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**Original Article**

# Effects of occupation on intracerebral hemorrhage-related deaths in Inner Mongolia

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**Abstract: This study assessed the relationship between occupation and Intracerebral Hemorrhage-related deaths and compared the differences in ICH-related deaths rates between the eastern and midwestern regions of Inner Mongolia. We used the case-control method. Cases included Intracerebral Hemorrhage-related deaths that occurred from 2009 to 2012 in Inner Mongolia while controls included non-circulatory system disease deaths that occurred during the same period. Odds ratios (ORs) for Intracerebral Hemorrhage-related deaths were calculated using logistic regression analysis, estimated according to occupation, and adjusted for marital status and age. The Intracerebral Hemorrhage mortality rate in the eastern regions (125.19/100000) was nearly 3 times higher than that in the midwestern regions (45.31/100000). ORs for agriculture-livestock workers, service professionals and general workers, professional workers and senior officials were in descending order. The age-adjusted OR for Intracerebral Hemorrhage-related deaths was lowest in unmarried men senior officials (OR 0.37, 95% CI 0.14–0.99). The Intracerebral Hemorrhage mortality rate in the eastern regions was much higher than that of the midwestern regions, since about 90% of Intracerebral Hemorrhage-related deaths in the eastern regions were those of agriculture-livestock workers who has the largest labor intensity of any other occupation assessed.**

**Key words:** Intracerebral hemorrhage, Mortality, Occupational health, Risk, Inner Mongolia

## Introduction

Stroke is estimated to result in 134,000 deaths annually and is the third leading cause of death (after heart disease and cancer) in the nation[1)]. Stroke is classified primarily into 2 types, ischemic (80–85% of cases) and hemorrhage (15–20% of cases) in Brazil and in Latin America[2)]. Intracerebral hemorrhage (ICH) accounts for 10–20% of strokes in Western countries, however, can reach twice this proportion in Asia[3, 4)]. In China, ICH accounts for up to a third of all strokes[5)]. ICH is the most serious and least treatable form of stroke; additionally, it is associated with a mortality rate of up to 50%, and half of those who survive are left with significant disabilities[3)].

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Differences in the prevalence of major risk factors among the stroke subtypes, demonstrating that knowledge of pathophysiology is essential for the proper management of these patients. Given this, learning more about the epidemiologic data of the region is vital[2]. In China, significant geographic variations in ICH mortality rates were observed, with higher rates being found in the north and lower rates in the south[6]. Some studies have shown that age, ethnicity, educational status, and marital status are associated with ICH[7–10]. Compared to other age groups, the older adult population is at a higher risk of ICH, as the mortality rate in the ≥70 group has recently shown an alarming increase[10]. Although there are many studies examining the relationship between cerebrovascular or stroke deaths and occupation, these studies have not been conducted uniformly[11–13]. Some epidemiological studies investigating the association between ICH-related deaths and occupation classified occupation in terms of working hours[14], socioeconomic status[15], and work intensity[16]. Despite the potential for certain occupations to increase the risk of stroke, the Guidelines for the Primary Prevention of Stroke in America currently do not consider working conditions and labor intensity as documented risk factors for cardiovascular diseases or stroke[17]. To our knowledge, so far, there are no empirical studies examining the relationship between ICH-related deaths and occupation in China.

Our previous study showed that circulatory system diseases are considered as the main cause of death in Inner Mongolia[18], however, we did not know about how ICH severity relates to the circulatory system. Our objective was to evaluate the relationship between occupation and ICH. The distance difference between the eastern and midwestern regions is 2,400 km, which leads to a different geographical environment between eastern and midwestern regions in Inner Mongolia. The latitude difference between the eastern and midwestern regions is 29°, which leads to a different climate[19]. The above two reasons lead to great differences in industrial characteristics. Since the differ greatly in terms of lifestyle, temperature, and historical and geographical environments, we discuss the above-mentioned relationship with regard to these regions. This study provides data for future research on ICH, and the results may help guide future interventions.

