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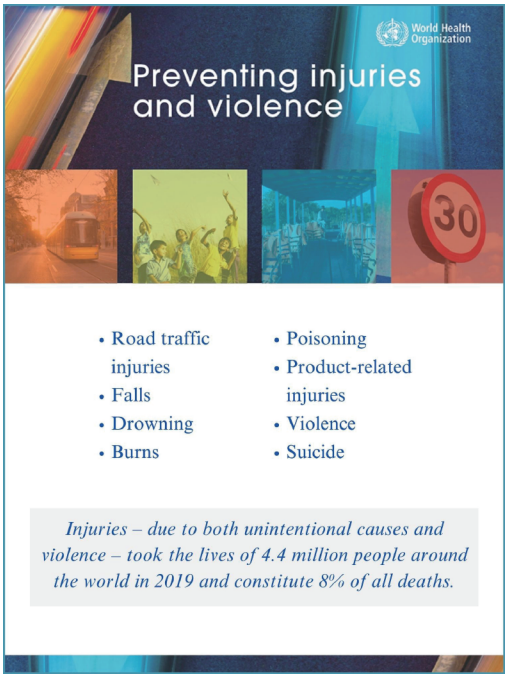

PREVENTING INJURIES AND VIOLENCE ISSUE

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Cover Image: adapted from the World Health Organization, https://www.who.int/publications/i/item/9789240047136.
This week's issue was organized by Guest Editor Leilei Duan.

Preplanned Studies

Effectiveness of Group-Based Interventions for Fall Prevention Among Community-Dwelling Older Adults — 7 Regions, 6 PLADs, China, 2019–2020

Yuliang Er[1,&]; Zhiming Lu[2,&]; Ye Jin[1]; Pengpeng Ye[1]; Leilei Duan[1,#]

Summary

What is already known about this topic?

Many of the current studies focusing on fall prevention interventions have been conducted in hospital settings within a select few urban areas in China, thus yielding limited evidence on the effectiveness of large-scale, multicenter, community-based interventions.

What is added by this report?

In comparison to the control group, participants in the intervention group exhibited a 64% reduction in fall risk. Group-based fall prevention programs have demonstrated efficacy in mitigating fall risk among the elderly population.

What are the implications for public health practice?

Group-based fall prevention interventions serve as a significant adjunctive resource for the management of elderly health within communities and offer compelling evidence to support the incorporation of fall prevention strategies into health policy frameworks in China.

In 2020, China's population aged 60 or older reached 264 million individuals, comprising 18.70% of the nation's total population (*1*). The swift increase in the aging demographic intensifies the prevalence of fall-related incidents. Falls represent the primary reason for injury-related medical consultations, the leading cause of injury-related fatalities, and the predominant cause of hip fractures among individuals aged 65 and older (*2*–*4*). Evidence suggests that group-based fall prevention programs that combine exercise initiatives with health education can effectively reduce the incidence of falls (*5*). Nonetheless, data on the efficacy of such interventions in preventing falls among the elderly in China remain scarce.

This investigation evaluated the efficacy of a community-based fall prevention program through a multicenter, cluster-randomized controlled trial conducted from August 2019 to December 2020 across six provincial-level administrative divisions (PLADs) in China. We enrolled 60 communities, randomly assigning them to either the intervention or the control group. Of the initially screened 954 senior adults from community health service centers (CHSCs), all met the eligibility criteria. These participants were monitored for a period of 12 months by means of telephone or in-person follow-ups. The results indicated that, in comparison to the control group, the intervention group exhibited a substantial reduction in fall risk [odds ratio (*OR*): 0.36; 95% confidence interval (*CI*): 0.24–0.52].

This cluster randomized controlled trial was carried out across 60 communities in 7 Chinese regions: Suzhou City in Jiangsu Province, Ningbo City in Zhejiang Province, Hefei City in Anhui Province, as well as Pudong and Songjiang districts in Shanghai Municipality, Shenzhen City in Guangdong Province, and Shijiazhuang City in Hebei Province. Under simple random sampling methods, communities were allocated equally into either the intervention group (30 communities) or the control group (30 communities). Eligible participants were selected following preliminary screenings conducted by CHSCs. Enrollment criteria included: age between 65 and 84, a history of at least one fall within the previous 12 months, independent ambulatory capabilities, normal communication abilities, and residency within the study area (excluding those in care facilities) for the upcoming 14 months. Exclusion criteria consisted of psychological or neurological disorders, an intolerance for exercise, or diseases affecting balance, such as vertigo or Meniere's disease. Individuals in the intervention group partook in a six-month group-based fall prevention program that included health education lectures and the cultivation of exercise skills aimed at enhancing balance, endurance, and lower limb strength. The program was facilitated by two trained physicians from the CHSCs, employing aid materials such as slides, an exercise demonstration video, and an

intervention manual. Additionally, CHSC staff conducted home-fall hazard assessments for the intervention group during the third month, providing feedback and suggestions for improvements post-assessment. Further details regarding the interventions can be found in Supplementary Table S1 (available in https://weekly.chinacdc.cn). On the contrary, participants in the control group received a total of three health education lectures that covered the same topics. Each session lasted approximately 40 minutes and was conducted monthly by trained CHSC physicians.

In this study, the primary outcome measured was the incidence of falls. Following the initial baseline survey, participants were required to maintain a monthly diary documenting any falls experienced throughout the duration of the follow-up period. A fall is characterized as an unintentional event where an individual comes to rest on the ground, floor, or another lower surface. Fall-related self-efficacy was evaluated using the Fall Efficacy Scale, which comprises 16 items. Each item is scored on a scale from 1 to 4 — where a score of 1 signifies no fear of falling, and a score of 4 indicates a high level of fear regarding potential falls. Balance function was assessed by the Short Physical Performance Battery (SPPB), which incorporates three distinct tests: the Side-by-Side Stand, the Semi-Tandem Stand, and the Tandem Stand. For the Side-by-Side Stand and Semi-Tandem Stand tests, participants received a score of 1 point if they could maintain the stance for 10 seconds and 0 points if they could not, or if the attempt was not made. The Tandem Stand was scored with 2 points for maintaining the position for 10 seconds, 1 point for holding it between 3 and 9.99 seconds, and 0 points for holding it for less than 3 seconds or if the stance was not attempted. The cumulative score, with a possible range of 0 to 4 points, represents the sum of points from all three tests.

Data analysis was conducted using SAS software (version 9.4; SAS Institute, Inc., Cary, NC, USA). We performed a descriptive analysis of the demographic characteristics, disease status, balance function, and other related factors of the study participants. To compare baseline characteristics between the two groups, we employed the *t*-test or Mann-Whitney U test for continuous variables and the chi-square test or Fisher's exact test for categorical variables. We used logistic regression models to evaluate the impact of the intervention on the occurrence of falls, calculating the *OR*s with 95% *CI* accordingly. The inclusion criteria for the analysis stipulated that participants in the intervention group must have engaged in the intervention activities at least twice. Similarly, subjects in the control group who did not attend any educational lectures were excluded from the analysis. We considered a two-tailed *P*-value less than 0.05 as statistically significant. The Ethical Review Committee of the National Center for Chronic and Noncommunicable Disease Control and Prevention, part of the China CDC, has approved this study under the protocol (201907).

Participant flowchart showing 488 participants in the intervention group and 487 in the control group with a total of 21 dropouts, including withdrawn consents (n=18) and deaths (n=3), leaving 954 participants for the final analysis with 477 from each group (Figure 1). Baseline characteristics of the 954 individuals analyzed, comprising 698 (73.17%) females with an average age of 71.71±4.50 years, and showing no significant differences between the intervention and control groups (Table 1).

During the 12-month follow-up, falls occurred in 53 out of 477 participants (an 11.11% fall rate) in the intervention group. In contrast, the control group saw 114 out of 477 participants experience falls, representing a 23.90% fall rate. A multivariate logistic regression analysis was conducted, employing two models. The basic Model 1 included only the independent variable, while Model 2 was adjusted for variables showing statistically significant differences, such as education level and disease status (i.e., osteoporosis, arthritis, cervical spondylopathy, lumbar herniated disc, depression, and cataract). The analysis revealed that in comparison to the control group, the intervention group had a 60% reduced risk of falling according to Model 1 (*OR*: 0.40, 95% *CI*: 0.28–0.56) and a 64% reduced risk in Model 2 (*OR*: 0.36, 95% *CI*: 0.24–0.52), (Table 2). Subgroup analyses based on gender, age group, and fall efficacy scores [with 35 points chosen as the cutoff value, informed by prior literature (*6*)] showed no statistically significant differences in the efficacy of the intervention strategies among the subgroups, even after adjusting for confounding factors (all *P* for interaction >0.05), (Supplementary Table S2, available in https://weekly.chinacdc.cn).

