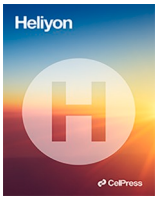
Heliyon 10 (2024) e37950

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon



Research article

The epidemiology of employee injuries in a monitoring sentinel unit of a coastal area in China:A nine-year retrospective analysis of clinical data

Dongxian Ye, Libo Zhang, Yajun Ding *, Chunxia Xu, Yaner Yu, Yachun Zhou, Yingbin Wang

Department of the Public Health Care, Zhejiang University School of Medicine First Affiliated Hospital Beilun Branch, Ningbo, Zhejiang, 315800, PR China

ARTICLE INFO

Keywords:
Employee injuries
Epidemiological characteristics
Economic burden
Monitoring
Floating population

ABSTRACT

The epidemiology of injury among subgroups of minors, older adults, students, and athletes has previously been investigated; however, studies investigating employee-related injuries are limited. We aimed to retrospectively analyze the epidemiological characteristics and dynamic change trends of injury among employees over a nine-year period in a coastal area in China to provide a reference for formulating injury prevention and control measures among employees. All 14,168 employee injury cases registered in a hospital injury monitoring system were analyzed from January 2013 to December 2021. The male-to-female sex ratio of the employee injury cases was 3.52:1. The floating-to-registered residence population ratio was 2.05:1. March, May, July, and September–October were peak months for employee injuries. Within the day, the injury cases of employees reached five peaks at 0800, 1000, 1500, 1800, and 2000 h. The highest five causes of injury were falling, blunt injuries, motor vehicle accidents, sharps injuries, and non-motor vehicle accidents. The highest five injury types were fracture; concussion or contusion of the brain; injury from a sharp instrument, bite, or open wound; contusion or abrasion; and sprain or strain. The main locations of the injuries were roads and streets, industrial and building sites, and homes. Vulnerable body regions included the upper limbs, lower limbs, head, trunk, and multiple regions. The independent predictors of all outcomes were census register classification; age; injury causes, locations and types; vulnerable body regions; and injury severity; on multivariate logistic regression analysis ($P < 0.05$). The average durations of missed work in the different injury outcome groups due to injuries among employees were 50.21, 42.57, 44.57, and 38.20 days, respectively. The average number of missed work days due to injuries was 49.77 days, with an increasing annual trend ($F = 79.872$, $P < 0.01$). The average hospitalization cost for employee injuries was ¥16250.37, with a decreasing annual trend ($F = 4.621$, $P < 0.01$). The average length of hospitalization was 15.22 days, with a decreasing annual trend ($F = 76.657$, $P < 0.01$), and the average number of days of missed work due to injuries was 49.77 days, with an increasing annual trend ($F = 79.872$, $P < 0.01$). The correlation coefficients showed a significant positive correlation between the average length of hospitalization and average hospitalization expenses, with

Abbreviations: LSD, The Least-significant difference.

* Corresponding author. Department of the Public Health Care, Zhejiang University School of Medicine First Affiliated Hospital Beilun Branch, 1288 Lushan East Road, Beilun District, Ningbo city, Zhejiang Province, PR China.

E-mail addresses: 736250312@qq.com (D. Ye), 945632815@qq.com (L. Zhang), 1059506379@qq.com (Y. Ding), 160413343@qq.com (C. Xu), 553213948@qq.com (Y. Yu), 151715806@qq.com (Y. Zhou), wyb1176990694@163.com (Y. Wang).

https://doi.org/10.1016/j.heliyon.2024.e37950
Received 25 April 2024; Received in revised form 3 September 2024; Accepted 13 September 2024
Available online 19 September 2024

an increasing trend from 2014 to 2021 ($P < 0.05$). Most employee injuries occurred in the male and floating populations. Targeted intervention measures should be implemented according to the epidemiological characteristics of injuries in relation to different populations, sexes, and ages to prevent and control injuries.

1. Introduction

Injury is a serious threat to human health, an important public health issue, and a primary cause of death worldwide [1]. According to Global Burden of Disease estimates, approximately 4.7 million injury-induced deaths (255.4 million life years) worldwide were reported in 2016 [2]. In China, the high incidence of injuries requiring health resources results in a considerable disease burden to society and families [3,4]. The incidence and mortality rates of injuries in China have decreased in recent years; however, 77.1 million new injuries in 2017 resulted in >730,000 deaths, comprising 7.0 % of the total number of deaths in China. The direct and indirect economic burdens owing to injuries in China are reported to be US 379.231 billion dollars and US 251.966 billion dollars, respectively [5]. Beilun District, located in the coastal area of Ningbo City, Zhejiang Province, has the world's largest cargo throughput at Beilun Port. Beilun District has a permanent population of approximately 890,000 people, of which >50 % are migrants. The Zhejiang University School of Medicine First Affiliated Hospital Beilun Branch is the largest tertiary comprehensive hospital in the Beilun District, with 800 beds and the most comprehensive medical resources and technology in the entire district. As an injury monitoring sentinel unit of Ningbo and National Trauma Treatment Center, the hospital is responsible for the treatment of injured patients throughout the entire region, particularly patients who are critically ill and those with emergency injuries. According to the injury monitoring sentinel unit in Beilun District, 25,375 injuries were reported between 2013 and 2021, of which 14,168 occurred among employees, comprising 55.92 % of the total injuries. Several epidemiological studies on injury involving minors, older adults, students, and athletes have been reported; however, research investigating employee-related injuries is limited. This study aimed to analyze the epidemiological characteristics and dynamic change trends in relation to injury among employees over a nine-year period (2013–2021), providing a reference for government departments to formulate corresponding prevention and control measures.

2. Methods

As the injury monitoring sentinel unit of Ningbo, the hospital utilizes an injury monitoring system uniformly formulated by the Center of Disease Control of Ningbo. Attending physicians are required to report case information within 48 h post-discharge in relation to all injured patients, including patient demographics (e.g., sex, age, occupation), hospitalization information (admission and discharge time), injury-related details (cause, type, place of injury, activity type, vulnerable region), clinical information concerning the injury (diagnosis, severity, outcome), and economic burden (hospitalization expenses and the duration of missed time at work). When precise clinical diagnosis injury codes are beyond the scope of the International Classification for Disease-10th Revision (ICD-10), upper-level clinical diagnosis ICD-10 codes are used.

The hospital employs dedicated functional department staff to verify the relevant data based on the hospitalized case system; thus, ensuring accuracy and consistency in the reported information. Cases that were revisited owing to the same injury were excluded from this study. Diagnoses are reported in terms of the ICD-10 Chinese modification (ICD-10-CM), with a single principle diagnosis related to the injury, and with further diagnoses entered if required. Multiple search terms including 'injury,' 'fracture,' 'closed injury,' 'defects,' 'dislocation,' 'crush injury' 'bruise,' 'pressure injury,' and 'bone break' were searched to obtain a maximum capture of injuries. In this hospital injury monitoring system, 'location' refers to where an injury occurs and the activity being undertaken at the time of injury, including injuries that occur at work and those that occur in other circumstances, such as during leisure or domestic activities.

All employee injury cases obtained from the hospital injury monitoring system were retrospectively analyzed to investigate employee injuries from January 2013 to December 2021. An employee was defined as a person aged >14 years undertaking some type of full- or part-time employment, including those employed by or contracted with a company, gig workers, household workers, and public employees. Child workers were excluded. Data were analyzed regarding patient demographics, injury characteristics, and economic burden.

2.1. Quality control

In accordance with Ningbo Hospital Injury Monitoring Quality Control Plan requirements, once-yearly business training, quarterly on-site quality control supervision (including missing report investigation, card quality spot checks, self-inspection of data entry quality, and qualitative interviews), and once-monthly online inspection of injury data were undertaken to ensure quality control. The timeliness rate of the reporting, audit rate, and data integrity were all >95 %.

2.2. Statistical analysis

The hospital provided all clinical data pertaining to 14,168 injured employees between January 2013 and December 2021. Statistical analyses of the demographic information, basic injury situation, clinical information relating to the injury, and hospital costs

were performed using SPSS (version 13.0; SPSS Inc., Chicago, IL, USA) software. Chi-squared and rank-sum tests were used to compare demographic information, basic injury situation, and clinical information in relation to the injury (the rank-sum test was used for rank data) among three age groups (15–44 years, 45–64 years, and ≥65 years), while analysis of variance or a non-parametric test was used to compare the economic burden (according to homogeneity based on the variance test). The least significant difference or a Kruskal-Wallis test was used to compare the economic burden among these three age groups, and statistical significance was set at $P < 0.05$.

3. Results

3.1. Demographic characteristics of injured employees

The sentinel hospital in Beilun District reported 25,375 injuries between 2013 and 2021, of which 14,168 occurred among employees, comprising 55.92 % of the total injuries. Employee injuries in the 15–44 group (n = 7778) accounted for 54.90 % of all employee injuries, with incidence rates decreasing yearly (highest in 2013 [59.09 %], lowest in 2020 [49.59 %]). Injuries in a middle-to-older-aged group (45–64-group; n = 5488) accounted for 38.74 % of the injuries, with incidence rates increasing annually (highest in 2020 [44.27 %], lowest in 2013 [33.38 %]). The male-to-female sex ratio was 3.52:1, comprising injuries to 11,031 male and 3137 female employees. The sex ratios of the 15–44-group, 45–64-group, and an older-adult group (≥65-group) were 3.95:1, 3.49:1, and 1.63:1, respectively. A statistically significant difference in sex ratios was observed among the three age groups ($\chi^2 = 148.898$, $P < 0.01$). The incidence rates of injuries among the floating and registered residence populations were 32.78 % and 67.22 %, respectively; and the average migrant employee-to-registered residence ratio was 2.05:1. The ratios of employee injuries among the floating and registered residence populations showed an increasing trend (highest proportion in 2021 [3.95 %], lowest proportion (1.44 %) in 2014; $\chi^2 = 212.04$, $P < 0.01$). Among the injured employees, the incidence rates among production operation-transportation equipment personnel and professional and technical personnel were the highest, accounting for 30.63 % and 27.09 %, respectively, followed by production personnel in agriculture-animal husbandry-fishery-water conservation, accounting for 20.60 %. The incidence rates of injuries among professional and technical personnel increased annually, with the highest proportion (43.80 %) in 2021 and the lowest proportion (13.16 %) in 2013. The incidence rates of injuries among production operation-transportation equipment personnel showed a decreasing trend (35.28 % in 2013 and 15.83 % in 2021; $\chi^2 = 1197.88$, $P < 0.01$; Table 1).

