The burden of the current curative expenditure of injury in Dalian, China-A study based on “System of Health Accounts 2011”

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Abstract

Background: Injury is one of the major public health problems, which causes more than 5 million deaths in the world every year. Cases of specific types of injury put a great threat to human health and also add a heavy medical burden on individuals and societies. This study is aimed at assessing the financial burden of injury on patients.

Methods: A total of 565 medical institutions were selected with multistage stratified cluster random sampling, containing 152553 valid samples. Subsequently, the distribution of injury current curative expenditure (CCE) in different dimensions (including age and site of injury) was analyzed under the framework of System of Health Accounts 2011(SHA 2011) using the established database.

Results: In China, from 2006 to 2016, both urban and rural injury mortality rates showed an upward trend of more than 5 percentage points. In Dalian, the CCE of injury had reached 1572.73 million RMB, accounting for 7.45% of the total curative care expenditure. In the 15-24 age group, the cost of injury accounts for a larger proportion of CCE than other age groups. Among the injuries in different regions of the body, injuries to the spine, lower limb, head and foreign body entering cost the most.

Conclusions: Dalian has a relatively serious burden of injury costs. The essential and primary goal is to reduce the cost. Young people in daily life and work should pay attention to protect their head and limbs from injury, the corresponding units should also do a good job in prevention.

Background

In recent years, the incidence and mortality of injury have an increasing trend on a global scale. Injuries–resulting from traffic collisions, drowning, poisoning, falls or burns from assault , self-inflicted violence or acts of war–kill more than five million people worldwide annually and cause harm to millions more[1]. They account for 9% of global mortality, and are threat to health in every country of the world. Injuries become a major public health problem facing all countries in the world [2]. Injuries are one of the leading causes of death in China, with about 300 million injuries occurring each year, accounting for 11% of deaths nationwide [3].

Injuries are the leading cause of death among young people. About 1.25 million people died from road traffic injuries in 2013[4]. Road traffic injuries are the leading cause of death among people aged 15 to 29. Globally, road traffic deaths increased by about 13 percent between 2000 and 2013 . We estimated that road injuries will cost the world economy US$1.8 trillion (constant 2010 US$) in 2015-30, which is equivalent to an annual tax of 0.12% on global gross domestic product (GDP) [5]. Open lower limb fractures are expensive to treat at a cost of approximately £19,200 per patient in England, because it is resource intensive injuries, which in turn result in a great labor force and economic loss and then further stunt the process of social development [6]. As a result of the high incidence and heavy financial burden of injury, governments around the world had become compelled to find means of decreasing and preventing the high incidence of injuries, due to the significant social impact and financial burden caused

by them.The high current curative expenditure (CCE) of injury in China poses a sizeable challenge. Injuries imposed heavy costs on individuals and society. According to WHO estimation for China in 2016, the age-standardized Disability Adjusted Life Years (DALYs) per 100,000 from injuries were 31343.7 [7]. In 2014, medical expenses for unintentional injuries in Sichuan province were 491.15 million yuan [8]. In 2017, the CCE of injury in Gansu province was 3.831 billion yuan [9].According to the report of China national statistical yearbook 2017, the mortality of injuries in 2016 for urban residents and rural residents were 37.34 and 54.48 per 100,000 respectively. Deaths from injuries contributed 6.08% of all deaths in urban residents and as much as 8.01% of all deaths in rural residents [10]. Approximately 50% of deaths in the age of 15-30 were due to injuries [11].

In previous studies, the data for injuries was mostly obtained from the death registration reporting system of China Center for Disease Control and Prevention or the National Injury Surveillance System (NISS) [12], which were analysed according to external causes. Most studies' analysis of the burden of injuries was based on incidence, mortality, cause of death sequence and DALYs. However, those studies were lacking the details of treatment and payment. Measuring the cost of injuries and its characteristics is critical to identifying priorities for policies, which is aimed at reducing injuries and their consequences. Therefore, the study of the CCE needs further research [13-15].

System of Health Accounts 2011(SHA 2011) is a new health care accounts system, which provides a framework to account for the CCE by different types of diseases and different age groups, excluding the expenditure of prevention [16]. This study used SHA 2011 to analyze the distribution of injury cost in different age groups and in different classifications, and then assessed the economic burden.

Methods

Data Source

Macro data was obtained via 2017 Liaoning Health Statistical Yearbook, 2017 Liaoning Health Financial Annual Reports, Dalian Current Health Expenditure Report 2016, China National Health Accounts Report 2017. The yearbook and annual report were provided by the Dalian Health Commission. The data of patients' medical expenses were collected from medical institutions in Dalian by sampling survey. Injury mortality and its percentage of all causes of deaths in China (2006-2016) were extracteed from the China national statistical yearbook 2007-2017.

