Psychological Recovery 5 Years After the 2004 Niigata-Chuetsu Earthquake in Yamakoshi, Japan

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ABSTRACT

Background: The 2004 Niigata-Chuetsu earthquake of Japan caused considerable damage. We assessed long-term changes in psychological distress among earthquake victims during the period 5 years after the earthquake.

Methods: The participants were people aged 18 years or older living in Yamakoshi, a community in Niigata Prefecture near the epicenter. A self-administered questionnaire survey was conducted annually for 5 consecutive years after the earthquake. Response rates were 1316/1841 (71.5%) in 2005, 667/1381 (48.3%) in 2006, 753/1451 (51.9%) in 2007, 541/1243 (43.5%) in 2008, and 814/1158 (70.3%) in 2009. The questionnaire asked about demographic characteristics, including sex, age, employment status, social network, and psychological status. Psychological distress was assessed using the 12-item General Health Questionnaire and was defined as a total score of 4 or higher.

Results: The overall prevalence of psychological distress decreased (P < 0.0001) gradually from 2005 (51.0%) to 2008 (30.1%) but tended to increase from 2008 to 2009 (P = 0.1590). Subgroup analyses showed that prevalence did not decrease over the 5-year study period among participants with poor social contact (P = 0.0659). From 2008 to 2009 prevalence increased in women (+7.5%, P = 0.0403) and participants aged 65 years or older (+7.2%, P = 0.0400).

Conclusions: The prevalence of psychological distress in Yamakoshi people decreased steadily during the 4 years immediately after the earthquake but appeared to increase thereafter. The earthquake victims are still reestablishing their lives. Thus, continued attention should be focused on maintaining and further assessing their mental health.

Key words: epidemiologic studies; earthquakes; mental health; psychological distress; social support

INTRODUCTION

The 2004 Niigata-Chuetsu earthquake in Japan had a near-epicenter maximum seismic intensity of 7 on the Japan Meteorological Agency’s Intensity (JMAI) scale and killed more than 60 people. Approximately 103,000 people sought refuge, and 16,000 houses were destroyed.¹ A unique characteristic of the Niigata-Chuetsu earthquake was that mountainous areas experienced considerable damage on the ground and disruption of both traffic and communication networks.² Such a large earthquake adversely affects the psychological status of people. After the Niigata-Chuetsu earthquake, various short-term psychiatric problems and symptoms of psychological distress were documented among the victims.³ Psychological problems appear to persist long after earthquakes. Previous epidemiologic studies found that the prevalence of psychological distress remains elevated many years after earthquakes.⁴,⁵ Similar long-standing adverse effects on psychological health may have been present after the Niigata-Chuetsu earthquake. Thousands of people in the disaster area required temporary housing for 3 years,⁶ and financial problems due to property damage and/or unemployment after the earthquake were long-lasting.² Thus, the long-term effects of psychological distress after the Niigata-Chuetsu earthquake warrant investigation.

The village of Yamakoshi (currently part of Nagaoka City) was located near the epicenter of the earthquake, where physical damage was enormous. All village residents sought refuge in a nearby city after the event. To care for
these people, annual health checks were conducted for 5 consecutive years after the earthquake. In this setting, the psychological status of Yamakoshi residents was also evaluated. The aim of this study was to assess long-term changes in psychological distress among the resident population during the 5 years after the Niigata-Chuetsu earthquake.

METHODS

Participants
The Niigata-Chuetsu earthquake occurred on October 23, 2004 and measured M 6.8 on the Richter scale. The epicenter was located at latitude 37°29′ N and longitude 138°87′ E. The survey was conducted by the local government and the Niigata Institute for Traumatic Stress (Mental Health and Welfare Association in Niigata Prefecture) as part of post-earthquake health checks for people registered as Yamakoshi residents between 2005 and 2009. All residents aged 18 years or older were targeted. Response rates to the survey were 1402/1841 (76.2%) in 2005, 729/1381 (52.8%) in 2006, 841/1451 (58.7%) in 2007, 594/1243 (47.9%) in 2008, and 883/1158 (77.3%) in 2009. After excluding people with missing data on age, sex, or psychological status, the final response rates were 1316/1841 (71.5%) in 2005, 667/1381 (48.3%) in 2006, 753/1451 (51.9%) in 2007, 541/1243 (43.5%) in 2008, and 814/1158 (70.3%) in 2009. Although the response rate differed by year, 224 participants participated in all 5 surveys. This subgroup was also analyzed for comparison with the results of whole-population analyses.

