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中国疾病预防控制中心周报

World Health Organization

Suicide: facts and figures globally

More than **700 000** people died by suicide in 2019

High-income countries: **77%** of suicides occurred in low- and middle-income countries in 2019

More than **1 in 100** (1.3%) were by suicide in 2019

Suicide is the **fourth** leading cause of death among **15-29** year-olds in 2019

58% of suicides happened before the age of **50** years in 2019

Implement LIVE LIFE to reach that target of reducing suicide rates by **1/3** by **2030** according to the UN Sustainable Development Goals 2030 and the WHO Mental Health Action Plan 2013-2030

LIVE cross-cutting foundations

Key effective evidence-based interventions

L I F E

- L**imit access to means of suicide
- I**nteract with the media on responsible reporting
- F**oster life skills of young people
- E**arly identify and support everyone affected

Source: Suicide worldwide in 2019. <https://www.who.int/publications/m/item/suicide-worldwide-in-2019>

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This week's issue was organized by Guest Editor Guoqing Hu.

Suicide Prevention: More Actions Are Needed

Guoqing Hu^{1,2,#}

Suicide has long been a significant global public health issue. Annually, approximately 800,000 individuals succumb to suicide worldwide, resulting in more fatalities than those caused by malaria, breast cancer, or war and homicide (1). A striking 79% of these suicide-related deaths transpire in low- and middle-income countries (LMICs) (1). Remarkably, suicide ranks as the second leading cause of death among young individuals aged 15–29 years for both males and females, with 90% of adolescents who died by suicide originating from LMICs (1).

Addressing the critical issue of suicide, the United Nations has prioritized the reduction of suicide mortality as an integral component (Indicator 3.4.2) of Target 3.4 within the Sustainable Development Goals (SDGs). The specific goal, “By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment, and promote mental health and well-being,” places emphasis on the importance of lowering the suicide mortality rate (Indicator 3.4.2) (2).

As the most populous LMIC in the world, China faces significant challenges related to suicide. According to estimates by the World Health Organization (WHO), the crude suicide rate in China was 9.7 per 100,000 population in 2016 (1). To promote suicide prevention in this region, the *China CDC Weekly* has published a specific issue featuring three insightful articles on the subject.

Using mortality data from the Chinese Health Statistical Yearbook and population data from the 2010 and 2020 Chinese National Population Census, Zhao et al. (3) examined suicide mortality by location, sex, and age group in China during 2010–2021 and reported a substantial decrease in the overall age-standardized suicide mortality rate, dropping from 10.88 to 5.25 per 100,000 population. In addition to reporting roughly similar reductions in subgroup suicide mortality rates by sex and location (urban *vs.* rural area), this study identified strikingly inconsistent mortality changes across age groups — large suicide mortality declines among three older age groups (25–44 years, 45–64 years, and 65 years or older) versus a significant increase in the youngest age group (5–14 years) and minimal change in the 15–24 years age group. These findings suggest a probable overall success of suicide prevention efforts in China over the past decade but indicate that current suicide prevention measures may not adequately address specific populations at risk, particularly for younger age groups (5–14 years and 15–24-years).

Sun et al. (4) examined the associations among distress rumination, somatic anxiety, and suicidal ideation in Chinese college students using a cross-sectional study design. Their findings revealed a significant link between distress rumination following traumatic events and both somatic anxiety ($r_s=0.340$, $P<0.001$) and suicidal ideation ($r_s=0.243$, $P<0.001$). Furthermore, the study identified a significant indirect effect of distress rumination on suicidal ideation, mediated by somatic anxiety, with an effect size of 0.267 [95% confidence interval (CI): 0.182–0.351]. These results underscore the significant influence of distress rumination after experiencing a traumatic event and illustrate the mediating role of somatic anxiety in the pathway from stress rumination to suicidal ideation.

Wang and Sun (5) investigated the prevalence rates of suicidal ideation, suicide planning, and suicide attempts among 486 community-dwelling individuals with serious mental disorders (SMD). This evidence is crucial for informing suicide prevention strategies. The study's findings indicated that the respective prevalence rates of suicidal ideation, suicide planning, and suicide attempts were 36.8%, 17.9%, and 15.0% among individuals with SMD residing in the community. Additionally, the authors explored the factors influencing these three suicidal behaviors. The results demonstrated that depressive symptoms were significantly related to all three suicidal behaviors, with odds ratios (OR) of 1.13 (95% CI: 1.09–1.18), 1.10 (95% CI: 1.05–1.15), and 1.10 (95% CI: 1.05–1.15). Furthermore, it was established that middle age, living alone, and having more severe depressive and psychiatric symptoms served as risk factors for specific suicidal behaviors.

On the one hand, the significant decrease in suicide mortality rates observed from 2010 to 2021, as reported by Zhao et al. (3), indicates the effectiveness of suicide prevention initiatives implemented in China over the past decade. On the other hand, however, their findings also highlight critical prevention gaps that necessitate further

efforts and research. These include a substantial increase in the 5–14 age group and an insignificant change in the 15–24 age group during 2010–2021, a positive association between distress rumination and suicidal ideation among college students who have experienced a traumatic event, and comparatively high prevalence rates of suicidal ideation, planning, and attempts among community-dwelling individuals with SMD.

It is evident that further efforts are required to address the issues identified in these studies. The recommendations provided by the WHO's LIVE cross-cutting foundations program (6) can serve as a valuable reference for China. Adequate resources must be invested to ensure the high-quality implementation of these recommended actions.

1) Restrict access to methods of suicide. Appropriate training for media professionals should be implemented to encourage responsible reporting of suicide events (7).

2) Foster life skills of young people by improving young people's problem-solving and coping skills through school-based programs.

3) Implement early identification, management, and follow-up strategies. Suicide prevention must be considered a fundamental aspect of the healthcare system, with health professionals receiving comprehensive training in basic suicide prevention knowledge and skills. This approach enables the early identification, assessment, management, and follow-up of individuals who have attempted suicide or are at risk. The universal health coverage program should ensure that all individuals have access to suicide prevention services.

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Preplanned Studies

Prevalence and Associated Factors of Suicidal Behaviors Among Community-Dwelling Individuals with Serious Mental Disorders — Shandong Province, China, 2022

Meiqi Wang^{1,2}; Long Sun^{1,2,#}

Summary

What is already known about this topic?

Serious mental disorders (SMD) are significant risk factors for suicide, and individuals with SMD are crucial target populations for suicide prevention efforts. While numerous studies have examined the prevalence of suicidal behaviors among psychiatric inpatients, fewer reports have addressed the occurrence of such behaviors in community-based patients.

What is added by this report?

The prevalence of suicidal ideation, planning, and attempts among community-dwelling individuals with SMD was found to be 36.8%, 17.9%, and 15.0%, respectively. A significant association was observed between the severity of psychiatric symptoms and the presence of suicidal behaviors. Notably, patients within the 55–59 age range demonstrated the highest rates of both suicidal planning and attempts.

What are the implications for public health practice?

Particular attention to the risk of suicide is crucial, especially for community-dwelling individuals with SMD of middle age, those with religious beliefs, living alone, and exhibiting more severe depressive and psychiatric symptoms.

Suicide constitutes a significant global public health issue, as it accounts for one out of every hundred deaths (1). Although the suicide rate has experienced a decline in China, this decrease has gradually slowed, with certain sub-populations even witnessing a reverse trend and an increase in rates (2). Consequently, suicide remains an area of public health concern. Gaining a comprehensive understanding of the factors correlating with suicidal behaviors among high-risk populations is essential for addressing this issue effectively.

Serious mental disorders (SMD) represent significant public health concerns globally. Official

reports indicate that approximately 4.7% of individuals in China experience SMD (3). Individuals with mental disorders exhibit a higher risk for suicidal behaviors compared to the general population. A meta-analysis revealed that the pooled suicide rate among SMD patients was 312.8 per 100,000 (4).

An increasing number of studies have examined the primary causes of suicidal behaviors among psychiatric inpatients; however, limited information is available regarding the prevalence and associated factors of suicidal behaviors among community SMD patients. These community patients are often more exposed to negative reactions and perceptions from their external environment (5). Consequently, there may be a disparity in suicidal behaviors between community patients and inpatients. To effectively prevent suicidal behaviors among community SMD patients in China, public health policymakers need to consider both prevalence and associated factors.

