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Suicide and Life-Threatening BEHAVIOR

ORIGINAL ARTICLE

Exploring the link between the increase in high-rise buildings and youth jumping suicide in Taiwan: A longitudinal study

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Abstract

Introduction: From 2010 to 2021, suicide rates in 15–24 age group in Taiwan increased by 70%, with jumping being the most common method in 2021. We examined the link between the rise in youth suicides and the increase in high-rise buildings during this period.

Methods: Spearman's correlation coefficients and negative binomial mixed-effects models were employed to assess the association between the increase in high-rise buildings and jumping suicides over time.

Results: Spearman's correlation coefficients of high-rise buildings and jumping suicide rates in youth decreased from 0.692 ($p < 0.001$) in 2010 to 0.354 ($p = 0.11$) in 2021. Negative binomial mixed-effects models showed that although jumping suicide rates in youths increased over time, the increase in numbers of high-rise buildings was not related to rates of youth suicide by jumping. Conversely, in older age groups, the correlations were still prominent.

Conclusion: Despite the rising trend in youth suicides by jumping over the past 11 years, our study refutes the intuitive notion that the increase in high-rise buildings contributes to this trend. It is imperative to identify and address other potential factors, such as academic stress and/or family disruptions, for effective prevention of youth suicide.

KEYWORDS

high-rise buildings, jumping suicide, Taiwan, youth

INTRODUCTION

Studies have consistently indicated a rise in youth (15–24 years) suicides in Taiwan since the early 2010s, despite a decrease in general population suicide rates (Chang et al., 2020; Chen et al., 2021). Youth suicides increased from 5.5 per 100,000 population in 2010 to 9.6 per 100,000 population in 2021, a 74% increase (Ministry of Health and Welfare, 2022). Approximately 60% of the increase was due to the rise in suicides by jumping (Ministry of Health and Welfare, 2022). This method was the most common method of suicide in 15–24 age group in 2021 (accounting for 35.6% of suicides); whilst it was the 3rd most common method in 2010 (accounting for 18.8% of suicides).

The increase in youth suicides by jumping has also been reported in other densely-populated East Asian

regions, such as Hong Kong (Yang & Yip, 2021) and South Korea (Park et al., 2014), where high-rise buildings are common. The majority of suicide jumps were from high-rise buildings in East Asia, in contrast to jumping from iconic bridges in the West (Chen et al., 2009; Yip et al., 2021).

It is widely recognized that the availability of lethal suicide methods is a crucial determinant of suicide rates (Yip et al., 2012). Previous studies on suicide by jumping from buildings have utilized cross-sectional ecological designs and identified a positive association between the density of high-rise buildings and jumping suicide rates (Lin & Lu, 2006; Marzuk et al., 1992). However, to the best of our knowledge, no longitudinal studies have yet examined the relationship between the changing density of high-rise buildings and corresponding changes in jumping suicide rates over time. Given concerns over the continuing rise in youth suicides, this paper reports on an examination of whether the increase in high-rise buildings in Taiwan between 2010 and 2021 was associated with the rise in jumping suicide rates in youths. In the past decade, we have witnessed changes in the lives of young individuals that might be related to their increased suicide rates. These social changes encompass increased income inequality, family disintegration, the pervasive influence of social media coupled with its cyberbullying ramifications, and a surge in economic unpredictability, limited life prospects, and escalating rates of youth unemployment (Chang et al., 2023; Chen et al., 2021; Craig et al., 2019; Fu & Chan, 2013). While the availability of suicide methods is recognized as a pivotal factor influencing method-specific suicide rates (Yip et al., 2012), the recent increase in youth jumping suicides might lead us to infer a correlation with the increase in high-rise buildings. Nevertheless, considering the profound sociocultural changes that are currently shaping the experiences of young individuals, we posit that the escalation in the number of suicides by jumping may not necessarily be associated with the increase in high-rise buildings in Taiwan over the past decade.

METHODS

Data

Total and age-stratified suicide mortality data was retrieved from Taiwan's national cause-of-death file for the years 2010–2021. The ICD-10 code used to identify deaths due to jumping suicide was X80 (intentional self-harm by jumping from a high place).

The Taiwanese 2010 Population and Housing Census published information on numbers and proportions of buildings higher than six floors for each city/county (Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C. (Taiwan), 2012). The Construction and Planning Agency, Ministry of Interior, publishes numbers and floor height of new buildings in each city/county each year (Construction and Planning Agency, Ministry of the Interior, R.O.C. (Taiwan), 2022). We used 2010 census data on numbers of buildings with six floors or higher as the baseline and added up the numbers of newly constructed buildings with six floors or higher in each city/county for each consecutive year.

We controlled for the past year jumping suicide rate in each city/county, calendar year, and level of urbanization (indicated as metropolitan cities, or not). Past year jumping suicide rate was adjusted to account for temporal autocorrelation. As the level of urbanization was associated with suicide rates (Casant & Helbich, 2022), and the level of urbanization was also associated with the number of high-rise buildings, we controlled for metropolitan status to serve as a proxy for the level of urbanization. In total, there are 22 cities/counties in Taiwan and among them, six are metropolitan cities (Office of the President Republic of China (Taiwan), 2022).

