



Research paper

Changing of suicide rates in China, 2002–2015

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A B S T R A C T

Background: The overall suicide rate in China has dropped substantially since

the 1990s, with patterns changing significantly. This study aims to further explore the latest changes in suicide rates in China.

Methods: Data on gender-age-specific suicide rates for rural and urban residents aged 15 years and above were retrieved from official records. Joinpoint regression analyses were applied to analyze time trends of suicide rates.**Results:** Overall, suicide rates in China dropped significantly from 2002 to 2015. However, the national suicide rates have decreased at a slower pace since 2006. Joinpoints on time trends of suicide rates were also observed among rural males, rural females and urban males in 2005, 2006 and 2008, respectively. Declines in suicide rates of a majority of groups aged 25–54 slowed around 2007, and even reversed among males aged 25–34 in both areas and rural males aged 45–54. Male suicide rates were increasingly higher than females' after 2006. Rural suicide rates were about twice those of urban groups in recent years.**Limitations:** Data on suicide is based on a large-sampled surveillance system, which may suffer from some quality flaws. Improvements in the quality of suicide rate data may lead to bias. Information on other potential differences in suicide rates over time is not available.**Conclusions:** Although the suicide rate in China dropped significantly from 2002–2015, a slowdown in the decrease and even a reversing trend was observed in some certain groups, which highlights the urgent need for targeted suicide prevention programs.

1. Introduction

Suicide is a serious public health problem. Globally, suicide was estimated to account for 788,000 deaths in 2015 (WHO, 2015). From 2000 to 2012, the total number of global suicides decreased by about 9% despite the increase in world population, and the global age-standardized suicide rate fell by 26% (WHO, 2014).

Suicide rates in China have changed dramatically over the past few decades. Suicide rates have significantly decreased in both rural and urban areas, among males and females, and in most age groups (Liu et al., 2017; Sha et al., 2016; Wang et al., 2014). Between 1995 and 1999, the suicide rate in China was estimated to be 23 per 100,000 people (Phillips et al., 2002). The alarmingly high suicide rate at that time drew widespread attention. By contrast, a recent study reported that the annual average suicide rate in China between 2012 and 2015 was 6.75 per 100,000 people (Liu et al., 2017), one of the lowest in the world. Patterns in gender-, age-, and rural/urban-specific suicide rates have also shown dramatic changes (Sha et al., 2016; Wang et al., 2014). In the 1990s, the rural suicide rate was three times higher than the urban suicide rate, the female suicide rate was 25% higher than the male suicide rate, and young rural women in particular committed suicide at an alarming rate (Phillips et al., 2002; Qin and Mortensen,

2001). Recently, a smaller rural-urban discrepancy and a lower male suicide rate was observed in China's suicide rates (Liu et al., 2017; Wang et al., 2014). Such remarkable changes in China's suicide rates have been validated in national-level studies (Liu et al., 2017; Sha et al., 2016; Wang et al., 2014; Zhang et al., 2014) and subnational-level studies (Sun et al., 2013; Zhang et al., 2013). The changes have been investigated in relation to many aspects, such as social changes (Yip et al., 2005), economic development (Zhang et al., 2010), aging and urbanization (Sha et al., 2016), and lethal poisons management (Page et al., 2017).

However, recent changes in suicide rates in China still need to be explored in more details. Studies suggested that time trends of suicide rates might vary across different periods and different subgroups, even within the same country. For example, between 1990 and 2011, Japan's overall suicide rate remained flat until 1996, increased sharply between 1996 and 1999, and then it plateaued (Yoshioka et al., 2016). In Norway, the male suicide rate increased from 1969 to 1989, and decreased between 1994 and 2012, while the female suicide rate increased until 1988, declined through 1995, and then stabilized (Puzo et al., 2016). Tremendous changes in China during the past decades may have influenced suicide rates. Previous research indicated that, from 2000 to 2010, the positive impact of urbanization on suicide

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rate decrease in China gradually diminished, and was overtaken by the aging effect (Sha et al., 2016). Additionally, both rural and urban suicide rates in China were at their lowest point in 2008 (Liu et al., 2017; Wang et al., 2014), raising concerns as to whether suicide rates in China can maintain a downward trend (Wang et al., 2014). The aim of the present study was to examine whether or not the reduction of China's suicide rate has continued in recent years, and to further explore the latest changes in suicide rates in China between 2002 and 2015.

2. Material and methods

2.1. Data sources

Data on suicide rates in China between 2002 and 2015 were retrieved from *China's Health Statistics Yearbooks* (CHSYB) (NHFPC, 2003–2016), which are based on China's Ministry of Health Vital Registration (MOH-VR) System. The data in this system are regularly submitted to the World Health Organization as China's official mortality figures (Yang et al., 2005). In China, urban and rural areas are classified mainly based on administrative divisions. In the MOH-VR system, cities are classified as urban areas; counties and towns are regarded as rural areas. The CHSYB provided rural and urban suicide rates by gender and 18 five-year age groups.