The cross-sectional study was conducted from August 2022 to September 2022 in Shandong Province, China. A randomized multistage stratified cluster sampling technique was employed for the study. Initially, the gross domestic product (GDP) of 16 administrative districts in Shandong Province was utilized to classify high and low economic zones within the province, resulting in the random selection of one city from each category (Jinan and Zaozhuang). Subsequently, one county from each city (Zhangqiu and Taierzhuang) was randomly selected. Following this step, six towns and streets were chosen at random from each county. Registered community SMD patients in the 12 towns and streets were then considered for the study. Ultimately, a total of 486 registered community SMD patients participated in the study.

All interviewers underwent training in communication techniques and received detailed information on the research and questionnaire materials prior to the study. Participants voluntarily

provided written, fully informed consent. Patients capable of communicating were interviewed individually ($n=37$), while those unable to communicate were interviewed through their primary caregivers ($n=449$) using a proxy-informant-based approach. The differences in patients' characteristics answered between patients themselves and caregivers are shown in the Supplementary Table S1 (available in <https://weekly.chinacdc.cn/>). Legal guardians were asked to provide informed consent on behalf of patients who were illiterate, below 18 years of age, or unable to communicate. Questionnaires were administered via face-to-face interviews between the interviewers and respondents, with interviewers completing the questionnaires based on the information received from the interviewees. Following the study, at least two trained postgraduate students checked the content and quality of the questionnaires; those with missing or unclear information were revisited and updated accordingly.

Suicidal ideation, suicide plans, and suicide attempts were assessed using three questions "During your lifetime, have you seriously considered committing suicide or taking your own life?", "During your lifetime, have you ever made a plan to commit suicide or take your own life" and "During your lifetime, have you ever attempted to commit suicide or tried taking your own life?". Response options included "no" and "yes". Participants who responded "yes" to the first question were subsequently asked the latter two questions, whereas those who responded "no" were not asked further.

Religious beliefs in the study comprised none, Buddhism, Christianity, Catholicism, and others, with "none" coded as 0 and all other responses coded as 1. The Brief Psychiatric Rating Scale (BPRS), which assesses the severity of psychiatric symptoms, was administered by locally trained psychiatric professionals.

Statistical analyses were conducted using IBM SPSS Statistics (web version 24.0; New York, USA). Descriptive statistics were employed to examine means and standard deviations for continuous variables with normal distributions, as well as numbers and percentages for categorical variables. Additionally, the frequency and percentages of suicidal behaviors were described based on gender and age group. Analysis of variance (ANOVA) and chi-square tests were utilized to compare suicidal behaviors concerning socio-demographic variables, illness information, and unhealthy behaviors. Multivariable logistic regressions

were applied to examine variables related to suicidal ideation, suicide plans, and suicide attempts. All tests were two-sided, with $P<0.05$ indicating statistical significance.

In the study, 210 (43.2%) male and 276 (56.8%) female participants were included, with 25.9% of patients being older than 65 years. The majority of patients were of Han ethnicity, married, had no religious affiliation, resided in rural areas, had children, and were not only child. A small percentage of patients engaged in alcohol use (8.4%) and cigarette smoking (14.2%). Furthermore, 37.0% of patients lived in impoverished families, and 27.8% were in debt. In total, 44.7% of the patients with SMD had other chronic diseases. Each patient lived with an average of 2.84 individuals, including themselves, and the mean BPRS score was 55.47 [standard deviation (SD)=21.19]. The majority of patients were diagnosed with schizophrenia (63.6%), followed by epileptic mental disorder (14.2%) and bipolar disorder (12.1%). Descriptive and single analyses of suicidal behaviors are presented in Table 1.

Furthermore, 63.2% of patients exhibited no suicidal behavior. There were significant differences in the prevalence of any suicidal behavior between males and females ($\chi^2=4.639$, $P<0.05$). Among the ideators, 18.1% had a plan, while 3.7% did not have a plan. In the case of attempters, 0.8% had a plan and 14.2% did not have a plan.

Figure 1 illustrates the percentages of suicidal behaviors across various age groups. Among these groups, patients aged 65–69 exhibited the highest percentage of suicidal ideation (47.3%), while those aged 55–59 demonstrated the highest percentages of both suicide planning and suicide attempts (31.0% and 29.3%, respectively). The percentages of suicidal ideation in younger patients showed a significant increase ($P<0.01$), whereas the percentages of suicide planning and attempts in the 55–59 age group significantly increased ($P<0.05$) and those in the 60–64 age group significantly declined ($P<0.05$).

The logistic regression results for suicidal behaviors are presented in Table 2. Depressive symptoms were found to be significantly associated with suicidal behaviors [odds ratio (OR)=1.13, 95% confidence interval (CI): 1.09–1.18; OR=1.10, 95% CI: 1.05–1.15; OR=1.10, 95% CI: 1.05–1.15]. After adjusting for depressive symptoms, both religious belief and the number of persons living together including patients (NPLT) emerged as significant factors associated with suicidal ideation. Patients without a

TABLE 1. Descriptive and single analysis for suicidal behaviors among community SMD patients.

Variable	Overall		Suicidal ideation		P-value	Suicide plan		P-value	Suicide attempt		P-value
	Numbers (%)		Yes	No		Yes	No		Yes	No	
Numbers (%)	486 (100.0)		179 (36.8)	307 (63.2)		87 (17.9)	399 (82.1)		73 (15.0)	413 (85.0)	
Age, n (%)					0.034						0.797
≤44 years	156 (32.1)		45 (28.8)	111 (71.2)		26 (16.7)	130 (83.3)		23 (14.7)	133 (85.3)	
45–64 years	204 (42.0)		80 (39.2)	124 (60.8)		37 (18.1)	167 (81.9)		33 (16.2)	171 (83.8)	
≥65 years	126 (25.9)		54 (42.9)	72 (57.1)		24 (19.0)	102 (81.0)		17 (13.5)	109 (86.5)	
Gender, n (%)					0.039						0.300
Male	210 (43.2)		66 (31.4)	144 (68.6)		30 (14.3)	180 (85.7)		27 (12.9)	183 (87.1)	
Female	276 (56.8)		113 (40.9)	163 (59.1)		57 (20.7)	219 (79.3)		46 (16.7)	230 (83.3)	
BMI, mean (SD)	24.68 (4.34)		25.22 (4.41)	24.36 (4.27)	0.036	25.29 (4.55)	24.55 (4.28)		25.67 (4.76)	24.50 (4.24)	0.033
Ethnicity, n (%)					0.978						1.000
Han	482 (99.2)		177 (36.7)	305 (63.3)		86 (17.8)	396 (82.2)		72 (14.9)	410 (85.1)	
Others	4 (0.8)		2 (50.0)	2 (50.0)		1 (25.0)	3 (75.0)		1 (25.0)	3 (75.0)	
Religious belief, n (%)					0.002						0.354
Yes	66 (13.6)		36 (54.5)	30 (45.5)		15 (22.7)	51 (77.3)		14 (21.2)	52 (78.8)	0.184
No	420 (86.4)		143 (34.0)	277 (66.0)		72 (17.1)	348 (82.9)		59 (14.0)	361 (86.0)	
Marital status, n (%)					<0.001						0.204
Unmarried	105 (21.6)		20 (19.0)	85 (81.0)		9 (8.6)	96 (91.4)		10 (9.5)	95 (90.5)	
Married	328 (67.5)		135 (41.2)	193 (58.8)		67 (20.4)	261 (79.6)		54 (16.5)	274 (83.5)	
Divorced/widowed	53 (10.9)		24 (45.3)	29 (54.7)		11 (20.8)	42 (79.2)		9 (17.0)	44 (83.0)	
Education, n (%)					0.105						0.599
Illiterate	163 (33.5)		53 (32.5)	110 (67.5)		26 (16.0)	137 (84.0)		21 (12.9)	142 (87.1)	
Primary school	138 (28.4)		47 (34.1)	91 (65.9)		28 (20.3)	110 (79.7)		21 (15.2)	117 (84.8)	
Junior high school or above	185 (38.1)		79 (42.7)	106 (57.3)		33 (17.8)	152 (82.2)		31 (16.8)	154 (83.2)	
Region, n (%)					1.000						0.401
Rural	436 (89.7)		161 (36.9)	275 (63.1)		78 (17.9)	358 (82.1)		68 (15.6)	368 (84.4)	
Urban	50 (10.3)		18 (36.0)	32 (64.0)		9 (18.0)	41 (82.0)		5 (10.0)	45 (90.0)	
Occupation, n (%)					0.122						0.616
Employed	210 (43.2)		86 (41.0)	124 (59.0)		42 (20.0)	168 (80.0)		34 (16.2)	176 (83.8)	
Unemployed	276 (56.8)		93 (33.7)	183 (66.3)		45 (16.3)	231 (83.7)		39 (14.1)	237 (85.9)	
Offspring, n (%)					<0.001						0.154
Yes	371 (76.3)		154 (41.5)	217 (58.5)		75 (20.2)	296 (79.8)		61 (16.4)	310 (83.6)	
No	115 (23.7)		25 (21.7)	90 (78.3)		12 (10.4)	103 (89.6)		12 (10.4)	103 (89.6)	