## Subjects and Methods

*Data source*

The data were obtained from the Death Registry System (DRS), which is maintained by the Ministry of Health of the People's Republic of China and executed by the Inner Mongolia Autonomous Region Centers for Disease Control and Prevention. The DRS uses a multistage cluster probability sampling strategy stratified by region, local gross domestic product, proportion of rural dwellers, and the total population of local areas[20]. The monitoring points of the DRS in Inner Mongolia included Kailu County and Bairin Youqi (eastern); and Sonid Youqi, the Muslim District, and the Linhe District (midwestern). All hospitals with adequate diagnostic qualifications are responsible for recording all ICH-related deaths in the DRS. These hospitals were divided into four levels: provincial, municipal, county, and township. Clinical diagnosis can be provided in all four level hospitals. These diagnostic methods include pathological, clinical, and surgical diagnoses, as well as postmortem evaluations. Clinical diagnosis includes imaging diagnosis, pathological-anatomical diagnosis, the diagnosis related to the need for surgery, and pathophysiological diagnosis[20]. In all cases, ICH was diagnosed using cranial computed tomography, magnetic resonance imaging scans, and complementary examinations.

We used data on the total population, total number of deaths, and number of ICH-related deaths from 2009 to 2012. Cases included ICH-related deaths that occurred from 2009 to 2012. The original data on the number of deaths were coded (ICH codes I61.0–I61.9) according to the Tenth Revision of the International Classification of Diseases. The controls included deaths that were randomly selected from all non-circulatory system disease deaths and were matched with the ICH-related death cases according to the time of death, area of death, gender, and age (± 2 yr) in a 1:1 ratio.

All data were checked for eligibility and validity prior to analysis. The data collected in the DRS included information on gender, age (<50 and ≥50), regions (rural and urban), ethnicity (Mongolian, Han, and other), marital status (married and unmarried—unmarried included those who were widowed or divorced), educational status (low [literature, and primary and middle school] and high [college and university]), and occupational status (occupations were categorized into the following 6 groups according to the PRC Occupational Classification: senior officials, professional workers, general workers, service professionals, agricultural-livestock workers, and others)[21]. The classification of work intensity is based on the recommendations of the Chinese Nutrition Society: it is divided into light work-intensity (75% of the time to sit or stand, 25% of the time is a standing activity), including: senior officials, moderate work-intensity (25% of the time to sit or stand,

75% time to engage in special professional activities of medium intensity), including: service professionals, professional workers, severe work-intensity (40% of the time to sit or stand, 60% of the time to engage in special professional activities of heavy intensity), including: agriculture-livestock workers, general workers[22]. "Others" refers to individuals who do not fit into the other five occupations, such as those with an unclear occupation record or who lack such a record, those without fixed work, and those who have never worked.

ICH is defined as (adapted from the Classification of Cerebrovascular Disease III-1989) a spontaneous, nontraumatic, abrupt onset of severe headache, altered level of consciousness, or focal neurological deficit that is associated with a focal collection of blood within the brain parenchyma seen on neuroimaging or at autopsy and is not attributable to hemorrhagic conversion of a cerebral infarction[23]. The procedure to identify the cause of death especially when a person died at home was based on "the place of death" in registration records in DRS.

*Statistical analysis*

The differences in ICH mortality between the eastern and midwestern regions from 2009 to 2012 was plotted on a graph. Unconditional multiple logistic regression was used to estimate age-adjusted odds ratios (ORs) for ICH-related deaths and 95% confidence intervals (95% CIs) according to occupation. To assess whether the association between occupation and ICH-related death was modified by marital status or age, the ORs for ICH-related deaths were estimated according to occupation and adjusted for marital status and age. The most frequent categories "agricultural-livestock workers" was set as referent.

Microsoft Excel and SPSS 13.0 statistical software were used for data management and analysis. $P<0.05$ was considered statistically significant difference throughout this study.

*Ethical approval*

Ethical approval for this study was obtained from the Ethics Committee of Inner Mongolia Medical University.

