Psychological Trauma: Theory, Research, Practice, and Policy
2017, Vol. 9, No. S1, 93–97

1942-9681/17/$12.00 http://dx.doi.org/10.1037/tra0000195

Mental Disorders Among Chernobyl Cleanup Workers From Estonia: A Clinical Assessment

Kaia Laidra and Kaja Rahu
National Institute for Health Development, Tallinn, Estonia

Katri-Evelin Kalaus
Center of Psychiatry and Psychotherapy SENSUS, Tallinn, Estonia

Mare Tekkel
National Institute for Health Development, Tallinn, Estonia

Mall Leinsalu
National Institute for Health Development, Tallinn, Estonia, and Södertörn University

Objective: To assess, at a clinical level, the mental health of former Chernobyl cleanup workers from Estonia by comparing them with same-age controls. ***Method:*** The Mini International Neuropsychiatric Interview (MINI) was administered during 2011–2012 to 99 cleanup workers and 100 population-based controls previously screened for mental health symptoms. ***Results:*** Logistic regression analysis showed that cleanup workers had higher odds of current depressive disorder (odds ratio [*OR*] = 3.07, 95% confidence interval [CI: 1.34, 7.01]), alcohol dependence (*OR* = 3.47, 95% CI [1.29, 9.34]), and suicide ideation (*OR* = 3.44, 95% CI [1.28, 9.21]) than did controls. Except for suicide ideation, associations with Chernobyl exposure became statistically nonsignificant when adjusted for education and ethnicity. ***Conclusion:*** A quarter of a century after the Chernobyl accident, Estonian cleanup workers were still at increased risk of mental disorders, which was partly attributable to sociodemographic factors.

Keywords: Chernobyl nuclear accident, cleanup workers, mental disorders, Estonia

In 1986, a reactor accident at the Chernobyl nuclear power plant in Ukraine caused a massive radioactive contamination that spread over a large part of continental Europe. About 115,000 persons were evacuated from the most affected areas, and about 530,000 persons from throughout the former Soviet Union were brought to the site to assist in the cleanup activities (United Nations Scientific Committee on the Effects of Atomic Radiation, 2011).

Mental health problems are considered the most significant public health consequence of the Chernobyl accident (Balonov, 2007; Bromet, Havenaar, & Guey, 2011). Elevated levels of mental distress have consistently been reported among diverse populations affected by the accident (for a review, see Bromet et al., 2011), but only a few studies have relied on standardized clinical interviews. One of these, a study of Ukrainian cleanup workers conducted 18 years after the accident, found higher rates of depression, anxiety disorders, posttraumatic stress disorder (PTSD) and suicide ideation relative to controls (Loganovsky et al., 2008).

Among cleanup workers, there were nearly 5,000 men from Estonia whose health has been examined in a number of record-linkage studies (for a review, see K. Rahu et al., 2015). These studies showed no increased risk of radiation-related cancer incidence or mortality compared with the general male population but revealed elevated risks for suicide and alcohol-related cancers (K. Rahu et al., 2013; K. Rahu, Rahu, Tekkel, & Bromet, 2006; M. Rahu et al., 1997). Concordantly, a mail survey conducted in 2010 found higher levels of self-reported symptoms of depression, anxiety, PTSD, somatization, and alcohol problems among the cleanup workers (Laidra, Rahu, Tekkel, Aluoja, & Leinsalu, 2015). However, the clinical diagnoses obtained from the Estonian Health Insurance Fund (EHIF) database did not confirm cleanup workers' increased risk for mental disorders except for those related to alcohol (K. Rahu et al., 2014). Such inconsistencies between studies could possibly be explained by underreporting of mental disorders among cleanup workers in the EHIF database, if they were less likely to seek professional help compared to the general population. Alternatively, it is possible that cleanup workers' mental health problems are present mainly at a subclinical level and do not meet diagnostic criteria (e.g., Havenaar et al., 1997).

To explore these hypotheses, this article reports the findings of a clinical interview study conducted as a follow-up 1–1.5 years after the initial mail survey (Laidra et al., 2015). Diagnostic interviews were completed by prescreened groups of Estonian Chernobyl cleanup workers and population-based controls to test

This article was published Online First September 26, 2016.