3.2. Time of injury occurrence

Over 1 year, injury occurrence rates among employees increased during summer and decreased during winter. March, May, July, and September–October were peak months for injury occurrence among male employees, whereas the incidence rates for injury among female employees were stable in the other months (Fig. 1A). March, May, July, and September–October were peak months of injury in the 15–44- and 45–64-year age groups. Injury occurrence in the ≥65-year age group was stable, with no obvious peak (Fig. 1B). Within a day, the number of injury cases among employees increased rapidly from 0600 h and reached five peaks at 0800, 1000, 1500, 1800, and 2000 h. After 2000 h, the number of injured employees decreased rapidly, reaching the lowest point at 0300 h. The time distribution of injury occurrence was consistent among male and female employees (Fig. 1C). Differences in the time distribution of injury occurrence were observed among the different age groups. The incidence of injury among the 45–64-group employees was higher at night than in the other age groups. Injuries to employees in the ≥65-year age group tended to occur between 0900 and 1500 h (Fig. 1D).

3.3. Causes of injury

The highest five causes of injury among employees were falls (29.43 %), blunt injuries (23.20 %), motor vehicle accidents (MVAs) (21.78 %), knife or sharps injuries (10.76 %), and non-MVAs (10.74 %), comprising 95.91 % of all injuries. The incidence rates for MVAs decreased annually (highest in 2013 [28.43 %], lowest in 2021 [18.37 %]; Table 2A). Falls were the leading cause of injury among male employees in all age groups. The incidence rate for falls gradually increased with age. MVAs were the primary cause of injuries among female employees in the 45–64- and ≥65-year age groups. With increasing age, falls were the primary cause of injuries among older female employees (comprising 65.31 % of injuries). Differences in the causes of injuries between different age groups were statistically significant ($\chi^2 = 544.912$, $P < 0.01$). There were statistically significant differences in the causes of injuries according to sex in the same age group ($\chi^2 = 50.603$, 26.635, and 26.635, respectively; $P < 0.01$; Table 3B).

3.4. Injury types

The highest five types of employee injuries were fractures (59.23 %); brain contusions and lacerations (13.02 %); sharp instrument injuries, bites, or open wounds (12.94 %); contusions or abrasions (6.94 %); and sprains or strains (3.37 %). These injuries comprised 95.50 % of all injuries. Fractures were the main type of injury across all age groups (Table 2B). Brain contusion and laceration rates showed a decreasing trend, while sharp instrument injury, bite, or open wound rates increased annually and were significantly higher among female employees. Differences in the types of injuries between the different age groups were statistically significant ($\chi^2 = 185.995$, $P < 0.01$). There were statistically significant differences in the types of injuries according to sex in the same age group ($\chi^2 = 20.850$, 45.182, and 36.276, respectively; $P < 0.01$, Table 3A).

Table 1
The compositions of the injury occurrence among employees based on different demographic characteristics between 2013 and 2021 [N (%)].

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total	χ^2	P value
Total	1474 (100.00)	1463 (100.00)	1413 (100.00)	1408 (100.00)	1774 (100.00)	1890 (100.00)	1750 (100.00)	1448 (100.00)	1548 (100.00)	14168 (100.00)		
Gender												
Male	1126 (76.39)	1125 (76.90)	1108 (78.41)	1103 (78.34)	1399 (78.86)	1493 (78.99)	1330 (76.00)	1101 (76.04)	1246 (80.49)	11031 (77.86)	18.04	0.021
Female	348 (23.61)	338 (23.10)	305 (21.59)	305 (21.66)	375 (21.14)	397 (21.01)	420 (24.00)	347 (23.96)	302 (19.51)	3137 (22.14)		
The sex ratio	3.24	3.33	3.63	3.62	3.73	3.76	3.17	3.17	4.13	3.52		
census register												
Registered residence	570 (38.67)	599 (40.94)	519 (36.73)	507 (36.01)	599 (33.77)	569 (30.11)	543 (31.03)	425 (29.35)	313 (20.22)	4644 (32.78)	212.04	0.000
Floating residence	904 (61.33)	864 (59.06)	894 (63.27)	901 (63.99)	1175 (66.23)	1321 (69.89)	1207 (68.97)	1023 (70.65)	1235 (79.78)	9524 (67.22)		
The ratio of floating population/registered residence	1.59	1.44	1.72	1.78	1.96	2.32	2.22	2.41	3.95	2.05		
Age												
The young to middle-aged group (15year~)	871 (59.09)	782 (53.45)	755 (53.43)	783 (55.61)	1018 (57.38)	1084 (57.35)	943 (53.89)	718 (49.59)	824 (53.23)	7778 (54.90)	118.93	0.000
The middle-aged to elderly group (45year~)	492 (33.38)	543 (37.12)	542 (38.36)	521 (37.00)	658 (37.09)	714 (37.78)	707 (40.40)	641 (44.27)	670 (43.28)	5488 (38.74)		
The elderly group (≥65year~)	111 (7.53)	138 (9.43)	116 (8.21)	104 (7.39)	98 (5.52)	92 (4.87)	100 (5.71)	89 (6.15)	54 (3.49)	902 (6.37)		
Occupation												
The related personnel of the production operation-transportation equipment	520 (35.28)	531 (36.30)	516 (36.52)	450 (31.96)	510 (28.75)	594 (31.43)	568 (32.46)	406 (28.04)	245 (15.83)	4340 (30.63)	1197.88	0.000
Professional and technical personnel	194 (13.16)	173 (11.83)	232 (16.42)	382 (27.13)	678 (38.22)	631 (33.39)	398 (22.74)	472 (32.60)	678 (43.80)	3838 (27.09)		
Production personnel of agriculture-animal husbandry-fishery-water conservancy	424 (28.77)	484 (33.08)	372 (26.33)	215 (15.27)	225 (12.68)	259 (13.70)	376 (21.49)	217 (14.99)	347 (22.42)	2919 (20.60)		
Commercial and Service Worker	151 (10.24)	184 (12.58)	149 (10.54)	185 (13.14)	204 (11.50)	216 (11.43)	203 (11.60)	188 (12.98)	166 (10.72)	1646 (11.62)		
Office staff	183 (12.42)	89 (6.08)	140 (9.91)	172 (12.22)	155 (8.74)	187 (9.89)	201 (11.49)	163 (11.26)	111 (7.17)	1401 (9.89)		
Soldier	2 (0.14)	2 (0.14)	4 (0.28)	4 (0.28)	2 (0.11)	3 (0.16)	4 (0.23)	2 (0.14)	1 (0.06)	24 (0.17)		

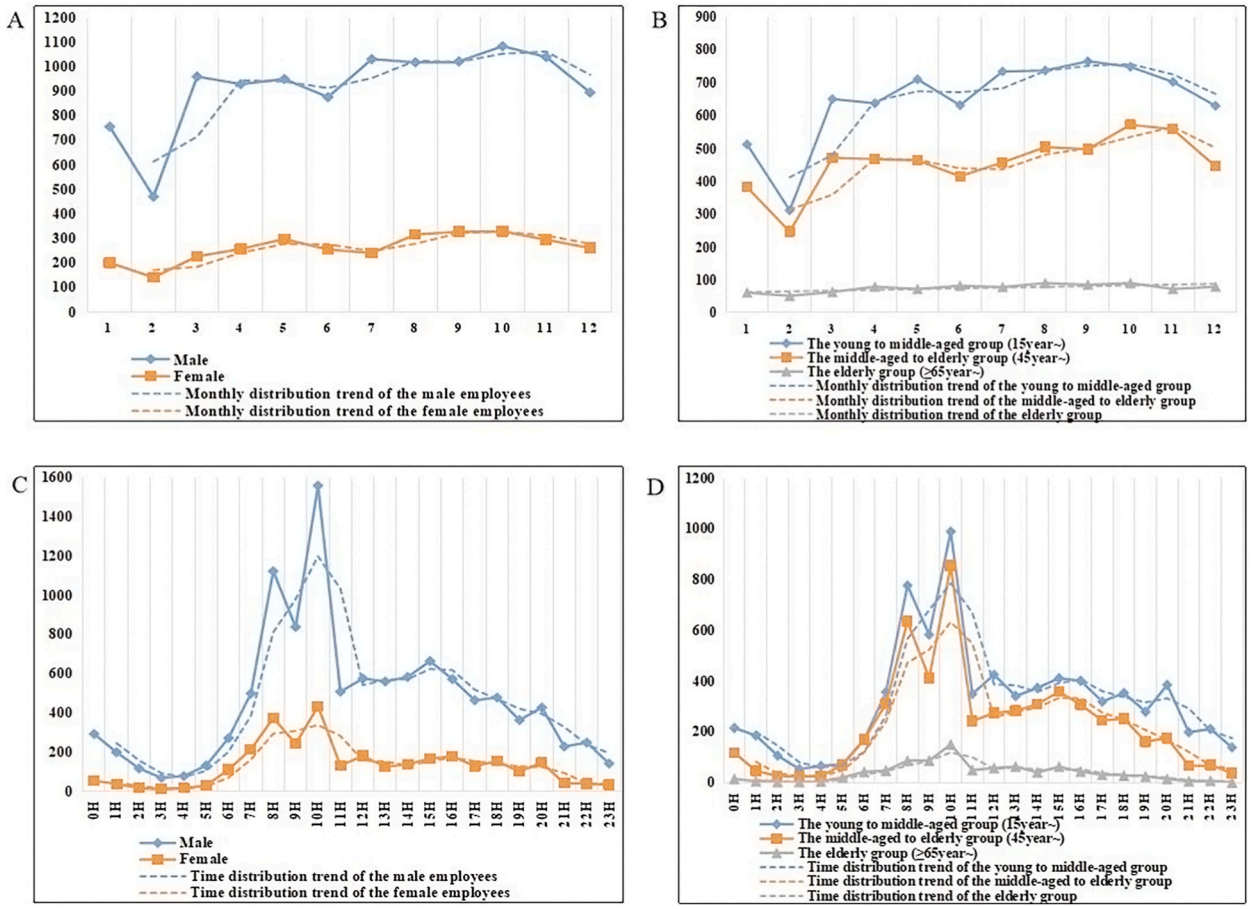


Fig. 1. A. Monthly distribution of injuries among employees of different sex between 2013 and 2021; B. Monthly distribution of injuries among employees of different age groups between 2013 and 2021; C. Time distribution of injuries among employees of different sex between 2013 and 2021; D. Time distribution of injuries among employees of different age groups between 2013 and 2021.

