | | |
| **65. People I work with are helpful in getting the job done** | | | | |
| **66. My supervisor is concerned about the welfare of those under him.** | | | | |
| **67. My supervisor pays attention to what I am saying** | | | | |
| **68. My supervisor is helpful in getting the job done** | | | | |
| **69. My supervisor is successful in getting people to work together** | | | | |
| **70. My job security is good** | | | | |
| **71. If I lost my job, it would be easy to find another job** | | | | |
| **72. The level of noise in the area(s) I work is usually high** | | | | |
| **73. The level of lighting in the area(s) I work is usually poor** | | | | |
| **74. In my job, I am well protected from exposure to dangerous substances** | | | | |
| **75. The temperature in my work area is comfortable** | | | | |
| **76. The air circulation in my work area is good** | | | | |
| **77. The air in my work area is clean and free from pollution** | | | | |
| **78. My work area(s) is crowded** | | | | |
| **79. I have trouble keeping my mind on what I am doing** | | | | |
| **80. I feel hopeful about the future** | | | | |
| **81. I feel that I am useful and needed** | | | | |
| **82. I feel depressed** | | | | |

**Questions on Fatigue**

Think of how you feel now. To what extent do the expressions below describe how you feel? For every expression, answer spontaneously, and mark the number that corresponds to how you feel right now. The numbers vary between 0 (not at all) and 10 (to a very high degree).

83. Tense muscle 0 1 2 3 4 5 6 7 8 9 10
84. Exhausted 0 1 2 3 4 5 6 7 8 9 10
85. Overworked 0 1 2 3 4 5 6 7 8 9 10
86. Uninterested 0 1 2 3 4 5 6 7 8 9 10

**Section 3: Health Status**

87. Have you ever had a menstrual period?
    (1) Yes (2) No
88. What age did you have your first period (according to the western calendar)?
    _____ years old

How many days does your period usually last? _____ Days

How many days are there between your periods?_____ Days

89. Is your period irregular (comes at an unexpected time each month)? (1) Y (2) N
90. In the last 12 months, have your periods been light, moderate, or heavy?
    (1) Light (2) Moderate (3) Heavy (4) Sometimes light, sometimes heavy
91. In the last 12 months, how often have you had painful periods?
    (1) Never (2) Occasionally (3) Often (4) Usually
92. Is the pain with your period usually mild, moderate, or severe?
    (1) Mild (2) Moderate (3) Severe (00) N/A
93. When did you last have a painful period?
    (1) In the last month (2) Between 1 and 3 months ago (3) More than 3 months ago (00) N/A
94. In the last 12 months did you experience vaginal discharge with an unusual color?
    (1) Yes (2) No
95. If you experienced discharge with an unusual color, what color was your vaginal discharge?
    (1) White (2) Yellow (3) Green (4) Grey (5) Other (00) N/A
96. If you experienced discharge with an unusual color, when did you discover it?
    __days ago (00) N/A
97. In the last 12 months did you experience an unusual smell from your vaginal discharge?
    (1) Yes (2) No
98. If you experienced an unusual discharge or smell, when did you discover it?
    __days ago (00) N/A

99. Are these symptoms regarding unusual discharge continuing or have they stopped?
(00) N/A
(1) Continuing (2) Stopped
100. How long did your symptoms regarding unusual discharge last?___days
(00) N/A
101. Did you have these symptoms regarding unusual discharge all the time or sometimes?
(1) All the time (2) Sometimes (00) N/A
102. When you had these symptoms regarding unusual discharge did you also experience a fever?
(1) Yes (2) No (00) N/A
103. In the last 12 months did you experience pain or sores in your genital area?
(1) Yes (2) No
104. Concerning the symptoms regarding pain or sores in your genital area, when did you discover them?____days ago (00) N/A
105. Are these symptoms regarding pain or sores in your genital area continuing or have they stopped?
(2) Continuing (2) Stopped (00) N/A
106. How long did your symptoms regarding pain or sores in your genital area last?___days (00) N/A
107. Did you have these symptoms regarding pain or sores in your genital area all the time or sometimes?
(2) All the time (2) Sometimes (00) N/A
108. When you had these symptoms regarding pain or sores in your genital area did you also experience a fever?
(2) Yes (2) No (00) N/A
109. In the last 12 months, have you had pain or burning when urinating?
(1) Yes (2) No
110. Concerning the symptoms regarding burning or pain when urinating, when did you discover them?____days ago (00) N/A
111. Are these symptoms regarding burning or pain when urinating continuing or have they stopped?
(1) Continuing (2) Stopped (00) N/A
112. How long did your symptoms regarding burning or pain when urinating last?___days (00) N/A
113. Did you have these symptoms regarding burning or pain when urinating all the time or sometimes?
(1) All the time (2) Sometimes (00) N/A
114. When you had these symptoms regarding burning or pain when urinating did you also experience a fever?
(1) Yes (2) No (00) N/A
115. In the last 12 months, during the months you worked, how much time have you taken off work because of any type of vaginal symptoms?

