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Effect of the 2008 cold spell on preterm births in two subtropical cities of Guangdong Province, Southern China

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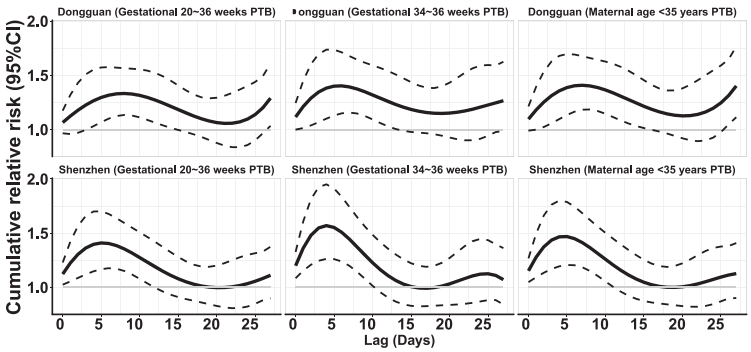
HIGHLIGHTS

- The first study on association of preterm birth with cold spell in subtropics.
- Cold spell increased the risk of preterm birth.
- The cumulative effect of cold spell on preterm birth lasted for over 1 week.
- Pregnant women of 34–36 gestational weeks were more susceptible.

GRAPHICAL ABSTRACT



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ABSTRACT

Background: A few studies have reported that low temperatures were associated with an increased risk of preterm birth. However, the effect of extreme weather events, such as cold spell, on preterm birth has not been studied in China.
Objective: This study was conducted to evaluate the impact of the 2008 cold spell on preterm birth in two subtropical cities of Guangdong Province.
Methods: Data of daily preterm birth, air pollution and meteorological variables from 2006 to 2010 were collected in Dongguan and Shenzhen. A Poisson regression with a distributed lag nonlinear model was used to investigate the association between the 2008 cold spell and daily rate of preterm birth for each city.
Results: During the 2008 cold spell, total vaginal preterm births were increased by 22.44% and 21.25% in Dongguan and Shenzhen, respectively. The effect of the cold spell on preterm births lasted for more than 1 week, the lag0–6 days cumulative relative risk (RR) is 1.32 (95% CI: 1.10–1.58) and 1.40 (95% CI: 1.18–1.68) in Dongguan and Shenzhen, respectively. The effects were found to be more pronounced for the pregnant women with 34–36 gestation weeks, maternal age < 35 years group.

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Conclusion: This study demonstrates that cold spell could increase the risk of preterm births in Dongguan and Shenzhen, and the effect lasts for more than 1 week. Specific measures should be considered to protect the pregnant women, especially the vulnerable subgroups.

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1. Introduction

Preterm birth (PTB), defined as live births before 37 completed weeks of gestation, is a complex syndrome that remains one of major public health problems (Goldenberg et al., 2008). In 2010, about 15 million premature infants were born globally (Blencowe et al., 2012). Recently, a study from 132 cities in China reported a high preterm birth rate with 7.2%. Preterm birth is associated with various adverse outcomes, including infant mortality, acute morbidity, long-term neurocognitive disorders, poor growth, respiratory problems, behavioral problems, and other complications (Saigal and Doyle, 2008).

Pregnant women have been reported to be particularly susceptible to the exposure to weather extremes, but received limited attention. A few recent studies have showed that exposure to weather extremes during the pregnant period was associated with higher risk of preterm birth (Basu et al., 2010; Dadvand et al., 2011; Guo et al., 2018; Schifano et al., 2013; Strand et al., 2012; Vicedo-Cabrera et al., 2014; Wang et al., 2013). One recent cohort study in Sweden claimed that extreme cold temperatures were related to an increased risk of preterm birth (Bruckner et al., 2014). Only two studies from Shenzhen (Liang et al., 2016) and Guangzhou (He et al., 2016) of China also showed that the cold temperature was associated with an increased risk of PTB. However, the mechanism by which the cold temperature triggered PTB is unclear. Previous studies suggested that low temperature could lead to the rise of the blood viscosity and the increase of vascular constriction (Fu and Yu, 2011). Owing to global climate change and high medical costs for preterm births, the effects of cold temperature on preterm birth risk should be further studied.