Analytic strategies

We first estimated the correlations between the number of high-rise buildings and age-stratified suicide rates using Spearman's correlation coefficients for the period spanning from 2010 to 2021. We further examined the association between the increase in the number of high-rise buildings, and suicides by jumping, in each city/county between 2011 and 2021, using mixed effects model with negative binomial link function. The dependent variable of the models was the number of suicides by jumping in each city/county of the overall and different age groups (15–24 years, 25–44 years, 45–64 years, and 65 years and above). The independent variable was the number of high-rise buildings (per 1000 buildings) in each city/county per year, during 2011 and 2021. Covariates were controlled in the models, including past year jumping suicide rates of the corresponding age group in each city/county (per 100,000 population), calendar year, and the level of urbanization. An offset of population size of the corresponding age groups, and a city/county-specific random effect, were also included.

Spearman's correlation coefficients and incidence rate ratios (IRRs) with 95% confidence intervals (95% CIs) were reported. The incidence rate ratios are the estimates generated by fitting the negative binomial regression model. If the incidence rate ratio is greater than one, it implies a positive association with the dependent variable (i.e., number of jumping suicide), whereas smaller than one

implies a negative relationship (Imai et al., 2006; Schober & Vetter, 2021). The significance level was set at $p < 0.05$. All the analyses were conducted with R, version 4.1.1 (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

The Spearman's correlations between the number of high-rise buildings and overall jumping suicide rate during 2010 and 2021 are shown in Table 1. The correlations between high-rise buildings and youth jumping suicide rates have generally become statistically insignificant after 2016 (except for the year 2020 which still showed significance). While for other older age groups, the correlations remained significant across the majority of the studied years.

Table 2 shows the results of the negative binomial regression analyses and IRRs are presented. After controlling for jumping suicide rate in the past year, calendar year and level of urbanization, the increase in the number of high-rise buildings was not associated with the overall suicide rate. Age-stratified analysis showed that for the youngest age group (15–24 years), the increase in high-rise buildings was not associated with the risk of jumping suicide; whereas for older age groups (25–44 years, 45–64 years and ≥65 years), the increase in tall buildings was positively associated with an increase in jumping suicides.

A statistically significant increase in jumping suicide risk over the study period was observed in the overall sample (all ages) (IRR = 1.026, 95% CI = 1.015–1.036) and for youths 15–24 years) (IRR = 1.070, 95% CI = 1.041–1.099), while the risk among people aged 25–44 years reduced over time (IRR = 0.986, 95% CI = 0.973–0.999). The risk of suicide by jumping did not change for the 45–64 year olds and those aged 65 years and older during the study period (Table 2). The past year jumping suicide rate, and level of urbanization, were not significantly associated with jumping suicides.

DISCUSSION

This is the first study we know of, that examined the longitudinal relationship between the increase in the availability of high-rise buildings and the rise in jumping suicide rate. It is a particularly important paper from an Asia country perspective, where suicide by jumping from high-rise buildings has been a common suicide method for several decades. We found that although jumping suicide rates in youths continued to rise during the study period, the increase in accessibility to high-rise buildings did not seem to contribute to the rise in youth jumping suicides. Thus, it seemed that other factors, rather than the increased availability to jumping sites, had exacerbated the rise in youth suicide in the past decade in Taiwan.

Jumping from high-rise buildings is a lethal and readily available method of suicide for people dwelling in densely populated Asian cities (Cai et al., 2022; Yip et al., 2021). A previous cross-sectional ecological study in the early 2000s in Taiwan indicated that the density of high-rise buildings at the city/county level was associated with jumping suicide rates (Lin & Lu, 2006). Our current analysis using updated data shows that this correlation had disappeared by 2021 when jumping suicide rate in the past year, calendar year and level of urbanization were controlled for. In addition, although jumping suicides in young people increased during the study period, our longitudinal analysis indicates that this increase was not associated with the

TABLE 1 Correlations between number of high-rise buildings and jumping suicide rates among different age groups, 2010–2021.

Number of high-rise buildings Spearman (ρ)	All age	Age 15–24	Age 25–44	Age 45–64	Age 65+
2010	0.601**	0.692**	0.396	0.695**	0.526*
2011	0.729**	0.690**	0.700**	0.750**	0.701**
2012	0.565**	0.594**	0.695**	0.461*	0.664**
2013	0.434*	0.365	0.055	0.643**	0.782**
2014	0.730**	0.451*	0.643**	0.603**	0.698**
2015	0.515*	0.447*	0.701**	0.204	0.733**
2016	0.268	0.343	0.254	0.453*	0.372
2017	0.222	0.321	0.495*	0.638**	0.429*
2018	0.299	0.226	0.532*	0.118	0.564**
2019	0.602**	0.312	0.734**	0.451*	0.416
2020	0.670**	0.573**	0.465*	0.630**	0.548**
2021	0.468*	0.354	0.639**	0.436*	0.747**

*$p < 0.05$; **$p < 0.01$.