## Results

The annual average population of the five monitoring points was 1.5 million, accounting for about 6% of the total population in Inner Mongolia (men: 50.84%; women: 49.16%). ICH death was ranked as the second highest circulatory system death out of all deaths. A total of 2,906 and 1,731 Inner Mongolia residents died from ICH in the eastern and midwestern regions, respectively, during the period from 2009 to 2012. The crude ICH mortality rate in Inner Mongolia at five monitoring points was 75.51/100000/yr from 2009 to 2012, which accounted for 52.05% of all cerebrovascular deaths. It is important to note that the mortality rate in the eastern regions—125.19/100,000 (95% CI: 120.64–129.74)—was nearly 3 times higher than that of the midwestern regions—45.31/100,000 (95% CI: 43.18–47.44). The ICH mortality rate for both men and women in the eastern regions was higher than that in the midwestern regions. The deaths in the ≥50 age group accounted for 76.82% of all ICH-related deaths. In the eastern regions, ICH-related deaths in the home accounted for about 80% of the agriculture-livestock workers' deaths, 60% of the professional workers' deaths, 40% of the general workers' deaths, and 30% of the service professionals' deaths.

Table 1 shows the number and percentage distribution of gender, age, region, ethnicity, marital status, occupational class and educational status for ICH and controls overall as well as in eastern and midwestern regions separately. Of the 4,637 ICH, 2,906 (62.7%) were in eastern regions, and 1,731 (37.3%) were in midwestern regions. For the agriculture-livestock works, 2,484 (85.48%) were in eastern regions, and 558 (32.24%) were in midwestern regions.

The ICH-related deaths of agriculture-livestock workers in the eastern regions was 4.45 times higher than that in the midwestern regions.

Figure 1 shows the temporal changes in ICH mortality rates between the eastern and midwestern regions. The ICH mortality rate in the eastern regions increased ($p<0.001$), with annual percentage change (APC) of 8.22% during a four-year period ($p<0.05$). There was no significant temporal change in mortality rate in the midwestern regions ($p=0.68$). During the period from 2009 to 2012, the ICH mortality rate in the eastern regions was 2–3 times higher than that in the midwestern regions.

The logistic regression analysis of ICH in relation to selected factors by gender in both the eastern and midwestern is shown in Table 2. The results showed that for men and women in both the eastern and midwestern, individuals who were unmarried and in the ≥50 age group were at a higher risk of ICH-related deaths than those who were unmarried and in the <50 age group, except for women marital status in eastern. The occupations associated with ICH-related deaths showed great variance. In the eastern regions, men senior officials and professional workers

**Table 1. Characteristics of ICH and control group**

| Factor | Eastern | | | | Midwestern | | | |
|---|---|---|---|---|---|---|---|---|
| | ICH (n) | % | Control (n) | % | ICH (n) | % | Control (n) | % |
| Gender | | | | | | | | |
| Women | 1,031 | 35.48 | 1,072 | 36.89 | 556 | 32.12 | 555 | 32.03 |
| Men | 1,875 | 64.52 | 1,834 | 63.11 | 1,175 | 67.88 | 1,178 | 67.97 |
| Age | | | | | | | | |
| <50 | 401 | 13.80 | 723 | 24.88 | 225 | 13.00 | 418 | 24.12 |
| ≥50 | 2,505 | 86.20 | 2,183 | 75.12 | 1,506 | 87.00 | 1,315 | 75.88 |
| Region | | | | | | | | |
| Rural | 2,902 | 99.86 | 2,899 | 99.76 | 735 | 42.46 | 719 | 41.49 |
| Urban | 4 | 0.14 | 7 | 0.24 | 996 | 57.54 | 1,014 | 58.51 |
| Ethnicity | | | | | | | | |
| Han | 2,329 | 80.14 | 2,355 | 81.04 | 1,553 | 89.72 | 1,577 | 91.00 |
| Mongolian | 562 | 19.34 | 528 | 18.17 | 102 | 5.89 | 90 | 5.19 |
| Other | 15 | 0.52 | 23 | 0.79 | 76 | 4.39 | 66 | 3.81 |
| Marital status | | | | | | | | |
| Unmarried | 1,201 | 41.33 | 760 | 26.15 | 1,115 | 64.41 | 148 | 8.54 |
| Married | 1,705 | 58.67 | 2,146 | 73.85 | 616 | 35.59 | 1,585 | 91.46 |
| Occupational class | | | | | | | | |
| Agriculture-Livestock | 2,484 | 85.48 | 2,133 | 73.40 | 558 | 32.24 | 510 | 29.43 |
| General workers | 85 | 2.92 | 130 | 4.47 | 355 | 20.51 | 239 | 13.79 |
| Service professionals | 62 | 2.13 | 65 | 2.24 | 76 | 4.39 | 76 | 4.39 |
| Professional workers | 147 | 5.06 | 239 | 8.22 | 48 | 2.77 | 29 | 1.67 |
| Senior officials | 25 | 0.86 | 77 | 2.65 | 135 | 7.80 | 95 | 5.48 |
| Other | 106 | 3.65 | 262 | 9.02 | 559 | 32.29 | 784 | 45.24 |
| Educational status | | | | | | | | |
| Low | 2,166 | 74.54 | 1,913 | 65.83 | 1,080 | 62.39 | 1,154 | 66.59 |
| High | 740 | 25.46 | 993 | 34.17 | 651 | 37.61 | 579 | 33.41 |

