

## Vital Surveillances

## Suicide Mortality by Place, Gender, and Age Group — China, 2010–2021

Min Zhao<sup>1</sup>; Li Li<sup>1</sup>; Zhenzhen Rao<sup>1</sup>; David C. Schwebel<sup>2</sup>; Peishan Ning<sup>1</sup>; Guoqing Hu<sup>1,3,#</sup>

### ABSTRACT

**Introduction:** Suicide is an important public health concern in China. We examined suicide mortality by place, sex, and age group from 2010 to 2021 to identify and quantify significant suicide mortality changes in China.

**Methods:** We retrieved age-standardized and age-specific suicide mortality rates by place (urban *vs.* rural) and sex from the Chinese Health Statistical Yearbook and population data from the 2010 and 2020 Chinese National Population Census. Line graphs were used to demonstrate trends in suicide mortality. Joinpoint regression models were fitted to detect the time periods experiencing significant suicide mortality changes, and average annual percent change (AAPC) and annual percent change were reported to quantify changes in suicide mortality from 2010 to 2021.

**Results:** The overall age-standardized suicide mortality rate decreased from 10.88 to 5.25 per 100,000 population between 2010 and 2021 (AAPC=-5.3%, 95% confidence interval: -6.5%, -4.0%). Similar reductions in suicide mortality were observed for both males and females, as well as in urban and rural settings during this period. From 2010 to 2021, significant declines in suicide mortality were observed among the three older age groups (25–44 years, 45–64 years, and 65 years or above), while a substantial increase was noted in the youngest age group (5–14 years). No significant change was found in suicide mortality rates for the 15–24 year age group. Subgroup analyses based on location and sex revealed consistent findings.

**Conclusion:** The findings of this study suggest a probable overall success of suicide prevention efforts in China over the past decade. However, the recent increase in suicide mortality among children aged 5–14 years calls for the attention of injury researchers, policymakers, and public health practitioners.

### INTRODUCTION

Suicide constitutes a global health crisis, claiming

over 700,000 lives annually, with 77% of these fatalities occurring in low- and middle-income countries (1). In response to this pressing issue, the United Nations incorporated the objective of reducing premature mortality from non-communicable diseases and suicide by one-third by 2030 into the Sustainable Development Goals (SDGs) (2). Regular examination of suicide mortality trends in individual countries is critical for monitoring progress toward the United Nations' suicide prevention target.

Previous research has documented trends in overall suicide rates and variations in suicide mortality rates across subgroups in the Chinese mainland over the past three decades (3–6). For instance, a study utilizing national surveillance data from 1995 to 1999 revealed significantly higher suicide mortality rates in rural areas and among older adults compared to urban areas and younger populations (4). Additionally, two recent studies employing data from the Chinese Health Statistics Yearbook observed considerable declines in overall and most subgroup suicide mortality rates (with the exception of adolescents) from 2004 to 2019 (5). These studies also noted increasing disparities in suicide rates between men and women and an almost unchanged urban-rural gap in suicide mortality from 2002 to 2019 (6). However, prior studies are limited by their reliance on outdated data (prior to 2019), necessitating updated analyses to examine recent trends.

Consequently, by utilizing the most recent data accessible, we analyzed alterations in overall and subgroup suicide mortality rates with regard to location (urban *vs.* rural), gender, and age groups in China. The purpose of this examination is to offer updated evidence to enhance suicide prevention and control strategies in China.

### METHODS

#### Data Source

Suicide mortality data for this study were obtained from the Chinese Health Statistical Yearbook

(2010–2021), which was drawn from the Vital Registration System of China’s Ministry of Health (6). Over the past few decades, this system has experienced substantial development, and as of 2021, it has encompassed 153 districts (urban areas) and 378 counties or county-level cities (rural areas) across 31 provincial-level administrative divisions (PLADs) (7). Population data were gathered from the Chinese National Population Census conducted in 2010 and 2020.

### Statistical Analysis

To compute age-standardized overall suicide mortality, we first estimated the population for each year using the Chinese National Population Census data conducted in 2010 and 2020, with other missing years estimated using a linear interpolation method (8). The 2020 Chinese National Census data served as the standard population. Following approaches from prior study (9), we grouped 16 five-year age segments and the 85 years or above category into five age cohorts for

analysis: 5–14 years, 15–24 years, 25–44 years, 45–64 years, and 65 years or above.

We plotted line graphs to illustrate the overall age-standardized suicide mortality trends and age-specific suicide mortality trends from 2010 to 2021. Joinpoint regression models were employed using Joinpoint Regression Program (version 4.9.1.0, National Cancer Institute, Calverton, USA) to identify significant changes in suicide mortality. Data are presented as annual percent change (APC) and average annual percent change (AAPC) to quantify significant suicide mortality changes.