Kaia Laidra and Kaja Rahu, Department of Epidemiology and Biostatistics, National Institute for Health Development, Tallinn, Estonia; Katri-Evelin Kalaus, Center of Psychiatry and Psychotherapy SENSUS, Tallinn, Estonia; Mare Tekkel, Department of Epidemiology and Biostatistics, National Institute for Health Development; Mall Leinsalu, Department of Epidemiology and Biostatistics, National Institute for Health Development, and Stockholm Centre for Health and Social Change, Södertörn University.

This work was supported by a grant from the Estonian Science Foundation (JD152) and by institutional research funding (IUT5-1) from the Estonian Ministry of Education and Research.

Correspondence concerning this article should be addressed to Kaia Laidra, Department of Epidemiology and Biostatistics, National Institute for Health Development, Hiiu 42, 11619 Tallinn, Estonia. E-mail: kaia.laidra@tai.ee

whether cleanup workers presented elevated risk of mental disorders.

Method

The study followed a two-phase design (Dunn, Pickles, Tansella, & Vázquez-Barquero, 1999) with self-report symptom scales used in the initial mail survey in Phase 1 and diagnostic interviews used in Phase 2. Phase 1 methods are described in detail elsewhere (Laidra et al., 2015). The study was approved by the Tallinn Medical Research Ethics Committee.

Participants

The cohort of Estonian Chernobyl cleanup workers consists of 4,831 men who worked in the Chernobyl area between 1986 and 1991 for decontamination, construction of buildings, transport, radiation measurement, guard duty, or related activities (K. Rahu et al., 2015). The largest occupational groups among cleanup workers were professional drivers (39%) and construction workers (11%) (Tekkel et al., 1997). Most of these men were military reservists at ages 20–39 at their deployment, and their median duration of stay in the Chernobyl area was 92 days (K. Rahu et al., 2013). Although 60% of the cleanup workers were deployed in 1986, when the level of radiation was highest, biodosimetry data indicated that an average absorbed dose in this cohort was low, in the order of 10 cGy (Bigbee et al., 1997).

The Phase 1 questionnaire was mailed to all the cleanup workers ($N = 809$) residing (according to the Estonian Population Register) in Harju County in September 2010 and to a randomly selected control group of 1,250 same-age male residents of Harju County drawn from the population register. Cleanup workers and men who had moved to Estonia after 1986 were excluded from the control group. A total of 1,070 Phase 1 participants had complete data on the measures used for screening (see the Measures section) and were eligible for Phase 2. On the basis of exposure status and screening result, four groups were defined: cleanup workers screening positive for a possible mental disorder ($n = 179$), cleanup workers screening negative ($n = 280$), controls screening positive ($n = 134$), and controls screening negative ($n = 477$). The goal was to interview 50 cleanup workers screening positive, 50 cleanup workers screening negative, 40 controls screening positive, and 60 controls screening negative in Phase 2. Participants screening positive at Phase 1 were oversampled for Phase 2 in order to have more clinical cases for statistical analysis.

Measures

Four self-report measures from Phase 1 were used to screen participants for possible mental disorders: the depression and anxiety subscales of the Emotional State Questionnaire 2 (EST-Q2; Aluoja, Shlik, Vasar, Luuk, & Leinsalu, 1999) with cutoffs of 12 for both scales (Aluoja, Leinsalu, Shlik, Vasar, & Luuk, 2004; Kleinberg, Aluoja, & Vasar, 2008), the Posttraumatic Stress Disorder Checklist—Civilian version (PCL–C) with a cutoff of 50 (Weathers, Litz, Herman, Huska, & Keane, 1993), and the Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, de la Fuente, & Grant, 1993) with a cutoff of 13 (Kihl, 2002). Participants were considered to screen positive if they scored at or above the cutoff on any of these measures. All the Phase 1 measures demonstrated good to excellent internal consistency, with Cronbach's alpha coefficients of .90 for the EST-Q2 depression, .88 for the EST-Q2 anxiety, .94 for the PCL–C, and .84 for the AUDIT.

