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The Psychological and Welfare Consequences of the Chernobyl Disaster:

A Systematic Literature Review, Focus Group Findings, and Future Directions

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under the sarcophagus built after the disaster.
(Source: Julien Behal/Chernobyl Children's Project)

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SUMMARY

On April 26, 1986, a nuclear disaster occurred at the Chernobyl Nuclear Power Plant, contaminating areas of what are now modern-day Belarus, Moldova, Russia, and Ukraine. Beyond radiation exposure and cancer risks, the disaster led to the imposition of diverse acute and chronic stressors on the people living around the site. Principal among these health effects are psychological consequences, including ongoing psychological stress, post-traumatic stress disorder, and diminished well-being.

Substantial time has now passed since the disaster occurred and the possibility of health effects other than cancer has not been sufficiently addressed. This report assesses the research conducted on these health effects, particularly quality of life, functioning, and neuropsychological status among the victims of the disaster. Through a systematic review approach, this report documents the range of studies that have been carried out—largely cross-sectional surveys with several cohort (follow-up) studies. This report includes 50 publications; their results have been considered within the outcomes of anxiety, depression, post-traumatic stress disorder, well-being, and cognition.

Based on this systematic review, we find that there is evidence for adverse psychological and welfare consequences of the Chernobyl disaster. The extent of the available research, however, was limited and the various Chernobyl-affected groups have not been systematically investigated. In research subsequent to the disaster, emphasis has been given to cancer risk, as a result of the widespread radiation exposure to workers and the population. Nonetheless, the studies conducted show consistent indication that exposure to the Chernobyl disaster, broadly construed, has led to adverse psychological consequences. They point to a range of adverse effects that might be mitigated through evidence-based interventions. However, the available data are again limited in their coverage of affected populations and they fail to provide a picture of ongoing challenges to well-being faced by the populations in the area affected by the accident.

As one step in exploring future research directions on the neuropsychological consequences of the Chernobyl disaster, we arranged for focus groups to learn the most critical concerns of residents in Kiev (Kyiv), Ukraine today. In general, the focus group discussions gave useful insights regarding people's perceptions, concerns, and attitudes towards their health and the current state of health care in Kiev. For most respondents, health was

considered one of the most important values in their lives; however, few reported about the medical services used in cases of illness. Among the main concerns on the future health consequences of the Chernobyl disaster, many respondents said that children need to have more detailed investigation of their health, including physical and mental health. The following emerged with consensus as key issues: dissatisfaction with the quality of the medical care, the use of non evidence-based diagnostics and treatments, lack of knowledge in the population about the signs of both physical and mental disorders, concerns about children's health, and the potential impact of environmental factors including the Chernobyl disaster.

In this report, we have considered two sources of evidence on the long-term neuropsychological consequences of the Chernobyl disaster: the published research evidence available in the accessible literature and the findings of focus groups conducted in Kiev in March, 2011. The broad findings from these two sources are convergent and clear: twenty-five years after the Chernobyl disaster, the populations affected at the time, whether by being displaced or exposed to radiation, have sustained neuropsychological consequences and these consequences remain of public health and medical significance.

At the 25th anniversary year of the disaster, it would be timely to give greater discussion to the topic of long-term neuropsychological consequences. Our recommendations address this need. They broadly cover future research, potential interventions, and networking in Ukraine, Belarus, Russia, and Moldova. In addition, we recommend the need for further understanding on how evidence on the neuropsychological consequences of the disaster and related support could make a difference to motivate action by policymakers. We also recommend a comprehensive cataloguing of ongoing research and an evaluation of opportunities for expanding studies to cover neuropsychological outcomes.



Reactor #4 of the Chernobyl Nuclear Power Plant under the sarcophagus built after the disaster.
(Source: Julien Behal/Chernobyl Children's Project)

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LITERATURE REVIEW, FOCUS GROUP FINDINGS AND RECOMMENDATIONS

On April 26, 1986, a nuclear disaster occurred at the Chernobyl Nuclear Power Plant, contaminating areas of what are now modern-day Belarus, Moldova, Russia, and Ukraine. In the aftermath of the wide spread radiation, there were concerns about risks to human health and of using contaminated land for farming. Given the high levels of radiation exposure to workers and to people residing adjacent to the plant, substantial emphasis was given to risk from radiation exposure, initially to acute radiation sickness and subsequently to cancer. Studies addressed acute radiation effects in victims (Guskova et al. 1988), leukemia and thyroid cancer occurrence among children (Astakhova et al. 1998; Noshchenko et al. 2001), and thyroid cancer among clean-up workers (Ivanov et al. 2008). Given the constraints posed by the circumstances of the disaster, the risks for radiation have been as closely tracked as may have been feasible, and the various research groups and researchers involved are at leading institutions.

The disaster occurred at a time when cancer risks associated with radiation were reasonably well understood, largely on the basis of the study of the Atomic Bomb Survivors, carried out by the Radiation Effects Research Foundation (Pierce et al. 1996; Shimizu et al. 1999). The information on radiation risks had been summarized and risk models proposed (UNSCEAR 1977; National Research Council 1990). Even though radiation risks were considered to be well understood, the epidemic of thyroid cancer in children that shortly followed the Chernobyl disaster was unexpected and still not fully explained (Williams 2002; Hatch et al. 2005). In addition, with the existing surveillance mechanisms and epidemiological cohorts, an excess of other cancers has not been detected with the possible exceptions of leukemia among the liquidation workers and premenopausal breast cancer in women in the general population (Chernobyl Forum 2006a; Chernobyl Forum 2006b; World Health Organization 2006).



Map of radiation zones resulting from the Chernobyl disaster.
(Source: Green Cross Belarus)

Substantial time has now passed since the disaster occurred and the possibility of health effects other than cancer has not been

sufficiently addressed. Principal among these health effects are psychological consequences, including ongoing psychological stress, post-traumatic stress disorder, and diminished well-being. The various summary reports and publications by the World Health Organization and the International Atomic Energy Agency have uniformly noted the lack of evidence on these health effects (Chernobyl Forum 2006a; Chernobyl Forum 2006b; World Health Organization 2006). A recent systematic review by Bromet, Havenaar, and Guey (2011) reached a similar conclusion.

Psychological and Psychiatric Consequences of the Disaster

Beyond radiation exposure, the disaster led to the imposition of diverse acute and chronic stressors on the people living around the site. Examples of these stressors include the acute stress of the disaster and its aftermath with the potential for post-traumatic stress disorder (PTSD), widespread displacement because of contamination, concern about future risks of disease, and even labeling of the exposed people as a group damaged by the disaster. These types of stressors have documented potential to affect quality of life and to lead to psychological and psychiatric disorders among the victims.

The mental health impact of the Chernobyl disaster among the exposed populations has not been sufficiently studied. The WHO report on the health effects of the Chernobyl disaster characterizes the "mental health impact" as "...the largest public health problem caused by the accident to date" (World Health Organization 2006). The report notes the evidence gaps and makes a bland and general call for an appropriate "mental health policy." In a systematic review published in 2007, which identified research conducted in the 20 years following the disaster (Bromet and Havenaar 2007), only four surveys met the authors' quality criteria, but all gave indication of adverse psychological consequences due to the disaster. The review by Bromet and Havenaar also called for more studies on the clean-up workers (liquidators), who live with the knowledge of increased disease risk, as did the 2011 review by Bromet and colleagues (Bromet et al. 2011).



Contaminated countryside after the disaster. (Source: Semion Shevtsov)

LITERATURE REVIEW, FOCUS GROUP FINDINGS AND RECOMMENDATIONS

The objective of this literature review is to assess the depth of research conducted on these health effects, especially quality of life, functioning, and neuropsychological status among the victims of the disaster. Through a systematic review approach, this literature review documents the range of studies that have been carried out—largely cross-sectional surveys with several cohort (follow-up) studies. There is a consistent indication that exposure to the Chernobyl disaster, broadly construed, has led to adverse psychological consequences. They point to a range of adverse effects that might be mitigated through evidence-based interventions. However, the available data are limited in their coverage of affected populations and they fail to provide a picture of ongoing challenges to well-being faced by the populations living in the area affected by the accident.

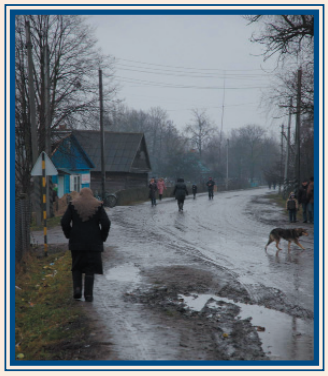
Beyond the literature review, focus groups were conducted to learn the most critical concerns of residents in Kiev (Kyiv), Ukraine at present. The protocol was developed in collaboration with Dr. Semyon Gluzman from the Ukrainian Psychiatric Association, Dr. Stanislav Kostyuchenko from the National Medical Academy of Postgraduate Education, and the Kiev International Institute of Sociology (KIIS). It covered a range of issues related to mental health and well being and the availability and adequacy of services.



Abandoned house near Chernobyl.
(Source: Semion Shevtsov)

METHODS

To capture the current state of the evidence on psychological and psychiatric consequences of the disaster, we carried out a systematic review of the available evidence. This document is based on an extensive literature review carried out in 2010 that included studies published through December 2009. We conducted keyword searches on the University of Southern California (USC) Scholars Portal, Google Scholar, and PubMed. The USC Scholars Portal is a search engine designed by the USC library that examines keywords among the university's subscribed peer-reviewed literature databases such as JSTOR and PubMed. To ensure that the USC



Typical village impression from a contaminated area in Belarus. (Source: Semion Shevtsov)

Scholars Portal captured all studies fitting our keyword search, we conducted another search on the World Wide Web using the same keywords on the search engines of Google Scholar and PubMed. For all searches, we used the following English search phrases for each engine: "Chernobyl disaster life quality" (n =19 articles identified), "Chernobyl disaster neuropsychological" (n=15), "Chernobyl disaster morbidity" (n=7), "Chernobyl disaster functioning" (n=6), and "Chernobyl disaster life expectancy" (n=4). In addition to those search phrases, we used the Ukrainian (alternative) spelling of Chernobyl (Chornobyl, n=10).

We considered research papers, books, newspapers, or other scientific publications that were found with this search strategy. If the publication was not in English, we reached out to the author for an English translated version. The USC Scholars Portal identified approximately 600 publications, which were screened by reading through the abstract and/or summary provided. Google Scholar identified 77,597 publications from the keywords. For each keyword search on Google Scholar, the abstracts for the first 60 hits were thoroughly examined and the summaries of the remaining searches were briefly reviewed. Searches from PubMed were used to ensure that the USC Scholars Portal and Google Scholar captured as much as literature available with our keywords. A publication was eliminated from selection by first reading through the abstract and/or summary. If the abstract or summary deemed relevant to our objective, we examined the publication further. This method allowed us to efficiently filter approximately 78,200 publications over several months to 963 that were read. Of this total read, 61 papers met the criteria for: 1) addressing our research question, 2) primary research, and 3) peer reviewed. After a closer screening, we removed 23 publications as duplicates, not relevant to our objectives, or not including relevant measured outcomes. Besides accepted searches, we found and included three articles through citations of rejected and accepted

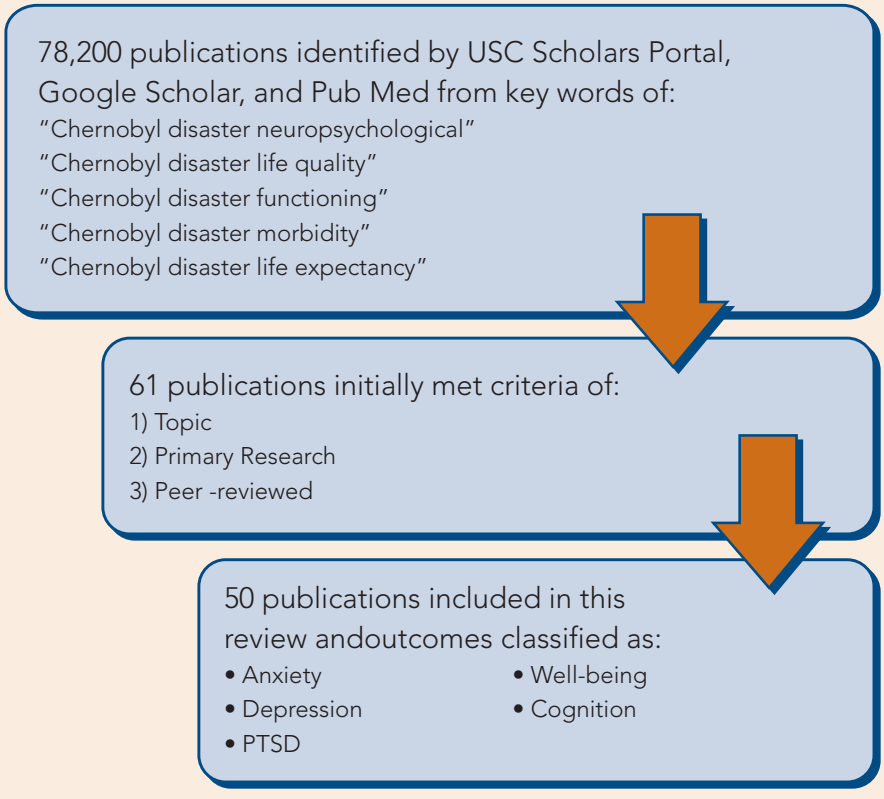


Family living near Chernobyl. (Source: Semion Shevtsov)

publications identified in our search strategy. Subsequent to the original publication cutoff date of December 2009, we updated the included studies with nine new and relevant publications. This updating was mainly done by using publication alerts of new papers with matching keywords in our search, notifications from colleagues, and following up on cited studies mentioned in the new articles. Therefore, this review includes 50 publications, which have been sorted by their results into the following measured outcomes of anxiety, depression, PTSD, well-being, and cognition.

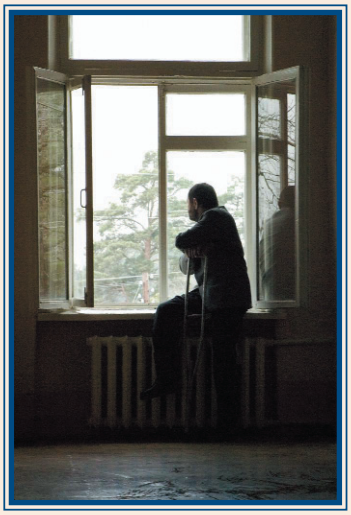
In March 2011, one of the authors of this report (SP) traveled to Ukraine and Belarus. In meetings there, he was made aware of a substantial "gray literature" of reports from various governmental and non-governmental entities. These documents have not yet been evaluated and are not included in this report.

Figure 1. Selection Process for Included Publications



RESULTS

We assembled evidence tables that highlight the main findings of the investigations conducted since the disaster. All tables are sorted by the first year of the data collected and then by location of the data collected. A table on study characteristics (Table 1) includes the following extracted information from each paper about the core project: study by principal author and citation, location and year of data collection, gender and age, selection approach, and population size. Selection approaches for the Chernobyl-affected populations targeted three major groups: 1) irradiated children and their mothers; 2) nuclear power plant operators and exposed clean-up workers/ liquidators; and 3) immigrants from Chernobyl-affected areas to other countries. Non-exposed individuals selected from government databases comprised the controls for most of the studies.



A man residing in a contaminated area in Belarus. (Source: Semion Shevtsov)

Table 2 lists the specific scales used by each study to measure the five outcome categories of anxiety, depression, PSTD, well-being, and cognition. Appendix A includes the full name and the measurement objective for each scale. The scales used for measuring anxiety, depression, PTSD, well-being, and cognition were satisfactorily documented in each study. These are well-established scales that were collected by trained students or lay workers in the various projects. Additionally, topic-specific scales were used in some studies.



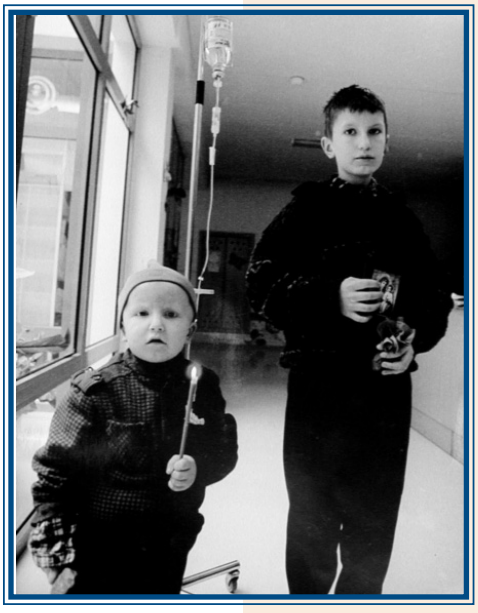
Patients at hospital near the disaster. (Source: Semion Shevtsov)

The widely used general questionnaires and inventories in the studies were the Minnesota Multiphasic Personality Inventory (MMPI), the Bradford Somatic Inventory (BSI), the General Health Questionnaire (GHQ), the Diagnostic and Statistical Manual of Mental Disorders (DSM), the World Health Organization Composite International Diagnostic Interview (WMH-CIDI), and the Brief Symptom Inventory/Global Severity Inventory

(GSI). The MMPI measures anxiety and depression as well as other psychopathologies (Sobchik 1990). The BSI compares an individual's somatic symptoms to those associated with patients who have "a clinical diagnosis of anxiety, depression, hysteria or hypochondriasis" (Mumford et al. 1991). The GHQ detects psychiatric disorders through a series of questions and can be based on 12, 28, 30, or 60 items (Goldberg et al. 1988). The DSM is a widely used guide to classify mental disorders (American Psychiatric Association 1980). The WMH-CIDI is a structured interview to detect and evaluate psychiatric disorders (Kessler and Ustun 2004). The Brief Symptom Inventory, which includes the GSI, provides a self-reported overview of the psychological symptoms and their intensity at a specific point in time. The GSI quantifies the severity of the psychological illness and "provides a composite score for measuring the outcome of a treatment program based on reducing symptom severity" (Derogatis 1993).



Children from the most contaminated areas in Belarus receiving treatments in a Green Cross therapy camp. (Source: Semion Shevtsov)



Patients at hospital near Chernobyl. (Source: Sergei Brushko)

Overall, based on the scales used in the 30 studies, the general trend in each outcome category was for higher or worse scores in the Chernobyl-affected populations than in the non-exposed comparison groups. For certain outcome categories, like anxiety and depression, a dose-response relationship was found after stratifying the Chernobyl-affected persons by distance to the disaster site. At the time of event, those who were nearer to the disaster site tend to have higher and worse scores than those further away. The longitudinal studies did not show consistent evidence of improvement in the health outcomes with increasing time since the disaster. Below, the results are reviewed in detail for each outcome category.

Anxiety: Table 3 summarizes mean inventory scores and specific prevalence percentages in regard to anxiety-related symptoms associated with

Chernobyl-related exposures. Of the studies reviewed, the majority used the Russian-translated Beck Anxiety Inventory (RBAI) and the Anxiety subscale from the Brief Scales for Anxiety and Depression. The RBAI consists of 21-multiple-choice questions designed to measure the severity of an individual's anxiety (Beck et al. 1988; Carter et al. 1995). The Anxiety subscale from the Brief Scales for Anxiety and Depression is a nine-item questionnaire designed to determine the potential mental health illnesses associated with anxiety for general practitioners and other non-psychiatrists (Goldberg et al. 1988).



Abandoned house in Pripyat, Ukraine. (Source: Green Cross Switzerland)

General anxiety and Chernobyl-focused anxiety were two distinct categories classified within the study populations. In the studies by Havenaar and colleagues (Havenaar et al. 1996a; Havenaar et al. 1996b; Havenaar et al. 1997a; Havenaar et al. 1997b; Havenaar et al. 2003), anxiety was measured in exposed populations in Gomel, Belarus and in non-exposed populations in Tver, Russia. The exposed populations in Gomel had a greater prevalence of having high scores on the Bradford Somatic Inventory and the Anxiety subscales of the Brief Scales for Anxiety and Depression than the non-exposed populations in Tver. The prevalences were elevated by 72% and 5%, respectively. For the outcome variable for greater prevalence of DSM-III-R Anxiety Disorders, the non-exposed comparison groups in Tver had an excess of 32% compared to Gomel. Havenaar et al. (Havenaar et al. 1997b) found anxiety disorders to be "more common in Tver, particularly general anxiety disorder (11% versus 4%)." For children's anxiety, the attention scores were significantly worse for children who had greater Chernobyl-focused anxiety (Bromet et al. 2000; Litcher et al. 2000; Adams et al. 2002; Drabick et al. 2006).



A child receiving treatment at a Green Cross therapy camp. (Source: Semion Shevtsov)

Mothers of exposed children were reported to have a higher level of concern regarding their child's health and to have greater fear for the

consequences of Chernobyl for their children (Bromet et al. 2000; Litcher et al. 2000; Adams et al. 2002; Bromet et al. 2002; Drabick et al. 2006). This anxiety on the part of the mothers was mirrored in the fathers. According to the study by Igumnov and colleagues (Igumnov 1996; Igumnov and Drozdovitch 2000; Igumnov and Drozdovitch 2002; Igumnov and Drozdovitch 2004), both exposed fathers and mothers had higher scores for personal anxiety on the STAI scale than the non-exposed fathers and mothers (31% vs. 15% and 51% vs. 24%, respectively).



A radiation reading in a contaminated area in Belarus (Source: Semion Shevtsov)

Within the Chernobyl-affected populations, Foster and Goldstein (2007) found mean RBAI scores for those living within 50 km of the accident site to be about 55% higher than for those living greater than 150 km from the site. Even in the preliminary analysis of this study, mean RBAI scores of those living within 150 km to the accident site were about 29% higher in comparison to those living further away (Foster 2002). These findings were consistent with the conclusions in both papers that people living closer to the disaster had higher levels of anxiety compared to those further away.

The Chernobyl-affected populations generally had higher and worse anxiety scores than the non-exposed comparison populations. Within the exposed populations, the amount of anxiety experienced was inversely related to distance from the accident site. There is not a clear indication as to whether time since the disaster lessened the anxiety caused by the Chernobyl disaster.



A group of children receiving treatment in a Green Cross therapy camp. (Source: Semion Shevtsov)

Depression: Table 4 gives mean inventory scores and specific prevalence percentages in regard to depression-related symptoms associated with Chernobyl-related exposures. The majority of the included studies used the Russian-translated Beck Depression Inventory (RBDI), the Centers for

Disease Control-Depression (CES-D), and the Depression subscale of Brief Scales for Anxiety and Depression to measure depression. The RBDI consists of 21-multiple-choice questions designed to quantify the severity of an individual's depression (Beck et al. 1988; Carter et al. 1995). The CES-D is a self-test that measures depressive feelings and behaviors during a certain period (Radloff 1977). The Depression subscale from the Brief Scales for Anxiety and Depression is a nine-item questionnaire designed to determine potential mental health illnesses associated with depression for general practitioners and other non-psychiatrists (Goldberg et al. 1988).

