Mental Health Problems Among Adults in Tsunami-Affected Areas in Southern Thailand

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O N THE MORNING OF DECEMber 26, 2004, a massive undersea earthquake northwest of Sumatra, Indonesia, with a Richter-scale magnitude of 9.3, caused a giant ocean shockwave or tsunami that devastated the shorelines of Indonesia, Sri Lanka, India, Thailand, and many other countries.[1] More than 200 000 individuals are estimated to have died from the tsunami, making it one of the deadliest natural disasters in history.[1] In Thailand, all provinces facing the Andaman Sea (Ranong, Phang Nga, Phuket, Krabi, Trang, and Satul) were affected but human losses and damages varied considerably. Phang Nga province was the most severely affected, followed by Krabi and Phuket.[2] In Phang Nga alone, more than 4200 individuals died and about 4250 individuals became displaced after their houses were destroyed; 721 individuals died in Krabi and 279 individuals died in Phuket. In

**See also pp 549 and 576
and Patient Page.**

Context On December 26, 2004, an undersea earthquake occurred off the northwestern coast of Sumatra, Indonesia. The tsunami that followed severely affected all 6 southwestern provinces of Thailand, where 5395 individuals died, 2991 were unaccounted for, and 8457 were injured.

Objective To assess the prevalence of symptoms of posttraumatic stress disorder (PTSD), anxiety, and depression among individuals residing in areas affected by the tsunami in southern Thailand as part of a public health emergency response and rapid assessment.

Design, Setting, and Participants A multistage, cluster, population-based mental health survey was conducted from February 15 to 22, 2005, of random samples of displaced (n=371) and nondisplaced persons in Phang Nga province (n=322) and nondisplaced persons in the provinces of Krabi and Phuket (n=368). Data were collected using an interviewer-administered questionnaire on handheld computers. A surveillance follow-up survey of the displaced persons (n=371) and nondisplaced persons (n=322) in Phang Na was conducted in September 2005.

Main Outcomes Measures Medical Outcomes Study-36 Short-Form Health Survey SF-36 to assess self-perceived general health, bodily pain, and social and emotional functioning; the Harvard Trauma Questionnaire to assess tsunami-specific traumatic events; and the Hopkins Checklist-25 to detect symptoms of anxiety and depression.

Results Participation rates for displaced and nondisplaced persons in the rapid assessment survey were 69% and 58%, respectively. Symptoms of PTSD were reported by 12% of displaced and 7% of nondisplaced persons in Phang Nga and 3% of nondisplaced persons in Krabi and Phuket. Anxiety symptoms were reported by 37% of displaced and 30% of nondisplaced persons in Phang Nga and 22% of nondisplaced persons in Krabi and Phuket. Symptoms of depression were reported by 30% of displaced and 21% of nondisplaced persons in Phang Nga and 10% of nondisplaced persons in Krabi and Phuket. In multivariate analysis, loss of livelihood was independently and significantly associated with symptoms of all 3 mental health outcomes (PTSD, anxiety, and depression). In the 9-month follow-up surveillance survey of 270 (73%) displaced and 250 (80%) nondisplaced participants in Phang Nga, prevalence rates of symptoms of PTSD, anxiety, and depression among displaced persons decreased to 7%, 24.8%, and 16.7%, respectively, and among nondisplaced persons, prevalence rates decreased to 2.3%, 25.9%, and 14.3%, respectively.

Conclusions Among survivors of the tsunami in southern Thailand, elevated rates of symptoms of PTSD, anxiety, and depression were reported 8 weeks after the disaster, with higher rates for anxiety and depression than PTSD symptoms. Nine months after the disaster, the rates of those reporting these symptoms decreased but were still elevated. This information is important for directing, strengthening, and evaluating posttsunami mental health needs and interventions.

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Figure 1. Tsunami-Affected Provinces on the Southern Thai Peninsula and Study Survey Sites
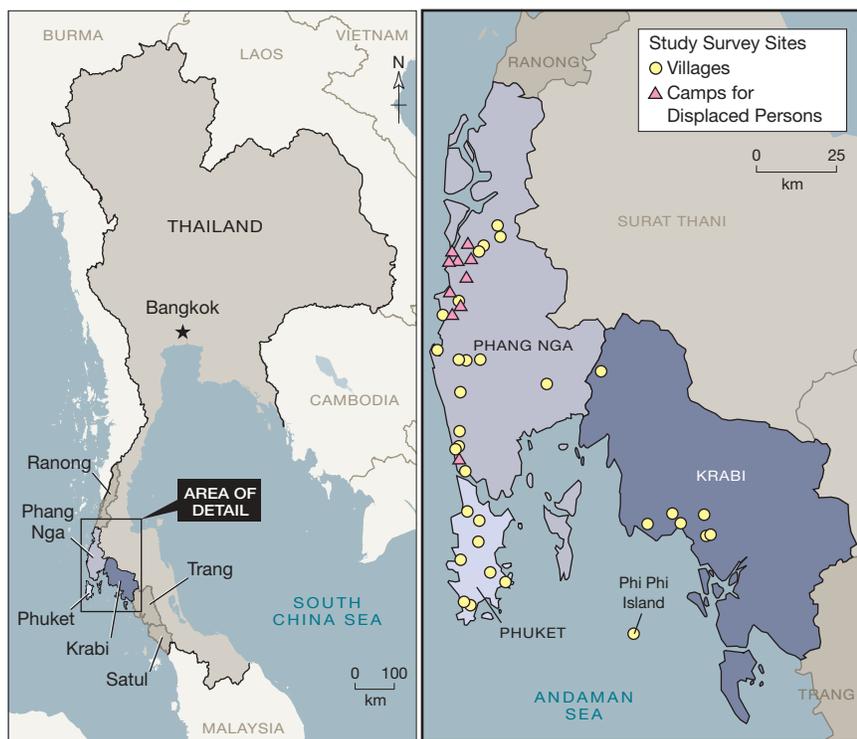
all 6 provinces combined, 5395 individuals died, 2991 were unaccounted for, and 8457 were injured.[3]

Previous assessments among survivors of natural disasters, wars, and conflicts have shown that posttraumatic stress disorder (PTSD) and other mental health problems are common.[4,5] However, the types of mental health problems and reported prevalence rates vary, possibly due to variation in study methods, disaster type and magnitude, and cultural differences in somatization and coping with disaster. Thailand does not have a history of natural disasters and the prevalence of PTSD among individuals exposed to traumatic events has not been assessed previously. Understanding basic posttsunami mental health indicators is essential for identifying vulnerable populations and developing culturally specific mental health interventions. As part of a public health emergency response, we conducted a rapid assessment of the prevalence of symptoms of PTSD, anxiety, and depression and associated factors among random samples of displaced and nondisplaced persons in the 3 Thai provinces of Phang Nga, Krabi, and Phuket, which were the most severely affected by the tsunami (**FIGURE 1**).