TABLE 1. (Continued)

Variable	Overall	Suicidal ideation		P-value	Suicide plan		P-value	Suicide attempt		P-value
		Yes	No		Yes	No		Yes	No	
Only child, n (%)				0.310			0.664			1.000
Yes	24 (4.9)	6 (25.0)	18 (75.0)		3 (12.5)	21 (87.5)		4 (16.7)	20 (83.3)	
No	462 (95.1)	173 (37.4)	289 (62.6)		84 (18.2)	378 (81.8)		69 (14.9)	393 (85.1)	
NPLT, mean (SD)	2.84 (1.20)	2.67 (1.15)	2.94 (1.23)	0.015	2.70 (1.06)	2.87 (1.23)	0.224	2.75 (1.05)	2.86 (1.23)	0.488
Years of SMD, mean (SD)	23.41 (13.41)	22.96 (13.75)	23.67 (13.22)	0.574	21.76 (13.80)	23.77 (13.32)	0.205	21.75 (14.05)	23.70 (13.29)	0.253
Alcohol use, n (%)				0.839			0.721			0.876
Yes	41 (8.4)	14 (34.1)	27 (65.9)		6 (14.6)	35 (85.4)		7 (17.1)	34 (82.9)	
No	445 (91.6)	165 (37.1)	280 (62.9)		81 (18.2)	364 (81.8)		66 (14.8)	379 (85.2)	
Cigarette smoking, n (%)				0.574			0.697			0.254
Yes	69 (14.2)	28 (40.6)	41 (59.4)		14 (20.3)	55 (79.7)		14 (20.3)	55 (79.7)	
No	417 (85.8)	151 (36.2)	266 (63.8)		73 (17.5)	344 (82.5)		59 (14.1)	358 (85.9)	
Poor family, n (%)				0.350			1.000			0.701
Yes	180 (37.0)	61 (33.9)	119 (66.1)		32 (17.8)	148 (82.2)		29 (16.1)	151 (83.9)	
No	306 (63.0)	118 (38.6)	188 (61.4)		55 (18.0)	251 (82.0)		44 (14.4)	262 (85.6)	
In debt, n (%)				0.225			0.053			0.078
Yes	135 (27.8)	56 (41.5)	79 (58.5)		32 (23.7)	103 (76.3)		27 (20.0)	108 (80.0)	
No	351 (72.2)	123 (65.0)	228 (35.0)		55 (15.7)	296 (84.3)		46 (13.1)	305 (86.9)	
Chronic disease, n (%)				<0.001			0.178			0.319
Yes	217 (44.7)	99 (45.6)	118 (54.4)		45 (20.7)	172 (79.3)		37 (17.1)	180 (82.9)	
No	269 (55.3)	80 (29.7)	189 (70.3)		42 (15.6)	227 (84.4)		36 (13.4)	233 (86.6)	
BPRS, mean (SD)	55.47 (21.19)	61.21 (21.85)	52.12 (20.09)	<0.001	64.01 (20.79)	53.60 (20.85)	<0.001	65.59 (21.65)	53.68 (20.63)	<0.001
Depressive symptoms, mean (SD)	9.71 (6.25)	12.54 (6.96)	8.06 (5.13)	<0.001	13.30 (7.14)	8.93 (5.75)	<0.001	13.41 (7.15)	9.06 (5.84)	<0.001
Types of SMD, n (%)				<0.001			<0.001			0.015
Schizophrenia	309 (63.6)	116 (37.5)	193 (62.5)		53 (17.2)	256 (82.8)		46 (14.9)	263 (85.1)	
Bipolar disorder	59 (12.1)	36 (61.0)	23 (39.0)		22 (37.3)	37 (62.7)		16 (27.1)	43 (72.9)	
Epileptic mental disorder	69 (14.2)	21 (30.4)	48 (69.6)		9 (13.0)	60 (87.0)		8 (11.6)	61 (88.4)	
Others	49 (10.1)	6 (12.2)	43 (87.8)		3 (6.1)	46 (93.9)		3 (6.1)	46 (93.9)	

Note: NPLT was counted including patients.

Abbreviation: BMI=body mass index; SD=standard deviation; NPLT=the number of persons living together; SMD=serious mental disorders; BPRS=brief psychiatric rating scale.

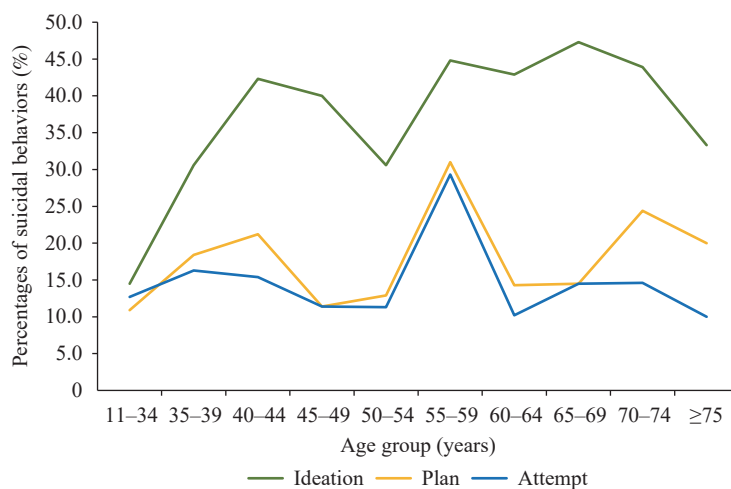


FIGURE 1. Percentages of suicidal ideation, suicide plan, and suicide attempts across various age groups.

religious belief ($OR=0.46$, 95% CI : 0.26–0.81) and more NPLT ($OR=0.80$, 95% CI : 0.66–0.98) demonstrated a lower likelihood of experiencing suicidal ideation. Additionally, NPLT was significantly linked to suicide plans, with patients living with more individuals being less likely to consider such plans ($OR=0.77$, 95% CI : 0.60–0.98).

Higher BPRS scores were associated with an increased likelihood of suicidal behaviors ($OR=1.02$, 95% CI : 1.01–1.03; $OR=1.03$, 95% CI : 1.01–1.04; $OR=1.03$, 95% CI : 1.01–1.04). Compared to patients with other SMD, those diagnosed with schizophrenia ($OR=3.33$, 95% CI : 1.19–9.31) and bipolar disorder ($OR=6.83$, 95% CI : 2.08–22.44) exhibited a higher propensity for suicidal ideation. Furthermore, bipolar disorder patients were more likely to have a suicide plan ($OR=7.70$, 95% CI : 1.80–32.91).

DISCUSSION

The findings of this study revealed a higher prevalence of suicidal ideation and suicide attempts (36.8%, 15.0%) among community-based patients with SMD than previously reported in a study focusing on inpatients with schizophrenia spectrum disorders (17.9%, 7.6%) (6). Additionally, the results indicated that 18.1% of community-based patients experienced ideation without a plan or attempt, and 15.0% of patients were attempters. In contrast, a study conducted in Sichuan Province found that 11.0% of psychiatric inpatients only considered suicide, while 27.6% attempted suicide (7). This comparison suggests that community-based patients exhibit a higher prevalence of suicidal ideation, but a lower prevalence

of suicide attempts compared to psychiatric inpatients. The disparity might be attributed to the differing social and community environments experienced by community-based patients and inpatients. The presence of family attachment and support for community-based patients could potentially contribute to a reduced risk of suicide attempts.