(1) No time (2) Less than 1 day (3) 1-2 days (4) 3-5 days (5) More than 5 days

116. In the last 12 months, have you had sexual intercourse?
(1) Yes (2) No

117. How many sexual partners have you had in the last 12 months?
(1) None (2) One (3) Two (4) Three (5) Four (6) More than four

118. What type(s) of contraception have you used in the past year?
(1) None (2) Withdrawal (3) Condoms (4) Oral Contraception (5) Injections (6) Male Sterilization (7) Female Sterilization/ Hysterectomy (8) IUD (9) Ring (10) Breastfeeding/ No Period (11) Calendar (12) Other (Specify) _____

119. Did you use a condom the last time you had sex?
(1) Yes (2) No (00) N/A

120. In the last 12 months, have you become pregnant?
(1) Yes (2) No (00) N/A

121. In the last 12 months, did you experience bleeding with sexual intercourse?
(1) Yes (2) No (00) N/A

122. Concerning the symptom regarding bleeding with sexual intercourse, when did you discover it?____days ago (00) N/A

123. Are these symptoms regarding bleeding with sexual intercourse continuing or have they stopped?
(1) Continuing (2) Stopped (00) N/A

124. How long did your symptoms regarding bleeding with sexual intercourse last?___days (00) N/A

125. Did you have these symptoms regarding bleeding with sexual intercourse all the time or sometimes?
(1) All the time (2) Sometimes (00) N/A

126. When you had these symptoms regarding bleeding with sexual intercourse did you also experience a fever?
(1) Yes (2) No (00) N/A

127. In the last 12 months, how often have you had pelvic pain during or in the 24 hours after sexual intercourse?
(1) Never (2) Occasionally (3) Often (4) Usually

128. At the times you had pelvic pain with sexual intercourse in the last 12 months, when have you felt the pain?
(1) During intercourse (2) In the 24 hours after intercourse (3) Both during and after intercourse (00) N/A

129. When did you last have pelvic pain with intercourse?
(1) In the last month (2) Between 1 month and 3 months ago (3) More than 3 months ago (00) N/A

130. In the past 12 months, have you had sexual intercourse less often than you wished because of your pelvic pain?
(1) Yes (2) No (00) N/A

131. Typically, is your pelvic pain with intercourse usually mild, moderate, or severe?
(1) Mild (2) Moderate (3) Severe (00) N/A

132. In the last 12 months, have you had pelvic pain NOT with periods or intercourse either on or off or constantly?
(1) Yes (2) No

133. In the last 12 months, how long did a typical episode of pelvic pain last?
(1) One hour or less (2) A few hours or 1 day (3) 2-5 days (4) 6-10 days (5) More than 10 days (00) N/A

134. In the last 12 months, how many of these pelvic pain episodes have you had approximately?
(1) 1-2 (2) 3-5 (3) 6-10 (4) More than 10 (00) N/A

135. When did you last have this pelvic pain?
(1) In the last month (2) Between 1 and 3 months ago (3) More than 3 months ago (00) N/A

136. Typically, is your pain not with periods or intercourse usually mild, moderate, or severe?
(1) Mild (2) Moderate (3) Severe (00) N/A