TABLE 2 Negative binomial regression on predictors of jumping suicides by age groups, 2011–2021.

	All age	Age 15–24	Age 25–44	Age 45–64	Age 65+
	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)	IRR (95% CI)
Number of high-rise buildings[a]	1.002 (1.000, 1.003)	1.000 (1.000, 1.001)	1.001* (1.000, 1.002)	1.003** (1.001, 1.004)	1.002* (1.000, 1.004)
Past year jumping suicide rate[b]	1.034 (0.943, 1.133)	1.020 (0.952, 1.093)	0.955 (0.902, 1.012)	1.005 (0.942, 1.072)	0.975 (0.942, 1.010)
Calendar year	1.026** (1.015, 1.036)	1.070** (1.041, 1.099)	0.986* (0.973, 0.999)	1.012 (0.998, 1.027)	0.983 (0.967, 1.000)
Metropolitan (ref: non-metro)	1.016 (0.626, 1.651)	1.252 (0.884, 1.774)	1.189 (0.832, 1.698)	0.680 (0.451, 1.025)	1.093 (0.627, 1.903)

Abbreviation: 95% CI, 95% Confidence interval; IRR, incidence rate ratio.

*$p < 0.05$; **$p < 0.01$.

[a]Per 1000 buildings.

[b]Per 100,000 population.

rise in the number of high-rise buildings. While restricting access to lethal means of suicide is a critical step in preventing suicide and prior studies have consistently emphasized the significance of accessibility to a specific method of suicide and its correlation with a rise in method-specific suicide rates (Yip et al., 2012). The increase in youth jumping suicide rates might lead us to assume that the availability of high-rise buildings is to blame. However, our paper illustrates that the increased availability of high-rise buildings did not contribute to the rise in youth jumping suicide rates; it seems that other factors are at play. Further investigations should be conducted to explore underlying factors that might affect youth mental health and suicide risk. These factors include academic stress, family disruptions, internet addictions, and access to mental health services (Chang et al., 2023), among others, that might influence the mental well-being of the young population. Additionally, suicide jumping sites might change over time. It is important to investigate whether there were other jumping sites apart from buildings exceeding six floors in height.

Although the increase in high-rise buildings was associated with the risk of jumping suicide in older people (25–44 year olds, 45–64 year olds and ≥65 year olds), jumping suicide rates did not significantly increase in these age groups during the study period. This finding supports the suicide prevention measures already in place, where fencing high-rise buildings has deterred impulsive suicidal jumps. However, it is important to explore the underlying reasons for the impact of the increase in high-rise buildings in the risk of suicidal jumps in older age groups. Factors such as cognitive availability, physical mobility and convenient access to high-rise buildings due to work or residential locations should be taken into consideration.

The findings in this study should be interpreted with caution, as there are limitations to the study. First, whilst we examined the longitudinal associations between the number of high-rise buildings and the incidence of jumping suicides, we could not know how the perceived availability to high-rise buildings affected suiciders' choice of method. Second, suicide by jumping (ICD-10 X80) also includes jumping from bridges or other high places, and we only considered buildings with six or more floors. Third, due to statistical power concerns and a limited number of data points, we did not include an exhaustive list of control covariates to the model.

In conclusion, over and above restricting access to lethal means of suicide, our current analysis highlights the need to address other underlying factors that may contribute to stress and mental health problems in young people, when considering suicide prevention initiatives.

FUNDING INFORMATION

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CONFLICT OF INTEREST STATEMENT

None declared.

DATA AVAILABILITY STATEMENT

Data underlying this article are available using the following link:

Taiwan's death records data:

1. Ministry of Health and Welfare. *Cause of Death Statistics*. https://dep.mohw.gov.tw/DOS/lp-5069-113.html

Information on proportions and numbers of high-rise buildings:

1. Directorate-General of Budget, Accounting and Statistics, Executive Yuan, R.O.C. (Taiwan). *2010 Population and Housing Census Report*. https://census.dgbas.gov.tw/PHC2010/chinese/rchome.htm
2. Construction and Planning Agency, Ministry of the Interior. *The statistical yearbook of construction and planning*. https://www.cpami.gov.tw/%E6%94%BF%E5%BA%9C%E8%B3%87%E8%A8%8A%E5%85%AC%E9%96%8B/%E4%B8%BB%E5%8B%95%E5%85%AC%E9%96%8B%E8%B3%87%E8%A8%8A/%E6%96%BD%E6%94%BF%E8%A8%88%E7%95%AB%E6%A5%AD%E5%8B%99%E7%B5%B1%E8%A8%88%E5%8F%8A%E7%A0%94%E7%A9%B6%E5%A0%B1%E5%91%8A/%E7%87%9F%E5%BB%BA%E7%B5%B1%E8%A8%88%E8%B3%87%E8%A8%8A/155-%E7%87%9F%E5%BB%BA%E7%B5%B1%E8%A8%88/7302-%E7%87%9F%E5%BB%BA%E7%B5%B1%E8%A8%88%E5%B9%B4%E5%A0%B1.html.

ETHICS STATEMENT

This study used public accessible datasets, ethical approval was not required.

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