When age was categorized into three groups, the prevalence of suicidal ideation and suicide plans increased with age. This finding aligns with a previous study indicating that older adults exhibited significantly higher suicide intent compared to younger and middle-aged adults (8). Moreover, the study also discovered that middle-aged patients demonstrated relatively high proportions of suicidal ideation, with the exception of those aged 50–54, while only patients aged 55–59 demonstrated relatively high percentages of suicide plans and attempts. This finding could suggest that community SMD patients contemplated suicide, but they did not act on these thoughts due to emotional stability, as well as a lack of motivation or courage to develop a plan or attempt suicide. Younger patients likely received family care and supervision, while older patients may have come to accept the reality of their long-term illness. However, community patients aged 55–59 might have experienced dual pressure from both their offspring and their patients, possibly leading to feelings of hopelessness regarding their recovery.

Community SMD patients with more severe depressive symptoms demonstrated a higher likelihood of engaging in suicidal behaviors, a finding consistent with previous research. Individuals without religious beliefs were found to be less susceptible to suicidal

TABLE 2. Logistic regression analysis for suicidal behaviors among community SMD patients.

Variable	Suicidal ideation		Suicidal ideation		Suicide plan		Suicide attempt		Suicide attempt	
	Crude OR (95% CI)	Adjusted OR (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)
Age (reference=younger patients)										
45–64 years	1.59 (1.02, 2.49)*	0.81 (0.44, 1.51)	1.10 (0.64, 1.92)	0.54 (0.26, 1.14)	1.12 (0.63, 1.99)	0.73 (0.33, 1.59)				
≥65 years	1.85 (1.13, 3.03)*	0.89 (0.42, 1.91)	1.18 (0.64, 2.17)	0.54 (0.22, 1.35)	0.90 (0.46, 1.77)	0.62 (0.23, 1.66)				
Male	0.66 (0.45, 0.96)*	0.85 (0.48, 1.49)	0.64 (0.40, 1.04)	0.80 (0.34, 1.24)	0.74 (0.44, 1.23)	0.75 (0.36, 1.56)				
BMI	1.05 (1.00, 1.09)*	1.02 (0.97, 1.08)	1.04 (0.99, 1.10)	1.01 (0.95, 1.08)	1.06 (1.00, 1.13)*	1.04 (0.98, 1.11)				
Han ethnicity	0.58 (0.81, 4.16)	0.51 (0.06, 4.22)	0.65 (0.07, 6.34)	0.31 (0.25, 3.72)	0.53 (0.05, 5.14)	0.26 (0.19, 3.56)				
No religious belief	0.43 (0.26, 0.73)**	0.42 (0.23, 0.77)**	0.70 (0.38, 1.32)	0.72 (0.35, 1.45)	0.61 (0.32, 1.16)	0.61 (0.30, 1.26)				
Marital status (reference=unmarried)										
Married	2.97 (1.74, 5.07)**	2.97 (0.75, 11.76)	2.74 (1.31, 5.71)**	3.15 (0.64, 15.49)	1.87 (0.92, 3.82)	1.43 (0.27, 7.48)				
Others	3.52 (1.70, 7.28)**	2.87 (0.72, 11.46)	2.79 (1.08, 7.24)*	2.76 (0.55, 13.79)	1.94 (0.74, 5.12)	1.19 (0.22, 6.35)				
Education (reference=junior high school or above)										
Illiterate	0.65 (0.42, 1.00)	0.75 (0.41, 1.38)	0.87 (0.50, 1.54)	1.24 (0.59, 2.61)	0.74 (0.40, 1.34)	1.02 (0.47, 2.22)				
Primary school	0.69 (0.44, 1.09)	0.66 (0.38, 1.16)	1.17 (0.67, 2.05)	1.42 (0.73, 2.75)	0.89 (0.49, 1.63)	0.93 (0.46, 1.88)				
Rural	1.04 (0.57, 1.91)	1.02 (0.49, 2.14)	0.99 (0.46, 2.13)	0.90 (0.38, 2.14)	1.66 (0.64, 4.34)	1.52 (0.53, 4.38)				
Employed	1.37 (0.94, 1.98)	1.52 (0.96, 2.40)	1.28 (0.81, 2.04)	1.53 (0.88, 2.66)	1.17 (0.71, 1.94)	1.40 (0.78, 2.52)				
Offspring	2.56 (1.57, 4.17)**	0.70 (0.18, 2.69)	2.18 (1.14, 4.16)*	0.66 (0.15, 2.99)	1.69 (0.88, 3.26)	1.04 (0.21, 5.15)				
Only child	0.56 (0.22, 1.43)	0.70 (0.20, 2.40)	0.64 (0.19, 2.21)	0.66 (0.15, 2.84)	1.14 (0.38, 3.43)	1.23 (0.31, 4.92)				
NPLT	0.82 (0.70, 0.96)*	0.75 (0.61, 0.93)*	0.88 (0.73, 1.08)	0.74 (0.57, 0.96)*	0.93 (0.75, 1.15)	0.84 (0.64, 1.10)				
Years of SMD	1.00 (0.98, 1.01)	1.00 (0.98, 1.02)	0.99 (0.97, 1.01)	0.99 (0.97, 1.02)	0.99 (0.97, 1.01)	0.99 (0.97, 1.02)				
Alcohol use	0.88 (0.45, 1.73)	0.92 (0.40, 2.13)	0.77 (0.31, 1.89)	0.78 (0.27, 2.26)	1.18 (0.50, 2.78)	1.22 (0.43, 3.46)				
Cigarette smoking	1.20 (0.72, 2.02)	1.57 (0.77, 3.21)	1.20 (0.63, 2.27)	1.46 (0.62, 3.43)	1.55 (0.81, 2.95)	1.87 (0.79, 4.41)				
Poor family	0.82 (0.56, 1.20)	0.91 (0.57, 1.46)	0.99 (0.61, 1.60)	1.13 (0.64, 1.99)	1.14 (0.69, 1.90)	1.24 (0.68, 2.25)				
In debt	1.31 (0.88, 1.97)	0.95 (0.57, 1.59)	1.67 (1.02, 2.73)*	1.47 (0.81, 2.65)	1.66 (0.98, 2.80)	1.35 (0.72, 2.54)				
Chronic disease	1.98 (1.36, 2.88)**	1.23 (0.77, 1.97)	1.41 (0.89, 2.25)	0.79 (0.44, 1.41)	1.33 (0.81, 2.19)	0.80 (0.43, 1.49)				
BPRS	1.02 (1.01, 1.03)**	1.01 (1.00, 1.02)*	1.02 (1.01, 1.03)**	1.02 (1.00, 1.03)*	1.03 (1.01, 1.04)**	1.02 (1.00, 1.03)*				
Depressive symptoms	1.13 (1.10, 1.17)**	1.13 (1.09, 1.18)**	1.12 (1.07, 1.16)**	1.10 (1.05, 1.15)**	1.11 (1.07, 1.16)**	1.10 (1.05, 1.15)**				
Types of SMD (reference=others)										
Schizophrenia	4.31 (1.78, 10.43)**	3.33 (1.19, 9.31)*	3.17 (0.95, 10.59)	2.63 (0.70, 9.88)	2.68 (0.80, 8.99)	1.89 (0.51, 7.09)				
Bipolar disorder	11.22 (4.12, 30.54)**	6.83 (2.08, 22.44)**	9.12 (2.53, 32.84)**	7.70 (1.80, 32.91)**	5.71 (1.55, 20.96)**	4.05 (0.94, 17.55)				
Epileptic mental disorder	3.14 (1.16, 8.49)*	1.99 (0.63, 6.31)	2.30 (0.59, 8.98)	1.73 (0.40, 7.55)	2.01 (0.51, 8.00)	1.30 (0.29, 5.81)				

Note: NPLT was counted including patients; younger patients denote patients younger than or equal to 44 years old.

Abbreviation: BMI=body mass index; NPLT=the number of persons living together; SMD=serious mental disorders; BPRS=Brief Psychiatric Rating Scale; OR=odds ratio; CI=confidence interval.

* $P < 0.05$.