Procedure
Self-administered questionnaires for the years 2005 through 2008 were delivered and collected by hand (for participants living in temporary refugee housing) or sent and collected by mail (for other participants). The 2009 questionnaires were delivered and collected by hand (for participants living in temporary refugee housing) or sent and collected by mail (for other participants). The 2009 questionnaires were delivered and collected by hand (for participants living in temporary refugee housing) or sent and collected by mail (for other participants). The 2009 characteristics of the 224 participants who participated in all 5 surveys, is illustrated in Figure 1. The mean ages (SD) of the participants were 59.4 (17.6) years in 2005, 61.0 (17.2) years in 2006, 63.6 (16.4) years in 2007, 64.5 (15.9) years in 2008, and 62.7 (16.9) years in 2009. The decrease in mean age in 2009 was due to the higher participation rate, especially among younger residents (Table 1). The 2005 characteristics of the 224 participants who participated in all 5 surveys are shown in Table 2. Their mean age in 2005 was 64.0 (13.7) years.

RESULTS

Table 1 shows the characteristics of participants in each survey year. The mean ages (SD) of the participants were 59.4 (17.6) years in 2005, 61.0 (17.2) years in 2006, 63.6 (16.4) years in 2007, 64.5 (15.9) years in 2008, and 62.7 (16.9) years in 2009. The decrease in mean age in 2009 was due to the higher participation rate, especially among younger residents (Table 1). The 2005 characteristics of the 224 participants who participated in all 5 surveys are shown in Table 2. Their mean age in 2005 was 64.0 (13.7) years.

The secular change in the prevalence of psychological distress in all participants, as well as in the 224 participants who participated in all 5 surveys, is illustrated in Figure 1. The overall prevalence of psychological distress (Figure 1, left) was highest in 2005, before decreasing to its lowest value in 2008. The decreasing trend from 2005–2009 was statistically significant (P < 0.0001). The secular trend in...
The prevalence among the 224 participants (Figure 1, right) decreased in a similar manner ($P < 0.0001$).

Secular changes in the prevalence of psychological distress in all participants according to sex, age ($\leq 64$ vs $\geq 65$ years), jobless status (unemployed vs other), and degree of social contact (often/sometimes vs not often/rarely) are shown in Figure 2. A statistically significant decreasing trend in prevalence was noted between 2005 and 2009 for all groups except those reporting infrequent social contact ($P = 0.0659$). In relation to the respective comparison groups, the prevalence of psychological distress was higher among those reporting infrequent social contact (Figure 2, lower right) and unemployed participants (Figure 2, lower left) and tended to be higher among women than among men (Figure 2, upper left). There was no significant difference in prevalence between age groups (Figure 2, upper right).

Despite the overall decreasing trend in prevalence, psychological distress appeared to increase from 2008 to 2009 (Figure 1), although the change ($+3.7\%$) was not statistically significant ($P = 0.1590$). However, changes in prevalence within some subgroups (Figure 2) were statistically significant, such as the increases in the prevalence of psychological distress among women ($+7.5\%$; $P = 0.0403$) and participants aged 65 years or older ($+7.2\%$; $P = 0.0400$). Multiple logistic regression analysis was conducted to identify independent factors related to change in distress status in 2008–2009 as an outcome variable (those without a diagnosis of psychological distress in 2008 and a new diagnosis of psychological distress in 2009 were coded as 1 [n = 38]; others were coded as 0 [n = 383]) in participants who participated in both the 2008 and 2009 examinations. This analysis revealed that none of the 4 possible predictors—ie, age ($P = 0.1105$), sex ($P = 0.4550$), employment status ($P = 0.3360$), and social

