Indoor Pollution: Radon and Other Hazards

Division of Cancer Epidemiology and Genetics
NCI, NIH, DHHS

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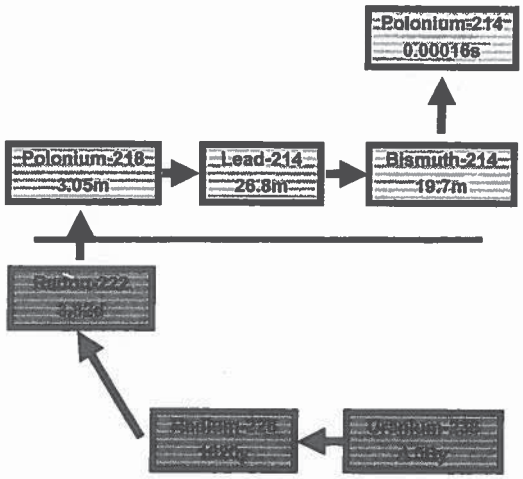
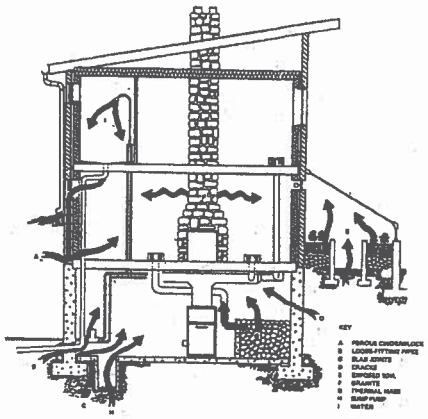
12/4/2002

What is Radon?





Why is Radon of Public Health Importance?

- 12% of U.S. lung cancer deaths
- ~20,000 lung cancer deaths / year
- 2nd leading cause of lung cancer

NAS BEIR VI, 1999

Measuring Radon in Homes

	Concentration		Exposure (25y)
	Bq/m³	pCi/l	WLM
EPA Action Level	148	4	20
U.S. homes (mean)	46	1.2	
	37	1	
1 decay/sec/m³	1		

Status of Radon Knowledge in Mid-1980's

- Risk models based on 4 studies of miners with 350 lung cancers (NAS BEIR IV, 1988)
- No studies of radon and lung cancer using indoor air measurements

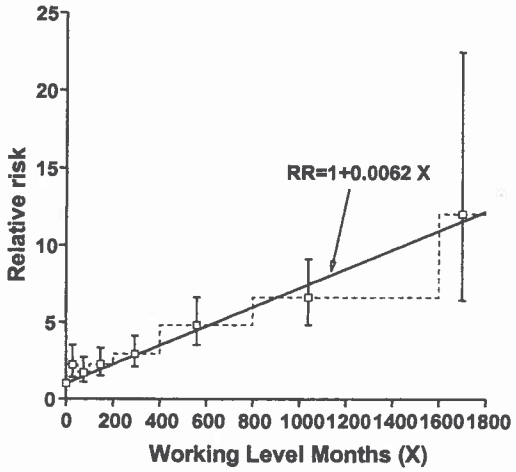
DCEG Research Activities to Evaluate Radon Effects

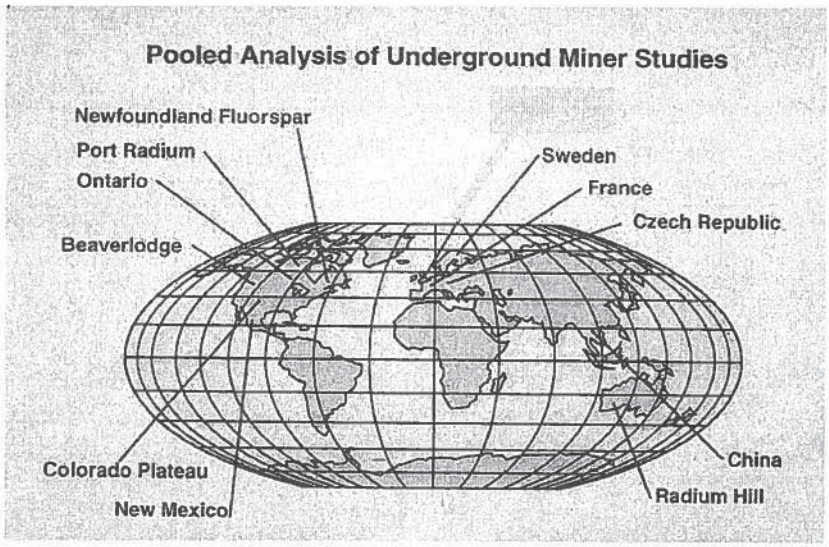
- Studies of Rn-exposed miners
  - China tin miners - case/cntrl (1990)
  - China tin miners - cohort (1993)
  - New Mexico U miners (1991)
  - Newfoundland (1998)
- Studies of indoor radon
  - Shenyang, China (1990)
  - New Jersey (1989)
  - Missouri-1 (1995)
  - Missouri-2 (1999)
  - Gansu (2002)
- Data synthesis
  - pooling studies of Rn-exposed miners
  - pooling US miner studies
  - expert committees: NAS, ICRP, NCRP
  - meta-analysis of indoor studies
  - pooling indoor studies: North America, European, world
- Non-lung cancer outcomes
  - pooled miner data
  - childhood ALL