3.5. Injury locations

The main locations of injuries among employees were roads and streets (39.46 %), industrial and building sites (37.15 %), and homes (11.17 %) (Table 2C). The main locations of injury among male employees in the 15–44- and 45–64-year age groups were industrial and construction sites. The main locations of injury among male employees in the ≥65-year age group were roads and streets. The main locations of injury for female employees in the 15–44- and 45–64-year age groups were roads and streets. The main site of injury among female employees in the ≥65-year age group was the home. Differences in the places of injury occurrence between different age groups were statistically significant ($\chi^2 = 1042.924$, $P < 0.01$). There were statistically significant differences in the places of injury occurrence according to sex in the same age group ($\chi^2 = 309.183$, 151.453, and 109.651, respectively; $P < 0.01$; Table 3C).

3.6. Types of injury-related activities

The types of injury-related activities in employees were paid activities (related to employment) (39.93 %), driving and riding in a vehicle (30.10 %), and leisure activities (15.87 %). The rates of paid activities associated with injury occurrence increased annually, with the lowest in 2014 (27.07 %) and the highest in 2021 (52.97 %). The injury rates in relation to driving and riding in a vehicle decreased yearly (highest in 2014 [40.87 %], lowest in 2021 [21.06 %], $\chi^2 = 665.414$, $P < 0.01$; Table 2D). The activity types for injuries in male and female employees in the 15–44- and 45–64-year age groups were primarily paid activities and riding in vehicles. The injury activity types in male employees in the ≥65-year age group were mainly riding in vehicles and leisure activities, whereas those in female employees were leisure and housework activities. There was a statistically significant difference in the activity types for injury between the different age groups ($\chi^2 = 642.843$, $P < 0.01$). There were statistically significant differences in the activity types for injury according to sex in the same age group ($\chi^2 = 239.415$, 157.956, and 93.499, respectively; $P < 0.01$; Table 3D).

Table 2
The compositions of the causes, types, places of injury, activity types, vulnerable parts, severity degree and outcomes of injury among employees between 2013 and 2021 [N (%)].

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total	χ^2	P value
Total	1474 (100.00)	1463 (100.00)	1413 (100.00)	1408 (100.00)	1774 (100.00)	1890 (100.00)	1750 (100.00)	1448 (100.00)	1548 (100.00)	14168 (100.00)		
A. The causes of the injury occurrence among employees												
fall	491 (33.31)	519 (35.48)	499 (35.31)	406 (28.84)	412 (23.22)	471 (24.92)	474 (27.09)	467 (32.25)	430 (27.78)	4169 (29.43)	231.908	0.000
blunt injury	257 (17.44)	239 (16.34)	273 (19.32)	29 5 (20.95)	482 (27.17)	486 (25.71)	476 (27.20)	320 (22.10)	459 (29.65)	3287 (23.20)		
motor vehicle accident	419 (28.43)	399 (27.27)	316 (22.36)	374 (26.56)	392 (22.10)	361 (19.10)	324 (18.51)	266 (18.37)	235 (15.18)	3086 (21.78)		
knife/sharp injury	82 (5.56)	57 (3.90)	87 (6.16)	115 (8.17)	246 (13.87)	319 (16.88)	212 (12.11)	163 (11.26)	243 (15.70)	1524 (10.76)		
non-motor vehicle accident	177 (12.01)	210 (14.35)	187 (13.23)	174 (12.36)	162 (9.13)	172 (9.10)	166 (9.49)	146 (10.08)	128 (8.27)	1522 (10.74)		
others	18 (1.22)	3 (0.21)	12 (0.85)	13 (0.92)	50 (2.82)	35 (1.85)	45 (2.57)	45 (3.11)	34 (2.20)	255 (1.80)		
poisoning	16 (1.09)	13 (0.89)	12 (0.85)	9 (0.64)	9 (0.51)	13 (0.69)	31 (1.77)	27 (1.86)	8 (0.52)	138 (0.97)		
undefinable injury	9 (0.61)	17 (1.16)	19 (1.34)	10 (0.71)	13 (0.73)	20 (1.06)	15 (0.86)	7 (0.48)	3 (0.19)	113 (0.80)		
burn and scald	3 (0.20)	1 (0.07)	6 (0.42)	5 (0.36)	3 (0.17)	3 (0.16)	1 (0.06)	3 (0.21)	5 (0.32)	30 (0.21)		
firearm wound	1 (0.07)	1 (0.07)	1 (0.07)	4 (0.28)	2 (0.11)	4 (0.21)	4 (0.23)	4 (0.28)	3 (0.19)	24 (0.17)		
animalsinjury	N/A	1 (0.07)	1 (0.07)	2 (0.14)	N/A	5 (0.26)	N/A	N/A	N/A	9 (0.06)		
drowning	1 (0.07)	2 (0.14)	N/A	1 (0.07)	2 (0.11)	1 (0.05)	1 (0.06)	N/A	N/A	8 (0.06)		
asphyxiation/suspension	N/A	1 (0.07)	N/A	N/A	1 (0.06)	N/A	1 (0.06)	N/A	N/A	3 (0.02)		
B. The types of the injury occurrence among employees												
fracture	878 (59.57)	882 (60.29)	867 (61.36)	808 (57.39)	980 (55.24)	1066 (56.40)	1019 (58.23)	886 (61.19)	1006 (64.99)	8392 (59.23)	65.412	0.000
brain contusion and laceration	264 (17.91)	265 (18.11)	221 (15.64)	201 (14.28)	232 (13.08)	193 (10.21)	184 (10.51)	151 (10.43)	134 (8.66)	1845 (13.02)		
sharp instrument injury/bite/open wound	80 (5.43)	55 (3.76)	85 (6.02)	148 (10.51)	330 (18.60)	393 (20.79)	297 (16.97)	191 (13.19)	255 (16.47)	1834 (12.94)		
contusion/abrasion	119 (8.07)	140 (9.57)	131 (9.27)	112 (7.95)	87 (4.90)	107 (5.66)	131 (7.49)	95 (6.56)	61 (3.94)	983 (6.94)		
sprain/strain	41 (2.78)	55 (3.76)	47 (3.33)	69 (4.90)	65 (3.66)	52 (2.75)	48 (2.74)	56 (3.87)	45 (2.91)	478 (3.37)		
the organ damage	80 (5.43)	64 (4.37)	45 (3.18)	49 (3.48)	40 (2.25)	51 (2.70)	48 (2.74)	46 (3.18)	15 (0.97)	438 (3.09)		
others	6 (0.41)	N/A	11 (0.78)	7 (0.50)	31 (1.75)	16 (0.85)	19 (1.09)	18 (1.24)	25 (1.61)	133 (0.94)		
burn and scald	6 (0.41)	2 (0.14)	6 (0.42)	13 (0.92)	7 (0.39)	3 (0.16)	1 (0.06)	4 (0.28)	6 (0.39)	48 (0.34)		
undefinable types	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.07)	2 (0.11)	9 (0.48)	3 (0.17)	1 (0.07)	1 (0.06)	17 (0.12)		
C. The places of the injury occurrence among employees												

(*continued on next page*)

Table 2 (*continued*)