METHODS
Study Design
We aimed to enroll random samples of 392 displaced and 323 nondisplaced persons from Phang Nga and 323 nondisplaced persons from Krabi and Phuket each. The sample size was calculated on the basis of an assumed PTSD prevalence of 15% in displaced persons and 12.5% in nondisplaced persons, a design effect of 2 and a 95% confidence interval (CI). Estimates of PTSD prevalence in east-Asian populations postdisaster typically vary between 5% and 30%,[6-8] hence we used a 15% prevalence to calculate the sample size of our survey. Households were used as the primary sampling unit and were defined as any group of persons (sometimes multiple families) sharing the same structure (usually a tent or other

form of temporary housing) and resources, such as food or bedding. Household members were not necessarily relatives by blood or marriage.

We drew a systematic sample of households from camps for the displaced in Phang Nga (range for household size, 15-520; range for population size, 73-1353). Of 16 camps registered in Phang Nga by February 14, 2005, 10 were selected. One camp, Bang Moung, administratively consisted of 3 subcamps (Bang Moung, Wat Samakheetham, and Ban Tung La-ong), each with separate household registration lists. For sampling purposes, these 3 subcamps were considered individual camps and are depicted separately in Figure 1. Six camps were excluded for reasons of efficiency; they had fewer than 50 households (**FIGURE 2**). Camp household registration data showed a mean (SD) household size of 3.5 (1.3). To account for ineligibility, refusal, and absence, we estimated that 200 households were needed to enroll 392 persons. To do this, we first calculated a sampling ratio[9] (target number of households/total number of households in all of the camps) and then multiplied this ratio by the number of households in each of the camps. This provided us with the number of households to be enrolled from every camp, proportional to its size. Next, we calculated a sampling interval[9] (number of households in the camp/ number of households to be sampled from the camp), which provided us with the distance (or the number of households) between the 2 households to be selected in the sample. At the start of data collection, a daily generated random number between 1 and 10 was used to determine which housing structure was sampled first; this number was then increased systematically by the sampling interval. For example, the sampling ratio of camp households was $(200/1595 = 0.125)$, hence from a camp with 240 households we needed to enroll $(0.125 \times 240 = 30)$ households. In this example, the sampling interval is $(240/30 = 8)$, meaning that 8 housing structures needed to be skipped between the 2 selected households. In every

household, consent to participate was requested from individuals aged 15 years or older. If a household member was not present but would return later, the household was revisited on the same day for a maximum of 2 times. Household members attending school or occupational training were approached for enrollment at that venue. Household members were ineligible if they were younger than 15 years old, unable to speak Thai, or if they did not have a Thai national identification card (eg, Thai nationality). If household members were present, refusal to participate was rare.

To obtain our sample of nondisplaced persons, we drew a multistage cluster sample from households of nondisplaced persons (**FIGURE 3**). In the first stage, we used the number of tsunami-related deaths to define Phang Nga as a high-impact cluster (4224 deaths) and Krabi and Phuket as a lower-impact cluster (721 and 279 deaths, respectively).[3] In Thailand, every province is administratively organized at the district, subdistrict, and village levels.

In the second stage, villages were stratified by whether they were affected or unaffected by the tsunami. We then randomly sampled a cluster of 3 subdistricts with affected villages and 3 subdistricts with nonaffected villages from both the high-impact and lower-impact clusters (a village was classified as affected if it had been flooded by the tsunami).

In the third stage, 8 villages with more than 200 households were randomly sampled from each cluster of 3 subdistricts, resulting in 16 villages from the Phang Nga province and 16 villages from the Krabi and Phuket provinces. Provincial registration data showed a mean household size of 3.5 for Phang Nga and 2.5 for Krabi and Phuket. To account for ineligibility, refusal, and absence, we estimated that 150 households were needed from Phang Nga and 200 from Krabi and Phuket to enroll 323 persons from each of the high-impact and lower-impact clusters. In the fourth stage, we applied a sampling ratio and sampling interval[9] to determine the number of

households to be enrolled from each village to get the desired sample size. The procedure for the selection and systematic sampling of households in the villages was the same as that used in the camps for displaced persons (Figure 2).

Instruments and Data Collection

Before conducting the survey, we collected information from key informants (persons affected by the tsunami, health care workers, and community leaders) about traumatic experiences, cultural-specific coping mechanisms (such as seeing ghosts or hearing voices of the deceased), and tsunami-related mental health and subsistence issues. We also reviewed population and health statistics about displaced and nondisplaced persons. We used this information to develop questions regarding tsunami-specific traumatic events, coping mechanisms, and to determine the sampling design. The Medical Outcomes Study-36 Short-Form Health Survey (SF-36),[10-12] the Harvard Trauma Questionnaire (HTQ),[13] and the Hopkins Checklist-25 (HSCL-25)[14,15] were used to assess mental health conditions.

For our survey, we selected four 5-point scales from the SF-36 to assess self-perceived general health, bodily pain, and social and emotional functioning. Each raw score was then transformed on a 0 to 100 scale using a standard formula, with the higher scores representing better functioning.[10-12] Symptoms of PTSD, anxiety, and depression were all measured on 4-point scales with responses ranging from "not at all" to "extremely." The SF-36 was constructed from the Medical Outcomes Study and developed in the United States.[16] The validity and reliability of the SF-36 have been extensively tested in the United States and several other countries, and the instrument had good reliability and validity. The SF-36 has been widely translated and used in diverse cultural groups.[16,17] The US Centers for Disease Control and Prevention has used selected questions from the SF-36 in mental health population surveys in postwar Kosovo, Afghanistan, and in refugee populations in Thailand.[5,6,18]

Figure 2. Sampling Stages for Displaced Adults in Phang Nga Province
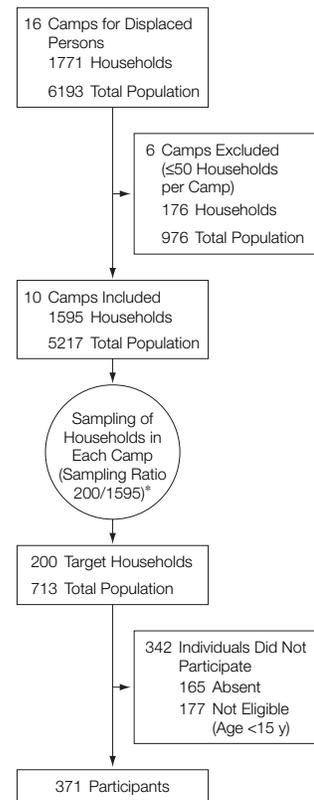
*Households were used as the primary sampling unit and were defined as any group of persons (sometimes multiple families) sharing the same structure and resources, such as food or bedding.

