Meta-analysis of the Unintentional Death of Children Aged 0 to 5 Years in China Between 1995 and 2015

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OBJECTIVES
The aim of this study was to identify the primary cause of and a means by which to prevent the unintentional injury and death of children aged 0 to 5 years in China.

METHODS
A systematic review of literature published in this area between 1995 and 2015, accessible through Chongqing VIP, Wanfang, CNKI, and PubMed databases, in addition to other electronic databases and related magazines and professional information, was conducted. The data were retrieved using Cochrane Systematic review methods. All information was judged using the Jadad method. A meta-analysis was carried out on homogeneous studies. RevMan 5.3 software was used to analyze the gathered information.

RESULTS
A total of 125 related pieces of literature were retrieved. Of the 14 that met the inclusion criteria, 6 were of moderate quality and 8 of general quality. The meta-analysis showed that in a comparison of unintentional injury and death of male and female children, the odds ratio was [1.73 to 1.95] for a 95% confidence interval ($P < 0.00001$). In a comparison of urban and rural areas, the odds ratio was [0.02, 0.02] for a 95% confidence interval ($P < 0.00001$).

Conclusions: Based on accessible literature, the incidence of unintentional injury and death of boys is higher than that of girls and is also higher in rural areas than in urban areas of China. Considering the significant difference in the latter comparison, developing and implementing methods to reduce the unintentional injury and death of children in rural areas should receive greater attention.

Key Words: 55 years old, meta-analysis, unintentional death

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Unintentional injury refers to events where injury occurs due to an accident, which is particularly common in children 5 years or younger. Unintentional injury has become an important factor leading to death and places a huge burden on the public health system in China, the country with the greatest number of children in the world. In China, it is estimated that approximately 350,000 children aged 0 to 14 years are injured in accidents each year, with the majority occurring within the first 5 years of life.

Although the body of literature addressing unintentional injury in children 5 years or younger is increasing, the results of individual studies are quite different. This article presents a systematic review of published studies by way of a meta-analysis. This study presents relevant factors and differences in rates of unintentional childhood injury in China and provides suggestions to aid in the prevention of future incidents.

METHODS

Search Strategy
Literature addressing unintentional injury or death in children, whose definition of unintentional injury complied with our own and whose study cohort fell within the age limit, were included in the analysis. Literature published between 1995 and 2015, in both domestic (Chinese) and international medical journals, which addressed unintentional death in children 5 years or younger of any gender, were included in the study. Search databases included CNKI, VIP (Chinese scientific and technical journals databases), Wanfang Data Resource Systems database, MEDLINE/PubMed database, and Google Scholar. The strategy involved searching for the following key terms in any field within the whole text: (unintentional injury) or (unintentional death) + (children) + (China) or (Chinese) + (0–5 years) for fuzzy matching. Articles about unintentional injury in children were obtained by computer search combined with reference tracing. The retrieval languages were Chinese and English, and the retrieval time limited to July 2015.

Outcomes of Interest
Information regarding the unintentional injury of boys and girls and in urban and rural places was provided in the literature obtained by contacting the author.

Inclusion Criteria
The criteria for inclusion were as follows: (a) the study must be observational; (b) subjects must be Chinese; (c) aged between 0 and 5 years; (d) who had unintentional injury; (e) unintentional death is the outcome measure; (f) the definition of unintentional injury is consistent; (g) the time and location of the study is clearly stated; (h) the study method is explicit and similar; (i) the number of deaths must include all kinds of unintentional injuries (not just subgroups); (j) the number of unintentional death and total samples, or the mortality is reported or can be deduced from existing data; (k) literature covering the scope of a province or a city is preferred.

Exclusion Criteria
The criteria for exclusion were as follows: (a) subjects are only in urban or rural places, or (b) their age exceeds 5 years; (c) samples are too special to represent the general population, especially those in hospitals or migrant and abandoned children; (d) the efficiency indicator is incidence of unintentional injury rather than death rate; (e) there are obvious flaws in design or errors in statistics, or the information is incomplete; (f) the literature was repeatedly published or is a summary; (g) the literature was published before 1995 or after July 2015; (h) the location is too restricted or has already been covered under provincial units in other pieces of literature.

