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Occupational injury among migrant workers in China: a systematic review

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Abstract

Objectives—This review considers the state of occupational injury surveillance and prevention among migrant workers in China and suggests areas of focus for future research on the topic.

Methods—Bibliographic databases were searched for qualitative and quantitative studies on surveillance of and interventions to prevent occupational injury among migrant workers in mainland China. Additional abstracts were identified from the citations of relevant articles from the database search. Studies fitting the inclusion criteria were evaluated, and findings were extracted and summarised.

Results—The search uncovered 726 studies in the English-language databases searched, and 3109 in the Chinese database. This article analyses a total of 19 research articles that fit the inclusion criteria with qualitative or quantitative data on occupational injury surveillance and prevention of migrant workers in China. Despite evidence of the vulnerability of migrant workers in the workplace, there is little systematic surveillance of occupational injury and few evaluated interventions.

Conclusions—Migrant workers account for a disproportionate burden of occupational injury morbidity and mortality in China. However, data are inconsistent and inadequate to detail injury

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incidence or to evaluate interventions. The following are suggestions to decrease injury incidence among migrants: strengthen the national system of occupational injury surveillance; focus surveillance and interventions on high-risk occupations employing migrants such as construction, manufacturing and small mining operations; improve occupational safety training and access to appropriate safety equipment; evaluate recent changes in occupational health and safety and evaluate outcome of multi-party interventions to reduce occupational injury among migrant workers.

Migrant workers around the world tend to be employed in more dangerous jobs and have higher rates of injury than native-born workers.[1–4] Migrants from rural China to the major employment centres of the nation have become an important part of one of the world's largest economies even as high profile incidents of workplace injury have become global news.[5,6] The estimated 145–230 million rural Chinese migrants, called *nongmingong* in Chinese and often translated as 'peasant workers' in English, are clearly defined by their legal residency status, or *hukou*, first codified in a system of population controls under the leadership of Mao Zedong.[5]

In the last 10 years, literature reviews have described employment and migration patterns,[7] as well as changes in household registration policy for China's migrant workers.[5,8] Other reviews have described the scale of unintentional injury[9] and occupational disease among the general population in China,[10,11] including the disparities between the so-called township-village enterprises (TVE) and large state owned companies.[12,13] The reviews suggest that China's migrant workers bear a disproportionate burden of occupational injury morbidity and may represent the majority of deaths from occupational injury in China.[9,12]

The rural migrants are predominantly young men between 20 and 30 years old with no more than a junior high school education, though about 35% of migrant workers are women.[14] Without legal urban residency, migrant workers suffer pervasive job discrimination and are concentrated in low-wage sectors of the economy, often in physically demanding, dirty or dangerous jobs that local workers avoid.[15] These migrant workers typically work greater than 10–12 h per day for 6 or 7 days per week in poorly regulated businesses, often without a contract or formal labour agreement.[16]

While migrants work in many different sectors of the economy, they are concentrated in manufacturing, construction and the service sector.[7,17] Up to a third of migrant men work in construction, making up over 90% of the urban construction workforce.[18] Many others work in the informal economy as vendors, recyclers or repairmen, while women find work on labour intensive production lines or as domestic workers.[19]

Despite the large working migrant population, there has been no systematic review of literature on occupational injury risk, surveillance and prevention among migrant workers in China. As China seeks to modernise its injury prevention infrastructure,[20,21] the occupational safety and injury surveillance of China's large migrant work force will be important in informing this process. This paper aims to summarise the available research in English and Chinese related to surveillance and prevention of occupational injury among China's

migrant workers and identify ways to improve injury surveillance and prevention within this population.

METHODS

The review identified articles through searches of 13 electronic bibliographic databases and websites, including a primarily Chinese language database (box 1). The search strategy used text words and filters for articles published from 2000 through 2011 to identify peer-reviewed articles or government reports published in English or Chinese about occupational injury risk, surveillance or prevention among migrant workers in China. The full search strategy is described in the online supplementary file 1.