We used the HTQ to assess tsunami-specific traumatic events (part 1, 13 questions) **BOX**, which were selected after interviews with key informants in the tsunami-affected area, and PTSD symptoms according to the *Diagnostic and Statistical Manual of Mental Disorders* (part 3, 16 questions).[19]

We defined PTSD as a score of 3 or 4 on at least 1 of 4 reoccurring symptoms, at least 3 of 7 avoidance and numbing symptoms, and at least 2 of 5 arousal symptoms.[20,21] The HTQ was developed by Mollica et al[20,21] and has been widely translated and used in diverse cultural groups and validated against clinical diagnoses.[22] The HTQ has demonstrated high internal consistency and reliability in studies of Bosnian- and Croatian-speaking individuals and in Cambodian refugee populations.[20-23]

The HSCL-25, a screening tool to detect symptoms of anxiety and depression, comprises a 10-item subscale for anxiety and a 15-item subscale for depression. Mean cumulative symptom scores higher than 1.75 indicated the presence of anxiety and depression and have been found to be valid in predicting clinical diagnoses of these disorders.[14] The HSCL-25 has been validated in the US population and used in many refugee studies. The content and design of a 4-point severity scale is acceptable to the Indo-Chinese populations, and reviews in the cultural psychiatry literature consider the measure valid.[13-15] The HSCL-25 in the 3 Indo-Chinese groups showed excellent test and retest reliability and good validity in predicting depression and anxiety diagnoses.[15]

The recall period for the standard instrument questions was 4 weeks. In addition, we asked several yes or no questions about culture-specific coping

Figure 3. Sampling Stages for Nondisplaced Adults in Phang Nga, Phuket, and Krabi Provinces
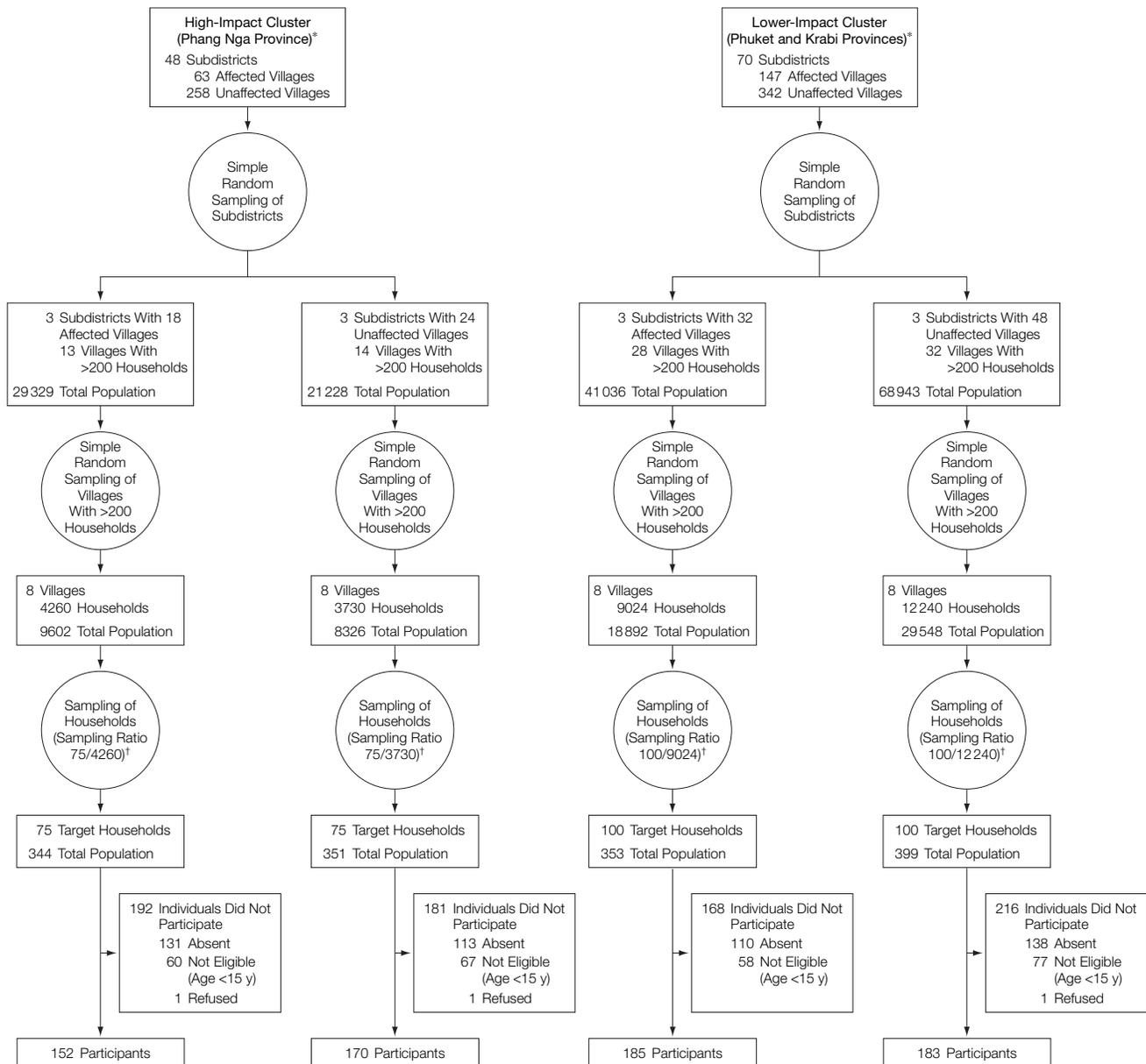
*High-impact cluster was used to describe the large number of tsunami-related deaths in the Phang Nga Province (4224 deaths). Krabi and Phuket were characterized as lower-impact clusters (721 and 279 deaths, respectively).
†Households were used as the primary sampling unit and were defined as any group of persons (sometimes multiple families) sharing the same structure and resources, such as food or bedding.

mechanisms, previous diagnoses of mental illness and mental health support, substance abuse, and suicide ideation and attempts.