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Document Extraction and Quality Control

The database was established in Excel (Microsoft Excel 2003; Microsoft, Redmond, WA), and the following information was excerpted from included pieces of literature: title, year of publication, authors, study area, beginning and ending time, number of deaths of male and females, number of deaths in urban and rural areas, total sample size, and causes of mortality.

Document searching, screening, excerption of information, and quality assessment were conducted by 2 trained personnel, separately. Any issues that arose during the process were solved by central discussion or consulting a third party.

Evaluation Results

Currently, there is not yet a quality evaluation standard for observational studies. The quality evaluation guideline for disease prevalence studies, as proposed by Loney et al., was used to evaluate the included literature. The aspects taken into consideration included effectiveness of study methods, rationality of explanation, and suitability scope.

Statistical Analysis

RevMan 5.3 software (Cochrane Collaboration, Copenhagen, Denmark) was used for the meta-analysis. Measurement data were presented as weighted mean difference, and count data as odds ratio (OR); both were based on a 95% confidence interval (CI). A fixed-effects model (FEM) was adopted.

RESULTS

Eligible Studies

A total of 125 pieces of literature were retrieved, 18 of which were repeated, 69 of which scored lower than C, and 24 of which did not contain content that qualified. This left 14 articles that met the inclusion criteria: their characteristics are listed in Table 1A and 1B.

The Comparison of Causes of Unintentional Injury in Male and Female Children

Figure 1 shows the number of unintentional deaths of children 5 years or younger in China was 5373 for boys and 3958 for girls. Heterogeneity was clear when boys and girls were compared across the 14 included studies ($\chi^2 = 67.66, P < 0.00001$). In the FEM, these data were categorically variable and presented as OR. The total OR value was 1.84 (95% CI, 1.73–1.95). A test for overall effect resulted in $Z = 19.33 (P < 0.00001)$. This statistically significant difference suggests boys are more prone to unintentional injury than girls.

The Comparison of Causes of Unintentional Injury in Urban and Rural Areas

Figure 2 shows the number of unintentional deaths to be 836 in urban areas and 7341 in rural areas. Two studies were excluded because they lacked a comparison of urban and rural areas. A comparison of urban and rural areas within the 12 remaining studies revealed clear heterogeneity ($\chi^2 = 461.44, P < 0.00001$). In the FEM, these data were categorically variable and presented as OR. The total OR value was 0.02 (95% CI, 0.02–0.02). A test for overall effect resulted in $Z = 78.42 (P < 0.00001)$. This statistically significant difference suggests rural children are more prone to unintentional injuries than urban children.

Publication Bias

It is easy to publish papers with good bias study results (positive conclusion) but is difficult to publish those with poor results (negative conclusion). This is called publication bias. We have data (not shown) to demonstrate that the results roughly follow normal distribution, with some deviations in acceptable range. Thus, the credibility of the literature is high.

Other Outcomes of Interest

The cause of death data, such as is seen in Figure 3, is consistent with the results of previously published literature. The causes of death in 7 different studies were plotted (Fig. 4), and the total number of deaths due to poisoning and falls varied little between studies, whereas the number of deaths due to suffocation, traffic