DISCUSSION

This investigation was structured as a cluster-randomized controlled trial encompassing a substantial

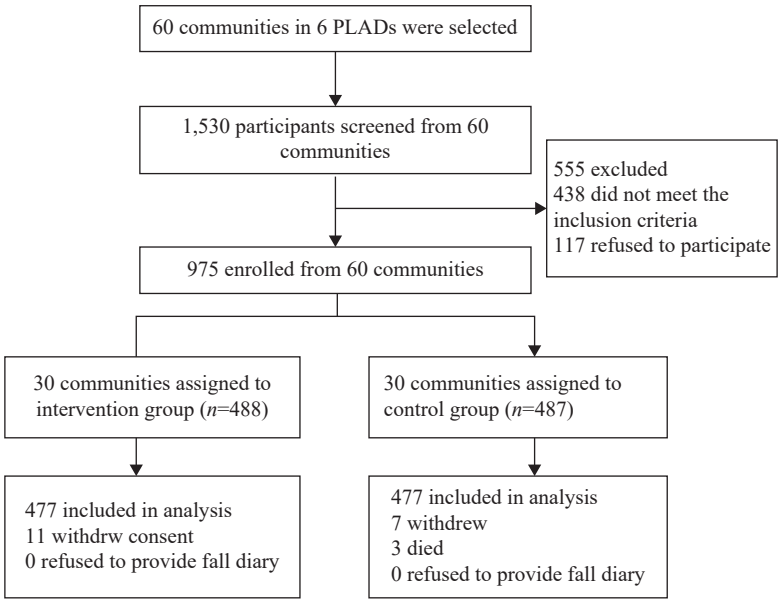

FIGURE 1. Flowchart of participants recruitment, screening, and participation — six PLADs, China, 2019–2020.
Abbreviation: PLADs=provincial-level administrative divisions.

participant cohort across six PLADs in China. The findings indicate that group-based interventions can significantly decrease the incidence of falls among community-dwelling elderly individuals when compared with the control cohort.

The observed incidence of falls was notably lower in the intervention group (11.11%) than in the control group (23.90%) during the 12-month follow-up period. Results of the multivariate logistic regression analysis indicated a 64% reduction in the risk of falls for participants in the intervention group when compared with the control group. These findings lend support to the efficacy of group-based fall prevention interventions in diminishing the risk of falls among community-dwelling older adults. These results align with those from a similar cluster randomized controlled trial conducted in Australia, which incorporated exercise and health education as part of the intervention and found a 43% decrease in fall risk (*7*). Conversely, not all studies have corroborated these findings. Waterman et al. (*8*) evaluated the effect of home environment safety assessments and prescribed home exercises for the elderly yet discovered no significant fall risk reduction when compared with conventional care in the control group. These disparate outcomes may be attributable to variations in the nature of the interventions, characteristics of the study population, sample size, and duration of the intervention.

Exercise has been recognized as an efficacious approach for the prevention of falls (*9*). The World Health Organization's latest guidelines on "Strategies for Preventing and Managing Falls Across the Life-Course" highlight exercises aimed at enhancing gait and balance as the most strongly recommended intervention to prevent falls among older adults. In the present study, participants were instructed in 14 exercise regimens designed to improve balance, as well as strength and endurance in the lower limbs, and were consistently motivated to incorporate these exercises into their daily routines following each session. Prior research has demonstrated that regular physical activity can bolster lower limb muscle strength, augment flexibility, stabilize gait, and enhance balance. These improvements can lead to faster reaction times and, consequently, a diminished risk of falls (*10*).

The study boasts a robust design, an ample sample size, and trustworthy findings. However, it is not without its drawbacks. First, the COVID-19 pandemic potentially influenced the outcomes, as participants were required to stay home more frequently during the follow-up. This unusual circumstance may have had unforeseen effects on the results. Secondly, the follow-up duration was relatively brief, which leaves the long-term efficacy of the interventions in question. Finally, the research focused on older individuals who were already identified as having a high risk of falls, evidenced by at least one incident in the prior year. Consequently, the applicability of the interventions to the broader population of the elderly has yet to be

TABLE 1. Baseline characteristics of participants — six PLADs, China, 2019–2020.

Characteristics	Intervention group, *N* (%)	Control group, *N* (%)	Total	*P* value
Age (years), ($\bar{X}$±SD)	71.74±4.40	71.69±4.60	71.71±4.50	0.869
Age group (years)				0.433
65–74	344 (72.12)	333 (69.81)	677 (70.96)	
75–84	133 (27.88)	144 (30.19)	277 (29.04)	
Gender				0.661
Male	131 (27.46)	125 (26.21)	256 (26.83)	
Female	346 (72.54)	352 (73.79)	698 (73.17)	
Education level				<0.001
Primary	217 (45.49)	279 (58.49)	496 (51.99)	
Middle school	159 (33.33)	121 (25.37)	280 (29.35)	
High school or above	101 (21.17)	77 (16.14)	178 (18.66)	
Diseases				
Hypertension	282 (59.12)	263 (55.14)	545 (57.13)	0.214
Heart disease	74 (15.51)	66 (13.84)	140 (14.68)	0.464
Diabetes	102 (21.38)	101 (21.17)	203 (21.28)	0.937
Osteoporosis	108 (22.64)	61 (12.97)	169 (17.71)	<0.001
Arthritis	87 (18.24)	49 (10.27)	136 (14.26)	<0.001
Peripheral nervous system diseases	9 (0.94)	3 (0.63)	6 (1.26)	0.315
COPD	7 (1.47)	5 (1.05)	12 (1.26)	0.561
Asthma	9 (1.89)	4 (0.84)	13 (1.36)	0.163
Osteoproliferation	84 (17.61)	64 (13.42)	148 (15.51)	0.074
Cervical spondylopathy	118 (24.74)	74 (15.51)	192 (20.13)	<0.001
Lumbar Herniated Disc	100 (20.96)	56 (11.74)	156 (16.35)	<0.001
Depression	4 (0.42)	0 (0.00)	4 (0.42)	0.045
Cataract	156 (32.70)	114 (23.90)	270 (28.30)	0.003
Glaucoma	12 (2.52)	5 (1.05)	17 (1.78)	0.087
Tympanitis	8 (1.68)	3 (0.63)	11 (1.15)	0.129
Epicophosis	13 (2.73)	19 (3.98)	32 (3.35)	0.281
Tumour	10 (2.10)	8 (1.68)	18 (1.89)	0.634
ADL disability	25 (5.24)	33 (6.92)	58 (6.08)	0.278
Fall efficacy score, ($\bar{X}$±SD)	47.60±9.11	46.69±8.30	47.15±8.72	0.106
Balance function score, ($\bar{X}$±SD)	3.84±0.50	3.82±0.51	3.83±0.50	0.666

Abbreviation: PLADs=provincial-level administrative divisions; COPD=chronic obstructive pulmonary disease; ADL=activities of daily living; SD=standard deviation.

TABLE 2. Comparison of falls between the intervention and control groups during the follow-up — six PLADs, China, 2019–2020.

Group	*N*	Incidence of falls (%)	Model 1	Model 2
			OR (95% *CI*)	*OR* (95% *CI*)
Control	477	23.90	1.00	1.00
Intervention	477	11.11	0.40 (0.28-0.57)	0.36 (0.24-0.52)

Note: Model 1 incorporated only the independent variable. Model 2, however, was adjusted for educational level and disease status, encompassing conditions such as osteoporosis, arthritis, cervical spondylopathy, lumbar herniated discs, depression, and cataracts.
Abbreviation: PLADs=provincial-level administrative divisions; *OR*=odds ratio; *CI*=confidence interval.

established and warrants further examination.

Group-based fall prevention interventions have demonstrated efficacy in mitigating the risk of falls in older populations. The results suggest that these interventions serve as an invaluable adjunct to the management of elder health within community settings. Consequently, it is recommended that governmental authorities promote the incorporation of fall prevention strategies into the existing framework of community health services.

Conflicts of interest: No conflicts of interest.

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SUPPLEMENTARY MATERIAL

SUPPLEMENTARY TABLE S1. Frequency and contents of the intervention group.