In the studies by Havenaar and colleagues (Havenaar et al. 1996a; Havenaar et al. 1996b; Havenaar et al. 1997a; Havenaar et al. 1997b; Havenaar et al. 2003), depression was measured in the exposed populations in Gomel, Belarus and non-exposed populations in Tver, Russia. In comparison to Tver, the exposed populations in Gomel had a greater prevalence of having scores classified as high in the Bradford Somatic and the Depression subscales of the Brief Scales for Anxiety and Depression. The prevalence excesses were 72% and 54%, respectively. In the study of Loganovsky et al. (Loganovsky et al. 2007), the Chernobyl clean-up workers had higher percentages for depressive disorders and were 1.7 times more likely to have a depressive disorder than non-clean-up workers (adjusted OR=1.7, 85% CI: 1.0-2.7, $p<0.05$).



Radiation sign in a contaminated area in Belarus. (Source: Semion Shevtsov)

In a group of Chernobyl-affected immigrants to the United States, Foster and Goldstein (2007) found mean RBDI scores for those living within 50 km of the accident site to be about 39% higher than for those living greater than 150 km from the site. In the preliminary study of immigrants by Foster (2002), mean RBDI scores of those living within 150 km of the accident site were about 16% higher in comparison to those living further away. These findings led to conclusions in both reports that people living closer to the disaster had higher risks for depression compared to those further away.

In the 20 months after the disaster, mean MMPI scores for depression in Chernobyl Nuclear Power Plant operators increased by 6% according to the study by Koscheyev et al. (Koscheyev et al. 1993). Koscheyev et al. (Koscheyev et al. 1993) also found mean MMPI scores for Chernobyl operators to be about 14% higher than for non-exposed operators at the Ignalina Nuclear Power Plant. In contrast, the study by Cwikel et al. (Cwikel et al. 1997) showed

mean CES-D scores as decreasing from the initial time period in 1994 to the final time period in 1995 among all exposed and non-exposed population groups. Cwikel et al. (Cwikel et al. 1997) concluded that "a significant effect on depression scores over time" had occurred ($p < 0.001$). In both reports, higher mean scores for depression were found in the exposed population groups than in the non-exposed population groups.



Patients at hospital near Chernobyl. (Source: Semion Shevtsov)

The Chernobyl-affected populations generally had less favorable scores for depression than the non-exposed comparison populations. Within the exposed populations, the amount of depression experienced was inversely related to distance to the accident site. There is not a clear indication as to whether increasing time since the Chernobyl disaster is associated with decreased depression symptoms.

PSTD: Table 5 summarizes questionnaires and interviews used to measure PTSD. Measurements mainly included the Impact of Events (IES) and the Revised Mississippi PTSD (R MISS PTSD) scales. The IES is a 15-item questionnaire focused on the effects of traumatic events (Horowitz et al. 1979). The R MISS PTSD assesses the symptoms and frequently observed features associated with PTSD in those questioned (Norris and Perilla 1996).

In the studies by Bromet and colleagues (Bromet et al. 2000; Litcher et al. 2000; Adams et al. 2002; Bromet et al. 2002; Drabick et al. 2006), mothers who were evacuated due to the Chernobyl disaster were twice as likely to have a health concern regarding PTSD for their children than mothers who were not evacuated (OR = 2.05, 95% CI 1.27 -3.32, $p < 0.01$). Throughout these studies, Bromet and colleagues (Bromet et al. 2000; Litcher et al. 2000; Adams et al. 2002; Bromet et al. 2002; Drabick et al. 2006) have uniformly noted that mothers who were evacuated believed that their health and their children's health were adversely affected due to the disaster, especially for Chernobyl-induced PSTD. In addition, more evacuee mothers received a diagnosis of a Chernobyl-related illness by local physicians (Bromet et al. 2000; Litcher et al. 2000; Adams et al. 2002; Bromet et al. 2002; Drabick et al. 2006).

In the study by Loganovsky et al. (Loganovsky et al. 2007), the prevalence for PTSD since 1986 in the Chernobyl clean-up workers was substantially

greater than in the comparison group. Loganovsky et al. (Loganovsky et al. 2007) found the clean-up workers to be 3.5 times more likely to have PTSD than non-clean-up workers in the past 12 months of the study (adjusted OR = 3.5, 95% CI: 1.0-12.1, $p<0.05$). Although the exposed groups still had a higher PTSD score, the exposed and comparison groups within the study by Cwikel et al. (Cwikel et al. 1997) showed a significant decrease in PTSD over time ($F(3,482)=7.85$, $p<0.0001$). Within Chernobyl-affected populations, Foster (2002) found R MISS PTSD mean scores for those living within 150 km of the accident site to be 16% higher than for those living beyond 150 km. Additionally, Foster (2002) concluded that Russian immigrants in the New York tri-state area, who had lived closer and had greater exposure to the disaster, experienced "higher levels of posttraumatic reactions" than Russian immigrants who had lived at a further distance ($p<0.03$).

The Chernobyl-affected populations generally had higher and worse PTSD scores than the non-exposed comparison populations. Within the exposed populations, the frequency of PTSD experienced was inversely related to their distance to the accident site. Only one study, Cwikel et al. (Cwikel et al. 1997), had evidence on whether time since the Chernobyl disaster is associated with lower PTSD. Further studies should be conducted, in order to clarify this association between time and PTSD.



Radioactivity signs in a contaminated area near Chernobyl.
(Source: Semion Shevtsov)

Well-being: Table 6 gives qualitative and quantitative outcomes for different measures of well-being. The indicators of well-being ranged from overall distress, such as somatization, to the presence of specific symptoms, such as severe headaches. Of the studies reviewed, interviews and GHQ scales were the predominant choices to measure well-being.

In the study by Remennick (2002), Russian immigrants to Israel from Chernobyl-affected areas had a greater prevalence of self-reported somatization than Russian immigrants who were not from Chernobyl-affected areas. In immigrants to the United States, Foster and Goldstein (2007) found similar findings with 76% of those exposed reporting being frightened for their safety due to the accident. Additionally, Foster and Goldstein (2007) found that those exposed had substantially higher

prevalence of self-reported "poor" physical and mental health than those non-exposed.

In the study by Cwikel et al. (Cwikel et al. 1997), the groups of clean-up workers (liquidators), and low exposed and high exposed people had a higher self-reported percentage for having three or more chronic conditions than the non-exposed group (liquidators: 57%, high exposed 47%, low exposed 49% versus non-exposed 30%). Cwikel et al. (Cwikel et al. 1997) also noted that the relative risk for migraine headaches was about twice as high in the high exposed groups than the non-exposed (RR = 2.0, 95% CI: 1.02–3.90, p=0.056). In the 20 months after the disaster, the number of Chernobyl Nuclear Power Plant Operators having at least one or more elevated MMPI clinical scores was increased by 79 % in the study by Koscheyev et al. (Koscheyev et al. 1993). Although the control population (Ignalia Nuclear Power Plant Operators) for this study was not followed during the same time period, Koscheyev et al. (Koscheyev et al. 1993) suggest that possible psychopathological problems could be present in these operators.

In the studies by Bromet and colleagues (Bromet et al. 2000; Litcher et al. 2000; Adams et al. 2002; Bromet et al. 2002; Drabick et al. 2006), evacuee mothers believed that their children's well-being was worse after learning about the somatic symptoms listed on the CSI and the CBCL. Although no significant differences were found in the comparisons of children who were exposed in utero and classmates who were not, Bromet and colleagues (Bromet et al. 2000; Litcher et al. 2000; Adams et al. 2002; Bromet et al. 2002; Drabick et al. 2006) found the relationship between Chernobyl stress and illness was twice as strong in evacuee (exposed) mothers than the non-evacuee (non-exposed) mothers. In addition, evacuee mothers consistently reported having poor physical health and taking more sick days when compared to the non-evacuee mothers. Evacuee mothers scored significantly higher on the GSI than the comparison group ($p<0.001$). Similarly, Ginzburg and colleagues (Ginzburg and Reis 1991; Ginzburg 1993) found a higher percentage of people who believed they have illness related to radiation in the exposed population than in the non-exposed (45% vs. 30%).



Parents learning to measure the amount of radioactivity in food at a Green Cross family club.
(Source: Semion Shevtsov)

The Chernobyl-affected populations generally had higher and worse scores related to well-being than the non-exposed comparison populations.

Within the exposed populations, the loss of well-being experienced was inversely related to their distance to the accident site. There is not a clear indication whether time since the disaster reduced the poor well-being caused by the Chernobyl disaster.

Cognition: Table 7 summarizes the results for measured cognition. Of the studies reviewed, cognitive functioning was mostly determined by electroencephalogram (EEG) pattern analysis and intelligence exams, such as the Raven Standard Progressive Matrices Test. The EEG pattern analysis examines the characteristics of EEG for the specific mental activities performed by each study participant. The Raven Standard Progressive Matrices Test is an exam that determines abstract reasoning through multiple-choice questions (Raven 1941).

In the studies by Havenaar and colleagues (Havenaar et al. 1996a; Havenaar et al. 1996b; Havenaar et al. 1997a; Havenaar et al. 1997b; Havenaar et al. 2003) and Gamache et al. (Gamache et al. 2005), the exposed groups had worse cognitive functioning than the groups not exposed to the Chernobyl disaster. Havenaar and colleagues (Havenaar et al. 1996a; Havenaar et al. 1996b; Havenaar et al. 1997a; Havenaar et al. 1997b; Havenaar et al. 2003) found that the prevalence for mood disorders was about 29% greater in Gomel (exposed group) than in Tver (non-exposed group). Gamache et al. (Gamache et al. 2005) found the exposed groups to have "significantly lower" four-year average scores than the non-exposed group in the accuracy and efficiency for performance tasks of continuous memory and two-choice reaction time.



A patient being examined by a Green Cross medical health care team. (Source: Semion Shevtsov)

Exposure levels for the children who were irradiated in utero were not associated with the children's cognitive scores in all studies. In the study by Joseph et al. (Joseph et al. 2004), the mean scores for the Conners' test taken by the children ranged from 46 to 48 in the exposed and non-exposed groups. Joseph et al. (Joseph et al. 2004) also found similar findings for mothers as the mean scores ranged from 51 to 53 in all groups. Still, children who were irradiated in utero had lower intelligence test scores, as shown in the studies by Loganovskaja and Loganovsky (1999),

by Nyagu et al. (Nyagu et al. 1998), by Igumnov and colleagues (Igumnov 1996; Igumnov and Drozdovitch 2000; Igumnov and Drozdovitch 2002; Igumnov and Drozdovitch 2004), and by Kolominsky et al. (Kolominsky et al. 1999). Loganovskaja and Loganovsky (1999) found abnormal EEG-patterns to be more frequent in children who were irradiated in utero than those who were not (74% versus 10%, respectively). Loganovskaja and Loganovsky (1999) identified that the mother's classification of verbal intellectual level of these children was lower in the exposed group. Furthermore, Nyagu et al. (Nyagu et al. 1998), Igumnov and colleagues (Igumnov 1996; Igumnov and Drozdovitch 2000; Igumnov and Drozdovitch 2002; Igumnov and Drozdovitch 2004), and by Kolominsky et al (Kolominsky et al. 1999) found higher IQ scores among non-exposed children in general.

The Chernobyl-affected populations generally had higher and worse cognitive scores than the non-exposed comparison populations. Within the exposed populations, the relationship between the amount of diminished cognition experienced and the level of exposure from the accident is not clearly understood. There is also not a clear indication as to whether longer time since the Chernobyl disaster is associated with poor cognitive functioning.

FINDINGS OF FOCUS GROUPS IN KIEV (KYIV), UKRAINE

As one step in exploring future research directions on the neuropsychological consequences of the Chernobyl disaster, we arranged for focus groups to learn the most critical concerns of residents in Kiev (Kyiv), Ukraine today (see Appendix B for full report). Data were collected in Kiev because of its relative proximity to Chernobyl, the presence of an affected population, and the availability of a team to collect data. We collaborated with Dr. Semyon Gluzman from the Ukrainian Psychiatric Association and Dr. Stanislav Kostyuchenko from the National Medical Academy of Postgraduate Education in designing the focus group protocol and the specific items to be addressed. The focus groups were conducted in Kiev, Ukraine from March 21 to 23, 2011 by the Kiev International Institute of Sociology (KIIS).



A child being examined by a member of the Green Cross medical health care team. (Source: Semion Shevtsov)



A burning house in a contaminated region. (Source: Sergei Brushko

The focus group findings pointed to several general themes regarding the population perception of health and wellbeing, the quality of medical care and the possible health consequences of the Chernobyl disaster. For most respondents, health was considered one of the most important values in their lives; however, few reported about the medical services used in cases of illness. For example, when asked about how they generally cared for the flu, almost all respondents described using "traditional means" such as "staying at home," "lying in bed," or "hot tea," and very few mentioned that they would seek medical care advice. Many respondents even said that the second step after "traditional means" would be to "go to a drugstore" for "self care" or obtain advice from the pharmacist.

Twenty-five years after the disaster, many respondents mentioned Chernobyl as a possible threat to their health. Health consequences of the Chernobyl disaster were noted spontaneously in almost all groups before the facilitator put the question towards the groups. The respondents were clear that the Chernobyl disaster affected their lives and they still remember some details of events in April–May 1986. The majority of people agreed that they need more detailed health investigations to define their state of health and identify possible consequences of the Chernobyl disaster for health. They voiced an interest in participating in studies.

Among the main concerns on the future health consequences of the Chernobyl disaster, many respondents said that children need to have more detailed investigation of their health, including physical and mental health. With regard to mental health as a consequence of the Chernobyl disaster, respondents did not state directly that their mental health had been affected. Nevertheless, they described many symptoms of depression when asked, such as sleep disturbances, loss of interest and fatigue. This topic was discussed at particular length among the group of older women (age 56+).

In general, the focus group discussions gave useful insights regarding people's perceptions, concerns, and attitudes towards their health and the

current state of health care in Kiev. They also noted other environmental risk factors in Kiev that could affect health within Kiev. The following emerged with consensus as key issues: dissatisfaction with the quality of the medical care, the use of non evidence-based diagnostics and treatments, lack of knowledge in the population about the signs of both physical and mental disorders, concerns about children's health, and the potential impact of environmental factors including the Chernobyl disaster.



An evacuated house in the closed area around Chernobyl. (Source: Semion Shevtsov)

DISCUSSION

Based on a systematic review, we found that there is evidence for adverse psychological and welfare consequences of the Chernobyl disaster. The extent of the available research, however, was limited and the various Chernobyl-affected groups have not been systematically investigated. In research subsequent to the disaster, emphasis has been given to cancer risk, as a result of the widespread radiation exposure to workers and the population. Nonetheless, the studies conducted showed persistent neuropsychological consequences in populations studied as recently as 2003-2004 (Loganovsky et al. 2007) and 2005-2006 (Guey et al. 2008; Taormina et al. 2008; Bromet et al. 2009; Bromet et al. 2010). Other reviews have provided parallel and confirmatory documentation (Yablokov et al. 2010; Bromet et al. 2011).



A child receiving care at hospital near disaster. (Source: Semion Shevtsov)

Children: Children were placed at risk for diverse outcomes consequent to the disaster, including increased cancer risk, developmental problems, and loss of well-being. Only six unique populations of children were identified in our literature search: in Kiev, Ukraine (Bromet et al. 2000; Litcher et al. 2000; Adams et al. 2002; Bromet et al. 2002; Drabick et al. 2006; Guey et al. 2008; Taormina et al. 2008; Bromet et al. 2009; Bromet et

al. 2010), in Ukraine (Nyagu et al. 1998; Loganovskaja and Loganovsky 1999), in Belarus (Igumnov 1996; Kolominsky et al. 1999; Igumnov and Drozdovitch 2000; Arynchin et al. 2002; Igumnov and Drozdovitch 2002; Igumnov and Drozdovitch 2004), in Norway (Heiervang et al. 2010a; Heiervang et al. 2010b), and in immigrants to Haifa, Israel (Joseph et al. 2004). The most detailed study was carried out by a team of investigators from the United States and the Ukraine. The study population included mothers and children, either in utero or infants at the time of the accident. They have now been followed up to age 19 years of age. The findings point to the complexity of research in this area. Comparing exposed and non-exposed children, clear-cut differences in neuropsychological functioning were not found, but mothers of exposed children viewed their children as more vulnerable and affected, and at age 19 years, the exposed children rated their health more poorly than did the control children. The more detailed neuropsychological evaluation in the study by Loganovskaja and Loganovsky (1999) found evidence suggestive of a lasting effect of prenatal radiation. The study in Israel, by contrast, found no indication of neurobehavioral or cognitive effects.

This mixed evidence leaves unanswered the key question of possible long-term effects of the accident on children. The study by Bromet and her colleagues in the United States and Ukraine highlights the complicated interplay between effects on the mother, the vulnerability of the child, and the child's perception of their own health and well-being. Only carefully planned research will resolve such mixed findings.



An abandoned building near the disaster sight. (Source: Semion Shevtsov)

Clean-up Workers (Liquidators): The literature search identified 12 different populations, including multiple groups in Ukraine (Koscheyev et al. 1993; Snegir and Snegir 1999; Loganovsky and Loganovskaja 2000; Polyukhov et al. 2000; Gamache et al. 2005; Loganovsky et al. 2007), Russia (Ivanov et al. 2000; Rumyantseva and Stepanov 2008), and separate groups in Estonia (Rahu et al. 1997; Tekkel et al. 1997; Rahu et al. 2006), Hungary and Italy (Zhavoronkova et al. 1995), Latvia (Viel et al. 1997), and Israel (Cwikel et al. 1997). These studies have included a wide range of outcome measures, ranging from standard

assessments to tracking of mortality from suicide. The papers describing the findings uniformly indicate adverse effects of clinical and public health significance. For example, cohort studies of clean-up workers, extending to 18 years after the accident, shows persistence of higher rates of depression (Loganovsky et al. 2007) and of suicide (Rahu et al. 1997; Tekkel et al. 1997; Rahu et al. 2006) among clean-up workers versus the controls.

Given this clear indication of lasting neuropsychological consequences for clean-up workers, research might be best directed at determining the extent and adequacy of treatment that they may be receiving. The existing studies are sufficient to identify a need to consider approaches to prevention and treatment.

General Population: Multiple studies have been carried out on adults in the general population, including Ukraine (Ginzburg and Reis 1991; Ginzburg 1993; Bromet et al. 2002; Loganovsky and Yuryev 2004; Bromet et al. 2005; Gamache et al. 2005; Webb et al. 2005; Bromet et al. 2007), Russia (Ginzburg and Reis 1991; Ginzburg 1993; Viinamäki et al. 1995), Belarus (Ginzburg and Reis 1991; Ginzburg 1993; Havenaar et al. 1996a; Havenaar et al. 1996b; Havenaar et al. 1997a; Havenaar et al. 1997b; Havenaar et al. 2003), immigrants to Israel (Cwikel et al. 1997; Remennick 2002)) and New York (Foster 2002; Foster and Goldstein 2007). These studies, in spite of varying methodology and populations studied, are consistent in identifying adverse effects of the Chernobyl accident on mental health and general wellbeing. The study populations include Ukraine, Belarus, and Russia, as well as immigrants to the United States and Russia. The earliest was carried out in 1990 and the most recent in 2002-2003.



A family living near Chernobyl.
(Source: Semion Shevtsov)

The evidence is strongest in indicating an adverse effect on general wellbeing, including increased stress and anxiety. For example, Havenaar and colleagues (Havenaar et al. 1996a; Havenaar et al. 1996b; Havenaar et al. 1997a; Havenaar et al. 1997b; Havenaar et al. 2003) found higher levels of psychological distress and psychiatric disorders among survey respondents in the Gomel region compared with a non-exposed group in Tver. Findings in immigrants to the

United States and Israel from the region were similar, even though immigrants tend to be healthier than non-immigrants. Several researchers propose that the Chernobyl disaster may also have led to increased rates of DSM classifiable mental illness.



A radiation warning along the road in Belarus.
(Source: Semion Shevtsov)

Limitations: We have reviewed a diverse body of research findings, based on studies from multiple countries and investigators. Methods vary widely around population selection, data collection, and data analysis. There are obvious potential limitations of the studies, reflecting in large part the difficulties of carrying out such studies and the particular challenges posed by research on those affected by the Chernobyl accident.

In particular, population selection methods were variable, as were response rates, and the possibility of selection bias needs consideration. Those with symptoms attributed to the disaster may have been more likely to participate, for example. There is also a potential for information bias, even though standardized and validated instruments were used in most of the studies.

Nonetheless, taking these potential limitations into account, we conclude that the evidence is sufficiently coherent to support the conclusions and recommendations that follow. Others have made recommendations with regard to the neuropsychological consequences of the Chernobyl disaster. The 2006 report of the UN Chernobyl Forum's expert group on health called for medical monitoring and called for community programs for psychological support (World Health Organization 2006). It cited community centers that were created within the framework of the UNESCO-Chernobyl Programme. The recommendations to governments of Belarus, the Russian Federation, and Ukraine made by the Chernobyl Forum 2003-2005 also covered this general area of health concern, while giving far greater emphasis to malignancy (Chernobyl Forum 2006a). The report did not offer any relevant research recommendations, but did call for support programs for children and for those who were children at the time of the accident. Most recently, Bromet and colleagues (Bromet et al. 2011) called for further mental health research, pointing to the need to incorporate appropriate assessments into

epidemiological studies of other health outcomes. A more holistic research approach seems warranted, given the wide range of health effects that are still of concern.

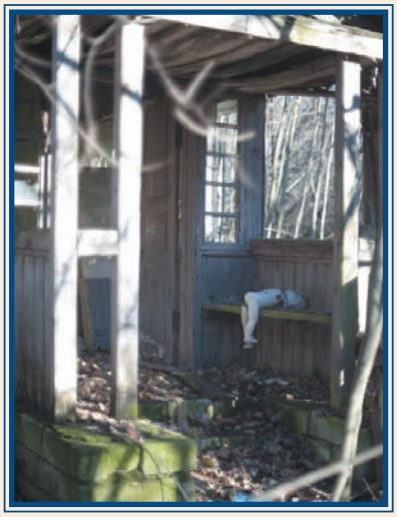
CONCLUSIONS AND RECOMMENDATIONS

We have considered two sources of evidence on the long-term neuropsychological consequences of the Chernobyl disaster: the published research evidence available in the accessible literature and the findings of focus groups conducted in Kiev in March, 2011. The broad findings from these two sources are convergent and clear: twenty-five years after the Chernobyl disaster, the populations affected at the time, whether by being displaced or exposed to radiation, have sustained neuropsychological consequences and these consequences remain of public health and medical significance. This finding is not surprising, given experience with the aftermath of disasters generally.



A group of people measuring the radioactivity at a prohibited entrance. (Source: Semion Shevtsov)

In proposing follow-up to this report, there is little need to make the inevitable call for more research. Studies of neuropsychological consequences in children, adults, and workers are consistent in indicating adverse effects. Some studies are apparently ongoing. The focus groups are confirmatory and speak more directly to the need for medical services and interventions that would reduce the persistent burden of neuropsychological morbidity.


An abandoned house in a contaminated region. (Source: Semion Shevtsov)

The current context needs careful consideration in planning further data collection and programs. Twenty-five years after the disaster there are various initiatives in place. Additionally, there is now a lengthy history of government and non-government programs, apparently of variable effectiveness. There is also a general lack of trust on the part of affected populations that can reach to governmental and non-governmental organizations.