Sample data

A total of 565 health institutions were chosen with multistage stratified cluster random sampling from the city of Dalian in the Province of Liaoning in China in 2016. Firstly, this study selected seven districts and two counties and the municipal medical institutions and public health institutions in Dalian. Secondly, 21 institutions were chosen per district or county, including one general hospital, one maternal and child health hospital, one center of disease control and prevention, one traditional Chinese medicine hospital and 17 clinics. The next step in each district was to select five community health service centers (CHS)

and three stations per CHS. The subsequent step in each county was to select 20 township hospitals and three subordinate village clinics, each in the respective township. Thirdly, researchers cleaned up and standardized the key information which was uploaded by these institutions, such as age, gender, disease, International Classification of Disease Tenth Revision (ICD-10) codes, expense, types of insurance, etc. Finally, the state database was created, the total database contains 4,375,351 valid samples , of which the injury sample has 152553 after excluding the invalid data.

Classification methods

This study divided the samples into eight age groups [17]. These age groups were divided unevenly, mainly due to the differences in injury profiles (degree and type) among different age brackets [18-19]. Including less than 1, 1 and 4, 5 and 14, 15 and 24, 25 and 34, 35 and 44, 45 and 64, 65 and above. Injuries were classified according to the region of injury, based on the codes in chapter 19 of the International Statistical Classification of Diseases and Related Health Problems, tenth revision (ICD-10). Codes ranging from S00-T97 were selected. In this study, the classification method was used to define different types of injuries, a total of 13 categories including head injury, neck injury and chest injury, etc.

Formula

Current curative expenditure includes medical income, government basic expenditure subsidy and government project subsidy income, which are divided into outpatient and inpatient parts. Taking the expenses of Injury as an example (there is no project subsidy for this disease, so the calculation is omitted), curative services includes curative income (S_{CI}) and basic curative expenditure subsidy (S_{BCS}). S_{CI} represents direct medical health expenditure includes treatment fees, medicine fees, diagnosis fees, nursing fees, bed fees, etc. S_{BCS} represents that to ensure the normal operation of the institution and the completion of daily work tasks, the subsidy provided by the finance mainly includes personnel funds and public funds, and the security provision for curative services.

When calculating the CCE, we must firstly exclude the data related to prevention and then ran the following formula, differentiating outpatient and inpatient.

See formula 1 in the supplementary files section.

In the above formula, S_{CCE}, S_{INC} and S_{ALL} were macro data, representing the CCE of all patients, curative income and basic expenditure allowance respectively in different medical institutions. S_{kEXP} and S_{TEXP} were sample data, representing the curative income in each patient and the total curative income respectively in different types of medical institutions. The ratio of S_{kEXP} to S_{TEXP} provided the sharing coefficient of S_{INC}. S_{kSTA} and S_{TSTA} were also derived from sample data, representing each patient's stay days and the total stay days respectively, which ratio was the sharing coefficient of S_{ALL}. K could be the total of different age groups, the total of different types of diseases and so on. Using this formula could bring out the CCE in various dimensions [16]. All data analysis was performed using STATA12.0.

Results

1. demographic of the participants

A total of 152553 participates in our study, including 88,289 male and 64,264 female. 36.89% aged 15-44 years and 36.46% aged 45-64 years. There were 108,615 outpatients and 43,938 inpatients. Among the hospitalized patients, 22,218 were hospitalized for 1-3 days, 6,245 for 4-7 days, 9,383 for 8-15 days, and 6,092 for more than 15 days. Individuals with injury mean expenditures of 3661.268 RMB [95%CI: 3610.479-3712.057].

2. Injury mortality and its percentage of all causes of death in China (2006-2016)

Table 1 illustrates the changes of injury-related mortality and composition ratio from 2006 to 2016 in China. In terms of mortality, there were increases from 32.36/100,000 in 2006 to 37.34/100,000 in 2017 and from 46.12/100,000 in 2006 to 54.48/100,000 in 2017 in urban and rural residents respectively. Injuries as the fifth leading cause of death contributed a lot to the burden on families and society. Moreover, the mortality and composition ratio of injuries in rural were greater than urban (Table 1).

3. General situation of CCE

In 2016,The CCE for all diseases in Dalian was 21.109 billion RMB, including 7421.92 million RMB (35.16%) for outpatient service and 13686.90 million RMB(64.84%) for inpatient service. The CCE of injury in Dalian had reached 1572.73 million RMB, accounting for 7.45% of the total curative care expenditure, 0.23% of gross domestic product (GDP).

To identify the distribution of CCE of different age groups, the data was divided into 8 groups and we calculated the CCE both in outpatient and inpatient. The CCE of injuries in outpatient was 356.26 million RMB, accounting for 4.80% of total curative care expenditure in outpatient. The CCE of injury in inpatient was much higher than outpatient, which was 1216.47 million RMB, accounting for 8.89% of total curative care expenditure in inpatient. Overall, injuries were responsible for 7.45% of Dalian's total burden of disease expenditure.

3.1 The CCE of injuries in different age groups

The CCE of injuries was gradually increasing from newborns to 65 years old, and the age group 45-64 had the highest CCE of injuries, while the age group less than 1 had the lowest figure. Compared to the other age groups, the CCE of injuries accounted for a larger proportion of total curative care expenditure in the 15-64 age group (Table 2).