Session	Time (week)	Main contents
Session 1	1st	1. Severity and risk factors for falls among older people 2. Exercise safety 3. Two balance exercises 4. Methods of making action plans
Session 2	2nd	1. How to solve problems in the implementation of the plan 2. Hazards in and around the home and how to reduce them 3. How to adjust and perfect action plans 4. Two balance and strength exercises
Session 3	3rd	1. Recognition of fall-hazards in the community and public places 2. Two balance and strength exercises
Session 4	4th	1. Treatment guidance of illness-related falls. 2. Two balance and strength exercises
Session 5	5th	1. Selection and use of assistive tools related to falls prevention 2. Two endurance exercise
Session 6	6th	1. Overcome fear of falls 2. Rational drug use 3. Two balance and strength exercises
Session 7	7th	1. Changing fall-related risk behaviors 2. Review knowledge and skills that have learned 3. Review exercise methods that have learned
Session 8 (home visit)	8th–13th	1. Assessment of home hazard factors related to falls 2. Guidance of home hazard modification
Session 9	14th–16th	Comprehensive review, experience sharing and encouragement
Session 10	22nd–24th	Comprehensive review, experience sharing, encouragement and graduation ceremony

SUPPLEMENTARY TABLE S2. Subgroup analysis of the effectiveness group-based interventions on falls — six PLADs, China, 2019–2020.

Subgroup	*OR**	95% *CI*	*P* for interaction
Gender			0.269
Male	0.26	0.11–0.62	
Female	0.38	0.25–0.58	
Age group (years)			0.135
65–74	0.40	0.25–0.62	
75–84	0.24	0.11–0.54	
Fall efficacy score			0.563
≤35	0.42	0.14–1.25	
>35	0.35	0.23–0.52	

Abbreviation: PLADs=provincial-level administrative divisions; *OR*=odds ratio; *CI*=confidence interval.
* adjusted for education level and disease status (osteoporosis, arthritis, cervical spondylopathy, lumbar herniated disc, depression, and cataract).

Preplanned Studies

Characteristics of Poisoning Cases Admitted to Outpatient and Emergency Department — China, 2019

Xiao Deng[1]; Ye Jin[2]; Yuan Wang[2]; Pengpeng Ye[2]; Yuan Yuan[1]; Chengye Sun[1,#]; Leilei Duan[2,#]

Summary

What is already known about this topic?

Poisoning constitutes a significant cause of mortality among individuals aged 1 to 44 in China. Nonetheless, the epidemiological understanding of poisoning incidents within emergency departments remains fragmented across the region.

What is added by this report?

In 2019, the NISS recorded 31,382 cases of poisoning, predominantly among males (62.85%) and individuals aged 25–44 (44.13%). In all poisoning cases, 82.60% were unintentional. The predominant substances exposure in poisoning cases presenting to outpatient and emergency departments were alcohol (56.38%), medications (14.21%), and pesticides (9.78%).

What are the implications for public health practice?

This study has shed light on the evidence for nonfatal poisoning prevention to a variety of different groups, and informed special attention needed for high-risk population and substance exposed.

Poisoning remains a serious global public health concern (*1*). The World Health Organization (WHO) reported that in 2019, unintentional poisoning was responsible for an estimated 84,278 deaths worldwide. Furthermore, approximately 20% of suicides globally are attributed to pesticide self-poisoning, a trend most prevalent in rural, agricultural regions of low- and middle-income countries (*2*). In China, poisoning is a leading cause of mortality among individuals aged 1 to 44 years. Data from 2020 indicates that unintentional poisoning ranked as the eighth leading cause of death for those aged 1–4 and 15–29, and the ninth for those aged 5–14 and 30–44 (*3*). Poisoning also constitutes a common reason for emergency hospital visits in many nations (*1*). Despite its prevalence, comprehensive knowledge on the epidemiology of poisoning incidents in emergency departments is lacking in China. To bridge this informational shortfall, we utilized data from the national injury surveillance system to investigate the epidemiological characteristics of poisoning cases in outpatient and emergency settings within China for the year 2019.

The research included data on poisoning cases reported by a network of 252 national surveillance hospitals connected to the national injury surveillance system (NISS) from January 1 to December 31, 2019. The NISS, established by the Ministry of Health, acts as an efficient information gathering system capturing the epidemiological characteristics of patients admitted to outpatient and emergency departments across China for injuries. The distribution of surveillance sites and the methodology for data collection have been thoroughly detailed in previously published research (*4*).

For this study, we employed the "clinical diagnosis" text variable from the reported poisoning cases to recode the categorization of the substances involved. This recoding was founded on a coding dictionary developed for the study, which was informed by resources such as the Poison Information Package for Developing Countries (INTOX). It is important to note that the term "poisoning" within the scope of this research is confined to instances of acute poisoning and does not encompass chronic poisoning or pathological conditions such as allergic or infectious diseases induced by external substances.

Descriptive analysis was conducted on demographic information, occurrence information and clinical information of poisoning case by age, gender, intent and type of substance exposed. Chi-square test was used to compare the constituent ratios, $P<0.05$ was considered to be significant. Software SAS (version 9.4, SAS Institute Inc., Cary, USA) was used for statistical analysis.

In 2019, the NISS recorded 31,382 cases of poisoning, predominantly among males (19,723 cases, 62.85%) and individuals aged 25–44 (13,849 cases, 44.13%). The majority of these poisoning incidents were unintentional, accounting for 82.60% of the total cases. The intent behind the poisonings varied significantly by age group ($\chi^2=355.73$, $P<0.05$) and

gender (χ^2=743.48, P<0.05). The proportion of poisonings with self-harm or suicidal intent was highest in the elderly aged 65 and older (14.57%) among all age groups, and it was higher in females (11.92%) than in males (4.12%).

The occurrences of poisoning were distributed evenly throughout all seasons but were slightly higher in winter (27.83%) and summer (27.40%). Home was the most frequent location for poisoning incidents among females (64.98%) in contrast to males (41.53%) (χ^2=1766.33, P<0.05). Severely affected cases made up 52.11% of the total, with moderate injuries comprising 39.90%. A significantly higher proportion of severe poisoning was observed in children aged 0–4 years (63.17%) (χ^2=1024.35, P<0.05), and was more common in males (53.66%) than in females (49.48%) (χ^2=145.81, P<0.05).

Post-treatment outcomes, including observation, admission, or transfer to another hospital, were noted in 57.46% of poisoning cases, and there were 141 fatalities (0.45%). The disposition of poisoning cases demonstrated significant differences when analyzed by age group (χ^2=647.18, P<0.05) and gender (χ^2= 275.49, P<0.05) (Table 1).

In 2019, out of 31,382 reported poisoning incidents recorded in the NISS database, 96.46% were successfully categorized by identified substances after undergoing re-coding. The predominant substances involved in poisoning cases presenting to outpatient and emergency departments were alcohol (56.38%), medications (14.21%), and pesticides (9.78%). The analysis revealed statistically significant variations in the distribution of involved substances by age group (χ^2=7243.55, P<0.05), by gender (χ^2=3939.79, P<0.05), and by intention (χ^2=6,119.54, P<0.05). The leading substances exposed of child poisoning were medications both in the 0–4 age group (42.08%) and 5–14 age group (25.68%). Similarly, among seniors aged 65 and older, medications (24.51%) were the leading cause of poisoning. Alcohol-related poisonings constituted 69.5% of the cases in males, which was more than twice the rate observed in females. With regard to the intent of poisoning, alcohol was implicated in 61.02% of unintentional poisonings, while medications were involved in 46.19% of cases with suicidal intent (Table 2).

Throughout the year, seasonal trends are evident in the incidence of various poisoning types. Drug poisoning peaked during the spring, accounting for 27.16% of cases, while pesticide poisoning and incidents involving toxic flora and fauna were most frequent in summer, representing 32.68% and 58.37% of cases, respectively. Winter saw the majority of alcohol poisoning, carbon monoxide (CO) poisoning, and chemical poisoning cases, with prevalences of 28.94%, 59.87%, and 33.45%, respectively.

Location-wise, alcohol poisoning was primarily concentrated in commercial and service areas, constituting 42.56% of incidents. Conversely, other poisonings predominantly occurred in residential settings. In terms of post-incident care, alcohol poisoning cases frequently resulted in discharge following treatment, comprising 53.31% of the outcomes. However, other poisoning types were commonly subject to observation, admission, or transfer (Table 3).