All questions were translated from English to Thai and pilot-tested among social workers and counselors to assess cultural appropriateness, understandability, and acceptability. Instruments were not backtranslated but their translation was verified for accuracy by local bilingual mental health experts. Questionnaires were programmed for use on handheld computers and administered during a face-to-face interview by trained interviewers who were psychologists, social workers, or psychiatric nurses. Because interviews were conducted on location, interviewers were not blinded with respect to displacement status. At the end of each day, all completed questionnaires were downloaded on a laptop computer using Hotsync (process of synchronizing information between handheld computers and desktop computers) and electronically transported to the Bangkok-based data management center using the Global Packet Radio Service (a wireless telephony network).

Data for the rapid assessment survey were collected between February 15 and 22, 2005, 8 weeks after the tsunami. A surveillance follow-up survey of the displaced and nondisplaced participants in Phang Nga (the high-impact cluster) was conducted between September 7 and 12, 2005, 9 months after the disaster.

The protocol of this study was reviewed by the US Centers for Disease Control and Prevention and by the Department of Mental Health, Thailand Ministry of Public Health, and was determined to be an emergency public health response which, consequently, did not require review by an institutional review board. Prior to enrollment in the assessment, verbal informed consent was obtained from participants, who were reimbursed 100 Thai Baht (40 Thai Baht= US $1) for their time and effort. All participants were referred for mental health services available in mobile clinics provided by the Department of Mental Health of the Thailand Ministry of Public Health.

Box. Tsunami-Specific Traumatic Events Assessed by 13 Questions on the Harvard Trauma Questionnaire

1. Did 1 or more of your children die during the tsunami disaster?
2. Did your spouse die during the tsunami disaster?
3. Did other family members die during the tsunami disaster?
4. Were you injured as a result of the tsunami disaster?
5. Were members of your family injured as a result of the tsunami disaster?
6. Are there individuals missing in your family as a result of the tsunami disaster?
7. If individuals died in your family as a result of the tsunami disaster were the bodies found?
8. Did someone you know (like a neighbor or someone from your village) die as a result of the tsunami disaster?
9. Is someone you know missing as a result of the tsunami disaster?
10. Did you lose your home as a result of the tsunami disaster?
11. Was this house your or your family's property?
12. Did you lose other belongings as a result of the tsunami disaster?
13. Did you lose your livelihood as a result of the tsunami disaster?*

*For the purpose of this questionnaire, livelihood was defined as a person's main way to make a living.

Data Analysis

Prevalence rates for symptoms of PTSD, anxiety, depression, and other characteristics were calculated and analyzed using SPSS version 12.0 (SPSS Inc, Chicago, Ill). χ^2 Tests were used to evaluate differences in categorical variables and *t* tests and 1-way analysis of variance tests were used to evaluate differences in continuous variables, correcting for multiple comparisons if necessary. If continuous variables were not normally distributed, nonparametric tests were applied. Backward stepwise multivariate logistic regression analysis was used to identify independent risk factors for symptoms of PTSD, anxiety, and depression, while adjusting for clustering of venues and calendar dates using Stata version 8.1 (StataCorp, College Station, Tex). All variables that were theoretically relevant and had *P* values of $<.05$ in bivariate analysis were entered into the models.

RESULTS

Of the 371 eligible displaced persons (participation rate, 69%), 41% were male, 93% were Buddhist, and 95% were Thai; their mean (SD) age was 39.5 (15) years (range, 15-90 years). Of the 690 eligible nondisplaced persons (participation rate, 58%), 37% were male, 62% were Buddhist, 98% were Thai; their mean (SD) age was 42 years (15.5 years) (**TABLE 1**). In almost all cases, absence at the time of the interview was the reason for nonparticipation. The mean age and sex of displaced and nondisplaced participants were not significantly different from the nonparticipants.

Before the tsunami, mean income did not differ significantly between displaced persons and nondisplaced persons in Phang Nga (17 127 vs 15 085 Thai Baht; *P* = .83) but was lower among nondisplaced persons in Phang Nga than among nondisplaced persons in Krabi and Phuket (15 085 vs 18 458 Thai Baht; *P* = .002). After the tsunami, the mean income of displaced persons (2010 Thai Baht) was significantly lower than that of nondisplaced persons in Phang Nga (6885 Thai Baht; *P*<.001), which was significantly lower than that of nondisplaced persons in Krabi and Phuket (10 037 Thai Baht; *P*<.001).

Symptoms of PTSD were reported by 12% of displaced persons and 7% of nondisplaced persons in Phang Nga and 3% of nondisplaced persons in Krabi and Phuket. Anxiety symptoms were reported by 37% of displaced persons and 30% of nondisplaced persons in Phang Nga and 22% of nondisplaced persons in Krabi and Phuket. Symptoms of depression were reported by 30% of displaced persons and 21% of nondisplaced persons in Phang Nga and 10% of nondisplaced persons in Krabi and Phuket (**TABLE 2**). Prevalence rates for symptoms of PTSD, anxiety, and de-

Table 1. Demographic Characteristics of Adults in Tsunami-Affected Provinces in Southern Thailand, 2005

Characteristic	Displaced	Nondisplaced		P Value*
	Phang Nga (n = 371)	Phang Nga (n = 322)	Krabi and Phuket (n = 368)	
Male, No. (%) [95% CI]	151 (40.7) [36.7-44.7]	119 (37.0) [32.7-41.2]	140 (38.0) [34.0-42.1]	.43
Age, mean (SD) [range], y	39.5 (15.0) [15-90]	44.2 (16.1) [15-86]	40.8 (14.8) [15-84]	.001
Married or living together, No. (%) [95% CI]	284 (76.5) [71.3-81.9]	232 (72.0) [66.3-77.8]	264 (71.7) [66.7-76.8]	.37
Education primary school or lower, No. (%) [95% CI]	266 (71.7) [66.8-76.6]	225 (69.9) [64.4-75.3]	204 (55.4) [50.4-60.5]	<.001
Buddhist religion, No. (%) [95% CI]	341 (91.9) [87.8-96.1]	229 (71.1) [63.3-78.9]	201 (54.6) [47.3-61.9]	<.001
Income, mean (SD) [range], Thai baht Before tsunami	17 127 (46 165) [200-500 000]	15 085 (21 884) [400-200 000]	18 458 (23 093) [1000-150 000]	.29
After tsunami	2010 (5414) [0-80 000]	6885 (1623) [0-100 000]	10 037 (13 523) [0-100 000]	<.001

Abbreviation: CI, confidence interval.
*Expresses the result of statistical testing across the 3 groups.

