Community Patterns of Psychiatric Disorders After the *Exxon Valdez* Oil Spill

Lawrence A. Palinkas, Ph.D., John S. Petterson, Ph.D., John Russell, Ph.D., and Michael A. Downs, Ph.D.

Objective: *This study examined the relationship between exposure to the Exxon Valdez oil spill and subsequent cleanup efforts and the prevalence of generalized anxiety disorder, posttraumatic stress disorder (PTSD), and depressive symptoms in 13 Alaska communities.* *Method:* *A community survey of 599 men and women was conducted approximately 1 year after the spill occurred. Questions from the National Institute of Mental Health Diagnostic Interview Schedule were used to assess symptoms of generalized anxiety disorder and PTSD. The Center for Epidemiologic Studies Depression (CES-D) Scale was used to assess levels of depressive symptoms.* *Results:* *The post-spill (i.e., 1-year) prevalence of generalized anxiety disorder and PTSD for the study communities with all degrees of exposure was 20.2% and 9.4%, respectively. The prevalence of respondents with CES-D Scale scores above 16 and 18 was 16.6% and 14.2%, respectively. When compared with the unexposed group, members of the high-exposure group were were 3.6 times as likely to have generalized anxiety disorder, 2.9 times as likely to have PTSD, 1.8 times as likely to have a CES-D Scale score of 16 and above, and 2.1 times as likely to have a CES-D Scale score of 18 and above. Women exposed to this event were particularly vulnerable to these conditions, and Alaska Natives were particularly vulnerable to depressive symptoms after the oil spill.* *Conclusions:* *The results suggest that the oil spill's impact on the psychosocial environment was as significant as its impact on the physical environment. The Exxon Valdez experience suggests a number of implications for the mental health needs of disaster victims, particularly in primary care settings.*
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On March 24, 1989, an accident involving the supertanker *Exxon Valdez* resulted in a spill of 11 million gallons (260,000 barrels) of crude oil into the waters of Prince William Sound, Alaska. During the months following the spill, the primary focus of public concern and subsequent mitigation efforts by Exxon and federal, state, and local agencies was on the direct environmental and economic impact. Relatively little attention was paid to the indirect social and psychological impact. Significantly increased rates of physical health symptoms and psychiatric disorders have been found in studies of victims of other natural and technological disasters (1–8). However, the *Exxon Valdez* experience differed from previous disasters such as Three Mile Island and Mount St. Helens in that the victims were never in physical danger and the perceived risk to their personal safety was believed to be relatively low. Threat of injury or death and the scope and intensity of property destruction have been found in previous studies to contribute to the impact of a disaster (9).

Nevertheless, the *Exxon Valdez* oil spill threatened the traditional subsistence activities of Alaska Natives who lived in the affected region and the commercial fishing activities of Alaska Natives and non-Alaska Natives alike. In the months after the oil spill, there were a number of reports of community conflict created by the unequal distribution of cleanup jobs and compensation for the use of boats and equipment owned by local residents, as well as the influx of outsiders and resulting strain on community services (10, 11). Moreover, visits to community clinics for primary care and mental health services throughout the affected region also increased dramatically after the spill (11).

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This paper presents cross-sectional data collected from a household survey of 599 residents living in 13 different communities in the Prince William Sound, Kenai Peninsula, Kodiak Island, Alaska Peninsula, and Southeast Alaska regions. The objectives of this study were to describe the prevalence of selected psychiatric conditions 1 year after the oil spill and to examine the association between the prevalence of these disorders and levels of exposure to the oil spill and subsequent cleanup efforts.

METHOD

Sample

A survey of 599 households in 13 communities was conducted between March 30 and May 15, 1990. Eleven of the communities (N=437 households) were in the region directly exposed to the oil spill itself. In addition, two communities in southeast Alaska away from the oil spill (N=162 households) served as a source of unexposed respondents. These two were selected because of their similarities to the two major types of communities in the affected region with respect to their demographic (large, predominately non-Alaska Native versus small, predominately Alaska Native) and economic (based primarily on commercial extraction of natural resources versus heavily involved in subsistence production and distribution) characteristics.