DISCUSSION

Based on data from the NISS 2019, our analysis identified males and middle-aged individuals in China as the demographics most frequently admitted to outpatient services and emergency departments for poisoning. Notably, the majority of poisoning incidents were unintentional, yet the prevalence of suicidal poisoning presents a significant concern, with higher proportions observed among women and older adults, and with larger case number within the 25–44 age cohort. These observations align with research conducted in the United States (*5*). The elevated risk of poisoning in men may be attributed to factors such as increased exposure to occupational hazards, a greater propensity for risk-taking behaviors, and higher instances of alcohol consumption (*6*). The pressures faced by middle-aged individuals, arising from critical life milestones such as career development and marriage, may contribute to psychological vulnerabilities and, consequently, a higher risk of extreme responses to stress (*7*). The study's findings also highlight a greater propensity for self-poisoning among women, paralleling the patterns of suicide prevalence in China (*7*). The study's findings also show the concern of self-poisoning among women and elderly population, paralleling the patterns of suicide prevalence and depression in China (*7*).

Compared to the full spectrum of injuries presenting in outpatient and emergency department settings, poisoning cases exhibit a higher level of severity and require more medical resources, underscoring the need for heightened efforts in poisoning prevention. Our study revealed that in 2019, the fraction of poisoning cases classified as severe and the rate at which patients

TABLE 1. The characteristics of poisoning cases from NISS in China, 2019.

Items	Age (years)						Gender		Total, *N* (%)
	0–4, *N* (%)	5–14, *N* (%)	15–24, *N* (%)	25–44, *N* (%)	45–64, *N* (%)	≥65, *N* (%)	Male, *N* (%)	Female, *N* (%)	
Intention									
Unintentional	1,144 (92.41)	771 (80.82)	4,566 (81.23)	11,537 (83.31)	6,351 (83.05)	1,552 (74.87)	16,944 (85.91)	8,977 (77.00)	25,921 (82.60)
Self-harm/suicide	0 (0.00)	72 (7.55)	455 (8.09)	826 (5.96)	547 (7.51)	302 (14.57)	812 (4.12)	1,390 (11.92)	2,202 (7.02)
Violence/assault	0 (0.00)	16 (1.68)	122 (2.17)	240 (1.73)	119 (1.56)	35 (1.69)	267 (1.35)	265 (2.27)	532 (1.69)
Unknown	94 (7.59)	95 (9.96)	478 (8.50)	1,246 (9.00)	630 (8.24)	184 (8.88)	1,700 (8.62)	1,027 (8.81)	2,727 (8.69)
Season									
Spring	383 (30.94)	241 (25.26)	1,263 (22.47)	3,006 (21.71)	1,713 (22.40)	531 (25.62)	4,506 (22.85)	2,631 (22.57)	7,137 (22.74)
Summer	363 (29.32)	231 (24.21)	1,590 (28.29)	3,687 (26.62)	2,212 (28.93)	516 (24.89)	5,367 (27.21)	3,232 (27.72)	8,599 (27.40)
Autumn	265 (21.41)	201 (21.07)	1,290 (22.95)	3,057 (22.07)	1,645 (21.51)	454 (21.90)	4,364 (22.13)	2,548 (21.85)	6,912 (22.03)
Winter	227 (18.34)	281 (29.45)	1,478 (26.29)	4,099 (29.60)	2,077 (27.16)	572 (27.59)	5,486 (27.82)	3,248 (27.86)	8,734 (27.83)
Site									
Home	1,150 (92.89)	767 (80.40)	2,116 (37.64)	5,750 (41.52)	4,257 (55.67)	1,727 (83.31)	8,191 (41.53)	7,576 (64.98)	15,767 (50.24)
Commercial and service area	3 (0.24)	35 (3.67)	1,863 (33.14)	4,370 (31.55)	1,569 (20.52)	73 (3.51)	6,021 (30.53)	1,892 (16.23)	7,913 (25.22)
Public residential institution	11 (0.89)	41 (4.30)	794 (14.13)	1,891 (13.65)	762 (9.96)	97 (4.68)	2,705 (13.71)	891 (7.64)	3,596 (11.46)
School and school-related areas	41 (3.31)	72 (7.55)	519 (9.23)	751 (5.42)	331 (4.33)	35 (1.69)	1,204 (6.10)	545 (4.67)	1,749 (5.57)
Farm/farmland	22 (1.78)	12 (1.26)	17 (0.30)	136 (0.98)	255 (3.33)	92 (4.44)	308 (1.56)	226 (1.94)	534 (1.70)
Road/street	4 (0.32)	10 (1.05)	103 (1.83)	271 (1.96)	125 (1.63)	12 (0.58)	426 (2.16)	99 (0.85)	525 (1.67)
Industrial and construction area	1 (0.08)	3 (0.31)	51 (0.91)	292 (2.11)	157 (2.05)	7 (0.34)	308 (1.56)	203 (1.74)	511 (1.63)
Sports and athletics area	2 (0.16)	4 (0.42)	8 (0.14)	28 (0.20)	13 (0.17)	3 (0.14)	45 (0.23)	13 (0.11)	58 (0.18)
Others	1 (0.08)	5 (0.52)	29 (0.52)	82 (0.59)	47 (0.61)	8 (0.39)	119 (0.60)	53 (0.45)	172 (0.55)
Unknown	3 (0.24)	5 (0.52)	121 (2.15)	278 (2.01)	131 (1.71)	19 (0.92)	396 (2.01)	161 (1.38)	557 (1.77)
Severity									
Mild	97 (7.84)	69 (7.23)	292 (5.19)	797 (5.75)	785 (10.27)	469 (22.62)	1,311 (6.65)	1,198 (10.28)	2,509 (8.00)
Moderate	359 (29.00)	317 (33.23)	2,262 (40.24)	5,506 (39.76)	3,170 (41.45)	906 (43.70)	7,828 (39.69)	4,692 (40.24)	12,520 (39.90)
Severe	782 (63.17)	568 (59.54)	3,067 (54.56)	7,546 (54.49)	3,692 (48.28)	698 (33.67)	10,584 (53.66)	5,769 (49.48)	16,353 (52.11)
Disposition									
Discharged after treatment	397 (32.07)	296 (31.03)	2,501 (44.49)	6,357 (45.90)	2,961 (38.72)	431 (20.79)	8,831 (44.78)	4,112 (35.27)	12,943 (41.24)
Observed/admitted/ transferred	822 (66.40)	644 (67.51)	3,058 (54.40)	7,343 (53.02)	4,565 (59.70)	1,599 (77.13)	10,647 (53.98)	7,384 (63.33)	18,031 (57.46)
Dead	2 (0.16)	5 (0.52)	15 (0.27)	41 (0.30)	55 (0.72)	23 (1.11)	78 (0.40)	63 (0.54)	141 (0.45)
Others	17 (1.37)	9 (0.94)	47 (0.84)	108 (0.78)	66 (0.86)	20 (0.96)	167 (0.85)	100 (0.86)	267 (0.85)
Total	1,238 (100.00)	954 (100.00)	5,621 (100.00)	13,849 (100.00)	7,647 (100.00)	2,073 (100.00)	19,723 (100.00)	11,659 (100.00)	31,382 (100.00)

Abbreviation: NISS=national injury surveillance system.

TABLE 2. The distribution of substances exposed in poisoning cases from NISS in China, 2019.