| TABLE 1A. Characteristics of Included Studies |

| Included Literature | Time of Publication | Duration of Study | Male | Female | Urban Resident | Rural Area | Total |
|---------------------|---------------------|-------------------|------|--------|----------------|------------|-------|
| Chen et al⁴         | Fujian              | 2001              | 95–99| 1095   | 850            | 205        | 1740  | 1945  |
| Zhou et al²         | Shandong            | 2006              | 00–04| 318    | 283            | 100        | 501   | 601   |
| Huang and Chen⁶     | Shanxi              | 2007              | 96–05| 1186   | 913            | 252        | 1847  | 2099  |
| Yang et al⁷         | Ningxia             | 2007              | 96–05| 275    | 171            | 23         | 423   | 446   |
| Sun⁸                | Qinghai             | 2008              | 04–08| 549    | 388            | 47         | 890   | 937   |
| Jiang et al⁹        | Nanning             | 2009              | 03–07| 91     | 44             | 50         | 85    | 135   |
| Wang¹⁰              | Dalian              | 2009              | 01–05| 89     | 78             | 45         | 122   | 167   |
| Cai and Feng¹¹      | Shijiazhuang        | 2010              | 07–10| 72     | 62             | 13         | 121   | 134   |
| Lin et al¹²         | GuangZhou           | 2012              | 2010 | 379    | 209            | 29         | 559   | 588   |
| Huang et al¹³       | Hainan              | 2012              | 05–10| 112    | 95             | 16         | 191   | 207   |
| Zhu and Sun¹⁴       | Changchun           | 2012              | 95–08| 36     | 16             | —          | —     | 52    |
| Yan and Zhu¹⁵       | Beijing             | 2012              | 03–12| 172    | 125            | 24         | 273   | 297   |
| Gu and Xu¹⁶         | Wuxi                | 2014              | 04–13| 364    | 257            | 32         | 589   | 621   |
| Lin et al¹⁷         | Shenzhen            | 2015              | 97–06| 635    | 467            | —          | 11    | 1102  |
**FIGURE 1.** Forest plot of the comparison of causes of unintentional injury in male and female children.

| Study or Subgroup | Events | Total | Events | Total | Weight | Odds Ratio | M-H, Fixed, 95% CI |
|-------------------|--------|-------|--------|-------|--------|------------|-------------------|
| a 2001            | 1095   | 1945  | 850    | 1945  | 24.9%  | 1.66 [1.46, 1.88] |                  |
| b 2006            | 318    | 601   | 283    | 601   | 8.9%   | 1.26 [1.01, 1.58] |                  |
| c 2007            | 1186   | 2099  | 913    | 2099  | 26.7%  | 1.69 [1.49, 1.91] |                  |
| d 2007            | 275    | 446   | 171    | 446   | 4.4%   | 2.59 [1.97, 3.39] |                  |
| e 2008            | 549    | 937   | 388    | 937   | 10.8%  | 2.00 [1.67, 2.41] |                  |
| f 2009            | 91     | 135   | 44     | 135   | 1.0%   | 4.28 [2.57, 7.12] |                  |
| g 2009            | 89     | 167   | 78     | 167   | 2.4%   | 1.30 [0.85, 2.00] |                  |
| h 2010            | 72     | 134   | 62     | 134   | 1.9%   | 1.35 [0.83, 2.18] |                  |
| i 2012            | 379    | 588   | 209    | 588   | 5.0%   | 3.29 [2.59, 4.18] |                  |
| j 2012            | 112    | 207   | 95     | 207   | 2.9%   | 1.39 [0.94, 2.05] |                  |
| k 2012            | 36     | 52    | 16     | 52    | 0.3%   | 5.06 [2.20, 11.64] |                  |
| l 2012            | 172    | 297   | 125    | 297   | 3.5%   | 1.89 [1.37, 2.62] |                  |
| m 2014            | 364    | 621   | 257    | 621   | 7.1%   | 2.01 [1.60, 2.51] |                  |
| n 2015            | 635    | 1102  | 467    | 0     | Not estimable |                  |

Total (95% CI) 9331 8229 100.0% 1.84 [1.73, 1.95]

Total events 5373 3958

Heterogeneity: Chi² = 67.66, df = 12 (P < 0.00001); I² = 82%

Test for overall effect: Z = 19.33 (P < 0.00001)