Sampling frames were developed in the field from Census Bureau tract maps, other city maps, or maps developed by interviewers and local experts. In some instances, addresses were drawn from electric company billing listings. In each community, however, the number and location of households were verified by a census conducted by study field workers. After the addresses of all domiciles in the community were listed, numbers were assigned to each household in the sampling frame.

After the sampling frame for each community was completed, random samples of households were drawn at a predetermined ratio by using computer-generated tables of random numbers. For communities with more than 650 households (e.g., Valdez, Cordova, Seward, and Kodiak), approximately 7% of the households were selected for interviewing. Smaller communities, such as Tatitlek, Chenega Bay, Chignik, and Akhiok, were intentionally oversampled at a 50% or higher ratio based on the total number of households in order to obtain sufficient numbers of Alaska Natives for analysis. Replacement households, necessitated in the case of refusals or unoccupied dwellings, were also selected from the same sampling frame by using a table of random numbers.

Once each household was selected, a respondent within the household was randomly selected on the basis of birth date. For all persons within the household who were at least 18 years of age, the one whose birthday was closest to the date of the interview was selected as the respondent. If, for some reason, that person was unable to be interviewed, then the person with the next closest birth date was selected. Informed consent was obtained from each respondent after the interview procedures had been fully explained. Interviews were conducted by 15 trained field workers and lasted between 45 and 120 minutes.

Eighty-four percent of all randomly selected respondents agreed to participate. The sociodemographic characteristics of the sample were compared to those reported for each community in the most recent local census available. No significant differences were found in the distribution of study samples and community residents by age (excluding residents under 18 years of age), sex, and ethnicity, which suggests that overall the sample was representative of the population of each community.

Measures

Demographic variables. Demographic variables examined included age, gender, ethnicity, and socioeconomic status. Ethnicity was assessed on the basis of respondent identification with one of 12 categories: white/Caucasian, Koniag/Aleut/Sugpiaq, Eyak, Athapaskan, Yup'ik/Inupiaq, other Alaska Native, Filipino, Hispanic, Asian/Oriental, black, American Indian, and other. These categories were further dichotomized into Alaska Native and non-Alaska Native groups. Socioeconomic status was determined on the basis of number of years of formal education, median household income for 1989, and employment status. Respondents were classified into two groups on the basis of whether their household income was above or below a median of $40,000. Employment status was defined on the basis of whether an individual was unemployed but looking for work.

Exposure. Following the procedure used in cross-sectional studies of previous disasters (2, 3, 5–8), the impact of the oil spill on the selected psychiatric disorders was determined by classifying study participants on the basis of their exposure to the oil spill and subsequent events. This was assessed on the basis of responses to six different questions: 1) Did you or anyone in your household use, before the spill, areas along the coast that were affected by the spill? 2) Did you work on any of the shoreline or water cleanup activities of the oil spill? 3) Are there any other ways that you came into contact with the oil spill or cleanup activities, such as during recreation, hunting, fishing, or gathering activities? 4) Did you have any property that was lost or damaged because of the oil spill or cleanup? 5) Did the oil spill cause any damage to the areas where you or other household members fish commercially? 6) Has the oil spill directly affected the hunting, fishing, or gathering activities of any members of this household? Each response was coded 0 for a no response and 1 for a yes response; the responses were then summed to provide a continuous measure of exposure with a range of 0 to 6 in an ordinal scale. The Exposure Index was found to have an internal consistency reliability (Cronbach's alpha) of 0.74 for this population. The mean exposure score for all study respondents was 1.97 (SD=1.77). Subjects were classified into three groups on the basis of maximum level of exposure. Residents in the affected communities were classified as being either exposed or unexposed, depending on whether their Exposure Index score fell above or below the group median of 2.00. Exposed residents were further dichotomized into low-exposure (Exposure Index score=2 or 3) and high-exposure (score=4 and above) groups on the basis of a median split.