Type of substance	Age (years)						Gender		Intention			Total, *N* (%)
	0–4, *N* (%)	5–14, *N* (%)	15–24, *N* (%)	25–44, *N* (%)	45–64, N (%)	≥65, *N* (%)	Male, *N* (%)	Female, *N* (%)	Unintentional, *N* (%)	Self-harm/ suicide, *N* (%)	Violence/ assault, *N* (%)	
Alcohol	17 (1.37)	97 (10.17)	3,804 (67.67)	9,504 (68.63)	3,996 (52.26)	276 (13.31)	13,707 (69.50)	3,987 (34.20)	15,816 (61.02)	83 (3.77)	247 (46.43)	17,694 (56.38)
Medication	521 (42.08)	245 (25.68)	944 (16.79)	1,441 (10.41)	799 (10.45)	508 (24.51)	1,585 (8.04)	2,873 (24.64)	2,912 (11.23)	1,017 (46.19)	139 (26.13)	4,458 (14.21)
Pesticide	198 (15.99)	107 (11.22)	266 (4.73)	976 (7.05)	1029 (13.46)	493 (23.78)	1,509 (7.65)	1,560 (13.38)	1,750 (6.75)	937 (42.55)	115 (21.62)	3,069 (9.78)
CO	50 (4.04)	200 (20.96)	285 (5.07)	759 (5.48)	752 (9.83)	391 (18.86)	1,071 (5.43)	1,366 (11.72)	2,206 (8.51)	19 (0.86)	3 (0.56)	2,437 (7.77)
Toxic flora and faunat	55 (4.44)	168 (17.61)	117 (2.08)	548 (3.96)	617 (8.07)	234 (11.29)	844 (4.28)	895 (7.68)	1,592 (6.14)	6 (0.27)	2 (0.38)	1,739 (5.54)
Chemical	176 (14.22)	50 (5.24)	99 (1.76)	299 (2.16)	161 (2.11)	49 (2.36)	421 (2.13)	413 (3.54)	709 (2.74)	40 (1.82)	6 (1.13)	834 (2.66)
Combined poisoning*	1 (0.08)	1 (0.10)	4 (0.07)	22 (0.16)	8 (0.10)	3 (0.14)	16 (0.08)	23 (0.20)	23 (0.09)	11 (0.50)	3 (0.56)	39 (0.12)
Unspecified	220 (17.77)	86 (9.01)	102 (1.81)	300 (2.17)	285 (3.73)	119 (5.74)	570 (2.89)	542 (4.65)	913 (3.52)	89 (4.04)	17 (3.20)	1,112 (3.54)
Total	1,238 (100.00)	954 (100.00)	5,621 (100.00)	13,849 (100.00)	7,647 (100.00)	2,073 (100.00)	19,723 (100.00)	11,659 (100.00)	2,5921 (100.00)	2,202 (100.00)	532 (100.00)	31,382 (100.00)

Abbreviation: NISS=national injury surveillance system; CO=carbon monoxide.

* Combined poisoning refers to the exposure of a poisoning case to two or more substances.

were observed, admitted, or transferred following outpatient and emergency treatment were 52.11% and 57.46%, respectively. These rates significantly exceed the corresponding rates for all types of injury cases, which stood at 1.77% and 13.96% in the same year (*8*). Such a distribution aligns with the established pyramid model of poisoning and mirrors trends observed in injury surveillance data from the United States (*9*). Specifically, in the United States in 2019, 28.39% of emergency department visits for poisoning resulted in hospitalization or transfer, compared to just 12.86% for all injury-related visits (*9*).

In 2019, the substances most frequently implicated in poisoning cases among both men and women in China were alcohol, medications, and pesticides. This pattern diverges from the distribution observed in fatal poisonings within China and nonfatal poisonings reported in other nations. Data from 2016 indicate that the predominant substances associated with poisoning fatalities in China were pesticides, alcohol, and toxic gases for men, and pesticides, toxic gases, and medications for women. In contrast, the leading exposures in poisoning cases in the United States have been pharmaceuticals, household cleaning products, and personal care products (*5*). Additionally, research in Europe highlights medications misuse and chemicals as the principal substances involved in poisoning fatalities (*10*).

Enhancing awareness of medications and chemical poisoning among children in China is crucial, particularly as these incidents already constitute a significant health concern in high-income countries. In China, the propotion of medication poisoning among all child poisoning cases admitted to outpatient and emergency department aged 0–4 years and 5–14 years has risen from 31.25% to 42.08% and from 17.81% to 25.68%, respectively, between 2006 and 2019. Research indicates that pharmaceuticals are the primary cause of non-fatal poisoning in children, with analgesics, non-steroidal anti-inflammatory drugs, and antihistamines being the substances most frequently ingested by children between the ages of 1 and 5 (*5,10*).

Regarding chemical poisonings, they represent a smaller proportion of the total: 2.66%. However, in the 0–4-year age group, chemical poisonings make up 14.22% of poisoning cases admitted to outpatient and emergency department in China. To put this into perspective, in the United States, over 120,000 children under the age of 6 were poisoned by common household cleaning agents, including laundry

TABLE 3. The characteristics of different types of poisoning according to substances exposed from NISS in China, 2019.

Items	Alcohol poisoning	Medication poisoning	Pesticide poisoning	CO poisoning	Toxic flora and fauna poisoning	Chemical poisoning
Intention						
Unintentional	15,816 (89.39)	2,912 (65.32)	1,750 (57.02)	2,206 (90.52)	1,592 (91.55)	709 (85.01)
Self-harm/suicide	83 (0.47)	1,017 (22.81)	937 (30.53)	19 (0.78)	6 (0.35)	40 (4.80)
Violence/assault	247 (1.39)	139 (3.12)	115 (3.75)	3 (0.12)	2 (0.11)	6 (0.72)
Unknown	1,548 (8.75)	390 (8.75)	267 (8.70)	209 (8.58)	139 (7.99)	79 (9.47)
Season						
Spring	3,881 (21.93)	1,211 (27.16)	813 (26.49)	487 (19.98)	223 (12.82)	196 (23.50)
Summer	4,704 (26.59)	1,176 (26.38)	1,003 (32.68)	158 (6.48)	1015 (58.37)	196 (23.50)
Autumn	3,988 (22.54)	1,084 (24.32)	668 (21.77)	333 (13.66)	423 (24.32)	163 (19.54)
Winter	5121 (28.94)	987 (22.14)	585 (19.06)	1,459 (59.87)	78 (4.49)	279 (33.45)
Site						
Home	4,814 (27.21)	3,846 (86.27)	2,608 (84.98)	2,035 (83.50)	1,145 (65.84)	435 (52.16)
Commercial and service area	7,531 (42.56)	118 (2.65)	17 (0.55)	132 (5.42)	50 (2.88)	15 (1.80)
Public residential institution	3,076 (17.38)	159 (3.57)	78 (2.54)	80 (3.28)	117 (6.67)	35 (4.20)
School and school-related areas	1,286 (7.27)	214 (4.80)	72 (2.35)	58 (2.38)	59 (3.39)	36 (4.32)
Farm/farmland	13 (0.07)	23 (0.52)	219 (7.14)	7 (0.29)	245 (14.09)	3 (0.36)
Road/street	401 (2.27)	22 (0.49)	13 (0.42)	10 (0.41)	44 (2.53)	6 (0.72)
Industrial and construction area	28 (0.16)	12 (0.27)	30 (0.98)	80 (3.28)	32 (1.84)	276 (33.09)
Sports and athletics area	36 (0.20)	3 (0.07)	1 (0.03)	0 (0.00)	7 (0.40)	10 (1.20)
Others	100 (0.57)	10 (0.22)	4 (0.13)	23 (0.94)	24 (1.38)	10 (1.20)
Unknown	409 (2.31)	51 (1.14)	27 (0.88)	12 (0.49)	16 (0.92)	8 (0.96)
Severity						
Mild	360 (2.03)	572 (12.83)	980 (31.93)	332 (13.62)	86 (4.95)	50 (6.00)
Moderate	6,666 (37.67)	2,096 (47.02)	1,237 (40.31)	1,065 (43.70)	770 (44.28)	249 (29.85)
Severe	10,668 (60.29)	1,790 (40.15)	852 (27.76)	1,040 (42.68)	883 (50.78)	535 (64.15)
Disposition						
Discharged after treatment	9,432 (53.31)	1,099 (24.65)	447 (14.57)	626 (25.69)	638 (36.69)	323 (38.73)
Observed/admitted/transferred	8,126 (45.93)	3287 (73.73)	2,537 (82.67)	1,738 (71.32)	1,081 (62.16)	507 (60.79)
Dead	5 (0.03)	17 (0.38)	56 (1.82)	51 (2.09)	0 (0.00)	3 (0.36)
Others	131 (0.74)	55 (1.23)	29 (0.94)	22 (0.90)	20 (1.15)	1 (0.12)

Abbreviation: NISS=national injury surveillance system.

detergents and bleach, in the year 2019 alone (*5*).

Limitations of this study: 1) The incidence of poisoning cases in China could not be estimated due to the lack of NISS sampling data; 2) The NISS surveillance hospitals are all comprehensive medical institutions at all levels, and professional institutions related to the diagnosis and treatment of occupational poisoning, such as occupational prevention, hospitals are not included, so the study results mainly reflect the characteristics of non-occupational poisoning cases.

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Vital Surveillances

Unintentional Drowning Mortality Among Individuals Under Age 20 — China, 2013–2021

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ABSTRACT

Introduction: This study seeks to elucidate the evolving trend and identify disparities among subgroups in the mortality rate due to unintentional drowning in individuals under the age of 20 from the timeframe of 2013 to 2021 in China.

