Letter to the Editor

Injury Morbidity between 2013 and 2018 in Hunan Province, China*

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Accurate and timely injury statistics are critical to assess the severity of public health problems. Such statistics allow researchers, practitioners, and policy-makers to determine morbidity and mortality rate disparities across socio-demographic subgroups and to evaluate rate changes over time. With such information, appropriate intervention strategies can be developed to target at-risk populations and situations.

Unlike data involving fatal injuries, non-fatal injury statistics are not available for most countries worldwide. The Global Burden of Disease (GBD) Study Group regularly estimates injury morbidity rates for greater than 190 countries and territories using complex mathematical models. Indeed, these estimates are considered among the best available; however, the GBD Study Group estimates are also potentially biased by the absence of relevant or low-quality data in many countries[1].

The GBD Study Group used hospital-based surveillance and published epidemiological data to generate estimates of non-fatal injury indicators in China, the most populated country in the world[2]. These data include the number of hospital-reported injury cases; however, the data have at least three limitations. First, use of hospital-reported injury cases omits injury cases that may have been treated outside hospitals and clinics[3]. Second, Chinese hospitalization data are criticized as potentially influenced by changes in the national social medical insurance policy[4]. As larger segments of the population have become insured, especially in the late 1990s and early 2000s, there may have been an artificial increase in higher hospitalization rates because insured individuals are more likely to seek hospital-based treatment. Finally, hospital-based surveillance data are derived from a limited number of monitoring points (84 areas and 252 hospitals), thus may not be generalizable to the entire population. Together, these limitations suggest that the GBD Study Group estimates may underestimate injury morbidity rates in China[3].

Population-based survey data offer an alternative data source that may provide more accurate information about injury morbidity in China. The Health Service Household Interview Survey of Hunan Province, China is a provincially-representative population-based survey that was conducted in 2013 and 2018[5]. The current study represents a secondary data analysis of the 2013 and 2018 Health Service Household Interview Surveys. Hunan Province is a non-coastal province located south of the Yangtze River in southern China with an estimated population of 68.99 million in 2018.

In both 2013 and 2018, the Health Service Household Interview Survey of Hunan Province, China adopted the survey scheme used in the National Health Service Household Interview Survey (NHSHIS)[6], which includes a rigorous random multi-stage, stratified, cluster sampling scheme. Fourteen municipalities in Hunan Province were randomly divided into two groups of seven. The first seven municipalities were used for selection of urban samples and the other seven were for selection of rural samples. For each municipality, one district/county was further chosen at random (district for urban sampling points and county for rural sampling points). Next, in each sampling

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district/country, five towns were randomly selected for district and for county separately. Two communities/villages were chosen from each selected town (community for district towns and village for rural towns). Sixty households were randomly selected from each community/village and all family members in the 60 households were invited to participate in the survey; specifically, there were 8,400 households in 2013 and 8,404 households in 2018.

The NHSHIS survey questionnaire collected information about health service needs (health status), health service utilization, basic social medical insurance coverage, lifestyle, and sociodemographic factors[6]. Research protocols for administration of the surveys were designed under the Declaration of Helsinki and approved by the Hunan Health Commission. Oral consent was obtained when interviewers invited residents to participate in the survey. Substantial quality control measures were implemented for both rounds of surveys in Hunan.

This NHSHIS questionnaire includes two morbidity indicators related to injury: the 2-week prevalence; and the 1-year hospitalization rate. The 2-week prevalence ascertains if the respondent experienced an injury event, as defined by the survey in the prior 2 weeks (*n.b.*, a 2-week recall period is documented to reduce recall bias for minor injuries[7]). The 1-year hospitalization rate determines if the respondent experienced an injury-induced hospitalization in the prior 12 months (*n.b.,* in addition to self-reported data, respondents provided medical records relevant to hospitalizations, thus offering increased validity to these reports[4]). Therefore, we calculated two injury morbidity indicators (the 2-week injury prevalence and the 1-year injury hospitalization rate).

Based on available data and relevance to injury morbidity, we included the following sociodemographic variables: location (urban *vs*. rural areas); sex (male vs. female); age group (0−24 years, 25−44 years, 45−64 years, and ≥ 65 years); race (Han *vs*. minority race in China); and household income per capita. Given substantial disparities in urban versus rural incomes, and dramatic income increases between 2013 and 2018 in China, we classified households into five groups of equal size based on household income per capita, in which the income of all household members was divided by the number of people in the household in the current year. Incomes in urban and rural areas and in 2013 and 2018 were computed separately[4].