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total	χ^2	P value
roads and streets	669	747	627	645	651	633	615	532	471	5590	766.271	0.000
	(45.39)	(51.06)	(44.37)	(45.81)	(36.70)	(33.49)	(35.14)	(36.74)	(30.43)	(39.46)		
industrial and building sites	444	360	412	454	714	829	697	594	759	5263		
	(30.12)	(24.61)	(29.16)	(32.24)	(40.25)	(43.86)	(39.83)	(41.02)	(49.03)	(37.15)		
homes	160	167	163	149	184	199	236	157	167	1582		
	(10.85)	(11.41)	(11.54)	(10.58)	(10.37)	(10.53)	(13.49)	(10.84)	(10.79)	(11.17)		
public resident place	75	69	83	62	71	67	71	40	50	588 (4.15)		
	(5.09)	(4.72)	(5.87)	(4.40)	(4.00)	(3.54)	(4.06)	(2.76)	(3.23)			
trade and service place	41	29	31	39	74	77	56	47	55	449		
	(2.78)	(1.98)	(2.19)	(2.77)	(4.17)	(4.07)	(3.20)	(3.25)	(3.55)	(3.17)		
schools and public places	14	17	23	26	25	28	17	14	15	179		
	(0.95)	(1.16)	(1.63)	(1.85)	(1.41)	(1.48)	(0.97)	(0.97)	(0.97)	(1.26)		
sports venues	22	13	10	19	22	20	25	21	17	169		
	(1.49)	(0.89)	(0.71)	(1.35)	(1.24)	(1.06)	(1.43)	(1.45)	(1.10)	(1.19)		
farmland	11	14	17	9	20	23	14	22	9	139		
	(0.75)	(0.96)	(1.20)	(0.64)	(1.13)	(1.22)	(0.80)	(1.52)	(0.58)	(0.98)		
undefinable places	32	44	45	2	N/A	N/A	N/A	N/A	N/A	123		
	(2.17)	(3.01)	(3.18)	(0.14)						(0.87)		
others	6	3	2	3	13	14	19	21	5	86		
	(0.41)	(0.21)	(0.14)	(0.21)	(0.73)	(0.74)	(1.09)	(1.45)	(0.32)	(0.61)		
D. The activity types of the injury occurrence among employees												
paid activities	454	396	443	479	788	890	747	640	820	5657	665.414	0.000
	(30.80)	(27.07)	(31.35)	(34.02)	(44.42)	(47.09)	(42.69)	(44.20)	(52.97)	(39.93)		
driving and riding vehicle	549	598	493	481	499	455	451	413	326	4265		
	(37.25)	(40.87)	(34.89)	(34.16)	(28.13)	(24.07)	(25.77)	(28.52)	(21.06)	(30.10)		
leisure activities	208	262	238	250	238	296	309	223	224	2248		
	(14.11)	(17.91)	(16.84)	(17.76)	(13.42)	(15.66)	(17.66)	(15.40)	(14.47)	(15.87)		
undefinable activity types	141	128	137	118	112	109	75	51	39	910		
	(9.57)	(8.75)	(9.70)	(8.38)	(6.31)	(5.77)	(4.29)	(3.52)	(2.52)	(6.42)		
domestic chores	73	50	62	42	88	103	111	75	96	700		
	(4.95)	(3.42)	(4.39)	(2.98)	(4.96)	(5.45)	(6.34)	(5.18)	(6.20)	(4.94)		
physical activity	31	22	30	30	16	16	27	15	22	209		
	(2.10)	(1.50)	(2.12)	(2.13)	(0.90)	(0.85)	(1.54)	(1.04)	(1.42)	(1.48)		
others	18	7	10	8	33	21	30	31	21	179		
	(1.22)	(0.48)	(0.71)	(0.57)	(1.86)	(1.11)	(1.71)	(2.14)	(1.36)	(1.26)		
E. The vulnerable parts of the injury occurrence among employees												
the upper limbs	276	259	291	412	746	826	723	578	751	4862	4.748	0.000
	(18.72)	(17.70)	(20.59)	(29.26)	(42.05)	(43.70)	(41.31)	(39.92)	(48.51)	(34.32)		
lower limbs	381	398	415	371	392	436	400	344	338	3475		
	(25.85)	(27.20)	(29.37)	(26.35)	(22.10)	(23.07)	(22.86)	(23.76)	(21.83)	(24.53)		
head	443	431	356	319	327	287	303	232	184	2882		
	(30.05)	(29.46)	(25.19)	(22.66)	(18.43)	(15.19)	(17.31)	(16.02)	(11.89)	(20.34)		
trunk	264	242	234	181	182	203	204	160	184	1854		
	(17.91)	(16.54)	(16.56)	(12.86)	(10.26)	(10.74)	(11.66)	(11.05)	(11.89)	(13.09)		
multiple parts	40	79	59	81	73	53	65	77	63	590		
	(2.71)	(5.40)	(4.18)	(5.75)	(4.11)	(2.80)	(3.71)	(5.32)	(4.07)	(4.16)		
alimentary system	24	16	12	12	13	11	7	10	7	112		
	(1.63)	(1.09)	(0.85)	(0.85)	(0.73)	(0.58)	(0.40)	(0.69)	(0.45)	(0.79)		
respiratory system	7	10	9	8	8	26	23	16	3	110		
	(0.47)	(0.68)	(0.64)	(0.57)	(0.45)	(1.38)	(1.31)	(1.10)	(0.19)	(0.78)		

(*continued on next page*)

Table 2 (*continued*)

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total	χ^2	P value
nervous system	19	9	12	10	11	11	15	12	11	110		
	(1.29)	(0.62)	(0.85)	(0.71)	(0.62)	(0.58)	(0.86)	(0.83)	(0.71)	(0.78)		
Extensive systemic injury	13	16	21	12	16	10	4	9	5	106		
	(0.88)	(1.09)	(1.49)	(0.85)	(0.90)	(0.53)	(0.23)	(0.62)	(0.32)	(0.75)		
others	7	3	4	1	6	22	4	8	2	57		
	(0.47)	(0.21)	(0.28)	(0.07)	(0.34)	(1.16)	(0.23)	(0.55)	(0.13)	(0.40)		
undefinable parts	N/A	N/A	N/A	1	N/A	5	2	2	N/A	10		
				(0.07)		(0.26)	(0.11)	(0.14)		(0.07)		
F. The severity degrees of injury among employees												
Moderate injury	823	814	799	825	1051	1150	1092	916	1110	8580	193.856	0.000
	(55.80)	(55.64)	(56.55)	(58.59)	(59.24)	(60.85)	(62.40)	(63.26)	(71.71)	(60.56)		
mild injury	454	410	438	403	563	535	428	336	334	3901		
	(30.80)	(28.02)	(31.00)	(28.62)	(31.74)	(28.31)	(24.46)	(23.20)	(21.58)	(27.53)		
Severe injury	197	239	176	180	160	205	230	196	104	1687		
	(13.40)	(16.34)	(12.46)	(12.78)	(9.02)	(10.85)	(13.14)	(13.54)	(6.72)	(11.91)		
G. The outcomes of injury among employees												
returned home after treatment	1368	1339	1329	1327	1688	1797	1670	1372	1505	13395	86.461	0.000
	(92.81)	(91.52)	(94.06)	(94.25)	(95.15)	(95.08)	(95.43)	(94.75)	(97.22)	(94.54)		
transferred to upper hospital	62	75	60	51	61	69	43	41	31	493		
	(4.21)	(5.13)	(4.25)	(3.62)	(3.44)	(3.65)	(2.46)	(2.83)	(2.00)	(3.48)		
others	26	25	15	14	14	13	19	24	10	160		
	(1.76)	(1.71)	(1.06)	(0.99)	(0.79)	(0.69)	(1.09)	(1.66)	(0.65)	(1.13)		
death	18	24	9	16	11	11	18	11	2	120		
	(1.22)	(1.64)	(0.64)	(1.14)	(0.62)	(0.58)	(1.03)	(0.76)	(0.13)	(0.85)		

Table 3
The top five causes, types, places of injury, activity types and vulnerable parts for injury, and all severity degrees and outcomes of injury among employees of different age groups and sex between 2013 and 2021 [N (%)].

Age	The young to middle-aged group (15year~) (N = 7778)				The middle-aged to elderly group (45year~) (N = 5488)				The elderly group (≥65year~) (N = 902)				Total		χ^2	P value
Gender	Male		Female		Male		Female		Male		Female					
A. The types of the injury occurrence																
1	fracture	3599 (57.99)	fracture	925 (58.84)	fracture	2513 (58.91)	fracture	805 (65.88)	fracture	303 (54.20)	fracture	247 (72.01)	fracture	8392 (59.23)	185.995	0.000
2	sharp instrument injury/bite/ open wound	1011 (16.29)	brain contusion and laceration	203 (12.91)	brain contusion and laceration	619 (14.51)	brain contusion and laceration	143 (11.70)	brain contusion and laceration	137 (24.51)	brain contusion and laceration	45 (13.12)	brain contusion and laceration	1845 (13.02)		
3	brain contusion and laceration	698 (11.25)	sharp instrument injury/bite/ open wound	193 (12.28)	sharp instrument injury/bite/ open wound	493 (11.56)	sharp instrument injury/bite/ open wound	93 (7.61)	sprain/strain	40 (7.16)	sprain/strain	16 (4.66)	sharp instrument injury/bite/ open wound	1834 (12.94)		
4	sprain/strain	419 (6.75)	sprain/strain	108 (6.87)	sprain/strain	317 (7.43)	sprain/strain	83 (6.79)	sharp instrument injury/bite/ open wound	36 (6.44)	the organ damages	16 (4.66)	sprain/strain	983 (6.94)		
5	contusion/ abrasion	203 (3.27)	contusion/ abrasion	63 (4.01)	contusion/ abrasion	134 (3.14)	contusion/ abrasion	60 (4.91)	the organ damages	24 (4.29)	sharp instrument injury/bite/ open wound	8 (2.33)	contusion/ abrasion	478 (3.37)		
χ^2	20.850				45.182				36.276							
P value	0.000				0.000				0.000							
B. The causes of the injury occurrence																
1	fall	1733 (27.92)	motor vehicle accident	484 (30.79)	fall	1317 (30.87)	motor vehicle accident	351 (28.72)	fall	217 (38.82)	fall	224 (65.31)	fall	4169 (29.43)	544.912	0.000
2	blunt injury	1716 (27.65)	fall	333 (21.18)	blunt injury	1010 (23.68)	fall	345 (28.23)	motor vehicle accident	170 (30.41)	motor vehicle accident	36 (10.50)	blunt injury	3287 (23.20)		
3	motor vehicle accident	1081 (17.42)	blunt injury	292 (18.58)	motor vehicle accident	964 (22.60)	blunt injury	216 (17.68)	non-motor vehicle accident	75 (13.42)	non-motor vehicle accident	30 (8.75)	motor vehicle accident	3086 (21.78)		
4	knife/sharp injury	851 (13.71)	non-motor vehicle accident	229 (14.57)	knife/sharp injury	421 (9.87)	non-motor vehicle accident	201 (16.45)	blunt injury	35 (6.26)	blunt injury	18 (5.25)	knife/sharp injury	1524 (10.76)		
5	non-motor vehicle accident	587 (9.46)	knife/sharp injury	163 (10.37)	non-motor vehicle accident	400 (9.38)	knife/sharp injury	61 (4.99)	knife/sharp injury	25 (4.47)	poisoning	14 (4.08)	non-motor vehicle accident	1522 (10.74)		

(*continued on next page*)