Methods: Data retrieved from the National Mortality Surveillance System served as a foundation for estimating the unintentional drowning mortality rate. The inadvertent drowning mortality rate for individuals below the age of 20 was computed, differentiated by categorization groups such as age, gender, areas, and regions within each given year. The linear regression model was employed to calculate the annual percent of change (APC) with its 95% confidence interval (*CI*), providing a depiction of the mortality rate's shifting trend.

Results: In 2021, the inadvertent drowning fatality rate for individuals under 20 years of age in China was recorded at 3.28 per 100,000. A steady reduction was observed in the national drowning mortality rate from 6.60 per 100,000 in 2013 down to 3.28 per 100,000 in 2021, signifying a cumulative decrease of 50.30% [APC=–9.06% (95% *CI*: –11.31%, –6.76%)]. Across all sexes, regions, age groups, and residential areas, a consistent decline in mortality rates was evident between 2013 and 2021.

Conclusion: An analysis of the data from 2013 to 2021 reveals a declining trend in the mortality rate due to unintentional drowning among individuals under 20 years of age in China. However, the rate of decline varied when stratified by sex, urban versus rural locations, age-specific groups, and geographical regions.

INTRODUCTION

Globally, drowning claimed 235,642 lives in 2019 (*1*). Notably, in China, it is deemed the primary cause of death for children between the ages of 1 and 14. According to 2021 data, the rate of unintentional drowning in this age group is 3.23 per 100,000, surpassing road traffic injuries, the second leading cause of fatalities, by 0.99 per 100,000. The issue of unintentional drowning has evolved into a significant yet overlooked public health dilemma in China with limited research available showcasing the mortality rate in selective provinces or cities (*2*).

On a promising note, in recent years, the Chinese central government has proactively emphasized the prevention of unintentional drowning. The national health strategy "Healthy China 2030" coupled with the "China Children's Development Program (2021–2030)", issued by the government, has made the prevention of unintentional drowning among children and adolescents a national health priority. Both programs identify the reduction of drowning-related deaths as the primary prevention and control objective.

Nonetheless, the changing trends of unintentional drowning rate among individuals under 20 years at a national level remain ambiguously defined. As such, the study intends to furnish comprehensive nationwide data on unintentional drowning mortality in 2021. In addition, it aims to chart its evolving trends among individuals under 20 years from 2013 to 2021, spotlighting disparities according to sex, age groups, geographical areas, and regions. This information will prove instrumental in appraising the future efficacy of unintentional drowning prevention and control strategies.

METHODS

The data utilized in this study was sourced from the National Mortality Surveillance System (NMSS) in China, which encompasses 605 monitoring points spanned across 31 provincial-level administrative divisions (PLADs). Notably, the monitoring points offer a representative sampling of over 300 million individuals nationwide. Each monitoring point typically represents an administrative unit, either a

rural county or an urban district, within China. Detailed information regarding this system has been previously outlined in depth (*3*).

This study focuses on subjects under the age of 20 who tragically died from unintentional drowning. Drowning is defined as "process of experiencing respiratory impairment from submersion/immersion in liquid" (*4*). In this context, unintentional drowning pertains to drowning incidents caused by objective factors, but excludes cases induced by self-harm, harm from others, natural disasters, traffic accidents, and water transportation accidents. The International Classification of Diseases 10th revision (ICD-10) served as a tool for identifying and coding deaths due to unintentional drowning (W65–W74). Areas were categorized as either urban or rural, and regions were differentiated as eastern, central, or western, following the definitions used in the NMSS. Lastly, age groups were divided into five categories: less than 1 year, 1–4 years, 5–9 years, 10–14 years, and 15–19 years.

The crude mortality rate for unintentional drowning was ascertained by employing the number of deaths and regulated populations (the quantity of unintentional drowning fatalities of this demographic/the number of supervised populations in this demographic × 100,000/100,000). The annual percent of change (APC) and its 95% confidence interval (*CI*) were deduced using linear regression model to delineate the changing trajectory of unintentional drowning mortality rate. The formula for calculating the APC (%) is $(e^{\beta}-1) \times 100$, where β denotes the regression coefficient (*5*). The statistical analysis was conducted utilizing SAS software (version 9.4, SAS Institute Inc., Cary, USA). Statistical significance was noted at $P<0.05$.

RESULTS

The Rate of Unintentional Drowning Mortality in 2021

In 2021, the rate of unintentional drowning mortality among individuals under 20 years of age in China was identified as 3.28 per 100,000. The rate of mortality was particularly higher in males, calculated at 4.64 per 100,000, as compared to females, pegged at 1.71 per 100,000. Interestingly, this mortality rate fluctuated across various age brackets, peaking at 3.95 per 100,000 in the 15–19 year age group, and reducing to the lowest rate of 0.44 per 100,000, observed in the 0–1 year age demographic. In all identified age groups, a notably higher mortality rate was recorded in males than in females ($P<0.05$) (Table 1).

The mortality rates for the eastern, central, and western regions were 2.35 per 100,000, 3.80 per 100,000, and 3.83 per 100,000, respectively. Observations indicated a higher mortality rate in rural environments, standing at 3.84 per 100,000, compared to their urban counterparts at a rate of 2.01 per 100,000. Notably, rural areas exhibited roughly double the mortality rate found in urban areas, a trend consistent across all age categories (Table 1).

The Trend in Unintentional Drowning Mortality Rates from 2013 to 2021

Between 2013 and 2021, the unintentional drowning mortality rate decreased by 50.30%, from 6.60 per 100,000 to 3.28 per 100,000, recording an APC of −9.06% (95% *CI*: −11.31%, −6.76%). Mortality rates for both genders declined during this period, with the rate for males decreasing to 4.64 per 100,000 [APC=−9.06% (95% *CI*: −11.57, −6.48)] and that for females to 1.71 per 100,000 [APC=−9.24% (95% *CI*: −11.40, −7.04)]. Consequently, the mortality gap between males and females diminished from 5.26 per 100,000 to 2.93 per 100,000.

Significant reductions were observed in mortality rates across the 0–14 age group. The 0–1 age group charted the most substantial decrease of approximately 79.72% [APC=−15.63% (95% *CI*: −20.15, −10.86)], whereas the 10–14 age group experienced the least pronounced reduction of roughly 43.52% [APC=−8.70% (95% *CI*: −11.40, −5.92)].

Despite the broad downward trend, the 15–19 age group presented mixed results. Its mortality rate declined from 4.52 per 100,000 to 3.95 per 100,000, albeit without significance [APC=−3.15% (95% *CI*: −7.69, 1.71)]. Furthermore, exceptions to the general declining rates were noticed for the 10–14 age group between 2019 and 2021, and the 15–19 age group between 2018 and 2021.

In detail, the unintentional drowning mortality rate in the 15–19 years age group decreased from 4.52 per 100,000 in 2013 to 2.63 per 100,000 in 2018 before seeing a rise to 3.95 per 100,000 in 2021, marking the third highest mortality rate over the past decade (Table 2).

The mortality rates across all three regions declined, with the most significant reduction observed in the western region, approximately 58.99% [APC=−10.68% (95% *CI*: −11.40, −9.97)], and the

TABLE 1. The unintentional drowning mortality rate (per 100,000) by age groups, sexes, regions, and areas in China, 2021.

Characteristic	<1 age group	1–4 age group	5–9 age group	10–14 age group	15–19 age group	Total
Sex						
Male	0.42	4.93	2.93	5.65	5.99	4.64
Female	0.46	2.33	1.35	1.90	1.55	1.71
Area						
Urban	0.28	2.03	1.53	2.28	2.54	2.01
Rural	0.52	4.44	2.49	4.65	4.56	3.84
Region						
Eastern	0.12	2.25	1.58	3.3	2.71	2.35
Central	0.28	4.66	2.40	4.06	5.18	3.80
Western	0.99	4.54	2.78	4.60	4.02	3.83
Total	0.44	3.69	2.21	3.92	3.95	3.28

least in the central region, around 38.41% [APC=−10.68% (95% *CI*: −11.13, −3.73)]. Notably, slight increments in the mortality rate were perceptible in the central region between 2018 and 2021 and in the eastern region between 2019 and 2021. The accidental drowning mortality rate in the central region dropped from 6.17 per 100,000 in 2013 to 3.21 per 100,000 by 2018 before slightly increasing to 3.80 per 100,000 by 2021. A similar trend was noticed in the eastern region, where the mortality rate declined from 4.81 per 100,000 in 2013 to 2.06 per 100,000 by 2019, which again rose marginally to 2.35 per 100,000 by 2021. Both urban and rural areas displayed a descending trend in accidental drowning mortality rate between 2013 and 2021, showing an APC=−9.70% (95% *CI*: −11.22, −8.24) and APC=−8.70% (95% *CI*: −11.22, −6.20) respectively. The disparity in the mortality rates between urban and rural areas in 2021 was 1.82 per 100,000, marking a reduction from the difference observed in 2013 (Table 2).