We recommend:

- A systematic assessment of ongoing research and programs related to neuropsychological consequences of the disaster should be carried out. At the least, the survey should cover Ukraine, Belarus, Russia, and Moldova. This assessment could be carried out using the resources of the Green Cross offices within each country.
- Data should be collected that will directly address the need for services and other interventions in the populations that continue to be affected by the Chernobyl disaster. These populations can be defined on a geographic basis.
  - The literature reviewed in this report, the focus group findings, and the expertise of researchers an practitioners in the affected areas should be the basis for developing a brief instrument that could be readily implemented and that would provide findings useful for guiding program development.
  - There are a number of institutions with relevant expertise and experience that should be collectively involved in developing the instrument and the general approach. There are also researchers external to Eastern Europe who should be involved, e.g., Dr. Evelyn Bromet.
  - While ideally, data would be collected through population surveys, more practical and feasible approaches might be used, such as approaching people in clinics, worksites, and educational institutions.
  - Multi-country studies carried out with standardized instruments and uniform protocols may be particularly informative.
- A major uncertainty, not addressed in this report, is the potential for further data to motivate action, whether by governmental or non governmental organizations. A "mapping" or a description of the "actors" in each country would be valuable and needed to understand how further data collection on the neuropsychological consequences of the disaster could make a difference.



A child living in a contaminated area in Belarus. (Source: Semion Shevtsov)

- Further research, beyond the programmatically-oriented data collection proposed above, could be useful. There have been studies of the long-term neuropsychological consequences of disasters of various types, but the exposures of Chernobyl are unique. Information might be gained that would relevant to the current crisis in Japan.
- We concur with the recommendation made recently by Bromet et al. (Bromet et al. 2011) that the possibility of augmenting ongoing epidemiological studies to address neuropsychological consequences of the disaster should be explored.
- At the 25th anniversary year of the disaster, it would be timely to give greater discussion to the topic of long-term neuropsychological consequences. The planned 25th anniversary conference, for example, "Twenty-five Years after Chernobyl Accident. Safety for the Future", Kyiv, April 20-22, 2011, does not appear to give any emphasis to this topic.
    - Funding should be sought for holding a conference with the goals of further characterizing the current state of the evidence, obtaining input into developing a data collection instrument, defining further research needs, and establishing a network of collaborators.



Reactor #4 of the Chernobyl Nuclear Power Plant under the sarcophagus built after the disaster. (Source: Julien Behal/Chernobyl Children's Project)

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TABLE 1: STUDY CHARACTERISTICS

Study By Principal Author	Population Type	Location / Year(s) of Data Collection	Sex / Age (yrs)	Selection Approach	Size (N)
Havenaar (Havenaar, Poelijoe et al. 1996; Havenaar, Van Den Brink et al. 1996; Havenaar, Rumyantzeva et al. 1997; Havenaar, Rumyantzeva et al. 1997; Havenaar, De Wilde et al. 2003)	Adults	Gomel, Belarus Tver, Russia 1992-1993	Male: 44.5% Female: 55.5% *Subsample* Male: 39.2% Female: 60.8% 18-65	Random samples from employed inhabitants of exposed regions (Gomel) corresponding to census data from 1989 compared to unexposed regions (Tver) with similar cultural background, socioeconomic structure, and population size	Total: 3044 Subsample: 449
Remennick (Remennick 2002)	Adults	Israel 1997	Male: 45% Female: 55% 30-59	Russian immigrants from Chernobyl-affected areas who stayed at least 3 years in Israel after disaster compared to similar immigrants from other areas of former Soviet Union	Total: 380 Controls: 200 Exposed: 180
Viinamaki (Viinamäki, Kumpusalo et al. 1995) (Subgroup from ESMER project [n=1,279 total])	Adults	Bryansk area, Russia Jan–Apr 1993	Male: 45% Female: 55% 14-54	At time of ESMER (ecological, social and medical research on the long-term consequences of Chernobyl nuclear power station accident) project, the exposed study group was living in the contaminated village of Mirnyi (>1300 kBq/m^2 of ^{137}Cs). Non-exposed study group (controls) was living in the non-contaminated village of Krasnyi Rog (<37 kBq/m^2 of ^{137}Cs).	Total: 603 Controls: 278 Exposed: 325
Loganovsky (Loganovsky and Yuryev 2004)	Adults	Ukraine 1996-2001	Male: 100% Female: 0% < 60	Confirmed and non-confirmed right-handed ARS (acute radiation sickness) patients who were exposed to 1986 accident with absence of any neuro-psychiatric and physical disease or head trauma before the accident and absence of head trauma, stroke, neuro-infections, and dependence on any psychoactive substances (other than tobacco) after the accident	Total: 63
Webb (Bromet, Gluzman et al. 2005; Webb, Bromet et al. 2005; Bromet, Havenaar et al. 2007) ("Ukraine World Mental Health Survey")	Adults	Ukraine 2002	Male: 38% Female: 62% ≥ 18	Nationally representative survey of residents from the 24 oblasts (states) and the autonomous republic of Crimea	Total: 4,725

TABLE 1: STUDY CHARACTERISTICS

Study By Principal Author	Population Type	Location / Year(s) of Data Collection	Sex / Age (yrs)	Selection Approach	Size (N)
Foster (Foster and Goldstein 2007)	Adults	New York, USA 2000-2003	Male: 44.1% Female: 55.9% 19-85	Russian speaking immigrants from Ukraine, Belarus, and Russia living in New York, New Jersey, Connecticut, and Pennsylvania, and recruited through Russian/Ukrainian newspapers, postings in ethnic shopping districts, community centers, and word-of-mouth. Divided into 3 groups based on distance to Chernobyl Power Plant: close (0-50 km), mid (50-150 km), and far (150+ km)	Total: 316 Close: 70 Mid: 119 Far: 127
Foster (Foster 2002) (Part of a larger ongoing study of 500 on which data collection was still ongoing)	Adults	New York, USA 2001	Male: 29.7% Female: 70.3% *	Russian immigrants arriving after 1986 either classify as general sample (Russian immigrants living in tristate New York metro area) or clinical sample (currently being treated at outpatient mental health clinic in NY for psychiatric conditions excluding organic and acute psychotic disorders)	Total: 261 General: 147 Clinical: 114
Ginzburg (Ginzburg and Reis 1991; Ginzburg 1993) (Based on IAEA Study)	Adults and Children	USSR 1989	Male: * Female: * 2-60	Cross-sectional sampling technique was used. Study included matched population from 13 contaminated and control settlements in the three republics and selected the following five groups: 1. Children born in 1988 2. Children born in 1985 3. Children born in 1980 4. Adults born in 1950 5. Adults born in 1930	Total: 1,356 *Adults* Exposed: 263 Controls: 236
Cwikel (Cwikel, Abdelgani et al. 1997)	Adults and Workers	Israel 1994 (wave1) -1995 (wave 2)	Male Wave 1: 41% Wave 2: 45% Female Wave 1: 59% Wave 2: 55% ≥18	Using list of names from Kordyshetal's Cs Study (1991), matched by age, gender, year of immigration, and exposure level. Liquidators: wave 1 = 0 wave 2 = 30 More exposed group (>1 Ci/km^2): wave 1 = 121 wave 2 = 87 Less exposed group (<1 Ci/km^2): wave 1 = 253 wave 2 = 217 Comparison group: wave 1 = 334 wave 2 = 216	Total Wave 1: 708 Unexposed: 334 Exposed: 374 Total Wave 2: 520 Unexposed: 216 Exposed: 304

TABLE 1: STUDY CHARACTERISTICS

Study By Principal Author	Population Type	Location / Year(s) of Data Collection	Sex / Age (yrs)	Selection Approach	Size (N)
Gamache (Gamache, Levinson et al. 2005)	Adults and Workers	Regions of Ukraine (Ternopil, Kiev, Ovruch forest, and Razumntsia) 1995-1998	Male: 81.1% Female: 18.9% 11-61	Volunteer groups at different distances to exposure area: AC – control group in Ternopil at 280 miles away AE – Eliminators in Kiev at 62 miles away AF – Forestry workers in Ovruch forest at 55 miles away AG – Agricultural workers in Razumnytsia at 155 miles away	Total: 127
Arynchyn (Arynchin, Avhacheva et al. 2002)	Children	Gomel, Mogilev, Brest, Vitebsk, Belarus 1990-2001	Male: 55% Female: 45% 6-21	Prospective cohort study between randomly selected children who permanently live in radioactively contaminated territories of Gomel, Mogilev and Brest regions and randomly selected children who permanently live in the territories with natural background radiation in Vitebsk region. All children had at least two clinical examinations (one between 1995-1998 and second between 1998-2001).	Total: 319 Controls: 186 Exposed: 133
Igumnov (Igumnov 1996; Igumnov and Drozdovitch 2000; Igumnov and Drozdovitch 2002; Igumnov and Drozdovitch 2004) (Conducted on database of the Republican Health Centre of Radiation Medicine in 1992-1993 and 1996-1997)	Children	Belarus 1992-1993 & 1996-1997	Male: 51% Female: 49% 6-7 &10-12	The exposed children were born during the period from May 1986 to February 1987, whose mothers had lived in the contaminated areas of Belarus and Pripyat, Ukraine (evacuated to Belarus after disaster) during the disaster (100 to 15,400 kBq/m^2 of ^{137}Cs). The non-exposed children (controls) were born in the period from May 1986 to February 1987, whose mothers had constantly lived in the non- and slightly contaminated areas of Belarus (0.2 to 200 kBq/m^2 of ^{137}Cs). Parents of the controls and exposed children were used for the STAI (anxiety).	Total Children: 500 Controls: 250 Exposed: 250 Mothers Controls: 250 Exposed: 250 Fathers Controls: 235 Exposed: 245
Kolominsky (Kolominsky, Igumnov et al. 1999) (Same database as Igumnov)	Children	Belarus 1992-1993 & 1996-1997	Male: * Female: * 6-7 &10-11	The exposed children were born during the period from May 1986 to February 1987, whose mothers had lived in the contaminated areas of Belarus during the disaster. The	Total: 160 Controls: 122 Exposed: 138

TABLE 1: STUDY CHARACTERISTICS

Study By Principal Author	Population Type	Location / Year(s) of Data Collection	Sex / Age (yrs)	Selection Approach	Size (N)
Kolominsky *(continued)*				non-exposed children (controls) were born in the period from May 1986 to February 1987, whose mothers had constantly lived in non-contaminated areas of Belarus	
Beehler (Beehler, Baker et al. 2008)	Children	Gomel and Mogilev, Belarus 2002-2003	Male: 47.8% Female: 52.2% 16-64	Selected 105 families from a previous case-control study of childhood leukemia among Belarusian families (Mahoney leukemia study, 2004)	Total: 381
Joseph (Joseph, Reisfeld et al. 2004)	Children	Haifa, Israel 1998-2001	Male: 52% Female: 48% 12-18	Immigrated children from different exposure areas Highly exposed – Gomel Mildly exposed – Mogilev and Kiev Nonexposed – Moscow and St. Petersberg	Total: 1,629
Heiervang (Heiervang, Mednick et al. 2010; Heiervang, Mednick et al. 2010)	Children	Oppland, Nord-Trondelag, Akershus, and Oslo Norway 2005-2006	Male: 49% Female: 51% 16.3-20	The exposed students were those living in the counties of Oppland and Nord-Trondelag (most heavily contamination) and were born between zero to 548 days after the Chernobyl disaster. The controls wer recruited from the counties of Akershus and Oslo (almost no increase in radiation was registered). Questionnaires to mothers confirm location during birth.	Total: 178 Controls: 94 Exposed: 84
Nyagu (Nyagu, Loganovsky et al. 1998)	Children	Ukraine 1993-1996	Male: 54% Female: 46% 6-8	Prenatally irradiated children (born between April 26, 1986 to February 26, 1987) in public kindergartens and schools separated by exposure level; compared to those living in radioactively clean zones of Kharkov Province	1,303 Controls: 795 Exposed: 508
Loganovskaja (Loganovskaja and Loganovsky 1999) (Subgroup of Nyagu)	Children	Ukraine 1995-1996	Male: 53% Female: 47% 9-10	Randomly selected prenatally irradiated right-handed children compared to non-exposed control children	Total: 100 Controls: 50 Irradiated in utero: 50

TABLE 1: STUDY CHARACTERISTICS

Study By Principal Author	Population Type	Location / Year(s) of Data Collection	Sex / Age (yrs)	Selection Approach	Size (N)
Bromet (Bromet, Goldgaber et al. 2000; Litcher, Bromet et al. 2000; Adams, Bromet et al. 2002; Bromet, Gluzman et al. 2002; Drabick, Beauchaine et al. 2006) ("Stony Brook Kyiv Chernobyl Project")	Children and Adults	Kiev (Kyiv), Ukraine 1997	Male: 48% Female: 52% 10-12	Randomly selected exposed children from merging the registry lists from Ministry of Health (Ukraine), Help for Families from Chornobly (NGO), and Children of Chornobyl for Survival (NGO). After selected exposed children, controls were randomly selected from matching same homeroom at school. All children were born between Feb. 1,1985 to Jan. 31, 1987.	Total: 1,799 *Children* Total: 600 Classmates (Controls): 300 Evacuees (Exposed): 300 Mothers: 600 Teachers: 599
Taormina (Guey, Bromet et al. 2008; Taormina, Rozenblatt et al. 2008; Bromet, Taormina et al. 2009; Bromet, Guey et al. 2010) (Follow-up of Bromet)	Children and Adults	Kiev, Ukraine 2005-2006	Male: 48% Female: 52% 19	8 yr follow-up of Stony-Brook's children study with original evacuees and non-evacuees classmates. Also, a population-based control group was recruited with criteria of born in 1985-1986, being in Kiev in 1997, and not evacuated from contaminated areas	Total: 1,626 *Children* Total: 853 Classmates (Controls): 261 Evacuees (Exposed): 265 Population-based controls: 327 Mothers Total: 773 Classmates (Controls): 234 Evacuees (Exposed): 243 Population-based controls: 296

TABLE 1: STUDY CHARACTERISTICS

Study By Principal Author	Population Type	Location / Year(s) of Data Collection	Sex / Age (yrs)	Selection Approach	Size (N)
Koscheyev (Koscheyev, Martens et al. 1993)	Workers	Chernobyl NPP+ Ignalina NPP+ 1985-1987 Time 1: July 1986 Time 2: Sept/Oct. 1986 Time 3: Mar/Apr. 1987 Time 4: Nov/Dec. 1987 Controls: Apr. 1988	Male: * Female: * 24-53	Chief operators at Chernobyl Nuclear Power Plant assessed at 4 time periods. Chief operators at Ignalina Nuclear Power Plant+ are Controls. Controls not assessed at same time periods	Total: 479 Controls: 110 Time 1: 55 Time 2: 111 Time 3: 106 Time 4: 97
Rahu (Rahu, Tekkel et al. 1997; Tekkel, Rahu et al. 1997; Rahu, Rahu et al. 2006)	Workers	Estonia 1992 - 2002	Male: 100% Female: 0% ≥19-60+	Estonian clean up workers from 1986-1991 who posses an official record by the Estonian government and non-government databases. Follow up until death, emigration, or Dec. 31, 2002.	Total: 4,786
Zhavoronkova (Zhavoronkova, Kholodova et al. 1995)	Workers	Medicor, Hungary; OTE Biomedica, Italy 1991-1993	Male: 100% Female: 0% 25-45	Right-handed clean-up workers in 1986-1987 with official dose of radiation from 15 to 50 R compared to non-exposed controls.	Total: 250 Controls: 150 Exposed: 100
Viel (Viel, Curbakova et al. 1997)	Workers	Latvia 1994-1995	Male: 100% Female: 0% <25 to ≥55	From all 4,665 male liquidators, selection was made by basic questionnaire. Due to economic difficulties, only 1,444 liquidators were selected for follow-up questionnaire to learn detailed data on exposure and risk factors. Of 1,444 total, 31 were withdrawn from study due to missing data, and one was withdrawn because "he represented on his own a stratum without any health event under study." No comparison to controls.	Total: 1,412 No controls

TABLE 1: STUDY CHARACTERISTICS

Study By Principal Author	Population Type	Location / Year(s) of Data Collection	Sex / Age (yrs)	Selection Approach	Size (N)
Ivanov (Ivanov, Maksioutov et al. 2000)	Workers	Russia 1999	Male: 100%* Female: 0%* 18-45+	Selected the best verified medical cohort from the Russian National Medical and Dosimetric Registry. The cohort was followed from 1986 to 1996.	Total: 68,309
Rumyantseva (Rumyantseva and Stepanov 2008)	Workers	Russia* 2001-2003	Male: % Female: % Combatants: 27 ± 2.8 Liquidators: 43.7 ± 4.5	Chose two groups of patients: combatants and Chernobyl cleanup workers. Combatants were observed after 5-6 years from onset of trauma. Chernobyl clean-up workers were observed after 15-17 years from onset of trauma. Both groups were treated with Coaxil at a dose of 37.5 mg/day for four weeks.	Total: 63 Combatants: 30 Cleanup Workers: 33
Polyukhov (Polyukhov, Kobsar et al. 2000)	Workers	Kiev, Ukraine *	Male: 55% Female: 45% Workers: 30-64 Residents: 20-80	Workers at Chernobyl Nuclear Power Plant from 1986-1992; compared to random Kiev residents sample	Total: 684 Workers (M/F): 223/83 Residents (M/F): 151/227
Snegir (Snegir and Snegir 1999)	Workers	Ukraine* 1992-1997	Male: 51% Female: 49% Exposed: 36.0 ± 2.5 Controls: 28.5 ± 6.0	The exposed group was cleanup workers who stayed in the 30-km exclusion zone for 3 months to 4.5 years (excluded any workers with disorders in the eye optic system). The controls were 18 healthy people who had never visited the areas located closer than 50 km from the Chernobyl Nuclear Power Plant.	Total: Unknown Controls: 18 Exposed: Unknown
Loganovsky (Loganovsky and Loganovskaja 2000)	Workers	Ukraine 1996-1998	Male: 100% Female: 0% Group A: 35-64 Group B: 25-48 Group C: 25-64	Groups formed at Neurology Department, at Academy of Medical Sciences of the Ukraine. *Group A:* Right-handed patients with acute radiation sickness with exposure up to 6.6 Gy *Group B:* Right-handed liquidators-volunteers in the Chernobyl exclusion zone for 5 or more years since 1986-1987	Total: 320

TABLE 1: STUDY CHARACTERISTICS

Study By Principal Author	Population Type	Location / Year(s) of Data Collection	Sex / Age (yrs)	Selection Approach	Size (N)
Loganovsky *(continued)*				*Group C:* Veterans of the Afghanistan war with post-traumatic stress disorder, Veterans with both PTSD and closed head injury, and Normal age- and gender-matched adults	
Loganovsky (Loganovsky, Havenaar et al. 2007)	Workers	Ukraine 2003-2004	Male: 100% Female: 0% *	Clean up workers sent in to Chernobyl compared to geographically matched non-clean up workers (controls). 397 of 692 from Ukraine World Mental Health Survey (2002)	Total: 692

*was not given or unclear in publication

TABLE 1: STUDY CHARACTERISTICS

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TABLE 2: USED MEASUREMENTS

Study By Principal Author	Population Type	Measured Scales*				
		Anxiety	Depression	PTSD	Well Being	Cognition
Havenaar (Havenaar, Poelijoe et al. 1996; Havenaar, Van Den Brink et al. 1996; Havenaar, Rumyantzeva et al. 1997; Havenaar, Rumyantzeva et al. 1997; Havenaar, De Wilde et al. 2003)	Adults	Brief Scales for Anxiety, Bradford Somatic Inventory, DSM-III-R	Brief Scales for Depression, Bradford Somatic Inventory		Well being GHQ-12, DMS-III-R, ICDD-9-CM, MOS-SF	GHQ, Medical Service Use, MDCL, Hazard Perception Scale, Likert-Scale Questionnaire: Risk Perception Scale, Credibility of Information Scale, Sense of Control, and Expectation of Recurrence, DSM-III-R, Bradford Somatic Inventory
Remennick (Remennick 2002)	Adults	5-point Likert Scale, Interview	5-point Likert Scale, Interview		5-point Likert Scale, Interview	
Viinamaki (Viinamäki, Kumpusalo et al. 1995) (Subgroup from ESMER project)	Adults				GHQ-12, 5-point Likert Scale Structured Questionnaire	
Loganovsky (Loganovsky and Yuryev 2004)	Adults					Quantitative EEG
Webb (Bromet, Gluzman et al. 2005; Webb, Bromet et al. 2005; Bromet, Havenaar et al. 2007) ("Ukraine World Mental Health Survey")	Adults	WMH-CIDI, DSM-IV	WMH-CIDI, DSM-IV		WMH-CIDI, DSM-IV	WMH-CIDI, DSM-IV
Foster (Foster and Goldstein 2007)	Adults	RBAI	RBDI	R MISS PTSD	Interview, BAS	
Foster (Foster 2002) (Part of a larger ongoing study of 500 on which data collection was still ongoing)	Adults	RBAI	RBDI	R MISS PTSD	Interview	

TABLE 2: USED MEASUREMENTS

Study By Principal Author	Population Type	Measured Scales*				
		Anxiety	Depression	PTSD	Well Being	Cognition
Ginzburg (Ginzburg and Reis 1991; Ginzburg 1993) (Based on IAEA Study)	Adults and Children	Structured Interview			Structured Interview, Clinical Examinations, Symptom Checklist	
Cwikel (Cwikel, Abdelgani et al. 1997)	Adults and Workers	Derogatis SCL-90	CES-D	IES	Interview	
Gamache (Gamache, Levinson et al. 2005)	Adults and Workers					ANAMUKR
Arynchyn (Arynchin, Avhacheva et al. 2002)	Children				Clinical examinations	Clinical examinations
Igumnov (Igumnov 1996; Igumnov and Drozdovitch 2000; Igumnov and Drozdovitch 2002; Igumnov and Drozdovitch 2004) (Conducted on database of the Republican Health Centre of Radiation Medicine in 1992-1993 and 1996-1997)	Children	STAI			ICD-10	ICD-10, WISC-III UK
Kolominsky (Kolominsky, Igumnov et al. 1999) (Same database as Igumnov)	Children				ICD-10	ICD-10, WISC-III UK
Beehler (Beehler, Baker et al. 2008)	Children	BSI	BSI			

TABLE 2: USED MEASUREMENTS

Study By Principal Author	Population Type	Measured Scales*				
		Anxiety	Depression	PTSD	Well Being	Cognition
Joseph (Joseph, Reisfeld et al. 2004)	Children					Raven Standard Progressive Matrices Test, ADHD, Conners' Rating Scales-Revised
Heiervang (Heiervang, Mednick et al. 2010; Heiervang, Mednick et al. 2010)	Children					WASI, Vocabulary and Matrix Reasoning, MATRICS Consensus Cognitive Battery, Backward Masking
Nyagu (Nyagu, Loganovsky et al. 1998)	Children				GHQ-28, Interview	Computerized EEG, WAIS, Draw-a-Man test, Raven Coloured Matrices, British Picture Vocabulary Scale, Rutter scale A(2)
Loganovskaja (Loganovskaja and Loganovsky 1999) (Subgroup of Nyagu)	Children				GHQ-28, ICD-10	Computerized EEG, WAIS, Draw-a-Man test, Raven Coloured Matrices, British Picture Vocabulary Scale, Rutter scale A(2), ICD-10
Bromet (Bromet, Goldgaber et al. 2000; Litcher, Bromet et al. 2000; Adams, Bromet et al. 2002; Bromet, Gluzman et al. 2002; Drabick, Beauchaine et al. 2006) ("Stony Brook Kyiv Chernobyl Project")	Children and Adults	GSI, CBCL	DSM-III-R, Depression Self Rating Scale	IES	CSI, CBCL, GSI, SCL-90, IES	SCL-90, VSAT, Iowa Conners' Teachers Rating Scale, Detroit Tests of Learning Aptitude, BVRT A
Taormina (Guey, Bromet et al. 2008; Taormina, Rozenblatt et al. 2008; Bromet, Taormina et al. 2009; Bromet, Guey et al. 2010) (Follow-up of Bromet)	Children and Adults	MMPI	MMPI		CSI, WMH-CIDI, Interviews	VSAT, Trail-Making Test, Underline-the-words test, BVRT A, HVLT A, WAIS
Koscheyev (Koscheyev, Martens et al. 1993)	Workers				16 PF, psychiatric interview	Raven Standard Progressive Matrices Test

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TABLE 2: USED MEASUREMENTS

Study By Principal Author	Population Type	Measured Scales*				
		Anxiety	Depression	PTSD	Well Being	Cognition
Rahu (Rahu, Tekkel et al. 1997; Tekkel, Rahu et al. 1997; Rahu, Rahu et al. 2006)	Workers				Suicides	
Zhavoronkova (Zhavoronkova, Kholodova et al. 1995)	Workers	Neuropsycho-logical investigations			Neuropsycho-logical investigations	Neuropsychological investigations , EEG analysis
Viel (Viel, Curbakova et al. 1997)	Workers					
Ivanov (Ivanov, Maksioutov et al. 2000)	Workers				ICD-9	
Rumyantseva (Rumyantseva and Stepanov 2008)	Workers			SCID-PTSD, CAPS, IES-R		
Polyukhov (Polyukhov, Kobsar et al. 2000)	Workers				BA, IBA, CPA, PA	
Snegir (Snegir and Snegir 1999)	Workers					VEP
Loganovsky (Loganovsky and Loganovskaja 2000)	Workers	GHQ-28, BPRS	GHQ-28, BPRS, MMPI	GHQ-28	GHQ-28, BPRS	BPRS, SANS, GHQ-28, MMPI, Computerized EEG
Loganovsky (Loganovsky, Havenaar et al. 2007)	Workers	WMH-CIDI	WMH-CIDI	IES, Interview	WHO-DAS, WMH-CIDI	SCL-90, WMH-CIDI

* Names of acronyms can be found in Appendix A.