Two reviewers each reviewed the resulting article titles and publication information to exclude all articles that were neither peer-reviewed nor government reports, as well as those clearly unrelated to the topics of interest. After this exclusion, two reviewers examined all abstracts that fit the search criteria and identified for full text review all articles pertaining to migrant workers in mainland China that included themes of interest. Articles focused on Taiwan, and the 'special administrative zones' of Hong Kong and Macau were excluded because of differences in policy and administration. Articles with policy or research suggestions that lacked supporting qualitative or quantitative evidence were excluded. Citations of relevant articles were also reviewed to find additional articles missed by our original search terms. Inclusion and exclusion criteria are detailed in the accompanying box 2.

All peer-reviewed studies and government reports with qualitative or quantitative data concerning occupational injury risks, surveillance and prevention among migrant workers in China were analysed. Two researchers independently examined each of these articles to extract information about the population studied, sample size, study design, principal findings, study limitations and risk of bias. All quantitative data on injury incidence and as well as HRs or ORs of risk factors for occupational injury were extracted as possible principal summary measures. This information was organised in a table (see online supplementary table 1) to present extracted information for each article.

When reviewers disagreed on the inclusion of an article, the disagreement was discussed and if no agreement was possible the article was included.

Reviewers used a modified Cochrane Collaboration tool for non-randomised trials to assess risk of bias and presented high or unclear risks of bias in a data extraction table (see online supplementary table 1).[22]

RESULTS

Description of studies included

The database search results were 726 unique articles from the English-language databases, and 3109 articles from the Chinese database China National Knowledge Infrastructure (CNKI). After excluding clearly irrelevant titles from the search results as well as articles from the CNKI database that were neither government reports nor peer-reviewed studies,

151 articles from the English language search and 283 from the Chinese database were identified for abstract review. From the abstract review, 43 English-language articles and 45 Chinese articles related to the themes of interest were identified for a full text review. An abstract review of these articles identified an additional 84 articles of interests, including 56 articles found to be relevant and reviewed in full. A total of 19 studies were identified that fit the inclusion criteria. The process of search, exclusion and inclusion of articles is detailed in an accompanying flow diagram (figure 1). The 19 articles analysed for this review are presented in the online supplementary table 1.

These 19 studies included two sets of key informant interviews,[2324] six cross-sectional surveys of migrant workers,[25–30] one case-control study,[31] four hospital-based surveys of injured workers,[32–35] two analyses of government data,[3637] one description of an unevaluated intervention,[38] two evaluated injury prevention interventions[3940] and one literature review.[41] Nine included studies were published in international journals[122324272832333940] and seven in Chinese journals.[252629–313537] Three were Chinese government reports.[343638]

Primary outcomes

One study published ORs for risk factors of occupational injury comparing injured and uninjured migrant workers in a case-control model.[31] Three studies published the self-reported annual injury incidence based on surveys of migrant workers, including information on mechanism of injury.[25–27] Two studies published the prevalence of a history of workplace injury,[2829] and one of these compared the prevalence among urban workers, rural workers and migrant workers using χ^2 analysis.[28]

Four studies published the proportion of occupational injury or certain traumatic injury patients at local hospitals who were migrants.[32–35] One of these studies compared the proportion of injuries presenting to a Shanghai ER that happened at work between patients born in Shanghai and migrant workers in Shanghai using an adjusted prevalence ratio.[33]

One study published the proportion of annual occupational injury-related mortality in one province among migrant workers.[36] Another government report estimated the proportion of deaths caused by occupational injury in the construction industry nationwide among migrant workers.[37]

Of the two interventions designed to decrease injury among migrant workers, one was evaluated using improved occupational health and safety knowledge, while another measured improved access to occupational health and safety services as an outcome of interest.[3940]

Summary results

Workplace hazards for migrant workers—Griggers-Smith interviewed injured migrant workers seeking legal redress for their injuries. The workers reported that they routinely ignored safety precautions because their workloads required them to work prohibitively fast. Some interviewed migrants reported physical assaults by employers and

management, while others suffered traumatic amputations while working with machinery without adequate training or safety equipment.[23]

Interviewed migrant workers in Shanghai reported that companies producing hazardous chemicals purposefully hired migrants for short-term employment to handle toxic chemicals.[24] The authors speculate that this allows employers to change workers before the detrimental effects of chemical exposure manifest. However, the data from this survey were incompletely reported, and it is unclear how interviewed migrants were recruited.[24]