The survey sample from 2018 was used as the reference population to calculate age-standardized morbidity rates and 95% confidence intervals (*CI*s). Univariate and multivariate logistic regression were used to evaluate changes in injury morbidity rate between 2013 and 2018. Age-standardized odds ratios (*OR*s) based on univariate logistic regression and adjusted *OR*s based on multivariable logistic regression quantified injury morbidity rate changes between 2013 and 2018. The sampling weights of an individual were the reciprocal of the product of the probability that an individual was selected at each stage, and applied to correct unequal probabilities of being selected and non-response to obtain unbiased estimates[3]. Complex sampling weights were applied in parameter estimation and statistical tests. All analyses were performed using SAS 9.4 software. All statistical tests were two-sided and a $P < 0.05$ was considered statistically significant.

This study was conducted and reported in compliance with the REporting of studies Conducted using Observational Routinely-collected Data (RECORD) Statement[8]. The secondary data analysis plan was approved by the Medical Ethics Committee of Central South University (Changsha, China; No. XYGW-2020-46).

A total of 24,282 and 22,530 Hunan Province residents completed the 2013 and 2018 surveys, respectively (Supplementary Table S1, available in www.besjournal.com). Neither the proportion of urban versus rural residents or the male-to-female ratio changed significantly between 2013 and 2018, but the proportion of individuals in the older age groups rose significantly (from 32.7% to 38.8% for the 45−64 year age group and from 11.8% to 20.0% for ≥ 65 year age group) across the 5 years ($P < 0.05$). The composition of racial groups (Han *vs*. other) was nearly unchanged across the two surveys ($P > 0.05$).

The overall age-standardized 2-week injury prevalence did not change significantly between 2013 and 2018 (0.39% *vs*. 0.32%; *OR* = 0.81, 95% *CI*: 0.42–1.56; $P > 0.05$; Table 1). Subgroup analysis by sociodemographic variables showed significant decreases between 2013 and 2018 in the ≥ 65 year age group (from 0.92% to 0.41%, *OR* = 0.44, 95% *CI*: 0.23−0.85) and among respondents from households with the lowest income per capita (from 1.08% to 0.28%, *OR* = 0.26, 95% *CI*: 0.16−0.42), and a substantial increase among respondents from households with the highest income per capita (from 0.10% to 0.42%, *OR* = 4.39, 95% *CI*: 1.06−18.25).

The overall age-standardized 1-year injury hospitalization rate remained nearly unchanged between 2013 and 2018 (0.91% *vs*. 0.87%; *OR* = 0.95,

95% *CI*: 0.47−1.94; *P* > 0.05; Table 2). Subgroup analysis showed no statistically significant rate changes in any demographic subgroup between 2013 and 2018 (*P* > 0.05).

As shown in Table 3, the overall 2-week prevalence did not change significantly across the years (2018 *vs.* 2013, adjusted *OR* = 0.77, 95% *CI*: 0.40−1.48) after controlling for other variables. Rural residents, males, and the oldest age group (≥ 65 years) had comparatively higher 2-week injury prevalence rates than urban residents (adjusted *OR* = 2.83, 95% *CI*: 1.39−5.78), females (adjusted *OR* = 1.70, 95% *CI*: 1.09−2.64), and the youngest age group (0–24 years, adjusted *OR* = 3.71, 95% *CI*:

Table 1. Two-week injury prevalence rates in 2013 and 2018 in Hunan Province, China