TABLE 2: USED MEASUREMENTS

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TABLE 3: OUTCOMES RELATED TO ANXIETY

Study By Principal Author	Scale	Result
Beehler (Beehler, Baker et al. 2008)	BSI	• Correlation between BSI somatization and BSI anxiety: $r = 0.64$, $p<0.01$ • Correlation between BSI anxiety and BSI depression: $r = 0.70$, $p<0.01$ • Variability in BSI anxiety scores across households: $\tau = 0.033$, $p<0.001$
Bromet (Bromet, Goldgaber et al. 2000; Litcher, Bromet et al. 2000; Adams, Bromet et al. 2002; Bromet, Gluzman et al. 2002; Drabick, Beauchaine et al. 2006) ("Stony Brook Kyiv Chernobyl Project")	GSI, CBCL	Data Related to Mothers • Rate (%) of health concern that they will be diagnosed with Chernobyl-related condition Evacuees: 54.5 Controls: 18.7 OR = 5.20 (Evacuees and Controls, 95% CI 3.60-7.52, $p<0.001$) • Rate (%) of health concern that think their health was very affected by Chernobyl Evacuees: 44.7 Controls: 19.6 OR = 3.31 (Evacuees and Controls, 95% CI 2.30-4.78, $p<0.001$) • Rate (%) of health concern that think their child's health was very affected by Chernobyl Evacuees: 58.3 Controls: 29.8 OR = 3.30 (Evacuees and Controls, 95% CI 2.36-4.63, $p<0.001$) • Rate (%) of health concern that think the health of future generations will adversely be affected Evacuees: 71.6 Controls: 60.5 OR = 1.64 (Evacuees and Controls, 95% CI 1.17-2.31, $p<0.01$) • Rate (%) of health concern that the Chernobyl consequences are worse than feared Evacuees: 55.0 Controls: 44.2 OR = 1.55 (Evacuees and Controls, 95% CI 1.12-2.14, $p<0.01$)

TABLE 3: OUTCOMES RELATED TO ANXIETY

Study By Principal Author	Scale	Result
Bromet *(continued)*		Children Related Data: • Mothers' report on CBCL anxiety depression, Mean ± SD Evacuees: 57.88 ± 7.11 Classmates (Controls): 56.58 ± 7.18 t = –1.82 (paired t test, p>0.05) • Self-report on Children's Manifest Anxiety Scale, Mean ± SD Evacuees: 13.30 ± 5.39 Classmates (Controls): 12.68 ± 5.04 t = –1.54 (paired t test, p>0.05) • Self-report on Children's Chernobyl Anxiety Scale, Mean ± SD Evacuees: 15.74 ± 9.88 Classmates (Controls): 13.88 ± 9.34 t = –2.36 (paired t test, p = 0.02) • For both groups, children with greater Chernobyl-focused anxiety performed significantly worse than children with less Chernobyl-focused anxiety on measures of attention
Cwikel (Cwikel, Abdelgani et al. 1997)	Derogatis SCL-90	• Percentage (%) with acute symptoms (self-reported) Liquidators: 30 More exposed group (>1 Ci/km^2): 26 Less exposed group (<1 Ci/km^2): 14 Comparison group (unexposed): 2 χ^2 = 44.36, df=6, p < 0.0001 • Pulse rate, Mean ± SD Liquidators: 72.7 ± 8.7 More exposed group (>1 Ci/km^2): 72.05 ± 9.8 Less exposed group (<1 Ci/km^2): 71.48 ± 8.05 Comparison group (unexposed): 68.8 ± 8.62 • Comparison group (unexposed) pulse rate is lower than exposed group ($F_{(3,512)}$ = 3.6, p<0.05) • % with 3 or more chronic conditions (self-reported) Liquidators: 57 More exposed group (>1 Ci/km^2): 47 Less exposed group (<1 Ci/km^2): 49 Comparison group (unexposed): 30

TABLE 3: OUTCOMES RELATED TO ANXIETY

Study By Principal Author	Scale	Result
Cwikel *(continued)*		• A significant effect for exposure on anxiety at both time points and a significant decrease over time ($p<0.01$ [for exposure]; $p<0.001$ [for time]) • % with migraine headaches (self-reported and significant exposure effect was found) Liquidators: 23 More exposed group (>1 Ci/km^2): 22 Less exposed group (<1 Ci/km^2): 21 Comparison group (unexposed): 11 • Relative risk ratio for migraine headaches (comparing most exposed and comparison groups): 2.0, 95% CI: 1.02-3.90, $p = 0.056$
Foster (Foster 2002) (Part of a larger ongoing study of 500 on which data collection was still ongoing)	RBAI	• RBAI, Mean ± SD Close (0-150km): 15.07 ± 11.53 Far (150km+): 11.67 ± 9.12 $p < 0.03$ • RBAI, Mean ± SD General population: 8.65 ± 8.20 Clinical population: 18.49 ± 9.93 $p<0.0001$ • Russians who had lived closer to the disaster, and had greater exposure to it, experience higher levels of anxiety ($p<0.0004$) than Russians who had lived at a further distance
Foster (Foster and Goldstein 2007)	RBAI	• Greater symptoms across all mental health outcome measures from those expressed current-life dissatisfaction (RBAI: $t = 3.52$, $p<0.001$) • RBAI (Scale: 0-63), Mean ± SD Close (0-50km): 11.87 ± 11.33 Mid (50-150km): 8.67 ± 8.26 Far (150km+): 7.64 ± 7.36 $F = 5.41$, $p < 0.01$
Ginzburg (Ginzburg and Reis 1991; Ginzburg 1993) (Based on IAEA Study)	Structured Interview	• Levels of anxiety "appeared to be disproportionate to the biological significance of the radioactive contamination"

TABLE 3: OUTCOMES RELATED TO ANXIETY

Study By Principal Author	Scale	Result
Havenaar (Havenaar, Poelijoe et al. 1996; Havenaar, Van Den Brink et al. 1996; Havenaar, Rumyantzeva et al. 1997; Havenaar, Rumyantzeva et al. 1997; Havenaar, De Wilde et al. 2003)	Brief Scales for Anxiety, Bradford Somatic Inventory, DSM-III-R	• Prevalence (%) of Bradford Somatic Inventory score ≥17 Gomel: 51.1 Tver: 29.7 aOR⁺ = 3.16 (95% CI: 1.95-5.11) • Prevalence (%) of Brief Scales for Anxiety subscale score ≥4 Gomel: 46.1 Tver: 43.8 aOR⁺ = 1.18 (95% CI: 0.77-1.83) • Prevalence (%) of DSM-III-R Anxiety Disorders Gomel: 12.6 Tver: 18.5 aOR⁺ = 0.70 (95% CI:0.40-1.24)
Igumnov (Igumnov 1996; Igumnov and Drozdovitch 2000; Igumnov and Drozdovitch 2002; Igumnov and Drozdovitch 2004) (Conducted on database of the Republican Health Centre of Radiation Medicine in 1992- 1993 and 1996-1997)	STAI	• Percentage (%) of Personal Anxiety felt by Mothers, STAI *High (more than 45 points)* Controls: 24.4, n = 61 Exposed: 50.8, n = 127 χ^2 = 37.13, p<0.001 *Moderate* (31-45) Controls: 75.6, n = 189 Exposed: 49.2, n = 123 • Percentage (%) of Personal Anxiety felt by Fathers, STAI *High (more than 45 points)* Controls: 14.9, n = 35 Exposed: 31.0, n = 76 χ^2 = 17.55, p<0.001 *Moderate* (31-45) Controls: 85.1, n = 200 Exposed: 69.0, n = 169
Koscheyev (Koscheyev, Martens et al. 1993)	MMPI	• MMPI scale scores for Psychasthenia, Mean ± SD by Time since Chernobyl Time 1 (July 1986): 53.5 ± 6.5 Time 2 (Sept/Oct. 1986): 53.0 ± 7.0 Time 3 (Mar/Apr. 1987): 54. 0 ± 8.5 Time 4 (Nov/Dec. 1987): 55.0 ± 7.5 Ignalina operators (Controls, Apr. 1988): 52.5 ± 6.5 *F* = 1.75, p = NS

TABLE 3: OUTCOMES RELATED TO ANXIETY

Study By Principal Author	Scale	Result
Koscheyev *(continued)*		• Percentage of Chernobyl operators with one or more elevated MMPI clinical scale scores by Time since Chernobyl Time 1 (July 1986): 18.4% Time 2 (Sept/Oct. 1986): 20.5% Time 3 (Mar/Apr.1987): 29.2% Time 4 (Nov/Dec. 1987): 33% Ignalina operators (Control, Apr. 1988): 10% $\chi^2(4) = 19.61$, $p<0.001$
Loganovsky (Loganovsky and Loganovskaja 2000)	GHQ-28, BPRS	• Percentage (%) with symptom of anxiety Group A (exposed ARS patients): 29 Group B (Liquidators-volunteers): 46 Vets w/ PTSD: 90, $p<0.001$ relative to Group A, chi-square test Vets w/ PTSD and closed head injury: 84, $p<0.001$ relative to Group A, chi-square test People w/ small dose (< 0.3 Sv): 52 People w/ moderate or large dose (> 0.3 Sv or 30 rem & Group A): 32 $\chi^2 = 6.50$, df = 1, p = ns • BPRS – anxiety score, Mean ± SD People w/ small dose (< 0.3 Sv): 3.0 ± 1.7 People w/ moderate or large dose (>0.3 Sv or 30 rem & Group A): 2.4 ± 1.8 t = 2.11, df = 198, p = ns
Loganovsky (Loganovsky, Havenaar et al. 2007)	WMH-CIDI	• Percentage (%) of Anxiety disorder (except PTSD) Since 1986 Clean-up workers: 5.8 Controls (Non-clean-up workers): 5.6 $aOR^+ = 4.0$, 95% CI: 1.3-12.5, $p<0.05$ *Past 12 months* Clean-up workers: 5.1 Controls (Non-clean-up workers): 3.0 $aOR^+ = 8.7$, 95% CI: 2.0-38.5, $p<0.01$

TABLE 3: OUTCOMES RELATED TO ANXIETY

Study By Principal Author	Scale	Result
Remennick (Remennick 2002)	5-point Likert Scale, Interview	• Mean score of cancer anxiety (composite index from 1 to 5): Survivors (exposed) 2.8, Others (non-exposed) 0.6 • Percentage of chronic migraine ailment: Survivors 10%, Others 4%
Webb (Bromet, Gluzman et al. 2005; Webb, Bromet et al. 2005; Bromet, Havenaar et al. 2007) ("Ukraine World Mental Health Survey")	WMH-CIDI, DSM-IV	• Most common diagnoses for men were alcohol disorders (26.5% lifetime) and mood disorders (9.7% lifetime) • Most common diagnoses for women were mood disorders (20.8% lifetime) and anxiety disorders (7.9% lifetime) • Male to Female ratios for mood and anxiety disorders were 1:2, while that for alcoholism was 9:1
Zhavoronkova (Zhavoronkova, Kholodova et al. 1995)	Neuropsychological investigations	• All exposed patients had complaints of severe headaches and disturbances of sleep cycles.

+ adjusted Odds Ratio

TABLE 3: OUTCOMES RELATED TO ANXIETY

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TABLE 4: OUTCOMES RELATED TO DEPRESSION

Study By Principal Author	Scale	Result
Beehler (Beehler, Baker et al. 2008)	BSI	• Correlation between BSI anxiety and BSI depression: $r = 0.70$, $p<0.01$ • Correlation between BSI somatization and BSI depression $r = 0.52$, $p<0.01$ Variability in depression scores across households $\tau = 0.036$, $p<0.001$
Bromet (Bromet, Goldgaber et al. 2000; Litcher, Bromet et al. 2000; Adams, Bromet et al. 2002; Bromet, Gluzman et al. 2002; Drabick, Beauchaine et al. 2006) ("Stony Brook Kyiv Chernobyl Project")	DSM-III-R, Depression Self Rating Scale	Data related to Mothers: • Percentage (%) of lifetime depression Evacuees: 46.7 Controls: 33.0 $\chi^2 = 10.60$ (McNemar test, Evacuee vs. Non-Evacuee, $p<0.001$) Data related to Children: • Self-report on Depression Self-Rating Scale, Mean ± SD Evacuees: 0.80 ± 0.35 Classmates (Controls): 0.76 ± 0.33 $t = -1.27$ (paired t test, $p>0.05$) • Mothers' report on CBCL anxiety depression, Mean ± SD vacuees: 57.88 ± 7.11 Classmates (Controls): 56.58 ± 7.18 $t = -1.82$ (paired t test, $p>0.05$) • Poor mother-child communication was related to depressive symptoms for both boys and girls $r = -0.44$, $p<0.001$ (Evacuees) • Attention problems were associated with depressive symptoms for boys and girls $r = -0.19$, $p<0.01$ (Evacuees) • Child's emotional lability was related specifically to child conduct problems $r = -0.39$, $p<0.001$ (Evacuees) • Maternal punishment was related specifically to depressive symptoms $r = 0.29$, $p<0.001$ (Evacuees)
Cwikel (Cwikel, Abdelgani et al. 1997)	CES-D	• "A significant effect of time is apparent for depression scores ($p<0.001$) while exposure effect is apparent only at time wave 1 between exposed and comparison groups ($p<0.001$)"

TABLE 4: OUTCOMES RELATED TO DEPRESSION

Study By Principal Author	Scale	Result
Foster (Foster 2002) (Part of a larger ongoing study of 500 on which data collection was still ongoing)	RBDI	• Clinical group scored higher than general population for depression specific to Chernobyl event (RBDI, p<0.0001) • RBDI, Mean ± SD General population: 8.53 ± 7.34 Clinical population: 19.80 ± 11.38 p<0.0001 • RBDI, Mean ± SD Close (0-150km): 14.67 ± 10.87 Far (150km+): 12.62 ± 10.84 p = 0.19
Foster (Foster and Goldstein 2007)	RBDI	• Greater symptoms across all mental health outcome measures from those expressed current-life dissatisfaction (RBDI: *t* = 3.75, p<0.001) • RBDI (Scale: 0-63), Mean ± SD Close (0-50km): 11.02 ± 8.63 Mid (50-150km): 8.37 ± 9.23 Far (150km+): 7.94 ± 7.36 *F* = 3.28, p<0.05
Havenaar (Havenaar, Poelijoe et al. 1996; Havenaar, Van Den Brink et al. 1996; Havenaar, Rumyantzeva et al. 1997; Havenaar, Rumyantzeva et al. 1997; Havenaar, De Wilde et al. 2003)	Brief Scales for Depression, Bradford Somatic Inventory	• Brief Scales for Depression subscale score ≥3, Prevalence % Gomel: 40.9 Tver: 26.6 aOR = 2.36 (95% CI: 1.46-3.83) • Bradford Somatic Inventory score ≥17, Prevalence % Gomel: 51.1 Tver: 29.7 aOR = 3.16 (95% CI: 1.95-5.11)
Koscheyev (Koscheyev, Martens et al. 1993)	MMPI	• MMPI scale scores for Depression, Mean ± SD by Time since Chernobyl Time 1 (July 1986): 53.5 ± 9.0 Time 2 (Sept/Oct. 1986): 54.0 ± 8.5 Time 3 (Mar/Apr. 1987): 57. 0 ± 12.0 Time 4 (Nov/Dec. 1987): 56.0 ± 8.5 Ignalina operators (Controls, Apr. 1988): 49.0 ± 7.5 F = 11.98, p<0.001 • Percentage of Chernobyl operators with one or more elevated MMPI clinical scale scores by Time since Chernobyl Time 1 (July 1986): 18.4%,

TABLE 4: OUTCOMES RELATED TO DEPRESSION

Study By Principal Author	Scale	Result
Koscheyev *(continued)*		Time 2 (Sept/Oct. 1986): 20.5%, Time 3 (Mar/Apr. 1987): 29.2%, Time 4 (Nov/Dec. 1987): 33% Ignalina operators (Controls, Apr. 1988): 10% χ^2 (4) = 19.61, p<0.001
Loganovsky (Loganovsky and Loganovskaja 2000)	GHQ-28, BPRS, MMPI	• Percentage (%) with symptom of depression Group A (exposed ARS patients): 42 Group B (Liquidators-volunteers): 48 Vets w/ PTSD: 44 Vets w/ PTSD and closed head injury: 42 People w/ small dose (<0.3 Sv): 48 People w/ moderate or large dose (>0.3 Sv or 30 rem & Group A): 47 χ^2 = 0.06, df = 1, p = ns • BPRS – depressive mood score, Mean ± SD People w/ small dose (<0.3 Sv): 3.6 ± 2.0 People w/ moderate or large dose (>0.3 Sv or 30 rem & Group A): 2.5 ± 2.2 t = 3.20, df = 198, p = ns • MMPI – depression score, Mean ± SD People w/ small dose (<0.3 Sv): 85.0 ± 12.6 People w/ moderate or large dose (>0.3 Sv or 30 rem & Group A): 78.9 ± 13.3 t = 2.98, df = 198, p = ns
Loganovsky (Loganovsky, Havenaar et al. 2007)	WMH-CIDI	• Prevalence (%) of depressive disorder Since 1986 Clean-up workers: 18.0 Controls (Non-clean-up workers): 13.1 aOR = 1.7, 95% CI: 1.0 – 2.7, p<0.05 *Past 12 months* Clean-up workers: 14.9 Controls (Non-clean-up workers): 7.1 aOR = 3.2, 95% CI: 1.7– 5.9, p<0.001

TABLE 4: OUTCOMES RELATED TO DEPRESSION

Study By Principal Author	Scale	Result
Remennick (Remennick 2002)	5-point Likert Scale, Interview	• Mean self-rated score of the interference of depression with daily functioning (scale from 1 [not at all] to 5 [strongly]): Survivors 3.1, Others 1.4 • Percentage of depression episode(s) during the last year: *Self-reported:* Survivors 36 Others 12 *Clinically diagnosed:* Survivors 15 Others • Percentage on anti-depression medication: *During the last year:* Survivors 17 Others 5 *Even after immigration:* Survivors 26 Others 12 • OR (Survivors vs. Others) of depression episodes during last year = 2.29, $p<0.005$
Webb (Bromet, Gluzman et al. 2005; Webb, Bromet et al. 2005; Bromet, Havenaar et al. 2007) ("Ukraine World Mental Health Survey")	WMH-CIDI, DSM-IV	• Highly significant linear relationship of number of risk factors including depression with heavy alcohol use was found for both sexes

TABLE 4: OUTCOMES RELATED TO DEPRESSION

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TABLE 5: OUTCOMES RELATED TO PTSD

Study By Principal Author	Scale	Result
Bromet (Bromet, Goldgaber et al. 2000; Litcher, Bromet et al. 2000; Adams, Bromet et al. 2002; Bromet, Gluzman et al. 2002; Drabick, Beauchaine et al. 2006) ("Stony Brook Kyiv Chernobyl Project")	IES	Data Related to Mothers: • Rate (%) of mothers with concern about proxy PTSD Evacuees: 18.0 Controls: 9.7 OR = 2.05 (Evacuees and Controls, 95% CI 1.27-3.32, p<0.01) • IES, Mean ± SD Evacuees: 0.84 ± 0.67 Controls: 0.52 ± 0.55 t = –8.38 (paired t test, p<0.001) • More evacuee mothers received a diagnosis of a Chernobyl-related illness by a local physician, believed that their health and their children's health had been adversely affected, and were positive for Chernobyl-induced post-traumatic stress disorder
Cwikel (Cwikel, Abdelgani et al. 1997)	IES	• In both time waves, exposure had a significant effect on PTSD symptom scores • There was significant decrease in PSTD over time among exposed and comparison groups ($F_{(3,482)}$ = 7.85, p<0.0001)
Foster (Foster 2002) (Part of a larger ongoing study of 500 on which data collection was still ongoing)	R MISS PTSD	• Russians who had lived closer to the disaster, and had greater exposure to it, experience higher levels of posttraumatic reactions (p<0.03) than Russians who had lived at a further distance • Clinical group scored higher than general population for traumatic symptoms specific to Chernobyl event (R MISS PTSD, p<0.0001) • Subjects who lived closer to Chernobyl area were more likely to show traumatic reactions (R MISS PTSD, p<0.0004) to the Chernobyl event than those who had resided at a further distance • R MISS PTSD, Mean ± SD General population: 55.13 ± 13.90 Clinical population: 72.07 ± 17.84 p<0.0001