Favours experimental Favours control

**FIGURE 2.** Forest plot of comparison of causes of unintentional injury in urban and rural areas.

| Study or Subgroup | Events | Total | Events | Total | Weight | Odds Ratio | M-H, Fixed, 95% CI |
|-------------------|--------|-------|--------|-------|--------|------------|-------------------|
| a 2001            | 205    | 1945  | 1740   | 1945  | 23.5%  | 0.01 [0.01, 0.02] |                  |
| b 2006            | 100    | 601   | 501    | 601   | 6.3%   | 0.04 [0.03, 0.05] |                  |
| c 2007            | 252    | 2099  | 1847   | 2099  | 24.6%  | 0.02 [0.02, 0.02] |                  |
| d 2007            | 23     | 446   | 423    | 446   | 6.1%   | 0.00 [0.00, 0.01] |                  |
| e 2008            | 47     | 937   | 890    | 937   | 12.8%  | 0.00 [0.00, 0.00] |                  |
| f 2009            | 50     | 135   | 85     | 135   | 0.8%   | 0.35 [0.21, 0.57] |                  |
| g 2009            | 45     | 167   | 122    | 167   | 1.3%   | 0.14 [0.08, 0.22] |                  |
| h 2010            | 13     | 134   | 121    | 134   | 1.7%   | 0.01 [0.01, 0.03] |                  |
| i 2012            | 29     | 588   | 559    | 588   | 8.0%   | 0.00 [0.00, 0.00] |                  |
| j 2012            | 16     | 207   | 191    | 207   | 2.7%   | 0.01 [0.00, 0.01] |                  |
| l 2012            | 24     | 297   | 273    | 297   | 3.8%   | 0.01 [0.00, 0.01] |                  |
| m 2014            | 32     | 621   | 589    | 621   | 8.4%   | 0.00 [0.00, 0.00] |                  |

Total (95% CI) 8177 8177 100.0% 0.02 [0.02, 0.02]

Total events 836 7341

Heterogeneity: Chi² = 461.44, df = 11 (P < 0.00001); I² = 98%

Test for overall effect: Z = 78.24 (P < 0.00001)

Favours experimental Favours control
accidents, and drowning varied greatly between studies, suggesting that the number differs according to area.

**DISCUSSION**

Unintentional injury of children places a heavy burden—both emotional and financial—on families and society. As the country with the largest population in the world, China has a huge base number of children and unbalanced development. The number of unintentional injuries of children in the Chinese population is much higher than those of developed countries. Developing and implementing a means to reduce the incidence of unintentional injury in children during social development are therefore of great significance in China.

Wang et al.\(^{18}\) studied unintentional injury in children between 1 and 4 years old, considering drowning and traffic accidents as the main causes of death. Because infant asphyxia is also an important factor, this article was not included. In addition, the article by Liu and Jiang\(^{19}\) addresses mainly newborn infants. The article by Feng et al.\(^{20}\) analyzed the mortality of children but was not focused on unintentional death. The other English articles did not meet the inclusion criteria and were excluded. The meta-analysis of the included literature (Fig. 1) shows that the number of deaths of boys was significantly higher than that of girls, irrespective of environment. It is possible that this can be attributed to the natural curiosity and exploratory behavior boys exhibit after the age of 2 years. The likelihood of unintentional injury or death is therefore...

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**FIGURE 3.** Mean graph of causes of death.