DISCUSSION

This study provides a contemporary analysis of unintentional drowning mortality rates for individuals under the age of 20 in China in 2021, with a specific focus on population distribution and spatial patterns. Additionally, it outlines the fluctuating trends in unintentional drowning mortality rate among those under 20, delineating disparities based on gender, age groups, and specific areas and regions across China from 2013 to 2021.

The male mortality rate consistently surpassed that of females with a statistically significant difference (P<0.05). This disparity is likely attributable to males engaging in riskier behaviors related to drowning, such as swimming in unguarded areas, more frequently than females (*6*). During the period from 2013 to 2020, the unintentional drowning mortality rate was highest among children aged 1–4, compared to all other age groups. This trend might be due to the increased activity level of 1–4-year-olds relative to the 0–1 age group, coupled with their comparatively inferior capability to recognize risk compared to the 5–19 age bracket. Without effective adult supervision, the propensity for drowning may be escalated among the 1–4 age group in comparison to the 0–1 age range. In line with this, a previous investigation found that 89.6% of drowning incidents involving children occurred in the absence of adult supervision (*7*). Thus, enforcing robust parental supervision could be instrumental in safeguarding children from hazardous aquatic surroundings (*1*). In 2021, we observed that the unintentional drowning mortality rate among older children aged 10–19 was significantly higher than that of their younger counterparts aged 0–9 (P<0.05). Furthermore, within the younger children demographic, those aged 5–9 manifested a significantly lower unintentional drowning mortality rate than the 1–4 age bracket (P<0.05). The underlying reasons behind these observed patterns are still ambiguous and necessitate further research.

The mortality rate among individuals under 20 years old in rural areas consistently exceeded that of those in urban areas, potentially attributable to the advanced level of education, improved parental supervision, and enhanced child risk prevention awareness in urban regions (*8*). Both central and western regions demonstrated a higher mortality rate compared to eastern regions (P<0.05). This disparity could be

TABLE 2. The unintentional drowning mortality rate (per 100,000) by sexes, areas, regions, and age groups in China, 2013–2021.

Characteristic	2013	2014	2015	2016	2017	2018	2019	2020	2021	APC (95% *CI*)
Sex										
Male	9.05	8.05	7.26	7.16	5.61	4.71	4.50	4.63	4.64	−9.06 (−11.57, −6.48)
Female	3.79	3.25	2.85	2.80	2.17	1.94	2.15	1.84	1.71	−9.24 (−11.40, −7.04)
Age groups (years)										
0−1	2.17	1.34	1.60	1.60	1.02	0.94	0.93	0.65	0.44	−15.63 (−20.15, −10.86)
1−4	11.17	9.26	8.40	8.25	6.63	5.63	4.95	4.60	3.69	−12.45 (−13.76, −11.13)
5−9	5.72	5.18	4.41	4.04	2.89	2.51	2.72	2.66	2.21	−11.40 (−14.27, −8.33)
10−14	6.94	6.46	5.79	5.87	4.77	3.95	3.51	3.54	3.92	−8.70 (−11.40, −5.92)
15−19	4.52	4.06	3.66	3.85	3.01	2.63	3.11	3.26	3.95	−3.15 (−7.69, 1.71)
Region										
Eastern	4.81	3.80	3.00	3.26	2.41	2.21	2.06	2.25	2.35	−8.88 (−12.80, −4.78)
Central	6.17	5.59	5.43	5.34	3.96	3.21	3.48	3.57	3.80	−7.50 (−11.13, −3.73)
Western	9.34	8.65	7.47	7.11	6.06	5.23	4.93	4.35	3.83	−10.68 (−11.40, −9.97)
Area										
Urban	4.64	4.00	3.64	3.32	2.75	2.45	2.34	2.32	2.02	−9.70 (−11.22, −8.24)
Rural	7.31	6.53	5.81	5.88	4.53	3.86	3.84	3.77	3.84	−8.70 (−11.22, −6.20)
Total (crude)	6.60	5.82	5.20	5.13	4.01	3.43	3.40	3.34	3.28	−9.06 (−11.31, −6.76)
Total (age-standardized)	6.70	5.91	5.27	5.21	4.07	3.47	3.40	3.34	3.30	−9.24 (−11.49, −6.95)

Abbreviation: APC=annual percent of change; *CI*=confidence interval.

attributed to the superior management of water resources, including an increasingly safe water environment, as well as prompt, accessible medical rescue systems in eastern areas (*9*). Therefore, the need exists to identify and eliminate potential drowning hazards in both home and school environments, bolster safety measures related to various water bodies, and provide emergency rescue equipment tailored for rural children (*1*,*4*).

Notably, an uptick in the mortality rates was observed in China's central and eastern regions in 2020 and 2021. This rise can be partially linked to severe rainfall and corresponding floods in provinces like Henan, where torrential downpours in Zhengzhou resulted in urban water-logging, river flooding, and consequentially, 302 fatalities in 2021 (*10*).

Additionally, over time, the disparity observed between different areas and regions gradually diminished, with the variance between the central and western regions reducing to 0.03/100,000 in 2021. The decrease in disparity might be mainly due to the intensified education on knowledge and skills pertaining to drowning prevention and emergency rescue, as well as advancements in children's swimming and water safety skills (*11*).

In summation, from 2013 to 2021, China observed a decreasing trend in the rate of unintentional drowning mortalities among individuals less than 20 years old. This overall descent signifies the efficacy of recent measures, such as access to healthcare improvements and child intervention policies (*12*,*13*). However, unintentional drowning remains the primary cause of death in individuals aged 1–14 and the secondary cause in those aged 15–19, thus persisting as a public health concern in China. This rate is significantly higher than in more affluent countries such as the United States, which maintains a mortality rate of 1.00 per 100,000 (*14*) for the same age group. Consequently, it is imperative to implement evidence-based prevention strategies and targeted measures to mitigate unintentional drowning fatalities in China (*1*,*13*–*15*). For instance, the government could proactively establish a national policy for drowning prevention. The Red Cross Society of China could intensify training for safe rescue and resuscitation. Schools could organize more educational activities and water safety courses, thereby enhancing students' drowning prevention knowledge and their safety awareness and skills. Further, parents should closely and continuously supervise their children without

diverting attention, safeguarding effective care (*13*). These advancements in unintentional drowning prevention and control interventions are essential in attaining the objective of reducing child injury mortality rates by 20% from 2021 to 2030, as stipulated in the "China Children's Development Program (2021–2030)" policy from 2021 to 2030.

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Commentary

Enhancing Injury Prevention and Control in China: Establishment of Evidence System

Leilei Duan[1]; Min Yu[2]; Ming Zhao[2]; Jing Wu[1,#]

Injuries, alongside communicable and chronic non-communicable diseases, represent significant public health challenges impacting global population health (*1*). The World Health Organization (WHO) reports that in 2019, approximately 4.4 million deaths were attributed to unintentional injuries and violence, constituting 8% of all deaths worldwide (*2–3*). Moreover, each year, countless individuals suffer from non-fatal injuries. The Global Burden of Disease Study 2019 (GBD 2019) highlights this concern, revealing an injury-specific standardized mortality rate of 54.65 per 100,000 and injury-specific standardized disability-adjusted life years (DALYs) of 3168.70 per 100,000. The economic impact of injuries is profound, costing billions of dollars annually in healthcare, lost productivity, and law enforcement across various nations. Particularly in China, a rapidly developing country, injuries pose a significant health threat. In 2021, China's injury mortality rate stood at 46.90 per 100,000, representing 6.61% of total deaths. Notably, the rate of injury mortality was higher among males and in rural areas. Unsettlingly, injuries have become the leading cause of death for children aged 1–14 in China (*4*).