137. Thinking of all your pelvic pain, in the last 12 months, during the months you worked, how much time have you taken off work because of any type of pelvic pain?
(1) No time (2) Less than 1 day (3) 1-2 days (4) 3-5 days (5) More than 5 days (00) N/A

138. Do you think that the symptoms you mentioned are part of the same illness or a separate illness?
(1) Same Illness (2) Separate Illness (3) Don't know

139. Which do you think is your most serious symptom?
(1) Color of Discharge (2) Smell of Discharge (3) Sores/Blisters (4) Pain in lower abdomen (5) Pain during urination
(6) Pelvic pain during intercourse (7) Pelvic pain during menstruation (8) Pelvic pain not during intercourse or menstruation (9) Irregular menstruation
(10) Other (Specify) _____ (11) Don't know

140. Do you know anyone at your place of work with who has reproductive health concerns?
(1) Yes (2) No

141. If you know someone at your place of work with who has reproductive health concerns, what are they?
Please Specify

142. What is your most important reproductive health concern? Please Specify
_____

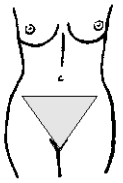
143. What are your top three most important health concerns?

(1)_____

(2)_____

(3)_____

***You have finished the survey, thank you so much for your time!***

 This picture shows the location of lower abdominal pain.

## Appendix B
## Consent and Survey in Chinese

**天津职业女工生殖健康调查**

研究者：金晓婷，王延让，韩承， 刘静，韩诗博：

您好,为更好的提供女性生殖健康服务，天津市疾病预防控制中心对贵公司在职女工工作情况进行相关调查，同时我们需要了解您生殖健康方面的情况，您所提供的信息对今后从业女性生殖疾病防治工作有重要的作用。如果您愿意参与，您需要完成一个大约 20 分钟的问卷调查。虽然您不一定会直接受益，但是您提供的信息会更好的帮助保护女性工人生殖健康。其中的一些问题也许会比较敏感，请您尽量作答。您可以拒绝回答任何问题。您提供的信息完全出于自愿而且保密。我们不会收集个人信息。您的雇主也同意我们在您允许的情况下就本次调查和您谈话。如果您不愿意，也可以不进行谈话。我们不会问及任何个人信息，也不会和雇主或者其他人共享信息。您提供的信息将会妥善保密，只有参与本项目的人可以接触到。如果我们发布任何结果，不会公布任何个人信息。本课题的研究数据也会被用在流行病学研究生毕业论文中，所有信息都是匿名的。您参与此次调查不会影响您的工作。您将会收到一份小奖品作为参与的奖励。

联系方式: 金晓婷：15022670593 天津市疾病预防控制中心：24333521 韩诗博：harlow@isr.umich.edu

密歇根大学医德中心：irbhsbs@umich.edu.

谢谢您的合作！

*请您在所选答案处划勾*

**第一部分：个人基本信息**

1. 您的出生日期(阳历)：_____年_____ 月
2. 民族 (1)汉 (2)少数民族（请注明）_____
3. 您的出生地：_____省 _____市
4. 您的籍贯：_____省 _____市
5. 您目前的婚姻状况：
   (1) 未婚 (2) 已婚 (3) 离婚 (4) 丧偶 (5) 其他（请注明）_____
6. 您有多少孩子: (1) 0 （2）1 （3）多于 1 个
7. 您的文化程度：
   (1) 不识字或识字少 (2)小学 (3)初中 (4)高中/技校/中专 (5)大专及以上
8. 您平均 1 个月收入：

(1)低于 500 元 (2)500－1000 元 (3)1000－2000 元 (4) 2000－3000 元 (5) 3000－4000 元 (6)4000 元以上