were at a lower risk for ICH-related deaths compared to the agriculture-livestock workers, while in the midwestern regions, the senior officials, professional workers and general workers showed risk factors compared to the agriculture-livestock. Eastern general workers women had significant risk factors.

Table 3 shows the adjusted ORs and 95% CIs for ICH-related deaths according to occupation for both men and women in the eastern and midwestern regions. Among men, in the eastern regions, regardless of whether we adjusted only for age or for both age and marital status, the adjusted ORs showed a dose-dependent decrease with work-intensity level with agriculture-livestock workers as the reference. In the Midwestern regions, professional workers and senior officials had a higher risk of ICH-related death, regardless of whether adjustments had been made for certain variables. However, for women, there were no significant differences in ICH risk between the Eastern and Midwestern regions, regardless of whether adjustments had been made for certain variables.

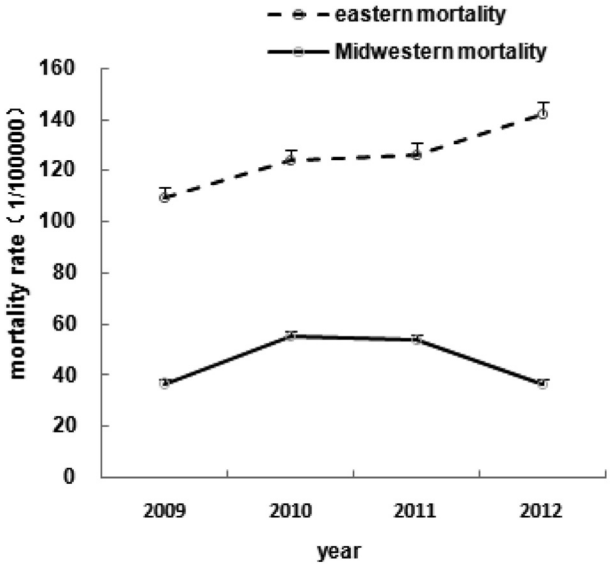


**Fig. 1. ICH mortality in the eastern and midwestern regions of Inner Mongolia.**

**Table 2. Logistic regression analysis of ICH by gender in both the eastern and midwestern regions**

| Factors | Men | | | | Women | | | |
|---|---|---|---|---|---|---|---|---|
| | Eastern | | Midwestern | | Eastern | | Midwestern | |
| | Crude OR | 95% CI | Crude OR | 95% CI | Crude OR | 95% CI | Crude OR | 95% CI |
| Age | | | | | | | | |
| <50 | 1 | referent | 1 | referent | 1 | referent | 1 | referent |
| ≥50 | 1.83 | 1.56–2.14 | 1.92 | 1.56–2.36 | 3.01 | 2.31–3.93 | 2.93 | 2.04–4.22 |
| Region | | | | | | | | |
| Rural | 1 | referent | 1 | referent | 1 | referent | 1 | referent |
| Urban | 0.98 | 0.24–3.92 | 1.06 | 0.90–1.25 | 0.00 | 0.00–0.00 | 0.78 | 0.62–0.99 |
| Ethnicity | | | | | | | | |
| Han | 1 | referent | 1 | referent | 1 | referent | 1 | referent |
| Mongolian | 1.06 | 0.90–1.25 | 1.07 | 0.74–1.53 | 1.10 | 0.88–1.37 | 1.33 | 0.81–2.19 |
| Other | 0.55 | 0.25-1.19 | 1.27 | 0.85–1.91 | 1.06 | 0.31–3.67 | 0.97 | 0.53–1.78 |
| Marital status | | | | | | | | |
| Unmarried | 1 | referent | 1 | referent | 1 | referent | 1 | referent |
| Married | 0.15 | 0.12–0.18 | 0.04 | 0.03–0.06 | 1.23 | 1.04–1.46 | 0.07 | 0.05–0.10 |