Anxiety. A modified version (i.e., with an abbreviated panel of questions relating to physical causes of symptoms and physician consultation for any one symptom) of the National Institute of Mental Health Diagnostic Interview Schedule (DIS) (12) was used to detect cases of "generalized anxiety disorder," based on DSM-III criteria. Respondents first had to acknowledge anxiety (i.e., a positive response to the question, "Have you ever had a time when for a month or more most of the time you felt worried or anxious, perhaps afraid that something bad was going to happen either to you or someone that you cared about?"). In addition, respondents had to acknowledge at least three additional symptoms of anxiety. These included one or more symptoms of motor tension (i.e., muscle tension, restlessness, and easy fatigability), one or more symptoms of autonomic hyperactivity, and one or more symptoms of vigilance and scanning (i.e., feeling keyed up or on edge, difficulty concentrating, trouble falling or staying asleep, and irritability).

Posttraumatic stress disorder (PTSD). A modified version of Version III of the DIS (13) was used to identify cases of PTSD, based on DSM-III-R criteria. A respondent was diagnosed with PTSD if he or she experienced 1) one or more of the following: persistent unpleasant memories, repeated bad dreams or nightmares, disturbing memories, feeling worse when in a situation reminiscent of a past event, and a flashback; 2) three or more of the following: loss of interest in previously important activities, trying hard not to think of something that happened to you, no longer caring about previously important activities, avoidance of places or activities reminiscent of something that had happened, avoidance of feelings about a past event, avoidance of other people, loss of feeling or reduction in emotion, change in future plans, and inability to remember part of past; and 3) two of the following: trouble concentrating, vigilance, insomnia, startled by noise, feeling panicky or fearful or anxious, irritability, and autonomic hyperactivity (sweating, breathing heavily, heart pounding).

Depressive symptoms. Depressive symptoms were measured by using the Center for Epidemiologic Studies Depression (CES-D) Scale

(14). The CES-D Scale was selected for use in this particular study for three reasons: 1) it reflected an attempt to incorporate both symptom-based (2, 9, 15) and diagnosis-based (3, 5–8, 16) (represented by the DIS measures) traditions in disaster stress research; 2) given the relatively small population, it was uncertain whether we would have sufficient statistical power to examine the association between exposure and DSM-III diagnoses; and 3) preliminary pilot testing of both the CES-D Scale and DIS depressive disorders scales in the study communities indicated that the former was easier and took less time to administer, an important consideration in an interview that lasted as long as 2 hours.

Respondents described their mood over the past week by rating each of 20 items on a scale from 0 (rarely or none [less than 1 day]) to 3 (most or all [5–7 days]). A depression score was calculated for each respondent by summing the ratings, after first reversing the ratings of four reverse-worded items. If a respondent had completed 85% or more of the CES-D Scale items but less than 100% (N=10), responses to missing items were imputed by using the mean of that person's answers to the nonmissing items.

Data on the scale's reliability and validity are reported elsewhere for general populations (14, 17). In this population, the CES-D Scale was found to have an internal consistency reliability (Cronbach's alpha) of 0.88; among Alaska Native respondents, the reliability was 0.90 and among non-Alaska Native respondents, the reliability was 0.86.

Respondents with scores of 16 or above were classified as being depressed for the purpose of calculating prevalence rates. A number of studies have documented the validity of this cutoff point in distinguishing groups with high depressive symptoms from those with low depressive symptoms (14, 17–19). However, the use of this cutoff point was not intended to ascertain rates of clinical depression as defined by DSM-III or DSM-III-R in the general population (20). Moreover, the validity of this cutoff point as a method for screening American Indians/Alaska Natives has never been documented. We therefore calculated the prevalence of scores of 18 and above, 20 and above, and 24 and above in this population, based on the findings of earlier studies that higher cutoff points lead to an increase in the scale's specificity and reduction in positive misclassification rate (proportion of screen positive cases that are criterion negative cases)—at the risk of also lowering the scale's sensitivity (20, 21). Although similar associations between exposure level and CES-D Scale scores of 18 and above, 20 and above, and 24 and above were found in univariate analyses, we report only the prevalence of CES-D Scale scores of 16 and above and 18 and above in this paper.

