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Suicide trends following the Taiwan earthquake of 1999: empirical evidence and policy implications

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Objective: Mental health impact of severe earthquakes on survivors has attracted considerable attention. Suicide represents a terminal outcome of the spectrum of potential major mental health issues spawned by severe earthquakes. This study used time-series analysis to examine the time trends of increased suicide rates after the Chi–Chi earthquake of 1999 in Taiwan in the affected counties.
Method: Adult cause of death data were used to study monthly suicide rates per 100,000 adult population in the study and control counties, during January 1995 to December 2001. Box and Tiao's event intervention analysis was used to examine changes in monthly suicide rates before and after the Chi–Chi earthquake.
Results: During the post-quake period, October 1999 to December 2001, the mean monthly suicide rate in the affected counties was 1.567 per 100,000, compared with the control counties' rate of 1.297 per 100,000. Mean monthly suicide rate among the high-exposure group was 42% higher during the 26 months following the earthquake than the average for the entire observation period. Examined by time trends, the increased suicide rate registered in the first month following the quake began a monthly gradual decline by 0.7/100,000 thereafter, accounting for a total reduction of 98% in quake-related suicides by the end of 10 months. Suicide rates fell to the baseline level after 10 months.
Conclusion: We found that the mean monthly suicide rate for earthquake victims was higher while the low-exposure group remained stable and consistent throughout the observation period, indicating that the impact on the high-exposure group was attributable to the earthquake. This indicates the need for providing strengthened psychiatric services during the first year following major disasters.

Key words: natural disasters; suicide; Taiwan

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Significant outcomes

- Significant increase in suicide rates among survivors of the Chi–Chi earthquake of Taiwan.
- Higher suicide rates were observed over a 10-month period following the disaster.
- Possibilities for mobilization of mental health professionals in disaster-affected areas are recommended for a significant time period following a disaster.

Limitations

- Due to sample size specific age groups or gender particularly vulnerable to suicide among the disaster survivors could not be identified.
- Inability to link death statistics data with national statistics for health care utilization and mental health care utilization data.
- Lack of data on the number of attempted but incomplete suicide.

Introduction

The mental health impact of severe earthquakes has attracted considerable attention, leading to several studies on the immediate and long-term psychological effects on earthquake survivors. These studies have consistently reported significant mental health problems, specifically major depression and post-traumatic stress disorder (PTSD) following high-intensity earthquakes (1–6). In addition, some studies have indicated that the 8–11% of earthquake victims have suicidal ideation in the aftermath of earthquakes (5, 7, 8) due to increase in physical or emotional stress, death of relatives, financial losses, destruction of property, exposure to threat of injury, or disruption of personal relationships or social network directly or indirectly from earthquake. Following the 1999 Taiwan earthquake, Chou et al. reported that earthquake victims, affected by loss of a close relative, major property loss, and/or disabling physical injury were 1.46 times more likely than non-victims to commit suicide (9).

However, the studies concerning the suicide rates following earthquakes yield inconsistent findings, Krug et al. reporting no significant change (10), and Shioiri et al. reporting significant reduction (11). In addition, there is no documentation of population-based longitudinal studies, systematically examining suicide rate trends among earthquake survivors.

Taiwan's earthquake of September 21, 1999 (also called the '921 earthquake') of magnitude 7.3 on the Richter scale, struck the central Chi–Chi region causing 2454 deaths, 11,305 injured, and 50 missing, with the complete destruction of 53,024 houses and buildings, and serious damage to over 100,000 houses and buildings, requiring the evacuation and resettlement of thousands. The estimated property loss exceeded US$36 billion. During the first month following the quake, over 10,000 aftershocks were recorded, that continued to cause fresh damage in many cities and villages. The major casualties occurred in four prefectures in central Taiwan (Nan-tou, Tai-chung, Chung-hua, and Yin-lin). Although minor quake damage and casualties were recorded in other cities and regions, the four central Taiwan prefectures were the most severely affected (12, 13) with severe casualty rates and heavy personal, financial, and interpersonal loss experienced by survivors.

Chou et al. summarized the factors mediating increased suicide risk in earthquake survivors. They reported increase in physical or emotional stress, loss of social networks, and loss of basic material comforts and conveniences as the factors contributing to suicidal ideation or completed suicides among PTSD patients (9). Kotler et al. showed that level of social support was negatively related to suicide risk among patients with PTSD (14). While the negative psychological and psychosocial impacts of earthquakes are well-documented, no documentation is available on time trends of suicide rates among survivors.

