

Emotional Consequences of Nuclear Power Plant Accidents

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TMI, Chernobyl, Fukushima: Common thread

After TMI (1979) and Chernobyl (1986):

Official consensus was that the biggest short- and long-term public health effect → mental health.

- *Yet, few resources were devoted to intervention programs or to research designed to shape them.*
- *Significance and importance were largely unappreciated and seen as confirmation that health effects were non-existent (TMI) or limited (Chernobyl).*

After Fukushima: Mental health has again emerged as a major health issue (UNSCEAR 2014).

- *Discussion began at the 2011 International Expert Symposium in Fukushima*

In 2011, we discussed the health and socio-economic consequences of poor mental health

- A leading cause of disability worldwide (by 2020, depression = 2nd leading causing of disability)
- Poor physical health (onset and persistence)
- Greater use and cost of medical services
- Mortality (not just suicide)
- Poor quality of life
- Failure to achieve educational and occupational potential
- Decreased productivity and family stress

Outline of talk

1. Mental health after toxic disasters in general
2. Three Mile Island (TMI)
3. Chernobyl
4. Value of health surveillance programs in Fukushima for monitoring health and mental health and for meaningful risk communication

Some 20th and 21st century toxic disasters

- Atomic bombs, Japan (1945)
- Agent Orange in Vietnam (1960s)
- Love Canal in Buffalo, New York (1978) –
- Three Mile Island, Pennsylvania (1979)
- Union Carbide gas leak, Bhopal, India (1984)
- Chernobyl, Ukraine (1986)
- Khamisiyah ammunition storage facility explosion, Iraq (1991)
- Sarin subway attack in Tokyo (1995)
- World Trade Center disaster, New York (2001)
- BP oil spill disaster in the Gulf of Mexico (2010)
- Fukushima, Japan (2011)

Research shows that among toxic exposures, events involving radiation are most threatening of all

- Conjure up terrifying images and memories



Emotional consequences

- Range of psychosocial consequences
 - *Depression, grief, extreme distress
 - *Post-traumatic stress disorder (PTSD)
 - *Medically unexplained physical symptoms/chronic health anxiety
 - *Smoking and alcoholism
 - *Stigma
 - *Suicide
- Prevalence ranges from 25%-75% in the first year, depending on:
 - magnitude of destruction/environmental impact
 - the post-disaster management
 - short- and long-term economic impact
 - degree of personal involvement of study population
 - assessment tools and case definitions
 - in-person vs phone vs mail, and response rates
 - location/culture
 - when the study took place

Risk factors for post-disaster health

- Many established risk factors for poor mental health, but after toxic disasters, health risk perceptions are at the top of the list.
- How do health risk perceptions arise?
- Signals sent by scientists, news media, government and industry spokesmen, activist organizations, politicians, physicians, and social and personal networks
- W.I. Thomas: 1928
“If men define situations as real, they are real in their consequences.”