### RESULTS

From 2010 to 2021, the overall age-standardized suicide mortality rate experienced a downward trend, decreasing from 10.88 to 5.25 per 100,000 [AAPC=−5.3%, 95% confidence interval (CI): −6.5%, −4.0%] (Figure 1A, Supplementary Table S1, available in <http://weekly.chinacdc.cn/>). Both urban and rural

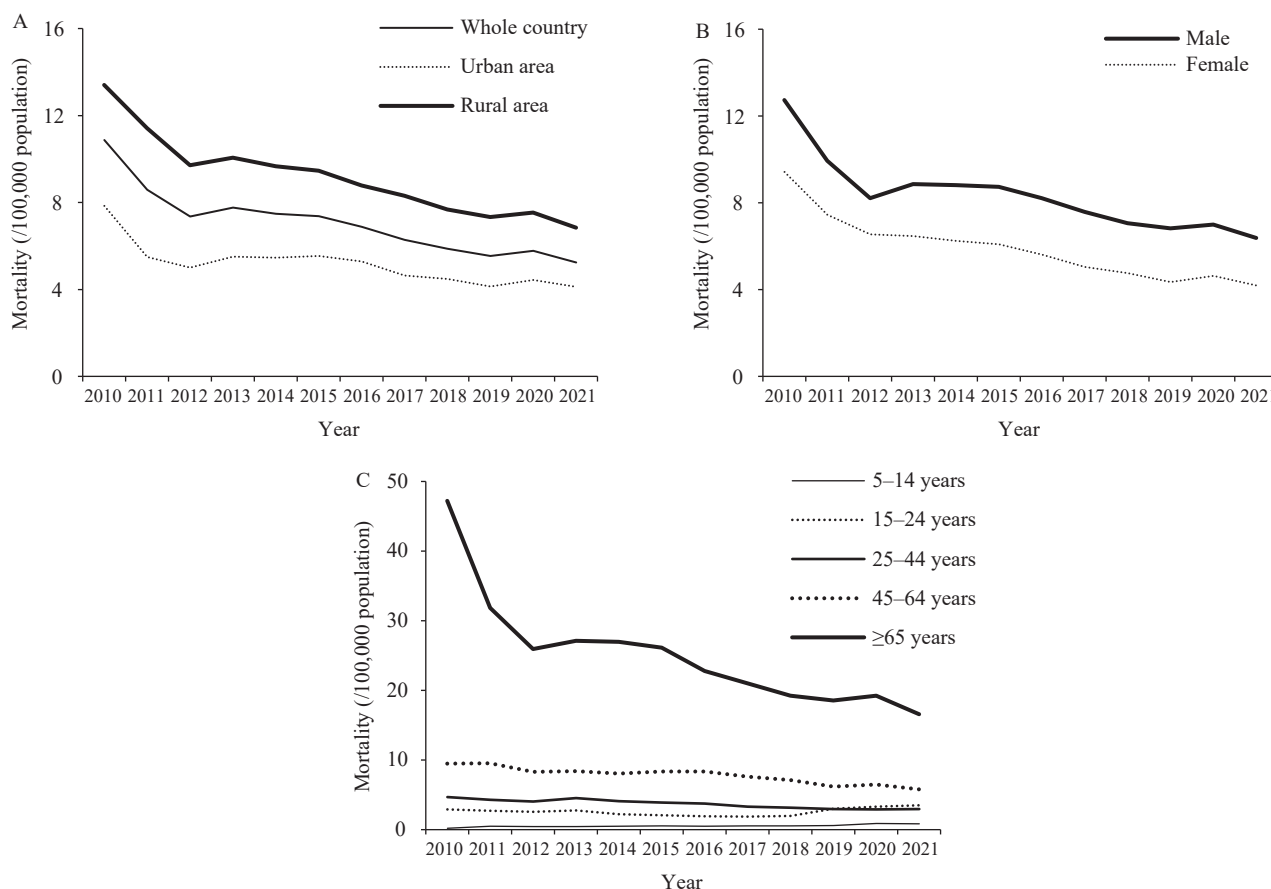


FIGURE 1. Suicide mortality rates in China by location, gender, and age group from 2010 to 2021. (A) Age-standardized suicide mortality by location. (B) Age-standardized suicide mortality by gender. (C) Age-specific suicide mortality by age group.

areas showed significant reductions in age-standardized mortality (urban: AAPC=-4.1%, 95% CI: -5.8%, -2.3%; rural: AAPC=-5.7%, 95% CI: -7.1%, -4.3%) (Figure 1A, Supplementary Table S1). The age-standardized mortality rates observed a similar decrease for males and females (males: AAPC=-6.0%, 95% CI: -9.0%, -3.0%; females: AAPC=-6.2%, 95% CI: -7.4%, -5.1%) (Figure 1B, Supplementary Tables S2–S3, available in <http://weekly.chinacdc.cn/>).