3.2 CCE for different injuries regions

To further understand the distribution of CCE of different types of injuries in the population, we divided 13 types of injuries according to the regions of injuries. In terms of injuries of outpatient, the highest expenditure happened in "Injuries to the head", followed by "Injuries to the lower limb" and "Injuries to the

spine, skin or blood vessel and effects of foreign body entering". The top three accounted for 73.39% of the CCE of injuries (Fig. 1). However, among inpatients the top three cost categories of injuries were different: "Injuries to the spine, skin or blood vessel and effects of foreign body entering", "Injuries to the lower limb" and "Injuries to the head" in inpatient. A total of these three was about 733.60 million RMB, occupying 63.59% of the total in inpatient's injuries (Fig. 2). The CCE of injuries was 1572.74 million RMB after the outpatient and inpatient were combined, the highest of which was "Injuries to the spine, skin or blood vessel and effects of foreign body entering".

3.3 The CCE of different types of injuries for each age group Table 3 provided a comparison of the CCE of different types of injuries by age groups in outpatient. Analyzing these data, we found that the most costly type of injury in the 0-14 age group was "Injuries to the spine, skin or blood vessel and effects of foreign body entering". "Injuries to the head" was followed. The most costly type of injury in the 15-64 age group was "Injuries to the head". "Injuries to the lower limb" was followed. In the 65 and above age group, the top two were "Injuries to the lower limb" and "Injuries to the head" (Table 3). As can be seen the inpatient data in Table 4, the most costly type of injury in the age group 0-14, 15-24 were "Injuries to the head" and "Injuries to the spine, skin or blood vessel and effects of foreign body entering" respectively. In addition, the CCE of injuries to the shoulder, upper arm and lower limb deserves emphases of the government (Table 4).

Discussions

To the best of our knowledge, this study was the first to study the CCE of injuries in dimensions of age and site of injury at this scale among the Chinese population. This research showed the evidence-based target population and categories of injuries that could be the priorities of interventions reducing the burden of injuries.

1. The rising mortality rate in injuries and its differences between urban and rural areas

Injuries are the fifth leading cause of death in our country and impose a heavy financial burden on society and the state. Over the period 2006-2016, injury mortality has increased with fluctuations in China[20]. When looking at the CCE according to the statistic provided by Dalian City, injuries are major public health issues and the enormous cost burden to sustain. Overall, the mortality and composition ratio of injuries in Chinese rural areas were higher than in urban areas. The finding agreed with the research led by Chunhua He in 2017 who indicated that injury mortality in under-5 children in rural areas was higher than in urban areas [21]. It was probably because rural people were at higher risk of injuries since they usually live, work and go to school in unsafe environments. They also benefit less from basic public health services, and have less access to high-quality treatment and rehabilitation services due to the underdeveloped economy.

2. Differences in CCE consumption in different age groups, with emphasis on high consumption age groups

The study found that the CCE of injuries in Dalian had reached 1572.73 million RMB, accounting for 7.45% of the total curative care expenditure, 0.23% of GDP [22]. Not only in China, but also the expenditure on injury treatment was high in some developed countries. The adjusted national medical cost of injuries was estimated at 56 billion dollars and out-of-pocket cost was approximately 4 billion dollars (1$=6.7932 RMB in 2016) in the USA [23].

On one hand, the CCE of injuries in the 45-64 age group as the top one among the 8 age groups, accounting for 41.13% of the total CCE of injuries in Dalian. In this study, patients aged 45-64 years accounted for 36.46%, So that explains that 41% of CCE injury being spent on 36.46% of injury incidents.This may be due to the large population of this age group, resulting in the high cost of injuries. Based on the data of China Statistic Yearbook 2017, the proportion of the population aged 45-64 in the total population has reached 28.46%, which is the highest in the eight age groups. Another reason may be that middle-aged adults (aged 45-64 years) are more likely to be injured because they undertake more socially productive activities [24]. On the other hand, the CCE of injuries contributed a higher proportion of total curative care expenditure in the 15-44 age group than that in other age groups. The latter situation could be explained by discharge records in 2016 that 36.7% of discharge patients of hospitals in this age group were diagnosed with injuries [10]. This study showed that interventions to reduce CCE should be implemented, targeting people at the age of 15-64.

3. Patterns of injury burden among different age groups

For outpatient, the interpretation of the CCE of injuries were divided into three age groups. As for under-15 children, the cost of injuries was mainly caused by “Injuries to the spine, skin or blood vessel and effects of foreign body entering” and “Injuries to the head”. The top two of people aged 15 to 64 years and elderly people over the age of 65 were “head, lower limb” and “lower limb, head” respectively. The probable reason was that people in different age groups were vulnerable to different injuries. Mostly caused by falls, there were high rates of head injury admissions to hospitals occurred among 0–4-year-old (215.5 per 100,000) and people over 65 years of age (188.5 per 100,000) annually [25]. These findings were consistent with the international mainstreams of opinions.For those 70 years or older, falls are the leading category in injury-related deaths. An injury surveillance system pilot study conducted in 4 low/middle-income countries found that falls accounted for the largest percentage (56%) of recorded injuries among children [26]. A study conducted in India similarly found that the most common type of home injury in children aged 0-14 was falling [27]. Children and the elderly were most likely exposed to foreign body and fall-related injuries, in US in 2012, direct medical costs to people over 65 totaled $30.3 billion for non-fatal injuries in 2012 and rose to $31.3 billionin 2015 [28]. The inpatient data presented results similar to the outpatient.