**FIGURE 4.** Line graph of different causes of death.
TABLE 1B. Characteristics of Included Studies

| Author          | Time  | Accidental Suffocation | Traffic Injuries | Drowning | Poisoning | Fall | Evaluation Results |
|-----------------|-------|------------------------|-----------------|----------|-----------|------|--------------------|
| Chen et al⁴     | 2001  | —                      | —               | —        | —         | —    | C                 |
| Zhou et al⁵     | 2006  | —                      | —               | —        | —         | —    | C                 |
| Huang and Chen⁶ | 2007  | 29.75                  | 12.4            | 10.74    | 14.88     | 11.57| B                 |
| Yang et al⁷     | 2004  | 27.58                  | 21.3            | 25.78    | 12.33     | 2.69 | B                 |
| Sun⁸            | 2008  | —                      | —               | —        | —         | —    | C                 |
| Jiang et al⁹    | 2009  | —                      | —               | —        | —         | —    | C                 |
| Wang¹⁰          | 2009  | —                      | —               | —        | —         | —    | C                 |
| Cai and Feng¹¹  | 2010  | 11.94                  | 42.54           | 16.42    | 12.69     | 10.45| B                 |
| Lin et al¹²     | 2012  | —                      | —               | —        | —         | —    | C                 |
| Huang et al¹³   | 2012  | 30.92                  | 13.04           | 43.00    | 6.30      | —    | C                 |
| Zhu and Sun¹⁴   | 2012  | —                      | —               | —        | —         | —    | C                 |
| Yan and Zhu¹⁵   | 2012  | 43.10                  | 27.61           | 6.73     | 7.41      | 8.42 | B                 |
| Gu and Xu¹⁶     | 2014  | 22.22                  | 13.37           | 54.59    | 1.29      | 3.86 | B                 |
| Lin et al¹⁷     | 2015  | 24.46                  | 20.76           | 40.11    | 5.11      | 9.57 | B                 |

inherently higher.²⁴ In developing countries such as China, greater attention should therefore be paid to boys of this age, in an attempt to reduce the occurrence of unintentional injury and death.

Figure 2 shows a comparison of urban and rural areas. The number of deaths in urban areas was significantly lower than that in rural areas. There are many potential reasons for this. First, it may be that rural children are not cared for as well as urban children. Over the past 15 years, with the increasing number of migrant workers in China, a unique social phenomenon has developed in rural areas: the elderly care for the children.²² Because many elderly people have physical and energy limitations, children’s outdoor activities may not be guarded as well as by younger, more physically able, carers; thus, the probability of accidents is increased. The second reason for the increased mortality rate in rural areas may be due to the fact that, compared with urban children, rural children are usually allowed to play in the whole village or even nearby villages. The greater area means traffic accidents, drowning, poisoning, or other accidents might occur more easily. The third reason may be due to the fact that the poorer members of the Chinese population are mostly localized to villages. Given the size of rural China, the number of children living in a state of poverty is high. The number of unintentional injuries in poorer areas is much higher than that in urban places.

Mortality was grouped according to cause, and statistical significance was assessed using SPSS; however, no statistical difference between the mortality of each group was observed. The incidences of traffic accidents, suffocation, and drowning varied, depending on location; for example, the chance of drowning is increased in places with adequate water, and traffic accidents and suffocation are more likely to occur in areas with high traffic and lower levels of health education, respectively.

Although China currently has the world’s second-largest economy, it is still considered a developing country, and as expected, the overall number of unintentional deaths and serious injuries of children is significantly greater than that in developed countries.²³ There are many ways to reduce the occurrence of accidents. First, particular attention should be paid to boys. Second, a greater effort should be made at the national level to propagate knowledge of unintentional injury, particularly in villages, where most unintentional childhood deaths happen. The primary causes of unintentional injury are accidental suffocation, traffic accident injuries, and drowning; therefore, this knowledge should be strengthened in areas in which these accidents are more likely to occur.

In China, as society develops, the incidence of unintentional injury will decrease, although this is still a long way off. In our review of the literature, articles covering the provincial scope are few, suggesting that at present not enough attention is paid to the unintentional injury of children. It is hoped that this situation can be addressed in the future.