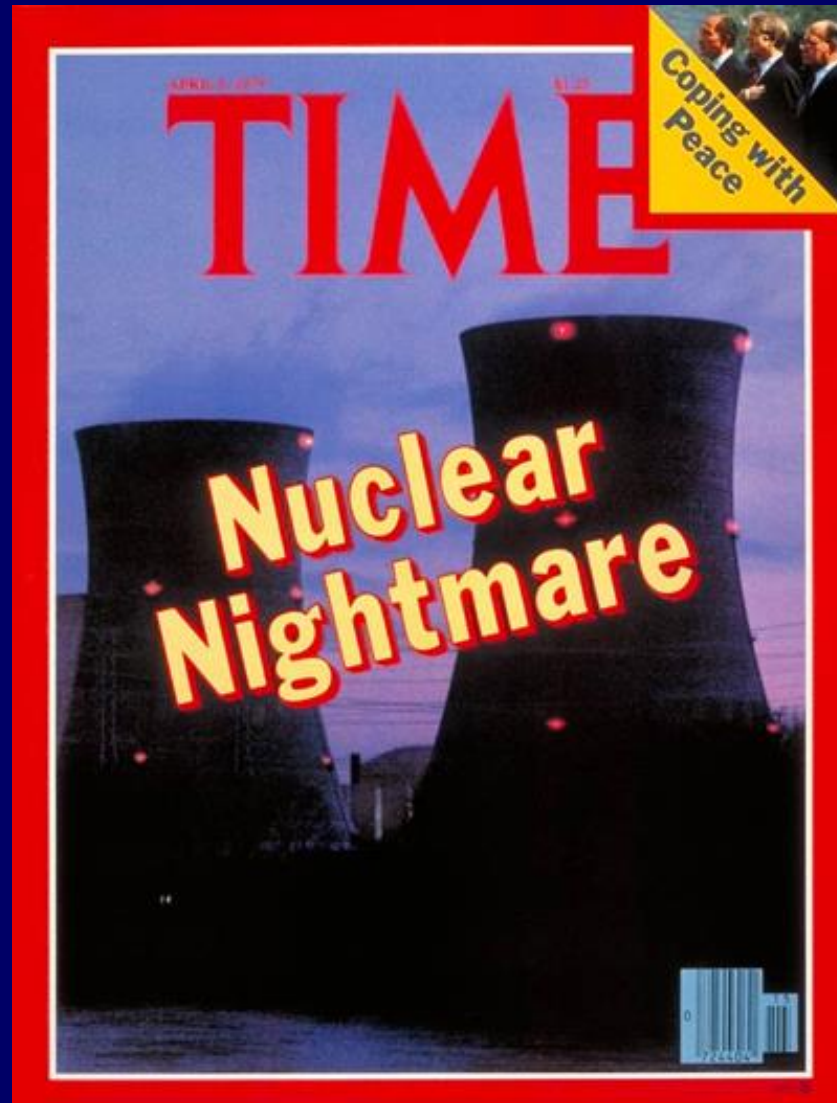
Three Mile Island (central Pennsylvania)



1979

Three Mile Island (March 28, 1979, 4:00 a.m.)





April 9, 1979

March 28-30

Governor's office, NRC, and scientists made contradictory statements about the accident → reported in the media → confusion and fear in populations near and far

Evacuation advisory (March 30); handled incrementally

New York Times: March 30 “The Credibility Meltdown”

“Credibility was not enhanced by public statements... Was it a little leak, a bigger leak – or a general emergency? The reactor's operators said one thing, state officials another, Federal officials yet another, not to mention the contributions of equipment manufacturers and politicians. ... Who is to be believed? The profusion of explanations and of contradictory statements has meant troubling confusion.”

Two “scientific” perspectives on TMI

- Union of Concerned Scientists: exact amount of radiation unknown because crucial records during first two days went missing
- PhD physicist from U-Pitt showed ‘data’ suggesting an increase in still births downwind of TMI
- Anti-nuclear researchers claimed massive increase in cancer
- **President’s Commission Report, December 1979:**
- **Max. individual dose estimate = <1 mSv**
- **1-2 excess cancers possible (workers)**
- *Biggest impact was on mental health which was subsiding by autumn of 1979*

TMI mental health research

- Funded by NIH and a non-profit foundation
- Focused on 4 potentially high risk groups
 - Mothers of young children living in the 10 mile radius of TMI (n=~400)
 - TMI workers (n=~175)
 - Psychiatric outpatients in the public mental health system (n=90)
 - Pre-teen children of moms and workers (n=150)
- Comparison groups from near another nuclear plant in western Pennsylvania and later also from a coal-fired plant

Focus of study

Diagnostic interviews on depression and anxiety

Self-report symptom scales

Range of risk factors, including risk perceptions

In-person assessments by mental health professionals

9, 12, 30, 42 months post-TMI

7 years later -- 1985 (one month after the restart of Unit 1)

10th anniversary -- 1989

Mailed questionnaires to TMI mothers (response rate ~50%) [no funding]

Main findings

Mothers

- 25% of TMI moms vs 14% of controls had clinical depression or generalized anxiety in year after TMI.
- Mental health symptoms remained high over 10 years.
- Mothers continued to worry about health impact.