Table 2. Mental Health Outcomes, Culture-Specific Symptoms, Social Functioning, and Traumatic Events Among Adults in Tsunami-Affected Provinces in Southern Thailand, 2005

Variable*	Displaced	Nondisplaced		P Value
	Phang Nga (n = 371)	Phang Nga (n = 322)	Krabi and Phuket (n = 368)	
Mental Health				
PTSD	44 (11.9) [8.1-15.6]	22 (6.8) [3.8-9.9]	11 (3.0) [0.9-5.0]	<.001
Anxiety	137 (36.9) [31.4-42.5]	96 (29.8) [24.4-35.2]	81 (22.0) [16.9-27.1]	<.001
Depression	112 (30.2) [25.2-35.2]	66 (20.5) [15.5-25.5]	38 (10.3) [6.7-13.9]	<.001
Use of illicit drugs	18 (4.9) [2.6-7.1]	12 (3.7) [1.7-5.8]	18 (4.9) [2.3-7.4]	.74
Drink ≥3 glasses/d of alcohol	10 (3.3) [1.3-5.2]	10 (3.4) [1.3-5.5]	13 (3.8) [1.6-6.1]	.92
Prior diagnosis of mental illness	42 (11.3) [7.5-15.2]	11 (3.4) [1.4-5.4]	10 (2.7) [0.6-4.8]	<.001
Received mental health support	213 (57.4) [51.8-63.0]	38 (11.8) [7.5-16.1]	34 (9.2) [5.8-12.7]	<.001
Tsunami-Related Traumatic Events				
Family member died or missing	190 (51.2) [44.6-57.8]	87 (27.0) [20.8-33.2]	48 (13.0) [8.8-17.3]	<.001
Injury to self or family member	214 (57.7) [51.5-63.9]	68 (21.1) [15.2-27.0]	51 (13.9) [9.2-18.5]	<.001
Lost home or property	366 (98.7) [97.5-99.8]	102 (31.7) [24.5-38.9]	73 (19.8) [14.7-25.0]	<.001
Lost livelihood	181 (48.8) [43.3-54.3]	61 (18.9) [14.0-23.9]	65 (17.7) [13.2-22.1]	<.001
Household member planned suicide	29 (7.8) [4.6-11.0]	9 (2.7) [1.0-4.6]	7 (1.9) [0.5-3.3]	<.001
Culture/Context–Specific Events				
Saw ghost	70 (18.9) [14.5-23.2]	22 (6.8) [3.9-9.8]	17 (4.6) [2.3-7.0]	<.001
Heard voice(s)	41 (11.1) [7.7-14.4]	10 (3.1) [1.2-5.0]	11 (3.0) [1.1-4.9]	<.001
General Health and Functioning				
Psychosomatic problem Stomach pain or headache	247 (66.6) [61.6-71.6]	185 (57.5) [51.3-63.6]	165 (44.8) [39.3-50.4]	<.001
Trouble sleeping	219 (59.0) [53.7-64.4]	186 (57.8) [51.9-63.7]	175 (47.6) [41.9-53.2]	.007
Role-emotional functioning†	72.8 (23.6)	77.8 (22.6)	80.0 (23.5)	<.001
General health perception†	64.4 (28.6)	66.8 (26.3)	69.3 (24.9)	.07
Bodily pain†	73.1 (28.5)	76.2 (26.7)	81.5 (25.0)	<.001
Social functioning†	65.7 (28.3)	74.9 (27.5)	75.5 (27.5)	<.001

Abbreviations: CI, confidence interval; PTSD, posttraumatic stress disorder.
*Values are expressed as number (percentage) [95% CI] unless otherwise indicated.
†Values are expressed as mean (SD).

pression were significantly higher among those who were displaced than among those who were not displaced in Phang Nga (all *P*<.05). Nondisplaced persons in Phang Nga, in turn, had higher prevalence rates for symptoms of PTSD, anxiety, and depression than nondisplaced persons in Krabi and Phuket (all *P*<.02).

Displaced persons experienced significantly more traumatic events. Fifty-one percent of displaced persons reported having had a family member who died or was missing compared with 27% of nondisplaced persons in Phang Nga (*P*<.001) and 13% of nondisplaced in Krabi and Phuket (*P*<.001). Almost all (98.5%) displaced persons had lost their home or property and almost half reported having lost their livelihood (Table 2).

The mean (SD) score for role-emotional functioning was lower among displaced persons (72.8 [23.6]) than among nondisplaced persons (77.8 [22.6]) in Phang Nga (*P*<.005); there were no differences in this respect between nondisplaced persons in Phang Nga and in Krabi and Phuket (mean [SD], 80.0 [23.5]).

The results of bivariate analysis for effects of demographic and trauma exposure variables on symptoms of PTSD appear in TABLE 3 and anxiety and depression appear in TABLE 4. Symptoms of PTSD, anxiety, and depression were significantly higher among displaced persons, those aged 35 to 54 years, those with lower education, and those who had no income after the tsunami. Rates of these conditions were also significantly higher among respondents who reported seeing ghosts or hearing voices and those who received mental health support after the tsunami. Anxiety and depression symptoms were significantly more common among women whereas PTSD symptoms were more common among those who were Buddhist. Symptoms of PTSD and depression were more common among those with a prior diagnosis of mental illness. Respondents who had experienced traumatic events, such as

Table 3. Bivariate Analysis of Effects of Demographic and Exposure Variables on Symptoms of PTSD Among Adults in Tsunami-Affected Provinces in Southern Thailand, 2005