We standardized national suicide rates from 2002 to 2015 for people aged 15 years and over, using the Sixth National Population Census (NPC) data from 2010 (NBS, 2015). We also calculated age-adjusted suicide rates for four rural/urban- and gender-specific cohorts and seven age groups (15–24, 25–34, 35–44, 45–54, 55–64, 65–74, and 75 years and above) in each cohort. The Sixth NPC was selected as a standard population, since it was the latest population census, and was near the middle of the study timeline. It should be noted that the definitions of rural and urban areas are different across the MOH-VR system and NPC data sets. Counties are regarded as rural areas in the MOH-VR system, but are classified as urban areas in the NPC data sets. Accordingly, we projected the rural suicide rates from the MOH-VR system onto the combined populations of towns and counties from the NPC data, and projected the urban suicide rates onto city populations. This method to reassemble urban and rural populations across data sets was also used in prior studies with the same data source (Phillips et al., 2002; Zhang et al., 2014).

2.2. Statistical analysis

We examined time trends of standardized suicide rates using joinpoint regression analysis (Joinpoint Regression Program, Version 4.5.0.1) (SMAB, 2017) at the national level and within rural/urban-, gender-, and age-specific cohorts. The Grid Search method, Monte Carlo permutation tests and Modified Bayesian Information Criterion were performed to identify the best-fitting combination of line segments and joinpoints (Kim et al., 2000). The analysis started with zero joinpoints (i.e. a straight line) and tested whether one or more joinpoints must be added to the model. It ended when there were no more joinpoints to fit the data better. Each joinpoint in the final model indicated a significant change in slope. In this study, the number of joinpoints was limited to a maximum of two according to the time interval of the datasets (Branch, 2013). To determine a summary measure of the trend, we also calculated the annual percent change (APC) of each line segment, and average annual percent change (AAPC) over the entire period. The AAPC was a weighted average of the APCs from the joinpoint model. When no joinpoint was detected, the AAPC would coincide with the APC.

Additionally, we calculated the male-to-female (M/F) ratios of suicide rates in rural areas and urban areas, and the rural-to-urban (R/U) ratios of suicide rates in both gender groups. We used AAPC to measure the linear trends of these ratios, which were then analyzed using Poisson regression models. We calculated the AAPC using the following

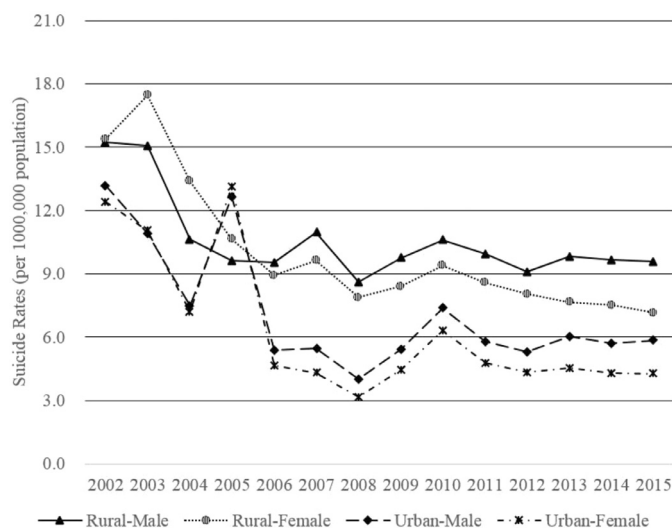


Fig. 1. Crude suicide rate by region and gender in China, (per 100,000 persons aged 15 years and over), 2002–2015.

equation: $AAPC = [exp(\beta) - 1] \times 100$, where β is the slope of the regression of log rates over one year. In this study, the suicide rate was specified per 100,000 people per year. The overall probability of type 1 error was maintained at 0.05.

3. Results

3.1. General description

The crude rural/urban- and gender-specific suicide rates in China for 2002–2015 are depicted in Fig. 1. Suicide mortality rate decreased in all groups during this period. During this period, the crude suicide rate among rural males dropped from 15.24 to 9.58, and that among rural females dropped from 15.40 to 7.16. In urban areas, the rate among urban males and urban females decreased from 13.16 to 5.85, and 12.40 to 4.27, respectively. The largest reduction in crude suicide rate was among urban females (65.56% decrease), and the lowest reduction was in rural males (37.14% decrease).

3.2. Time trends of suicides by rural/urban region and gender

Time trends of standardized suicide rates for the general population and rural/urban-gender-specific groups are presented in Fig. 2 and Table 1. Joinpoint regression analysis results indicated that suicide rates in all these groups decreased significantly from 2002 to 2015. The overall suicide rate decreased by 16.0% per year until 2006, and then reduced by 3.4% per year through 2015. Suicide rate among rural males and rural females declined at a smaller slope after 2005 and 2006, respectively. Urban-male suicide rate declined remarkably from 2002 to 2008, and then stabilized. Urban-female suicide rate decreased by 9.4% throughout the study time period.

3.3. Suicide rate ratios for rural/urban region and gender

Changes in male-to-female (M/F) ratios and rural-to-urban (R/U) ratios of suicide rates from 2002 to 2015 are presented in Fig. 3. In both rural and urban areas, male suicide rates exceeded females' in 2006 and were about 1.4 times females' in 2015. The M/F ratios in both rural and urban areas significantly increased from 2002 to 2015, with AAPCs of 2.8% (95%CI 1.5, 4.0) and 2.3% (95%CI 1.2, 3.4), respectively. In both genders, there was no statistically significant decrease in the R/U ratios of suicide rates during this period (AAPC for males: -2.7% , 95%CI $-1.5, 7.2$; for females: 2.3% , 95%CI $-2.5, 7.2$). The R/U ratios were

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