9. 您现在的住房情况：
   (1) 公寓 (2) 平房 (3) 地下室 (4) 单位宿舍 (5) 其他（请注明）_____
10. 您现在和谁一起居住: **多项选择**
    (1) 一个人住 (2) 我的配偶 (3) 父母 (4) 孩子（们）(5) 亲戚 (6) 男朋友
    (7) 同事 (8) 村民 (9) 朋友 (10) 其他（请注明）_____
11. 总的来说， 您的健康情况怎么样？
    (1) 极好的 (2) 很好 （3）好 （4）一般 （5）不好
12. 您平时生病的时候怎么处理？**多项选择**
    (1) 置之不理 (2) 自己医治 (3) 向朋友寻求建议 (4) 大医院 (5) 合法诊所 (6) 医疗急救中心 (7) 药房 (8) 社区诊所 (9) 私人或地下诊所 (10) 其他(请注明)_____
13. 您在天津就医时，去过那里？**多项选择**

(1) 大医院 (2) 合法诊所 (3) 医疗急救中心 (4) 药房 (5) 社区诊所 (6) 私人或地下诊所 (7) 没有去过以上地方 （8）其他(请注明)_____

14. 您的住所或工作场所附近有什么样的医疗设施？ **多项选择**

(1) 大医院 (2) 合法诊所 (3) 医疗急救中心 (4) 药房 (5) 社区诊所 (6) 私人或地下诊所（健康中心） (7) 其他(请注明)_____

15. 从您的住处需要多少公里到最近的医疗机构? _____公里
16. 从您工作的地方处需要多公里到最近的医疗机构? _____公里
17. 您有医疗保险吗? （1）有 (2) 没有
18. 以下的几种医疗保险， 您有几种？ **多项选择**
    (1) 商业保险 (2) 社会保险 (3) 免费保险 (4) 其他(请注明) _____
19. 在过去的 1 个月内， 您有没有抽超过 5 支香烟？（1）有 (2) 没有
20. 在过去的 1 个月内， 您有没有喝过啤酒，红酒,白酒，还是黄酒？ （1）有 (2) 没有
21. 您在天津有多少朋友？（1）0 (2) 1-10 (3) 11-20 (4) 20 多
22. 您现在的户口在天津市吗？（1）是 (2) 不是
23. 到目前为止，您在天津居住了多长时间:__ __年 __ __月 (00) 我是天津本地人
24. 在您搬来天津前， 您认识多少人是住在天津的？ （1）0 (2) 1-10 (3) 11-20 (4) 20 多 (00) 我是天津本地人

**第二部分：基本工作坏境**

25. 在过去的12个月内， 您为几种的雇主工作过？（1）1 种 (2)2 种 (3)3 种或更多
26. 您现在在哪里工作？
    (1) 电子或家电业工厂 (2) 服饰工厂 (3) 汽车工厂 (4) 化工厂 (5) 食品 / 饮料加工
    (6) 机械器具工厂 (7) 其他（请注明）_____
27. 您现在的职务是什么？ （1）工人 (2) 组长 (3)办公室职员 (4)其他（请注明)_____
28. 您从事的工种是什么？ 请注明_____
29. 您在现在的岗位工作多久了？_____年_____月
30. 在过去的 1 个月里，您原先计划每天工作几个小时？_____小时
31. 最近 1 个月内您实际每天工作几小时？_____小时
32. 在最近的 1 个月里， 您平均每周工作多少天？ _____天
33. 在最近的 1 个月里,您经常加班吗？ (1) 是 (2) 不是
34. 如果是，您平均每周加几次班？ （1）1 个 (2) 2 个 (3) 3 个或更多
35. 您会工作到深夜吗？（1）是 (2) 不是
36. 如果是，您每周一般会有几天如此工作到深夜？（1）1 个 (2) 2 个 (3) 3 个或更多
37. 您可以选择不加班吗？（1）可以 （2）不可以
38. 您每班工间休息多少次？ _____次吃饭休息 _____次非用餐的休息
39. 您可以不可以用洗手间随您的方便吗？ （1）是 (2) 不是
40. 您的工作合同期限？（1）3 个月 (2) 6 个月 (3) 1 年及以上
41. 您对您的工作的满意度？
    (1) 非常满意 (2) 满意 (3) 一般 (4) 不满意 (5) 非常不满意
42. 在过去 12 个月您工作的时间内，您是否经常由于生病而减少工作量?
    (1) 一直 (2) 大多数时间 (3) 有时 (4) 很少 (5) 从来没有
43. 在过去 12 个月您工作的时间内， 您因为不舒服休息过多长时间？
(1) 没有休息 (2) 少于 1 天 (3) 1 至 2 天 (4) 3 至 5 天 (5) 6 至 10 天 (6) 11 至 30 天 (7) 多于 30 天
44. 您每天工作有指标要求吗？ （1）有 (2)没有
45. 在过去 12 个月内， 您由于健康问题有几天工作没有达标？ _____天
46. 您的工作很否稳定？（1）很有规律并稳定 (2) 有季节性 (3) 不稳定 (4)其他（请注明)_____
47. 在未来几年里,您可能会失去目前的这份工作？(1)很本不可能 (2) 不可能 (3) 有可能 (4) 很有可能 (5) 不知道