Guangdong, a subtropical province in Southern China, was hit by an unusually persistent and widespread severe cold spell in 2008. The daily mean temperature during this extreme weather event was much lower than it had been during the same period in previous years. According to previous studies, people in low latitude have fewer opportunities to be exposed to low temperatures. So, they have a lower adaptation to low ambient temperature (Huang et al., 2015). Compared with populations in high latitude, they are more sensitive to low temperature (Wu et al., 2013). This cold spell episode provided a good opportunity to investigate the effect of the cold spell on preterm birth for subtropical population. However, no such study has been available in the literature.

This is the first large-scale and population-based epidemiologic study on the association between cold spell and preterm birth risk for Chinese subtropical population. We aimed to evaluate the health impacts of the 2008 cold spell in two subtropical cities of Guangdong by analyzing extended time-series data for daily preterm births and modeling lagged effects by using distributed lag models. The findings of this study will improve our understanding of relationships between extreme cold events and preterm births in subtropical areas, and provide evidence to support the need to develop adaptation strategies in favor of mitigating the adverse effects of cold climate extremes in the context of climate change, even in subtropical regions.

2. Methods

2.1. Study settings

Guangdong is one of southernmost provinces in China. It has an average annual temperature of 22 °C with a typical subtropical climate. Note that the preterm birth rate in Dongguan and Shenzhen is higher than those in other cities in Guangdong. Therefore, based on data availability, we selected these two cities for this analysis (Fig. 1). Dongguan, the third biggest city of Guangdong Province, has a total population of over 8,261,400 by the end of 2016; and Shenzhen, a coastal city in southern Guangdong, has a population over 11,908,400 by the end of 2016.

The institutional ethical committee board of Guangdong Women and Children's Hospital was approved this study. Data used in this study were anonymous and no individual identifiable information was available for the analysis.

2.2. Preterm birth

Daily data of preterm birth from January 2006 to December 2010 were collected from the birth registry database, which covered all midwifery clinics and hospitals in the two cities. All midwifery clinics and hospitals were requested to report birth information to the system. One component of the system is birth certificate and all midwifery clinics and hospitals are using this system to issue birth certificate by the network. When the birth certificate is issued, the Department of Medical Administration and parents also confirm the birth information. In accordance with previous studies (Darrow et al., 2009; He et al., 2016), all singleton vaginal live births among women who had reached at least 20 weeks of gestation and had not exceeded 44 weeks of gestation were included in the present study. The births among women whose gestational age was implausible (<20 or >44 weeks) were excluded. The information included date of birth, date of mother's last menstrual period (LMP), maternal age, delivery mode, birth weight, infant sex, etc. According to an ultrasound examination in the first or second trimester (Fu and Yu, 2011), gestational age at birth was determined. If the ultrasound examination was unavailable, the gestational age was estimated based on the mother's last menstrual period.

Preterm birth was defined as births <37 completed weeks of gestation (Muglia and Katz, 2010). Preterm birth was divided into two groups: early preterm birth (20–33 weeks of gestation) and late preterm birth (34–36 weeks of gestation) (Davidoff et al., 2006).

2.3. Definition of the cold spell

Daily meteorological data from January 1, 2006 to December 31, 2010 were collected from the local meteorological bureaus of each city. We used the daily mean temperature (T_m) and relative humidity (RH) in this study.

In accordance with previous studies (Xie et al., 2013; Wang et al., 2016a), we defined a weather fluctuation as a cold spell if the daily mean temperature fell below the 5th percentile of the study period from January 2006 to December 2010 in a specific city for at least 5 consecutive days. Specifically, the cold spell is defined as a binary variable assuming a value of 1 during the cold spell period. Based on this definition, the 2008 cold spell episode was identified, which lasted for 21 days (between Jan 25th and Feb 14th) in Dongguan, and 23 days (between Jan 24th and Feb 15th) in Shenzhen. Table 1 shows the detailed information on this cold spell in the two cities.

2.4. Air pollution

Air pollution data were collected from the local air monitoring department for the same period, which included daily average

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