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# Estimating the influence of the socio-economic inequalities on counties' occupational injuries in Central China

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ABSTRACT

This study explores the influence of socio-economic inequalities on the occupational safety situation in counties in Central China. Self-organizing feature maps (SOFMs) are applied to cluster the occupational safety situation in 346 counties in Central China. The results show that some socio-economic factors, such as the secondary industry added value, scalable industrial output value, infrastructure investment, and gross domestic product, and social factors, such as medical beds, fiscal expenditure, deposits from residents, and employed persons, had significant effects on the occupational safety situation in counties. An S-shaped relationship was also found between the increase of socio-economic development level and the death toll among clusters. Socio-economic inequalities could influence occupational safety on the county level and the significant growth in social level can improve occupational safety situation.



## 1. Background and objectives

China has experienced rapid economic growth and social development since 1978, when the government enacted the reform and opening-up policy. Along with socio-economic reform, a fundamental transformation of new problems in workplace safety emerged (He and Li, 2012), rendering new features to the occupational health and safety issues in China. The overall occupational safety situation in China, as well as in other countries, is still severe. More than 16 million enterprises are estimated to be involved in occupational hazards in Mainland China every year. Consequently, more than 200 million workers are exposed to potential hazards in the workplace every year (Yu et al., 2012). As shown in Fig. 1, the annual number of safety accidents in China has been over 300.000 in the last decade. Although the death toll steadily decreased during the last decade, the occurrence of major accidents demonstrates the serious situation of occupational injuries, with more than 70 000 deaths every year, as shown in Fig. 2. It has greatly offset the normal output of socio-economic.[4]

The origin of accident analysis and accident prevention is rooted in the works of Heinrich (Vitor et al., 2014), who defined a sequential model with domino theory (Heinrich, 1930a). According to this theory, an accident is the culmination of a series of factors and circumstances. Among these elements, the socio-economic factor is an important link, because it shows that an accident can be avoided by removing the socio-economic factor in the sequence (Heinrich, 1930b, 1931). Furthermore, in the epidemiological model of accidents, the occurrence is influence by multiple factors, which form triangular structure and the socio-economic factors, which is at one corner of this triangle (Gordon, 1949 and Swuste et al., 2014). Accidents can be prevented by stopping the vector of socio-economic factors.

An increasing number of studies are becoming relevant to the influence of socio-economic inequalities on the occupational injuries based on geographical areas (Diez Roux, 2001), as regional socio-economic development is recognized as a key aspect affecting occupational safety (Klinische, 2007 and Barth et al., 2007). Some studies have concluded the inverted U-shaped relationship between regional economic development and occupational injuries (Gerdtham and Ruhm, 2006; Law et al., 2008 and Traynor, 2008).

Although some studies have analyzed the inequalities in occupational injury-related mortality by the socio-economic level at both the regional and individual levels (Mercè et al., 2013), only a few studies have done so at the county level or in some small administrative areas (Michelozzi et al., 1999 and Nolasco et al., 2009).

It has been a unique achievement for the modernization process of China and the most significant driving force of the sustained rapid economic development and social progress for the last three

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[4] China's Work Safety Year Book 2004–2013.

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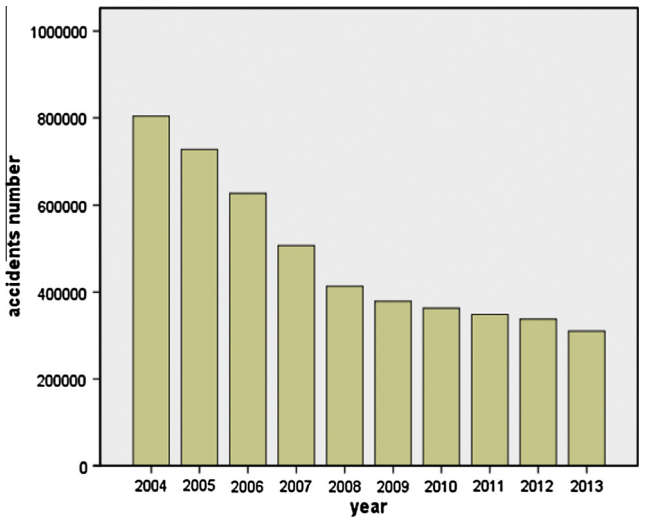