Variable	2013			2018			Crude *OR* (95% *CI*)	Adjusted *OR*[d] (95% *CI*)
	N	Prevalence (%)[a]	95% *CI*	*N*	Prevalence (%)[a]	95% *CI*		
Overall	91	0.39	(0.24, 0.54)	73	0.32	(0.11, 0.53)	0.77 (0.40, 1.48)	0.81 (0.42, 1.56)
Location								
Urban	34	0.18	(0.05, 0.31)	33	0.16	(0.08, 0.24)	0.83 (0.36, 1.93)	0.88 (0.36, 2.12)
Rural	57	0.47	(0.30, 0.64)	40	0.38	(0.09, 0.67)	0.78 (0.37, 1.66)	0.81 (0.38, 1.75)
Sex								
Male	57	0.48	(0.31, 0.65)	47	0.40	(0.12, 0.69)	0.85 (0.38, 1.91)	0.84 (0.38, 1.87)
Female	34	0.30	(0.11, 0.49)	26	0.23	(0.07, 0.39)	0.67 (0.37, 1.22)	0.77 (0.42, 1.40)
Age group, years								
0–24	10	0.15	(0.02, 0.28)	10	0.16	(0.00, 0.34)	1.06 (0.35, 3.22)	1.06 (0.35, 3.22)
25–44	19	0.41	(0.01, 0.81)	21	0.42	(0.03, 0.81)	1.02 (0.41, 2.57)	1.02 (0.41, 2.57)
45–64	32	0.39	(0.29, 0.49)	24	0.31	(0.07, 0.55)	0.79 (0.34, 1.85)	0.79 (0.34, 1.85)
≥ 65	30	0.92	(0.42, 1.42)	18	0.41	(0.18, 0.64)	0.44 (0.23, 0.85)*	0.44 (0.23, 0.85)*
Race								
Han	77	0.42	(0.25, 0.59)	61	0.31	(0.13, 0.49)	0.71 (0.41, 1.21)	0.74 (0.43, 1.28)
Other	14	0.27	(0.22, 0.32)	12	0.33	(0.00, 0.83)	1.19 (0.23, 6.13)	1.24 (0.24, 6.31)
Household income per capita[b, c]								
Lowest	28	1.08	(0.12, 2.05)	21	0.28	(0.10, 0.46)	0.25 (0.15, 0.41)*	0.26 (0.16, 0.42)*
Low	19	0.36	(0.12, 0.59)	14	0.34	(0.00, 0.69)	0.93 (0.24, 3.56)	0.97 (0.25, 3.79)
Average	23	0.34	(0.13, 0.55)	14	0.22	(0.09, 0.34)	0.61 (0.31, 1.20)	0.64 (0.32, 1.27)
High	10	0.36	(0.02, 0.69)	9	0.32	(0.00, 0.64)	0.93 (0.29, 3.00)	0.90 (0.29, 2.79)
Highest	10	0.10	(0.00, 0.19)	15	0.42	(0.00, 0.93)	3.93 (0.94, 16.45)*	4.39 (1.06, 18.25)*

Note. 95% *CI*, 95% confidence interval; *OR*, odds ratio. *$P < 0.05$. [a]Overall and subgroup 2-week injury prevalence rates were calculated based on sampling weights in each survey year and age-standardized using the population structure of the survey sample in 2018, except for the four age groups in which age-specific rates were applied. [b]The sum of subgroup counts is less than the total number of respondents due to missing values. [c]Households were separately divided into 5 categories according to the quintiles of household incomes for urban and rural areas: 2013, [lowest (urban, < 6,667 Yuan; rural, < 3,334 Yuan); low (urban, 6,667–9,999 Yuan; rural, 3,334−4,999 Yuan); average (urban, 10,000–14,999 Yuan; rural, 5,000–7,499 Yuan); high (urban, 15,000–23,999 Yuan; rural, 7,500–9,999 Yuan); and highest (urban, ≥ 24,000 Yuan; rural, ≥ 10,000 Yuan)]; 2018, [lowest (urban, < 100,000 Yuan; rural, < 4,500 Yuan); low (urban, 10,000–14,999 Yuan; rural, 4,500−8,333 Yuan); average (urban, 15,000–22,499 Yuan; rural, 8,334–13,333 Yuan); high (urban, 22,500–32,499 Yuan; rural, 13,334–19,999 Yuan); and highest (urban, ≥ 32,500 Yuan; rural, ≥ 20,000 Yuan)]. [d]Adjusted *OR*s were estimated based on age-standardized rates, except for the age-specific rates; crude and age-adjusted *OR*s were identical for specific age groups in the table.

1.23−11.25), respectively.