Notably, suicide mortality rates declined significantly in the three older age groups (25–44 years: AAPC=-4.6%, 95% CI: -5.5%, -3.5%; 45–64 years: AAPC=-4.1%, 95% CI: -5.2%, -3.1%; ≥65 years: AAPC=-8.3%, 95% CI: -10.7%, -5.9%). However, there was an increase in suicide mortality for children aged 5–14 years (AAPC=9.3%, 95% CI: 4.6%, 14.3%). The suicide mortality rate for adolescents aged 15–24 years initially decreased between 2010 and 2017 (APC=-6.8%, 95% CI: -10.5%, -2.9%), but later increased from 2017 to 2021 (APC=19.6%, 95% CI: 8.6%, 31.8%) (Figure 1C, Supplementary Table S1).

Both males and females exhibited comparable patterns in age-standardized mortality rates (Figure 2). Throughout the period of 2010–2021, individuals residing in rural areas experienced higher suicide mortality rates compared to their urban counterparts for both male (suicide mortality ratio: 1.65 to 2.14) and female (suicide mortality ratio: 1.64 to 2.02) populations.

The trends in suicide mortality rate varied across the five age groups. For children aged 5–14 years, urban and rural suicide mortality rates almost overlapped, and both showed increasing trends from 2010 to 2021 (urban area: AAPC=9.5%, 95% CI: 5.4%, 13.7%;

rural area: AAPC=9.9%, 95% CI: 2.9%, 17.3%) (Figure 3A, Supplementary Table S1). For adolescents aged 15–24 years, the overall and place-specific suicide rates first decreased and then increased significantly after 2017 (Figure 3B); For the other three older age groups, the suicide mortality rates reduced from 2010 to 2021 in both urban and rural areas (Figure 3C–3E).

Subsequent analyses stratified by age group, location, and gender revealed significant variations. Suicidal mortality rates among both male and female youths aged 5–14 years increased in both urban and rural regions between 2010 and 2021, with the most substantial significant suicide mortality observed among rural female adolescents (AAPC=12.0%, 95% CI: 3.1% to 21.7%) (Figure 4A, Supplementary Tables S2–S3). The AAPCs for the 15–24 age group were not statistically significant for either gender or location (Supplementary Tables S2–S3). In the three older age groups, suicidal mortality rates substantially declined for both genders and in both urban and rural settings, with the most significant decrease observed among rural females aged 65 years and older (AAPC=-8.1%, 95% CI: -11.2%, -4.8%). Excluding the youngest age group, suicide mortality rates were highest among rural males and lowest among urban females (Figures 4A).

## DISCUSSION

This study investigated recent trends in suicide mortality in China using nationally representative data. Three significant findings emerged: 1) the overall age-standardized suicide mortality rate experienced a notable decline between 2010 and 2021 in China, with a slight increase in overall and subgroup suicide