Lung Cancer in Underground Miners of the Yunnan Tin Corp

- 17,125 male miners
- 980 lung cancer deaths
- follow-up from 1976-1989
- 50+ years of exposure
- 56% 1st exposed <15

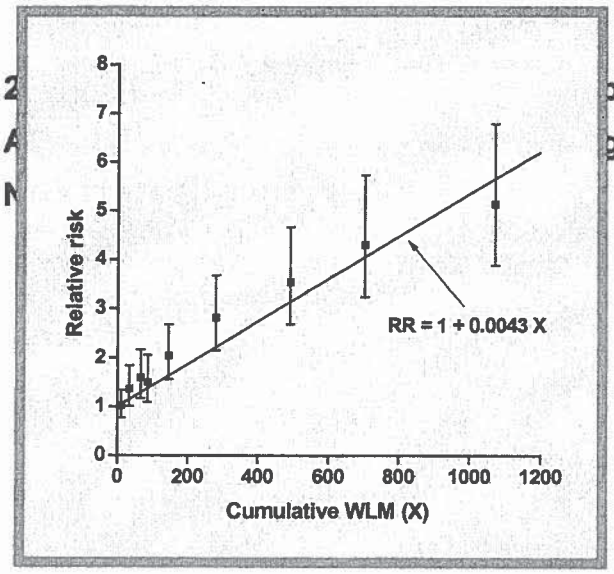
Xuan et al 1993





RRs from Pooled Analysis of 11 Miner Cohort Studies

- 2 ... o-yrs
- A ... g trend
- N

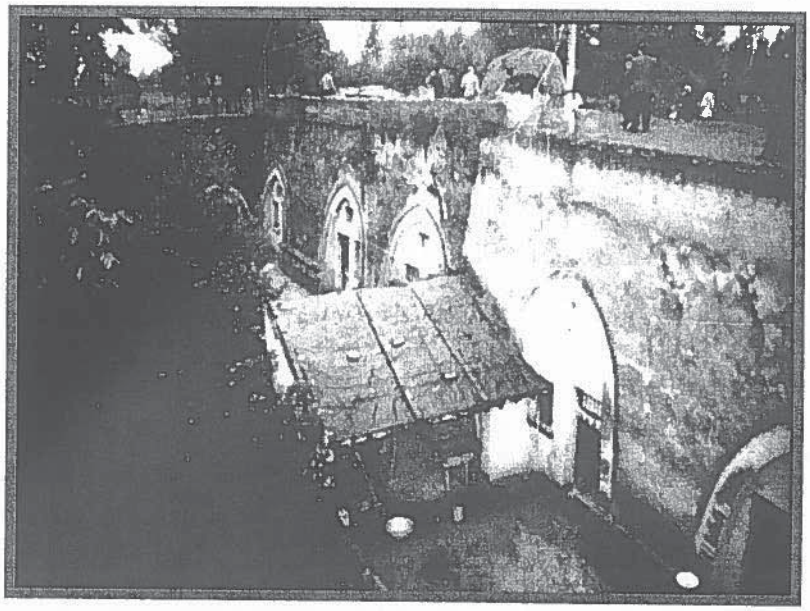


Lubin et al 1995, 1997, 1998

Case-Control Studies of Lung Cancer and Residential Radon

- Directly estimate exposure-response relationship
- Evaluate other factors, e.g., females, children
- Compare residential risks with miner extrapolation

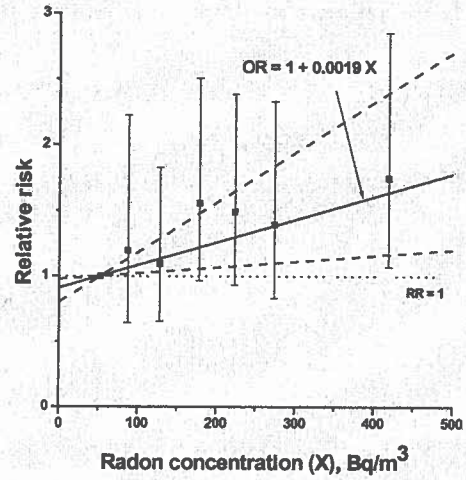
PEOPLE'S REPUBLIC OF CHINA



ORs of Lung Cancer by Radon Level for Gansu Study

- Study area:
  rural, stable, little industry
  high radon (mean=225 Bq/m^3)
- 768 cases (M:563, F:205)
- 1,659 cntrls (M:1,232, F:437)
- 1-yr a-track monitors