| Occupational class | | | | | | | | |
| Agriculture-Livestock | 1 | referent | 1 | referent | 1 | referent | 1 | referent |
| General workers | 0.77 | 0.52–1.13 | 0.89 | 0.61–1.29 | 1.01 | 0.43–2.39 | 1.15 | 0.51–2.59 |
| Service professionals | 0.69 | 0.45–1.06 | 1.44 | 1.12–1.85 | 0.51 | 0.35–0.74 | 1.21 | 0.85–1.70 |
| Professional workers | 0.43 | 0.33–0.56 | 1.89 | 1.04–3.44 | 0.83 | 0.56–1.21 | 0.99 | 0.44–2.20 |
| Senior officials | 0.26 | 0.16–0.43 | 1.42 | 1.03–1.94 | 0.34 | 0.09–1.30 | 0.85 | 0.40–1.79 |
| Other | 0.34 | 0.25-0.46 | 0.66 | 0.54–0.80 | 0.34 | 0.24–0.50 | 0.63 | 0.48–0.84 |
| Educational status | | | | | | | | |
| Low | 1 | referent | 1 | referent | 1 | referent | 1 | referent |
| High | 1.53 | 1.34–1.75 | 0.84 | 0.71–0.99 | 1.68 | 1.34–2.12 | 0.80 | 0.62–1.04 |

Table 4 shows the age-adjusted ORs for ICH-related death by occupation separately for both married and unmarried men. For the eastern regions, the age-adjusted ORs for ICH-related deaths were lower for married senior officials (OR 0.15, 95% CI 0.08–0.31), professional workers (OR 0.38, 95% CI 0.27–0.52) and other groups (OR 0.41, 95% CI 0.29–0.58), compared to the agriculture-livestock workers. For the midwestern regions, compared to the agriculture-livestock married men, senior officials and professional workers had higher age-adjusted OR for ICH-related deaths.

Table 5 shows the number of ICH and controls, ORs, and 95% CIs for ICH-related death by occupation for both married and unmarried men in the ≥50 and <50 age groups. The proportion of ICH-related deaths of ≥50 age group within light and moderate work-intensity in midwestern regions had a 3.7-fold higher than in the eastern regions. In the eastern regions, for the ≥50, the marital status-adjusted ORs for ICH-related deaths were the lowest for senior officials, followed by professional workers and other groups compared to agriculture-livestock. Additionally, the ORs for senior officials and professional workers in the ≥50 age group were lower than were those in the <50 age group.

In the midwestern regions, with regard to the <50 age group senior officials and service professionals had higher marital status-adjusted ORs than agriculture-livestock and the ≥50 age group, only professional workers had higher marital status-adjusted ORs than agriculture-livestock.