Wang and colleagues reviewed research on occupational safety within local-government owned businesses known as TVE. They report two Chinese articles showing that migrants constitute the majority of workers within selected TVE in Shanxi. They also publish survey data that between 2% and 8% of TVE shoe workers suffer acute chemical poisoning. Their article additionally contains an analysis showing that TVE mines had a reported death rate between seven and eight times higher than that for larger state mines in previously published data from 1992 to 2003. However, the data that migrants are the majority of certain TVE enterprises are not from the same samples as the injury and exposure data.[12]

Risk factors for injury among migrant workers—In one case-control study of 217 injured migrants and 220 healthy migrants in Shanghai, occupational injury was associated with lower education (OR 16.67), longer weekly work hours (OR 3.72) and less job experience and training (OR 2.12) ($p<0.05$).[35] Surveys of other migrant workers in Shanghai found that electricians, lifeguards and construction workers were at the highest risk of getting injured.[27] Injury incidence of male workers was also significantly higher than that of female workers ($\chi^2=22.7$, $p<0.01$).[27] However, surveys of construction workers in Hefei found no significant difference between unadjusted injury rates of male and female workers.[25]

Occupational injury surveillance among migrant workers—One analysis of national government data estimated that migrants make up 32 million of the 38.93 million construction workers in the country and 85% of the deaths from occupational injury in that field.[37] Another government report detailed occupational injury-related mortality in Jiangsu province reporting that migrant workers made up approximately a third of the province's workforce, but accounted for 80% of the 252 fatal workplace injuries reported during the first 8 months of 2006, and 90% of such deaths in construction.[36]

Several studies reported results from hospital-based surveys of injured migrant patients. The Ministry of Health reported that 84% of the traumatic hand injury patients at Tianjin Hospital over 1 year were rural migrants to the area.[34] Of these, 91% of the injuries happened at work.[34] However, outcome data were incompletely reported from this government research.[34] Xie and colleagues report that 95% of 244 burn patients at the Guangdong Red Cross Hospital over a 4-year period were migrants, and 68% of these injuries occurred at work.[32] Another hospital-based surveillance system in Shanghai reported that 60% of injury patients who were migrants were injured at work, while 30% of the Shanghai-born patients were injured at work, with a prevalence ratio of 1.6, adjusted for gender and salary.[33] In Wuhan city, 88% of 597 'accidental injury' patients presenting to the

Xiehe Hospital of Tongji Medical College over 12 months during 2008 and 2009 were migrant workers. It is unclear how many of these injuries occurred at work.[35]

Self-reported injury data—Surveys of construction workers in Hefei City found the self-reported annual injury incidence per 100 workers to be 20.4 in railroad construction[25] and 28.96 in building site construction.[26] Among migrant workers of various jobs in Hangzhou, 23% reported a history of work-related injury compared with 16% of locally born urban workers in the same work units and 10% of workers still in rural Zhejiang.[28] Shi Zheng found 40.7% of 383 migrant workers interviewed in Beijing reported a history of workplace injury.[29]

Recent research exploring occupational injury among migrant workers in Shanghai found an annual injury incidence rate of 38.3 per 100 workers, though 60% of these injuries occurred outside of work.[27]

Injury mechanism—One study among migrant construction workers in Hefei City reported the 1 year mechanism specific injury incidence rates per 100 people of the following most common injury mechanisms: falls (5.6), being struck by an object (5.5) and penetrating trauma (4.0).[25] A cross-sectional study of Shanghai migrant workers injury found the following annual injury incidences by mechanism per 100 workers: penetrating injury (9.5), falls (7.2), traffic injury (6.3) and burns (5.3). These rates include injuries while working and during workers' free time.[27] Another study of migrant construction workers in Hefei presented the following most common causes of injuries as a percentage of total injuries: falls (21.61%), struck by an object (19.42%), machinery and equipment related (17.37%), and traffic injury (10.59%).[26]

Occupational safety resources—One cross-sectional survey of 8014 migrant workers in Shenzhen showed 33% were aware of basic occupational health services, fewer than half were using the protective equipment provided, and only 35% had any occupational health or safety training.[30] Two nationwide surveys of TVE, in 1990 and in 2000, found less than 2% of workplaces had preventive safety inspections, and less than 4% had any workplace hazard monitoring.[12]