TABLE 5: OUTCOMES RELATED TO PTSD

Study By Principal Author	Scale	Result
Foster *(continued)*		• R MISS PTSD, Mean ± SD Close (0-150km): 67.46 ± 19.29 Far (150km+): 58.36 ± 15.30 p<0.0004
Foster (Foster and Goldstein 2007)	R MISS PTSD	• Greater symptoms across all mental health outcome measures from those expressed current-life dissatisfaction R MISS PTSD *t* = 1.99, p<0.05 • Length in United States negatively related to Chernobyl trauma R MISS PTSD: *r* = –.11, p<0.05 • R MISS PTSD (Scale: 30-150), Mean ± SD Close (0-50km): 62.46 ± 16.75 Mid (50-150km): 56.86 ± 14.13 Far (150km+): 51.60 ± 10.85 *F* = 14.78, p<0.001
Loganovsky (Loganovsky and Loganovskaja 2000)	GHQ-28	• Percentage (%) with symptom of nightmares Group A (exposed ARS patients): 20 Group B (Liquidators-volunteers): 14 Vets w/ PTSD: 68, p<0.001 relative to Group A, chi-square test Vets w/ PTSD and closed head injury: 72, p<0.001 relative to Group A, chi-square test • Percentage (%) with symptom of flashbacks Group A (exposed ARS patients): 18 Group B (Liquidators-volunteers): 2, p<0.001 relative to Group A, chi-square test Vets w/ PTSD: 52, p<0.001 relative to Group A, chi-square test Vets w/ PTSD and closed head injury: 48, p<0.001 relative to Group A, chi-square test
Loganovsky (Loganovsky, Havenaar et al. 2007)	IES, Interview	• Prevalence (%) of PTSD *Since 1986* Clean-up workers: 3.7 Controls (Non-clean-up workers): 1.3 aOR = 2.5, 95% CI: 0.9-7.1 *Past 12 months* Clean-up workers: 4.1 Controls (Non-clean-up workers): 1.0 aOR = 3.5, 95% CI: 1.0-12.1, p<0.05

TABLE 5: OUTCOMES RELATED TO PTSD

Study By Principal Author	Scale	Result
Loganovsky *(continued)*		• Overall PSTD symptoms, Mean ± SD High exposure: 1.0 ± 0.7 Moderate exposure: 0.6 ± 0.7 Low exposure: 0.6 ± 0.6 p = 0.002
Rumyantseva (Rumyantseva and Stepanov 2008)	SCID-PTSD, CAPS, IES-R	• PTSD symptom appearance was seen 2-3 years after stressful event in Clean-up Workers while in Combatants was seen 2-6 months after stressful event • Tendency to suicidal behavior was permanent in Clean-up Workers, as compared to Combatants who were episodic • Scores for the Severity of "Immersion" on CAPS, Mean ± SD *Before Treatment* Clean-up Workers: 7.00 ± 2.3 Combatants: 9.0 ± 4.26 *After Treatment* Clean-up Workers: 2.31 ± 2.3 Combatants: 3.9 ± 1.95 • Scores for the Severity of "Avoidance" on CAPS, Mean ± SD *Before Treatment* Clean-up Workers: 18.31 ± 5.65 Combatants: 9.5 ± 3.89 *After Treatment* Clean-up Workers: 16.89 ± 4.4 Combatants: 5.5 ± 2.3 • Scores for the Severity of Hyperexcitability on CAPS, Mean ± SD *Before Treatment* Clean-up Workers: 24.41 ± 3.9 Combatants: 17.0 ± 7.75 *After Treatment* Clean-up Workers: 10.72 ± 3.0 Combatants: 10.9 ± 2.98 • Scores for the Severity of Mean Total Points on CAPS, Mean ± SD *Before Treatment* Clean-up Workers: 49.72 ± 10.1 Combatants: 35.5 ± 15.9 *After Treatment* Clean-up Workers: 29.92 ± 9.7 Combatants: 20.3 ± 5.23

TABLE 5: OUTCOMES RELATED TO PTSD

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TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Arynchyn (Arynchin, Avhacheva et al. 2002)	Clinical Examinations	• Frequency of complaint concerning weakness (%) *1st Examination* Exposed: 31.6 Controls: 11.9 p<0.05 *2nd Examination* Exposed: 28.6 Controls: 24.7 • Frequency of complaint concerning dizziness (%) *1st Examination* Exposed: 12.8 Controls: 4.9 <0.05 *2nd Examination* Exposed: 17.3 Controls: 5.8 p<0.05 • Frequency of complaint concerning headache (%) *1st Examination* Exposed: 37.6 Controls: 20.7 p<0.05 *2nd Examination* Exposed: 45.1 Controls: 25.9 p<0.05 • Frequency of complaint concerning syncope (%) *1st Examination* Exposed: 0.8 Controls: 0 *2nd Examination* Exposed: 2.3 Controls: 0 • Frequency of complaint concerning nasal bleeding (%) *1st Examination*

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Arynchyn *(continued)*		Exposed: 2.3 Controls: 0.5 *2nd Examination* Exposed: 3.8 • Frequency of complaint concerning fatigability (%) *1st Examination* Exposed: 27.1 Controls: 8.2 p<0.05 *2nd Examination* Exposed: 23.3 Controls: 17.2 • Frequency of complaint concerning irritability (%) *1st Examination* Exposed: 3.0 Controls: 1.1 *2nd Examination* Exposed: 4.5 Controls: 2.9 • Frequency of complaint concerning troubled sleep (%) *1st Examination* Exposed: 3.0 Controls: 0.5 *2nd Examination* Exposed: 1.5 Controls: 0 • Frequency of complaint concerning uracrasia (%) *1st Examination* Exposed: 0.8 Controls: 0.5 *2nd Examination* Exposed: 1.5 Controls: 1.7

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Arynchyn *(continued)*		• Frequency of complaint concerning heartache (%) *1st Examination* Exposed: 6.8 Controls: 13.0 *2nd Examination* Exposed: 9.0 Controls: 11.5 • Frequency of complaint concerning arrhythmia (%) *1st Examination* Exposed: 1.5 Controls: 0 *2nd Examination* Exposed: 18.8 Controls: 5.8 p<0.05 • Frequency of complaint concerning stomachache (%) *1st Examination* Exposed: 51.9 Controls: 21.2 p<0.05 *2nd Examination* Exposed: 64.7 Controls: 44.3 p<0.05 • Frequency of complaint concerning belching (%) *1st Examination* Exposed: 9.8 Controls: 2.2 p<0.05 *2nd Examination* Exposed: 15.8 Controls: 12.6 p<0.05 • Frequency of complaint concerning heartburn (%) *1st Examination*

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Arynchyn *(continued)*		Exposed: 1.5 Controls: 1.6 *2nd Examination* Exposed: 7.5 Controls: 5.8 • Frequency of complaint concerning decreased appetite (%) *1st Examination* Exposed: 9.0 Controls: 1.1 p<0.05 *2nd Examination* Exposed: 14.3 Controls: 10.3 • Frequency of complaint concerning diarrhea (%) *1st Examination* Exposed: 2.3 Controls: 0.5 *2nd Examination* Exposed: 0.8 Controls: 0 • Frequency of complaint concerning constipation (%) *1st Examination* Exposed: 0.8 Controls: 1.1 *2nd Examination* Exposed: 0.8 Controls: 0.6 • Frequency of complaint concerning allergic eruptions (%) *1st Examination* Exposed: 1.5 Controls: 0.5 *2nd Examination* Exposed: 3.0 Controls: 5.8

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Bromet (Bromet, Goldgaber et al. 2000; Litcher, Bromet et al. 2000; Adams, Bromet et al. 2002; Bromet, Gluzman et al. 2002; Drabick, Beauchaine et al. 2006) ("Stony Brook Kyiv Chernobyl Project")	CSI, CBCL, GSI, IES	Overall: • After controlling for Chernobyl stress variables, differences in the number of health problems commonly attributed to Chernobyl remained significant but differences in general health ratings were not necessary significant • Relationship between Chernobyl stress and illness was twice as strong in evacuee mothers (OR = 6.95) as in Kiev controls (OR = 3.34) and weakest in the national sample (OR = 1.64) Data Related to Mothers: • Mother evacuees scored higher on the GSI ($p<0.001$), reported lower perceived physical health and took more sick days relative to non evacuees mothers, even after controlling for demographic factors, stressors and stress moderators • Evacuee mothers rated their children's well-being as significantly worse, especially with respect to somatic symptoms on CSI and CBCL • Global Severity Index, Mean ± SD Evacuees: 0.81 ± 0.47 Controls: 0.66 ± 0.38 $t = 3.8$ (two-tailed t test, $p<0.001$) • SCL-90 somatization, Mean ± SD Evacuees: 1.49 ± 0.71 Controls: 1.10 ± 0.60 $t = –7.37$ (matched pairs of evacuees and controls, paired t test, $p<0.001$) • IES, Mean ± SD Evacuees: 0.84 ± 0.67 Controls: 0.52 ± 0.55 $t = –8.38$ (paired t test, $p<0.001$) • Sick days (logged), Mean ± SD Evacuees: 1.90 ± 1.43 Controls: 1.47 ± 1.25 $t = 3.3$ (two-tailed t test, $p<0.001$) • Mothers' Scores from Chernobyl Health Stress Scale, Mean ± SD Evacuees: 9.98 ± 2.23

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Bromet *(continued)*		Controls: 8.33 ± 2.65 t = –6.41 (paired t test, p<0.001) • Percentage (%) of mothers who have high social support Evacuees: 67.7 Controls: 55.6 t = 6.5 (two-tailed t test, p<0.05) • Prevalence (%) of mothers indicating their health is bad or very bad Evacuees: 38.5 Controls: 23.3 OR = 2.05 (95% CI 1.44-2.93) • Prevalence (%) of mothers indicating of having greater than 3 Chernobyl-linked conditions Evacuees: 32.4 Controls: 8.1 OR = 5.44 (Evacuees and Controls, 95% CI 3.29-9.00) • Rate (%) of mothers who think they will be diagnosed with Chernobyl-related condition Evacuees: 54.5 Controls: 18.7 OR = 5.20 (Evacuees and Controls, 95% CI 3.60-7.52, p<0.001) • Rate (%) of mothers who think their health was very affected by Chernobyl Evacuees: 44.7 Controls: 19.6 OR = 3.31 (Evacuees and Controls, 95% CI 2.30-4.78, p<0.001) • Rate (%) of mothers who think their child's health was very affected by Chernobyl Evacuees: 58.3 Controls: 29.8 OR = 3.30 (Evacuees and Controls, 95% CI 2.36-4.63, p<0.001) • Rate (%) of mothers who think the health of future generations will adversely be affected Evacuees: 71.6 Controls: 60.5 OR = 1.64 (Evacuees and Controls, 95% CI 1.17-2.31, p<0.01)

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Bromet *(continued)*		• Rate (%) of mothers who think the Chernobyl consequences are worse than feared Evacuees: 55.0 Controls: 44.2 OR = 1.55 (Evacuees and Controls, 95% CI 1.12-2.14, p<0.01) Data Related to Children: • Evacuee children were not significantly different from their classmates on the objective measures (grades; Symbolic Relations subtest of the Detroit Test; VSAT; Benton Form A; Trails A; Underline the Words Test) or on most of the subjective measures (the attention subscale of the CBCL completed by mothers; the attention items of the Iowa Conners Teacher's Rating Scale; mother and child perceptions of school performance) • Evacuee mothers rated their children's well-being as significantly worse, especially with respect to somatic symptoms on CSI and CBCL • Self-report on Children's Somatization Inventory, Mean ± SD Evacuees: 17.57 ± 15.85 Classmates (Controls): 15.23 ± 16.31 t = –1.74 (evacuees and classmates, paired t test, p>0.05) • Self-report on Fear Inventory, Mean ± SD Evacuees: 2.09 ± 0.59 Classmates (Controls): 2.03 ± 0.61 t = –1.16 (evacuees and classmates, paired t test, p>0.05) • Self-report on Depression Self-Rating Scale, Mean ± SD Evacuees: 0.80 ± 0.35 Classmates (Controls): 0.76 ± 0.33 t = –1.27 (paired t test, p>0.05) • Self-report on Children's Manifest Anxiety Scale (self-reported), Mean ± SD Evacuees: 13.30 ± 5.39

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Bromet *(continued)*		Classmates (Controls): 12.68 ± 5.04 t = –1.54 (paired t test, p > 0.05, effect size = 0.13) • Self-report on Children's Chernobyl Anxiety Scale (self-reported), Mean ± SD Evacuees: 15.74 ± 9.88 Classmates (Controls): 13.88 ± 9.34 t = –2.36 (paired t test, p = 0.02, effect size = 0.19) • Self-Perceived Scholastic Competence, Mean ± SD Evacuees: 2.63 ± 0.72 Classmates (Controls): 2.78 ± 0.69 t = 2.46 (evacuees and classmates, paired t test, p = 0.02) • Self-Perceived Social Competence, Mean ± SD Evacuees: 2.89 ± 0.69 Classmates (Controls): 2.82 ± 0.79 t = –1.08 (evacuees and classmates, paired t test, p>0.05) • Self-Perceived Athletic Competence, Mean ± SD Evacuees: 2.66 ± 0.69 Classmates (Controls): 2.76 ± 0.70 t = 1.81 (evacuees and classmates, paired t test, p>0.05) • Self-Perceived Physical Competence, Mean ± SD Evacuees: 2.82 ± 0.68 Classmates (Controls): 2.90 ± 0.66 t = 1.54 (evacuees and classmates, paired t test, p>0.05) • Self-Perceived Behavioral Competence, Mean ± SD Evacuees: 2.85 ± 0.60 Classmates (Controls): 2.84 ± 0.63 t = –0.39 (evacuees and classmates, paired t test, p>0.05) • Self-Perceived Self-worth, Mean ± SD Evacuees: 2.95 ± 0.58 Classmates (Controls): 2.99 ± 0.53 t = 0.87 (evacuees and classmates, paired t test, p>0.05) • School performance, Mean ± SD Evacuees: 2.84 ± 1.21 Classmates (Controls): 2.98 ± 1.34

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Bromet *(continued)*		t = 1.44 (evacuees and classmates, paired t test, p>0.05) • Teacher's rating of child's health Evacuees: 2.96 ± 0.75 Controls: 3.28 ± 0.71 t = 6.24 (paired t test, p<0.001) • Mother's rating of child's health, Mean ± SD Evacuees: 2.66 ± 0.60 Controls: 3.05 ± 0.62 t = 7.90 (paired t test, p<0.001) • Mothers' report on Child's CBCL somatic complaints, Mean ± SD Evacuees: 70.47 ± 9.42 Classmates (Controls): 65.14 ± 9.21 t = –6.55 (evacuees and classmates, paired t test, p<0.001) • Mothers' report on Child's CBCL thought problems, Mean ± SD Evacuees: 54.67 ± 6.64 Classmates (Controls): 53.00 ± 5.15 t = –3.05 (evacuees and classmates, paired t test, p = 0.003) • Mothers' report on Children's Somatization Inventory, Mean ± SD Evacuees: 22.92 ± 15.54 Classmates (Controls): 14.05 ± 11.27 t = –7.96 (evacuees and classmates, paired t test, p<0.001) • Mothers' report on Children's Attention Problems, Mean ± SD Evacuees: 60.48 ± 7.78 Classmates (Controls): 59.03 ± 7.79 t = –1.39 (evacuees and classmates, paired t test, p>0.05) • Mothers' report on CBCL withdrawn, Mean ± SD Evacuees: 58.14 ± 7.61 Classmates (Controls): 57.18 ± 7.30 t = –1.32 (evacuees and classmates, paired t test, p>0.05) • Mothers' report on CBCL withdrawn, Mean ± SD Evacuees: 58.14 ± 7.61 Classmates (Controls): 57.18 ± 7.30 t = –1.32 (evacuees and classmates, paired t test, p>0.05)

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Bromet *(continued)*		• Mothers' report on CBCL anxiety depression, Mean ± SD Evacuees: 57.88 ± 7.11 Classmates (Controls): 56.58 ± 7.18 t = –1.82 (paired t test, p>0.05) • Mothers' report on CBCL social problems, Mean ± SD Evacuees: 55.77 ± 7.22 Classmates (Controls): 55.18 ± 6.75 t = –0.44 (paired t test, p>0.05) • Mothers' report on CBCL aggressive behavior, Mean ± SD Evacuees: 54.28 ± 5.46 Classmates (Controls): 54.53 ± 5.97 t = 0.76 (paired t test, p>0.05) • Mothers' report on CBCL delinquent behavior, Mean ± SD Evacuees: 53.71 ± 5.62 Classmates (Controls): 55.06 ± 6.39 t = 2.99 (paired t test, p = 0.003)
Cwikel (Cwikel, Abdelgani et al. 1997)	Interview	• Percentage (%) with acute symptoms (self-reported) Liquidators: 30 More exposed group (>1 Ci/km^2): 26 Less exposed group (<1 Ci/km^2): 14 Comparison group (unexposed): 2 χ^2 = 44.36, df = 6, p < 0.0001 • Percentage (%) with migraine headaches (self-reported and significant exposure effect was found) Liquidators: 23 More exposed group (>1 Ci/km^2): 22 Less exposed group (<1 Ci/km^2): 21 Comparison group (unexposed): 11 • Relative risk ratio for migraine headaches (comparing most exposed and comparison groups): 2.0, 95% CI: 1.02-3.90, p = 0.056 • Percentage (%) with three or more chronic conditions (self-reported and significant exposure effect was found) Liquidators: 57 More exposed group (>1 Ci/km^2): 47 Less exposed group (<1 Ci/km^2): 49 Comparison group (unexposed): 30

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Cwikel *(continued)*		• Relative risk ratio for three or more chronic conditions (comparing most exposed and comparison groups): 1.57, 95% CI: 1.09-2.26, p = 0.02
Foster (Foster 2002) (Part of a larger ongoing study of 500 on which data collection was still ongoing)	Interview	• Subjects who lived closer to Chernobyl area were more likely to be currently anxious (RBAI, p<0.03) and show traumatic reactions (R MISS PTSD, p<0.0004) to the Chernobyl event than those who had resided at a further distance
Foster (Foster and Goldstein 2007)	Interview, BAS	• 86.3% of all believed they had been exposed to radiation • 75.9% of all reported they had been frightened for safety • 10.3% of all reported they had to physically relocate after Chernobyl • "Poor" current physical health (% self-reported): Close (0-50km): 62.9 Mid (50-150km): 36.1 Far (150km+): 23.6 χ^2 = 30.24, p < 0.001 • Poor" current mental health (% self-reported): Close (0-50km): 15.7 Mid (50-150km): 8.3 Far (150km+): 2.4 χ^2 = 11.67, p < 0.01
Ginzburg (Ginzburg and Reis 1991; Ginzburg 1993) (Based on IAEA Study)	Structured Interview, Clinical Examinations, Symptom Checklist	• Levels of anxiety and stress "appeared to be disproportionate to the biological significance of the radioactive contamination" • High levels of stress based on sleep disturbance reports, complaints from symptom check lists, and fatigue when waking up • Percentage of people who believed they have illness related to radiation Exposed: 44.5 Controls: 29.7

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Havenaar (Havenaar, Poelijoe et al. 1996; Havenaar, Van Den Brink et al. 1996; Havenaar, Rumyantzeva et al. 1997; Havenaar, Rumyantzeva et al. 1997; Havenaar, De Wilde et al. 2003)	GHQ-12, DMS-III-R, ICDD-9-CM, MOS-SF	• Prevalence (%) of having GHQ ≥ 2 (Psychological distress) Gomel (exposed): 64.8 Tver (non-exposed): 48.1 aOR = 2.03 (95% CI: 1.75-2.37) Mean ± SD Gomel: 3.91 ± 3.28 Tver: 2.65 ± 2.76 t = 11.01 (p<0.001) • Prevalence (%) of having health fair or poor, MOS-SF Gomel: 74.5 Tver: 56.5 aOR=2.80 (95% CI: 2.35-3.34) Mean ± SD Gomel: 3.96 ± 0.77 Tver: 3.58 ± 0.82 = 12.79 (p<0.001) • Medical service use, Mean ± SD Gomel: 0.74 ± 1.06 Tver: 0.48 ± 0.76 t = 7.01 (p<0.001) • Prevalence (%) of having any psychiatric diagnosis, DSM-III-R Gomel: 35.8 Tver: 37.1 aOR = 1.08 (95% CI: 0.70-1.67) • Prevalence (%) of having any physical clinical diagnosis, ICD-9-CM Gomel: 63.7 Tver: 55.1 aOR = 1.57 (95% CI: 0.99-2.49)
Igumnov (Igumnov 1996; Igumnov and Drozdovitch 2000; Igumnov and Drozdovitch 2002; Igumnov and Drozdovitch 2004) (Conducted on database of the Republican Health Centre of Radiation Medicine in 1992- 1993 and 1996-1997)	ICD-10	• Prevalence (%) of Emotional disorders with onset specific to childhood, ICD-10 Age 6-7 Controls: 7.6, n = 19 Exposed: 18, n = 45 χ^2 = 12.11, p≤0.001, OR = 2.67 (95% CI: 1.12-3.50) • Prevalence (%) of Disorders of social functioning, ICD-10 Controls: 3.6, n = 9 Exposed: 4.8, n = 12 χ^2 = 0.45

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Igumnov *(continued)*		• Prevalence (%) of Transient tic disorder, ICD-10 Controls: 4.8, n = 12 Exposed: 6.4, n = 16 χ^2 = 0.61 • Prevalence (%) of Other ICD-10 diagnoses Controls: 6.8, n = 17 Exposed: 9.2, n = 23 χ^2 = 0.98 • Prevalence (%) of One or more ICD-10 diagnoses Controls: 24.8, n = 62 Exposed: 40.4, n = 101 χ^2 = 13.85, p≤0.001, OR = 2.06 (95% CI: 1.35-2.90)
Ivanov (Ivanov, Maksioutov et al. 2000)	ICD-9	• Estimation of parameters of dose dependency of incidence rates for Mental Disorder (ICD-9) ERR (Gy^{-1}) = 0.40 (95% CI 0.17, 0.64), p<0.001 • Estimation of parameters of dose dependency of incidence rates for Mental Disorder (ICD-9) in 1986 ERR (Gy^{-1}) = 0.53 (95% CI 0.21, 0.85), p<0.05
Kolominsky (Kolominsky, Igumnov et al. 1999) (Same database as Igumnov)	ICD-10	• Prevalence (%) of One or more ICD-10 diagnoses Age 6-7 Controls: 21.3, n = 26 Exposed: 41.3, n = 57 χ^2 = 11.01, p≤.05 Age 10-11 Controls: 23.7, n = 25 Exposed: 37.0, n = 51 χ^2 = 7.71, p≤.05 • Prevalence (%) of Other ICD-10 diagnoses Age 6-7 Controls: 9.8, n = 12 Exposed: 19.6, n = 27 χ^2 = 4.07, p≤.05