** $P < 0.01$.

*** $P < 0.001$.

ideation. This aligns with prior studies, which reported a positive association between religious beliefs and suicide risk for non-political believers (9). Additionally, community patients living with more people exhibited a lower probability of considering and planning suicide. For these patients, cohabiting with family members provided opportunities to share their feelings, potentially reducing negative emotions and suicidal ideation. Furthermore, patients diagnosed with bipolar disorder were found to have an increased risk of suicidal ideation and planning.

The severity of psychiatric symptoms was found to be significantly associated with suicidal behaviors; however, the *ORs* were close to 1. One possible explanation for this finding is that the BPRS was primarily designed for assessing schizophrenia. In this study, however, patients with SMD included other diagnostic categories. Furthermore, other studies have also reported that the BPRS scores were not significantly associated with suicidal behaviors (10). Most notably, only a few correlated factors were identified. This suggests that the underlying nature of their illness may have influenced the likelihood of suicidal behaviors.

This study was subject to several limitations. First, the study employed a retrospective and cross-sectional design, which raised uncertainty regarding the causal relationships among socio-demographic factors, psychiatric symptom severity, and suicidal behaviors. Additionally, recall bias may have influenced the documented outcomes. Second, interviews with caregivers of patients who lacked communication abilities may have led to an underestimation of the results. Third, although the BPRS can assess psychotic symptoms, potential differences in symptoms among SMDs may have introduced bias to the findings. Finally, the results may not be generalizable, as a broader range of participants would be necessary to ensure the applicability of the outcomes to a wider population.

In summary, early identification and management of associated factors can effectively prevent the development of suicidal ideation and the progression to suicidal actions, ultimately reducing the overall suicide rate. Special attention should be given to the risk of suicide among community-based patients with SMD, particularly those who have religious beliefs, live alone, exhibit severe depressive symptoms, or experience pronounced psychiatric symptoms. It is crucial for governmental agencies and healthcare administrators to provide additional support and

welfare programs for middle-aged community patients to alleviate their stress and mitigate their potential for suicide.

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SUPPLEMENTARY MATERIAL

SUPPLEMENTARY TABLE S1. Descriptions and differences in demographic variables, illness information, and suicidal behaviors between patients and caregivers.

Variable	Patients (n=37)	Caregivers (n=449)	F/ χ^2	P-value
Age			13.167	0.001
≤44 years	2 (5.4)	154 (34.3)		
45–64 years	21 (56.8)	183 (40.8)		
≥65 years	14 (37.8)	112 (24.9)		
Gender, <i>n</i> (%)			0.116	0.733
Male	15 (40.5)	195 (43.4)		
Female	22 (59.5)	254 (56.6)		
BMI, mean (SD)	25.60 (4.66)	24.60 (4.31)	1.807	0.180
Ethnicity, <i>n</i> (%)			–	1.000
Han	37 (100.0)	445 (99.1)		
Others	0 (0.0)	4 (0.9)		
Religious belief, <i>n</i> (%)			0.237	0.626
No	31 (83.8)	389 (86.6)		
Yes	6 (16.2)	60 (13.4)		
Marital status, <i>n</i> (%)			11.282	0.004
Unmarried	5 (13.5)	100 (22.3)		
Married	21 (56.8)	307 (68.4)		
Divorced/widowed	11 (29.7)	42 (9.4)		
Education, <i>n</i> (%)			2.272	0.321
Illiterate	9 (24.3)	154 (34.3)		
Primary school	14 (37.8)	124 (27.6)		
Junior high school or above	14 (37.8)	1,171 (38.1)		
Occupation, <i>n</i> (%)			1.919	0.166
Employed	20 (54.1)	190 (42.3)		
Unemployed	17 (45.9)	259 (57.7)		
Region, <i>n</i> (%)			0.220	0.639
Rural	34 (91.9)	402 (89.5)		
Urban	3 (8.1)	47 (10.5)		
Offspring, <i>n</i> (%)			0.500	0.479
Yes	1 (2.7)	23 (5.1)		
No	36 (97.3)	426 (94.9)		
Only child, <i>n</i> (%)			2.284	0.131
Yes	32 (86.5)	339 (75.5)		
No	5 (13.5)	110 (24.5)		
Ideation, <i>n</i> (%)			8.814	0.003
Yes	15 (40.5)	292 (65.0)		
No	22 (59.5)	157 (35.0)		
Plan, <i>n</i> (%)			2.269	0.132
Yes	27 (73.0)	372 (82.9)		
No	10 (27.0)	77 (17.1)		

TABLE S1. (Continued)

Variable	Patients (n=37)	Caregivers (n=449)	F/ χ^2	P-value
Attempt			1.367	0.242
Yes	29 (78.4)	384 (85.5)		
No	8 (21.6)	65 (14.5)		
NPLT, mean (SD)	1.97 (1.12)	2.92 (1.18)	21.808	0.000
Years of SMD, mean (SD)	22.38 (11.29)	23.49 (13.58)	0.236	0.627
Alcohol use, n (%)			1.164	0.281
Yes	5 (13.5)	36 (8.0)		
No	32 (86.5)	413 (92.0)		
Cigarette smoking, n (%)			3.371	0.066
Yes	9 (24.3)	60 (13.4)		
No	28 (75.7)	389 (86.6)		
Poor family, n (%)			4.081	0.043
Yes	8 (21.6)	172 (38.3)		
No	29 (78.4)	277 (61.7)		
In debt, n (%)			0.011	0.916
Yes	10 (27.0)	125 (27.8)		
No	27 (73.0)	324 (72.2)		
Chronic disease, n (%)			2.375	0.123
Yes	21 (56.8)	196 (43.7)		
No	16 (43.2)	253 (56.3)		
BPRS, mean (SD)	50.89 (19.40)	55.84 (21.31)	1.870	0.172
Depressive symptoms, mean (SD)	10.05 (7.39)	9.68 (6.15)	0.120	0.729
Types of SMD, n (%)			4.750	0.191
Schizophrenia	25 (67.6)	284 (63.3)		
Bipolar disorder	7 (18.9)	52 (11.6)		
Epileptic mental disorder	4 (10.8)	65 (14.5)		
Others	1 (2.7)	48 (10.7)		

Note: NPLT was counted including patients.

Abbreviation: BMI=body mass index; SD=standard deviation; NPLT=the number of persons living together; SMD=serious mental disorders; BPRS=Brief Psychiatric Rating Scale.

Preplanned Studies

Associations among Distress Rumination, Somatic Anxiety, and Suicidal Ideation in Chinese College Students — Shandong Province, China, 2019–2020

Guoxiao Sun¹; Zhiyao Ma¹; Zongyu Liu¹; Jenny Huen²; Bob Lew³; Augustine Osman⁴; Cunxian Jia^{5,†}

Summary

What is already known about this topic?

The literature has consistently demonstrated that distress rumination following a traumatic event has significant implications for mental health. However, the potential association between distress rumination and suicidality, as well as the underlying mechanisms driving this relationship, remains to be elucidated.

What is added by this report?

The current study demonstrated a significant, positive correlation between distress rumination and suicidal ideation in college students who have encountered traumatic events. The findings indicate that somatic anxiety serves as a mediator between distress rumination and suicidal ideation.

What are the implications for public health practice?

Interventions aimed at reducing somatic anxiety may contribute to a decrease in suicidal ideation. Assessing and addressing somatic anxiety symptoms in college students experiencing distressful rumination following traumatic events could potentially lower the risk of suicide.

Traumatic events have been linked to negative psychological outcomes, such as experiencing psychological distress and engaging in distress rumination. This study aimed to examine the association between distress rumination following a traumatic event and suicidal ideation, while also assessing the mediating role of somatic anxiety in this relationship. A cross-sectional survey was conducted with 1,798 Chinese college students, and data from 379 (21.08%) participants who reported at least one traumatic event were analyzed. Participants completed self-report measures assessing distress rumination after traumatic events, suicidal ideation, and somatic anxiety.

Results indicated that distress rumination following

a traumatic event was significantly and positively associated with both somatic anxiety ($r_s=0.340$, $P<0.001$) and suicidal ideation ($r_s=0.243$, $P<0.001$). Specifically, somatic anxiety fully mediated the relationship between distress rumination and suicidal ideation [indirect effect=0.267, 95% confidence interval (CI): 0.182–0.351]. These findings suggest that evaluating and addressing somatic anxiety symptoms among Chinese college students who exhibit distress rumination after traumatic events may help reduce the risk of suicidal ideation.