Interventions—The Ministry of Health published a brief description of pilot projects designed to increase availability of basic occupational health and safety services that have been established in 20 counties specifically targeting the needs of migrant workers.[38] One of these pilot programmes was evaluated in a Shanghai district home to an estimated two million migrant workers.[39] Occupational health and safety surveillance improved from covering approximately 12% of migrant workers in 2001 to close to 80% in 2008.[39]

Szudy and colleagues designed a participatory model for employers to work with migrant workers to improve occupational safety, including needs assessment, participatory occupational safety workshop, and plant-wide health and safety committees with worker participation. Evaluations showed enthusiastic worker cooperation and improved safety knowledge. The researchers also noted resistance from supervisors and an inability to implement safety improvements suggested by the safety committees.[40]

Risk of bias across studies—Several studies cited interviews with selected groups of injured migrant workers, which are fraught with selection bias. Without quantitative data, these interviews are largely useful to direct further investigation and to formulate hypotheses.[2324] Incomplete reporting of outcomes of both government reports and independent research also calls into question much of the data on occupational injury surveillance among migrants in China.[24343637] While it is unclear if incomplete reporting biases in one direction, it is clear that many of the cross-sectional surveys of migrant workers will tend to underestimate injuries, since severely injured workers are less likely to return to work to be surveyed and may return to their home village for care.[25–30] On the other hand, surveys that do not specify where an injury occurs may tend to inflate occupational injury incidence estimates and distort cause analyses by mixing workplace injuries with unrelated injuries of migrants.[33–35]

DISCUSSION

Summary of evidence

A thorough review of the literature revealed inconsistent injury surveillance among migrant workers in China. There is some information from poorly described national databases and samples of local research from a few specific locations. However limited, the data suggest that many migrants work in dangerous environments, that migrants' injury rates are disproportionately high, and that migrants constitute the majority of certain traumatic injuries in specific hospitals in some urban areas where manufacturing or construction dominate. This has prompted at least one knowledgeable researcher to comment that occupational injury-related mortality occurs 'mainly among rural residents who have joined the workforce in poorly regulated private mining, construction, and manufacturing firms.'[9] However, a review of the literature shows very little occupational injury data about a very large working population with evidence of significant injury risk and incidence. There are several ways that injury surveillance and prevention could be improved based on the available evidence and corresponding lack of evidence.

Recommendations and supporting evidence

Identify geographical areas and high-risk occupations employing migrants such as construction, manufacturing and TVE mining operations, and target these areas for evaluated interventions to improve injury surveillance and prevention—Interviews of injured migrant workers show that certain positions are fraught with hazards to life and limb, and there is empirical evidence identifying high-risk positions such as construction workers, machine operators, chemical workers and miners. Some of the riskiest positions in the Chinese labour market are in poorly regulated and undersampled populations such as small mining operations.[6] However, this review of the literature showed very little data about injury risks, morbidity or mortality for such positions. Similarly, there are significant geographic variations in occupational safety and injury rates within China.[102021] It may be most impactful to target resources toward identifying and intervening in such high-risk occupations and locations.

Identifying the positions that employ migrants may help identify such high-risk positions. Wang and colleagues argue that migrants are the primary employees of the most dangerous small mines such as TVE mining operations, but there is limited evidence documenting that assertion.[12] The data have not kept up with popular understanding of migrant worker injuries in China.

Even where migration data are unavailable, researchers notice differences that they attribute to large numbers of migrants. In their analysis of industrial injuries in Shunde City in Guangdong, Yu and colleagues attributed the surprisingly high mortality among female workers in their study to predominantly female group of migrant workers in the industrial factories of their survey area.[41] This demonstrates the value of understanding where migrant workers are employed and what their work-place injury risks are.