Aims of the study

We examine the hypothesis that suicide rate increases among survivors of severe earthquakes, and report the time trends of its magnitude and distribution, along with the policy implications.

Material and methods

High- and low-exposure groups

This study applied time-series analysis to a 72-month mortality database to examine time trends of suicide rates among survivors of the Chi–Chi earthquake that struck Taiwan in 1999. In the affected four central Taiwan prefectures, there are a total of 88 municipalities. Of these, 26 municipalities were severely affected by the earthquake and were declared quake-affected, eligible for reconstruction funds from the Chi–Chi Earthquake Post-Disaster Reconstruction Commission. Based on the criteria of loss of co-resident family members, sustaining severe injury and/or severe property damage, about 24% of residents of the quake-affected area were classified as victims, eligible for co-payments waiver by the National Health Insurance and other benefits (9). Areas that were not declared quake-affected had only 1% of residents classified as victims. The population of the quake-affected area, 26 municipalities forms the high-exposure group, and the population of the remaining 62 municipalities in the same four prefectures formed the low-exposure group. Demographic characteristics of the study group and low-exposure group were comparable, the only differentiating factor being the intensity of earthquake damage (Table 1).

Data sources and description

We used adult Cause of Death data (aged over 20 years) to study monthly suicide rates per 100,000 adult population in the study and low-exposure groups, during January 1995 to December 2001. The total observation period of 72 months spans 45 months prior to the earthquake and 27 months following, presenting an opportunity to study any

Table 1. Taiwan's 1999 earthquake: demographic and suicide characteristics among high- and low-exposure groups

Variable	High-exposure group Pre*	High-exposure group Post†	Low-exposure group Pre*	Low-exposure group Post†
Total	1,359,646	1,370,867	1,972,047	2,241,640
Mean monthly population				
Gender				
Male	695,309 (51)	697,873 (51)	1,006,628 (51)	1,143,273 (51)
Female	664,337 (49)	672,994 (49)	965,419 (49)	1,098,367 (49)
Age				
20–64	1,204,503 (89)	1,207,921 (88)	1,758,806 (89)	1,987,421 (89)
≥65	155,143 (11)	162,946 (12)	213,241 (11)	254,220 (11)
Total number of suicides	673	580	1148	785
Gender				
Male	466 (69)	394 (68)	750 (65)	538 (69)
Female	207 (31)	186 (32)	398 (35)	247 (31)
Age				
20–64	535 (80)	455 (79)	844 (74)	581 (74)
≥65	138 (20)	125 (21)	304 (26)	204 (26)
Suicide method				
Hanging, strangulation and suffocation		265 (46)		313 (40)
Ingested poisons		210 (36)		275 (35)
Jumping from a height		35 (6)		51 (6)
Poisoning by other gases and vapors		20 (3)		42 (5)
Unspecified means		19 (3)		44 (5)
Cutting and piercing instruments		15 (3)		17 (2)
Submersion (drowning)		14 (2)		36 (4)
Firearms and explosives		2 (0)		3 (0)
Poisoning by gases in domestic use		1 (0)		5 (1)
Mean monthly suicide rate (per 100,000)	1.100	1.567	1.294	1.297

Values are expressed as *n* (%).
*Pre-earthquake period covers 45 months.
†Post-earthquake period covers 27 months.

change in suicide rates over the 6-year period. The Cause of Death Data File was collected from the Department of Health and the population data from the Ministry of Interior (Population by Sex and Quinquennial Age Group for Counties, Cities, Township, and Districts of Taiwan-Fuchien Area File). As it is mandatory to register all births, deaths, marriages/divorces, and migration, Taiwan's population and vital event statistics are highly accurate and complete. The mean monthly adult population before and after the earthquake, among the high-exposure group was 1,359,646 and 1,370,867, respectively, and among the low-exposure group, 1,972,047 and 2,241,640, respectively. The total number of completed suicides before the earthquake among the high-exposure group was 673 (1.100 per 100,000 population per month), for the low-exposure group was 1148 (1.294 per 100,000 per month). After the quake, it was 580 (1.567 per 100,000 per month) and 785 (1.297 per 100,000 per month) among the high- and low-exposure groups, respectively.

Statistical methods

Repeated measures ANOVA was carried out to examine the significance of differences between pre- and post-quake suicide rates in the high-exposure group compared with the low-exposure group.