Statistical Analysis

Prevalence rates of depressive symptoms, generalized anxiety disorder, and PTSD were calculated on the basis of percentage of respondents or groups of respondents who met the criteria for these conditions. Post-spill prevalence rates, based on respondents' recollections of having experienced the symptoms within the past year (i.e., after the oil spill), were calculated for generalized anxiety disorder and PTSD by using DIS algorithms. Lifetime prevalence rates were also calculated for these disorders, based on respondents' recollections of ever having experienced these symptoms. The prevalence of CES-D Scale scores of 16 and above and 18 and above were based on reports of depressive symptoms experienced within the previous week.

Comparison of prevalence rates and proportional distributions of demographic characteristics across the three exposure categories were based on a chi-square test for trend in proportions (22). In addition to levels of exposure, other potential risk factors, including age, sex, ethnicity, marital status, and socioeconomic status variables, were analyzed by means of univariate logistic regressions that were used to calculate odds ratios and 95% confidence intervals. Factors that had statistically significant odds ratios were then entered into multivariate logistic regression analyses by using SPSSPC software to estimate adjusted odds of each factor, controlling for all other factors. Finally, interaction terms were added to the main effects to determine whether respondents were particularly vulnerable to the effects of exposure on the prevalence of each psychiatric condition on the basis of age, sex, and ethnicity. At this step, each of the main effects and respective two-way interaction terms were subjected to a forward selection, whereby they were added to the model if their inclusion contributed significantly ($p<0.05$) to the classification of whether or not respondents had a specific psychiatric condition.

To permit later cross-validation analyses, we first developed multivariate logistic models for each psychiatric condition on a randomly selected subset of two-thirds of the respondents. Then we cross-validated the models by applying them to the remaining one-third of the respondents and assessing how accurately the respondents were classified as to psychiatric condition.

TABLE 1. Demographic Characteristics of *Exxon Valdez* Study Respondents (N=593) by Exposure Status, 1990[a]

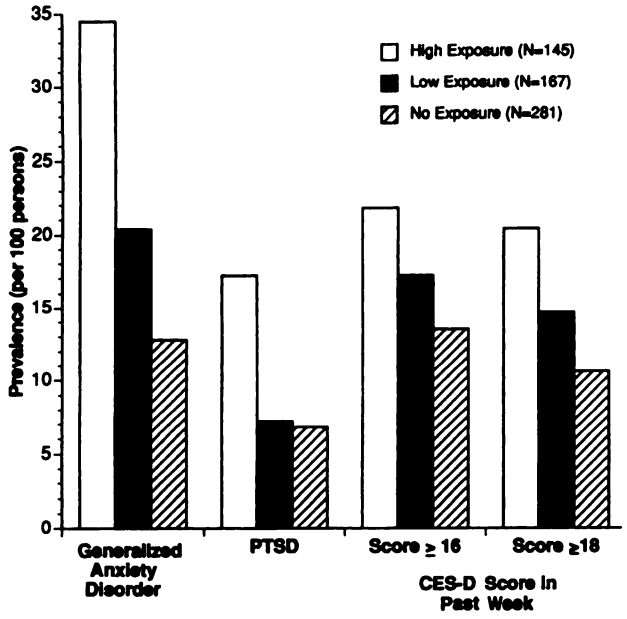
	Exposure Status					
	High (N=145)		Low (N=167)		Unexposed (N=281)	
Item	N	%	N	%	N	%
Gender						
Male	83	57.2	81	48.5	134	47.7
Female	62	42.8	86	51.5	147	52.3
Age (years)						
18–24	16	11.0	13	7.8	14	5.0
25 or older	129	89.0	154	92.2	267	95.0
Ethnicity						
Alaska Native	61	42.1	59	35.3	69	24.6
Non-Alaska Native	84	57.9	108	64.7	212	75.4
Education						
Less than 12 years	21	14.5	32	19.2	42	14.9
High school graduate	124	85.5	135	80.8	239	85.1
1989 household income						
Less than $40,000	51	35.2	77	46.1	144	51.2
$40,000 or more	94	64.8	90	53.9	137	48.8
Unemployment rate[b]	2	1.4	5	3.0	7	2.5
Marital status						
Married[c]	101	69.7	111	66.5	202	71.9
Never married	22	15.2	19	11.4	28	10.0
Separated/divorced/ widowed	22	15.2	37	22.1	51	18.1