The overall 1-year hospitalization rate between 2013 and 2018 also did not change significantly across time after adjusting for other variables (adjusted *OR* = 0.88, 95% *CI*: 0.45−1.73; Table 3). Similar to the results from the 2-week prevalence, rural residents, males, and older age groups experienced higher 1-year hospitalization rates than urban residents (adjusted *OR* = 3.92, 95% *CI*: 2.08−7.36), females (adjusted *OR* = 1.52, 95% *CI*: 1.03–2.23), and the youngest age group (25–44 years *vs*. 0–24 years, adjusted *OR* = 1.61, 95% *CI*: 1.04–2.48; 45–64 years *vs.* 0–24 years, adjusted *OR* = 2.52, 95% *CI*: 1.88−3.37; and ≥ 65 years *vs.* 0−24 years, adjusted *OR* = 3.52, 95% *CI*: 2.29−5.41), respectively.

Table 2. One-year injury hospitalization rates in 2013 and 2018 in Hunan Province, China

Variable	2013			2018			Crude *OR* (95% *CI*)	Adjusted *OR*[d] (95% *CI*)
	N	Rate (%)[a]	95% *CI*	*N*	Rate (%)[a]	95% *CI*		
Overall	191	0.91	(0.53, 1.29)	179	0.87	(0.41, 1.32)	0.91 (0.45, 1.85)	0.95 (0.47, 1.94)
Location								
Urban	69	0.30	(0.00, 0.61)	51	0.27	(0.20, 0.35)	0.86 (0.27, 2.74)	0.91 (0.28, 2.97)
Rural	122	1.14	(0.79, 1.49)	128	1.12	(0.47, 1.77)	0.94 (0.42, 2.11)	0.98 (0.44, 2.20)
Sex								
Male	117	1.09	(0.54, 1.64)	111	1.05	(0.32, 1.77)	0.96 (0.39, 2.36)	0.96 (0.39, 2.40)
Female	74	0.73	(0.46, 1.01)	68	0.69	(0.37, 1.00)	0.85 (0.48, 1.51)	0.94 (0.53, 1.66)
Age group, years								
0−24	27	0.41	(0.16, 0.66)	22	0.47	(0.18, 0.77)	1.15 (0.38, 3.52)	1.15 (0.38, 3.52)
25−44	30	0.72	(0.34, 1.10)	26	0.51	(0.00, 1.05)	0.71 (0.21, 2.37)	0.71 (0.21, 2.37)
45−64	92	1.32	(0.77, 1.86)	77	0.92	(0.34, 1.49)	0.69 (0.30, 1.62)	0.69 (0.30, 1.62)
≥ 65	42	1.41	(0.50, 2.32)	54	1.53	(0.88, 2.19)	1.09 (0.58, 2.06)	1.09 (0.58, 2.06)
Race								
Han	159	0.80	(0.40, 1.20)	160	0.93	(0.59, 1.26)	1.11 (0.73, 1.68)	1.16 (0.77, 1.76)
Other	32	1.36	(0.98, 1.74)	19	0.64	(0.00, 2.05)	0.46 (0.04, 5.45)	0.47 (0.04, 5.62)
Household income per capita[b, c]								
Lowest	40	1.52	(0.63, 2.41)	35	0.82	(0.29, 1.34)	0.53 (0.21, 1.34)	0.53 (0.21, 1.40)
Low	26	0.65	(0.33, 0.97)	45	0.96	(0.44, 1.47)	1.39 (0.62, 3.11)	1.47 (0.66, 3.32)
Average	47	0.56	(0.25, 0.87)	39	0.68	(0.03, 1.33)	1.16 (0.35, 3.81)	1.21 (0.37, 3.97)
High	27	0.68	(0.12, 1.25)	22	0.54	(0.00, 1.09)	0.74 (0.28, 1.98)	0.79 (0.29, 2.12)
Highest	51	1.10	(0.63, 1.58)	38	1.27	(0.67, 1.86)	1.10 (0.61, 1.98)	1.15 (0.64, 2.05)