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Kolominsky *(continued)*		Age 10-11 Controls: 8.2, n = 10 Exposed: 10.9, n = 15 $\chi^2 = 0.27$ • Prevalence (%) of Disorders of social functioning, ICD-10 Age 6-7 Controls: 1.6, n = 2 Exposed: 4.4, n = 6 $\chi^2 = 0.81$ Age 10-11 Controls: 1.6, n = 2 Exposed: 7.3, n = 10 $\chi^2 = 3.44$, $p \leq .05$ • Prevalence (%) of Transient tic disorder, ICD-10 Age 6-7 Controls: 3.3, n = 4 Exposed: 6.5, n = 9 $\chi^2 = 0.83$ Age 10-11 Controls: 4.1, n = 5 Exposed: 6.5, n = 9 $\chi^2 = 0.35$ • Prevalence (%) of Emotional disorders with onset specific to childhood, ICD-10 Age 6-7 Controls: 7.4, n = 9 Exposed: 20.3, n = 28 $\chi^2 = 7.82$, $p \leq .05$ Age 10-11 Controls: 7.4, n = 9 Exposed: 18.1, n = 25 $\chi^2 = 5.66$, $p \leq .05$
Koscheyev (Koscheyev, Martens et al. 1993)	16 PF, Psychiatric Interview, MMPI	• MMPI scale scores for Psychopathic Deviate, Mean ± SD by Time since Chernobyl Time 1 (July 1986): 48.0 ± 8.0 Time 2 (Sept/Oct. 1986): 51.0 ± 8.5 Time 3 (Mar/Apr. 1987): 53.5 ± 9.0 Time 4 (Nov/Dec. 1987): 56.0 ± 6.0 Ignalina operators (Controls, Apr. 1988): 50.0 ± 7.0 $F = 6.54$, $p < 0.001$

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Loganovskaja (Loganovskaja and Loganovsky 1999) (Subgroup of Nyagu)	GHQ-28, ICD-10	• Percentage (%) with emotional disorders with onset specific to childhood (ICD-10, F93) Irradiated in utero: 32 Control: 8 χ^2 = 9.0 p<0.01 • Percentage (%) with specific evelopment disorders of speech and language (ICD-10, 80) Irradiated in utero: 22 Control: 6 χ^2 = 6.25 p<0.05 • Percentage (%) with specific developmental disorders of scholastic skills (ICD-10, F81) Irradiated in utero: 30 Control: 10 χ^2 = 5.32 p<0.05 • Percentage (%) with other behavioural and emotional disorders with onset usually occurring in childhood and adolescence (ICD-10, F98) Irradiated in utero: 26 Control: 10 χ^2 = 4.34 p<0.05 • Percentage (%) with one or more diagnoses of ICD-10 mental disorders Irradiated in utero: 72 Control: 28 χ^2 = 19.36 p<0.01 • Mental health of parents based on GHQ-28, Mean ± SD Irradiated in utero ("experimental" group): 27.4 ± 1.1 Control: 18.1 ± 1.2 p<0.01
Loganovsky (Loganovsky and Loganovskaja 2000)	GHQ-28	• Percentage (%) with emotional lability symptom Group A (exposed ARS patients): 52 Group B (Liquidators-volunteers): 78, p<0.001 relative to Group A, chi-square test

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Loganovsky *(continued)*		Vets w/ PTSD: 84, p <0.001 relative to Group A, chi-square test Vets w/ PTSD and closed head injury: 90, p<0.001 relative to Group A, chi-square test People w/ small dose (<0.3 Sv): 74 People w/ moderate or large dose (>0.3 Sv or 30 rem & Group A): 62 χ^2 = 5.48, df = 1, p = ns • Percentage (%) with negative psychopathological symptom present Group A: 81 Group B: 62 Vets w/ PTSD: 18, p<0.001 relative to Group A, chi-square test Vets w/ PTSD and closed head injury: 32, p<0.001 relative to Group A, chi-square test People w/ small dose (<0.3 Sv): 48 People w/ moderate or large dose (>0.3 Sv or 30 rem & Group A): 80 χ^2 =19.80, df = 1, p< 0.001 • GHQ -28 general score, Mean ± SD People w/ small dose (<0.3 Sv): 39.7 ± 11.6 People w/ moderate or large dose (>0.3 Sv or 30 rem & Group A): 36.8 ± 13.4 t = 1.40, df = 198, p = ns • BPRS – somatic concern score, Mean ± SD People w/ small dose (<0.3 Sv): 4.1 ± 1.7 People w/ moderate or large dose (>0.3 Sv or 30 rem & Group A): 4.2 ± 1.6 t = –0.38, df = 198, p = ns • Persons exposed to 0.30 Sv or more are at higher risk of schizophrenia spectrum disorders
Loganovsky (Loganovsky, Havenaar et al. 2007)	WHO-DAS, WMH-CIDI	• Affected workers lost more work days than affected non clean-up workers

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Loganovsky *(continued)*		• Percentage (%) of Suicide ideation *Since 1986* Clean-up workers: 9.2 Controls (Non-clean-up workers): 4.1 aOR = 2.1, 95% CI: 1.1-4.1, p < 0.05 *Past 12 months* Clean-up workers: 2.7 Controls (Non-clean-up workers): 2.3 aOR = 1.2, 95% CI: 0.4-3.2 • Percentage (%) of Alcohol use disorder *Since 1986* Clean-up workers: 24.3 Controls (Non-clean-up workers): 22.2 aOR = 1.2, 95% CI: 0.8-1.8 *Past 12 months* Clean-up workers: 8.5 Controls (Non-clean-up workers): 10.1 aOR = 0.8, 95% CI: 0.4-1.3 • Percentage (%) of Severe headaches *Past 12 months* Clean-up workers: 69.2 Controls (Non-clean-up workers): 12.4 aOR = 16.6, 95% CI: 9.4-29.5, p<0.001 • Somatization symptoms, Mean ± SD High exposure: 1.4 ± 0.7 Moderate exposure: 1.2 ± 0.8 Low exposure: 1.2 ± 0.7 p = 0.06
Nyagu (Nyagu, Loganovsky et al. 1998)	GHQ-28, Interview,	• Mental health of parents based on GHQ-28, Mean ± SD Irradiated in utero ("experimental" group): 24.29 ± 0.4 Control: 20.73 ± 0.5 p<0.05
Polyukhov (Polyukhov, Kobsar et al. 2000)	BA, IBA, CPA, PA	• Exposed workers' integral biological age (IBA) score, Mean years ± SD Total: 5.1 ± 0.5 *Sex* Men: 4.9 ± 0.5 Women: 5.9 ± 1.0

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Polyukhov *(continued)*		*Age* (significant difference between age, $p < 0.001$) <45 years: 7.5 ± 0.7 45+ years: 3.0 ± 0.7 • Exposed workers' cardiopulmonary age (CPA) score, Mean years ± SD Total: 5.3 ± 1.1 *Sex* (significant difference between gender, $p < 0.001$) Men: 3.6 ± 1.3 Women 8.7 ± 1.9 *Age* <45 years: 4.5 ± 1.6 45+ years: 6.0 ± 1.5 • Exposed workers' psychological age (PA), Mean years ± SD Total: 11.6 ± 0.6 *Sex* (significant difference between gender, $p < 0.05$) Men: 12.6 ± 0.7 Women 8.2 ± 1.2 *Age* <45 years: 12.6 ± 0.9 45+ years: 10.6 ± 0.9 • Accelerated rate of aging was found in 81% of exposed male workers and in 77% of exposed female workers compared to random sample of Kiev
Rahu (Rahu, Tekkel et al. 1997; Tekkel, Rahu et al. 1997; Rahu, Rahu et al. 2006)	Suicides	• 1986-1993 standardized mortality ratio [SMR] (general population of Estonia as reference) for suicides = 1.54 (95% CI, 1.03-2.21) • Rate ratio for suicide after Chernobyl for 5 to 9 years compared to less than 5 years = 1.09 (95% CI, 0.56-2.10) • 1994-2002 SMR (general population of Estonia as reference) for suicides = 1.21 (95% CI, 0.86-1.64) • Rate ratio for suicide after Chernobyl for 10+ years compared to less than 5 years = 1.00 (95% CI, 0.48-2.05) • 1986-2002 SMR (general population of Estonia as reference) for suicides = 1.32 (95% CI, 1.03-1.67)

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Rahu *(continued)*		• Rate ratio observed for suicide death compared to all death from 1986-2002 = 1.03 (95% CI, 0.56-1.91) • Out of 4,786 men, 550 died and below are well-being related causes of death (number of death): Neoplasms (69) Diseases of the circulatory system (139) Diseases of the respiratory system (30) Diseases of the digestive system(25) Accidental poisoning by alcohol (32) Suicide (69)
Remennick (Remennick 2002)	5-point Likert Scale, Interview	• Mean self-rated score of state of health (scale from 1 [very poor] to 5 [excellent]): Survivors (exposed) 2.6, Others (non-exposed/controls) 4.3 • Mean self-rated score of extent to which chronic morbidity limits daily functioning (scale from 1 [not at all] to 5 [very much]): Survivors 2.4, Others 0.8 • Percentage of self-reported somatization: *Having one episode:* Survivors 44 Others 21 *Recurrent episodes:* Survivors 27 Others 9 • Percentage of self-reported somatization: *Having one episode:* Survivors 44 Others 21 *Recurrent episodes:* Survivors 27 Others 9 • Percentage of most common chronic ailments: *Heart Disease:* Survivors 30 Others 11 *Hypertension:* Survivors 39 Others 18 *Thyroidal dysfunction:* Survivors 23 Others 7 *Diabetes:* Survivors 18 Others 7

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Remennick *(continued)*		*Migraine:* Survivors 10 Others 4 *Heart Disease:* Survivors 44 Others 21 • OR (Survivors vs. Others) of Somatization episodes (ever/never) = 2.57, p<0.005 • OR (Survivors vs. Others) of general health (mean score on 5-point scale) = 0.6, p<0.001 • OR (Survivors vs. Others) of mean number of annual GP visits = 1.72, p<0.005 • OR (Survivors vs. Others) of mean number of chronic conditions = 3.83, p<0.001 • OR (Survivors vs. Others) of use of alternative medicine (ever/never) = 3.21, p<0.001
Taormina (Guey, Bromet et al. 2008; Taormina, Rozenblatt et al. 2008; Bromet, Taormina et al. 2009; Bromet, Guey et al. 2010) (Follow-up of Bromet)	CSI, WMH-CIDI	Data Related to Mothers: • Percentage (%) of mothers who rated their health as poor Evacuees: 31.5 Controls: 26 aOR = 1.2 (Evacuees and Controls, 95% CI: 0.7-2.0) • Mothers who have illness worry, Mean ± SD Evacuees: 3.3 ± 2.2 Controls: 2.8 ± 2.0 aOR = 1.3 (Evacuees and Controls, 95% CI: 1.0-1.6, p<0.05) • SCL-90 GSI, Mean ± SD Evacuees: 0.8 ± 0.5 Controls: 0.6 ± 0.4 aOR = 1.4 (Evacuees and Controls, 95% CI: 1.1-1.8, p<0.01) • Percentage (%) of mothers who think they will be diagnosed with Chernobyl-related illness Evacuees: 38.9 Controls: 24.0 aOR = 1.9 (Evacuees and Controls, 95% CI 1.1 -3.2, p<0.05) • Percentage (%) of mothers who think Chernobyl will be most influential event of life

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Taormina *(continued)*		Evacuees: 70.8 Classmate Controls: 17.5 Population Controls: 13.9 χ^2 = 231.8, p<0.001 (Significant pairwise differences between Evacuees and Classmate Controls) • Percentage (%) of mothers who think future generations will be very affected by Chernobyl Evacuees: 47.7 Classmate Controls: 41.0 Population Controls: 36.5 χ^2 = 7.0, p<0.05 (Between Evacuees and Classmate Controls) • Percentage (%) of mothers who think the consequences of Chernobyl were worse than feared Evacuees: 37.0 Classmate Controls: 26.5 Population Controls: 25.7 χ^2 = 9.7 p<0.01 (Between Evacuees and Classmate Controls) • Percentage (%) of mothers with 0 negative belief Evacuees: 7.8 Classmate Controls: 35.9 Population Controls: 35.8 χ^2 = 112.4, p<0.001 (Between Evacuees and Classmate Controls) • Percentage (%) of mothers with 1 negative belief Evacuees: 16.5 Classmate Controls: 26.5 Population Controls: 29.4 • Percentage (%) of mothers with 2 or more negative beliefs Evacuees: 75.7 Classmate Controls: 37.6 Population Controls: 34.8 • Percentage (%) of mothers who think health will be very affected by Chernobyl Evacuees: 54.3 Classmate Controls: 25.6 Population Controls: 24.0 χ^2 = 65.2, p<0.001 (Significant pairwise differences between Evacuees and Classmate Controls)

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Taormina *(continued)*		Data Related to Young Adults: • Percentage (%) of mothers who reported their child to have childhood behavioral problems Evacuees: 20.9 Controls: 15.6 aOR = 1.4 (Evacuees and Controls, 95% CI 0.8-2.6) • Percentage (%) of mothers who think their child's health was very affected by Chernobyl Evacuees: 45.4 Controls: 36.5 aOR = 1.3 (Evacuees and Controls, 95% CI 0.8-2.1) • Percentage (%) of young adults who think Chernobyl will be most influential event of life Evacuees: 22.6 Classmate Controls: 5.4 Population Controls: 6.1 χ^2 = 53.0, p<0.001 (Significant pairwise differences between Evacuees and Classmate Controls) • Percentage (%) of young adults who think future generations will be very affected by Chernobyl Evacuees: 12.8 Classmate Controls: 16.1 Population Controls: 17.4 χ^2 = 2.4 (Between Evacuees and Classmate Controls) • Percentage (%) of young adults who think the consequences of Chernobyl were worse than feared Evacuees: 17.7 Classmate Controls: 14.9 Population Controls: 21.4 χ^2 = 4.1 (Between Evacuees and Classmate Controls) • Percentage (%) of young adults with 0 negative belief Evacuees: 51.3 Classmate Controls: 66.7 Population Controls: 59.9 χ^2 = 14.4, p<0.01 (Between Evacuees and Classmate Controls)

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Taormina *(continued)*		• Percentage (%) of young adults with 1 negative belief Evacuees: 30.6 Classmate Controls: 23.4 Population Controls: 27.2 • Percentage (%) of young adults with 3 negative beliefs Evacuees: 18.1 Classmate Controls: 10.0 Population Controls: 12.8 • Percentage (%) of young adults who think health will be very affected by Chernobyl Evacuees: 19.6 Classmate Controls: 8.8 Population Controls: 13.8 χ^2 = 12.8, p<0.01 (Significant pairwise differences between Evacuees and Classmate Controls) • CSI (child self-report), Mean ± SD Evacuees: 16.5 ± 16.0 Controls: 16.3 ± 18.7 aOR = 1.0 (Evacuees and Controls, 95% CI: 0.8-1.3) • Percentage (%) of young adults who reported with mental health problems, MDD/GAD (CIDI diagnosis) Evacuees: 16.2 Controls: 7.1 aOR = 2.5 (Evacuees and Controls, 95% CI 1.2-5.1) • Percentage (%) of young adults who think they will be diagnosed with Chernobyl-related illness Evacuees: 22.8 Controls: 14.3 aOR = 1.9 (Evacuees and Controls, 95% CI 1.1-3.2, p<0.05) • Percentage (%) of young adults who think their health has been very affected by Chernobyl Evacuees: 15.1 Controls: 7.9 aOR = 2.2 (Evacuees and Controls, 95% CI 1.1 -4.4, p<0.05)

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Taormina *(continued)*		• Percentage (%) of young adults who discuss consequences of disaster often Evacuees: 12.7 Controls: 3.2 aOR = 4.6 (Evacuees and Controls, 95% CI 1.7-12.9, p<0.01)
Viinamaki (Viinamäki, Kumpusalo et al. 1995) (Subgroup from ESMER project (n = 1,279 total)	GHQ-12, 5-point Likert Scale Structured Questionnaire	• Overall GHQ-12 Score, Age-adjusted Mean ± SD Exposed Male: 2.2 ± 2.9 Exposed Female: 3.9 ± 3.4 Non-exposed Male: 1.4 ± 2.4 Non-exposed Female: 1.7 ± 2.7 Differences significant between males (p<0.01) and females (p<0.001) • Subjective Health Status, GHQ Score Mean ± SD [prevalence of people with minor mental disorder] *Good* Exposed Male, n = 139 [23%]: 1.7 ± 2.5 Exposed Female, n = 119 [39%]: 2.5 ± 2.7 Non-exposed Male, n = 99 [23%]: 1.5 ± 2.3 Non-exposed Female, n = 124 [27%]: 1.5 ± 2.3 *Poor* Exposed Male, n = 17 [75%]: 4.2 ± 4.3 Exposed Female, n = 50 [80%]: 5.4 ± 3.9 (vs. controls, p<0.05) Non-exposed Male, n = 16 [75%]: 3.3 ± 2.7 Non-exposed Female, n = 39 [60%]: 3.9 ± 3.3 • Social Support, GHQ Score Mean ± SD [prevalence of people with minor mental disorder] *Sufficient* Exposed Male, n = 137 [26%]: 2.0 ± 3.0 Exposed Female, n = 132 [40%]: 3.4 ± 3.4 (vs. controls, p<0.05) Non-exposed Male, n = 97 [21%]: 1.5 ± 2.1

TABLE 6: OUTCOMES RELATED TO WELL-BEING PROBLEMS

Study By Principal Author	Scale	Result
Viinamaki *(continued)*		Non-exposed Female, n = 136 [30%]: 2.2 ± 2.5 *Insufficient* Exposed Male, n = 14 [30%]: 1.4 ± 1.8 (vs. controls, p<0.05) Exposed Female, n = 30 [60%]: 3.9 ± 3.1 Non-exposed Male, n = 16 [54%]: 0.7 ± 2.8 Non-exposed Female, n = 25 [43%]: 2.9 ± 3.6
Webb (Bromet, Gluzman et al. 2005; Webb, Bromet et al. 2005; Bromet, Havenaar et al. 2007) ("Ukraine World Mental Health Survey")	WMH-CIDI, DSM-IV	• Lifetime prevalence estimate rate of nine disorders was higher in men than women (OR = 1.43) • Close to one third of the population experienced at least one DSM-IV disorder in their lifetime, 17.6% experienced an episode in the past year, and 10.6% had a current disorder • 12-month rates of heavy alcohol use were 38.7% in men and 8.5% in women (22.0% overall) • Among heavy alcohol users, 92% of men and 52% of women consumed at least 80 g of ethanol in a typical drinking day on a monthly basis in the year before the interview
Zhavoronkova (Zhavoronkova, Kholodova et al. 1995)	Neuropsychological investigations	• About 70% of exposed workers had paroxysmal EEG activity and intermittent seizures associated with loss of consciousness • All exposed patients had complaints of: "severe headache, derangement of memory, weakness, disposition to perspire, emotional instability and disturbances of sleep cycles with drowsiness in day time and insomnia at night"

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TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Arynchyn (Arynchin, Avhacheva et al. 2002)	Clinical Examinations	• Frequency of Vegetovascular and cardiac syndrome (%) *1st Examination* Exposed: 67.9 Controls: 40.3 $p<0.05$ *2nd Examination* Exposed: 73.7 Controls: 52.2 $p<0.05$ • Frequency of asthenoneurotic syndrome (%) *1st Examination* Exposed: 20.2 Controls: 7.5 $p<0.05$ *2nd Examination* Exposed:16.9 Controls: 11.3 • Relative Risk of Vegetovascular syndrome compared between exposed and controls (95% CI) *1st Examination* RR = 1.68 (1.36-2.07) $\chi^2 = 22.14$, $p<0.000003$ *2nd Examination* RR = 1.41 (1.19-1.68) $\chi^2 = 14.24$, $p<0.0002$
Bromet (Bromet, Goldgaber et al. 2000; Litcher, Bromet et al. 2000; Adams, Bromet et al. 2002; Bromet, Gluzman et al. 2002; Drabick, Beauchaine et al. 2006)	SCL-90, VSAT, Iowa Conners' Teachers Rating Scale, Detroit Tests of Learning Aptitude, BVRT A	Data Related to Mothers: • SCL-90 somatization, Mean ± SD Evacuees: 1.49 ± 0.71 Controls: 1.10 ± 0.60 t = –7.37 (matched pairs of evacuees and controls, paired t test, $p<0.001$) Data Related to Children: • 31.3% of evacuee mothers compared to 7.4% of classmate mothers indicated that their child had a memory problem, but subjective measure of memory problems was not significantly related to neuro psychological or school performance

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Bromet *(continued)*		• 48% of evacuee mothers compared to 14% of classmate mothers reported that their child was diagnosed with vascular dystony (χ^2 = 68.81, McNemar test, Evacuee vs. Controls, p<0.001) • Iowa Conners' Teachers Rating Scale on Children, Mean ± SD Evacuees: 5.93 ± 6.00 Classmates (Controls): 5.38 ± 5.42 t = –1.37 (evacuees and classmates, paired t test, p>0.05) • Self-Perceived Scholastic Competence, Mean ± SD Evacuees: 2.63 ± 0.72 Classmates (Controls): 2.78 ± 0.69 t = 2.46 (evacuees and classmates, paired t test, p = 0.02) • Self-report on Children's Somatization Inventory, Mean ± SD Evacuees: 17.57 ± 15.85 Classmates (Controls): 15.23 ± 16.31 t = –1.74 (evacuees and classmates, paired t test, p>0.05) • Mothers' report on Child's CBCL somatic complaints, Mean ± SD Evacuees: 70.47 ± 9.42 Classmates (Controls): 65.14 ± 9.21 t = –6.55 (evacuees and classmates, paired t test, p<0.001) • Mothers' report on Child's CBCL thought problems, Mean ± SD Evacuees: 54.67 ± 6.64 Classmates (Controls): 53.00 ± 5.15 t = –3.05 (evacuees and classmates, paired t test, p = 0.003) • Mothers' report on Children's Somatization Inventory, Mean ± SD Evacuees: 22.92 ± 15.54 Classmates (Controls): 14.05 ± 11.27 t = –7.96 (evacuees and classmates, paired t test, p<0.001) • Mothers' report on Children's Attention Problems, Mean ± SD Evacuees: 60.48 ± 7.78 Classmates (Controls): 59.03 ± 7.79 t = –1.39 (evacuees and classmates, paired t test, p>0.05)