[a]Information on exposure status was missing for six respondents.
[b]Respondents not working but looking for work.
[c]Includes living with a significant other.

RESULTS

A description of the characteristics of the study respondents by exposure status is provided in table 1. Overall, approximately 50% of the study respondents were male; 62% were between the ages of 25 and 44 years (mean age=41.1 years, SD=14.4); 68% were non-Alaska Native; 84% had 12 or more years of formal education; 54% belonged to households that earned $40,000 or more in 1989; 2% were unemployed and looking for work at the time of the survey; and 70% were currently married or living with a significant other. Exposure groups differed from one another only with respect to ethnicity ($\chi^2=14.3$, df=2, $p<0.001$) and 1989 median household income ($\chi^2=9.23$, df=2, $p<0.01$). Alaska Natives were slightly overrepresented in the high-exposure group and slightly underrepresented in the low-exposure group. Household income was associated with greater exposure because many of the residents living in affected communities were paid by Exxon to assist in cleanup efforts. Otherwise, the three

FIGURE 1. Prevalence of Generalized Anxiety Disorder[a], PTSD[a], and Depressive Symptoms[b] in *Exxon Valdez* Study Respondents (N=593) by Exposure Status, 1990



[a]One year after the oil spill.
[b]CES-D Scale scores of 16 and above and 18 and above within the past week.

exposure groups were fairly well matched with respect to distribution of age, gender, marital status, and socioeconomic status.

The lifetime prevalence of generalized anxiety disorder and PTSD in the study region (including the control communities) was 27.2% and 21.5%, respectively. The post-spill (i.e., symptoms reported to have been present within the year since the spill) prevalence of generalized anxiety disorder and PTSD was 20.2% and 9.4%, respectively. The prevalence of CES-D Scale scores of 16 and above and 18 and above in the study region was 16.6% and 14.2%, respectively.

Exposure status was significantly associated with the post-spill prevalence of generalized anxiety disorder (χ^2 trend=27.01, df=1, p<0.0001), PTSD (χ^2 trend=10.50, df=1, p=0.001), and CES-D Scale scores of 16 and above (χ^2 trend=4.72, df=1, p=0.03) and 18 and above (χ^2 trend=7.44, df=1, p=0.006) (figure 1). When compared with the unexposed group, members of the high-exposure group were 3.58 (95% confidence interval= 2.20–5.87) times as likely to have generalized anxiety disorder, 2.87 (95% confidence interval=1.53–5.44) times as likely to have PTSD, 1.79 (95% confidence interval=1.06–3.03) times as likely to have a CES-D Scale score of 16 and above, and 2.13 (95% confidence interval=1.19–3.84) times as likely to have a CES-D Scale score of 18 and above. Members of the high-exposure group were also 2.06 (95% confidence interval= 1.24–3.43) times as likely to have generalized anxiety disorder as were members of the low-exposure group who, in turn, were 1.74 (95% confidence interval= 1.16–2.91) times as likely to have generalized anxiety disorder as the unexposed group; this indicates a monotonic dose-response relationship between exposure and the prevalence of generalized anxiety disorder.