Table 1. Characteristics of participants, by survey year

|          | 2005 (n = 1316) | 2006 (n = 667) | 2007 (n = 753) | 2008 (n = 541) | 2009 (n = 814) |
|----------|----------------|---------------|---------------|----------------|----------------|
| **Age**  |                |               |               |                |                |
| $\leq 64$ years | 715 (54.3%)  | 329 (49.3%)  | 344 (45.7%)  | 228 (42.1%)  | 401 (49.3%)  |
| $\geq 65$ years | 601 (45.7%)  | 338 (50.7%)  | 409 (54.3%)  | 313 (57.9%)  | 413 (50.7%)  |
| **Sex**  |                |               |               |                |                |
| Male     | 652 (49.5%)  | 326 (48.9%)  | 351 (46.6%)  | 252 (46.6%)  | 388 (47.7%)  |
| Female   | 664 (50.5%)  | 341 (51.1%)  | 402 (53.4%)  | 289 (53.4%)  | 426 (52.3%)  |
| **Job status** |            |               |               |                |                |
| Unemployed | 409 (31.9%)  | 226 (35.0%)  | 228 (31.6%)  | 151 (29.2%)  | 202 (25.7%)  |
| Other    | 873 (68.1%)  | 419 (65.0%)  | 493 (68.4%)  | 367 (70.9%)  | 583 (74.3%)  |
| Data missing | 34           | 22            | 32            | 23            | 29            |
| **Contact with neighbors** |        |               |               |                |                |
| Often    | 484 (37.4%)  | 239 (36.7%)  | 254 (35.5%)  | 200 (38.3%)  | 277 (35.2%)  |
| Sometimes | 546 (42.1%)  | 304 (46.7%)  | 336 (46.9%)  | 233 (44.6%)  | 347 (44.0%)  |
| Not often | 185 (14.3%)  | 80 (12.3%)   | 98 (13.7%)   | 61 (11.7%)   | 113 (14.3%)  |
| Rarely   | 81 (6.3%)    | 28 (4.3%)    | 28 (3.9%)    | 28 (5.4%)    | 51 (6.5%)    |
| Data missing | 20           | 16            | 37            | 19            | 26            |
| **GHQ-12 score** |        |               |               |                |                |
| $\leq 3$ (normal) | 645 (49.0%)  | 384 (57.6%)  | 475 (63.1%)  | 378 (69.9%)  | 539 (66.2%)  |
| $\geq 4$ (psychological distress) | 671 (51.0%)  | 283 (42.4%)  | 278 (36.9%)  | 163 (30.1%)  | 275 (33.8%)  |

Abbreviation: GHQ-12, 12-item General Health Questionnaire.

Table 2. The 2005 characteristics of the 224 participants who participated in all 5 surveys, 2005–2009

|          | Number of participants |
|----------|-----------------------|
| **Age**  |                       |
| $\leq 64$ years | 96 (42.9%)  |
| $\geq 65$ years | 128 (57.1%) |
| **Sex**  |                       |
| Male     | 104 (46.4%)           |
| Female   | 120 (53.6%)           |
| **Job status** |         |
| Unemployed | 79 (35.9%)  |
| Other    | 141 (64.1%)           |
| Data missing | 4               |
| **Contact with neighbors** |     |
| Often    | 107 (47.8%)           |
| Sometimes | 88 (39.3%)            |
| Not often | 22 (9.8%)             |
| Rarely   | 7 (3.1%)              |
| **GHQ-12 score** |        |
| $\leq 3$ (normal) | 116 (53.2%)  |
| $\geq 4$ (psychological distress) | 102 (46.8%)  |
| Data missing | 6               |

Abbreviation: GHQ-12, 12-item General Health Questionnaire.
contact ($P = 0.7121$)—were independently associated with change in prevalence in 2008–2009. Another multiple logistic regression analysis was conducted to identify independent factors related to psychological distress in 2009 (those who received a diagnosis of psychological distress were coded as 1 [$n = 281$]; others were coded as 0 [$n = 558$]) among participants who participated in the 2009 examinations. Psychological distress was independently associated with social contact (odds ratio [OR] = 2.93, 95% CI: 2.03–4.25, $P < 0.0001$), employment status (OR = 1.56, 95% CI: 1.07–2.27, $P = 0.0219$), and sex (OR = 1.70, 95% CI: 1.24–2.34, $P = 0.0010$), but not age (OR = 1.14, 95% CI: 0.81–1.60, $P = 0.4517$).

**DISCUSSION**

This study presented findings related to recovery from psychological distress among adults living in a community
hit by a large earthquake. We found that the prevalence of psychological distress decreased gradually and reached its lowest point at 4 years after the earthquake.

Although the short-term effects of earthquakes on mental health are well-documented, there are limited data on the long-term impacts of such events. Most prior studies assessed psychological disorders several months or a few years after earthquakes, but few studies investigated long-term outcomes (ie, >5 years after an earthquake). Bland et al assessed symptoms of psychological distress in people 7 years after the 1980 earthquake and found that levels of psychological distress were higher among those who had reported damage from the earthquake than among those who had not. Priebe et al assessed mental disorders in a randomly selected sample of 200 people who had experienced a 1997 earthquake in Italy 8 years before and concluded that the prevalence of mental disorders did not differ from that in comparable populations. Although the results of these 2 studies are inconsistent and not directly comparable with ours, the findings suggest that a large earthquake could affect the mental health of victims for a very long time, up to 7 years. Thus, to facilitate comparison with previous studies, further follow-up investigation in Yamakoshi is warranted.