Table 3 (*continued*)

Age	The young to middle-aged group (15year~) (N = 7778)				The middle-aged to elderly group (45year~) (N = 5488)				The elderly group (≥65year~) (N = 902)				Total		χ^2	P value
Gender	Male		Female		Male		Female		Male		Female					
χ^2	50.603				26.635				26.635							
P value	0.000				0.000				0.000							
C. The places of the injury occurrence																
1	industrial and building sites	2730 (43.99)	roads and streets	812 (51.65)	industrial and building sites	1802 (42.24)	roads and streets	654 (53.52)	roads and streets	291 (52.06)	homes	186 (54.23)	roads and streets	5590 (39.46)	1042.924	0.000
2	roads and streets	2070 (33.35)	industrial and building sites	375 (23.85)	roads and streets	1656 (38.82)	industrial and building sites	296 (24.22)	homes	136 (24.33)	roads and streets	107 (31.20)	industrial and building sites	5263 (37.15)		
3	homes	498 (8.02)	homes	218 (13.87)	homes	388 (9.10)	homes	156 (12.77)	industrial and building sites	53 (9.48)	Public resident place	13 (3.79)	homes	1582 (11.17)		
4	Public resident place	336 (5.41)	Trade and service place	54 (3.44)	Public resident place	133 (3.12)	Public resident place	40 (3.27)	farmland	34 (6.08)	Trade and service place	7 (2.04)	Public resident place	588 (4.15)		
5	Trade and service place	234 (3.77)	Public resident place	48 (3.05)	Trade and service place	106 (2.48)	Trade and service place	39 (3.19)	Public resident place	18 (3.22)	industrial and building sites	7 (2.04)	Trade and service place	449 (3.17)		
χ^2	309.183				151.453				109.651							
P value	0.000				0.000				0.000							
D. The activity types of the injury occurrence																
1	paid activities	2891 (46.58)	driving and riding vehicles	645 (41.03)	paid activities	1911 (44.80)	driving and riding vehicles	514 (42.06)	driving and riding vehicles	207 (37.03)	leisure activities	167 (48.69)	paid activities	5657 (39.93)	642.843	0.000
2	driving and riding vehicles	1574 (25.36)	paid activities	432 (27.48)	driving and riding vehicles	1271 (29.79)	paid activities	333 (27.25)	leisure activities	164 (29.34)	domestic chores	62 (18.08)	driving and riding vehicles	4265 (30.10)		
3	leisure activities	930 (14.99)	leisure activities	259 (16.48)	leisure activities	511 (11.98)	leisure activities	217 (17.76)	paid activities	73 (13.06)	driving and riding vehicles	54 (15.74)	leisure activities	2248 (15.87)		
4	Undefinable activity types	389 (6.27)	domestic chores	98 (6.23)	Undefinable activity types	296 (6.94)	domestic chores	79 (6.46)	Undefinable activity types	55 (9.84)	Undefinable activity types	29 (8.45)	Undefinable activity types	910 (6.42)		
5	domestic chores	226 (3.64)	Undefinable activity types	89 (5.66)	domestic chores	192 (4.50)	Undefinable activity types	52 (4.26)	domestic chores	43 (7.69)	paid activities	17 (4.96)	domestic chores	700 (4.94)		
χ^2	239.415				157.956				93.499							
P value	0.000				0.000				0.000							
E. The vulnerable parts of the injury occurrence																
1	The upper limbs	2384 (38.41)	The upper limbs	590 (37.53)	The upper limbs	1340 (31.41)	The upper limbs	424 (34.70)	head	178 (31.84)	The lower limbs	131 (38.19)	The upper limbs	4862 (34.32)	406.389	0.000
2	The lower limbs	1517 (24.44)	The lower limbs	380 (24.17)	The lower limbs	1010 (23.68)	The lower limbs	295 (24.14)	The lower limbs	142 (25.40)	trunk	76 (22.16)	The lower limbs	3475 (24.53)		
3	head	1242	head	327	head	871	trunk	209	trunk	91	head	60	head	2882		

(*continued on next page*)

Table 3 (*continued*)

Age	The young to middle-aged group (15year~) (N = 7778)				The middle-aged to elderly group (45year~) (N = 5488)				The elderly group (≥65year~) (N = 902)				Total		χ^2	P value
Gender	Male		Female		Male		Female		Male		Female					
		(20.01)		(20.80)		(20.42)		(17.10)		(16.28)		(17.49)		(20.34)		
4	trunk	636 (10.25)	trunk	148 (9.41)	trunk	694 (16.27)	head	204 (16.69)	The upper limbs	79 (14.13)	The upper limbs	45 (13.12)	trunk	1854 (13.09)		
5	multiple parts	23 0 (3.71)	multiple parts	68 (4.33)	multiple parts	200 (4.69)	multiple parts	53 (4.34)	multiple parts	31 (5.55)	respiratory system	10 (2.92)	multiple parts	590 (4.16)		
χ^2	6.095				24.557				40.098							
P value	0.807				0.000				0.000							
F.The severity degrees of injury																
1	mild injury	3689 (59.44)	mild injury	915 (58.21)	mild injury	2648 (62.07)	mild injury	781 (63.91)	mild injury	327 (58.50)	mild injury	220 (64.14)	Moderate injury	8580 (60.56)	102.563	0.000
2	Moderat-e injury	1843 (29.70)	Moderat-e injury	509 (32.38)	Moderat-e injury	1048 (24.57)	Moderat-e injury	312 (25.53)	Moderate injury	133 (23.79)	Severe injury	67 (19.53)	mild injury	3901 (27.53)		
3	Severe injury	674 (10.86)	Severe injury	148 (9.41)	Severe injury	570 (13.36)	Severe injury	129 (10.56)	Severe injury	99 (17.71)	Moderat-e injury	56 (16.33)	Severe injury	1687 (11.91)		
χ^2	5.788				6.740				7.155							
P value	0.055				0.034				0.028							
G.The outcomes of injury																
1	returned home after treatment	5895 (94.99)	returned home after treatment	1501 (95.48)	returned home after treatment	4003 (93.83)	returned home after treatment	1150 (94.11)	returned home after treatment	517 (92.49)	returned home after treatment	329 (95.92)	returned home after treatment	13395 (94.54)	23.696	0.000
2	transferred to upper hospital	217 (3.50)	transferred to upper hospital	46 (2.93)	transferred to upper hospital	163 (3.82)	transferred to upper hospital	40 (3.27)	transferred to upper hospital	19 (3.40)	transferred to upper hospital	8 (2.33)	transferred to upper hospital	493 (3.48)		
3	Others	53 (0.85)	death	15 (0.95)	Others	53 (1.24)	Others	26 (2.13)	Others	13 (2.33)	Others	5 (1.46)	Others	160 (1.13)		
4	death	41 (0.66)	Others	10 (0.64)	death	47 (1.10)	death	6 (0.49)	death	10 (1.79)	death	1 (0.29)	death	120 (0.85)		
χ^2	3.476				9.618				6.742							
P value	0.324				0.022				0.081							

Table 4
The independent risk predictors of the outcomes of injury by the multivariate logistic regression analysis [OR (95%CI)].

Variable Name	Likelihood Ratio Tests of the all outcomes		Parameter Estimates for the outcome of upper hospital				Parameter Estimates for the outcome of transferred to death				Parameter Estimates for the outcome ofothers			
	Wald χ^2	P value	β	SE(β)	OR	95 % CI for OR	β	SE(β)	OR	95 % CI for OR	β	SE(β)	OR	95 % CI for OR
Intercept	442.864	0.000	−5.194	0.483			−20.627	2.031			−8.207	0.840		
Gender	2.235	0.525	−0.143	0.120	0.866	0.684,1.097	0.138	0.254	1.148	0.697,1.890	0.116	0.188	1.123	0.778,1.623
Census register	31.942	0.000*	−0.585	0.104	0.557	0.455,0.683*	0.140	0.237	1.151	0.723,1.831	0.027	0.186	1.027	0.713,1.480
Age	17.945	0.000*	−0.239	0.082	0.787	0.671,0.924*	0.168	0.168	1.183	0.851,1.645	0.361	0.132	1.434	1.107,1.859*
Occupation	6.507	0.089	0.064	0.031	1.066	1.004,1.132*	0.022	0.064	1.022	0.902,1.158	0.081	0.055	1.085	0.975,1.207
The causes of the injury occurrence	15.401	0.002*	−0.072	0.022	0.930	0.892,0.971*	−0.041	0.037	0.959	0.893,1.031	−0.058	0.036	0.944	0.880,1.012
The places of the injury occurrence	8.036	0.045*	0.046	0.026	1.047	0.996,1.101	0.100	0.056	1.105	0.990,1.235	−0.050	0.041	0.951	0.878,1.030
The activity types of the injury occurrence	2.558	0.465	0.033	0.033	1.033	0.968,1.103	0.057	0.064	1.059	0.935,1.200	0.056	0.055	1.057	0.949,1.178
The types of the injury occurrence	106.686	0.000*	0.144	0.020	1.155	1.110,1.202*	0.304	0.042	1.355	1.248,1.470*	0.119	0.035	1.126	1.052,1.207*
The vulnerable parts of the injury occurrence	24.324	0.000*	0.082	0.024	1.085	1.035,1.139*	−0.019	0.041	0.981	0.905,1.063	0.155	0.039	1.168	1.081,1.261*
The severity degrees of injury occurrence	628.218	0.000*	1.143	0.080	3.136	2.682,3.668*	5.134	0.587	169.624	53.734,535.466*	0.727	0.134	2.070	1.592,2.690*

3.7. Vulnerable body regions

The body regions most vulnerable to injury were the upper limbs (34.32 %), lower limbs (24.53 %), head (20.34 %), trunk (13.09 %), and multiple limbs (4.16 %) (Table 2E). The most common body regions vulnerable to injury in male and female employees in the 15–44- and 45–64-year age groups were the upper and lower limbs, respectively. In the ≥65-year age group, the most common parts vulnerable to injury were the head and lower limbs in males and the lower limbs and trunk in females. Differences in the vulnerable parts for injury between the different age groups were statistically significant ($\chi^2 = 406.389$, $P < 0.01$). There was no statistically significant difference in the vulnerable parts for injury in the 15–44-year age group according to sex ($\chi^2 = 6.095$, $P = 0.807$). However, there were statistically significant differences in relation to vulnerable regions for injury in the 45–64-, and ≥65-year age groups according to sex ($\chi^2 = 24.557$ and 40.098, respectively; $P < 0.01$; Table 3E).