## Discussion

The present study presents the dose-dependent relationships between ICH risk and the labor intensity of the five occupations. It was found that the risk of occupations for ICH was consistent with the labor intensity levels of these occupations. That is, for men in the eastern regions, the risk of ICH increased as labor intensity increased. Men were the main populations of severe work-intensity groups. In descending order of work-intensity levels, the occupational groups were as follows: agriculture-livestock workers, general workers, service professionals, profes-

**Table 3. Adjusted ORs and 95% CIs for ICH-related death by occupation in men and women in the eastern and midwestern regions**

| Occupation | Adjusted Only for Age | | | | | | Adjusted for Age and Marital Status | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Men | | | Women | | | Men | | | Women | | |
| | OR | 95% CI | *p* | OR | 95% CI | *p* | OR | 95% CI | *p* | OR | 95% CI | *p* |
| Eastern | | | | | | | | | | | | |
| Agriculture-Livestock | 1 | referent | | 1 | referent | | 1 | referent | | 1 | referent | |
| General workers | 0.81 | 0.55–1.20 | 0.302 | 1.08 | 0.45–2.59 | 0.872 | 0.70 | 0.46–1.07 | 0.099 | 1.05 | 0.43–2.55 | 0.910 |
| Service professionals | 0.75 | 0.48–1.15 | 0.190 | 0.52 | 0.36–0.76 | 0.001 | 0.61 | 0.38–0.98 | 0.041 | 0.50 | 0.34–0.73 | 0.000 |
| Professional workers | 0.43 | 0.33–0.55 | 0.000 | 0.8 | 0.55–1.18 | 0.263 | 0.42 | 0.31–0.55 | 0.000 | 0.78 | 0.53–1.14 | 0.195 |
| Senior officials | 0.25 | 0.15–0.40 | 0.000 | 0.33 | 0.09–1.24 | 0.100 | 0.20 | 0.12–0.34 | 0.000 | 0.32 | 0.08–1.23 | 0.097 |
| Other | 0.38 | 0.28–0.51 | 0.000 | 0.42 | 0.29–0.62 | 0.000 | 0.41 | 0.29–0.56 | 0.000 | 0.40 | 0.27–0.58 | 0.000 |
| Midwestern | | | | | | | | | | | | |
| Agriculture-Livestock | 1 | referent | | 1 | referent | | 1 | referent | | 1 | referent | |
| General workers | 0.95 | 0.65–1.39 | 0.780 | 1.20 | 0.53–2.73 | 0.669 | 1.41 | 0.90–2.23 | 0.137 | 1.52 | 0.60–3.85 | 0.379 |
| Service professionals | 1.52 | 1.77–1.97 | 0.001 | 1.24 | 0.87–1.75 | 0.239 | 1.26 | 0.91–1.76 | 0.165 | 1.19 | 0.79–1.79 | 0.415 |
| Professional workers | 2.07 | 1.13–3.81 | 0.019 | 0.94 | 0.42–2.11 | 0.875 | 2.84 | 1.41–5.73 | 0.004 | 0.90 | 0.34–2.37 | 0.823 |
| Senior officials | 1.44 | 1.05–1.99 | 0.025 | 1.10 | 0.50–2.39 | 0.815 | 1.50 | 1.01–2.23 | 0.044 | 1.00 | 0.40–2.52 | 0.999 |
| Other | 0.65 | 0.53–0.79 | 0.000 | 0.64 | 0.48–0.86 | 0.003 | 0.81 | 0.63–1.04 | 0.094 | 0.68 | 0.49–0.96 | 0.029 |