Note. 95% *CI*, 95% confidence interval; *OR*, odds ratio. [a]Overall and subgroup 2-week injury prevalence rates were calculated based on sampling weights in each survey year and age-standardized using the population structure of the survey sample in 2018, except for the 4 age groups in which age-specific rates were applied. [b]The sum of subgroup counts is less than the total number of respondents due to missing values. [c]Households were separately divided into five categories according to the quintiles of household incomes for urban and rural areas: 2013, [lowest (urban, < 6,667 Yuan; rural, < 3,334 Yuan); low (urban, 6,667–9,999 Yuan; rural, 3,334–4,999 Yuan); average (urban, 10,000−14,999 Yuan; rural, 5,000–7,499 Yuan); high (urban, 15,000–23,999 Yuan; rural, 7,500−9,999 Yuan); and highest (urban, ≥ 24,000 Yuan; rural, ≥ 10,000 Yuan)]; 2018, [lowest (urban, < 100,000 Yuan; rural, < 4,500 Yuan); low (urban, 10,000−14,999 Yuan; rural, 4,500−8,333 Yuan); average (urban, 15,000–22,499 Yuan; rural, 8,334–13,333 Yuan); high (urban, 22,500–32,499 Yuan; rural, 13,334–19,999 Yuan); and highest (urban, ≥ 32,500 Yuan; rural, ≥ 20,000 Yuan)]. [d]Adjusted *OR*s were estimated based on age-standardized rates except for age-specific rates; crude and age-adjusted *OR*s were identical for specific age groups in the table.

We generated three major findings. First, overall injury morbidity rates remained nearly unchanged between 2013 and 2018, both for the 2-week prevalence and 1-year hospitalization rates. Second, the 2-week injury prevalence decreased significantly between 2013 and 2018 among the oldest adults and among residents with the lowest household income per capita, but increased among those with the highest household income per capita. Last, after controlling for other demographic variables, rural residents, males, and older adult groups were at higher risk of injury morbidity compared to urban residents, females, and younger adults.

The stability of injury morbidity between 2013 and 2018 in Hunan Province was in contrast with estimates from the 2019 GBD Study Group, which is the only currently available source of Chinese injury morbidity data that showed substantial increases over the same time period in China (from 15.57% to 17.20% for the 1-year prevalence)[9]. There are several possible reasons for the discrepancy in the data sources. First, we examined data only from Hunan Province, whereas the 2019 GBD Study Group considered data across China. There was no a priori reason to expect the trends in Hunan would be vastly different from national trends, although similar analyses based on survey data from all of China and other individual provinces are

Table 3. Associations of two-week injury prevalence and one-year injury hospitalization rate with demographic factors based on multivariate logistic regression in Hunan Province, China

Variable	Two-week prevalence				One-year hospitalization rate			
	Crude *OR*	95% *CI*	Adjusted *OR*[c]	95% *CI*	Crude *OR*	95% *CI*	Adjusted *OR*[c]	95% *CI*
Year (ref = 2013)								
2018	0.75	(0.40, 1.41)	0.77	(0.40, 1.48)	0.89	(0.46, 1.72)	0.88	(0.45, 1.73)
Location (ref = Urban)								
Rural	2.79	(1.40, 5.59)*	2.83	(1.39, 5.78)*	3.91	(2.07, 7.39)*	3.92	(2.08, 7.36)*
Sex (ref = Female)								
Male	1.56	(0.95, 2.58)	1.70	(1.09, 2.64)*	1.45	(0.96, 2.20)	1.52	(1.03, 2.23)*
Age group, years (ref = 0–24)								
25–44	3.09	(0.84, 11.45)	3.09	(0.82, 11.66)	1.59	(1.02, 2.49)*	1.61	(1.04, 2.48)*
45–64	2.32	(0.92, 5.80)	2.34	(0.93, 5.91)	2.50	(1.88, 3.33)*	2.52	(1.88, 3.37)*
≥ 65	3.79	(1.27, 11.32)*	3.71	(1.23, 11.25)*	3.46	(2.25, 5.31)*	3.52	(2.29, 5.41)*
Race (ref = Han)								
Other	0.71	(0.30, 1.68)	0.72	(0.30, 1.71)	0.84	(0.44, 1.62)	0.85	(0.45, 1.62)
Household income per capita[a,b] (ref = Lowest)								
Low	0.61	(0.29, 1.30)	0.61	(0.28, 1.32)	0.84	(0.59, 1.20)	0.83	(0.59, 1.16)
Average	0.48	(0.12, 1.86)	0.47	(0.12, 1.84)	0.64	(0.31, 1.30)	0.63	(0.31, 1.27)
High	0.60	(0.27, 1.34)	0.62	(0.30, 1.30)	0.71	(0.45, 1.12)	0.69	(0.43, 1.10)
Highest	0.40	(0.10, 1.57)	0.39	(0.10, 1.56)	1.14	(0.94, 1.39)	1.12	(0.95, 1.32)