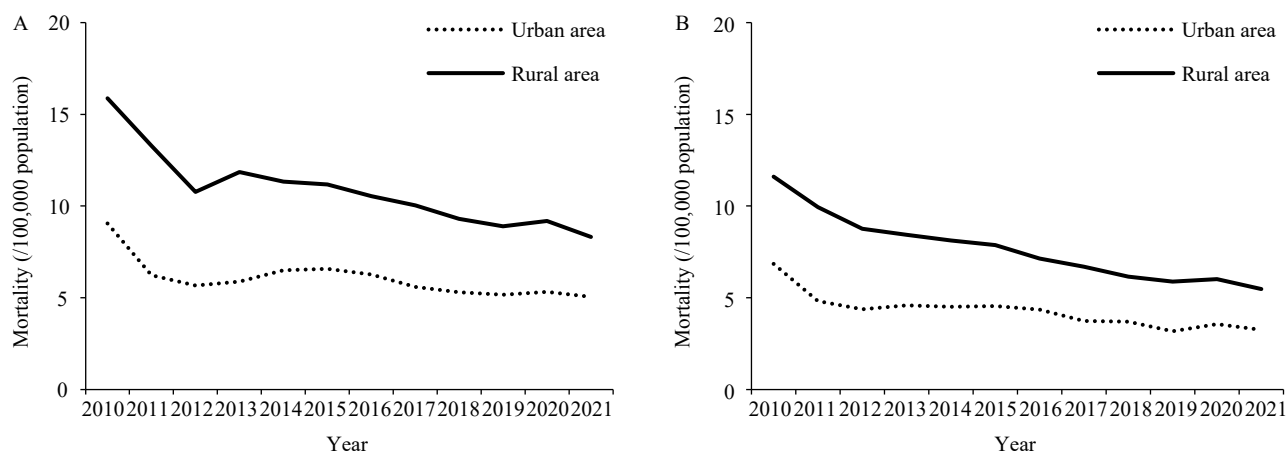


FIGURE 2. Age-standardized suicide mortality rates by sex and location in China, 2010–2021. (A) Male age-standardized suicide mortality in China by location. (B) Female age-standardized suicide mortality in China by location.

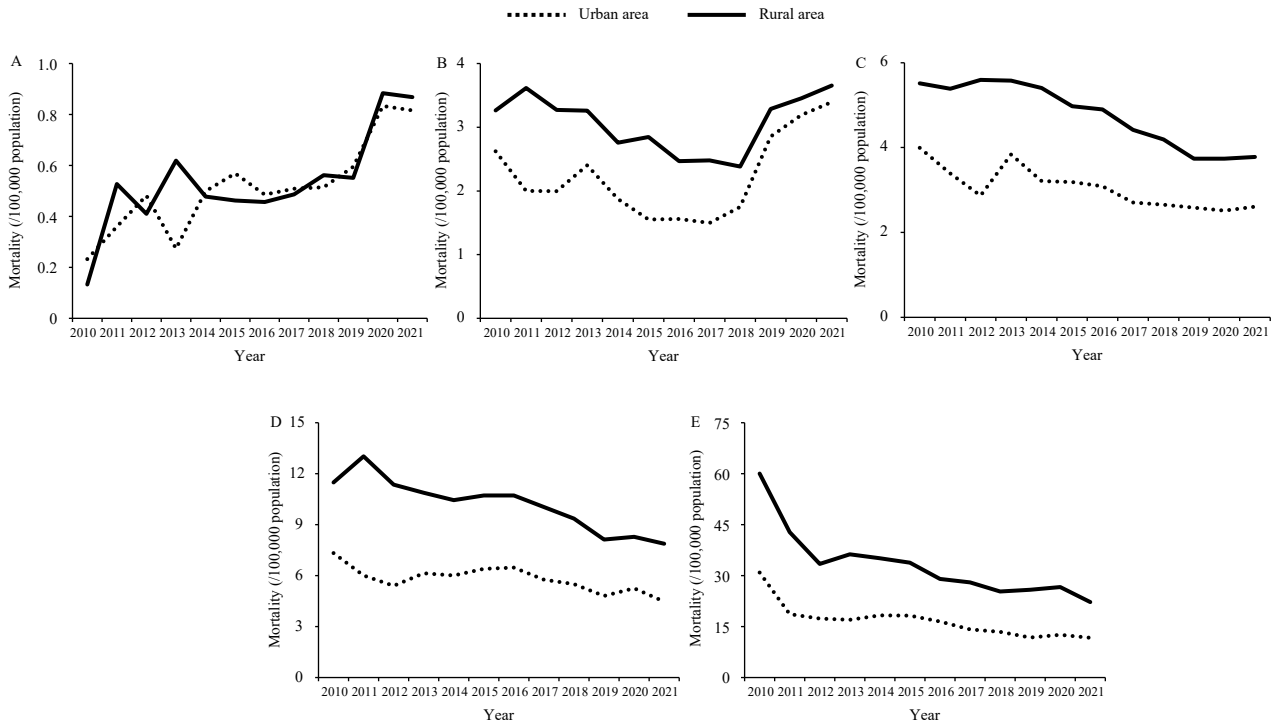


FIGURE 3. Age-specific suicide mortality by geographic location in China, 2010–2021. (A) Suicide mortality in children aged 5–14 years old by location. (B) Suicide mortality in adults aged 15–24 years old by location. (C) Suicide mortality in adults aged 25–44 years old by location. (D) Suicide mortality in adults aged 45–64 years old by location. (E) Suicide mortality in old adults aged 65 years or older by location.