Each of these psychiatric disorders was further examined to determine if certain social or cultural factors contributed to the excess risk. Logistic regression analyses were performed to test the effects of age, sex, ethnicity, education, 1989 household income, marital status, employment status, and exposure to the spill and cleanup on the likelihood of each psychiatric disorder. Sex was significantly associated with PTSD, generalized anxiety disorder, and CES-D Scale scores of 16 and above and 18 and above. Age was significantly associated with PTSD and CES-D Scale scores of 16 and above and 18 and above. Ethnicity was significantly associated with generalized anxiety disorder and CES-D Scale scores of 16 and above and 18 and above. Marital status and socioeconomic status measures of education, 1989 household income, and employment status were not significantly associated with any of the assessed psychiatric conditions.

Multivariate models were then developed on a two-thirds (N=400) random sample of the respondents. When age, sex, and ethnicity were controlled, members of the high-exposure group were 3.73 times as likely to have generalized anxiety disorder, 2.63 times as likely to have PTSD, 1.81 times as likely to have a CES-D Scale score of 16 and above, and 2.13 times as likely to have a CES-D score of 18 and above as were members of the unexposed group (table 2). Members of the high-exposure group were also 1.95 (95% confidence interval=1.04–3.64) times as likely to have generalized anxiety disorder as were members of the low-exposure group who, in turn, were 1.91 (95% confidence interval=1.01–3.60) times as likely to have generalized anxiety disorder as members of the unexposed group. The monotonic dose-response relationship found in the univariate analysis thus persisted when age, sex, and ethnicity were controlled. Female sex was independently associated with the likelihood of generalized anxiety disorder, PTSD, and a CES-D Scale score of 18 and above. Young age (18–24 years old) and Alaska Native ethnicity were independently associated with the likelihood of CES-D Scale scores of 16 and above. The generalized anxiety disorder, PTSD, CES-D Scale ≥16 and CES-D Scale ≥18 models correctly classified 79.6%, 89.8%, 84.4% and 86.5% of the respondents, respectively.

To determine whether specific segments of the subject population were particularly vulnerable to the effects of exposure to the oil spill and cleanup activities on each of the psychiatric conditions, interaction terms for age, sex, and ethnicity with exposure were added to the main effects models, which were subjected to a forward selection procedure. Women were particularly vulnerable to the effects of exposure to the oil spill and cleanup activities on the prevalence of generalized anxiety disorder (beta=0.22, p<0.0001; odds ratio=1.43,

TABLE 2. Odds Ratios and 95% Confidence Intervals for Psychiatric Disorders Associated With Sociodemographic Characteristics and Increasing Levels of Exposure to the *Exxon Valdez* Oil Spill and Clean-Up Activities: Results of Logistic Regression Analyses

	Generalized Anxiety Disorder		PTSD		CES-D Scale Score ≥16		CES-D Scale Score ≥18	
Risk Factor	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
Sex								
Male	1.00		1.00		1.00		1.00	
Female	1.90	1.13–3.19	2.20	1.10–4.42	1.66	0.94–2.92	2.10	1.13–3.91
Age (years)								
25 or older	1.00		1.00		1.00		1.00	
18–24	1.14	0.44–2.95	1.45	0.45–4.64	3.14	1.29–7.65	2.17	1.46–5.70
Ethnicity								
Non-Alaska Native	1.00		1.00		1.00		1.00	
Alaska Native	1.30	0.77–2.22	1.02	0.50–2.08	1.81	1.02–3.19	1.38	0.74–2.57
Exposure status								
Unexposed	1.00		1.00		1.00		1.00	
Low	1.91	1.01–3.60	0.84	0.34–2.07	1.52	0.78–2.96	1.69	0.82–3.50
High	3.73	1.99–6.97	2.63	1.22–5.66	1.81	0.91–3.61	2.13	1.01–4.50