Improve access to occupational safety training and strengthen requirements for the use of appropriate safety equipment, especially among migrant workers—The lack of proper training and the lack of proper use of safety equipment are repeated themes in interviews with injured workers.[2324] Data show that a majority of Shenzhen workers sampled lack safety training and do not use safety equipment,[30] and the lack of proper training and poor education are cited as risk factors for occupational injury among migrant workers.[31] Other authors speculate that the improper use of safety equipment may be related to increased rates of migrant worker chemical burns.[32] These are concrete actionable targets to improve injury prevention among vulnerable workers. Notably, research in Shanghai by Xia and colleagues suggests that migrant workers want more occupational safety education and training.[27]

Strengthen and standardise a nationwide system of injury surveillance in China with particular focus on occupational injury—The limited injury surveillance in China is not only a problem for migrant workers or for occupational injury data. Non-fatal injury surveillance in general was described in 2005 as ‘piecemeal and often of poor quality so reasonable estimates of national injury morbidity cannot be generated.’[9]

Surveillance of mortality from occupational injury is patchy, and different government agencies report conflicting results. The State Work Accident Briefing System recorded fewer than 14 000 work injury deaths during a 2-year period between Spring 2001 and 2003.[42] An analysis of these deaths revealed an implausibly low proportion of deaths from construction and manufacturing.[42] Though data on migration status are not reported, the absence of expected deaths in construction suggests that under-reporting among migrant workers was disproportionately high.

The Chinese Ministry of Health recorded more than 100 000 annual deaths from occupational injury from 1996 to 2005, with 139 393 deaths from occupational injury recorded in 2002 and 127 089 in 2005.[27] However, it is unclear how the data were collected, and the proportion of migrants that make up these deaths is not available. Furthermore, the job title or industry in which the occupational injury took place is available for only 15 868 of the deaths in 2005.[27]

Starting in 2005, the National Bureau of Statistics (NBS) published 'preliminary' occupational injury mortality data. While the figure for 2005 approximates the Ministry of Health total, NBS estimates steadily dropped approximately 10% per year with the most recent figure of 83 196 in 2009.[4344] However, independent researchers have not published analyses of these data nor the data collection methods. That this decline resulted immediately after reporting switched to a different agency is an additional reason to remain sceptical of the NBS figures.

Evaluate safety improvements and changes in occupational injury related to recent occupational health and safety regulations, particularly with regard to high-risk migrant workers—Though not specific to migrant workers, evaluations of recently strengthened occupational health and safety policy have important implications for China's most vulnerable work force. Recent reforms of occupational health and safety legislation and enforcement have made some significant structural improvements.[21] For example, until recently occupational health and safety regulation and enforcement were the responsibility of the ministry for each industry sector, while TVE were not regulated at all.[12]

The implementation of a centralised national State Administration of Coal Mine Safety was followed by a decrease in the number of mining disasters.[2021] Similarly, strict enforcement of mining regulations and closure of unlicensed and often unsafe TVE mines appear to correlate with a decrease in mining fatalities, though it has been difficult to keep such mines closed as enforcement remains under local control.[1221] In spite of these improvements, the small-scale mining operations, where migrants are said to be most likely to work, remain disproportionately dangerous.[122145] There is inadequate evidence to evaluate the effects of these new policies and regulations on the safety of migrant miners. Generally speaking, very little analysis of the effects of recent national occupational health and safety policy has been published. In light of changes in occupational health and safety regulation, a careful analysis of recent occupational injury data especially focusing on high-risk migrant workers would likely have very interesting results.

Evaluate outcomes of efforts to improve workplace injury surveillance and prevention among migrant workers—The success of the few published efforts to decrease the rate of occupational injury among migrant workers remains unclear.

The limited intervention data available suggest that recent efforts to improve occupational health and safety surveillance among migrant workers have had some success.[3940] However, the long-term effect of these interventions locally, as well as their applicability nationally, remains unclear.

The model of NGO, employer and employee cooperation proposed by Szudy and coworkers is intriguing, though the ultimate effect of their intervention on employee safety is not clear. Nevertheless, the model shows promise where worker conditions have become a well-known marketing liability. A recent example is the negative publicity surrounding worker suicides and working conditions at the Foxconn factory that produces the popular iPhone and iPad devices.[46] Apple and Foxconn contracted with the Fair Labour Association to evaluate

workplace conditions and make suggestions for improvement.[46] It would be very interesting to study the effects of such an intervention on workplace safety and injury.