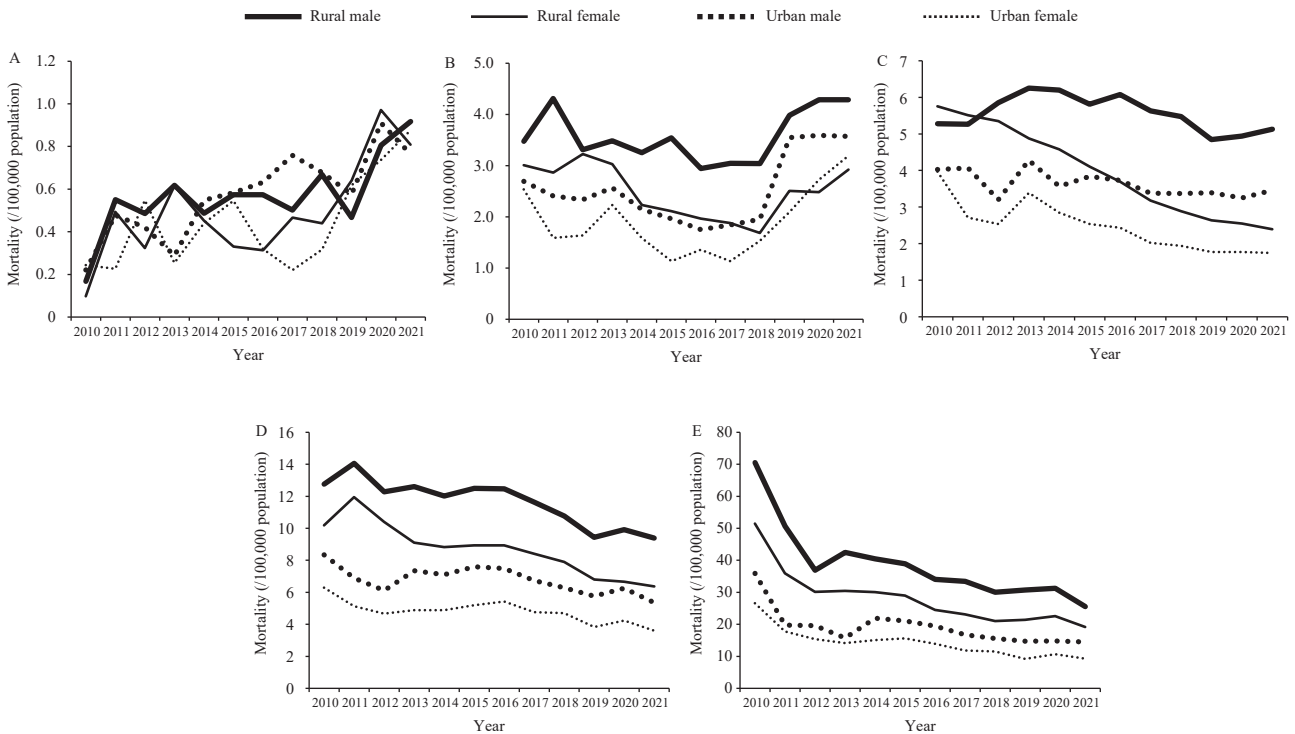


FIGURE 4. Age-specific suicide mortality rates for males and females in urban and rural areas of China, 2010–2021. (A) Suicide mortality rates in children aged 5–14 by gender and location. (B) Suicide mortality rates in adults aged 15–24 by gender and location. (C) Suicide mortality rates in adults aged 25–44 by gender and location. (D) Suicide mortality rates in children aged 45–64 by gender and location. (E) Suicide mortality rates in children aged 65 or older by gender and location.

mortality rates during the coronavirus disease 2019 (COVID-19) pandemic (2019–2021); 2) alterations in suicide mortality were consistent by sex and rural versus urban residence, but considerable variations were observed across sex-, location-, and age-specific groups; and 3) throughout the study period, males, rural inhabitants, and older individuals exhibited higher suicide mortality compared to females, urban inhabitants, and children, adolescents, and adults.

In line with the findings of previous studies (3–6), we observed a significant decrease in overall suicide mortality for both sexes from 2010 to 2021 in China. Contrary to a previous report that suggested substantial reductions in national suicide mortality between 1987 and 2008 occurred only in rural areas, particularly among rural females (10), our research detected comparable and considerable decreases in suicide mortality in both urban and rural areas and for both sexes from 2010 to 2021. The disparity in these findings may be attributed to the differing study time periods and may suggest the effectiveness of national suicide prevention efforts over the past two decades. For instance, China dedicated significant resources to initiate the national mental health program “Central Subsidy for Local Health Funding for the Management and Treatment of Serious Mental Illness (686 projects)” in 2004. Furthermore, rapid urbanization transpired across the country, a trend that was found to be strongly associated with decreased suicide deaths by pesticide among farmers and rural-to-urban migrants (6).

The observed modest elevations in overall and subgroup suicide mortality rates during the COVID-19 pandemic (2019–2021) have been documented in prior studies, suggesting potential associations with heightened levels of depression and anxiety in segments of the general population, as well as among healthcare professionals (11). Numerous individuals encountered social isolation, apprehension of contracting the virus, persistent stress, and financial hardships during this period, all of which have been linked to an increased risk of suicide (11).