In Phase 2, the Mini-International Neuropsychiatric Interview (Sheehan et al., 1998) was completed in either Estonian or Russian to assess psychiatric diagnoses according to the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM–IV;* American Psychiatric Association, 1994) and the International Statistical Classification of Diseases and Related Health Problems (10th ed.; ICD-10; World Health Organization, 1990). The following categories were analyzed: current depressive disorder (includes major depression in the past 2 weeks and dysthymia in the past 2 years), current anxiety disorder (includes generalized anxiety disorder in the past 6 months, panic disorder, agoraphobia, social phobia, obsessive–compulsive disorder, and PTSD in the past month), and current alcohol dependence (in the past 12 months), as well as lifetime (hypo)manic episode and lifetime psychotic disorders (combining both current and past episodes). All current disorders were further aggregated into the combined category of "any current disorder." Additionally, suicide ideation in the past month (coded as "present" if the participant endorsed any of the questions in the suicidality module) was examined.

Information on participants' ethnicity (Estonian vs. non-Estonian) and education (basic to secondary vs. higher education) was obtained from the Phase 1 questionnaire.

Procedure

Phase 1 mail survey was conducted in autumn 2010, and Phase 2 interviews were conducted between October 2011 and May 2012. The time lapse between the two phases ranged from 11 to 19 months, with a median of 15 months. Participants of Phase 2 were contacted by letter explaining the purpose of the study and inviting them to schedule an interview with a psychologist. Nonresponders were sent a second invitation 2–3 weeks after the first mailing. Within each group, participants were recruited serially, in random order, until the desired number of interviews was reached (except for cleanup workers screening negative, with 49 interviews in all). In total, invitations were sent to 470 Phase 1 participants. After persons who had died (according to the Estonian Population Register), were working abroad, or could not participate due to the long-term illness (information obtained from phone calls from invitees or their family members) were excluded, the participation rates in Phase 2 were 48.1% for cleanup workers screening positive, 49.0% for cleanup workers screening negative, 36.7% for controls screening positive, and 43.8% for controls screening negative. Comparison of Phase 2 participants with persons who were invited but did not participate showed that nonparticipation was higher among controls with non-Estonian ethnicity and less than higher education but was not related to age or screening result at Phase 1. Among cleanup workers, nonparticipation was not associated with any of the analyzed variables.

All interviews were conducted by clinical psychologists at the Center of Psychiatry and Psychotherapy SENSUS. Before the interview, participants signed a consent form. Interviewers were blind to participants' exposure status and screening result. However, exposure status was likely revealed during the interview.

After the interview, participants received feedback about their mental health status and were informed about the possibilities for mental health care. Supermarket gift cards were given to compensate for participants' time and travel costs.

Data Analysis

All analyses were performed using Stata/IC 14.1 (StataCorp, 2015). To correct for oversampling of participants screening positive, we weighted the results of Phase 2 back to the Phase 1 proportions, using inverse probabilities of participating in Phase 2 as weights (Dunn et al., 1999). The following weights were applied: 3.58 for cleanup workers screening positive, 5.71 for cleanup workers screening negative, 3.35 for controls screening positive, and 7.95 for controls screening negative. Logistic regression was used to assess the association of Chernobyl exposure with mental disorders. For each category of disorders, two regression models were analyzed: univariable model and multivariable model including ethnicity (reference group: Estonian) and education (reference group: higher education) as covariates.

Results

Phase 2 samples did not differ from each other in age: The mean age of cleanup workers was 55.3 ± 6.2 years and of controls 56.7 ± 6.8 years, $t(197) = 1.55$, $p = .124$. Similar to the case in Phase 1, there were significantly more cleanup workers with non-Estonian ethnicity (66 cleanup workers vs. 36 controls), $\chi^2(1) = 18.73$, $p < .001$, and with less than higher education (85 cleanup workers vs. 62 controls), $\chi^2(1) = 14.67$, $p < .001$ (unweighted data).

Cleanup workers had higher prevalence rates in each category of mental disorders (see Table 1). Results from the regression analysis revealed that cleanup workers had statistically significantly higher odds for current depressive disorder, suicide ideation, and alcohol dependence, as well as for the combined category of any current disorder (univariable models). After adjustment for ethnicity and education, only the association with suicide ideation remained significant at the $p < .05$ level. Cleanup workers tended to have higher odds of depressive disorder and alcohol dependence, although they did not reach the conventional level of statistical significance. Being non-Estonian or having less than higher education were stronger predictors than Chernobyl exposure for several categories of mental disorders (see Table 1).

