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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