The observed distinct suicide mortality trends across sex- and place-specific age groups corroborate previous reports (10). These findings imply that the ongoing suicide prevention interventions implemented by the Chinese government may not adequately address the needs of all age groups. Specifically, tailored approaches targeting children, adolescents, and young adults, potentially through the utilization of mobile internet programs, are advised (12). This

recommendation stems from the detected increasing rates of suicide mortality among children and young adolescents aged 5–14 between 2010 and 2021, and among older adolescents and young adults aged 15–24 between 2017 and 2021. At present, a significant number of Chinese parents and teachers adhere to the widespread educational belief that “academic performance in school is more important than any other thing”, which in turn generates immense pressure on the youth (13). Poorly managed pressure may result in severe mental disorders and elevated suicide risk (13).

Furthermore, we corroborated findings indicating that suicide mortality rates are higher among rural residents, males, and older adults in China compared to their urban, female, and younger counterparts (4,14–15). A prevailing hypothesis for these patterns suggests that the aforementioned populations may encounter a higher prevalence of stressful life events and circumstances (e.g., employment, life development stage, and living environment), potentially leading to more severe physical and psychological disorders that elevate the risk of suicide (4,14–15).

Our findings hold significant policy implications. First, they provide evidence suggesting that suicide prevention initiatives implemented over the past decade have been successful in China and warrant continuation. Second, the results indicate that current suicide prevention measures may not adequately address the specific populations at risk. Notably, the development of prevention programs targeting children and adolescents, who are experiencing increasing suicide rates, must be prioritized. The Chinese government should consider customizing existing interventions and adopting proven prevention measures from other countries that align with Chinese cultural contexts. Recommended strategies may include limiting access to means of suicide, collaborating with the media industry to encourage responsible reporting on suicide, promoting healthy socio-emotional life skills among adolescents, and establishing programs geared toward early identification, assessment, management, and follow-up of individuals affected by suicidal behaviors (1).

This study encountered limitations in terms of the availability and quality of the suicide mortality data utilized. The aggregated suicide mortality rates from the Chinese Health Statistics Yearbook are likely affected by underreporting and misclassification during data collection (3,5). Due to the absence of raw data,



the calculation of confidence intervals for suicide mortality rates was not possible. Similarly, the limited data availability hindered the assessment of self-harm morbidity trends and the exploration of risk factors for suicide mortality, restricting our ability to interpret the reasons behind the observed changes in suicide mortality. Moreover, the lack of detailed data prevented the examination of associations between changes in suicide mortality and major social determinants (e.g., economic development levels, education levels, and healthcare services). Further research is recommended to explore these associations, drawing upon both psychiatric models and psychological theories, particularly to explain the observed increases in suicide mortality among Chinese children, adolescents, and young adults.

## CONCLUSION

From 2010 to 2021, the overall age-standardized suicide mortality rate experienced a significant reduction in China, likely reflecting the successful implementation of suicide prevention efforts during this time period. The observed increase in suicide mortality among children and adolescents warrants attention from both injury researchers and policymakers. It is recommended to maintain comprehensive prevention strategies while also implementing tailored prevention efforts targeted at high-risk groups, such as the child and adolescent population.

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# Corresponding author: Guoqing Hu, [huguoqing@csu.edu.cn](mailto:huguoqing@csu.edu.cn).

<sup>1</sup> Department of Epidemiology and Health Statistics, Hunan Provincial Key Laboratory of Clinical Epidemiology, Xiangya School of Public Health, Central South University, Changsha City, Hunan Province, China; <sup>2</sup> Department of Psychology, University of Alabama at Birmingham, Birmingham, Alabama, USA; <sup>3</sup> National Clinical Research Center for Geriatric Disorders, Xiangya Hospital, Central South University, Changsha City, Hunan Province, China.

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SUPPLEMENTARY TABLE S1. APC and AAPC in suicide mortality in China, 2010–2021.