10 years later:

42% believed their health was affected by TMI

68% were concerned about their children's health because of TMI

• Risk perceptions were significantly correlated with distress and poor self-rated health; correlations increased over time

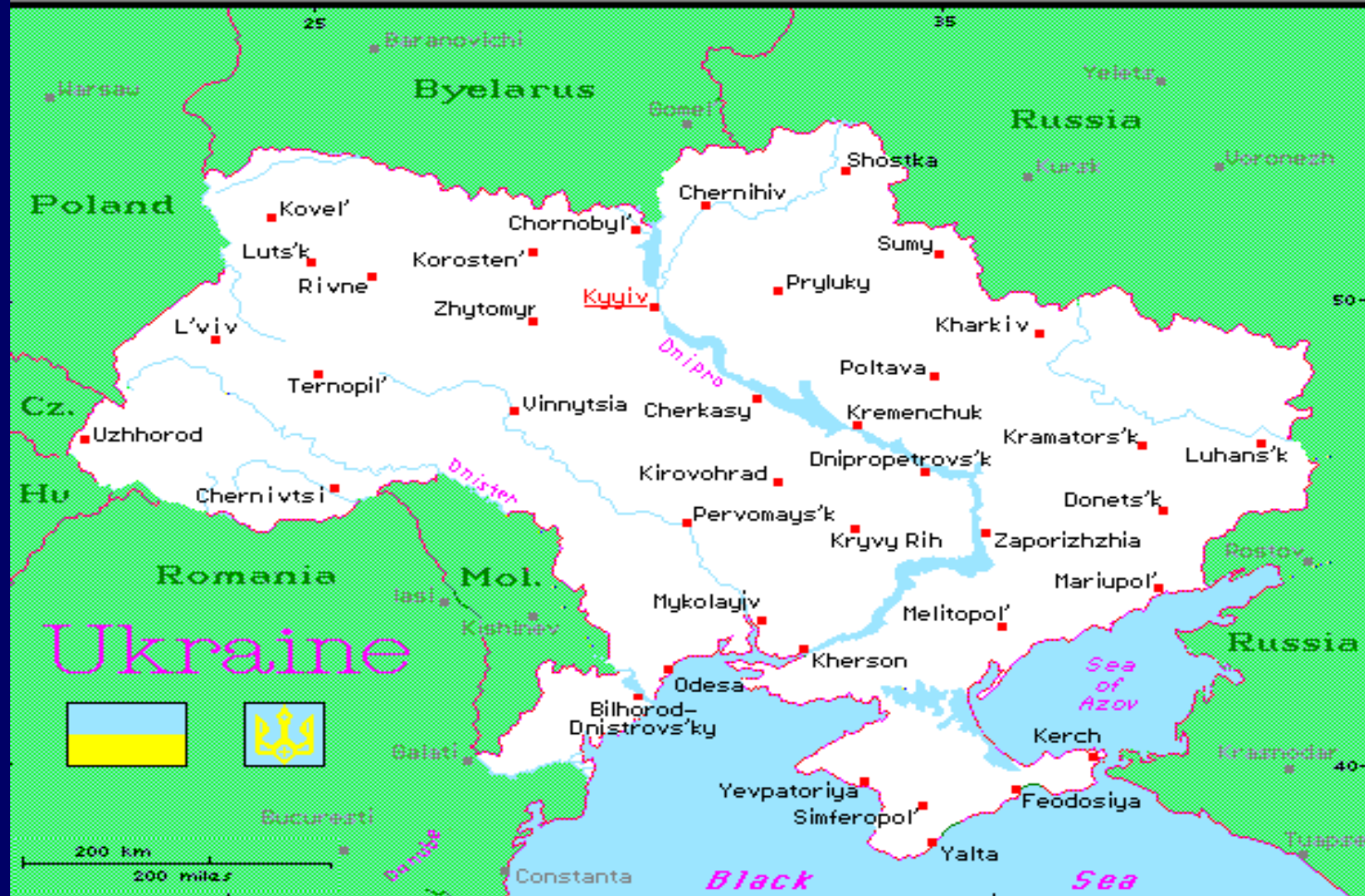
Children no differences

Workers > disorder in first year only; selection bias issues