Variable	PTSD		P Value
	No. (%)	OR (95% CI)	
Overall	77 (7.3)		
Venue			
Displaced (Phang Nga)	44 (11.9)	4.37 (1.99-9.59)	
Nondisplaced (Phang Nga)	22 (6.8)	2.38 (1.02-5.56)	<.001
Nondisplaced (Krabi/Phuket)	11 (3.0)	1.00	
Sex			
Male	23 (5.6)	1.00	
Female	54 (8.3)	1.52 (0.98-2.38)	.07
Age group, y			
15-34	20 (5.1)	1.00	
35-54	44 (9.7)	2.01 (1.13-3.59)	.04
≥55	13 (6.1)	1.21 (0.59-2.50)	
Marital status			
Married or living together	61 (7.8)	1.00	
Other	16 (5.7)	0.71 (0.39-1.31)	.27
Education			
Primary school or lower	59 (8.5)	1.79 (1.03-3.13)	.04
Higher than primary school	18 (4.9)	1.00	
Religion			
Buddhist	65 (8.4)	2.13 (1.05-4.35)	.04
Other	12 (4.1)	1.00	
Had income after tsunami			
Yes	40 (5.5)	1.00	
No	37 (11.0)	2.11 (1.26-3.54)	.005
Use of illicit drugs			
Yes	5 (10.4)	1.52 (0.58-3.99)	.40
No	72 (7.1)	1.00	
Had prior diagnosis of mental illness			
Yes	13 (20.6)	3.79 (1.80-7.99)	<.001
No	64 (6.4)	1.00	
Received mental health support after tsunami			
Yes	34 (11.9)	2.31 (1.40-3.80)	.001
No	43 (5.5)	1.00	
Family member died or missing during tsunami			
Yes	45 (13.9)	3.54 (2.13-5.87)	<.001
No	32 (4.4)	1.00	
Self or family member injured			
Yes	36 (10.8)	2.03 (1.24-3.32)	.005
No	41 (5.6)	1.00	
Lost home or property			
Yes	57 (10.5)	2.94 (1.68-5.15)	<.001
No	20 (3.9)	1.00	
Lost livelihood because of tsunami			
Yes	57 (18.6)	8.37 (4.78-14.64)	<.001
No	20 (2.7)	1.00	
Household member planned suicide			
Yes	8 (17.8)	2.97 (1.40-6.28)	.004
No	69 (6.8)	1.00	
Saw ghost(s)			
Yes	22 (20.2)	4.12 (2.34-7.26)	<.001
No	55 (5.8)	1.00	
Heard voice(s)			
Yes	11 (17.7)	3.05 (1.58-5.87)	.001
No	66 (6.6)	1.00	

Abbreviations: CI, confidence interval; OR, odds ratio; PTSD, posttraumatic stress disorder.

Table 4. Bivariate Analysis of Effects of Demographic and Exposure Variables on Symptoms of Anxiety and Depression Among Adults in Tsunami-Affected Provinces in Southern Thailand, 2005

Variable	Anxiety			Depression		
	No. (%)	OR (95% CI)	P Value	No. (%)	OR (95% CI)	P Value
Overall	314 (29.6)			216 (20.4)		
Venue						
Displaced (Phang Nga)	137 (36.9)	2.07 (1.42-3.02)		112 (30.2)	3.76 (2.39-5.90)	
Nondisplaced (Phang Nga)	96 (29.8)	1.51 (1.02-2.22)	<.001	66 (20.5)	2.24 (1.37-3.66)	<.001
Nondisplaced (Krabi/Phuket)	81 (22.0)	1.00		38 (10.3)	1.00	
Sex						
Male	84 (20.5)	1.00		63 (15.4)	1.00	
Female	230 (35.3)	2.12 (1.59-2.83)	<.001	153 (23.5)	1.69 (1.26-2.28)	.001
Age group, y						
15-34	87 (22.1)	1.00		59 (15.0)	1.00	
35-54	163 (36.0)	1.98 (1.44-2.73)	<.001	102 (22.5)	1.65 (1.14-2.39)	.004
≥55	64 (29.9)	1.51 (1.03-2.21)		55 (25.7)	1.96 (1.29-3.00)	
Marital status						
Married or living together	252 (32.3)	1.00		162 (20.8)	1.00	
Other	62 (22.1)	0.59 (0.43-0.83)	.002	54 (19.2)	0.91 (0.63-1.31)	.61
Education						
Primary school or lower	245 (35.3)	2.32 (1.72-3.23)	<.001	169 (24.3)	2.17 (1.52-3.13)	<.001
Higher than primary school	69 (18.9)	1.00		47 (12.8)	1.00	
Religion						
Buddhist	218 (28.3)	0.79 (0.57-1.11)	.19	164 (21.3)	1.24 (0.83-1.82)	.29
Other	96 (33.1)	1.00		52 (17.9)	1.00	
Had income after tsunami						
Yes	194 (26.8)	1.00		120 (16.6)	1.00	
No	120 (35.6)	1.51 (1.12-2.04)	.007	96 (28.5)	2.01 (1.44-2.78)	<.001
Use of illicit drugs						
Yes	22 (45.8)	2.09 (1.17-3.74)	.01	16 (33.3)	2.03 (1.13-3.65)	.02
No	292 (28.8)	1.00		200 (19.7)	1.00	
Had prior diagnosis of mental illness						
Yes	26 (41.3)	1.73 (0.98-3.07)	.06	23 (36.5)	2.40 (1.29-4.45)	.005
No	288 (28.9)	1.00		193 (19.3)	1.00	
Received mental health support after tsunami						
Yes	108 (37.9)	1.69 (1.23-2.32)	.001	80 (28.1)	1.84 (1.32-2.56)	<.001
No	206 (26.6)	1.00		136 (17.5)	1.00	
Family member died or missing during tsunami						
Yes	117 (36.0)	1.54 (1.14-2.08)	.005	107 (32.9)	2.82 (2.02-3.94)	<.001
No	197 (26.8)	1.00		109 (14.8)	1.00	
Self or family member injured						
Yes	141 (42.3)	2.36 (1.76-3.16)	<.001	109 (32.7)	2.82 (2.05-3.89)	<.001
No	173 (23.8)	1.00		107 (14.7)	1.00	
Lost home or property						
Yes	204 (37.7)	2.26 (1.67-3.04)	<.001	150 (27.7)	2.64 (1.86-3.74)	<.001
No	110 (21.2)	1.00		66 (12.7)	1.00	
Lost livelihood because of tsunami						
Yes	150 (48.9)	3.44 (2.58-4.58)	<.001	139 (45.3)	7.27 (5.17-10.24)	<.001
No	164 (21.8)	1.00		77 (10.2)	1.00	
Household member planned suicide						
Yes	24 (53.3)	2.86 (1.52-5.37)	.001	17 (37.8)	2.49 (1.31-4.73)	.005
No	290 (28.5)	1.00		199 (19.6)	1.00	
Saw ghost(s)						
Yes	58 (53.2)	3.09 (2.03-4.71)	<.001	49 (45.0)	3.84 (2.54-5.81)	<.001
No	256 (26.9)	1.00		167 (17.5)	1.00	
Heard voice(s)						
Yes	40 (64.5)	4.81 (2.76-8.38)	<.001	35 (56.5)	5.86 (3.53-9.72)	<.001
No	274 (27.4)	1.00		181 (18.1)	1.00	

Abbreviations: CI, confidence interval; OR, odds ratio.

having a family member who died or was missing, injury to self or a family member, loss of home or livelihood, or contemplation of suicide by a household member also had higher prevalence rates for symptoms of PTSD, anxiety, and depression.