Age group	Place	Block 1			Block 2			Block 3		
		Time period	APC (95% CI)	Time period	APC (95% CI)	Time period	APC (95% CI)	Time period	APC (95% CI)	AAPC (95% CI)
All ages	Total	2010–2021	-5.3 (-6.5, -4.0)*							-5.3 (-6.5, -4.0)*
	Urban area	2010–2021	-4.1 (-5.8, -2.3)*							-4.1 (-5.8, -2.3)*
	Rural area	2010–2012	-12.0 (-19.6, -3.7)*	2012–2021	-4.2 (-5.0, -3.4)*					-5.7 (-7.1, -4.3)*
5–14 years	Total	2010–2021	9.3 (4.6, 14.3)*							9.3 (4.6, 14.3)*
	Urban area	2010–2021	9.5 (5.4, 13.7)*							9.5 (5.4, 13.7)*
	Rural area	2010–2021	9.9 (2.9, 17.3)*							9.9 (2.9, 17.3)*
15–24 years	Total	2010–2017	-6.8 (-10.5, -2.9)*	2017–2021	19.6 (8.6, 31.8)*					2.1 (-1.6, 5.8)
	Urban area	2010–2017	-6.7 (-12.1, -1.0)*	2017–2021	26.2 (9.6, 45.3)*					4.1 (-1.3, 9.8)
	Rural area	2010–2017	-5.5 (-8.8, -2.0)*	2017–2021	11.6 (2.6, 21.5)*					0.4 (-2.7, 3.7)
25–44 years	Total	2010–2021	-4.6 (-5.5, -3.5)*							-4.6 (-5.5, -3.5)*
	Urban area	2010–2021	-3.6 (-5.1, -2.0)*							-3.6 (-5.1, -2.0)*
	Rural area	2010–2014	0.0 (-2.7, 2.8)	2014–2019	-7.1 (-9.6, -4.4)*	2019–2021	-0.7 (-9.1, 8.4)			-3.4 (-4.9, -1.8)*
45–64 years	Total	2010–2021	-4.1 (-5.2, -3.1)*							-4.1 (-5.2, -3.1)*
	Urban area	2010–2012	-12.9 (-30.6, 9.2)	2012–2015	6.4 (-15.2, 33.5)	2015–2021	-5.8 (-9.4, -2.1)*			-4.0 (-9.1, 1.5)
	Rural area	2010–2021	-3.9 (-5.0, -2.9)*							-3.9 (-5.0, -2.9)*
≥65 years	Total	2010–2012	-21.1 (-32.7, -7.5)*	2012–2021	-5.2 (-6.6, -3.8)*					-8.3 (-10.7, -5.9)*
	Urban area	2010–2021	-6.4 (-8.6, -4.1)*							-6.4 (-8.6, -4.1)*
	Rural area	2010–2012	-21.0 (-34.2, -5.3)*	2012–2021	-4.7 (-6.3, -3.1)*					-7.9 (-10.6, -5.1)*

Abbreviation: APC=annual percent changes; AAPC=average annual percent changes; CI=confidence interval.

\*  $P < 0.05$ .

SUPPLEMENTARY TABLE S2. APC and AAPC in male suicide mortality rates in China, 2010–2021.

Age group	Place	Block 1			Block 2			Block 3			AAPC (95% CI)
		Time period	APC (95% CI)	Time period	APC (95% CI)	Time period	APC (95% CI)	Time period	APC (95% CI)		
All ages	Total	2010–2012	-18.2 (-28.4, -6.4)*	2012–2015	1.0 (-11.7, 15.5)	2015–2021	-5.1 (-7.2, -2.9)*	2015–2021	-5.1 (-7.2, -2.9)*	-6.0 (-9.0, -3.0)*	
	Urban area	2010–2012	-19.9 (-32.8, -4.5)*	2012–2015	5.5 (-11.5, 25.7)	2015–2021	-4.6 (-7.4, -1.8)*	2015–2021	-4.6 (-7.4, -1.8)*	-5.0 (-9.0, -1.0)*	
	Rural area	2010–2012	-13.3 (-20.4, -5.5)*	2012–2021	-3.5 (-4.2, -2.7)*					-5.3 (-6.6, -4.0)*	
5–14 years	Total	2010–2021	8.8 (4.1, 14.0)*							8.8 (4.1, 14.0)*	
	Urban area	2010–2021	9.9 (5.0, 15.0)*							9.9 (5.0, 15.0)*	
	Rural area	2010–2021	8.1 (1.8, 14.9)*							8.1 (1.8, 14.9)*	
15–24 years	Total	2010–2017	-5.0 (-9.5, -0.2)*	2017–2021	16.9 (4.1, 31.3)*					2.4 (-1.9, 7.0)	
	Urban area	2010–2017	-5.4 (-11.0, 0.6)	2017–2021	22.8 (6.2, 42.1)*					4.0 (-1.5, 10.0)	
	Rural area	2010–2017	-3.3 (-7.5, 1.1)	2017–2021	10.6 (-0.5, 23.0)					1.5 (-2.4, 5.7)	
25–44 years	Total	2010–2021	-2.0 (-3.0, -0.9)*							-2.0 (-3.0, -0.9)*	
	Urban area	2010–2021	-1.6 (-3.0, -0.2)*							-1.6 (-3.0, -0.2)*	
	Rural area	2010–2013	7.1 (-0.7, 15.5)	2013–2021	-3.1 (-4.7, -1.5)*					-0.4 (-2.3, 1.6)	
45–64 years	Total	2010–2021	-3.5 (-4.6, -2.4)*							-3.5 (-4.6, -2.4)*	
	Urban area	2010–2012	-12.1 (-29.3, 9.4)	2012–2015	6.8 (-14.2, 32.9)	2015–2021	-5.6 (-9.0, -2.1)*			-3.6 (-8.6, 1.6)	
	Rural area	2010–2021	-3.2 (-4.3, -2.1)*							-3.2 (-4.3, -2.1)*	
≥65 years	Total	2010–2012	-22.7 (-34.6, -8.7)*	2012–2021	-4.5 (-5.0, -3.0)*					-8.1 (-10.6, -5.3)*	
	Urban area	2010–2021	-5.3 (-8.3, -2.2)*							-5.3 (-8.3, -2.2)*	
	Rural area	2010–2012	-22.3 (-34.6, -7.7)*	2012–2021	-4.4 (-5.9, -2.9)*					-7.9 (-10.5, -5.3)*	