To assess the time trend of the earthquake's impact on suicide rates, a single interrupted time-series design was used. Box and Tiao's event intervention analysis was used to examine changes in monthly suicide rates before and after the Chi–Chi earthquake (15). In fitting models for a single time-series data, we assume that the model is stable over time, in the environment through which the time series evolves. In other words, if the relevant environment of a time series of interest has undergone a discrete change, then a clear change in trend should be identifiable at a relevant point of time, indicating that the event impacted the behavior of the time series. To model the change in stable behavior of a time series, Box and Tiao's approach can be used. Our study hypothesis is that the trend of suicide rate following the earthquake among the high-exposure group will show a significantly increased magnitude and pattern compared with the pre-quake period, and the suicide rate in the low-exposure group will show a stable pattern through the pre- and post-quake period.

Box and Tiao's event intervention model conceptualizes the dependent variable, in this case, the monthly suicide rate, as a linear combination of a constant, the effect of the intervention (earthquake) represented as a parameter estimate, and the error term or noise level modeled by a univariate autoregressive integrated moving average (ARIMA) model. The effect of the earthquake can reasonably be conceptualized as a pulsed, one-time, immediate impact, which however will not fall to baseline levels immediately, but show a gradual decline with time. The parameter estimate for the intervention effect models the data incorporating an algebraic function to represent a pulsed increase immediately following the earthquake along with a time-dependent decline to reach zero or near zero levels at some point of time, after which the monthly suicide rate will return to the baseline level (i.e. the constant plus the noise level estimated by the univariate ARIMA model). The Scientific Computing Associates (SAC: http://www.scausa.com/) software system was used to estimate the model.

Results

The monthly suicide rate data series among the high- and low-exposure groups are shown in Fig. 1. The mean monthly suicide across the 72-month period for the high-exposure group was 1.276 per 100,000 (SE = 0.39), compared with 1.295 per 100,000 among the low-exposure group (SE = 0.345). The mean monthly suicide rate for the high-exposure group increased 42.3% (from 1.100 to 1.567 per 100,000) after the earthquake (Table 1). However, the low-exposure group rate in the post-quake period was almost identical (from 1.294 to 1.297 per 100,000) to its pre-quake rate. Overall, the monthly suicide rates of the high-exposure group show more variation than among the low-exposure group through the observation period (Table 2).

Analysis using Box and Taio's approach showed that for the high-exposure group, the sample autocorrelation function (ACF) and periodic autocorrelation function (PACF) data series were compatible with a stationary autoregressive moving average, ARMA(1,1) model (Table 3). Auto-regression, AR(1) is statistically significant at 0.01 level and moving average, MA(1) is significant at the 0.001 level. Among the high-exposure group, the suicide rate in any given month can be calculated based on the model estimates provided in Table 3. Details of the formula and calculations are provided in the Appendix. The t-value for omega (disaster impact) is 1.97, indicating statistical significance at the 0.05 level. This supports the hypothesis of a pulsed increase in the monthly suicide rate, following the quake.

In contrast, among the low-exposure group, the autocorrelation function and partial autocorrelation function plots indicated that the monthly data series are compatible with a moving average, MA(1) model [MA(1) is significant at the 0.01 level], and the t-value for omega (disaster impact) is not significant, indicating that there was no significant change in suicide rate among this group following the intervention (quake). The MA model representing monthly suicide rate among the low-exposure group is provided in the Appendix. Among this group, the t-value for omega (disaster impact) is −0.17 (parameter estimate divided by the standard error or −0.03/0.18). It is statistically insignificant, indicating that the intervention (earthquake) was not associated with any change in monthly suicide rate among the low-exposure group.