3.8. Injury severity

In total, 60.56 % of the employees had moderate injuries. Mild and severe injuries comprised 27.53 % and 11.91 % of injuries, respectively. The number of moderate injuries was lowest in 2013 (55.80 %) and highest in 2021 (71.71 %), indicating an increasing

Table 5
The distribution of the economic burden of injury (the average hospitalization expenses and the duration of missed work) on employees of the different age groups and sex between 2013 and 2021 [$\overline{x} \pm s$].

Year	N	$\overline{x} \pm s$	95%Confidence interval (95 % CI)	Statistics	Age group	Genders	N	$\overline{x} \pm s$	95%Confidence interval (95 % CI)	Statistics
A. The duration for missed work										
Total	**14168**	**49.77 ± 0.367**	**(49.05, 50.49)**			**Total**	**14168**	**49.77 ± 0.367**	**(49.05, 50.49)**	
2013	1474	33.80 ± 1.137	(31.57, 36.03)	F = 4.621	The young to middle-aged	Male	6206	49.69 ± 0.540	(48.63, 50.75)	F = 19.851
2014	1463	36.78 ± 1.069	(34.68, 38.87)	P = 0.000	group (15year~)	Female	1572	49.12 ± 1.091	(46.98, 51.26)	P = 0.000
2015	1413	40.38 ± 1.219	(37.99, 42.77)			**Total**	7778	49.57 ± 0.484[a]	(48.63, 50.52)	
2016	1408	53.68 ± 1.551	(50.64, 56.72)		The middle-aged to elderly group	Male	4266	50.90 ± 0.689	(49.55, 52.25)	
2017	1774	61.77 ± 0.978	(59.86, 63.69)			Female	1222	53.09 ± 1.408	(50.33, 55.86)	
2018	1890	54.16 ± 0.945	(52.30, 56.01)			**Total**	5488	51.39 ± 0.621[a]	(50.17, 52.61)	
2019	1750	54.33 ± 0.937	(52.49, 56.17)		The elderly group (≥65year~)	Male	559	42.82 ± 1.581	(39.71, 45.92)	
2020	1448	51.64 ± 1.014	(49.65, 53.63)			Female	343	39.51 ± 1.891	(35.79, 43.23)	
2021	1548	56.22 ± 0.878	(54.50, 57.94)			**Total**	902	41.56 ± 1.216[a]	(39.17, 43.94)	
B. The average hospitalization expenses										
Total	**14168**	**16250.37 ± 183.113**	**(15891.44, 16609.30)**	F = 79.872	The young to middle-aged	**Total**	**14168**	**16250.37 ± 183.113**	**(15891.44, 16609.30)**	F = 25.284
2013	1474	14900.59 ± 568.668	(13785.11, 16016.08)	P = 0.000	group (15year~)	Male	6206	15535.70 ± 266.664	(15012.94, 16058.45)	P = 0.000
2014	1463	17349.10 ± 696.039	(15983.76, 18714.44)			Female	1572	13345.02 ± 424.180[b]	(12513.00, 14177.04)	
2015	1413	16733.30 ± 569.180	(15616.78, 17849.83)			**Total**	7778	15092.94 ± 229.597	(14642.87, 15543.01)	
2016	1408	18194.65 ± 571.606	(17073.35, 19315.94)		The middle-aged to elderly group	Male	4266	17875.63 ± 364.016	(17161.97, 18589.29)	
2017	1774	16266.51 ± 464.280	(15355.91, 17177.10)			Female	1222	16244.54 ± 581.833[b]	(15103.03, 17386.04)	
2018	1890	16572.38 ± 505.224	(15581.53, 17563.24)			**Total**	5488	17512.44 ± 311.321[c]	(16902.12, 18122.75)	
2019	1750	16730.94 ± 537.156	(15677.41, 17784.48)		The elderly group (≥65year~)	Male	559	19392.52 ± 1238.525	(16959.78, 21825.26)	
2020	1448	14815.01 ± 608.895	(13620.60, 16009.42)			Female	343	17182.73 ± 1009.289[b]	(15197.54, 19167.93)	
2021	1548	14675.69 ± 424.429	(13843.17, 15508.21)			**Total**	902	18552.22 ± 858.518[c]	(16867.29, 20237.14)	

Notes.
[a] : P < 0.05, comparison of the average duration of missed work between the different age groups.
[b] : P < 0.05, comparison of average hospitalization expenses in the same age group between the different sex.
[c] : P < 0.05, comparison of average hospitalization expenses between the other age groups and the middle to the older-aged group.

trend. However, the number of severe injuries was highest in 2013 (16.34 %) and lowest in 2021 (6.72 %), indicating a decreasing trend ($\chi^2 = 193.856$, $P < 0.01$; Table 2F). A statistically significant difference in the severity of injury was observed between the different age groups ($\chi^2 = 102.563$, $P < 0.01$). With increasing age, the incidence rates relating to severe injuries gradually increased to 10.57 %, 12.74 %, and 18.40 % across the three age groups, respectively. There was no significant difference in incidence rates relating to severity of injury between the 15–44-year age group employees compared with different sex ($\chi^2 = 5.788$, $P > 0.05$). However, the severe injury rate was higher in male employees in the 45–64-year age group than in their female counterparts ($\chi^2 = 6.740$, $P < 0.05$). The incidence rates of severe injury was lower in male employees in the ≥65-year age group than in their female counterparts ($\chi^2 = 7.155$, $P < 0.05$; Table 3F).

3.9. Injury outcomes

In total, 94.54 % of injured employees returned home after treatment, 3.48 % were transferred to a higher tertiary hospital and rehabilitation hospital for further treatment, and 0.85 % died. Injury-related deaths were highest in 2013 (1.22 %) and lowest in 2021 (0.13 %), indicating a decreasing trend ($\chi^2 = 86.461$, $P < 0.01$; Table 2G). A statistically significant difference was observed in injury outcomes between different age groups ($\chi^2 = 23.696$, $P < 0.01$). With increasing age, the injury-related death rate gradually increased to 0.72 %, 0.97 %, and 1.22 % in the three age groups, respectively. No significant difference was observed in the number of deaths owing to injury between male employees in the 15–44- and ≥65-year age groups compared with female employees ($\chi^2 = 3.476$, 6.742, $P < 0.01$). However, the death rate due to injury was higher in male employees in the 45–64-year age group than in their female counterparts ($\chi^2 = 9.618$, $P < 0.05$; Table 3G).

3.10. Independent predictors of injury outcomes

Multivariate logistic regression analysis results indicated that independent predictors of all outcomes were census register classification (registered or floating residence); age; injury cause, location, and type; vulnerable body regions; and injury severity ($P < 0.05$). Compared with the 'discharged after treatment' outcome, according to the odds ratio (OR) value (from highest to lowest), the independent protective predictors of the 'transferred to a tertiary hospital' outcome were injury cause, census register classification, and age. The independent risk predictors of 'transferred to a tertiary hospital' outcomes were injury severity, injury type, vulnerable body regions, and occupation. The independent risk predictors of the 'death' outcome were degree of injury severity, injury type, and injury occurrence (ORs 169.624 and 1.355, respectively). The independent risk predictors of the 'others' outcome were injury severity, injury occurrence, age, vulnerable body regions, and injury types according to the OR (from highest to lowest) (Table 4).

3.11. Economic burden of injury

3.11.1. The duration of missed work owing to injury

The total duration of missed work due to injuries among employees between 2013 and 2021 was 705,097 days, and the average duration of missed work was 49.77 days, showing an increasing annual trend (F = 79.8724.621, $P < 0.01$; Table 5A). The average durations of missed work in the 15–44-, 45–64-, and ≥65-year age groups were 49.57, 51.39, and 41.56 days, respectively. The average duration of missed work was higher in the 15–44- and 45–64-year age groups than in the ≥65-year age group (F = 19.851, $P < 0.01$). There was no statistically significant difference in the duration of missed work due to injuries according to sex within the same age group (F = 0.227, 2.157, and 1.744, respectively; $P > 0.05$; Table 5A). The average durations of missed work in the different injury outcome groups owing to injuries among employees between 2013 and 2021 were 50.21, 42.57, 44.57, and 38.20 days, respectively. The average duration of missed work was longest in relation to the 'discharged after treatment' outcome. The average duration of

Table 6
The distribution of the duration of missed work of the different injury outcome groups on employees between 2013 and 2021 [$\bar{x} \pm s$].