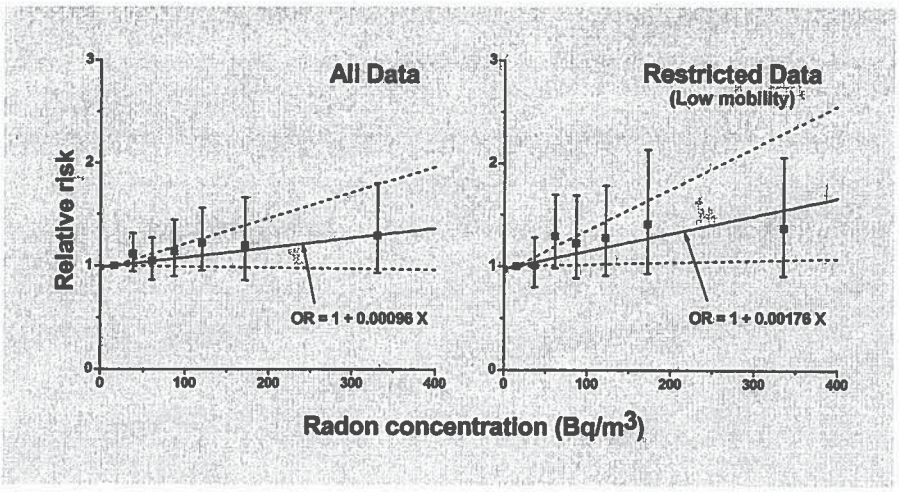
Lubin 2001, Wang 2002



Pooling of Residential Radon Studies

- Workshops/annual meetings
  - DOE and CEC (1989, 1991, 1995)
  - annual meetings
  - North American/European/World pooling projects
- North American pooling project
  - studies with 200+ cases and 1-yr radon detectors
  - 4,101 cases and 5,281 controls
    - New Jersey — Schoenberg 1990, 1992
    - Winnipeg — Létourneau 1994
    - Missouri-1 — Alavanja 1994
    - Missouri-2 — Alavanja 1999
    - Iowa — Field 2000
    - Connecticut — Sandler 2003
    - Utah — Sandler 2003

ORs by Radon Level for North American Studies

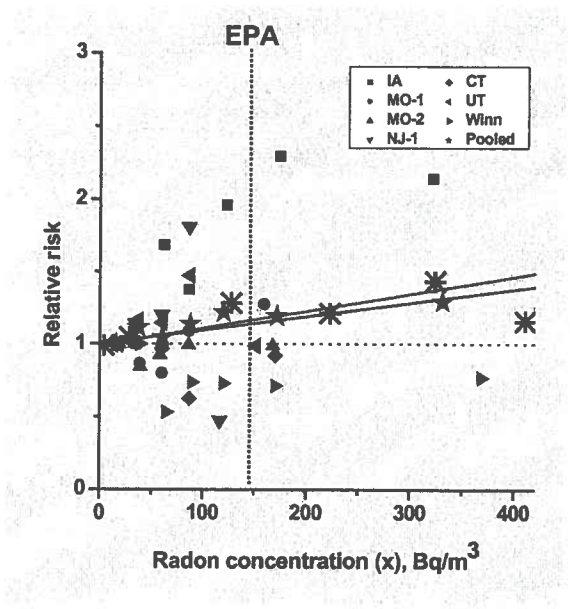


Krewski 2003, Lubin 2003

World Pooling Residential Radon Studies

	Cases	Controls
N Amer	4,108	5,301
China	1,076	2,015
Europe	8,652	15,856
Total	13,836	23,172

Comparison of North American Radon Studies with Miners



RR=1.2 at EPA Action Level

DCEG Studies of Indoor Pollution

- **Environmental tobacco smoke**
  - Missouri non-smoking women (1994)
  - Missouri women (1999)
  - Gansu study (2001)
- **Cooking fumes & oils (volatile organics, PAHs)**
  - Shanghai lung cancer study (1995)
  - Gansu lung cancer study (2001)
  - Shanghai Women's Cohort (75K)
- **Indoor pollution from coal use (PAHs, particulates)**
  - Shenyang lung cancer study (1990)
  - Gansu lung cancer study (2002)
  - Xuanwei & Fuyuan, China
- **Pesticide exposure**
  - childhood leukemia c/c study
  - NHL case-control study (pesticides, PAH, PCB)
- **Exposure to EM fields**
  - childhood leukemia c/c study (1998)
  - adult brain tumors c/c study (2001)