| **工作满意度** | | | | |
|---|---|---|---|---|
| **编号，问题** | **1. 非常不同意** | **2. 不同意** | **3. 同意** | **4. 非常同意** |
| 48. 我的工作要求我学习新的事物 | | | | |
| 49. 我的工作重复性很高 | | | | |
| 50. 我的工作需要我有创造性 | | | | |
| 51. 在工作中，很多事我可以自己做主 | | | | |
| 52. 我的工作技术要求高 | | | | |
| 53. 对于如何开展我的工作，我几乎没有决定权 | | | | |

| | | | | |
|---|---|---|---|---|
| 54. 在工作中，我可以做各式各样不同的事 | | | | |
| 55. 对于工作中发生的事，我的意见具有影响力 | | | | |
| 56. 在工作中，我有机会发挥我自己的特殊才能 | | | | |
| 57. 我的工作要求我做事做得很快 | | | | |
| 58. 我的工作要求我很努力 | | | | |
| 59. 我不会被要求加班工作 | | | | |
| 60. 我有足够的时间来完成工作 | | | | |
| 61. 我不需要按别人的不同要求去做相互抵触的事情 | | | | |
| 62. 我的上司会关心下属的福利 | | | | |
| 63. 我的上司会听取我的意见 | | | | |
| 64. 我的上司能帮助下属开展工作 | | | | |
| 65. 我的上司很有组织能力，让下属团结一致开展工 | | | | |
| 66. 我的同事能胜任他们的工作 | | | | |
| 67. 我的同事会关心我 | | | | |
| 68. 我的同事很友好 | | | | |
| 69. 我的同事在工作中会帮助我 | | | | |
| 70. 我的工作很有保障 | | | | |
| 71. 如果失去现在的工作，凭借在这里的经验，容易 | | | | |
| 72. 工作环境的噪声水平很高 | | | | |
| 73. 工作环境的采光/照明水平很差 | | | | |
| 74. 工作的时候是否使用保护用品，免于接触有害化 | | | | |
| 75. 工作环境的温度很舒适 | | | | |
| 76. 工作环境的通风循环很好 | | | | |
| 77. 工作环境的空气干净无污染 | | | | |
| 78. 工作环境非常拥挤 | | | | |
| 79. 我不能专注我做的事情 | | | | |
| 80. 我对未来充满希望 | | | | |
| 81. 我感觉我有很大的作用 | | | | |
| 82. 我觉得沮丧的 | | | | |