In the multivariate analysis, displacement was no longer associated with mental illness or symptoms of PTSD,

anxiety, and depression. In this analysis, seeing ghosts of individuals who had died, having a family member who died or was missing, loss of livelihood, and having a household member contemplate suicide were independently associated with higher prevalence rates for symptoms of PTSD (**TABLE 5**). Factors associated with higher prevalence of anxiety were being female, age of 35 to

54 years, having a lower educational level, having a religion other than Buddhist, using illicit drugs, seeing ghosts, hearing voices, experiencing injury to self or a family member, loss of home or livelihood, or having a household member contemplate suicide. Factors significantly associated with increased symptoms of depression were being female, being older, hearing

Table 5. Multivariate Analysis of Symptoms of PTSD, Anxiety, and Depression Among Adults in Tsunami-Affected Provinces in Southern Thailand, 2005

Variable	PTSD		Anxiety		Depression	
	OR (95% CI)	P Value	OR (95% CI)	P Value	OR (95% CI)	P Value
Venue						
Displaced (Phang Nga)	1.67 (0.72-3.83)		0.91 (0.50-1.65)		1.69 (0.99-2.87)	
Nondisplaced (Phang Nga)	2.21 (0.96-5.20)	.18	1.42 (0.92-2.18)	.08	2.20 (1.29-3.73)	.01
Nondisplaced (Krabi/Phuket)	1.00		1.00		1.00	
Sex						
Male	*	*	1.00		1.00	
Female			2.41 (1.72-3.36)	<.001	2.07 (1.42-2.99)	<.001
Age group, y						
15-34	*	*	1.00		1.00	
35-54			1.73 (1.18-2.53)	.02	1.81 (1.19-2.77)	<.001
≥55			1.50 (0.95-2.37)		2.96 (1.78-4.92)	
Education						
Primary school or lower	*	*	1.92 (1.33-2.70)	<.001	*	*
Higher than primary school			1.00			
Religion						
Buddhist	*	*	0.62 (0.42-0.93)	.02	*	*
Other			1.00			
Use of illicit drugs						
Yes	*	*	2.21 (1.13-4.32)	.02	*	*
No			1.00			
Family member died or missing during tsunami						
Yes	1.91 (1.07-3.42)	.03	*	*	1.58 (1.05-2.38)	.03
No	1.00				1.00	
Self or family member injured						
Yes	*	*	1.55 (1.08-2.23)	.02	1.52 (1.01-2.27)	.04
No			1.00		1.00	
Lost home or property						
Yes	*	*	1.66 (1.04-2.66)	.04	*	*
No			1.00			
Lost livelihood because of tsunami						
Yes	6.42 (3.55-11.61)	<.001	2.51 (1.82-3.48)	<.001	6.07 (4.17-8.85)	<.001
No	1.00		1.00		1.00	
Household member planned suicide						
Yes	2.83 (1.19-6.76)	.02	2.37 (1.19-4.74)	.02	*	*
No	1.00		1.00			
Saw ghost(s)						
Yes	2.38 (1.33-4.24)	.003	1.70 (1.01-2.85)	.04	*	*
No	1.00		1.00			
Heard voice(s)						
Yes	*	*	2.84 (1.44-5.60)	.003	4.40 (2.33-8.35)	<.001
No			1.00		1.00	

Abbreviations: CI, confidence interval; OR, odds ratio; PTSD, posttraumatic stress disorder.
*Variable was not retained in backward stepwise regression procedure.

voices, having a family member who died or was missing, loss of livelihood, and being injured as a result of the tsunami.

In the follow-up survey, we were able to assess the prevalence of mental health problems in 73% (270/371) of displaced persons and in 80% (250/322) of nondisplaced persons in the Phang Nga province, who participated in the initial assessment. The cross-sectional prevalence rates of symptoms in persons who were displaced at the time of the first assessment significantly decreased from 11.9% to 7% for PTSD (odds ratio [OR], 0.46; 95% CI, 0.22-0.93; *P*=.04), from 36.9% to 24.8% for anxiety (OR, 0.42; 95% CI, 0.25-0.71; *P*=.001), and from 30.2% to 16.7% for depression (OR, 0.20; 95% CI, 0.10-0.41; *P*<.001). Among nondisplaced persons, rates of symptoms also decreased but the decreases were not statistically significant from 6.8% to 2.3% for PTSD (OR, 0.46; 95% CI, 0.17-1.28; *P*=.14), from 29.8% to 25.9% for anxiety (OR, 0.81; 95% CI, 0.47-1.39; *P*=.45), and from 26.5% to 14.3% for depression (OR, 0.58; 95% CI, 0.28-1.21; *P*=.14). At the time of the follow-up survey, the prevalence of PTSD remained significantly higher among displaced persons than among nondisplaced persons (OR, 3.23; 95% CI, 1.25-8.03; *P*<.02) but prevalences were rather similar for anxiety (OR, 0.94; 95% CI, 0.64-1.41; *P*=.78) and depression (OR, 1.21; 95% CI, 0.75-1.92; *P*=.45).

COMMENT

This rapid assessment of random samples of persons residing in tsunami-affected areas in southern Thailand revealed high prevalences of mental illness among displaced and nondisplaced persons 8 weeks after the disaster. The higher prevalences for symptoms of PTSD, anxiety, and depression reported by displaced persons may have been due to the higher levels of impact experienced by this population. However, following multivariate analysis, displacement status was not independently associated with higher levels of symptoms of mental illness.

Bivariate analysis showed that a prior diagnosis of mental illness and receipt of mental health support after the tsunami were more common among displaced persons and were also associated with symptoms of PTSD, anxiety, and depression. This finding may be partially explained by an overreporting of mental health conditions by displaced persons and by the increased vulnerability of this group, making them more likely to seek mental health support and more likely to report symptoms. However, these associations were no longer significant in multivariate analysis.

Multivariate analysis also showed a number of demographic and trauma exposures that were independently associated with symptoms of PTSD, anxiety, and depression. Loss of livelihood as a result of the tsunami was independently and significantly associated with all 3 mental health conditions.

Little is known about the transient character of postdisaster mental health problems. For surveillance purposes, we conducted a follow-up survey of the prevalence for the symptoms of PTSD, anxiety, and depression among persons enrolled in the first assessment in the Phang Nga province, the high-impact cluster, 9 months posttsunami, using the same instruments. By that time, prevalence rates for symptoms of PTSD, anxiety, and depression in displaced persons had significantly decreased. At 9 months postdisaster, the prevalence rate for symptoms of PTSD was significantly higher among displaced persons and the prevalence rates for symptoms of anxiety and depression were rather similar. These findings suggest that over time there is a significant decrease in the prevalence of posttraumatic stress reactions, particularly among the displaced, which were the most severely affected. This decrease may be due to spontaneous recovery under improved social and environmental conditions, such as more permanent housing for displaced persons, continued mental health support and occupational

training, and restoration of livelihood programs, which were implemented in Phang Nga province by multiple governmental and nongovernmental organizations.