Note. *OR*, odds ratio; 95% *CI*, 95% confidence interval. *$P < 0.05$. [a]The sum of subgroup counts is less than the total number of respondents due to missing values. [b]Households were separately divided into five categories according to the quintiles of household incomes for urban and rural areas: 2013, [lowest (urban, < 6,667 Yuan; rural, < 3,334 Yuan); low (urban, 6,667−9,999 Yuan; rural, 3,334−4,999 Yuan); average (urban, 10,000−14,999 Yuan; rural, 5,000−7,499 Yuan); high (urban, 15,000–23,999 Yuan; rural, 7,500−9,999 Yuan); and highest (urban, ≥ 24,000 Yuan; rural, ≥ 10,000 Yuan)]; 2018, [lowest (urban, < 100,000 Yuan; rural, < 4,500 Yuan); low (urban, 10,000−14,999 Yuan; rural, 4,500-8,333 Yuan); average (urban, 15,000–22,499 Yuan; rural, 8,334–13,333 Yuan); high (urban, 22,500–32,499 Yuan; rural, 13,334–19,999 Yuan); and highest (urban, ≥ 32,500 Yuan; rural, ≥ 20,000 Yuan)]. [c]Adjusted *OR*s were calculated after controlling for the rest five demographic variables listed in the table.

recommended in the event some provincial-level difference in Hunan would explain the discrepancy. Second, the apparently contradictory results may be a result of differences in data collection across the two data sources. The GBD Study Group estimated Chinese injury morbidity rates using the national hospital-based injury surveillance system and published epidemiologic data. As reported previously, hospital-based surveillance data excluded the injured patients who do not seek evaluation at a hospital, and therefore the actual injury morbidity rate is underestimated[3]. Our results were derived from population-based surveys, while the 2019 GBD Study Group estimates were based on hospital-based surveillance data and the published epidemiologic literature data. Compared to hospital-based surveillance data, population-based survey data are reported to be more complete[3]; this finding may be particularly true in China given concerns that changes in the national social medical insurance policy influenced hospital visits and data, especially in the late 1990s and early 2000s[4], and evidence that some injuries are treated outside hospitals and clinics[3].

Our subgroup analysis showed significant decreases in the 2-week injury prevalence decreases among older adults and residents with the lowest income. These decreasing injury morbidity rates may reflect the effect of multifaceted prevention efforts and development of the economy[10], including healthier aging and efforts to improve the basic infrastructure for all citizens as the logical result of economic development. The increased injury morbidity rate among individuals living in households with the highest income may be related to increased exposure to risky behaviors that correspond to increased disposable income, as well as the rapid motorization in China. For example, individuals with the highest per capita household income are more likely to drive motor vehicles and engage in risky driving behaviors, such as driving while intoxicated, not using a seatbelt, or speeding. They may also engage in risky pleasure activities, like skiing, mountain climbing, and driving to remote places. Governmental regulations targeting risky pleasure activities, such as the required use of safety equipment (e.g., helmets and elbow/knee pads while skiing or motorcycling) might help reduce injuries.

This study replicated a previous report that rural residents, males, and older adults were at higher risk of injury morbidity than urban residents, females, and younger adults[11]. These disparities were primarily associated with exposure to specific injury risks and to safety awareness among some sub-populations. Compared to urban residents, rural residents had poorer public health services, lower health literacy, and poorer safety awareness. Rural residents were also exposed to risks through occupations, such as farming, and environmental factors, such as risky driving (e.g., not using seatbelts, a common practice among tractor and other agricultural vehicle drivers in rural areas). Males were more likely to engage in risky activities and to work in more dangerous occupations than females. Finally, aging was associated with a higher risk of injury due to diminished perceptual abilities, balance disorders, decreased muscle strength, and more fragile bone structures.

This study had two policy implications. First, we emphasized the importance and urgency to increase governmental efforts to injury prevention and control. Given the high rates of both fatal and non-fatal injuries in China compared to most high-income countries, evidence-based and feasible prevention interventions should be implemented nationwide. Targeted initiatives should be implemented to reduce injury morbidity disparities across urban/rural area, gender, and age groups. Second, further research should be supported to interpret the observed morbidity rate changes for specific populations and to develop new interventions and/or culturally-tailor existing effective interventions from other countries.