Discussion

This study investigated the risk of mental disorders among the Estonian Chernobyl cleanup workers in comparison with the same-age unexposed men from the general population. We found that 40% of cleanup workers versus 22% of controls had at least one current mental disorder. In particular, cleanup workers had higher odds of depressive disorder and alcohol dependence, and they engaged in suicide ideation statistically significantly more often than did controls. Our results were consistent with register-based morbidity and mortality studies of the Estonian cohort of Chernobyl cleanup workers, where excessive risks for suicide and alcohol-related diseases were documented (K. Rahu et al., 2013, 2014, 2006; M. Rahu et al., 1997) and reinforced the previous subclinical finding regarding Estonian cleanup workers' susceptibility to mental health problems (Laidra et al., 2015). The increased risk of clinically diagnosable mental disorders found in the present study was not evident from the registered diagnoses in the EHIF database (K. Rahu et al., 2014), suggesting that cleanup workers do not seek professional help for their mental health problems.

The prevalence rates of depressive and anxiety disorders, as well as suicide ideation, for both cleanup workers and controls were considerably higher in our study than in a similar study of Ukrainian cleanup workers (Loganovsky et al., 2008). Possible explanations for this include age (Ukrainian participants were younger at the time of the study) and period (before vs. after the late 2000s economic recession) effects and also the fact that diagnostic interviews were administered by clinical psychologists in Estonia but not in Ukraine. However, both studies are in agreement in finding higher odds of depressive disorders and suicide ideation among cleanup workers. Although more Ukrainian cleanup workers than controls experienced PTSD and other anxiety disorders in the Loganovsky et al. (2008) study, in our study, due to less statistical power, only the respective tendency could be observed for all anxiety disorders combined. Of note, all the six Estonian participants fulfilling the diagnostic criteria for PTSD were cleanup workers, providing preliminary evidence for the increased prevalence of this disorder. In contrast to our results, the results in the

Table 1
Mental Disorders Among Estonian Chernobyl Cleanup Workers and Population-Based Controls in 2011–2012

Disorder	Prevalence rate (%)		Univariable model (*OR* [95% CI]): Cleanup workers vs. controls	Multivariable model[a] (*OR* [95% CI])		
	Cleanup workers	Controls		Cleanup workers vs. controls	Non-Estonian vs. Estonian ethnicity	Less than higher vs. higher education
Depressive disorder (current)	25.4	10.0	3.07 [1.34, 7.01]**	2.25 [0.92, 5.51]†	1.78 [0.75, 4.19]	2.68 [0.85, 8.48]†
Anxiety disorder (current)	24.6	16.4	1.66 [0.82, 3.36]	1.13 [0.53, 2.40]	1.88 [0.84, 4.19]	3.73 [1.19, 11.72]*
Alcohol dependence (current)	16.4	5.3	3.47 [1.29, 9.34]*	2.38 [0.85, 6.65]††	2.84 [0.98, 8.24]†	2.42 [0.56, 10.42]
(Hypo)manic episode (lifetime)	8.7	3.7	2.49 [0.70, 8.89]	1.71 [0.48, 6.08]	2.84 [0.71, 11.35]	2.22 [0.38, 12.90]
Psychotic disorder (lifetime)	3.1	2.4	1.31 [0.26, 6.56]	1.36 [0.33, 5.57]	2.00 [0.47, 8.59]	0.46 [0.09, 2.47]
Any current disorder	40.4	22.3	2.35 [1.26, 4.41]**	1.56 [0.78, 3.13]	2.30 [1.14, 4.63]*	3.60 [1.43, 9.08]**
Suicide ideation (current)	14.2	4.6	3.44 [1.28, 9.21]*	2.75 [1.11, 6.81]*	2.76 [0.95, 8.01]†	0.98 [0.27, 3.57]

Note. Prevalence rates and odds ratios were weighted back to Phase 1 proportions. *OR* = odds ratio; CI = confidence interval.
[a] Multivariable model included Chernobyl exposure, ethnicity, and education as predictors.
† $p < .10$. * $p < .05$. ** $p < .01$.