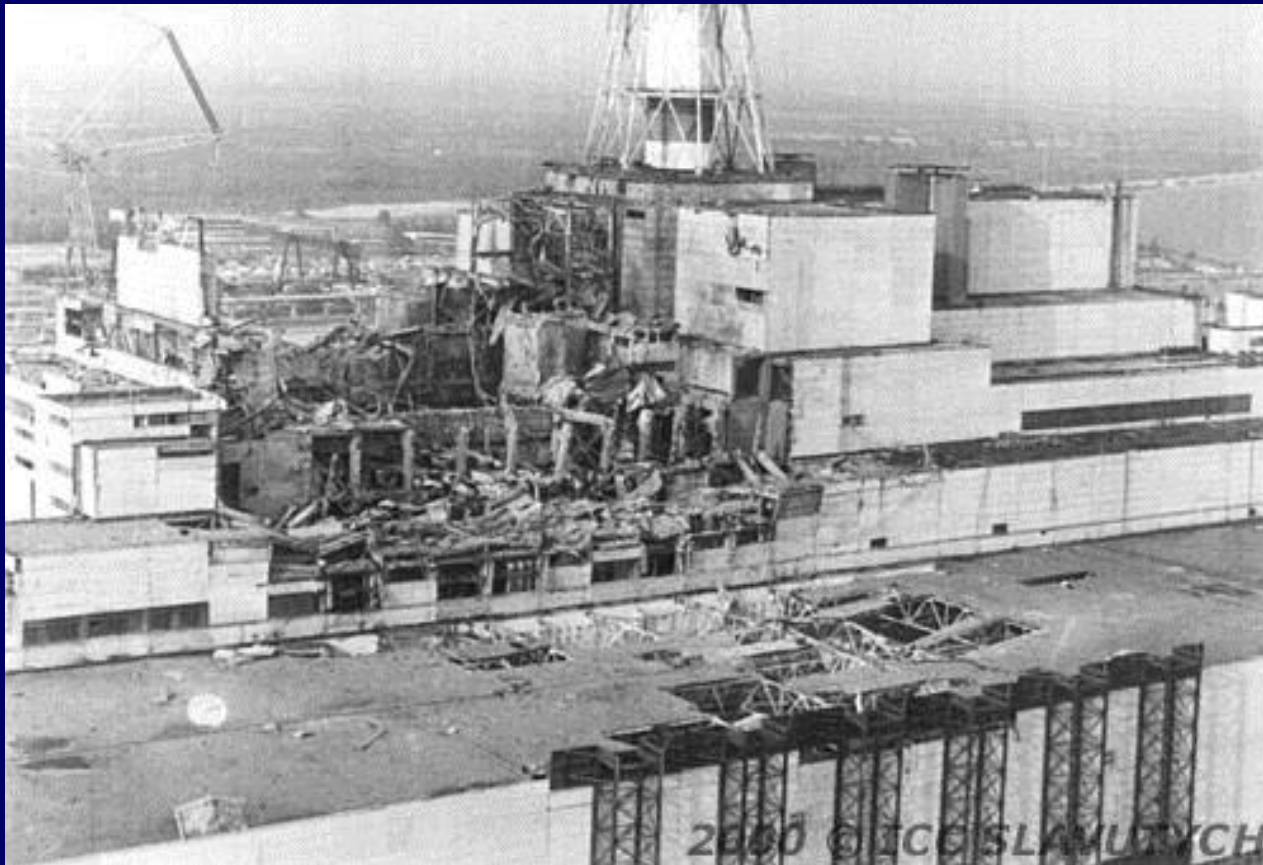
Patients no differences

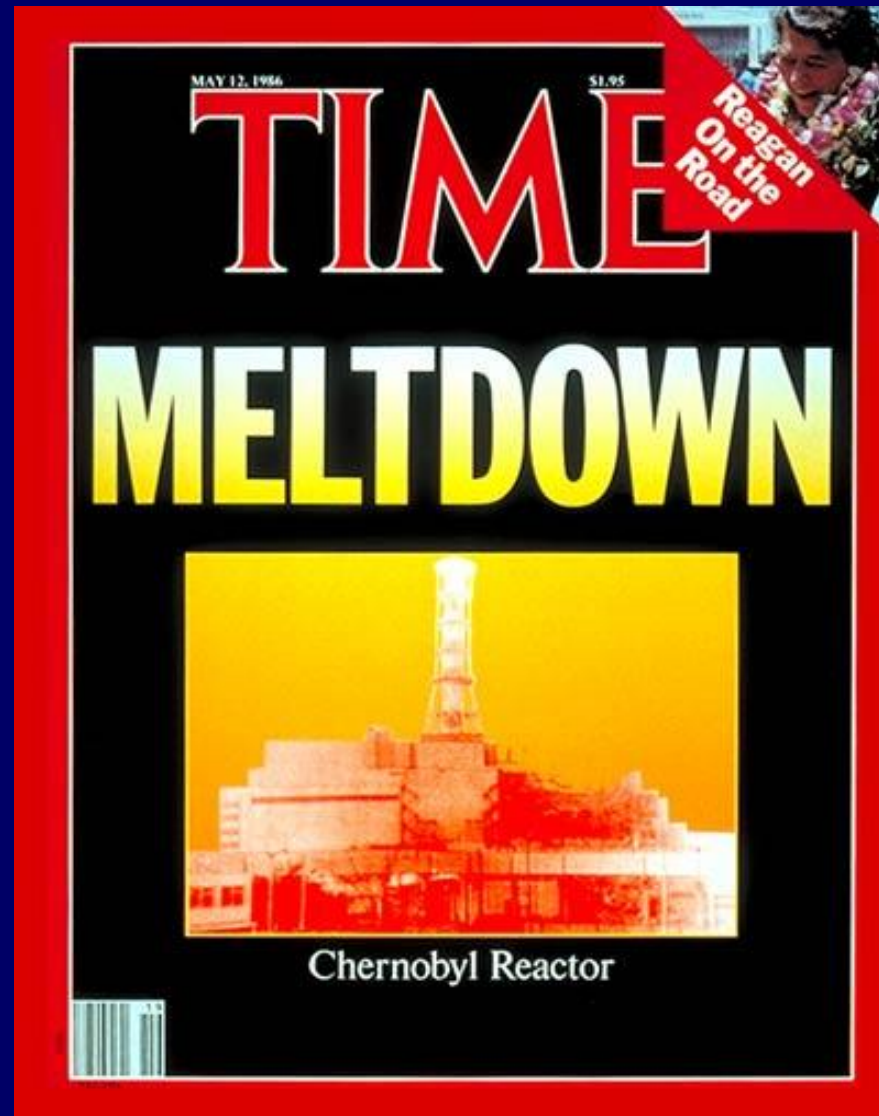
Other studies showed long-term psychological impacts.