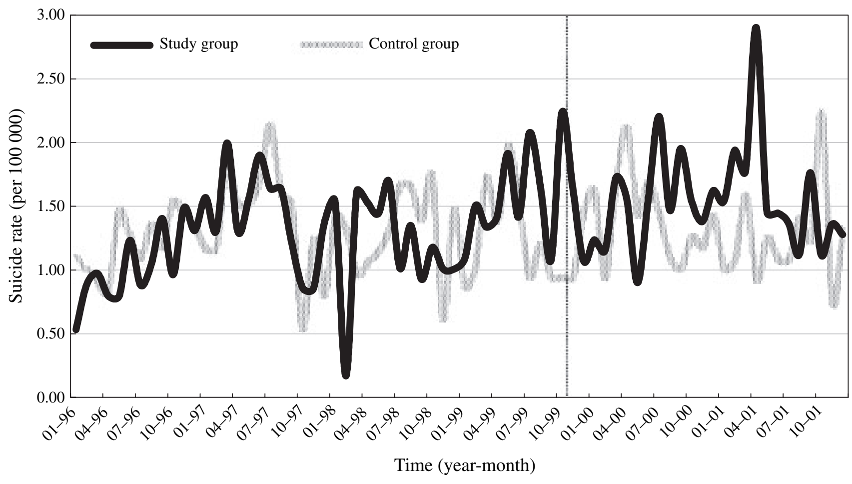

Fig. 1. Trend of suicide rates for the study and low-exposure group between 1996 and 2001.

Table 2. Repeated measures ANOVA results showing the earthquake's significance in post-quake suicide rates among the high-exposure group

Effect	Estimate	SE	*P*-value
Intercept	17.78	2.02	<0.001
Post-earthquake vs. pre-earthquake	0.96	2.45	0.695
High-exposure vs. low-exposure	3.70	1.95	0.059
Post-earthquake vs. high-exposure	5.27	2.25	0.020
Time trend	−0.68	0.77	0.382

Table 3. ARIMA model results showing monthly suicide rate trends before and after the earthquake

	High-exposure group	Low-exposure group
Constant value	1.45 (0.06)*	1.08 (0.03)*
Intervention parameter		
ω: disaster impact	0.54 (0.27)†	−0.03 (0.18)
Gradual decrease (fixed)‡	0.70	0.70
N_t (ARIMA model)		
ϕ: AR(1)	0.71 (0.14)§	
θ: MA(1)	0.52 (0.19)*	−0.33 (0.11)§
Outlier adjustment		
January 1998 (AO type)	−1.23 (0.03)*	
July 2000 (IO type)	0.94 (0.03)§	
April 2001 (AO type)	1.35 (0.03)*	
October 2001 (IO type)		0.62 (0.20)§
N (effective *n*)	71	72

Values are expressed as estimate (SE).
*$t = 2.74$; $P < 0.001$.
†$t = 1.97$ (0.54/0.27); $P < 0.05$.
‡The generally used fixed rate at 0.7 level.
§$t = 5.07$; $P < 0.01$.

Among the high-exposure group, the mean monthly growth rate of suicide was about 1.79 [0.54/(1–0.7)] per 100,000 following the quake. Disaggregated by time since the quake, the increased suicide rate registered in the first month following the quake began a gradual decline by 0.7 every month thereafter (delta = 0.7 in Table 3). The declining effect over the first 10 months following the quake accounted for about 98% of the overall increase in suicides among the high-exposure group. In other words, about 98% of the increased suicides among the severely quake-affected population occurred during the first 10 months following the earthquake, and the suicide rate fell to pre-quake rates after 10 months. The model results showed that overall, 68.47% of the variance in suicide rates were explained by the earthquake.

Discussion

This study used Box and Taio's intervention analysis to explore the time trends of suicide among survivors of severe earthquakes. We found that the mean monthly suicide rate for the high-exposure group was about 42% (0.537/1.276) higher during the 27 months following the earthquake than the average for the entire observation period (72 months). In contrast, the suicide rate among the low-exposure group remained stable and consistent throughout the observation period, indicating that the impact on the study group was attributable to the degree of exposure to the earthquake.

Our population-based study extends the findings of Chen et al. who found that 11% of 525 earthquake survivors who sought psychiatric service have had suicidal ideations (5). Our finding extends the findings of Chou et al. who reported that in the 1999 Taiwan earthquake, victims (affected by loss of a co-resident family member, or sustained a personal serious injury or severe property damage) were 1.46 times more likely to commit suicide than non-victims (9). In this study, we used Box and Tiao's intervention modeling (as a part of the Box and Jenkins stepwise process of time-series analysis) to evaluate the change in suicide rates with the disaster event and its gradual decline with time, among highly affected vs. low to nil affected population. Our study extents the findings of Chen et al. (5) by empirically quantifying the increase in completed suicides, among the total population rather than among those seeking mental health services.