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REFERENCES

1. Shi XQ, Qi YH, Cao BL. Unintentional-injury mortality among 0 ~ 14-year-old rural children: a meta-analysis [in Chinese]. J Child Health Care. 2013;21:134–136.
2. Ministry of health of the People’s Republic of China. 2004–2012 China Health Statistical Yearbook. Beijing, China: Peking Union Medical College Press; 2012.
3. Loney PL, Chambers LW, Bennett KJ, et al. Critical appraisal of the health research literature: prevalence or incidence of a health problem. Chronic Dis Can. 1998;19:170–176.
4. Chen X, Chen LM, Chi XX, et al. Monitoring and analysis of accidental death in children under 5 years old in Fujian province. China Misdiagnosis. 2001;1:194–196.
5. Zhou FR, Zhao Y, Zhang P, et al. Analysis of accidental death under 5 years old children in Shandong from 2000 to 2004. Chin J Child Health Care. 2006;14:37–39.
6. Huang J, Chen DF. Analysis of accidental death under 5 years old children in Shanxi from 1996 to 2005. Shanxi Med J. 2007;36:221–222.
7. Yang YF, Chen RM, Wang QL. Analysis of accidental death under 5 years old children in Ningxia from 1996 to 2005. Ningxia Med J. 2007;29:743–744.
8. Sun CL. Analysis on causes of accidental death under 5 years old children in Qinghai province from 2004 to 2008. Qinghai Med J. 2009;39:68–69.
9. Jiang W, Pan CH, Liu W, et al. Analysis of accidental death under 5 years old children in Nanning from 2003 to 2007. Chin J Child Health Care. 2009;17:231–233.
10. Wang Li. Analysis of accidental death under 5 years old children in Dalian from 2001 to 2005. *Matern Child Health Care China*. 2010;25: 1667–1668.

11. Cai JN, Feng SQ. Analysis on supervising results of unexpected death for the children under the age of 5 in Shijiazhuang from 2007 to 2010. *Hebei Med J*. 2012;34:3317–3318.

12. Lin SF, Hu Y, Jiang L, et al. Epidemiological analysis of accidental death trend under 5 years old children in Guangzhou from 2001 to 2010. *Chin J Epidemiol*. 2012;33:1258–1260.

13. Yan Huang, Zhang YQ, Yao YX. Analysis on supervising results of unexpected death for the children under the age of 5 in Hainan from 2005 to 2010. *Hainan Med J*. 2012;23:134–135.

14. Zhu JH, Sun JY. Analysis of accidental death under 5 years old children in Changchun from 1998 to 2008. *Matern Child Health Care China*. 2012;27: 1996–1998.

15. Yan SJ, Zhu XN. Epidemiological analysis of accidental death under 5 years old children in Beijing from 2003 to 2012. *Chin J Epidemiol*. 2014; 35:562–565.

16. Gu YJ, Xu Y. Analysis of accidental death under 5 years old children in Wuxi from 2004 to 2013. *China J Woman Child Health Res*. 2015;26: 16–18.

17. Lin Yan, Liu XX, Wang Hong. Analysis on the trend and causes of accidental death under 5 years old children in Shenzhen from 1997 to 2006. *Matern Child Health Care China*. 2007;22:3708–3710.

18. Wang Y, He C, Li X, et al. Nationwide study of injury-related deaths among children aged 1–4 years in China, 2000-2008. *J Paediatr Child Health*. 2014;50:E94–E101.

19. Liu YX, Jiang XM. Analysis of mortality among children under 5 years of age in Shenzhen from 2003 to 2013. *Zhongguo Dang Dai Er Ke Za Zhi*. 2015;17:390–394.

20. Feng J, Yuan XQ, Zhu J, et al. Under-5-mortality rate and causes of death in China, 2000 to 2010. *Zhonghua Liu Xing Bing Xue Za Zhi*. 2012;33: 558–561.

21. Yang HJ, Liu J, Zhang YH. Children accident analysis and prevention measures. *Chin Med Stat*. 2008;15:249–250.

22. Yang YY, Zhang Y, Li ST, et al. On the condition of rural left-behind children old people and child survival study. *Bus Rev*. 2014;193: 193–195.

23. *WHO and UNICEF World Report on Child Injury Prevention*. WHO. Available at: http://apps.who.int/iris/bitstream/10665/43851/1/9789241563574_eng.pdf. Accessed October 21, 2015.