Even though non-Thai tourists accounted for approximately half of all deaths reported in Thailand,[3] a myriad of logistical problems (eg, language differences, lack of sampling frame, tourists who had returned to their homes) prevented us from assessing the prevalence of mental health problems in this population.

In this study of the survivors of the tsunami in southern Thailand, symptoms of depression and anxiety were more common than symptoms of PTSD, which is similar to findings from several other postdisaster studies.[6,18,21] Grief, loss, uncertainty about the future, and the prospect of a possible recurrence of the tsunami may all play a role in the higher levels of depression and anxiety. Symptoms of PTSD on the other hand reflect a prior traumatic experience and may therefore have a less prominent role as a postdisaster mental health condition.

In our assessment, the prevalence for symptoms of PTSD among displaced persons and others affected by the tsunami was lower than that found among war-affected populations in Kosovo and Afghanistan.[5,18] In comparison, we previously reported a prevalence for symptoms of PTSD of 17% shortly after the end of the war in Kosovo and 42% in postwar Afghanistan.[5,18] One study found that the severity, symptom profile, and course of PTSD did not differ between persons exposed to a natural disaster (earthquake) and those exposed to human-perpetrated violence.[24] Our study found that the prevalence rate for symptoms of PTSD in the lower-impact cluster (Krabi and Phuket) was not higher than that in the general US population.[25] Overall, the prevalence of PTSD symptoms in our study population was lower than that in other populations affected by natural disasters. For instance, the prevalence rate of PTSD in communities affected by Typhoon Rusa in South Korea

was 36%[26]; prevalence among earthquake survivors in Turkey, 23%[27]; and among survivors of floods and mudslides in Mexico, 46%.[28] These differences may be due to variances in the duration and severity of disasters and culturally specific coping mechanisms. The Buddhist component of the Thai belief system, for instance, contemplates that life is to a certain extent predetermined and the result of one's own actions or karma.[29,30] This belief may help Buddhists accept and overcome negative events occurring during the course of their lives, which would be consistent with findings from other studies showing a protective effect of the Buddhist religion on anxiety and depression.[31,32]

Another aspect of the Thai belief system is the notion that every space, be it air or water, has a ruler or spirit, a supernatural power that governs the space.[29,30] For individuals to share the space, the ruler needs to be informed and pleased and its territory must be respected. Anecdotal conversations with tsunami survivors indicate that many individuals believe that overfishing and exploitation of the sea were causes of the tsunami, a revenge of the spirits of the sea. The notion of carrying a certain responsibility for the occurrence of the tsunami may make it easier to accept and cope with its consequences.

Tsunami survivor reports of seeing ghosts or hearing voices may be explained by the fact that the bodies of many tsunami victims were never found or could not be identified.[33,34] This may have caused distress among family members and others because Thai culture dictates that appropriate rituals for the dead are necessary for their ghosts to come to rest. Without funeral rites or with improperly performed funeral rites, it is believed that the deceased is reincarnated as a malevolent ghost (*phii*). Regarding the association of seeing or hearing ghosts with 1 or more mental health problems, it is likely that at least to some extent both phenomena are due to the loss of loved ones during the tsunami. Reports of seeing or hearing ghosts are common among

rural Thais and are not confined to periods of disaster or specific events but are a normal part of Thai culture and beliefs.[29,30] Hence, in most cases this phenomenon should be interpreted in the context of the local belief system and as a culturally specific way of coping with death and reincarnation rather than a symptom of mental illness.

Our survey shows that a focus on mental disorders other than PTSD, such as anxiety and depression, is justified. Most displaced persons had lost a family member, were injured, or had a family member who was injured during the tsunami. The loss of a family member was significantly associated with depression. Having sustained an injury was associated with symptoms of both depression and anxiety. The prevalence rate for symptoms of depression was higher than in US baseline populations (6%)[25] and comparable with that found in communities affected by natural disasters.

Some limitations of our assessment need to be mentioned. Two of the instruments used in our study were developed and validated in the Western world and cultural factors may therefore play a role in the underreporting or overreporting for symptoms of PSTD, anxiety, and depression. Also, due to time constraints, instruments could not be formally pretested or retested among the target population. On the positive side, instruments were the same for all subpopulations and did not change over time, allowing comparisons between groups and detection of trends. In addition, our instruments were similar to those used in many other postdisaster surveys, allowing comparison across studies and with the international scientific literature. The HSCL-25, HTQ, and SF-36 have been widely translated and used in diverse cultural groups, validated against clinical diagnoses, and have demonstrated high internal consistency and reliability in studies. The HTQ has been used in Thailand among Cambodian refugees.[21] The HSCL-25, selected questions from the SF-36, and the HTQ also have been used in a mental health sur-

vey among Karenni refugees on the Thai Burmese border.[6]

Another limitation is the relatively low participation rate (58% to 69%) in our survey. This is particularly concerning if nonparticipants had lower or higher prevalences of mental health illness than participants. However, in our assessment, refusal to participate was rare and nonparticipation was usually the result of absence or unknown whereabouts of the individual in the chaotic postdisaster environment. Even though participants did not differ by sex and age from nonparticipants, other factors may have accounted for differences that could not be assessed or controlled for in this study.

An additional drawback of the low participation rate is that we did not reach the target sample size of 392 displaced persons in Phang Nga. However, the estimate of our sample size was rather conservative because we considered the population size of displaced persons to be infinite and doubled our sample size to control for the design effect of cluster sampling. It is therefore unlikely that our sample size of 371 displaced persons has limited our ability to detect differences regarding displacement in our multivariate analysis. A more likely explanation for the lack of association between displacement status and mental illness is that the former is a surrogate for the loss of a family member or loved one, loss of home or livelihood, and having been injured as a result ot the tsunami—all of which were significantly associated with 1 or more mental health problems.

The loss of livelihood as a result of the tsunami in southern Thailand was extensive. The affected coastal areas were heavily dependent on the fishing and tourist industries, which came to an almost complete standstill after the disaster. In our survey, loss of livelihood was significantly associated with symptoms of PTSD, anxiety, and depression. Restoration of persons' livelihoods to prevent and diminish mental morbidity among populations affected by natural disasters is therefore of utmost importance.

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