Shioiri et al. reported a reduction in suicide earthquakes after the devastating Kobe earthquake in Japan in 1995, which measured 7.2 on the Richter scale, killing 3897 persons and severely injuring over 13,000, besides massive destruction of buildings. They attributed suicide reduction to a massive decrease in access to a commonly used suicide method, namely jumping off high-rise buildings. It may be noted that in our data (Table 1), jumping from a height is one of the least used suicide methods (accounting for 6% of all suicides), both in the high- and the low-exposure group. Therefore, access to locally preferred suicide methods does not seem to have been affected in the Taiwan quake. This may explain the difference between our data and that of the Kobe earthquake areas.

Our findings emphasize the need for effective policy responses to address mental health needs of populations affected by major disasters. Suicide among survivors of large-scale disasters is attributable to serious disruption of daily life and social networks due to bereavement, property loss, and the destruction of interpersonal and social networks (4). It represents a terminal outcome of the spectrum of major mental problems observed among survivors including depression, PTSD, and a sense of hopelessness. Therefore, apart from the medical, humanitarian and financial mobilization pursued vigorously in the wake of a disaster, mental health care mobilization for a sufficient period of time following a major disaster should be a key ingredient of disaster response plans. For this, policy makers need to take stock of the availability and accessibility of mental health providers, as well as financing mechanisms for mental health care.

The situation in Taiwan holds many lessons for policy makers from other countries. Current supply of psychiatrists is quite inadequate, both from quantitative and distribution perspectives. In 2003, there were 4.1 psychiatrists per 100,000 population in Taiwan compared with 7.5 in the US. Importantly, their distribution is heavily skewed to the urban agglomerations, with 43% of all psychiatrists practicing in Taipei City, Taipei County, and Kaoushung City, which together have 30% of Taiwan's population. The psychiatrist shortage is acute in rural counties with populations of < 50,000 that were powerfully hit by the quake. In addition, higher suicide rates in rural compared with urban areas among Chinese communities aggravates the issue of mal-distribution of psychiatrists in Taiwan (16, 17). Increases in the number of psychiatrists over time have not been commensurate with the increases observed in other specialties.

Mental health care is perhaps perennially underfunded in most countries. In Taiwan, under National Health Insurance, reimbursement is on par with consultations for physical ailments, at the same fixed rate per out patient visit, although mental health consultations typically last much longer, leading to fewer mean office visits per physicians. Although the form of under-funding may vary by country, there is a widespread perception that mental health is a low priority in most countries' funding priorities. Policy makers need to sponsor more research on measuring mental health care outcomes to enable a rational approach to reimbursing mental health services, to alleviate the chronic shortages of psychiatrists. In the meanwhile, every disaster preparedness plan should incorporate a plan for mobilization of mental health professionals for a duration that is adequate to meet the needs of disaster-affected population. Policy makers should also plan ahead for appropriate compensation schemes for these professionals, commensurate with the salience of their responsibility in situations with heightened mental health risks.