**Fig. 1.** Accidents due to occupational accident in China from 2004 to 2013.

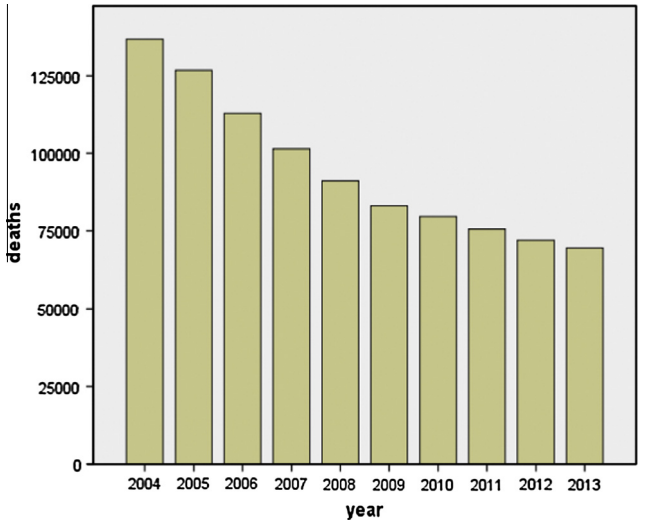


**Fig. 2.** Deaths due to occupational accident in China from 2004 to 2013.

decades.[5] Although the growth rate of the county economy has been significantly higher than the national average since 2008, a widening gap between the rich and the poor has been created in the past years (Ngan and Hui, 1996). Moreover the uneven process of interregional and intraregional development has been intensified. It brought a series of occupational health and safety issues, which is a serious issue that has attracted considerable attention from both policy makers and scholars (Cheng et al., 2013).

The county government always plays a major role in work-related safety management in China. The jurisdiction area of counties covers 92% of the land area of China and is home to 71% of the population of the country.[6] Therefore, the situation of the safety management in China is dominantly affected by the efforts of counties, which are the fundamental jurisdiction units and the most basic administrative divisions in China. The county government has great power over local autonomy which means that the local governments have more management resources to reduce socio-economic inequalities among counties. Therefore, studying the relationship between socio-economic inequalities in the county and the occupational safety situation is important.

However, because of the effects of many factors, such as history, natural resources, economic level, and social conditions, the socio-economic inequalities in occupational injuries have made a great difference in different regions. The rates of fatal occupational accidents are different for individual countries and regions and for separate branches of economic activity (Takala, 1999). A global estimate of occupational accidents indicates that the difference in accident rates between developed and developing countries is remarkable (Hämäläinen et al., 2006).

A total of 2078 counties (excluding prefecture-level cities and its municipal districts) are found in Mainland China,[7] where a major socio-economic inequality exists among them. Their social development and economic levels are different, and their occupational safety situation are also distinct.

In this study, we choose the counties in six provinces of Central China, namely, Shanxi, Henan, Anhui, Hubei, Hunan, and Jiangxi, as the research sample for two reasons. First, the population of the six provinces is 361 million, accounting for 28% or nearly one-third of the national rural population. A large number of migrant workers are exposed to hazards in the workplace (Xinhua Net, 2010) without a sound insurance system and a social security system. Second, because of the promotion plan for the development of Central China, which was issued by the Chinese government in 2004 to hasten the development of central regions, these six central provinces are striving to boost their socio-economic levels. The socio-economic inequalities in occupational injuries among the different counties are increasingly becoming apparent.

Therefore, we raise the following research questions: Does the situation of socio-economic inequalities in occupational injuries among counties truly exist? How do the socio-economic inequalities influence the occupational safety situation in the counties in Central China? Addressing these questions is very important to understand the current situation of occupational injuries in different counties in Central China.

The study was conducted to fill this research gap by modeling and clustering the occupational safety and socio-economic situation of 346 counties in six central provinces through Kohonen's self-organizing feature maps (SOFMs) (Kohonen, 1982). The objective of the present research is threefold. First, we compared the performance of SOFMs against traditional cluster analysis approaches such as K-means cluster and investigated whether SOFM is capable of detecting differences in occupational safety among regions. Second, we classified these 346 counties into several clusters to study the spatial characteristic and tested the factors that affect the safety situation in different clusters. Finally, we investigated the dual effect of socio-economic inequalities in occupational injuries and recommended some policy proposals for different categories of counties.

## 2. Methodology and data

### 2.1. Data collection and inclusion criteria

In this study, the actual numbers of occupational injury mortalities were used to reflect the occupational safety situation in different counties of the six central provinces in China. The data were taken from the website of the State Administration of Work Safety (SAWS).[8] SAWS is an agency directly under the State Council of China and is tasked with the overall supervision and regulation of occupational safety. SAWS is also the working body of the Office

[5] The report of the development of China's county economy, 2012.
[6] China county statistical yearbook, 2013.
[7] China county statistical yearbook, 2012.
[8] http://media.chinasafety.gov.cn:8090/iSystem/shigumain.jsp.