The outcomes of injury	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
Total	33.80 ± 1.137	36.77 ± 1.06	40.37 ± 1.219	53.68 ± 1.551	61.77 ± 0.978	54.16 ± 0.945*	54.33 ± 0.937	51.64 ± 1.014	56.22 ± 0.878	49.77 ± 0.367
returned home after treatment	33.78 ± 1.167*	36.94 ± 1.12*	40.56 ± 1.258	54.26 ± 1.622	62.07 ± 1.002*	54.31 ± 0.975*	54.79 ± 0.961*	52.43 ± 1.042°	56.63 ± 0.887	50.21 ± 0.378
transferred to upper hospital	30.04 ± 7.300*	34.29 ± 4.85*	36.42 ± 6.276 *	49.61 ± 6.186*	58.36 ± 5.357	51.68 ± 4.551 *	46.30 ± 6.046*	34.88 ± 5.613*	41.68 ± 6.566*	42.57 ± 2.003*
death	52.76 ± 0.000	45.26 ± 3.520	47.01 ± 5.752	44.43 ± 4.524*	32.35 ± 6.973	42.24 ± 7.706	42.72 ± 4.251*	48.06 ± 4.706°	29.88 ± 22.882	44.57 ± 1.645*
others	30.58 ± 8.539*	27.32 ± 9.548	35.40 ± 11.056*	23.86 ± 9.110	64.29 ± 11.668*	55.92 ± 9.288 *	43.1 ± 9.311*	36.54 ± 8.426 *	44.60 ± 13.430*	38.20 ± 3.366
χ^2	49.688	31.648	12.337	11.426	8.301	1.527	5.299	18.309	9.785	77.324
P value	0.000	0.000	0.006	0.010	0.040	0.676	0.151	0.000	0.020	0.000

Notes: *&°: P ≥ 0.05, comparison of the average duration of missed work between the different outcome groups of the injury.

missed work was shortest in relation to the 'others' outcome. No statistically significant difference was observed in the duration of missed work in relation to 'transferred to tertiary hospital' and 'death' outcomes ($P > 0.05$, Table 6).

3.11.2. Hospitalization costs relating to employees' injuries

Total hospitalization expenses owing to employee injuries between 2013 and 2021 totaled ¥ 230,235,257, with the average hospitalization expenses being ¥ 16250.37, which indicated a decreasing trend yearly ($F = 79.872$, $P < 0.01$; Table 5B). With increasing age, the average hospitalization expenses gradually increased. The average hospitalization expenses in relation to the 15–44-, 45–64-, and ≥65-year age groups were 15092.94, 17512.44, and 18552.22, respectively ($F = 25.284$, $P < 0.01$). The average hospitalization expenses in the 15–44-year age group were lower than those in the 45–64- and ≥65-year age groups. No significant difference was observed in the average hospitalization expenses between the 45–64- and ≥65-year age groups. The average hospitalization expenses owing to injuries were higher for male employees than for female employees in the 15–44- and 45–64-year age groups ($F = 14.707$ and 4.754, respectively, $P < 0.05$). No statistically significant difference was observed in the average hospitalization expenses resulting from injuries according to sex in the ≥65-year age group ($F = 1.562$, $P = 0.212$; Table 5B). The total length of hospitalization owing to employee injuries between 2013 and 2021 was 215,352 days and the average length of hospitalization was 15.22 days, indicating a decreasing annual trend ($F = 76.657$, $P < 0.01$). A correlation analysis indicated that the total correlation coefficient between the average length of hospitalization and average hospitalization expenses was 0.560, showing a significant positive correlation ($P < 0.05$). The correlation coefficients between the average length of hospitalization and average hospitalization expenses from 2014 to 2021 showed an increasing annual trend (Table 7).

4. Discussion

In addition to infectious and chronic non-infectious diseases, injury is another major public health issue globally [4,6]. To reduce injury occurrence, injury control aims to determine the distribution, causes, and risks of injury occurrence for targeted prevention [7]. Beilun District is an economic region with a total regional gross domestic product of 263.084 billion yuan in 2022. With the world's largest port production economy in terms of throughput, transportation and industrial production are relatively well developed. At the end of 2022, the permanent population of the entire district was 879,000 people, the registered residential population was 449,500, and the floating population was approximately 429,500. Injury is the leading cause of death in this region. The Zhejiang University School of Medicine First Affiliated Hospital Beilun Branch is the only injury-monitoring sentinel unit in Beilun District. Beilun District People's Hospital reported 25,375 injury cases between 2013 and 2021, of which 14,168 injuries occurred in employees, accounting for 55.92 % of the total injury cases. With currently no data analysis on the epidemiology of injuries among employees having been reported, this study analyzed the epidemiological characteristics and economic burden of employee injuries.

The study findings indicated that the incidence of injuries in males was significantly higher than that in females, possibly because of differences in work exposure and the scope of social activities between the sexes, which is consistent with previous studies [5,8]. The sex ratio was the highest in the 15–44-year age group, indicating that young men have a higher risk of injury than young women due to more sports, excitability, work of higher relative risk, and higher exposure to risk factors, in keeping with a previous study analyzing the characteristics of injuries from the Chinese National Injury Surveillance System [9]. Regarding age distribution, the injuries of employees in the 15–44- and 45–64-year age groups accounted for >98 % of all employee injuries. These two age groups are the main bearers of work and housework, with more social, entertainment, and sports activities; therefore, their exposure to injury risk factors is higher [5]. The proportion of injuries in the 45–64-year age group has increased annually, suggesting that middle- and older-aged employees are likely to be the key population for injury intervention [10,11]. Middle- and older-aged employees are engaged in varying types of production labor. With increasing age, the body responds more slowly and has poorer strain capacity, making accidental injuries more likely to occur [12]. The proportion of injuries among migrant employees was considerably higher than that among the registered residential population, increasing annually possibly because of a poor living environment and a lack of practical and occupational protection knowledge. This finding suggests that corresponding occupational protection security mechanisms and strengthened training in injury intervention knowledge should be provided to migrant employees.

The time distribution of injuries among employees showed a clear trend, increasing during summer and decreasing during winter

Table 7
The correlation of the length of hospitalization and hospitalization expenses of the injury on employees between 2013 and 2021 [$\bar{x} \pm s$].

Year	N	The average hospitalization expenses ($\bar{x} \pm s$)	Statistics	The average length of hospitalization ($\bar{x} \pm s$)	Statistics	Correlation Coefficient	P value
Total	14168	16250.37 ± 183.113	F =	15.22 ± 15.251	F =	0.560	0.000
2013	1474	14900.59 ± 568.668	79.872	17.42 ± 20.784	76.657	0.710	0.000
2014	1463	17349.10 ± 696.039	P = 0.000	16.40 ± 14.518	P = 0.000	0.467	0.000
2015	1413	16733.30 ± 569.180		17.37 ± 20.191		0.542	0.000
2016	1408	18194.65 ± 571.606		19.05 ± 18.869		0.475	0.000
2017	1774	16266.51 ± 464.280		17.50 ± 13.759		0.628	0.000
2018	1890	16572.38 ± 505.224		16.39 ± 12.738		0.631	0.000
2019	1750	16730.94 ± 537.156		12.89 ± 11.420		0.600	0.000
2020	1448	14815.01 ± 608.895		10.70 ± 10.320		0.645	0.000
2021	1548	14675.69 ± 424.429		9.52 ± 8.774		0.631	0.000

each year. This may be because of more holidays taken, less protective wear, fatigue, dizziness owing to hot weather, or other factors that increase the risk of injuries. The peak times of injury occurrence during the day were 0800, 1000, 1500, 1800, and 2000 h, possibly owing to commuting rush hours, heavier traffic conditions, more exposure to work, or engaging in fighting during night activities, which is consistent with a previous analysis in the Songjiang District of Shanghai [13].

The primary cause of injuries in young to middle-aged and middle to older-aged female employees was MVAs, which is consistent with a report from Songjiang District of Shanghai [11]. Falls were the primary cause of injuries among female employees in the ≥65-year age group and male employees in all age groups [14]. However, with increasing age, the proportion of falls among male employees gradually increased, which may be explained as due to men being mostly engaged in high-altitude work and in the construction industry [15]. These findings indicate that MVAs and falls are serious issues threatening the District's residents' health, and relevant departments should focus on preventing such injuries. There was an increase in the proportion of blunt injuries, indicating that personal security in relation to fighting-related injuries should also be considered.

Fractures were the primary injury type in all age groups. The proportion of fracture injuries among female employees was significantly higher than that among male employees owing to the physiological characteristics of female employees [15]. The primary location of injury for male employees in the 15–44- and 45–64-year age groups was industrial and building sites, mainly because of the high risk of injury caused by increased exposure at work. The primary location of injury for male employees in the ≥65-year age group was roads or streets, primarily owing to MVAs. The main locations of injury for female employees in the 15–44- and 45–64-year age groups were roads and streets. The main location of injury for female employees in the ≥65-year age group as at home because older adult women were mostly engaged in housework. This indicates that where an injury occurred was closely associated with activities that caused the injury.

The activity types for injury occurrence in male and female employees in the 15–44- and 45–64-year age groups were mostly paid activities and driving and in riding vehicles. The activity types for injury occurrence in male employees in the ≥65-year age group mostly involved driving, riding in vehicles, and leisure activities, whereas those for injury occurrence in female employees in the ≥65-year age group involved leisure and housework activities. This suggests that older employees should pay more attention to falls during leisure time, which is consistent with Lu et al.'s findings [16]. This indicates that interventions focusing on home injuries should be emphasized to prevent falls at home and during leisure activities.

The development of medical technology has improved the effectiveness of injury treatment. Of the injured employees, 94.54 % were discharged after treatment and only 0.85 % died. While the number of deaths owing to injury showed a decreasing trend, death avoidance remains important. Multivariate logistic regression analysis findings indicated that the independent risk predictors of death as an outcome were the degree of injury severity and injury type (ORs 169.624 and 1.355, respectively), which is consistent with other research findings [17]. In this study, 60.56 % of employees had moderate injuries. Mild and severe injuries accounted for 27.53 % and 11.91 % of injuries, respectively. While the proportion of patients with severe injuries decreased, the incidence rates concerning severe injury were higher for male employees in the 45–64-year age group than for their female counterparts, and the incidence rate for severe injury was lower in older adult male employees. Meanwhile, the incidence rates for brain contusion and laceration, and sharp instrument injury/bite/open wound were higher in male employees. The incidence rate for fractures was higher in female employees. Among middle-aged and older employees, greater attention needs to be paid to both male and female employees in relation to severe brain damage and fractures, respectively.