Ukrainian study showed no association between alcohol dependence (combined with alcohol abuse) and Chernobyl exposure. Hazardous drinking is known to be strongly associated with poor economic situation, especially among men (Jukkala, Mäkinen, Kislitsyna, Ferlander, & Vågerö, 2008). Ukrainian cleanup workers were more likely to be employed and to consider their financial status adequate than were controls (Loganovsky et al., 2008), which may explain the negative finding.

The association between Chernobyl exposure and mental disorders was attenuated to statistical nonsignificance (except for suicide ideation) after adjustment for education and ethnicity, highlighting sociodemographic inequalities in mental health. Similar to the samples of the present study, the entire cohort of Estonian Chernobyl cleanup workers was shown to have on average a lower level of education and to be more often of non-Estonian ethnicity than had the Estonian male population in general (K. Rahu et al., 2014; Tekkel et al., 1997). Our results confirmed the well-established link between lower educational attainment and depressive and anxiety disorders (Fryers, Melzer, & Jenkins, 2003; Lorant et al., 2003) and were in line with a population-based study in Estonia where alcohol-related mortality was higher among the less educated and non-Estonians (K. Rahu, Pärna, Palo, & Rahu, 2009).

The importance of sociodemographic variables found in the present study can at least partly be connected to the large-scale social, economic, and political reforms that followed the collapse of the Soviet Union. Estonia's far-reaching liberal free market reforms, accompanied by an immediate upsurge of unemployment and low social protection, affected particularly hard the low-educated and ethnic minorities. The situation of the Russian-speaking minority (about 30% of the population) was further aggravated by their inadequate command of the Estonian language, which hindered them from returning to employment. The non-Estonians and those with low education were less successful in adapting to the transition, as evidenced by rapidly increasing differences in wages and employment (Leping & Toomet, 2008; Noorkõiv, Orazem, Puur, & Vodopivec, 1998). These negative trends were reflected in the huge increase of both educational (Leinsalu, Vågerö, & Kunst, 2003) and ethnic (Leinsalu, Vågerö, & Kunst, 2004) differences in mortality over the 1990s.

The major limitations of this study included small sample size at Phase 2, which allowed us to detect only the most robust effects at a statistically significant level, and low participation rate, which may have resulted in participation bias. Considering that nonparticipation was related to lower education and non-Estonian ethnicity in the control group, we may have somewhat underestimated the prevalence of mental disorders among controls. Nevertheless, nonparticipation was not related to being symptomatic in Phase 1. Furthermore, the effects in Phase 2 may have been attenuated by the long time lapse between the Phase 1 and Phase 2 measurements, because most of the examined disorders run a fluctuating course.

In conclusion, the study confirmed that a quarter of a century after the Chernobyl accident, cleanup workers from Estonia were at increased risk of suicide ideation and mental disorders, particularly depressive disorders and alcohol dependence, although this association was partly attributable to sociodemographic factors. Special care should be taken in screening cleanup workers belonging to ethnic minority and low education subgroups for mental health concerns and to facilitate their use of mental health services.

References

Aluoja, A., Leinsalu, M., Shlik, J., Vasar, V., & Luuk, K. (2004). Symptoms of depression in the Estonian population: Prevalence, sociodemographic correlates and social adjustment. *Journal of Affective Disorders, 78,* 27–35. http://dx.doi.org/10.1016/S0165-0327(02)00179-9

Aluoja, A., Shlik, J., Vasar, V., Luuk, K., & Leinsalu, M. (1999). Development and psychometric properties of the Emotional State Questionnaire, a self-report questionnaire for depression and anxiety. *Nordic Journal of Psychiatry, 53,* 443–449. http://dx.doi.org/10.1080/080394899427692

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Balonov, M. I. (2007). The Chernobyl Forum: Major findings and recommendations. *Journal of Environmental Radioactivity, 96,* 6–12. http://dx.doi.org/10.1016/j.jenvrad.2007.01.015