4. Injuries to the spine, lower limb, head and the effects of foreign body entering need to pay attention

The CCE was also different in various body regions of injuries. As results showed, the highest cost happened in “Injuries to the spine, skin or blood vessel and effects of foreign body entering”, followed by “Injuries to the lower limb” and “Injuries to the head”. That could be attributed to the high frequency and

severity of these injury categories [29]. According to the estimate of National Spinal Cord Injury Statistical Center, the annual incidence of spinal cord injury was approximately 54 cases per one million people in the USA, in which the leading causes were vehicle crashes and falls [30]. A study carried out in New Zealand showed that head injuries remained a large proportion of injury-related deaths [25]. Besides, our results of body regions of injuries basically consistent with those of Zhao Meitao[9]. Research on the injury cost in Gansu Province, China shows that the cost of lower limb injury is as high as CNY 1.09 billion, which is the highest among all injury sites. Lower limb injury has a serious impact on the work and life of residents, and also causes heavy economic burden and social loss. The treatment cost of head injury is 847 million yuan in Gansu in 2017. The special physiological structure of the head leads to serious injuries and consequences after the injury, and the treatment cost is high. It is urgent to strengthen the head safety education and control in traffic and occupational places [9]. In terms of injuries to the extremities, extremity fractures had high costs due to high incidences and high productivity costs per patient [31]. Meanwhile, the UK study also shows that open lower limb fractures are expensive to treat at a cost of approximately 16,7961.60 RMB (£19,200) per patient and associated with the severity and area of the limb injury [6].

5. Suggestions to decision-makers

Injuries had led to high economic costs, in fact, injury prevention was an enormous challenge in China. Chinese authorities need to allocate more resources of injury prevention. Up to date, National Health Accounts showed government health funding for preventive programs remained minimal [32]. This article calls for increasing funding for injury-related prevention programs. We also highlight the importance of unintentional injury interventions, legislation, and enforcement at a national level. According to the characteristics of injuries in different age groups, the government can propose as a next step to look at the causes of these high-risk age-injury region groups in order to focus prevention strategies implement targeted interventions in different crowds and then test the effectiveness of them [33]. The study can propose as a next step to look at the causes of these high-risk age-injury region groups in order to focus prevention strategies.For instance, to protect children from fall-related injuries, schools can install soft rubber and waterproof floor for schoolyards [34].

Limitation

Our study has some limitations. Firstly, researchers considered the perfection of health information management system when choosing sample counties, which could have introduced biases. Such as, another county-level city in Dalian (Changhai County) was not included in the sample selection area mainly because of its medical conditions were relatively backward, the medical information system was not perfect, so it was unable to obtain complete samples of patients' treatment information. Secondly, The cost of injuries calculated in this study does not include the cost of subsequent treatment of other diseases resulting from the sequelae of injuries. Because some patients may suffer from a variety of diseases, doctors treat them with a comprehensive consideration of their conditions, so it's hard to

separate out the medical costs associated with complications. In this study, only the patients with the first diagnosis is injuries of all kinds were selected, without considering other complications.

Conclusion

Injuries were among the most prominent public health problems in the world. The CCE of injuries in Dalian had reached 1572.73 million RMB in 2016, accounting for 7.45% of the total curative care expenditure. People in age group 15-64 and “Injuries to the spine, lower limb, head and foreign body entering” should be priorities of interventions.

Declarations

Ethics approval and consent to participate

The study was supported by Health Commission of Dalian city and Ethics Committee of China Medical University. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the Helsinki declaration and its later amendments or comparable ethical standards. This manuscript adheres to the appropriate reporting guidelines and community standards for data availability.

Consent for publication

Not applicable.

Availability of data and material

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no conflict of interest.

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Authors’contributions

XW and YBY designed the study, helped in implementing the project and reviewed the manuscript. SS and LNY did the pre-research was the main drafters of the manuscript. LNY established database and contributed statistical analysis. XZH, YLZ and BXL searched papers and did some of manuscript editing. All contributing authors are aware of and agree to the submission of this manuscript.

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Abbreviations

WHO: World Health Organization; GDP: Gross domestic product; CCE: Curative care expenditure; DALYs: Disability adjusted life years; NISS: National Injury Surveillance System; SHA 2011: System of Health Accounts 2011; CHS: Community health service center; ICD-10: International Classification of Disease Tenth Revision

References

1. World Health Organization, https://www.who.int/topics/injuries/en/, 2020-9-23.
2. GBD 2017 DALYs and HALE Collaborators. Global, regional, and national disability-adjusted life-years (DALYs) for 359 diseases and injuries and healthy life expectancy (HALE) for 195 countries and

territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet. 2018;392(10159): 1859-1922.