References

1. Lima BR, Chavez H, Samaniego N et al. Disaster severity and emotional disturbance: implication for primary mental health care in developing countries. Acta Psychiatr Scand 1989;**79**:74–82.
2. Sharan P, Chaudhary G, Kavathekar SA, Saxena S. Preliminary report of psychiatric disorders in survivors of a severe earthquake. Am J Psychiatry 1996;**153**:556–558.
3. Kato H, Asukai N, Miyake Y, Minakawa K, Nishiyama A. Post-traumatic symptoms among young and elderly evacuees in the early stage following the 1995 Hanshin-Awaji earthquake in Japan. Acta Psychiatr Scand 1996;**93**:477–481.
4. Kilic C, Ulusoy M. Psychological effects of the November 1999 earthquake in Turkey: an epidemiological study. Acta Psychiatr Scand 2003;**108**:232–238.
5. Chen CC, Yeh TL, Yang Y et al. Psychiatric morbidity and post-traumatic symptoms among survivors in the early stage following the 1999 earthquake in Taiwan. Psychiatry Res 2001;**105**:13–22.
6. Chang HL, Chang TC, Lin TY, Kuo SS. Psychiatric morbidity and pregnancy outcome in a disaster area of Taiwan 921 earthquake. Psychiatry Clin Neurosci 2002;**56**:139–144.
7. Salciglu E, Basoglu M, Livanou M. Long-term psychological outcome for non-treatment-seeking earthquake survivors in Turkey. J Nerv Ment Dis 2003;**19**:154–160.
8. Blumenthal SJ. Suicide: a guide to risk factors, assessment, and treatment of suicides patients. Med Clin North Am 1998;**72**:937–971.
9. Chou YJ, Huang N, Lee CH et al. Suicides after the 1999 Taiwan earthquake. Int J Epidemiol 2003;**32**:1007–1014.
10. Krug EG, Kresnow M, Peddicord JP et al. Suicide after natural disasters. N Engl J Med 1998;**338**:373–378.
11. Shioiri T, Nishimura A, Nushida H, Tatsuno Y, Tang SW. The Kobe earthquake and reduced suicide rate in Japanese males. Arch Gen Psychiatry 1999;**56**:282–283.
12. Ministry of Interior. Special report: statistics and analyses of natural disasters in Taiwan and Fuei-ken area, 2002. Retrieved from: http://www.moi.gov.tw/W3/stst/home.-asp.
13. The 921 Earthquake Post-Disaster Reconstruction Commission. 921 Earthquake reconstruction experience, September 2001.
14. Kotler M, Iancu I, Efroni R et al. Anger, impulsivity, social support, and suicide risk in patients with posttraumatic stress disorder. J Nerv Ment Dis 2001;**189**:162–167.
15. Box GP, Tiao GC. Intervention analysis with applications to economic and environmental problem. J Am Stat Ass 1975;**70**:70–79.
16. Zhang J, Conwell Y, Zhou L, Jiang C. Culture, risk factors and suicide in rural China: a psychological autopsy case–control study. Acta Psychiatr Scand 2004;**110**:430–437.
17. Ran MS, Chan CL, Xiang MZ, Wu QH. Suicide attempts among patients with psychosis in a Chinese rural community. Acta Psychiatr Scand 2003;**107**:430–435.

Appendix

The general form of Box and Tiao's event intervention model can be expressed in the form of the following equation:

$$y_t = C + \omega\xi_t + N_t$$

where y_t is the dependent variable, C the constant, ω the parameter of the intervention variable, ξ_t the intervention variable, and N_t the noise model determined by an univariate ARIMA(P, d, q) model.

There are various formats of simple dynamic systems to represent the change caused by the indicator variable, the 'intervention' or event. The intervention effect may be immediate or delayed, and may also be temporary or event permanent (18, 19). In the case of an earthquake, its impact is more likely to be pulsed (i.e. a one-time impact). The pulse function can be expressed as:

$$\xi_t^{\text{Oct.1999}} = \left\{ \begin{array}{lll} 0 & \text{if} & t \neq \text{Oct.1999} \\ 1 & \text{if} & t = \text{Oct.1999} \end{array} \right\}$$

Incorporating the pulse function into the general form of Box and Taio's event intervention model, the equation stands modified as:

$$y_t = C + \frac{\omega}{1 - \delta B}\xi_t + N$$

where delta represents the monthly decline in suicide rates following the initial surge after the quake.

Our data showed that for the high-exposure group, the sample ACF and PACF data series were compatible with a stationary ARMA(1,1) model. The generally used rate for delta of 0.7 was used in the model. For the high-exposure group, the model can be represented as:

$$y_t = C + \frac{\omega}{1 - \delta B}\xi_t + \frac{\varphi B}{\theta B}a_t$$

Specifically, as per the results presented in Table 1, the model would be:

$$y_t = 1.446 + \frac{0.5373}{1 - 0.7B}\xi_t + \frac{0.7113B}{0.5228B}a_t$$

As omega is statistically significant at the 0.05 level (Table 3), our data supports the hypothesis of an increase in the monthly suicide rate, following the quake. For the low-exposure group, the autocorrelation function and partial autocorrelation function plots indicated compatibility with an MA(1) model (MA estimate of −0.33 is significant at the 0.01 level). In this group, the estimate for disaster impact, omega is not significant. The MA model representing the low-exposure group can be expressed as:

$$y_t = C + \frac{\omega}{1 - \delta B}\xi_t + \frac{1}{\theta B}a_t$$

Substituting the parameter estimates shown in Table 3, the model for the low-exposure group is expressed as:

$$y_t = 1.08 + \frac{-0.03}{1 - 0.7B}\xi_t + \frac{1}{-0.33B}a_t$$

The t-value for omega (disaster impact) works out to −0.17 (parameter estimate divided by the standard error, or −0.03/0.18). It is statistically insignificant, indicating that the intervention (earthquake) was not associated with any change in monthly suicide rate among the low-exposure group.