Bigbee, W. L., Jensen, R. H., Veidebaum, T., Tekkel, M., Rahu, M., Stengrevics, A., . . . Boice, J. D., Jr. (1997). Biodosimetry of Chernobyl cleanup workers from Estonia and Latvia using the glycophorin A in vivo somatic cell mutation assay. *Radiation Research, 147,* 215–224. http://dx.doi.org/10.2307/3579423

Bromet, E. J., Havenaar, J. M., & Guey, L. T. (2011). A 25 year retrospective review of the psychological consequences of the Chernobyl accident. *Clinical Oncology, 23,* 297–305. http://dx.doi.org/10.1016/j.clon.2011.01.501

Dunn, G., Pickles, A., Tansella, M., & Vázquez-Barquero, J. L. (1999). Two-phase epidemiological surveys in psychiatric research. *British Journal of Psychiatry, 174,* 95–100. http://dx.doi.org/10.1192/bjp.174.2.95

Fryers, T., Melzer, D., & Jenkins, R. (2003). Social inequalities and the common mental disorders: A systematic review of the evidence. *Social Psychiatry and Psychiatric Epidemiology, 38,* 229–237. http://dx.doi.org/10.1007/s00127-003-0627-2

Havenaar, J. M., Rumyantzeva, G. M., van den Brink, W., Poelijoe, N. W., van den Bout, J., van Engeland, H., & Koeter, M. W. (1997). Long-term mental health effects of the Chernobyl disaster: An epidemiologic survey in two former Soviet regions. *American Journal of Psychiatry, 154,* 1605–1607. http://dx.doi.org/10.1176/ajp.154.11.1605

Jukkala, T., Mäkinen, I. H., Kislitsyna, O., Ferlander, S., & Vågerö, D. (2008). Economic strain, social relations, gender, and binge drinking in Moscow. *Social Science & Medicine, 66,* 663–674. http://dx.doi.org/10.1016/j.socscimed.2007.10.017

Kihl, E. (2002). *Alkoholi tarvitamise küsimustiku loomine* [Development of Alcohol Use Questionnaire] (Unpublished master's thesis). University of Tartu, Tartu, Estonia.

Kleinberg, A., Aluoja, A., & Vasar, V. (2008). Depressiooni ja ärevuse esinemine Eesti inimestel: Depressiivse häire hetkelevimus, depressiivsuse ja ärevuse levimuse muutus kümne aasta jooksul [Prevalence of depression and anxiety among the Estonian population: Point prevalence of major depressive episode, 10-year trend in 1-month prevalence of depression and anxiety]. *Eesti Arst, 88,* 80–86.

Laidra, K., Rahu, K., Tekkel, M., Aluoja, A., & Leinsalu, M. (2015). Mental health and alcohol problems among Estonian cleanup workers 24 years after the Chernobyl accident. *Social Psychiatry and Psychiatric Epidemiology, 50,* 1753–1760. http://dx.doi.org/10.1007/s00127-015-1102-6

Leinsalu, M., Vågerö, D., & Kunst, A. E. (2003). Estonia 1989–2000: Enormous increase in mortality differences by education. *International Journal of Epidemiology, 32,* 1081–1087. http://dx.doi.org/10.1093/ije/dyg192

Leinsalu, M., Vågerö, D., & Kunst, A. E. (2004). Increasing ethnic differences in mortality in Estonia after the collapse of the Soviet Union.

Journal of Epidemiology and Community Health, 58, 583–589. http://dx.doi.org/10.1136/jech.2003.013755

Leping, K.-O., & Toomet, O. (2008). Emerging ethnic wage gap: Estonia during political and economic transition. *Journal of Comparative Economics, 36,* 599–619. http://dx.doi.org/10.1016/j.jce.2008.08.002

Loganovsky, K., Havenaar, J. M., Tintle, N. L., Guey, L. T., Kotov, R., & Bromet, E. J. (2008). The mental health of clean-up workers 18 years after the Chernobyl accident. *Psychological Medicine, 38,* 481–488. http://dx.doi.org/10.1017/S0033291707002371