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Bromet *(continued)*		• Evacuee children were not significantly different from their classmates on the objective measures (grades; Symbolic Relations subtest of the Detroit Test; VSAT; Benton Form A; Trails A; Underline the Words Test) or on most of the subjective measures (the attention subscale of the CBCL completed by mothers; the attention items of the Iowa Conners Teacher's Rating Scale; mother and child perceptions of school performance)
Gamache (Gamache, Levinson et al. 2005)	ANAMUKR: • Digit symbol (DGS) • Spatial processing (SPD) • Simple reaction time (SRT) • Tapping-right and left index fingers (TAPR and TAPL) • Stanford sleepiness scale (SLP) • Code substitution (CDS, CDI, CDD)	• Four-year average performances on running memory continuous performance task (CPT) *accuracy ("all scores significantly lower than control")* AC (Control group in Ternopil at 280 miles away): 93.66 AE (Eliminators in Kiev at 62 miles away): 77.06 AF (Forestry workers in Ovruch forest at 55 miles away): 86.08 AG (Agricultural workers in Razumnytsia at 155 miles away): 89.72 *efficiency ("all scores significantly lower than control")* AC (Control group in Ternopil at 280 miles away): 85.22 AE (Eliminators in Kiev at 62 miles away): 58.22 AF (Forestry workers in Ovruch forest at 55 miles away): 71.69 AG (Agricultural workers in Razumnytsia at 155 miles away): 79.00 • Four-year average performances on two-choice reaction time (2CH) *accuracy ("all scores significantly lower than control")* AC (Control group in Ternopil at 280 miles away): 97.36 AE (Eliminators in Kiev at 62 miles away): 92.76 AF (Forestry workers in Ovruch forest at 55 miles away): 92.91

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Gamache *(continued)*		AG (Agricultural workers in Razumnytsia at 155 miles away): 93.98 *efficiency ("all scores significantly lower than control")* AC (Control group in Ternopil at 280 miles away): 110.62 AE (Eliminators in Kiev at 62 miles away): 76.42 AF (Forestry workers in Ovruch forest at 55 miles away): 80.95 AG (Agricultural workers in Razumnytsia at 155 miles away): 101.27 • Indicated that the 4-year averaged levels of performance of the exposure groups (especially the Eliminators) were significantly lower than unexposed volunteers on most measures • Analyses of performance across time revealed significant declines in accuracy and efficiency, as well as psychomotor slowing, for all exposed groups over the 4-year period
Havenaar (Havenaar, Poelijoe et al. 1996; Havenaar, Van Den Brink et al. 1996; Havenaar, Rumyantzeva et al. 1997; Havenaar, Rumyantzeva et al. 1997; Havenaar, De Wilde et al. 2003)	GHQ, MDCL, Hazard Perception Scale, Likert-Scale Questionnaire: Risk Perception Scale, Credibility of Information Scale, Sense of Control, and Expectation of Recurrence, DSM-III-R, Bradford Somatic Inventory	• GHQ, Mean ± SD Gomel (exposed): 3.91 ± 3.28 Tver (non-exposed): 2.65 ± 2.76 t = 11.01 (p<0.001) • Medical service use, Mean ± SD Gomel (exposed): 0.74 ± 1.06 Tver (non-exposed): 0.48 ± 0.76 t = 7.01 (p<0.001) • Prevalence (%) of having Mood Disorders, DSM-III-R Gomel: 16.5 Tver: 12.81 aOR = 1.57 (95% CI: 0.87-2.82) • Prevalence (%) of Bradford Somatic Inventory score ≥ 17 Gomel: 51.1 Tver: 29.7 aOR = 3.16 (95% CI: 1.95-5.11)

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Heiervang (Heiervang, Mednick et al. 2010; Heiervang, Mednick et al. 2010)	WASI, Vocabulary and Matrix Reasoning, MATRICS Consensus Cognitive Battery, Backward Masking	• Scores from Vocabulary test, Mean ± SD Exposed: 47.9 ± 10.4 Control: 53.8 ± 10.1 $F = 11.2$, $p \leq 0.001$, $\eta^2 = 0.06$ • Scores from Matrix reasoning, Mean ± SD Exposed: 52.0 ± 8.5 Control: 52.3 ± 7.2 $F = 0.3$, $\eta^2 < 0.01$ • Scores from WASI IQ, Mean ± SD Exposed: 100.4 ± 13.1 Control: 105.4 ± 12.1 $F = 3.8$, $p \leq 0.05$, $\eta^2 = 0.02$ • Scores from Symbol Coding, Mean ± SD Exposed: 58.2 ± 11.5 Control: 62.9 ± 9.6 $F = 6.6$, $p \leq 0.011$, $\eta^2 = 0.04$ • Scores from CPT-IP: d', Mean ± SD Exposed: 2.3 ± 0.6 Control: 2.4 ± 0.7 $F = 1.4$, $\eta^2 = 0.01$ • Scores from Letter-Number Span, Mean ± SD Exposed: 13.8 ± 2.7 Control: 15.9 ± 2.9 $F = 18.5$, $p \leq 0.001$, $\eta^2 = 0.10$ • Scores from Spatial Span, Mean ± SD Exposed: 17.8 ± 3.4 Control: 18.6 ± 3.2 $F = 1.4$, $\eta^2 = 0.01$ • Scores from HVLT-R: Learning, Mean ± SD Exposed: 27.3 ± 4.9 Control: 29.2 ± 4.0 $F = 6.0$, $p = 0.016$, $\eta^2 = 0.03$ • Scores from HVLT-R: Recall, Mean ± SD Exposed: 9.7 ± 1.8 Control: 10.6 ± 1.5 $F = 10.7$, $p \leq 0.001$, $\eta^2 = 0.06$ • Scores from BVMT-R: Learning, Mean ± SD Exposed: 25.7 ± 5.8 Control: 26.4 ± 5.9 $F = 0.5$, $\eta^2 < 0.01$

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Heiervang *(continued)*		• Scores from BVMT-R: Recall, Mean ± SD Exposed: 10.3 ± 1.8 Control: 10.6 ± 1.7 F = 0.4, η^2 <0.01 • Scores from C-W condition 3+4: Time, Mean ± SD Exposed: 56.1 ± 10.9 Control: 52.9 ± 10.9 F = 3.1, η^2 = 0.02 • Scores from C-W condition 3+4: Errors, Mean ± SD Exposed: 4.0 ± 2.7 Control: 1.8 ± 2.5 F = 31.8, p≤0.001, η^2 = 0.16 • Scores from BWM: Total Correct, Mean ± SD Exposed: 66.4 ± 15.0 Control: 71.1 ± 13.0 F = 0.01, η^2 = 0.02
Igumnov (Igumnov 1996; Igumnov and Drozdovitch 2000; Igumnov and Drozdovitch 2002; Igumnov and Drozdovitch 2004) (Conducted on the database of the Republican Health Centre of Radiation Medicine in 1992-1993 and 1996-1997)	ICD-10, WISC-III UK	• Prevalence (%) of Mild mental retardation, ICD-10 Controls: 2.0, n = 5 Exposed: 2.0, n = 5 χ^2 = 0 • Prevalence (%) of Specific developmental disorders of speech and language, ICD-10 Controls: 8.4, n = 21 Exposed: 8.0, n = 20 χ^2 = 0.027 • Prevalence (%) of Specific developmental disorders of scholastic skills, ICD-10 Controls: 5.2, n = 13 Exposed: 7.2, n = 18 χ^2 = 0.86 • Prevalence (%) of Specific developmental disorders of motor function, ICD-10 Controls: 2.4, n = 6 Exposed: 4.4, n = 11 χ^2 = 0.22 • Prevalence (%) of Disturbance of activity and attention, ICD-10 Controls: 4.4, n = 11 Exposed: 4.5, n = 12 χ^2 = 0.05

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Igumnov *(continued)*		• Prevalence (%) of Emotional disorders with onset specific to childhood, ICD-10 Age 6-7 Controls: 7.6, n = 19 Exposed: 18, n = 45 χ^2 = 12.11, p≤0.001, OR = 2.67 (95% CI: 1.12-3.50) • Prevalence (%) of Disorders of social functioning, ICD-10 Controls: 3.6, n = 9 Exposed: 4.8, n = 12 χ^2 = 0.45 • Prevalence (%) of Transient tic disorder, ICD-10 Controls: 4.8, n = 12 Exposed: 6.4, n = 16 χ^2 = 0.61 • Prevalence (%) of Other ICD-10 diagnoses Controls: 6.8, n = 17 Exposed: 9.2, n = 23 χ^2 = 0.98 • Prevalence (%) of One or more ICD-10 diagnoses Controls: 24.8, n = 62 Exposed: 40.4, n = 101 χ^2 = 13.85, p≤0.001, OR = 2.06 (95% CI: 1.35-2.90) • Distribution of IQ (%) ≥90 (avg. & high avg. range) Age 6-7 Controls: 63.2, n = 158 Exposed: 50, n = 125 χ^2 = 8.866, p = 0.003 Age 10-12 Controls:77.2, n = 193 Exposed: 70.8, n = 177 χ^2 = 2.661 80-89 (low avg. range) Age 6-7 Controls: 26.4, n = 66 Exposed: 36.8, n = 92 χ^2 = 6.255

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Igumnov *(continued)*		Age 10-11 Controls: 16.8, n = 42 Exposed: 22.4, n = 56 χ^2 = 2.488 70-79 (borderline intellectual functioning) Age 6-7 Controls: 8.8, n = 22 Exposed: 10.8, n = 27 χ^2 = 0.566 Age 10-11 Controls: 4.0, n = 10 Exposed: 4.4, n = 11 χ^2 = 0.049 ≤69 (exceptionally low range) Age 6-7 Controls: 1.6, n = 4 Exposed: 2.4, n = 6 χ^2 = 0.408 Age 10-11 Controls: 2.0 n = 5 Exposed: 2.4, n = 6 χ^2 = 0.093
Joseph (Joseph, Reisfeld et al. 2004)	Raven Standard Progressive Matrices Test, Conners' Rating Scales-Revised (ADHD)	• Conners' test – Cognitive (Child's scores), Mean ± SD Gomel (Highly exposed): 47 ± 7 Mogilev (Mildly exposed): 48 ± 8 Kiev (Mildly exposed): 47 ± 7 Other Belarus (nonexposed): 46 ± 6 Moscow and St. Petersburg (nonexposed): 47 ± 7 • Conners' test – Cognitive (Mother's scores), Mean ± SD Gomel (Highly exposed): 51 ± 8 Mogilev (Mildly exposed): 52 ± 8 Kiev (Mildly exposed): 52 ± 7 Other Belarus (nonexposed): 52 ± 8 Moscow and St. Petersburg (nonexposed): 53 ± 8 Pregnant: 51.61 ± 7.60 Not pregnant: 50.81 ± 7.65 p = 0.119

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Kolominsky (Kolominsky, Igumnov et al. 1999) (Conducted on the database of the Republican Health Centre of Radiation Medicine in 1992-1993 and 1996-1997)	ICD-10, WISC-III UK	• Prevalence (%) of Mild mental retardation, ICD-10 *Age 6-7* Controls: 0.8, n = 1 Exposed: 1.5, n = 2 $\chi^2 = 0.01$ *Age 10-11* Controls: 0.8, n = 1 Exposed: 1.5, n = 2 $\chi^2 = 0.01$ • Prevalence (%) of Specific developmental disorders of speech and language, ICD-10 *Age 6-7* Controls: 8.2, n = 10 Exposed: 18.1, n = 25 $\chi^2 = 4.65$, $p \leq .05$ *Age 10-11* Controls: 3.3, n = 4 Exposed: 10.1, n = 14 $\chi^2 = 3.73$, $p \leq .05$ • Prevalence (%) of Specific developmental disorders of motor function, ICD-10 *Age 6-7* Controls: 4.9, n = 6 Exposed: 10.9, n = 15 $\chi^2 = 2.34$ *Age 10-11* Controls: 3.3, n = 4 Exposed: 7.3, n = 10 $\chi^2 = 1.30$ • Prevalence (%) of Disturbance of activity and attention, ICD-10 *Age 6-7* Controls: 2.5, n = 3 Exposed: 7.3, n = 10 $\chi^2 = 2.20$ *Age 10-11* Controls: 2.5, n = 3 Exposed: 5.1, n = 7 $\chi^2 = 0.59$

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Kolominsky *(continued)*		• Prevalence (%) of Emotional disorders with onset specific to childhood, ICD-10 *Age 6-7* Controls: 7.4, n = 9 Exposed: 20.3, n = 28 χ^2 = 7.82, p≤0.05 *Age 10-11* Controls: 7.4, n = 9 Exposed: 18.1, n = 25 χ^2 = 5.66, p≤0.05 • Prevalence (%) of Disorders of social functioning, ICD-10 *Age 6-7* Controls: 1.6, n = 2 Exposed: 4.4, n = 6 χ^2 = 0.81 *Age 10-11* Controls: 1.6, n = 2 Exposed: 7.3, n = 10 χ^2 = 3.44, p≤0.05 • Prevalence (%) of Transient tic disorder, ICD-10 *Age 6-7* Controls: 3.3, n = 4 Exposed: 6.5, n = 9 χ^2 = 0.83 *Age 10-11* Controls: 4.1, n = 5 Exposed: 6.5, n = 9 χ^2 = 0.35 • Prevalence (%) of Other ICD-10 diagnoses *Age 6-7* Controls: 9.8, n = 12 Exposed: 19.6, n = 27 χ^2 = 4.07, p≤0.05 *Age 10-11* Controls: 8.2, n = 10 Exposed: 10.9, n = 15 χ^2 = 0.27 • Prevalence (%) of One or more ICD-10 diagnoses *Age 6-7* Controls: 21.3, n = 26 Exposed: 41.3, n = 57 χ^2 = 11.01, p≤0.05

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Kolominsky *(continued)*		*Age 10-11* Controls: 23.7, n = 25 Exposed: 37.0, n = 51 χ^2 = 7.71, p≤0.05 • Distribution of IQ (%) ≥90 (avg. & high avg. range) *Age 6-7* Controls: 62.3, n = 76 Exposed: 43.5, n = 60 χ^2 = 9.96, p≤0.01 *Age 10-11* Controls:77, n = 94 Exposed: 68.1, n = 94 χ^2 = 3.05 80-89 (low avg. range) *Age 6-7* Controls: 31.2, n = 38 Exposed: 39.1, n = 54 χ^2 = 1.47 *Age 10-11* Controls: 18.9, n = 23 Exposed: 20.3, n = 28 χ^2 = 0.02 70-79 (borderline intellectual functioning) *Age 6-7* Controls: 5.7, n = 7 Exposed: 15.9, n = 22 χ^2 = 5.81, p≤0.05 *Age 10-11* Controls: 3.3, n = 4 Exposed: 10.1, n = 14 χ^2 = 3.73, p≤0.05 ≤69 (exceptionally low range) *Age 6-7* Controls: 0.8, n = 1 Exposed: 1.5, n = 2 χ^2 = 0.01 *Age 10-11* Controls: 0.8, n = 1 Exposed: 1.5, n = 2 χ^2 = 0.01

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Koscheyev (Koscheyev, Martens et al. 1993)	Raven Standard Progressive Matrices Test	• Not Available for report
Loganovskaja (Loganovskaja and Loganovsky 1999) (Subgroup of Nyagu)	Computerized EEG, WAIS, Draw-a-Man test, Raven Coloured Matrices, British Picture Vocabulary Scale, Rutter scale A(2), ICD-10	• Mothers' verbal intellectual level, WAIS, Mean ± SD Irradiated in utero ("experimental" group): 37.8 ± 1.2 Control: 45.3 ± 1.1 $p<0.05$ • Percentage (%) with emotional and behavioral disorders, Rutter scale A(2) Irradiated in utero: 58 Control: 24 $\chi^2 = 11.9$ $p<0.01$ • Percentage (%) with specific developmental disorders of scholastic skills (ICD-10, F81) Irradiated in utero: 30 Control: 10 $\chi^2 = 6.25$ $p<0.05$ • Percentage (%) with specific developmental disorders of motor function (ICD-10, F82) Irradiated in utero: 16 Control: 4 $\chi^2 = 4.0$ $p<0.05$ • Percentage (%) with any abnormal EEG-patterns Irradiated in utero: 74 Control: 10 $\chi^2 = 29.27$ $p<0.001$ • Percentage (%) with disorganized slow EEG-pattern with δ-activity domination (type of abnormal EEG-pattern) Irradiated in utero: 46 Control: 16 $\chi^2 = 10.52$ $p < 0.01$ • Percentage (%) with disorganized EEG-pattern with paroxysmal activity (type of abnormal EEG-pattern) Irradiated in utero: 28 Control: 4 $\chi^2 = 10.71$ $p<0.01$

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Loganovskaja *(continued)*		• Percentage (%) with interhemispheric asymmetry of the EEG-pattern (according to asymmetry index >5%) Irradiated in utero: 86 Control: 36 $\chi^2 = 26.27$ $p < 0.001$ • % with EEG-pattern of left-hemispherical laterality Irradiated in utero: 40 Control: 12 $\chi^2 = 10.19$ $p<0.01$
Loganovsky (Loganovsky and Yuryev 2004)	Quantitative EEG	• Confirmed ARS patients had high radiosensitivity of the brain, neocortex, and dominant hemisphere compared to non-confirmed • Percentage (%) with increased number of low voltage/ flat (abnormal) EEG patterns Confirmed ARS patients: 68 Non-confirmed ARS: 42 $\chi^2 = 3.98$, df = 1, $p<0.046$
Loganovsky (Loganovsky and Loganovskaja 2000)	BPRS, SANS, GHQ-28, MMPI, Computerized EEG	• Percentage (%) with symptom of cognitive dysfunction Group A (exposed ARS patients): 85 Group B (Liquidators-volunteers): 68 Vets w/ PTSD: 24, $p <0.001$ relative to Group A, chi-square test Vets w/ PTSD and closed head injury: 44, $p <0.001$ relative to Group A, chi-square test People w/ small dose (< 0.3 Sv): 63 People w/ moderate or large dose (> 0.3 Sv or 30 rem & Group A): 81 $\chi^2 = 7.54$, df = 1, p = ns • Percentage (%) with abnormal EEG pattern of flat polymorphic Group A (exposed ARS patients): 58 Group B (Liquidators-volunteers): 45 Vets w/ PTSD: 6, $p <0.001$ relative to Group A, chi-square test Vets w/ PTSD and closed head injury: 12, $p<0.001$ relative to Group A, chi-square test Normal: 0, $p<0.001$ relative to Group A, chi-square test

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Loganovsky *(continued)*		• Percentage (%) with EGG pattern of abnormal left hemisphere laterality Group A (exposed ARS patients): 57 Group B (Liquidators-volunteers): 31, p<0.001 relative to Group A, chi-square test Vets w/ PTSD: 2, p <0.001 relative to Group A, chi-square test Vets w/ PTSD and closed head injury: 8, p<0.001 relative to Group A, chi-square test Normal: 5, p<0.001 relative to Group A, chi-square test
Loganovsky (Loganovsky, Havenaar et al. 2007)	SCL-90, WMH-CIDI	• Prevalence (%) of intermittent explosive disorder *Since 1986* Clean-up workers: 6.1 Controls (Non-clean-up workers): 4.3 aOR = 1.5, 95% CI: 0.5-4.9 *Past 12 months* Clean-up workers: 4.4 Controls (Non-clean-up workers): 2.3 aOR = 2.1, 95% CI: 0.6-7.8 • Affected workers lost more work days than affected non clean-up workers
Nyagu (Nyagu, Loganovsky et al. 1998)	Computerized EEG, WAIS, Draw-a-Man test, Raven Coloured Matrices, British Picture Vocabulary Scale, Rutter scale A(2)	• Mothers' verbal intellectual level, WAIS, Mean ± SD Irradiated in utero ("experimental" group): 33.6 ± 0.6 Control: 43.6 ± 0.5 p<0.05 • Percentage (%) with emotional and behavioral disorders, Rutter scale A(2) Irradiated in utero ("experimental" group): 45 Control: 29 χ^2 = 35.6 p<0.001 • Percentage (%) in IQ scores based on non-verbal intelligence ("Draw-a-Man" test) *<70 IQ Score* Irradiated in utero: 2 Control: 1 p>0.05

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Nyagu *(continued)*		*70-90 IQ Score* Irradiated in utero: 25 Control: 13 p<0.01 *91-110 IQ Score* Irradiated in utero: 61 Control: 66 p>0.05 *110-140 IQ Score* Irradiated in utero: 11 Control: 17 p>0.01 *> 140 IQ Score* Irradiated in utero: 1 Control: 3 p<0.01 • Percentage (%) in IQ percentile based on non-verbal intelligence ("Raven Coloured Matrices") *<5 IQ percentile* Irradiated in utero: 11 Control: 12 p>0.05 *6-25 IQ percentile* Irradiated in utero: 24 Control: 13 p<0.01 *26-75 IQ percentile* Irradiated in utero: 52 Control: 50 p>0.05 *76-95 IQ percentile* Irradiated in utero: 11 Control: 16 p<0.01 *>95 IQ percentile* Irradiated in utero: 2 Control: 9 p<0.01

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Nyagu *(continued)*		• Percentage (%) in IQ scores based on verbal intelligence ("British Picture Vocabulary Scale") *<70 IQ Score* Irradiated in utero: 11 Control: 9 p>0.05 *70-90 IQ Score* Irradiated in utero: 21 Control: 13 p<0.01 *91-110 IQ Score* Irradiated in utero: 54 Control: 52 p>0.05 *110-140 IQ Score* Irradiated in utero: 10 Control: 16 p<0.01 *>140 IQ Score* Irradiated in utero: 4 Control: 10 p<0.01
Snegir (Snegir and Snegir 1999)	VEP	• Exposed group was "indicative of a discirculatory-dismetabolic dysfunction of the diencephalo-limbic-reticular brain structures" • Peak Latencies (PL) of P100 component, Mean ± SD Controls: 106.8 ± 1.5 msec Exposed: 119.8 ± 3.8 msec p<0.05 • Amplitude of P100 component, Mean ± SD Controls: 8.19 ± 0.82 μV Exposed: 4.24 ± 0.80 μV p<0.005 • Peak Latencies (PL) of P145 component, Mean ± SD Controls: 172.2 ± 6.0 msec Exposed: 193.2 ± 8.5 msec p<0.05

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Snegir *(cntinued)*		• Amplitude of P145 component, Mean ± SD Controls: 3.66 ± 0.89 μV Exposed: 1.33 ± 0.45 μV p<0.05 • Amplitude of P200 component, Mean ± SD Controls: 1.12 ± 1.01 μV Exposed: 1.52 ± 0.39 μV
Taormina (Guey, Bromet et al. 2008; Taormina, Rozenblatt et al. 2008; Bromet, Taormina et al. 2009; Bromet, Guey et al. 2010) (Follow-up of Bromet)	VSAT, Trail-Making Test, Underline-the-words test, BVRT A, HVLT A, WAIS	• Evacuees and classmates performed similarly and in the normal range on all tests • No differential temporal changes were found • Rates of university attendance and self reported memory problems were also similar • Evacuee mothers were almost three times as likely to report that their children had memory problems compared with non-evacuees • "Chernobyl did not influence cognitive functioning of exposed infants although more evacuee mothers still believed that their offspring had memory problems" • Lingering worries reflect a wider picture of persistent health concerns as a consequence of the accident • "Performance on each of the neuropsychological measures improved over time (analyses based on raw scores)" • BVRT (Memory), Mean ± SD *Parent(s) university graduates* Evacuees: 7.0 ± 1.7 Classmates (Controls): 7.3 ± 1.5 F_{time} = 28.5 (Scores differ between Time 1 (1997) and Time 2 (2005-2006), p<0.001)