3. Wang Lijun, Liu Yunning, Liu Shiwei, Yin Peng, Liu Jiangmei, Zeng Qingeng, Wang Linhong. An analysis of the burden of injury and disease among Chinese population in 1990 and 2010. Chinese J Prev Med. 2015;49(4): 321-326.
4. World Health Statistics 2017: Monitoring health for the SDGs. https://www.who.int/gho/publications/world_health_statistics/2017/en/
5. Chen S, Kuhn M, Prettner K, Bloom DE. The global macroeconomic burden of road injuries: estimates and projections for 166 countries. Lancet Planet health. 2019;3(9): e390–e398.
6. Tissingh EK, Memarzadeh A, Queally J, Hull P. Open lower limb fractures in Major Trauma Centers-A loss leader?. Injury. 2017;48(2): 353–356.
7. Global Health Estimates 2016: Disease burden by Cause, Age, Sex, by Country and by Region, 2000-2016. Geneva, World Health Organization; 2018.
8. Yang Li, Huang Yunxia, Wang Mei, Sun Qun, Huang Shiyao, Wang Ying. Calculation and analysis of medical expenses of accidental injuries of Residents in Sichuan Province. Health Economics Research. 2019;(11): 33-36.
9. Zhao Meitao, Hu Yuansheng, Qi Lei, Wang Ning, Cui Quanmiao, Cui Ya, Wang Lixia, Hu Xiaobin. Study on calculating the curative care expenditure of injury in Gansu Province based on "A System of Health Accounts 2011". Chinese J Prev Med. 2019;53(09): 900-906.
10. National Bureau of Statistics. China national statistical yearbook 2017. 2017-10-13. http://www.stats.gov.cn/tjsj/tjcbw/201710/t20171012_1541643.html.
11. National Health Commission of the People's Republic of China. China national health statistical yearbook 2017. 2017-03-31. http://www.nhfpc.gov.cn/htmlfiles/zwgkzt/ptjnj/year2017/index2017.html.
12. Duan L, Deng X, Wang Y, Wu C, Jiang W, He S, Wang L, Hyder AA. The National Injury Surveillance System in China: a six-year review.Injury. 2015;46(4): 572–579.
13. Segui-Gomez M, MacKenzie EJ. Measuring the public health impactof Epidemiol Rev. 2003;25: 3–19.
14. Yang L, Yue P, Jing Y, Wan Y, Wang W, Duan L. Analysis of the publication of data on national injury monitoring system from 2006 to 2016. Injury Med. 2018;2: 15-21.
15. Zhong W, Huang S, Lin X, Yue Y. Analysis of causes of child injury death in Fujian Province from 2007 to 2014. Injury 2018;1: 45-48.
16. Duan W, Zheng A, Mu X, Li M, Liu C, Huang W, Wang X. How great is the medical burden of disease on the aged? Research based on "System of Health Account 2011". Health Qual Life Outcomes. 2017;15(1):
17. Zhang L, Li Z, Li X, Zhang J, Zheng L, Jiang C, Li J. Study on the trend and disease burden of injury deaths in Chinese population, 2004-2010. PloS one. 2014;9(1): e85319.

18. Xie Yali, Ying Yanyan. A study on the char acteristic of injury- related death of differ ent age groups in Ningbo City from 2002 to 2004. Disease Surveillance. 2006;(08): 409-411+414.
19. Wang Xiaoli, Zhang Long, Zhang Yine, Ma Fang, Xie Fan, Tian Yuan. Analysis on the epidemiological characteristics of injury surveillance cases from 2006 to 2011 in Yinchuan Ningxia. Modern Prev Med. 2014;41(18): 3278-3281.
20. Zhao J, Tu EJ, McMurray C, Sleigh A. Rising mortality from injury in urban China: demographic burden, underlying causes and policy implications. Bull World Health Organ. 2012;90(6): 461–467.
21. He C, Liu L, Chu Y, Perin J, Dai L, Li X, Miao L, Kang L, Li Q, Scherpbier R, et al. National and subnational all-cause and cause-specific child mortality in China, 1996-2015: a systematic analysis with implications for the Sustainable Development Goals. The Lancet Glob health. 2017;5(2): e186–e197.
22. Liaoning Bureau of Statistics. Liaoning statistical yearbook 2017. 2018-04-09. http://tjj.ln.gov.cn/tjsj/sjcx/ndsj/otherpages/2017/indexch.htm
23. Alghnam S, Vanness DJ, Gaskin DJ, Thorpe RJ, Castillo R. Estimating annual medical and out-of-pocket expenditures associated with traumatic injuries in the United States. J Trauma Acute Care Surg. 2016;80(2): 258–264.
24. Caban-Martinez AJ, Courtney TK, Chang WR, Lombardi DA, Huang YH, Brennan MJ, Perry MJ, Katz JN, Christiani DC, Verma SK. Leisure-Time Physical Activity, Falls, and Fall Injuries in Middle-Aged Adults. Am J Prev Med. 2015;49(6): 888–901.
25. Kool B, Chelimo C, Ameratunga S. Head injury incidence and mortality in New Zealand over 10 Years. Neuroepidemiology. 2013;41(3-4): 189–197.
26. James SL, Lucchesi LR, Bisignano C, Castle CD, Dingels ZV, Fox JT, Hamilton EB, Henry NJ, Krohn KJ, Liu Z, et al. The global burden of falls: global, regional and national estimates of morbidity and mortality from the Global Burden of Disease Study 2017. Inj Prev. 2020. https://doi.org/10.1136/injuryprev-2019-043286
27. Bhuvaneswari N, Prasuna JG, Goel MK, Rasania SK. An epidemiological study on home injuries among children of 0-14 years in South Delhi. Indian J Public Health. 2018;62(1): 4–9.
28. Burns ER, Stevens JA, Lee R. The direct costs of fatal and non-fatal falls among older adults - United States. J Safety Res. 2016;58: 99-103.
29. Gerritsen H, Samim M, Peters H, Schers H, van de Laar FA. Incidence, course and risk factors of head injury: a retrospective cohort study. BMJ open. 2018;8(5): e020364.
30. National Spinal Cord Injury Statistical Center. Spinal Cord Injury Facts and Figures at a Glance. J Spinal Cord Med. 2014;37(3): 355–356.
31. Polinder S, Haagsma J, Panneman M, Scholten A, Brugmans M, Van Beeck E. The economic burden of injury: Health care and productivity costs of injuries in the Netherlands. Accid Anal Prev. 2016;93: 92–100.
32. Zhao X, Jiang Y, Mang X, Zhao L, Wang W, Li B, Chen W. Preventive service cost accounting result based on "health cost accounting system 2011" in Beijing. Chinese health 2018;2: 24-26.