Chernobyl, north central Ukraine



Exploded 7 years after TMI accident (Apr 26, 1986)





May 12, 1986

Unlike TMI in obvious respects

- Complete meltdown
- Permanent evacuation starting with the 30 km zone
- Women advised to have abortions
- 31 deaths in the immediate aftermath
- Information was controlled; minimal contradictions
- Cultural & political context; break-up of Soviet Union
- Stigma toward evacuees
- Relocation → battles for residency permits
- Later, increase in thyroid disease in exposed children

Parallels

- Occurred during the night
- Intangible
- Evacuation delayed
- Rumors about plants and animals
- Distrust in government and other authorities
- Concerns about future health effects
- **Lack of resolution**

Early studies of mental health using standard measures

- Local studies in Ukraine and Belarus that spun off from the WHO *Children in Utero* protocol, mostly focused on exposed children
- Havenaar et al. study of Gomel vs Tver, Russia, on adults
- Viinamäki et al. study of Bryansk vs a similar village, on adults
- Later Estonian mortality research finding excess suicide among liquidators
- Our research focused on evacuees living in Kyiv; done in collaboration with the Ukrainian Psychiatric Association and a survey research company

Dr. Semyon
Gluzman
in front of
KGB
building.
June 1992





Pripyat





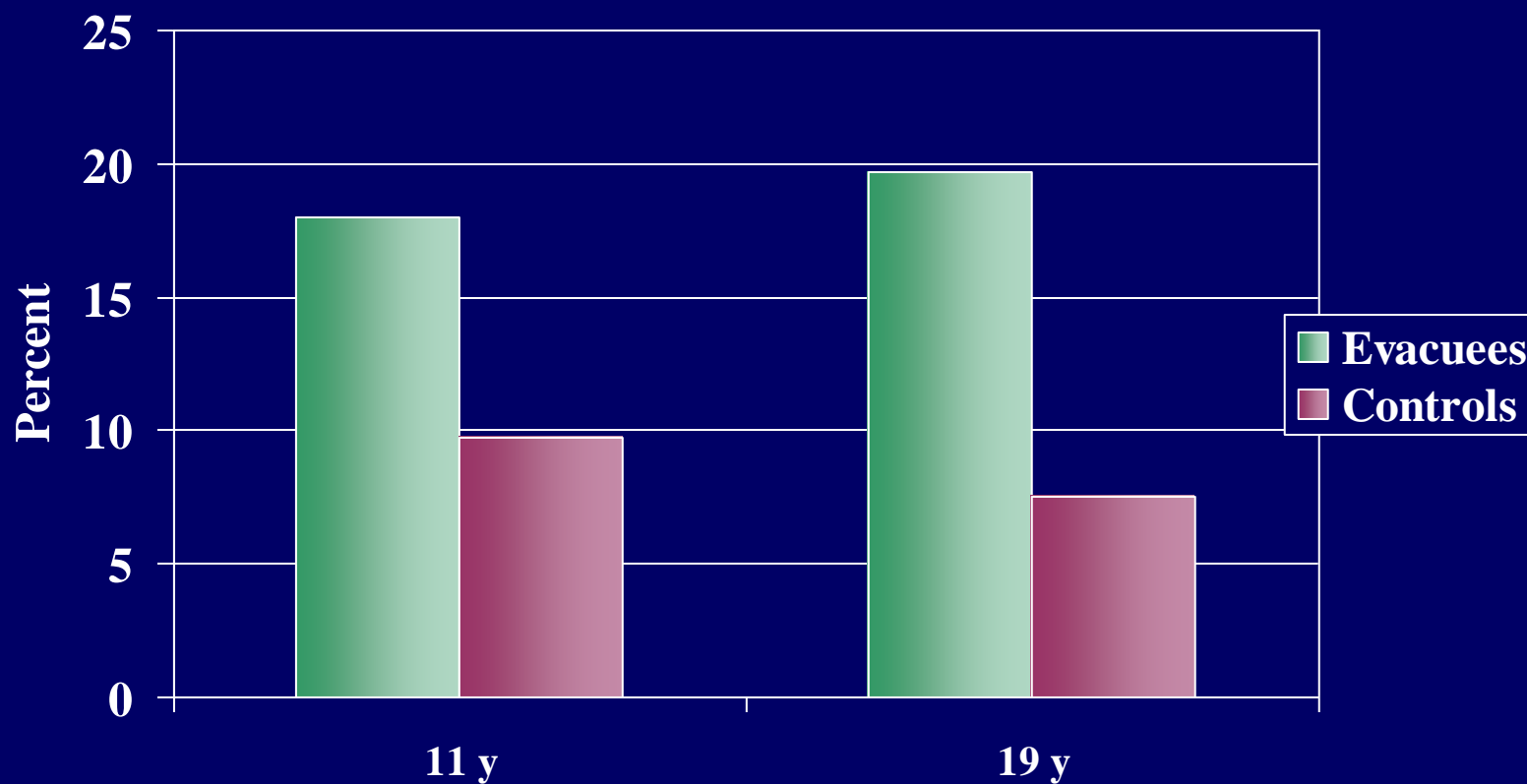
2-stage, longitudinal study of moms and kids