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Taormina *(continued)*		*Parent(s) not university graduates* Evacuees: 7.1 ± 1.6 Classmates (Controls): 7.3 ± 1.7 F_{time} = 92.9 (Scores differ between Time 1 (1997) and Time 2 (2005-2006), p<0.001) • VSAT Task 1 (Attention), Mean ± SD *Parent(s) university graduates* Evacuees: 71.8 ± 13.4 Classmates (Controls): 68.2 ± 14.6 F_{time} = 343.9 (Scores differ between Time 1 (1997) and Time 2 (2005-2006), p<0.001 *Parent(s) not university graduates* Evacuees: 69.5 ± 13.8 Classmates (Controls): 68.7 ± 12.5 F_{time} = 610.7 (Scores differ between Time 1 (1997) and Time 2 (2005-2006), p<0.001) • VSAT Task 2 (Attention), Mean ± SD *Parent(s) university graduates* Evacuees: 73.0 ± 13.0 Classmates (Controls): 70.5 ± 11.9 F_{time} = 506.3 (Scores differ between Time 1 (1997) and Time 2 (2005-2006), p<0.001) *Parent(s) not university graduates* Evacuees: 69.9 ± 12.9 Classmates (Controls): 69.5 ± 13.1 F_{time} = 753.0 (Scores differ between Time 1 (1997) and Time 2 (2005-2006), p<0.001) • VSAT Trail-Making Test Part A (Attention), Mean ± SD *Parent(s) university graduates* Evacuees: 38.7 ± 14.9 Classmates (Controls): 41.5 ± 22.3 F_{time} =41.7 (Scores differ between Time 1 (1997) and Time 2 (2005-2006), p<0.001)

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Taormina *(continued)*		*Parent(s) not university graduates* Evacuees: 40.8 ± 14.3 Classmates (Controls): 43.7 ± 18.6 F_{time} = 101.5 (Scores differ between Time 1 (1997) and Time 2 (2005-2006), p<0.001) • Underline-the-words, Total Words, Mean ± SD *Parent(s) university graduates* Evacuees: 15.3 ± 3.8 Classmates (Controls): 15.9 ± 4.1 F_{time} = 153.7 (Scores differ between Time 1 (1997) and Time 2 (2005-2006), p<0.001) *Parent(s) not university graduates* Evacuees: 15.6 ± 3.6 Classmates (Controls): 15.2 ± 3.9 F_{time} = 375.2 (Scores differ between Time 1 (1997) and Time 2 (2005-2006), p<0.001) • Underline-the-words, Chernobyl Words, Mean ± SD *Parent(s) university graduates* Evacuees: 4.2 ± 1.3 Classmates (Controls): 4.3 ± 1.3 F_{time} = 79.9 (Scores differ between Time 1 (1997) and Time 2 (2005-2006), p<0.001) *Parent(s) not university graduates* Evacuees: 4.1 ± 1.3 Classmates (Controls): 4.0 ± 1.3 F_{time} = 161.2 (Scores differ between Time 1 (1997) and Time 2 (2005-2006), p<0.001)
Webb (Bromet, Gluzman et al. 2005; Webb, Bromet et al. 2005; Bromet, Havenaar et al. 2007) ("Ukraine World Mental Health Survey")	WMH-CIDI, DSM-IV	• Most significant risk factors in men and women were age (26-54 years for men; 18-25 years for women), living in the Southeast region, being in the labor force whether employed or unemployed, and for men, low education and being the father of a young child

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

Study By Principal Author	Scale	Result
Zhavoronkova (Zhavoronkova, Kholodova et al. 1995)	EEG analysis	• About 70% of exposed workers had paroxysmal EEG activity and intermittent seizures associated with loss of consciousness • EEG power mapping showed higher than normal levels of alpha- and theta bands power, mainly in the frontal and central areas in one group of exposed workers while other group of exposed workers had lower power especially in alpha-band

TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

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TABLE 7: OUTCOMES RELATED TO COGNITIVE PROBLEMS

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APPENDIX A: ACRONYMS FOR MEASUREMENTS IN THE STUDIES

Acronym	Questionnaire	Measure	Reference Given (1st author, yr)
16 PF	16 Personality Factor Questionnaire	Personality	
ADHD	Assessment of attention deficit/hyperactivity disorder	Assessment of attention	
ANAMUKR	Ukrainian subset of the Automated Neuropsychological Assessment Metrics (ANAM) battery of tests	Neurocognitive impairment from exposure to ionizing radiation	Reeves, 1995
BA	Biological age assessment	Aging rate	Voitenko, 1984, 1986
BAS	Behavioral Acculturation Scale	Well being	Birman & Trickett, 2001
BPRS	Brief Psychiatric Rating Scale	Clinical psychiatric interview	Overall, 1962
BSI	Brief Symptom Inventory	Psychological distress symptoms	Derogatis, 1992
BVRT	Benton Visual Retention Test	Memory	Benton, 1974
CAPS	Clinical PTSD diagnostic scales	PTSD	Horowitz, 1987
CBCL	Child Behavior Checklist	Child Behavior Checklist	Russian translation: Carter, 1995
CES-D	Centers for Disease Control-Depression	Depression	RadloffL, 1977
CPA	Cardiopulmonary age	Part of BA	
CSI	Children's Somatization Inventory	Assess somatization disorder	Garber, 1991
Derogatis SCL-90 or SCL-90-R	Symptom Checklist-90 (Revised)	Mental health	Derogatis, 1983, Russian translation: Tarabrina, 1996.
DSM-III-R	Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised	Mental Disorder	American Psychiatric Association, 1980
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition	Mental Disorder	American Psychiatric Association, 1994
GHQ	General Health Questionnaire	Psychological well-being	Goldberg, 1988
GHQ-12	General Health Questionnaire, 12 item version	Psychological well-being	Goldberg, 1988
GHQ-28	General Health Questionnaire, 28 item version	Psychological well-being	Goldberg, 1988
GSI	Global Severity Index	Global indicator of distress	Derogatis, 1992
HVLT	Hopkins Verbal Learning Test	Memory	Russian modification: Brandt, 1991
IBA	Integral biological age	Part of BA	
ICD-10	International Classification of Diseases, 10th edition	Classification of mental and behavioral disorders	WHO, 1992
ICDD-9-CM	International Classification of Diseases, 9th edition Clinical Manual	Clinical diagnoses, overall health	

APPENDIX A: ACRONYMS FOR MEASUREMENTS IN THE STUDIES

Acronym	Questionnaire	Measure	Reference Given (1st author, yr)
IES	Impact of Events – 15-item with 2 subscales: avoidance and intrusive thinking	Posttraumatic stress disorder (PTSD) symptoms; mental health	Horowitz, 1979, 22 item: Weiss, 1997
MDCL	Munich Diagnostic Checklist	Diagnosing for DSM-III-R disorders	Hiller, 1990
MMPI	Method of Multi-lateral Personality Investigation, 377 items	Personality	Berezin, 1976
MMPI	Minnesota Multiphasic Personality Inventory	Personality	Sobchik, 1990
MOS	Medical Outcomes Study	Self-rating of health	Cunny, 1991
MOS-SF	Medical Outcomes Study, short form	Self-rating of health	Cunny, 1991
PA	Psychological age	Part of BA	
R MISS PTSD	Revised Mississippi PTSD Scale	PTSD	Norris, 1996
RBAI	Russian translated Beck Anxiety Inventory	Anxiety	Beck, 1988; Borden, 1991; Russian translation: Carter, 1995
RBDI	Russian translated Beck Depression Inventory	Depression	Beck, 1988; Russian translation: Carter, 1995
SANS	Scale for the Assessment of Negative Symptoms	presence and severity of the *negative* symptoms of schizophrenia	Andreasen, 1982
SCID-PTSD	Structured Clinical interviews	PTSD	Horowitz, 1987
STAI	The State-Trait Anxiety Inventory	Anxiety	Spielberger, 1970.
VEP	Visual evoked potentials	Visual Sensory System	Gnezditskii, 1997
VSAT	Visual Search and Attention Test	Visual attention	Trenerry, 1990
WAIS	Wechsler Adult Intelligence Scales	Intelligence test	Weschsler, 1999
WHO-DAS	WHO Disability Assessment Scale	Days lost from work	Buist-Bouwman, 2006
WMH-CIDI	World Mental Health version of Composite International Diagnostic Interview	Tool to assess DSM-IV; mental health	Kessler, 2004

APPENDIX B: FINDINGS OF FOCUS GROUPS IN KIEV (KYIV), UKRAINE

Findings of Focus Groups in Kiev (Kyiv), Ukraine

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INTRODUCTION

As one step in exploring future research directions on the neuropsychological consequences of the Chernobyl disaster, we arranged for focus groups to learn the most critical concerns of residents in Kiev (Kyiv), Ukraine today. Data were collected in Kiev because of its relative proximity to Chernobyl, the presence of an affected population, and the availability of a team to collect data. We collaborated with Dr. Semyon Gluzman from the Ukrainian Psychiatric Association and Dr. Stanislav Kostyuchenko from the National Medical Academy of Postgraduate Education. As stated in the analysis report of Drs. Gluzman and Kostyuchenko (Appendix C), the "living conditions in Kiev are better than in other regions of Ukraine;" if ill, people have more possibilities and options to obtained qualified medical care, especially those affected by the Chernobyl disaster, in comparison with other parts of Ukraine. Thus, these data can only be considered as reflecting the concerns of one particular and non-representative group.

The focus group findings provide evidence complementary to the literature review. The intent was to attain a broad survey of the views of men and women affected by the disaster at different points in their lives.

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METHODS

The focus group findings came from ten focus groups with ten participants in each group. The focus groups were conducted in Kiev, Ukraine from March 21 to 23, 2011 by the Kiev International Institute of Sociology (KIIS). Each focus group was conducted at the KIIS offices and lasted approximately an hour and half. Discussions were in Russian and recorded for proper transcription. The moderator was a trained and experienced sociologist.

Drs. Gluzman and Kostyuchenko designed the ten general questions that guided the KIIS interviewers. There was an agreement between the USC team and Drs. Gluzman and Kostyuchenko as to the questions and interview protocol. The questions were developed in Russian and then translated into English. The following questions were given to KIIS:

General Questions	
1)	What do you think about your health or health of your relatives? How much health problems are important for you and your families?
2)	What do you do in case of illness? If got flu? If you have chronic or serious disease? How often you visited medical facilities? What types of facilities – state, private or alternative *(non-traditional)*? In what way your relatives or friends deal in the case of disease?
3)	Do you have any barriers *(difficulties)* to visit a doctor in case of disease or get medical care you need, what kinds (location, money, other)? What types of barriers could meet other people to get medical care if they need.
4)	Were you satisfied by medical services you visited? What about quality of medical care you got? *(What was like your experience from medical care you got? Some examples of both positive and negative experience)*? How your relatives or friends assess the quality of medical care they got?
5)	Are there reasons for concerns about you health or for your relatives or friends? Are there threats for your health? What diseases?
6)	What do you think about Chernobyl disaster consequences for your lives? What happened (changed) into your lives (into lives of your relatives or friends) after Chernobyl disaster? Did you live in area of Chernobyl disaster?
7)	How Chernobyl affected the health of people? In what way the disaster affected your health or wellbeing or health and wellbeing of your relatives or friends? What types of your health problems due by Chernobyl disaster? Is there something wrong with your health because of Chernobyl? General health? Sleep? Appetite? Work performance? Tiredness? Fatigue? Depression? Anxiety?

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8)	Are there reasons to see a doctor because you have consequences of Chernobyl for your health? What problems with your health could be linked with Chernobyl disaster?
9)	Do you afraid of possible consequences for your health for your relatives or kids? What kinds of possible consequences? Cancer? Genetic risk? Other risks?
10)	Do you think that you need more detailed medical examination to define possible consequences of Chernobyl disaster for your health? What types – detailed interview, blood tests? What types of tests or investigations would you like or you need to proceed to define Chernobyl consequences for your health? Is it possible to get such investigations? Where?
Italics - *Statements changed after first focus group discussion*	

Participant Recruitment

KIIS recruiters recruited the respondents for the focus group discussions. The KIIS recruiters found prospective respondents through their social networks. The recruiters' social networks comprised people known to the recruiters and people referred by the index participants. This referral process continued until the KIIS recruiters had sufficient prospective respondents with general characteristics covering the target population. The resulting database was used to contact respondents for the focus group discussions.

The KIIS recruiters used the following criteria in selecting prospective respondents for the focus group discussions:

Table 1. Selection Criteria

1.	Gender – as assigned in Table 2 (Group Characteristics)
2.	Age – as assigned in Table 2 (Group Characteristics)
3.	Educational level - to ensure distribution of respondents with different educational levels within each group.
4.	Household well-being - to ensure distribution of respondents with different socioeconomic status within each group.
5.	Profession and place of work - to ensure that people working in health-care/medicine won't participate in the groups (since they have not common but expert opinions on the discussion's topic).

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Recruiters motivated the participation of the prospective respondents by appealing to the respondent's possible interest in the subject of discussion, emphasizing the scientific and social importance of the research, and providing a small monetary incentive.

The sex-age strata for the ten focus groups are shown in the table.

Table 2. Group Characteristics

Group Number	Gender	Age
1	Men	18-30
2	Women	18-30
3	Men	31-55
4	Women	31-55
5	Men	56+
6	Women	56+
7	Men and Women	18-45
8	Men and Women	18-45
9	Men and Women	45+
10	Men and Women	45+

The focus group findings discussed in this report were based on summary translated reports provided by KIIS and Drs. Gluzman and Kostyuchenko. The summary report provided by KIIS gave an abridged version of the responses shared during the focus groups. In this report, KIIS outlined the general themes within the discussions along with a few specific examples from the respondents. The recorded video on the ten focus groups and the actual Russian transcriptions of focus group discussions were provided. The USC investigators reviewed a Google translation of the interview transcripts for general validation.

We also received an independent analysis from Drs. Gluzman and Kostyuchenko, who have been researching mental health issues in Kiev for

many years (see representative publications - Bromet EJ. Gluzman SF, et al. The state of mental health and alcoholism in Ukraine. In: The WHO World Mental Health Surveys: Global Perspectives on the Epidemiology of Mental Disorders. Ed. by RC Kessler and T.B Ustun. 2008. Cambridge University Press. pp 431-446.; Gluzman S, Kostyuchenko, S (2006). Psychiatry in Ukraine. Bulletin of the Board of International Affairs of the Royal College of Psychiatrists 3, 38–40.). Drs. Gluzman and Kostyuchenko, who collaboratively developed the Russian and English-translated questions for the focus groups, observed the focus groups while they were in progress at the KIIS offices. Besides offering their expertise, they also examined the Russian transcriptions and the summary report provided by KIIS to ensure accuracy throughout the focus group process.

RESULTS

Focus group discussions pointed to several general themes regarding the population perception of health and wellbeing, the quality of medical care and the possible health consequences of the Chernobyl disaster. For most respondents, health was considered one of the most important values in their lives; however, few reported about the medical services used in cases of illness. For example, when asked about how they generally cared for the flu, almost all respondents described using "traditional means" such as "staying at home," "lying in bed," or "hot tea," and very few mentioned that they would seek medical care advice. Many respondents even said that the second step after "traditional means" would be to "go to a drugstore" for "self care" or obtain advice from the pharmacist.

Twenty-five years after the disaster, many respondents mentioned Chernobyl as a possible threat to their health. Health consequences of the Chernobyl disaster were noted spontaneously in almost all groups before the facilitator put the question towards the groups. The respondents were clear that the Chernobyl disaster affected their lives and that they still remember some details of events in April–May 1986. The majority of people agreed that they need more detailed health investigations to assess their state of health and identify possible consequences of the Chernobyl disaster for health. They voiced an interest in participating in studies.

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Among the main future concerns on the health consequences of the Chernobyl disaster, many respondents said that children need to have more detailed investigation on their health, including physical and mental health. With regards to mental health as a consequence of the Chernobyl disaster, respondents did not state directly that their mental health had been affected. Nevertheless, they described many symptoms of depression when asked, such as sleep disturbances, loss of interest and fatigue. This topic was discussed at particular length among the group of older women (age 56+).

In general, the focus group discussions gave useful insights regarding people's perception, concerns, and attitudes toward health and the current state of health in Kiev. They also noted other environmental risk factors in Kiev that could affect health within Kiev. The following emerged with consensus as the key issues: the dissatisfaction with the quality of the medical care, the use of non evidence-based diagnostics and treatments, lack of knowledge in the population about the signs of both physical and mental disorders, concerns about the children's health, and the potential impact of environmental factors including the Chernobyl disaster.

The information obtained during the focus group discussions requires further analysis to more fully define the population groups and the health conditions that should be studied further. Such analysis should focus on identifying specific vulnerable population groups and possible disorders. In addition, further studies should determine what are the suitable instruments to measure such population and disorders.

Table 3. General Conclusions From KIIS
(Taken verbatim without editing from the KIIS Report)

Themes:	**Summarized Conclusions**
General Perception of Health	Health for most people is one of the main values because health is directly connected with all other values in life, and possibility of enjoying them and life as a whole extremely highly depends on health.
Acting in Case of Illness	While for serious illness people see a doctor, for small ones most people prefer to deal with it by themselves because they are lacking trust to doctors and/or saving valuable time. While fighting a small illness some people rely on traditional medical means because they are having bad attitude to "chemical" pharmaceutical drugs and/or being stopped by their high cost, but some people rely on pharmaceutical medications either because it works faster and/or they are just used to it.

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Themes:	Summarized Conclusions
Quality of Medical Care	Satisfaction from medical care highly depends on the presence or absence of personal attention from doctor to patient. If such personal attention exists because of doctor's personality, or because doctor is personally recommended to patient by someone, or because of certain corporate culture at medical facility the doctor works for – satisfaction by medical care received is much more.
State and Private Medical Facilities	Private medical facilities are usually perceived as better ones comparing to state, and the reason detaining people from visiting private medical facilities more is much higher cost of services there.
Alternative Medical Facilities	Most people are interested in alternative medicine but they are held back by their suspicion of it and of its results.
Barriers to Visit a Doctor	The main reason for not visiting a doctor is lack of trust to them because they think about earning on patient more than about healing the patient and/or level of their knowledge is not good as desired.
Threats to Health	People see a lot of risk to the health that they can hardly resist if keeping live where they live now – in Kyiv. The main risks are connected with urban problems (air and water pollution) and with modern economy and lifestyle (bad food).
Perception of Chernobyl Disaster Today	The influence of the Chernobyl disaster on today's life is not big, especially as perceived by younger generation. Even nobody questions highly negative consequences of the accident – other health threats like air pollution, water pollution, bad food are more important today.
Influence of Chernobyl Disaster on Health	While people surely connect some of their current health problems to Chernobyl disaster (some thyroid problems, spine problems, skin diseases, etc) there is uncertainty about some other health problems (feet pain, problems with getting pregnant or problems with giving birth, vision problems, etc) – which of them are caused by Chernobyl disaster and which are caused by something else (age, environment pollution, bad food, etc).
Doctor's Diagnoses in Connection to Chernobyl Disaster	People do not rely on doctor's diagnoses in relation to Chernobyl: in the past doctors were not allowed to say that the problem is caused by Chernobyl, and now doctors say on many health problems that they are connected to Chernobyl just not to trouble themselves with looking for real explanation.
Threats of Possible Future Consequences of Chernobyl Disaster	People commonly do not think about possible consequences of Chernobyl disaster in future. And if they are asked, some think more about other threats (bad ecology in general), some recall that radiation does not go away for years and so it's still a threat, and some think of adaptation of human to radiation.

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Themes:	Summarized Conclusions
Perception of Possible Medical Examination Related to Consequences of Chernobyl Disaster on Health	If a detailed diagnostic defining possible consequence of Chernobyl disaster on health was available, many people would go for it if this was free and if this would take not much time. However some people would not do this because they see no sense in such diagnostic – it does not heal but just makes a psychological trauma.

APPENDIX C: ANALYSIS OF FOCUS GROUP DISCUSSIONS

Ukrainian Psychiatric Association

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Analysis of focus group discussions

The focus group discussions conducted by KIIS showed several important things regarding our population's perception of health and wellbeing, quality of medical care and possible health consequences of Chernobyl disaster.

Many people said that health is one of the most important values in their lives; however, only few of them reported about using medical services even if they were ill. When they were been asked about the flu, almost all respondents said about using 'traditional means' such as 'staying at home' 'lying in bed' 'hot tea' etc. Very rarely did someone say to call a doctor when asked about the flu. Many respondents said that the second step after such 'self-care' is 'to go to drugstore' but again visiting or calling the doctor was not mentioned.

Our focus group survey asked only people living in Kyiv, Ukraine. Living conditions in Kyiv are better than other regions of Ukraine. In case of illness, people have more possibilities and options to get qualified medical care, but they do not use it even when they are in need.

Even after 25 years since the Chernobyl disaster many people mentioned the Chernobyl disaster as a possible threat for health. It also was noted spontaneously in almost all groups before the facilitator put the question towards the groups. In addition, people mentioned that the Chernobyl disaster adversely affected their lives, and they still remember many details of the events occurring in April–May 1986.

As for the mental health consequences of the Chernobyl disaster, respondents did not say in a direct way, but they did describe many symptoms of depression, such as sleep disturbances, loss of interests, and fatigue. This was seen most prominently in the group discussion with older women (56+).

Among the main future concerns on the health consequences of the Chernobyl disaster, respondents said that the physical and mental health of children could have been affected, and they believe that children need more detailed health investigations.

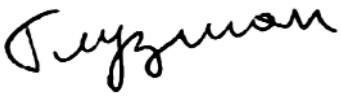
APPENDIX C: ANALYSIS OF FOCUS GROUP DISCUSSIONS

Majority of the people agreed that they need more detailed health investigations to define their state of health and their health effects related to the Chernobyl disaster. The respondents also said that they are ready to participate in future studies which look at the consequences of the Chernobyl disaster.

Overall, the discussions gave us very important insights regarding people's perceptions, concerns, and attitudes toward their health and the current health care. They also noted other environmental risk factors that could have affected their health by living in the city of Kiev. The discussions highlighted many important issues that should be studied, such as the following: dissatisfaction of quality of medical care, use of diagnostics and treatments with absent and doubt evidence base, lack of knowledge in population about signs of both physical and mental disorders, concerns about children's health, and potential input of environmental factors including Chernobyl disaster.

The focus groups discussions demonstrated that health and well-being problems are very important for our population, and the overall health consequence of the Chernobyl disaster was one of serious health concern among all discussions. Taking into an account that there was very few evidence-based information on health-related data from the focus group discussions, we could highlight many issues that require further research to collect such type of data.

The information obtained during the focus group discussions required further analysis to define future research studies. Population groups and health conditions are two things that should be studied more precisely if further studies will be conducted. Examples of the needed better definition are vulnerable population groups, possible disorders, and suitable measuring instruments such as interviews, medical tests, and etc.



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www.greencross.ch

Green Cross Switzerland facilitates overcoming consequential damages caused by industrial and military disasters and the clean-up of contaminated sites from the period of the Cold War. Central issues are the improvement of the living quality of people affected by chemical, radioactive and other types of contamination, as well as the promotion of a sustainable development in the spirit of co- operation instead of confrontation. This includes the involvement of all stakeholder groups affected by a problem.

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