Another area of interest is initiatives by migrant workers themselves to improve occupational health and safety. Migrants have historically been poorly represented in trade unions in China, but membership of migrants is increasing.[47] While representation of Chinese unions is inconsistent, there is some evidence that the presence of official unions in the Chinese workplace is associated with improved safety conditions.[48] Furthermore, a wave of unaffiliated 'wildcat' strikes and workplace actions led by migrant workers have occurred in response to unsafe work conditions as well as low wages.[49] These actions have met with some success in certain cases, but their effect on workplace safety and injury remains unclear and merits further research.[49]

Study limitations

This study is the result of an international, multi-lingual collaboration. The resulting cross-cultural and cross-linguistic communications could be a limitation. Attempts were made to clarify goals and criteria for the study. Additionally, two researchers performed each literature search independently in each language to allow some redundancy.

CONCLUSIONS

There is evidence of disproportionate workplace injury risk for China's migrant workers, but injury surveillance is patchy and inconsistent, and very few interventions targeting this population have been evaluated. There are opportunities to strengthen injury surveillance by improving the quality of national databases and focusing local efforts on high-risk workers such as migrants in mining, manufacturing and construction. Injury prevention work would also benefit from careful evaluation of interventions already being implemented including government policy changes and independent initiatives. This work has the potential to improve the lives of the workers and the health of the industries driving China's economic engine.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Box 1

Databases searched in this systematic review

1. Pubmed
2. EconLit
3. PyschInfo
4. Web of Science SSCI expanded
5. BIOSIS Preview
6. Journal Citation Reports
7. SafetyLit
8. HMIC
9. CINAHL
10. EPPI-Centre
11. Center for reviews and dissemination database
12. Database of abstracts of reviews and effects
13. China National Knowledge Infrastructure (CNKI)

Box 2

Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
▸ Peer reviewed articles or government reports ▸ Published from the beginning of 2000 to the end of 2011 ▸ Written in English or Chinese ▸ Contain qualitative or quantitative data about occupational injury risks, occupational injury surveillance or occupational injury prevention of migrant workers in China	▸ Data from only Hong Kong, Macau or Taiwan ▸ Commentary or recommendations without any supporting data

What is already known on the subject

- Migrant workers from rural China, known as *nongmingong*, have become a large part of the Chinese workforce, especially in low-wage and physically demanding positions.
- Injury prevention, especially occupational injury prevention, is an increasing concern among researchers and government officials in China.

What this study adds

- This study details existing surveillance of occupational injury among migrant workers in China and describes evaluated interventions to decrease occupational injury among this population.
- This study uses available research data to offer recommendations for improvement of occupational injury surveillance and prevention among migrant workers in China.

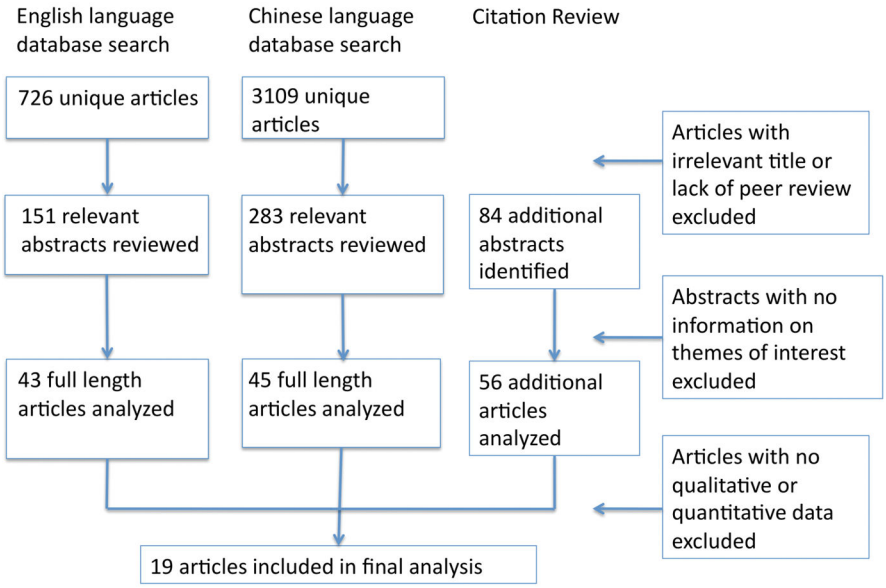

Figure 1.
Flow diagram of study search and selection.