- 300 evacuee children born shortly before or after accident and 300 gender-matched classmate controls
- 11 and 19 years after Chernobyl
- Stage 1: Mothers and children were interviewed simultaneously in their homes
- Stage 2: Children had medical exams and blood tests at a clinic
- At age 11, school records and teacher reports about behavior
- At age 19, we added population-based control group

Basic findings

- No differences between evacuee and control kids in mental health, neuropsychological performance, academic performance, physical health, blood tests
- Only diff's were evacuee children more often absent from school and rated their health less positively
- Large differences in mothers' mental health and self-reported medical conditions, almost entirely explained by Chernobyl risk perceptions and MDs' dx health conditions as C-related.
 - NOT explained by other forms of life stress, economic strains, marital problems, or demographic factors

PTSD (Post-traumatic stress disorder)



P values <0.001 At year 19, second control group had same rate as classmates' mothers; derived from IES-R

Liquidators

- Liquidators being monitored for cancer, but not mental health
- Mortality study from Estonia showed that excess suicide
- Collaborated with the Kiev Radiation Medicine Institute*
- In 2003-4, diagnostic interviews with 295 liquidators from 3 geographic areas of Ukraine
- Compared with 397 age/geographic matched controls from the Ukraine-World Mental Health Survey^o conducted in 2002 (NIH funded)

*Loganovsky et al. Psychol Med 2008;38:481–488.

^oWorld Mental Health Survey also conducted in Japan by Professor Norito Kawakami, University of Tokyo

Liquidators were more impaired

	<u>aOR</u> ¹	<u>95% CI</u>
• Mood disorder	1.8	(1.1-2.9)
• Suicide ideation	2.3	(1.2-4.5)
• PTSD	3.5	(1.0-12.1)
• Anxiety disorder	4.1	(1.3, 12.7)
• Severe headaches	16.6	(9.4-29.5)

¹adjusted for age in 1986 and onset of disorder < Chernobyl

- *Liquidators with disorders missed far more days of work than controls with same disorders*

Similar narrative post-Fukushima

One big difference: Importance of mental health is now more widely appreciated

The 1948 WHO definition of health is fully embraced:

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

Several ongoing surveys in Fukushima reflect the spirit of the WHO definition

Conclude: Untapped value of health surveillance

Can have enormous value to affected communities, if...

- Partner with natural community leaders and local organizations
- Incorporate local concerns into questionnaires
- Present results in person clearly and consistently to local stakeholders in open forums
- Actively engage study participants about radiation risk (rather than elicit perceptions and leave a pamphlet)

1. Use findings to de-stigmatize mental health problems

2. Reach out to the angriest communities

3. Compel scientists to think about better ways of communicating science which in the end might improve the community's trust in their work and raise the level of awareness and knowledge about the ingredients of good vs bad science

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