**第四部分：疲劳**

考虑一下您现在的感觉，请在下面的数字上面做标记。0表示没有，10表示严重。

144. 肌肉紧张程度 0 1 2 3 4 5 6 7 8 9 10

145. 疲劳程度 0 1 2 3 4 5 6 7 8 9 10

146. 工作过度 0 1 2 3 4 5 6 7 8 9 10

147. 兴致索然 0 1 2 3 4 5 6 7 8 9 10

**第五部分：健康情况**

148. 您有没有过月经？ （1）有 (2) 没有

149. 您几岁时来的第一次月经(阳历)？_____年龄； 持续时间是几天？____天；通常多少天来一次月经？____天

150. 您的月经周期是否规律？(1) 规律 (2) 不规律

151. 在过去的12个月内，每个月经期，每天的量是多少？
(1) 较少 (2) 一般 (3) 较多 （4）时多时少

152. 在过去的12个月内，您是否经常月经疼痛？
(1) 从来没有 (2) 有时 (3) 常常 (4) 总是

153. 您月经疼痛通常很轻微， 中等， 还是很严重？ （1）轻微 (2) 中等 (3) 严重 （00）此问题不适用于我

154. 近一次月经疼痛是什么时候？（1）上个月 (2) 过去的2至3个月 (3) 3个月以前 （00）此问题不适用于我

155. 过去12个月内，您有没有异常的阴道分泌物的颜色？ (1) 有 (2) 没有

156. 您的阴道分泌物是什么颜色？
（1）白色 (2) 黄色 (3) 绿色 (4) 灰色 (5) 其他(请注明)_____
(00) 此问题不适用于我

157. 如果有分泌物您最早什么时候发现的？____天 （00）此问题不适用于我

158. 过去12个月内您的阴道分泌物是否有异常气味？ （1）有 (2) 没有 （00）此问题不适用于我

159. 如果有异常气味您最早什么时候发现的？ ____天 （00）此问题不适用于我

160. （异常的阴道分泌物）现在消失了或者还在继续？（1）已消失 （2）继续 （00）此问题不适用于我

161. （异常的阴道分泌物）症状消失前症状延续了多久？ ____天 （00）此问题不适用于我

162. 异常的阴道分泌物期间， 您是一直有症状还是症状断断续续？（1）一直有 （2）有时有 （00）此问题不适用于我

163. 异常的阴道分泌物期间， 您是否也有发烧症状？（1）有 （2）没有 （00）此问题不适用于我

164. 过去12个月内您的外阴是否有疮或者水泡？（1）有 (2) 没有

165. 如果有外阴疮或者水泡， 您最早什么时候发现的？ ____天 （00）此问题不适用于我

166. 以上症状现在消失了或者还在继续？（1）已消失 （2）继续 （00）此问题不适用于我

167. 外阴疮或者水泡消失前症状延续了多久？____天 (00)此问题不适用于我

168. 外阴疮或者水泡期间,您是一直有症状还是症状断断续续？（1）一直 （2）有时 （00）此问题不适用于我

169. 外阴疮或者水泡期间，您是否也有发烧症状？ （1）有 （2）没有 （00）此问题不适用于我

170. 过去12个月内，您小便时是否疼痛或有灼烧感？ （1）有 (2) 没有

171. 如果有过以上类似症状，您最早什么时候发现的？____天 （00）此问题不适用于我

172. 小便时疼痛或有灼烧现在消失了或者还在继续？（1）已消失 （2）继续 （00）此问题不适用于我

173. 小便时疼痛或有灼烧消失前症状延续了多久？ ____天 （00）此问题不适用于我

174. 小便时疼痛或有灼烧期间，您是一直有症状还是症状断断续续？（1）一直有（2）有时有 （00）此问题不适用于我

175. 小便时疼痛或有灼烧期间，您是否也有发烧症状？ （1）有 （2）没有 （00）此问题

不适用于我

176. 在过去的12个月您工作的时间内， 您因为生殖系统症状(异常的阴道分泌物，外阴疮或者水泡, 小便时疼痛或有灼烧)休息过多长时间？（1）没有休息 (2) 少于1天 (3) 1至2天 (4) 3至5天 (5) 多于5天