Lorant, V., Deliège, D., Eaton, W., Robert, A., Philippot, P., & Ansseau, M. (2003). Socioeconomic inequalities in depression: A meta-analysis. *American Journal of Epidemiology, 157,* 98–112. http://dx.doi.org/10.1093/aje/kwf182

Noorkõiv, R., Orazem, P., Puur, A., & Vodopivec, M. (1998). Employment and wage dynamics in Estonia, 1989–95. *Economics of Transition, 6,* 481–503. http://dx.doi.org/10.1111/j.1468-0351.1998.tb00060.x

Rahu, K., Auvinen, A., Hakulinen, T., Tekkel, M., Inskip, P. D., Bromet, E. J., . . . Rahu, M. (2013). Chernobyl cleanup workers from Estonia: Follow-up for cancer incidence and mortality. *Journal of Radiological Protection, 33,* 395–411. http://dx.doi.org/10.1088/0952-4746/33/2/395

Rahu, K., Bromet, E. J., Hakulinen, T., Auvinen, A., Uusküla, A., & Rahu, M. (2014). Non-cancer morbidity among Estonian Chernobyl cleanup workers: A register-based cohort study. *British Medical Journal Open, 4:* 004516. http://dx.doi.org/10.1136/bmjopen-2013-004516

Rahu, K., Pärna, K., Palo, E., & Rahu, M. (2009). Contrasts in alcohol-related mortality in Estonia: Education and ethnicity. *Alcohol and Alcoholism, 44,* 517–522. http://dx.doi.org/10.1093/alcalc/agp035

Rahu, K., Rahu, M., Tekkel, M., & Bromet, E. (2006). Suicide risk among Chernobyl cleanup workers in Estonia still increased: An updated cohort study. *Annals of Epidemiology, 16,* 917–919. http://dx.doi.org/10.1016/j.annepidem.2006.07.006

Rahu, K., Rahu, M., Tekkel, M., Veidebaum, T., Hakulinen, T., Auvinen, A., . . . Boice, J. D., Jr. (2015). Chernobyl cleanup workers from Estonia: Cohort description and related epidemiological research. *Journal of Radiological Protection, 35,* R35–R45. http://dx.doi.org/10.1088/0952-4746/35/4/R35

Rahu, M., Tekkel, M., Veidebaum, T., Pukkala, E., Hakulinen, T., Auvinen, A., . . . Boice, J. D., Jr. (1997). The Estonian study of Chernobyl cleanup workers: II. Incidence of cancer and mortality. *Radiation Research, 147,* 653–657. http://dx.doi.org/10.2307/3579632

Saunders, J. B., Aasland, O. G., Babor, T. F., de la Fuente, J. R., & Grant, M. (1993). Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons With Harmful Alcohol Consumption–II. *Addiction, 88,* 791–804. http://dx.doi.org/10.1111/j.1360-0443.1993.tb02093.x

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., . . . Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): The development and validation of a structured diagnostic psychiatric interview for *DSM–IV* and ICD-10. *Journal of Clinical Psychiatry, 59*(Suppl. 20), 22–33.

StataCorp. (2015). *Stata statistical software: Release 14*. College Station, TX: Author.

Tekkel, M., Rahu, M., Veidebaum, T., Hakulinen, T., Auvinen, A., Rytömaa, T., . . . Boice, J. D., Jr. (1997). The Estonian study of Chernobyl cleanup workers: I. Design and questionnaire data. *Radiation Research, 147,* 641–652. http://dx.doi.org/10.2307/3579631

United Nations Scientific Committee on the Effects of Atomic Radiation. (2011). *Sources and effects of ionizing radiation: Vol. II. Effects: Annex D. Health effects due to radiation from the Chernobyl accident* (UNSCEAR 2008 report). New York, NY: United Nations.

Weathers, F. W., Litz, B. T., Herman, D. S., Huska, J. A., & Keane, T. M. (1993, October). *The PTSD Checklist (PCL): Reliability, validity, and diagnostic utility*. Paper presented at the annual meeting of the International Society for Traumatic Stress Studies, San Antonio, TX.

World Health Organization. (1990). *International statistical classification of diseases and related health problems* (10th ed.). Geneva, Switzerland: Author.

Received March 29, 2016
Revision received August 11, 2016
Accepted August 24, 2016 ■