The study was mainly limited by the design of the NHSHIS survey. The survey questionnaire excluded items involving details of the injury cases, such as external causes, severity of injury events, and relevant environmental and behavioral factors. Further, due to the limited sample size, we could not obtain robust confidence intervals of injury morbidity rates for certain subgroups, include more independent variables in multivariable analyses, and may have failed to detect moderate or minor rate differences across groups. These detailed analyses will be implemented when national survey data, or data from multiple provinces, are available for use.

In conclusion, injury morbidity rates did not significantly change between 2013 and 2018 in Hunan Province, although there were modest changes in a few subgroups of individuals. The Chinese government should invest resources to injury prevention considering the large number of fatal and non-fatal injuries and the large disparities in injury burden across socio-demographic subgroups. Further research is needed to interpret observed morbidity rate changes for certain

subgroups.

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HU Guo Qing developed the research idea and designed this study. WANG Wan Hui implemented the research, analyzed data, and drafted the manuscript. GAO De Yue, HUA Jun Jie, and NING Pei Shan helped to interpret the results and provide revisions. David C Schwebel and HU Guo Qing helped with revising and correcting the manuscript. All authors read and approved the final version of the manuscript.

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Supplementary Table S1. Sample characteristics of population surveys in 2013 and 2018 in Hunan province, China

Variable	2013			2018			χ^2	*P*
	N	Proportio, *n* (%)[a]	95% *CI*	*N*	Proportio, *n* (%)[a]	95% *CI*		
Total	24,282	100.0		22,530	100.0			
Location								
Urban	11,966	27.5	(10.68, 44.31)	11,404	30.0	(11.18, 48.74)	0.08	0.775
Rural	12,316	72.5	(55.69, 89.32)	11,126	70.0	(51.26, 88.82)		
Sex								
Male	12,184	49.9	(48.53, 51.36)	11,219	49.4	(48.38, 50.33)	1.04	0.308
Female	12,098	50.1	(48.64, 51.47)	11,311	50.6	(49.67, 51.62)		
Age group, years								
0–24	6,059	28.3	(23.91, 32.77)	5,225	22.5	(20.74, 24.29)	159.53	< 0.001
25–44	5,760	27.2	(24.90, 29.47)	4,549	18.7	(17.37, 19.90)		
45–64	8,644	32.7	(28.73, 36.61)	8,417	38.8	(36.70, 40.93)		
65 and above	3,819	11.8	(8.97, 14.64)	4,339	20.0	(18.05, 22.02)		
Race								
Han	21,436	80.5	(47.95, 100.00)	20,440	77.7	(48.54, 100.00)	0.54	0.462
Other	2,846	19.5	(0.00, 52.05)	2,090	22.3	(0.00, 51.46)		
Household income per capita[b,c]								
Lowest	4,779	15.9	(11.90, 19.98)	4,660	17.5	(14.70, 20.25)	23.79	< 0.001
Low	3,601	13.3	(11.99, 14.49)	4,773	18.7	(15.41, 22.05)		
Average	5,480	23.5	(19.57, 27.38)	5,278	24.4	(21.02, 27.82)		
High	4,338	16.9	(13.69, 20.15)	3,737	16.5	(14.38, 18.50)		
Highest	6,011	30.4	(23.66, 37.18)	4,061	22.9	(17.80, 28.08)		

Note. 95% *CI*, 95% confidence interval. [a]Proportion were calculated based on sampling weights in each survey year and age-standardized using the age structure of the 2018 survey sample. [b]The sum of subgroup counts is less than total respondents due to missing values. [c]Households were divided into five categories according to the quintiles of household incomes for urban areas and rural areas separately: 2013: lowest (urban, < 6,667 Yuan; rural, < 3,334 Yuan); low (urban, 6,667–9,999 Yuan; rural, 3,334–4,999 Yuan); average (urban, 10,000–14,999 Yuan; rural, 5,000–7,499 Yuan); high (urban, 15,000–23,999 Yuan; rural, 7,500–9,999 Yuan); and highest (urban, ≥ 24,000 Yuan; rural, ≥ 10,000 Yuan); 2018: lowest (urban, < 100,000 Yuan; rural, < 4,500 Yuan); low (urban, 10,000–14,999 Yuan; rural, 4,500–8,333 Yuan); average (urban, 15,000–22,499 Yuan; rural, 8,334–13,333 Yuan); high (urban, 22,500–32,499 Yuan; rural, 13,334–19,999 Yuan); and highest (urban, ≥ 32,500 Yuan; rural, ≥ 20,000 Yuan).