The present subgroup analysis showed that the prevalence of psychological distress did not decrease over 5 years among those with poor social contact. This finding agrees with the results of a number of previous reports on earthquakes, which showed that disruption of social networks is a major factor in poor mental health. Oyama et al found that earthquake victims who were estranged from others in their community were at higher risk (OR = 7) for psychological distress 3 years after the Niigata-Chuetsu earthquake. Bland et al reported that those who were evacuated farther away from family or friends had higher levels of psychological distress 3 to 4 years after an earthquake in Italy. Kiliç et al showed that disruption of social networks due to relocation increased psychological distress 4 years after 2 severe earthquakes in Turkey.

The prevalence of psychological distress was higher among unemployed people, which was also noted in other studies. This may be due in part to financial burdens from house damage that adversely affect psychological health.

The prevalence of psychological distress was higher among women than among men in 2005, 2006, and 2009. In general, common mental disorders are more prevalent among women, but a sex difference in the prevalence of GHQ-defined psychological distress was not found in a large Japanese population. A possible explanation for this higher prevalence in women may be the traditional, dependent roles of women in rural Japanese communities, including Yamakoshi. In such communities, women have a major role at home: they manage most of the housework and care for all family members, including their husband, children, and husband’s parents. Because of role change, post-earthquake burdens may have been greater for women than for men. The long-term higher prevalence of psychological distress in women versus men is noteworthy in relation to suicide rate after earthquakes. Long-term suicide rates after the Niigata-Chuetsu earthquake increased among women and decreased among men. The suicide rate among women may have been elevated because the prevalence of psychological distress in women was higher and increased over time.

The prevalence of psychological distress generally decreased after the earthquake, although there was an unexpected increase from 2008 to 2009. While multiple logistic regression analysis did not identify independent factors that contributed to this increase, there might have been stress-related factors beginning in 2009. Many people had been struggling to reestablish their lives and had difficulty continuing their daily tasks, which may have been reflected in greater psychological distress in 2009.

Many earthquake victims may have had difficulty rebuilding their lives due to financial losses, which are common after a large earthquake. In fact, the Niigata prefectural government reported declines in per capita income in the disaster areas after the Niigata-Chuetsu earthquake. Per capita income in the disaster areas decreased in 2008–2009, after rising in 2005–2007 as a result of temporary financial aid from the government (Figure 3). Financial problems caused by the earthquake may have been an important contributor to the worsening mental health of some Yamakoshi people 5 years later.

We evaluated the prevalence of psychological distress in an earthquake-stricken area rather than in a normal population. Few studies have used the GHQ-12 to investigate the prevalence of psychological distress in normal Japanese populations. Using the same GHQ-12 cutoff score, of 3/4, Shimbo et al reported that the prevalence rate of psychological distress was 18.9% to 20.0% in a randomly

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Figure 3. Secular change in per capita income in the disaster area (including Yamakoshi) of the Niigata-Chuetsu earthquake.
selected general population (n = 600) aged 20 to 69 years. This suggests that the prevalence of psychological distress in the present population was higher than that in a normal Japanese population.

A major limitation of this study is that participation rates differed throughout the 5-year study period; those between 2006 and 2008 (around 50%) were lower than those in 2005 and 2009. This discrepancy may have influenced prevalence rates. Secondly, we did not assess psychological distress before the earthquake and thus cannot determine whether the prevalence of psychological distress returned to pre-earthquake levels. Finally, the residents of Yamakoshi are mostly elderly adults in a rural area and, hence, generalization of our results requires caution. Our findings might not be applicable to younger populations in urban areas. Despite these limitations, data on long-term changes in post-earthquake psychological status among people living in a community near an earthquake epicenter are rare and worth reporting.

In summary, the overall prevalence of psychological distress steadily decreased during the 4-year period after the earthquake; however, prevalence tended to increase between the fourth and fifth years after the earthquake. In addition, the prevalence of psychological distress did not decrease among those who reported poor social contact. Rebuilding of the lives of earthquake victim is ongoing; thus, their mental health status should be closely monitored.

ONLINE ONLY MATERIALS

Abstract in Japanese.

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Conflicts of interest: None declared.

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