There is compelling evidence that injuries are both preventable and manageable. Consequently, injury prevention and control are garnering global attention. The United Nations and World Health Assembly have proposed several resolutions focusing on road traffic safety, drowning prevention, and child injury prevention. Increasingly, countries and regions are formulating action plans for injury prevention and control, elevating it as a critical public health priority. Furthermore, there is a consensus on the implementation of evidence-based strategies for injury prevention and control, adopting public health-related methodologies. The public health approach to injury prevention is multidisciplinary, underscoring the need for multisectoral collaboration to effectively tackle injury issues. This approach encompasses four essential steps: conducting injury surveillance, analyzing risk factors, developing effective interventions, and reviewing implementation and residual problems. China's efforts in injury prevention and control trace back to the 1980s. Health sectors have been instrumental in injury data collection and surveillance, applying epidemiological techniques to health policy, and initiating high-quality comprehensive healthcare services. Additionally, these sectors are involved in multisectoral collaborations, implementing preventive and control practices targeting key injury types and vulnerable groups, with the ultimate goal of transforming project outcomes into policies for the benefit of the entire population.

Emphasizing Injury Surveillance and Prioritizing Injury Prevention and Control

Effective injury prevention and control hinge on the fundamental collection of injury data, with injury surveillance being a pivotal method for this data collection. Since the inaugural World Conference on Injury Prevention and Control in 1989, global efforts have been concentrated on enhancing injury surveillance as a cornerstone of injury prevention and control. The main goal of injury surveillance is to delineate the specific disease burden of injuries, their epidemiological distribution, characteristics, and evolving trends (*5–6*). It seeks to address fundamental questions: "What is the problem?" and "Why does it occur?". Additionally, injury surveillance is vital for assessing the efficacy of intervention strategies, shedding light on "What works?" and "How can it be implemented?". An effective injury surveillance system should embody key attributes such as simplicity, flexibility, acceptability, reliability, usefulness, sustainability, and timeliness, while ensuring high levels of safety and confidentiality.

China has been proactively developing a comprehensive, national injury surveillance system (*7–8*). Initiated in 2008 by the National Center for Chronic and Noncommunicable Disease Control and Prevention (NCNCD) of the China CDC, this system is conceptualized on the injury pyramid theory. It

combines the National Injury Surveillance System (NISS) with data from the existing National Disease Surveillance Points (DSP), medical records related to injuries, and periodic population-based epidemiological surveys. This integration offers a thorough national overview of injury incidents. Established in 2005, the NISS is the first specialized Chinese injury surveillance system, tracking injury cases in over 310 health facilities. The DSP System, operational since 1978 with 605 sites, monitors population mortality and disease patterns, providing health indicators like mortality rates and life expectancy. Over the past decade, NCNCD has furthered the use of this comprehensive system. For example, in 2013, a collaborative report on child road traffic injuries was released with the Ministry of Public Security. Epidemiological surveys on child injuries and elderly falls were conducted in 2016 and 2022, respectively. The China Injury Status Report 2019 was published in 2019. From 2023 onwards, population-based epidemiological injury surveys are part of the Population Health and Health Services Monitor and the National Health Services Survey. These advancements largely stem from the development and ongoing enhancement of the national injury surveillance system. Notably, Zhejiang and Guangdong Provinces have seen successful implementations of provincial-level comprehensive injury surveillance systems (*9*–*10*). Zhejiang Province, for instance, has developed a system that encompasses cause-of-death monitoring, hospital injury surveillance, and community surveys, significantly aiding local injury prevention and control initiatives. In Guangdong Province, product injury surveillance findings are leveraged for in-depth investigations into product quality, substantially aiding in the recall of defective products.

Enhancing the Evaluation of Effectiveness and Identifying Optimal Strategies and Measures for Injury Prevention and Control

The prevention and control of injuries necessitate the identification of risk and protective factors and the determination of the best intervention methods. This process is informed by data derived from injury surveillance and epidemiological surveys. The complexity and diversity of injury causes and risk factors, coupled with the uneven distribution of injuries across various regions and populations, underscore the importance of conducting researches on injury prevention and control. The Haddon Matrix, a prevalent research model, deconstructs the process of injury occurrence in terms of timeline and contributing factors, aiding in the analysis of causes and influences. The "5E" intervention strategy — encompassing education, enforcement, engineering, environment, and evaluation — offers scientific guidance for developing preventive measures for different injury types. Evaluation is a crucial component in this context, with a comprehensive evaluation system (including formative, process, and effectiveness evaluation) being essential for project implementation. Such a system plays a pivotal role in demonstrating project value, refining project plans, showcasing achievements, and elevating both theoretical and practical aspects. Health economic evaluations based on effectiveness provide governmental sectors with vital economic data, facilitating more scientific and effective resource allocation, thereby enhancing investment returns. For instance, a study on the use of smoke alarms in preventing scald injuries indicated that each dollar spent on smoke alarms could prevent 28 US dollars (USD) in related healthcare costs (*11*).

The WHO has published various thematic reports on cross-national research and practical achievements in major injury types, such as road traffic injuries, drowning, and falls. These include the World Report on Road Traffic Injury Prevention, Global Report on Drowning, and Global Report on Falls Prevention in Older Adults. These reports guide countries in developing effective, locally tailored strategies for injury prevention and control, transforming these strategies into practice, and sustaining efforts in this domain. In China, health sectors, drawing from international injury prevention experiences, have established an evidence-based, problem-oriented, target population-focused, multisector-collaborative, and society-wide participatory injury intervention model. Since 2005, several pilot studies have been initiated, exploring various intervention patterns for different injury types and target populations, such as road traffic injuries, falls among older adults, drowning, animal bites, and child injuries. Enhanced international cooperation has led to numerous initiatives and deliverables, including the Global Road Safety Program and the Child Injury Prevention Project 2016–2020. Deliverables encompass injury intervention toolkits, models for child drowning intervention (e.g., Qujiang and Zhejiang models), and the "Tadpole Model" for fall prevention among older

adults. Additionally, these initiatives have culminated in the creation of various guidelines, such as the published Technical Guidelines for Falls Prevention and Control in Community-Dwelling Older Adults, Technical Guidelines for Drowning Prevention and Control in Children, and the draft Technical Standards for Falls Prevention and Control in Community-Dwelling Older Adults. These efforts significantly contribute to guiding nationwide injury prevention and control strategies.

Enhancing Policy Consultation and Upholding the Role of Health Guardianship

The development of policies for the prevention and control of injuries, as advocated by the WHO (*12*), is a critical strategy. This approach ensures coherence and clarity in the execution of injury prevention efforts at a political level. It fosters a unified perspective and shared values, brings together stakeholders from various sectors, and delineates the roles and responsibilities of each involved party. In some high-income countries, injury mortality rates have been halved over a period of 10–20 years, primarily due to the implementation of robust injury prevention policies and a series of related initiatives. Health sectors play a pivotal role in injury prevention and control. Their responsibilities encompass policy development, data gathering, providing services to victims, capacity building, and advocacy. Policy development should be multifaceted, and tailored to the national context and specific injury issues. Key roles include leadership, catalyzing actions, coordination, and support. Additionally, health sectors must enhance monitoring systems, analyze and disseminate data that impact health, promote preventive measures, conduct intervention trials and health education, provide healthcare services such as emergency response, treatment, and rehabilitation, advocate for government leadership, and foster an environment conducive to the development of injury prevention policies (*13*).

China has recently integrated the principle of Health in All Policies into its health policy framework. Several policies encompassing injury prevention and control have been enacted, including the Healthy China 2030 Blueprint, the China Children's Development Program (2021–2030), the National Disability Prevention Action Plan (2021–2025), and the 14th Five-Year Plan for National Health. The Healthy China 2030 blueprint explicitly emphasizes "preventing and reducing injuries" and "promoting road traffic safety". The China Children's Development Program (2021–2030) outlines ten major objectives and twelve strategic measures in its "Children and Safety" section, focusing on preventing child injuries and violence. The enactment and implementation of these policies provide a solid foundation for the high-quality development of injury prevention and control in China.

Injury prevention and control is an extensive social project. While China's rapid socioeconomic growth and heightened public health awareness present opportunities for the implementation of injury prevention and control strategies, challenges such as rapid urbanization, motorization, and an aging population pose significant hurdles. It is crucial for China's health sectors to transform these challenges into opportunities, focusing on promoting multisectoral cooperation, ensuring policy implementation, strengthening monitoring and evaluation, enhancing capacity building, deepening scientific research, engaging in extensive dissemination and education, and coordinating social resources. Looking forward, it is anticipated that China will develop a distinctive "Chinese paradigm" in injury prevention and control strategy, contributing this model to the global community.

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