177. 过去12个月内，您是否有过性交 ？（1）有 (2) 没有

178. 如果有，现在您有几个性伙伴？ （1）没有 (2) 1个 (3) 2个 (4) 3个 (5) 4个(6) 多于4个

179. 过去一年内您用过哪几种避孕措施？

（1）没有 (2) 体外射精 (3) 避孕套 (4) 口服避孕 (5) 注射避孕 (6) 女性绝育 (7) 男性结扎

(8) 宫内绝育器 (9) 上环 (10) 哺乳期/无月经 (11) 安全期避孕 (12) 其他(请注明)_____

180. 在过去的12个月内， 您上次性行为有没有使用避孕套？（1）有 (2)没有 (00)没有过性交

181. 在过去的12个月内， 您有没有怀孕过？（1）有 (2) 没有 (00)没有过性交

182. 过去12个月内您是否有性交时出血？（1）有 (2) 没有 (00)没有过性交

183. 有性交时出血如果有过类似症状， 您最早什么时候发现的？____天 (00)没有过性交

184. 有性交时出血现在消失了或者还在继续？（1）已消失 （2）继续 (00)没有过性交

185. 有性交时出血消失前症状延续了多久？ ____天 (00)没有过性交

186. 有性交时出血期间， 您是一直有症状还是症状断断续续？ （1）一直有 （2）有时有 (00)没有过性交

187. 有性交时出血期间， 您是否也有发烧症状？ （1）有 （2）没有 (00)没有过性交

188. 在过去的12个月内，您是否常常在性交时有下腹疼痛，或是在性交后的24小时内有下腹疼痛？（见附图）

(1) 从来没有 (2) 有时 (3) 常常 (4) 频繁 (00) 没有过性交

189. 在过去的12个月内， 如果您有性交有关的下腹疼痛， 您通常是什么时候感觉到疼痛？

(1) 性交时 (2) 性交后24小时以内 (3) 性交时和性交后24小时 (00)没有过性交

190. 您上一次性交时下腹疼痛是什么时候？(1) 上个月内 (2) 过去的2至3个月 (3) 3个月以前 (00)没有过性交

191. 在过去的12个月内， 您有没有因为下腹疼痛减少性交次数？ (1)有 (2) 没有 (00)没有过性交

192. 通常情况下， 您的下腹疼痛是很轻微， 中等，还是很严重？

(1) 轻微 (2) 中等 (3) 严重 (00) 没有过性交

193. 在过去的12个月内， 您有没有过持续或间断性的与月经或性交无关的下腹疼痛？（1）有 (2)没有

194. 在过去的12个月内，这样的 一次下腹疼痛通常持续多长时间？

（1）1个小时以内 (2) 几个小时或1天 (3) 2至5天 (4) 6至10天 (5) 多于10天 (00) 此问题不适用于我

195. 在过去的12个月内， 您大约有过几次这样的下腹疼痛？

（1）1至2次 (2) 3至5次 (3) 6至10次 (4) 多于10次 (00)此问题不适用于我

196. 您上一次这样的下腹疼痛是什么时候？

(1) 上个月内 (2) 过去的1至3个月 (3) 3个月以前 (00)此问题不适用于

我

197. 通常情况下， 您和月经或性交无关的下腹疼痛是很轻微，中等， 还是很严重？
(1) 轻微 (2) 中等 (3) 严重 (00)此问题不适用于我

198. 在过去的12个月您工作的时间内， 您因为任何下腹疼痛或者月经休疼痛息过多长时间？
(1) 没有休息 (2) 少于1天 (3) 1至2天 (4) 3至5天 (5) 多于5天

199. 您觉得上述分泌物、水泡、下腹痛症状是同一种疾病或是不同的疾病？
（1）同一种疾病 (2) 不同的疾病 (3) 不知道 (00) 我没有症状

200. 哪一种您觉得是(对于日常生活)最严重的症状？
(1) 分泌物的颜色 (2)分泌物的气味 (3) 疼痛和水泡 (4) 下腹疼痛 (5) 小便疼痛 (6) 性交疼痛
(7) 性行为有关的盆腔疼痛 (8) 月经疼痛 (9) 没有过持续或间断性的与月经或性交无关的下腹疼痛
(10)月经周期规律 (11)其他 (请注明)_____ （12）不知道

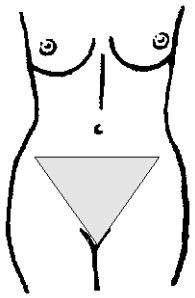
201. 您周围的同事有没有对于生殖健康的担忧？（1）有 （2）没有 （3）不知道

202. 如果您周围的同事有生殖健康问题，这些问题是什么？请注明
_____
_____
_____

203. 您主要的生殖健康问题是什么？ 请注明
_____
_____
_____

204. 您三个主要的健康问题是什么？ 请注明
a. _____
b. _____
c. _____

*问卷结束，谢谢！*



*图片三角区域表示下腹疼痛。*