33. Orton E, Whitehead J, Mhizha-Murira J, Clarkson M, Watson MC, Mulvaney CA, Staniforth JU, Bhuchar M, Kendrick D. School-based education programmes for the prevention of unintentional injuries in children and young people. Cochrane Database Syst Rev. 2016;12(12): CD010246.
34. Lee JC, Tung KT, Li TM, Ho FK, Ip P, Wong WH, Chow CB. Fall-related attendance and associated hospitalisation of children and adolescents in Hong Kong: a 12-year retrospective study. BMJ open. 2017;7(2): e013724.

Tables

Table1 Injury mortality and its percentage of all causes of death in China (2006-2016)

Year	Urban residents			Rural residents		
	Mortality（per100000）	Percentage（%）	Sequence	Mortality（per100000）	Percentage（%）	Sequence
2006	32.36	6.10	5	46.12	8.90	5
2007	37.63	6.09	5	52.07	8.96	5
2008	31.26	5.08	5	53.02	8.59	5
2009	34.66	5.59	5	54.11	8.25	5
2010	38.09	6.16	5	52.93	8.49	5
2011	33.93	5.47	5	56.50	8.85	5
2012	34.79	5.67	5	58.86	8.92	5
2013	39.01	6.30	5	57.14	8.72	5
2014	37.77	6.13	5	55.29	8.34	5
2015	37.63	6.05	5	53.49	8.07	5
2016	37.34	6.08	5	54.48	8.01	5

Table 2 CCE and the CCE of injuries in different age groups (RMB)

Age group	Outpatient			Inpatient		
	CCE (Million)	The CCE of injuries (Million)	Percentage (%)	CCE (Million)	The CCE of injuries (Million)	Percentage (%)
>1	61.48	0.73	1.19	161.70	2.83	1.75
1-4	365.79	11.26	3.08	299.33	4.26	1.42
5-14	419.65	16.72	3.98	211.15	15.12	7.16
15-24	366.70	25.78	7.03	242.76	62.83	25.88
25-34	1105.36	52.30	4.73	791.67	120.87	15.27
35-44	900.68	57.13	6.34	925.24	160.44	17.34
45-64	2399.59	142.18	5.93	5368.67	504.62	9.40
≥65	1802.66	50.16	2.78	5686.37	345.50	6.08

Table 3 CCE of different types of injury for each age group in outpatient (Ten thousand RMB)

Type of injury	Age group							
	>1	1-4	5-14	15-24	25-34	35-44	45-64	≥65
Injuries to the head	23.24	258.62	466.24	784.36	1419.12	1608.11	3857.19	1198.99
Injuries to the neck	1.24	1.11	7.38	7.66	31.28	34.13	74.41	39.69
Injuries to the thorax	1.45	3.63	9.15	54.04	154.67	188.43	618.85	252.72
Injuries to the abdomen, lower back, lumbar spine and pelvis	1.03	4.89	29.00	86.61	263.60	336.97	1059.58	491.70
Injuries to the shoulder and upper arm	2.02	43.81	157.46	236.06	489.88	512.38	1409.77	424.44
Injuries to the lower limb	14.88	139.22	268.20	653.11	1380.95	1511.96	3497.85	1256.73
Injuries involving multiple body regions	0.80	12.23	41.29	21.41	77.55	94.03	245.88	71.33
Injuries to the spine, skin or blood vessel and effects of foreign body entering	26.46	617.74	616.58	599.13	1195.21	1162.19	2673.99	916.91
Burns, corrosions and frostbite	0.00	15.45	10.34	14.95	24.91	43.40	125.23	47.13
Poisoning, drug reactions and allergic reactions	0.19	15.63	38.57	94.12	132.65	134.23	268.58	134.21
Other and unspecified effects of external causes	1.83	12.57	7.16	14.05	16.85	30.59	50.35	38.51
Old fractures and injuries	0.00	0.17	1.60	4.23	15.52	31.80	271.89	109.63
Sequelae of poisoning	0.00	0.00	1.07	1.76	1.54	2.00	0.00	0.00