This study was conducted between September 2019 and January 2020. The participants included 1,854 college students from five campuses of Shandong University, which is a comprehensive institution that encompasses a variety of disciplines such as Arts, Science, Engineering, and Medicine. This diverse student body was given access to an electronic questionnaire via a link printed on paper and distributed across the campuses. Students could scan the link and access the questionnaire using their smartphones.

A total of 56 participants were excluded from the analysis due to insufficient data, such as not being college students or not answering the questions as required. Additionally, 1,419 students who had not experienced a traumatic event were excluded from the study. The final sample size for analysis consisted of 379 students.

This research was approved by the Ethics Committee of the School of Public Health at Shandong University (approval No. 20190912), and all participants voluntarily agreed to take part.

The demographic data collected in this study consisted of individual-level information including age, gender, educational level, marital status, ethnicity, and economic status, and household-level variables encompassing factors such as the participant's status as an only child, rural or urban residence, marital condition, and parents' educational attainment.

Distress rumination was evaluated using the Life After Trauma Event Inventory-24 (LATI-24; unpublished manual by Osman), a measure developed to assess individuals' responses to traumatic events. Participants were asked to describe their thoughts, feelings, and behaviors in the past month (e.g., I have found it hard to take my mind off what happened), following a stressful, frightening, or distressing event, such as a natural disaster, sexual/physical assault, terrorist incident, serious accident, life-threatening illness, or combat exposure. The distress rumination dimension of the LATI-24 was employed. It consists of eight items rated on a six-point Likert scale, with higher scores indicating greater distress rumination. In this study, the Cronbach's α coefficient and McDonald's ω coefficient for the scale scores were 0.862 (95% *CI*: 0.840–0.882) and 0.866 (95% *CI*: 0.845–0.886), respectively.

Somatic anxiety was measured using the somatic anxiety dimension of the Anxiety Depression Distress Inventory-27 (ADDI-27), a condensed version of the Mood and Anxiety Symptom Questionnaire-90 (MASQ-90). The ADDI-27 is a self-report instrument consisting of 9 items rated on a 5-point Likert scale, which assesses the intensity of feelings, sensations, problems, and experiences (e.g., "Heart was racing or pounding") within the past 2 weeks. Previous researches have demonstrated the reliability and validity of these instruments (1–2). In the present study, the Cronbach's α coefficient and McDonald's ω coefficient for the somatic anxiety score were 0.912 (95% *CI*: 0.894–0.921) and 0.909 (95% *CI*: 0.896–0.923), respectively.

Suicidal ideation was assessed using the suicidal ideation dimension of the Multidimensional Suicide Inventory-28 (MSI-28; 3), which was developed as a multidimensional self-report measure to assess suicidal ideation. This dimension comprises 7 items rated on a 5-point Likert scale, representing a collection of common thoughts, feelings, and beliefs about suicide. Previous research has demonstrated the instrument's reliability and validity (3). In the current study, the Cronbach's α coefficient and McDonald's ω coefficient for the suicidal ideation score were 0.913 (95% *CI*: 0.906–0.931) and 0.920 (95% *CI*: 0.908–0.932), respectively.

We utilized the Trauma-related Suicide Potential Index-5 [TSPI-5, unpublished manual (1)] to screen college students who had experienced traumatic events. Within this scale, a traumatic event is defined as an occurrence in which 1) the participant believed that

someone might be killed, seriously injured, or have their physical integrity threatened during the event, 2) the participant experienced intense fear, helplessness, or other strong negative emotions during or shortly after the event. The scale, a brief self-report instrument developed by Osman and colleagues, assesses individuals' trauma and suicide-related responses (4). For our study, we utilized the first response of the five scale items (never experienced a traumatic event) to exclude college students who had not encountered a traumatic event. In the present study, the Cronbach's α and McDonald's ω coefficients of the scale scores were 0.860 (95% *CI*: 0.836–0.881) and 0.860 (95% *CI*: 0.838–0.882), respectively.

SPSS for Windows (version 22.0; IBM Corporation, Armonk, New York, USA) was employed for data analysis. All tests conducted were two-sided, adopting a significance level of 0.05. This study implemented the Hayes' PROCESS macro (5) for mediation analysis. PROCESS V3.3 was applied to verify the indirect and direct effects and to estimate bias-corrected *CI*s based on 5,000 bootstrap samples.

Table 1 presents the demographic data of the participants. The sample consists of 379 college students with a mean age of 20.19 years (*SD*=1.87). Among these participants, 214 (56.5%) were male, 53.0% were from urban areas, and 214 (56.5%) came from one-child families.

The results of Spearman's correlation analysis showed that distress rumination [Median=3.375, interquartile range (*IQR*)=2.750] was positively correlated with somatic anxiety (Median=2.667, *IQR*=1.667, $r_s=0.340$, $P<0.001$) and suicidal ideation (Median=2.429, *IQR*=1.143, $r_s=0.243$, $P<0.001$), significantly. Somatic anxiety was positively correlated with suicidal ideation ($r_s=0.710$, $P<0.001$).

A mediation analysis, based on 5,000 bootstrapping samples, was conducted to estimate the indirect effect of distress rumination on suicidal ideation through somatic anxiety. The results of the mediation analysis are presented in Table 2, while the mediation pathway is illustrated in Figure 1. Findings indicated that the total effect of distress rumination on suicidal ideation was 0.300 (95% *CI*: 0.204–0.395), with indirect effects of somatic anxiety being approximately 0.267 (95% *CI*: 0.182–0.351). However, the direct effect of distress rumination on suicidal ideation was found to be non-significant (95% *CI*: -0.044–0.110). These results demonstrated that somatic anxiety acts as a complete mediator between distress rumination and suicidal ideation.

TABLE 1. Description of demographic characteristics.

Demographic variables	Categories	Total, n (%)
Gender	Male	214 (56.5)
	Female	165 (43.5)
Grade	Freshmen	104 (27.4)
	Sophomores	119 (31.4)
	Juniors	105 (27.7)
	Seniors	51 (13.5)
Ethnicity	Han	377 (99.5)
	Minorities	2 (0.5)
Marital status	Unmarried	374 (98.7)
	Married	5 (1.3)
Residence	Urban	201 (53.0)
	Rural	178 (47.0)
Only child or not	Yes	214 (56.5)
	No	165 (43.5)
Economic conditions	Very bad	15 (4.0)
	Bad	80 (21.1)
	General	198 (52.2)
	Good	65 (17.2)
	Very good	21 (5.5)
Education level of father	Primary school and lower	47 (12.4)
	Junior high school	113 (29.8)
	High school	90 (23.7)
	Junior college	65 (17.2)
	University	53 (14.0)
	Master's degree	11 (2.9)
Education level of mother	Primary school and lower	70 (18.5)
	Junior high school	99 (26.1)
	High school	75 (19.8)
	Junior college	67 (17.7)
	University	57 (15.0)
	Master's degree	11 (2.9)
Marital status of parents	Very harmonious	101 (26.6)
	Harmonious	93 (24.5)
	Sometimes have conflicts	121 (31.9)
	Often have conflicts	31 (8.2)
	Separated	7 (1.8)
	Divorced	15 (4.0)
	One has passed away	11 (2.9)

DISCUSSION

In the present study, the researchers investigated the cross-sectional associations among distress rumination

following traumatic events, somatic anxiety, and suicidal ideation in college students. The findings revealed that: 1) there was a significant relationship between distress rumination after traumatic events and

TABLE 2. Outcomes of the multiple regression analysis.

Regression models		Goodness-of-fit indices			Regression coefficients and significance	
Outcome variables	Predictor variables	R	R ²	F	β	P
Suicidal ideation	Rumination distress	0.398	0.158	5.701	0.300	<0.001
Somatic anxiety	Rumination distress	0.452	0.204	7.787	0.386	<0.001
Suicidal ideation	Rumination distress	0.734	0.539	32.635	0.033	0.401
	Somatic anxiety				0.692	<0.001

Note: Demographic variables were controlled to ensure accuracy in the results. These variables include age, gender, grade, marital status, ethnicity, economic status, presence of siblings (i.e., whether the participant was the only child), residence location (rural vs. urban areas), marriage status of participants, and the educational level of parents.