The total hospitalization expenses due to employee injury between 2013 and 2021 demonstrated an annual decreasing trend. This is inconsistent with reports on injuries in Gansu Province between 2014 and 2018 [18]. This contrasting finding may be due to the implementation of diagnosis-related groups in Ningbo in recent years [19], thus decreasing the average hospitalization expenses. Furthermore, average hospitalization expenses gradually increased with age, possibly because of the recurrence of underlying diseases and complications resulting from injuries to older employees. The average hospitalization expenses of male employees were higher than those of female employees, possibly because of a severer degree of injury [20]. Correlation analysis indicated the total correlation coefficient between the average length of hospitalization and the average hospitalization expense was 0.560, showing a significant positive correlation, consistent with findings reported in a previous study [21]. Reducing the length of hospitalization is an effective strategy for controlling hospitalization expenses while ensuring the safety and effectiveness of medical treatment.

The total duration of missed work due to injuries among employees between 2013 and 2021 showed an increasing annual trend. The average durations of missed work in the different injury outcome groups due to injuries among employees between 2013 and 2021 were 50.21, 42.57, 44.57 and 38.20 days, respectively. The average duration of missed work was longest in relation to the 'discharged after treatment' outcome because recovery needed more time. No differences were observed between the sexes; however, the average days of missed work in the 15–44- and 45–64-year age groups were greater than that in the ≥65-year age group. Therefore, the indirect economic losses in relation to individuals and families, and the socioeconomic consequences due to missed work need to be considered as employees in the 15–44- and 45–64-year age groups comprise the main labor force in the family and in society.

This study had several limitations. The data utilized in this study were retrospectively gathered from a pre-existing database. The database is not specifically designed for a detailed investigation of employee injuries. The diagnoses and injury details were limited to those captured correctly in the database. The method of recording data in the hospital injury monitoring system may have resulted in mis-representation of employee injuries due to erroneous data entry. While we sought to ensure that our sample included only cases related to employees, it is possible that other injury types in other populations were incorrectly included owing to the nature of the coding system. We exclusively investigated injuries present in this database and did not include data on minor injuries that did not require medical treatment. However, relevant information concerning the prevalence, characteristics, and economic burden in relation to these types of patients has not been gathered. Extrapolation of the results requires more data to further verify our findings. Therefore, future studies are needed to elucidate injuries that do not require medical treatment.

5. Conclusion

This study analyzed data concerning 14,168 injuries among employees from the hospital injury monitoring system of a sentinel hospital, comprising the largest cohort in the current literature. We highlighted the prevalence and characteristics of injuries among employees, with fractures, brain contusions, lacerations, sharp instrument injuries or bites, and open wounds representing the most common injuries. The primary sites of injury in male employees were industrial and building sites, roads, and streets. The main locations of injury among male employees in the older age group were roads and streets. The main sites of injury in female employees were roads, streets, and homes. While focusing on the prevention and control of injuries among registered residents, injuries among the floating population should also be addressed [22,23]. Attention needs to be paid to the commuting rush hour and to work safety in terms of alleviating heavy traffic conditions and reducing the risk of industrial accidents that result in severe injuries and deaths. Although hospitalization expenses due to employee injury between 2013 and 2021 demonstrated a decreasing annual trend annually, the duration of missed work showed an increasing annual trend annually, particularly in the 15–44- and 45–64-year age groups, which comprise the main labor force. Therefore, reducing the length of hospitalization is an effective strategy for controlling hospitalization expenses and the duration of missed work.

This study was conducted in the coastal county of Zhejiang Province. Targeted intervention measures should be implemented to prevent and control injuries and reduce the economic burden caused by injuries according to the epidemiological characteristics of various injuries in different populations, sexes, and age groups. This study also provides a reference for research on injuries among employees in other coastal and inland areas.

Funding statement

This study was supported by the Public Welfare Project of Ningbo (grant numbers 2022S067) and the Soft science research project of grass-roots health of Zhejiang province (grant numbers 2023JC03).

Ethical approval

All study procedures were approved by the Ethics Committee of the Zhejiang University School of Medicine First Affiliated Hospital Beilun Branch (No.2022LP047). This study was a retrospective analysis of clinical data, and the ethics committee has waived the requirement for written informed consent, and the privacy.

Data availability statement

The data that support the findings of this study are available from the corresponding author on reasonable request.

CRediT authorship contribution statement

Dongxian Ye: Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization. **Libo Zhang:** Data curation. **Yajun Ding:** Writing – review & editing, Visualization. **Chunxia Xu:** Writing – review & editing. **Yaner Yu:** Writing – review & editing, Writing – original draft. **Yachun Zhou:** Writing – review & editing, Writing – original draft. **Yingbin Wang:** Writing – review & editing, Writing – original draft.

Declaration of competing interest

The author declares that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

Thanks to all authors for their contributions. This study has won the 1st Award of Excellent Paper from the Health Management Branch of Ningbo Medical Association in 2023.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e37950.

References

[1] Shengyong Wang, Chi Guibo, Ning Wang, Injury epidemiology, Liferatue and Information On Preventine 8 (4) (2002) 505–512.

[2] F. Alonso, C. Esteban, L. Montoro, et al., Knowledge, perceived effectiveness and qualification of traffic rules, police supervision, sanctions and justice, Cogent Social Sciences 3 (1) (2017) 1393855, https://doi.org/10.1080/23311886.2017.1393855.
[3] World Health Organization.Noncommunicable diseases: Key facts [EB/OL]. https://www.who.int/zh/news-room/fact-sheets/detail/noncommunicable-diseases[2018-06-01].
[4] World Health Organization, Injuries and violence, Available: www.who.int/news-room/fact-sheets/detail/injuries-and-violence, 2021. (Accessed 15 July 2022).
[5] L.I. Junyan, X.U. Haofeng, M.E.N.G. Ruilin, et al., The analysis of injury surveillance data during 2016 in guangdong province, Injury Medicine (Electronic Edition) 6 (4) (2017) 39–42.
[6] A. Asnaani, B. Hall-Clark, Recent developments in understanding ethnocultural and race differences in trauma exposure and PTSD, Curr Opin Psychol 14 (2017) 96–101, https://doi.org/10.1016/j.copsyc.2016.12.005.
[7] Shengyong Wang, Injury epidemiology[M], People's Medical Publishing House, Beijing, 2003, p. 13.
[8] Leilei Duan, Deng Xiao, Wang Yuan, et al., Analysis on the characteristics of injuries from the Chinese national injury surveillance system, 2010, Chinese Journal of Health Education 28 (4) (2012) 244–247.
[9] Y. Fang, R. Min-Qin, L. Xin-Yan, et al., Analysis of current situation of injury surveillance in Lanzhou from 2004 to 2017, Bulletin of Disease Control & Prevention(China) 34 (4) (2019) 26–29.
[10] Jie Shao, Zanqiong Chen, Xianqin Fu, Analysis of the characteristics of the injury surveillance cases in Weifang Community in Shanghai from 2011 to 2014, Shanghai Medical & Pharmaceutical Journal 37 (2) (2016) 43–46.
[11] Yulong Zhu, Yuanying Lu, Lei Chen, Analysis of the injury monitoring results in a community outpatient clinic in Songjiang District of Shanghai from 2015 to 2018, Shanghai Medical & Pharmaceutical Journal 40 (22) (2019) 42–46.
[12] Lun Cai, Cen Lin, Zi Zhou, et al., The research progress of public health of the falls in the elderly, Chinese Journal of Gerontology 38 (9) (2018) 2265–2268.
[13] Can Qin, Zhang Mingjuan, Analysis of epidemiological characteristics of injury surveillance cases in a community in Songjiang District, Shanghai from 2011 to 2020, Chinese Journal of Gerontology 42 (18) (2021) 44–48.
[14] Tingting Wu, Lili Wang, Bo Qixiu, Analysis of epidemic characteristics of injury surveillance cases in the dongying economic and technological development zone from 2018 to 2020, Chinese Preventive Medicine 23 (1) (2022) 77–80.
[15] S.H. Kim, Risk factors for severe injury following indoor and outdoor falls in geriatric patients, Arch. Gerontol. Geriatr. 62 (2016) 75–82, https://doi.org/10.1016/j.archger.2015.10.003.
[16] Zhiming Lu, Yuan Wang, Pengpeng Ye, et al., The Severity and Influencing Factors of Injuries Among Patients Attending Hospitals Due to Falls in China,2018, vol. 10, Chinese Journal of Disease Control & Prevention, 2020, pp. 1124–1128.
[17] M. Yang, Y. Zhang, Epidemiological features of 1,332 cases of hip fracture in Shanghai, China (2015-2020), Arthroplasty [J] 6 (1) (2024) 18, https://doi.org/10.1186/s42836-024-00236-4.
[18] Zhao Meitao, Study on the Current Status, Changing Trend and Influencing Factors of Injury Treatment Costs in Gansu Province[D], Lanzhou University, 2020.
[19] P. Ning, M. Cai, P. Cheng, Y. Zhang, et al., Trends in injury morbidity in China, 1993-2013: a longitudinal analysis of population-based survey data, Accid. Anal. Prev. (113) (2018) 179–186, https://doi.org/10.1016/j.aap.2018.01.017.
[20] Jie Zhang, Analysis on the Characteristics, Disease Burden and ARIMA Model of Injured Inpatients in Shenzhen from 2013 to 2018[D], Jinan University, 2020.
[21] F. Şahin, H. Akca, N. Akkaya, et al., Cost analysis and related factors in patients with traumatic hand injury, J Hand Surg Eur 38 (6) (2013 Jul) 673–679, https://doi.org/10.1177/1753193412469012.
[22] C. Tomas, K. Kallies, S. Cronn, et al., Mechanisms of traumatic injury by demographic characteristics: an 8-year review of temporal trends from the National Trauma Data Bank, Inj. Prev. 29 (4) (2023) 347–354, https://doi.org/10.1136/ip-2022-044817.
[23] V. Chikani, M. Brophy, A. Vossbrink, et al., Racial/ethnic disparities in rates of traumatic injury in Arizona, 2011-2012, Publ. Health Rep. 131 (5) (2016) 704–710, https://doi.org/10.1177/0033354916663491.