95% confidence interval=1.23–1.67), PTSD (beta=0.19, $p<0.001$; odds ratio=1.40, 95% confidence interval= 1.15–1.69), and CES-D Scale scores of 18 and above (beta=0.17, $p<0.001$; odds ratio=1.35, 95% confidence interval=1.13–1.60). Alaska Natives were particularly vulnerable to the effects of exposure on the prevalence of CES-D Scale scores of 16 and above (beta=0.14, $p<0.01$; odds ratio=1.28, 95% confidence interval= 1.08–1.50). The percent of respondents correctly classified with respect to generalized anxiety disorder, PTSD, and CES-D Scale scores of 16 and above and 18 and above by these models was identical to the percent of respondents correctly classified by each of the main effects models.

Finally, we conducted cross-validation analyses to assess the stability of the main effects models and main effects plus two-way interactions models. The models derived from the two-thirds random sample of the respondents were applied to the remaining one-third of the respondents. In the main effects models, the high-exposure respondents had significantly greater odds of generalized anxiety disorder, PTSD, and CES-D Scale scores of 18 and above. In the main effects plus two-way interaction models, the vulnerability of women to PTSD and CES-D Scale scores of 18 and above after exposure to the oil spill and cleanup remained statistically significant. When the main effects models and the main effects plus two-way interactions models were applied to the 199 respondents in the cross-validation subsample, 81.4%, 92.2%, 83.6%, and 88.4% of the respondents were correctly classified with respect to the prevalence of generalized anxiety disorder, PTSD, and CES-D Scale scores of 16 and above and 18 and above, respectively.

DISCUSSION

These results document the profound impact that exposure to the oil spill had on the prevalence of psychiatric disorders in residents living in affected communities. Similar results have been reported in studies of the psychological effects of other disasters, which have documented increasing rates of psychiatric disorders with increasing exposure (1–8, 23), although the rates reported in these studies vary considerably. For instance, the 21.5% lifetime prevalence of PTSD in this study is substantially larger than the 1% lifetime prevalence reported in the St. Louis Epidemiological Catchment Area (ECA) cohort (24), the 1.3% prevalence reported in North Carolina (25), and the 9.2% lifetime prevalence in young adults living in the Detroit area (26). The 17.2% post-spill prevalence of PTSD in the high-exposure group is lower than the 29% prevalence found in a study of on-site hotel employees who survived a plane crash into a hotel (3); however, it is higher than the 5.2% prevalence in persons directly exposed to floods and dioxin contamination (16) and the 2.7%–4.5% prevalence among survivors of the Mount St. Helens disaster (8). The 34.5% prevalence of generalized anxiety disorder in the high-exposure group was higher than the 29% prevalence in hotel employees, the 16.3% prevalence in persons exposed to dioxin and floods, and the 10.9% of survivors of the Mount St. Helens eruption. However, comparisons of rates reported in studies of disaster victims are often complicated by differences in the nature of the trauma, length and severity of exposure to the disaster, and the social and psychological characteristics of the victims of each event (27). Thus, caution should be exercised when comparing the results of this study with those of other disaster studies.

Women and Alaska Native residents of these communities appear to have been especially vulnerable to these negative effects. A study of the psychological impact of the Mount St. Helens disaster found that female disaster victims had significantly higher rates of psychiatric disorders than males (6–8). Community surveys have also found female gender to be a risk factor for PTSD after exposure to traumatic events (26). Although no

other study to date has examined ethnic differences in disaster-related stress, possible explanations for the vulnerability of Alaska Natives to this event include predisaster psychiatric condition—as evidenced by high rates of alcohol abuse, psychiatric inpatient admission, and suicide (28, 29)—and the oil spill's effect on subsistence activities that provide the foundation for social support and community cohesion (11, 30).