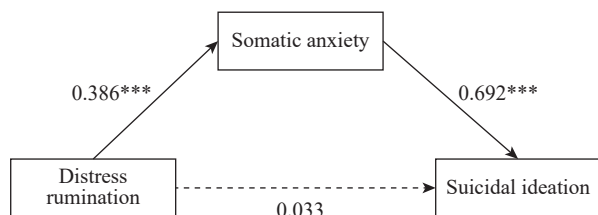


FIGURE 1. Analysis of the mediating effect of somatic anxiety on the relationship between distress rumination and suicidal ideation.

*** $P < 0.001$.

the presence of suicidal ideation; and 2) distress rumination following traumatic events appeared to influence the severity of suicidal ideation through the mediating role of somatic anxiety.

In this study, it was found that 21.08% of college students had experienced at least one major traumatic event, aligning with the findings of Freedy et al. which reported that 19.2% of college students had undergone a similar experience (6). The results of our study demonstrated that distress rumination following traumatic events was significantly associated with suicidal ideation among college students, thus supporting Hypothesis 1. This finding is in line with the stress-sensitization model, which posits that the interaction between stress (e.g., traumatic events) and individual susceptibility factors (e.g., distress rumination) can lead to suicidal ideation (7). It is postulated that distress rumination may amplify negative emotions and entrap individuals in a mindset of hopelessness, potentially causing them to view suicide as an attractive escape.

Our findings demonstrated that somatic anxiety had a significant mediating effect on the relationship between distress rumination after traumatic events and suicidal ideation, supporting Hypothesis 2. Distress rumination, characterized as a maladaptive coping style, may exacerbate anxiety. This finding aligns with the response style theory, which posits that college students with elevated levels of distress rumination

after traumatic events tend to adopt a ruminative response style (8). As a result, these students may involuntarily focus on their negative emotions instead of actively seeking solutions, leading to heightened anxiety levels. Anxiety is a prominent negative emotion that can adversely impact college students' mental and physical health (9). If students are unable to effectively manage their anxiety, they may be at risk for suicidal behavior (10).

This study is the first to uncover the mediating role of somatic anxiety in the relationship between rumination and suicidal ideation. Somatic anxiety emerges as a crucial factor contributing to suicidal ideation in the context of distress rumination following traumatic events. This finding not only elucidates the underlying mechanism of somatic anxiety's influence but also corroborates previous research on the impact of post-traumatic distress rumination on suicidal ideation. Consequently, interventions aimed at reducing somatic anxiety may aid in decreasing suicidal ideation among college students.

One of the limitations of the present study is its cross-sectional design, which precludes causal inferences. Future researches may benefit from employing a longitudinal approach. Moreover, this study exclusively relies on self-reported data; future investigations might consider incorporating multiple sources of information, such as interviews. Finally, it is recommended that future work also explore the potential mediating effects of other emotions.

In conclusion, a statistically significant association has been found between rumination following distressing events and the presence of suicidal thoughts. Furthermore, somatic anxiety appears to serve as a mediating factor in this relationship.

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Vital Surveillances

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

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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

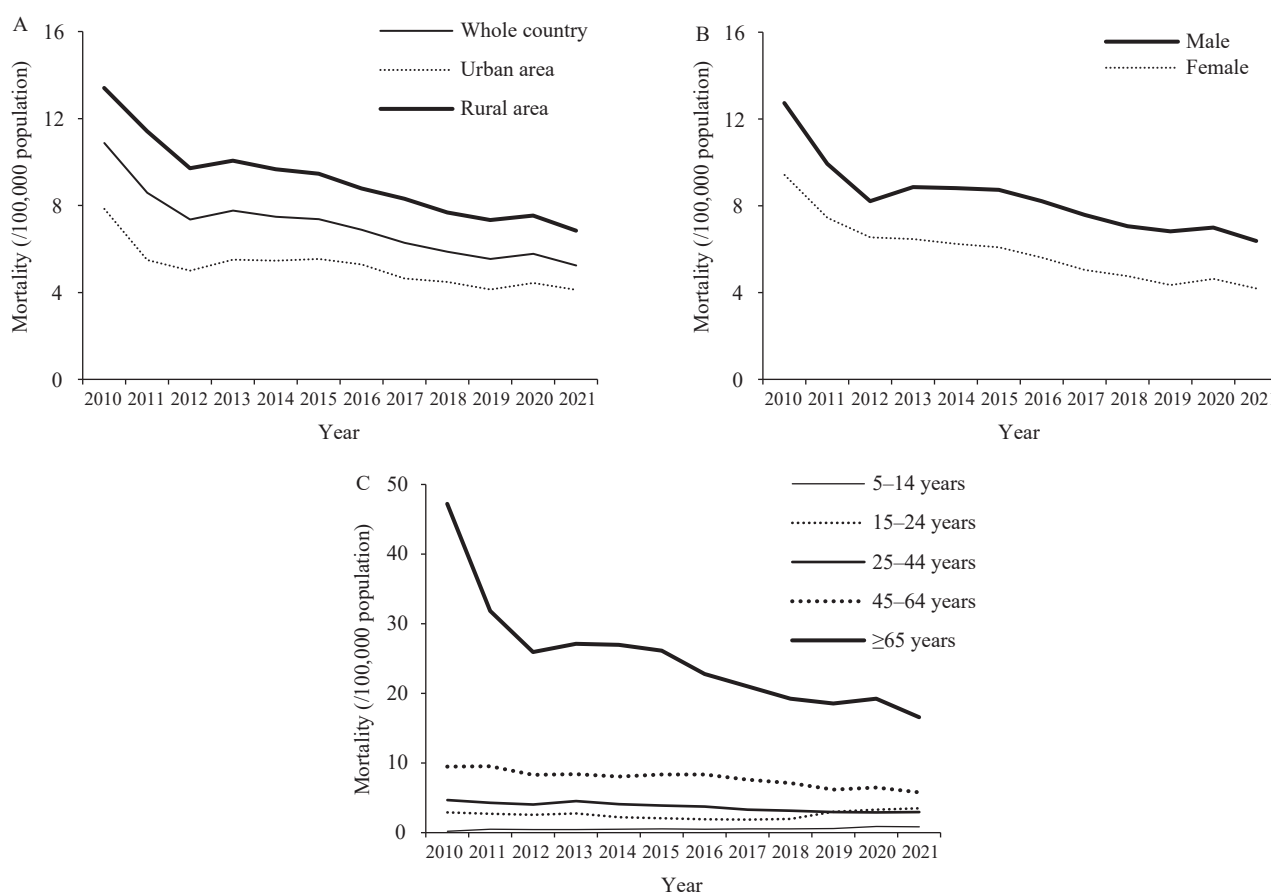


FIGURE 1. Suicide mortality rates in China by location, gender, and age group from 2010 to 2021. (A) Age-standardized suicide mortality by location. (B) Age-standardized suicide mortality by gender. (C) Age-specific suicide mortality by age group.

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

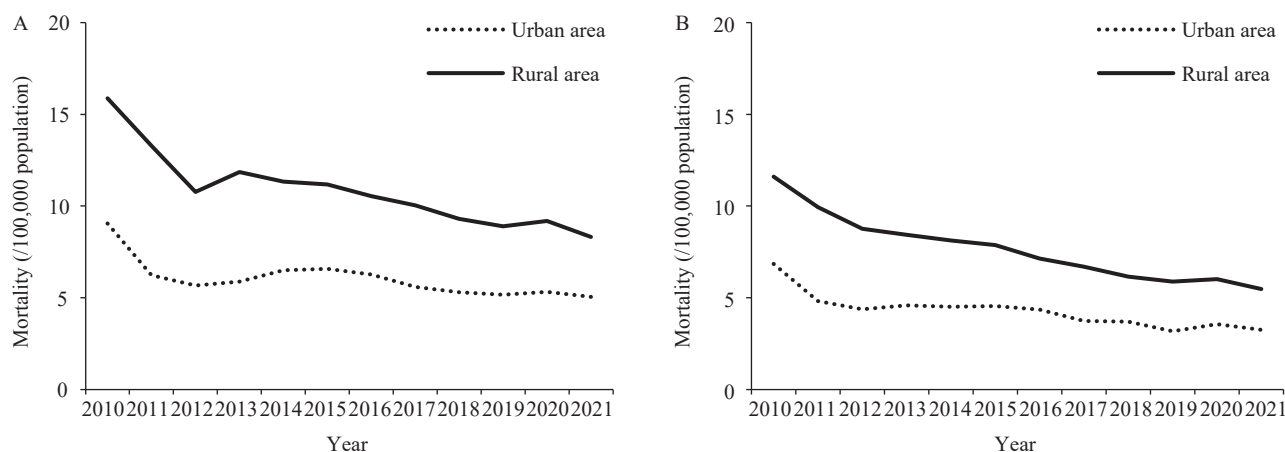


FIGURE 2. Age-standardized suicide mortality rates by sex and location in China, 2010–2021. (A) Male age-standardized suicide mortality in China by location. (B) Female age-standardized suicide mortality in China by location.