**Table 4. ICH-related deaths by occupation in married and unmarried men in the eastern and midwestern regions**

| Occupation | Married | | | | Unmarried | | | |
|---|---|---|---|---|---|---|---|---|
| | ICH (n) | Controls (n) | Age-Adjusted | | ICH (n) | Controls (n) | Age-Adjusted | |
| | | | OR | 95% CI | | | OR | 95% CI |
| Eastern | | | | | | | | |
| Agriculture-Livestock | 1,066 | 1,232 | 1 | referent | 541 | 97 | 1 | referent |
| General Workers | 27 | 50 | 0.65 | 0.40–1.05 | 24 | 5 | 0.99 | 0.36–2.68 |
| Service Professionals | 20 | 41 | 0.61 | 0.35–1.05 | 19 | 6 | 0.66 | 0.25–1.71 |
| Professional Workers | 56 | 169 | 0.38 | 0.27–0.52 | 37 | 10 | 0.70 | 0.33–1.46 |
| Senior officials | 9 | 63 | 0.15 | 0.08–0.31 | 13 | 6 | 0.37 | 0.14–0.99 |
| Other | 46 | 146 | 0.41 | 0.29–0.58 | 17 | 9 | 0.37 | 0.16–0.87 |
| Midwestern | | | | | | | | |
| Agriculture-Livestock | 115 | 337 | 1 | referent | 274 | 30 | 1 | referent |
| General Workers | 30 | 61 | 1.5 | 0.92–2.45 | 31 | 4 | 1.06 | 0.34–3.28 |
| Service Professionals | 50 | 131 | 1.18 | 0.80–1.75 | 171 | 14 | 1.49 | 0.76–2.90 |
| Professional Workers | 16 | 15 | 3.32 | 1.57–7.03 | 18 | 2 | 1.25 | 0.27–5.76 |
| Senior officials | 41 | 71 | 1.66 | 1.07–2.59 | 79 | 9 | 1.07 | 0.48–2.37 |
| Other | 140 | 470 | 0.85 | 0.64–1.13 | 210 | 34 | 0.69 | 0.41–1.17 |

sional workers, and senior officials. These results appear to be consistent with most previously published related studies[13, 16]. The agriculture-livestock group had a higher risk for ICH-related deaths, when compared with the other occupation groups. This may be because agricultural/livestock-related work primarily involves daytime outdoor activities and heavy exertion. A study reported that compared with white-collar workers, blue-collar workers have a higher risk of ICH[16]. A dose-dependent relationship between the risk of developing ICH and the duration of working time or strenuous activities, as well as this study results, revealed that the descending order was white-collar workers, housewives/none, and blue-collar workers[16]. The present study further indicated a major difference in patterns of ICH mortality in the eastern and midwestern regions. The mortality rate in the eastern regions was nearly three times higher than that in the midwestern regions. This was consistent with the proportion of ICH-related deaths for agriculture-livestock workers in both eastern and midwestern regions. The ICH-related deaths for

**Table 5. ICH-related deaths by occupation in married and unmarried men aged <50 and ≥50 yr in the eastern and midwestern regions of Inner Mongolia**

| Occupation | <50 | | | | ≥50 | | | |
|---|---|---|---|---|---|---|---|---|
| | ICH (n) | Controls (n) | Adjusted for marital status | | ICH (n) | Controls (n) | Adjusted for marital status | |
| | | | OR | 95% CI | | | OR | 95% CI |
| Eastern | | | | | | | | |
| Agriculture-Livestock | 260 | 331 | 1 | referent | 1,347 | 998 | 1 | referent |
| General Workers | 14 | 19 | 0.69 | 0.31–1.51 | 37 | 36 | 0.70 | 0.43–1.16 |
| Service Professionals | 12 | 19 | 0.58 | 0.26–1.32 | 27 | 28 | 0.62 | 0.35–1.01 |
| Professional Workers | 17 | 39 | 0.48 | 0.25–0.92 | 76 | 140 | 0.40 | 0.30–0.55 |
| Senior officials | 3 | 6 | 0.56 | 0.12–2.53 | 19 | 63 | 0.18 | 0.10–0.32 |
| Other | 11 | 83 | 0.17 | 0.09–0.34 | 52 | 72 | 0.59 | 0.40–0.86 |
| Midwestern | | | | | | | | |
| Agriculture-Livestock | 42 | 101 | 1 | referent | 347 | 266 | 1 | referent |
| General workers | 14 | 22 | 1.63 | 0.61–4.36 | 47 | 43 | 1.40 | 0.84–2.35 |
| Service professionals | 49 | 44 | 2.59 | 1.28–5.24 | 172 | 101 | 1.03 | 0.71–1.50 |
| Professional workers | 9 | 6 | 3.79 | 0.95–15.12 | 25 | 11 | 2.69 | 1.19–6.10 |
| Senior officials | 25 | 16 | 3.71 | 1.47–9.37 | 95 | 64 | 1.23 | 0.79–1.91 |
| Other | 40 | 113 | 0.91 | 0.47–1.74 | 310 | 391 | 0.79 | 0.60–1.03 |