Table 4 CCE of different types of injury for each age group in inpatient (Ten thousand RMB)

Type of injury	Age group							
	>1	1-4	5-14	15-24	25-34	35-44	45-64	≥65
Injuries to the head	183.13	217.65	393.17	1077.56	2135.74	2532.87	7989.89	4034.74
Injuries to the neck	8.44	0.00	5.78	49.10	264.79	313.86	2562.80	2492.32
Injuries to the thorax	7.70	9.94	42.85	97.83	245.24	592.08	2419.16	1750.91
Injuries to the abdomen, lower back, lumbar spine and pelvis	0.64	5.91	25.62	456.05	630.90	1309.01	4103.74	2606.48
Injuries to the shoulder and upper arm	0.68	60.75	343.79	1036.39	2287.04	3036.08	6935.01	2551.33
Injuries to the lower limb	25.03	30.71	243.11	1258.90	2266.28	3170.91	11142.59	8426.26
Injuries involving multiple body regions	0.00	0.00	7.14	3.97	13.49	28.00	59.52	19.59
Injuries to the spine, skin or blood vessel and effects of foreign body entering	53.37	32.33	288.04	1906.17	3416.66	4081.13	12054.58	10399.11
Burns, corrosions and frostbite	2.99	19.89	19.35	77.26	64.41	169.52	575.29	169.62
Poisoning, drug reactions and allergic reactions	1.00	44.90	103.08	228.80	541.51	538.87	1587.84	1425.62
Other and unspecified effects of external causes	0.00	3.89	0.20	2.20	37.89	31.69	95.20	120.07
Old fractures and injuries	0.00	0.00	32.01	8.52	56.83	20.96	128.20	73.45
Sequelae of poisoning	0.00	0.00	0.51	0.00	0.00	5.00	51.63	114.00