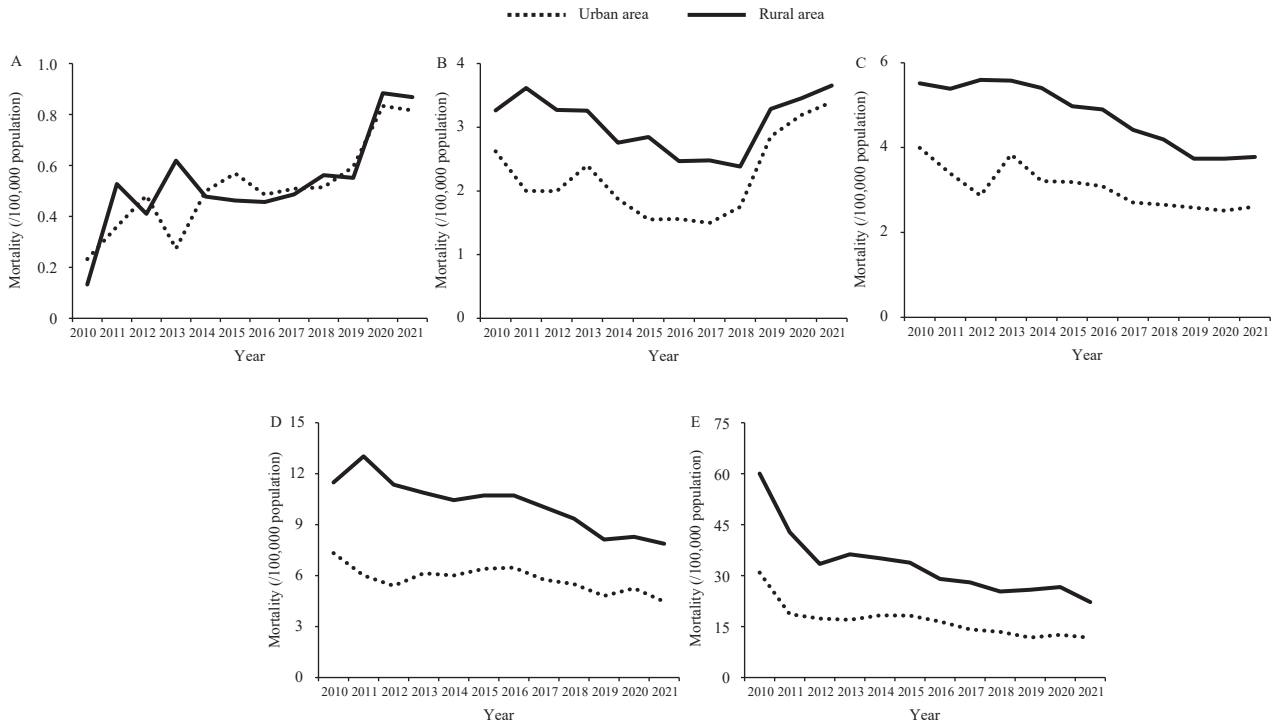


FIGURE 3. Age-specific suicide mortality by geographic location in China, 2010–2021. (A) Suicide mortality in children aged 5–14 years old by location. (B) Suicide mortality in adults aged 15–24 years old by location. (C) Suicide mortality in adults aged 25–44 years old by location. (D) Suicide mortality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

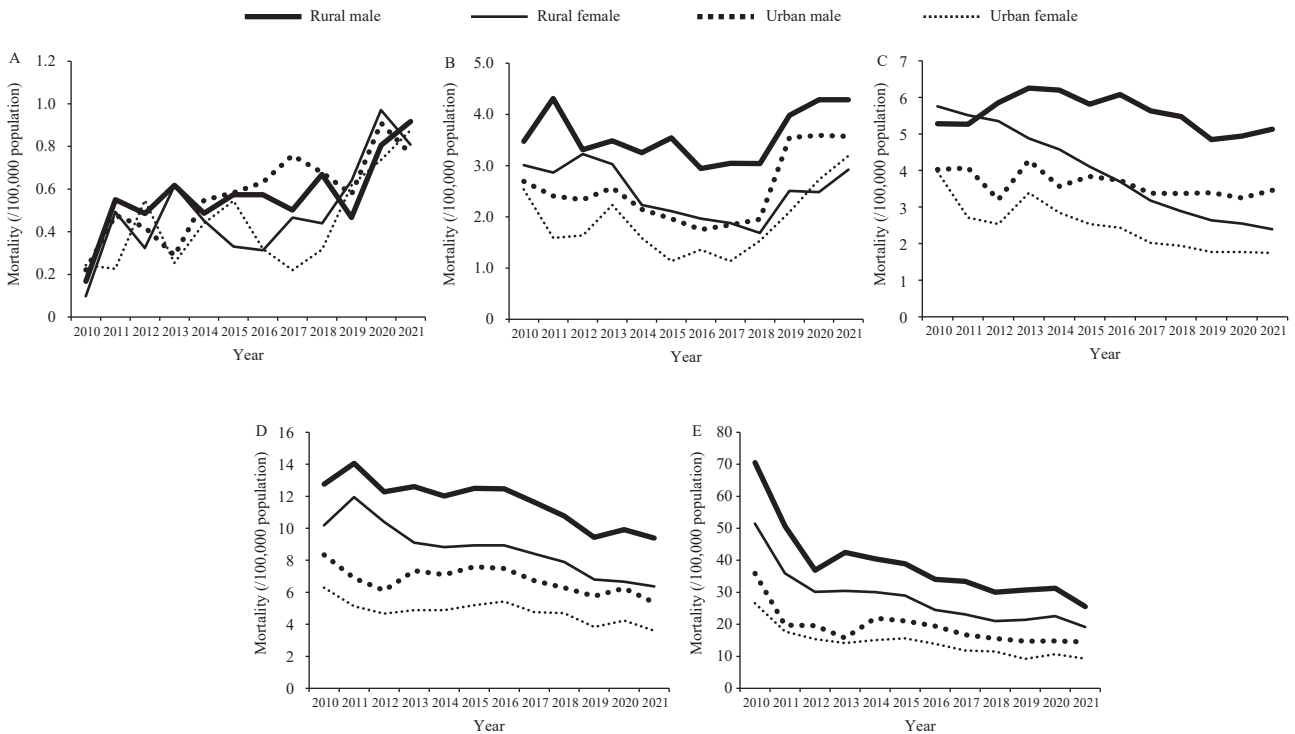


FIGURE 4. Age-specific suicide mortality rates for males and females in urban and rural areas of China, 2010–2021. (A) Suicide mortality rates in children aged 5–14 by gender and location. (B) Suicide mortality rates in adults aged 15–24 by gender and location. (C) Suicide mortality rates in adults aged 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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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	2010–2021	-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)*
15–24 years	Rural area	2010–2021	12.0 (3.1, 21.7)*								12.0 (3.1, 21.7)*
	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)
25–44 years	Rural area	2010–2018	-7.3 (-10.6, -3.9)*	2018–2021	19.5 (1.3, 40.9)*						-0.6 (-4.8, 3.8)
	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)*
45–64 years	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)*
	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)
≥65 years	Rural area	2010–2021	-4.9 (-6.0, -3.7)*								-4.9 (-6.0, -3.7)*
	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.

* $P < 0.05$.

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