The *Exxon Valdez* experience contains a number of implications for the mental health needs of disaster victims, particularly in primary care settings. Technological disasters leading to increased rates of psychiatric disorders can be expected to lead to substantial increases in utilization of primary care services. In the Medical Outcomes Study, Wells and associates (31) found that patients with depressive symptoms, even in the absence of clinical depression, had poor functioning as assessed by physical limitations, role performance, social activities, and number of bed days; their symptoms were thus of considerable clinical significance. Poor well-being and functioning are also of policy interest because of the societal costs due to loss of productivity, increased family burdens, and any associated use of health services (32). This utilization does not extend merely to mental health services. Most persons suffering from clinically significant depressive symptoms do not receive treatment, and most in treatment consult a primary care physician rather than a mental health service (33, 34). This is especially true in rural Alaska, where health care in small, predominately Alaska Native communities is provided by community health aides, family physicians, or other primary care providers. Moreover, reluctance to seek mental health services is particularly salient among Alaska Natives because of the shame and cultural stigma associated with alcohol abuse and mental disorders (28, 35) and the constraints imposed on access to mental health care, especially in villages, by the necessity of leaving one's home, often for long periods.

Several qualifications must be placed on the interpretation of these results. The 16.6% prevalence of CES-D Scale scores of 16 or greater reported in this study is much higher than the 6-month prevalence rates of DSM-III depressive disorders (ranging from 0.1% to 1.6% for major depressive episodes and from 0.5% to 3.1% for dysthymia) found in the ECA studies (36); however, comparison between the results of this study and those of the ECA studies are limited by differences in study criteria (depressive symptoms versus DSM-III diagnoses) and measurement (CES-D Scale versus DIS protocol). Since the CES-D Scale is intended to be used for screening purposes only, no attempt was made to use a CES-D Scale score of 16 or greater as a measure of major depressive disorder in this particular population.

Another qualification of this study is the possibility of reporting bias in that persons with psychiatric disorders may have used the oil spill to justify their symptoms and thus overreported levels of exposure to the spill. As noted earlier, Alaska Natives in particular are believed to be at risk for psychiatric disorders. However, there was no significant difference in level of reported exposure to the oil spill among residents of the two control communities when compared with the presence or absence of any of the psychiatric disorders examined. The prevalence of these disorders was further compared with two additional measures of exposure (proximity of the respondent's community to the source of the spill and percentage of the coastline near the community covered by oil), producing similar results (11). Survey responses were also cross-validated with data obtained from informal interviews with respondents, detailed interviews with key informants in each community, and participant observation of community activities by trained field workers.

As with any cross-sectional study, it is not possible to determine causality in the observed relationships. Although not all of the relationships were found to be monotonic, the consistent pattern of increasing rates of psychiatric diagnosis with increasing exposure to the spill and subsequent cleanup efforts does suggest a dose-response relationship. Nevertheless, the existence of a causal association between the oil spill and patterns of social and psychiatric disorder can only be resolved by comparing baseline measures of these conditions with a set of prospective measures across time.

Finally, the results reported in this paper represent the prevalence of psychiatric disorders approximately 1 year after the spill. However, research documenting the delayed presentation of PTSD in Vietnam veterans (37) suggests that a prolonged follow-up of any disaster-affected population may be necessary before conclusions are reached about the absence of disorder (38). Horowitz and Solomon (39) have emphasized that the detection of psychiatric disorders caused by stressful experiences is characteristically delayed or often missed. Thus, these data may represent only the tip of the iceberg as to the psychosocial sequelae of the *Exxon Valdez* oil spill.

Despite these limitations, the implications of the findings of this study are clear. When the *Exxon Valdez* ran aground in Prince William Sound, it spilled oil into a social as well as a natural environment. That spill resulted in increased rates of depressive symptoms, anxiety, and PTSD, especially in women and Alaska Natives. Only further research will determine whether these effects are transient or whether they are consequences of permanent changes in the social, cultural, and economic fabric of these communities.

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