Figures

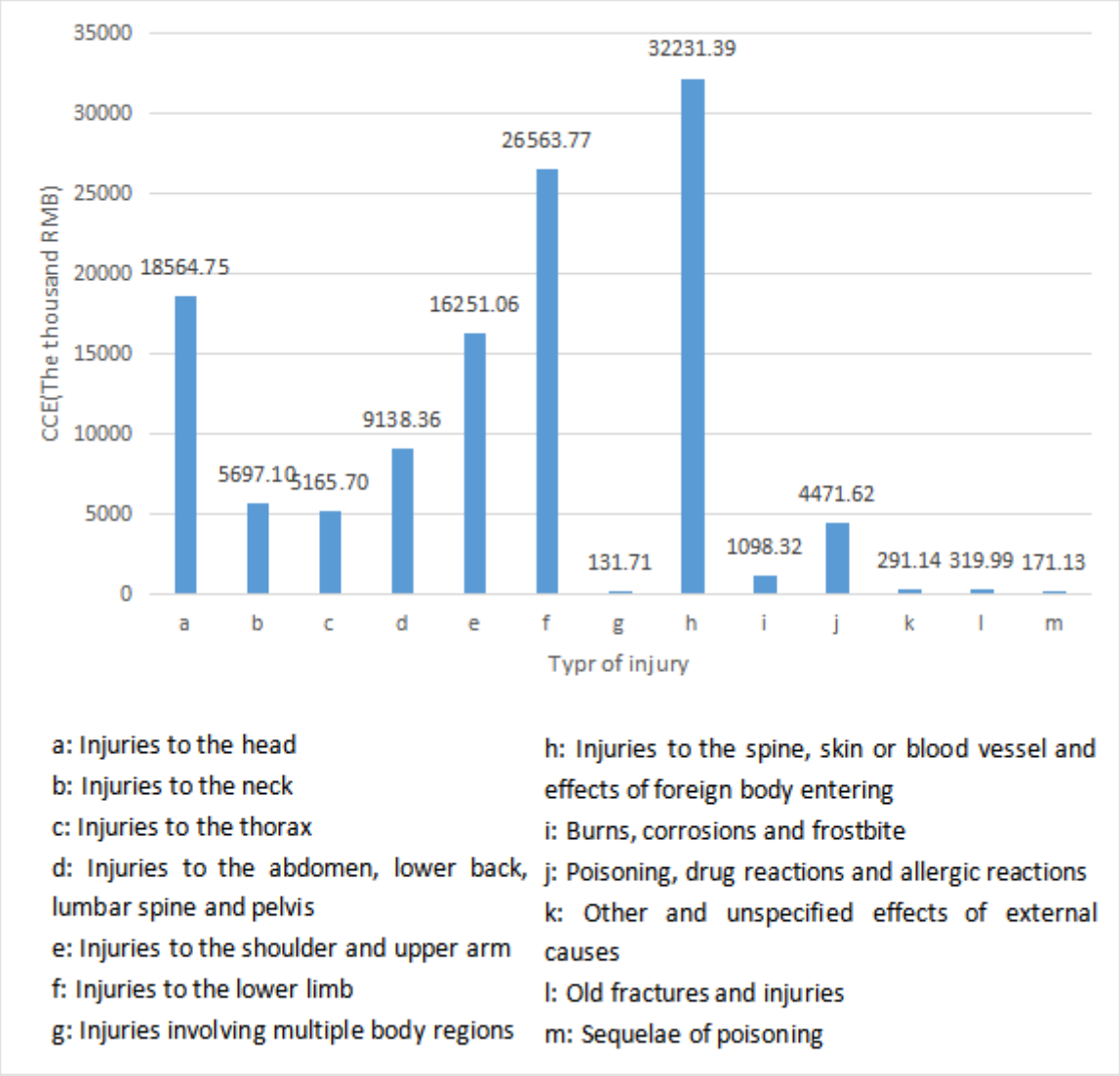

Figure 1

CCE for different injury regions in outpatient. The letters a-m represent 13 types of injuries. The horizontal axis indicates the types of injuries. The longitudinal axis represents the numerical value of CCE.

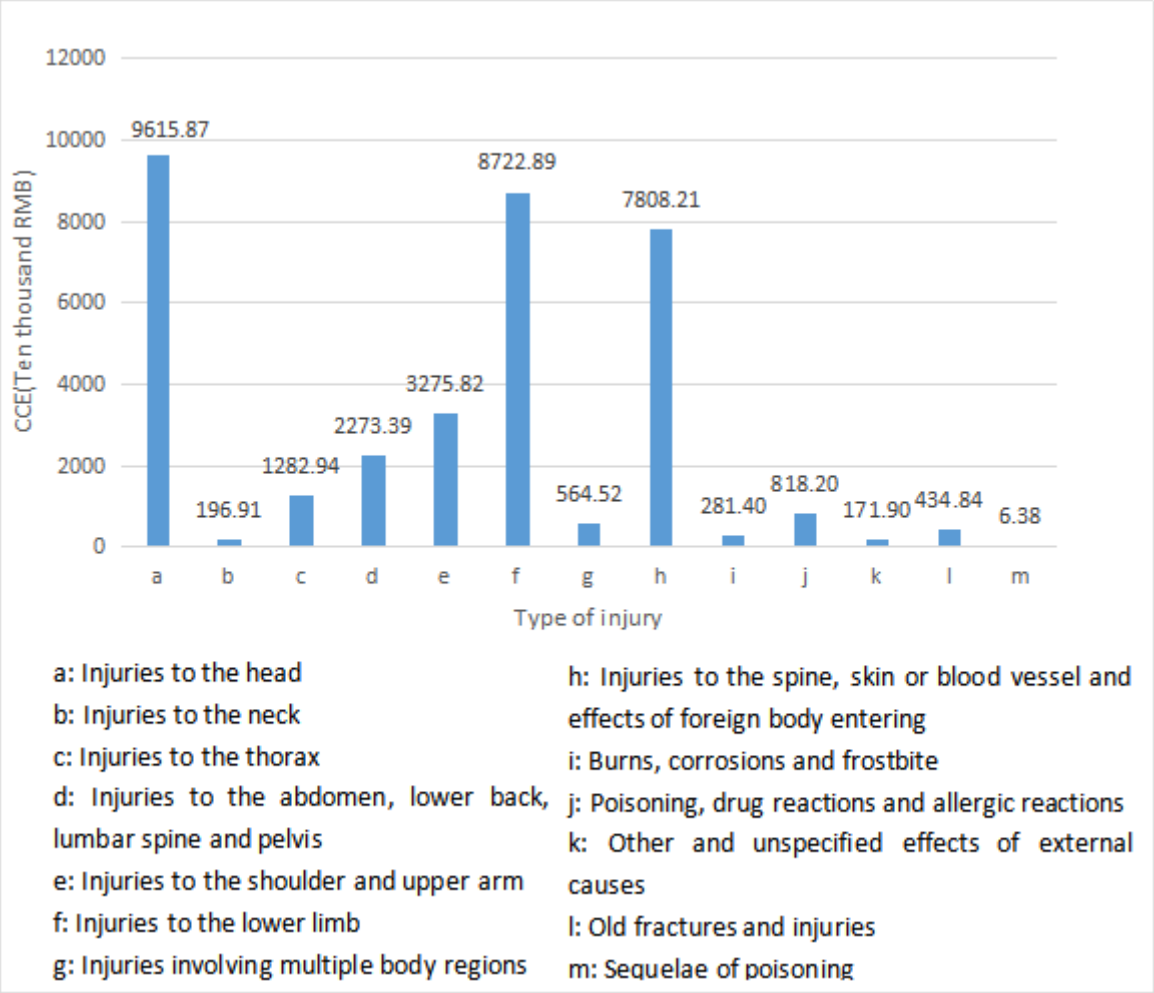

Figure 2

CCE for different injury regions in inpatient. The letters a-m represent 13 types of injuries. The horizontal axis indicates the types of injuries. The longitudinal axis represents the numerical value of CCE.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- ICD10AppendixtoInjuryClassification.docx
- SHA2011ApplicationAppendix.docx