agriculture-livestock workers in the eastern region were over four times higher than that in the midwestern region. In the eastern regions, approximately 90% of ICH-related deaths were agriculture-livestock workers. Therefore, the difference of ICH-related mortality between eastern and midwestern regions was caused by the ICH-related mortality of agriculture-livestock workers. However, in midwestern regions, the risk was notably higher for professional workers and senior officials after making adjustments, when compared to those in eastern regions. The reason is that the older men within light and moderate work-intensity in midwestern regions had a 3.7-fold higher than men in eastern regions. The present study confirms that old people of over fifty years old had a significantly higher risk of ICH-related deaths, when compared to those in the other age groups. The present conclusion was consistent with another study, in which older men in high official positions have a higher risk of stroke, when compared to men in the manual labor occupation[15]. In fact, the mortality of ICH-related deaths was much lower in the midwestern region, and the ICH-related deaths of light and moderate work-intensity occupations were relatively low. Therefore, the ICH-related deaths of light and moderate work-intensity in midwestern regions were hardly practical significance. For the "other occupation" group, in which the occupations could not be determined, the labor intensity could not be evaluated. Thus, the results for this other group were not discussed. The present findings suggest that more attention should be given to the management of ICH risk factors, particularly for individuals with severe work-intensity. The reduction of stroke requires effective primary and secondary prevention in high-risk segments of the working population[24]. Although agriculture workers, livestock workers and general workers are all severe work-intensity work, these have great differences in working nature and environment. Further research is needed to determine how to early prevent and develop effective risk management on this specific occupation.

A very high risk of ICH-related deaths was found in unmarried men agriculture-livestock worker groups. The reason could be that unmarried men laborers with high-intensity work lack the care of a spouse, and may be placed at a higher risk of ICH than married men. Reports on health and mortality by marital status have consistently identified that unmarried individuals generally report poorer health and higher mortality risks, when compared to their married counterparts, and men are particularly affected in this respect. Marital status in mid- and later-life is crucial in relation to subsequent forms of care provision[25], and caring and helpful spousal behaviors contribute to physical health[26]. One study reported that the prevalence of cardiovascular risk factors was higher in unmarried men, when compared to married participants[27]. These reports may explain the impact of marital status on ICH. It is noteworthy that approximately 80% of agriculture-livestock workers died in their homes. Hence, timely intervention is a critical factor for ICH prevention[28]. Many patients can be saved through timely identification or treatment[29]. The problem

of delayed medical treatment among agriculture-livestock workers is serious. The mortality of ICH in Inner Mongolia will be greatly reduced if this can be resolved. Further studies on actions to reduce the death of ICH at home and the promotion of timely medical treatment are needed.

The present study has several limitations. First, the intensity of work was not quantified, and this was only classified into five levels, according to occupational categories. Second, the present study did not directly assess whether ICH-related deaths were designated as deaths due to injury at work. Third, in addition to occupation, there are many factors associated with ICH-related mortality, such as smoking, alcohol drinking, obesity, and etc., However, detailed information could not be obtained from the death data.

In conclusion, the mortality for ICH mainly occurred in the eastern region of Inner Mongolia. The risk of ICH increased as the work-intensity level increased. Men and the elderly have high risk of ICH death. These were mainly attributable to the highest ICH death risk of agriculture-livestock workers, who had the highest labor intensity. The ICH deaths mainly occurred at home. Thus, an effective way to reduce the mortality of ICH is to solve the delayed medical treatment in Inner Mongolia.

## Conflict of Interest

We have no competing interests.

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