Abbreviation: APC=annual percent changes; AAPC=average annual percent changes; CI=confidence interval.

\*  $P < 0.05$ .



SUPPLEMENTARY TABLE S3. APC and AAPC in female suicide mortality in China, 2010–2021.

Age group	Place	Block 1			Block 2			Block 3			AAPC (95% CI)
		Time period	APC (95% CI)	Time period	APC (95% CI)	Time period	APC (95% CI)	Time period	APC (95% CI)		
All ages	Total	2010–2021	-6.2 (-7.4, -5.1)*								-6.2 (-7.4, -5.1)*
	Urban area	2010–2021	-5.1 (-6.8, -3.3)*								-5.1 (-6.8, -3.3)*
	Rural area	2010–2012	-12.1 (-20.8, -2.5)*	2012–2021	-5.3 (-6.2, -4.4)*						-6.6 (-8.1, -5.0)*
5–14 years	Total	2010–2012	66.1 (-10.9, 209.6)	2012–2017	-8.1 (-24.5, 11.9)	2017–2021	30.8 (7.5, 59.3)*				16.4 (3.9, 2.6)*
	Urban area	2010–2021	8.8 (1.0, 17.2)*								8.8 (1.0, 17.2)*
	Rural area	2010–2021	12.0 (3.1, 21.7)*								12.0 (3.1, 21.7)*
15–24 years	Total	2010–2017	-9.3 (-13.8, -4.4)*	2017–2021	23.3 (9.1, 39.4)*						1.5 (-3.1, 6.2)
	Urban area	2010–2017	-8.6 (-15.7, -1.0)*	2017–2021	30.7 (8.1, 58.0)*						4.1 (-3.1, 11.8)
	Rural area	2010–2018	-7.3 (-10.6, -3.9)*	2018–2021	19.5 (1.3, 40.9)*						-0.6 (-4.8, 3.8)
25–44 years	Total	2010–2021	-8.2 (-9.3, -7.1)*								-8.2 (-9.3, -7.1)*
	Urban area	2010–2021	-6.5 (-8.5, -4.4)*								-6.5 (-8.5, -4.4)*
	Rural area	2010–2014	-5.6 (-7.7, -3.4)*	2014–2018	-11.5 (-14.6, -8.3)*	2018–2021	-5.7 (-9.0, -2.3)*				-7.8 (-9.0, -6.6)*
45–64 years	Total	2010–2021	-5.0 (-6.0, -3.9)*								-5.0 (-6.0, -3.9)*
	Urban area	2010–2012	-13.4 (-32.9, 11.8)	2012–2016	3.5 (-8.9, 17.6)	2016–2021	-7.3 (-12.4, -1.8)*				-4.7 (-9.3, 0.2)
	Rural area	2010–2021	-4.9 (-6.0, -3.7)*								-4.9 (-6.0, -3.7)*
≥65 years	Total	2010–2012	-21.0 (-35.2, -3.6)*	2012–2021	-5.8 (-7.4, -4.0)*						-8.7 (-11.6, -5.7)*
	Urban area	2010–2021	-7.3 (-9.4, -5.1)*								-7.3 (-9.4, -5.1)*
	Rural area	2010–2012	-20.5 (-35.7, -1.6)*	2012–2021	-5.0 (-6.9, -3.2)*						-8.1 (-11.2, -4.8)*

Abbreviation: APC=annual percent changes; AAPC=average annual percent changes; CI=confidence interval.

\*  $P < 0.05$ .