

RADIATION & CANCER



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Radiation and Tolerance

- **Killer Dose 40,000 mSv**
- **Tolerable Dose 20,000 mSv**
- **Maximum cumulative allowed : 100 mSv**

- **Effects are Deterministic (Threshold)**
- **Stochastic (Lineal, cumulative, No threshold)**

Medical uses of radiation - Diagnostic

- Almost all imaging tests use radiation
- X-rays, CT scans, angiograms etc
- Worldwide, approximately 330 radiological examinations are done per 1000 population
- Extremely useful for diagnosis of most diseases including cancer
- Radio-isotopes : Bones scan,
PET Scan,
Perfusion scans

Radiation & Cancer Outcome

- Uterine Cervical Cancer > 90% survival
- Laryngeal Cancer > 95% survival
- Ewing's sarcoma & Hodgkin's lymphoma melt away with radiotherapy
- Radiotherapy improves cure rates by 30% when added to Surgery & Chemotherapy

Radiation : Stochastic

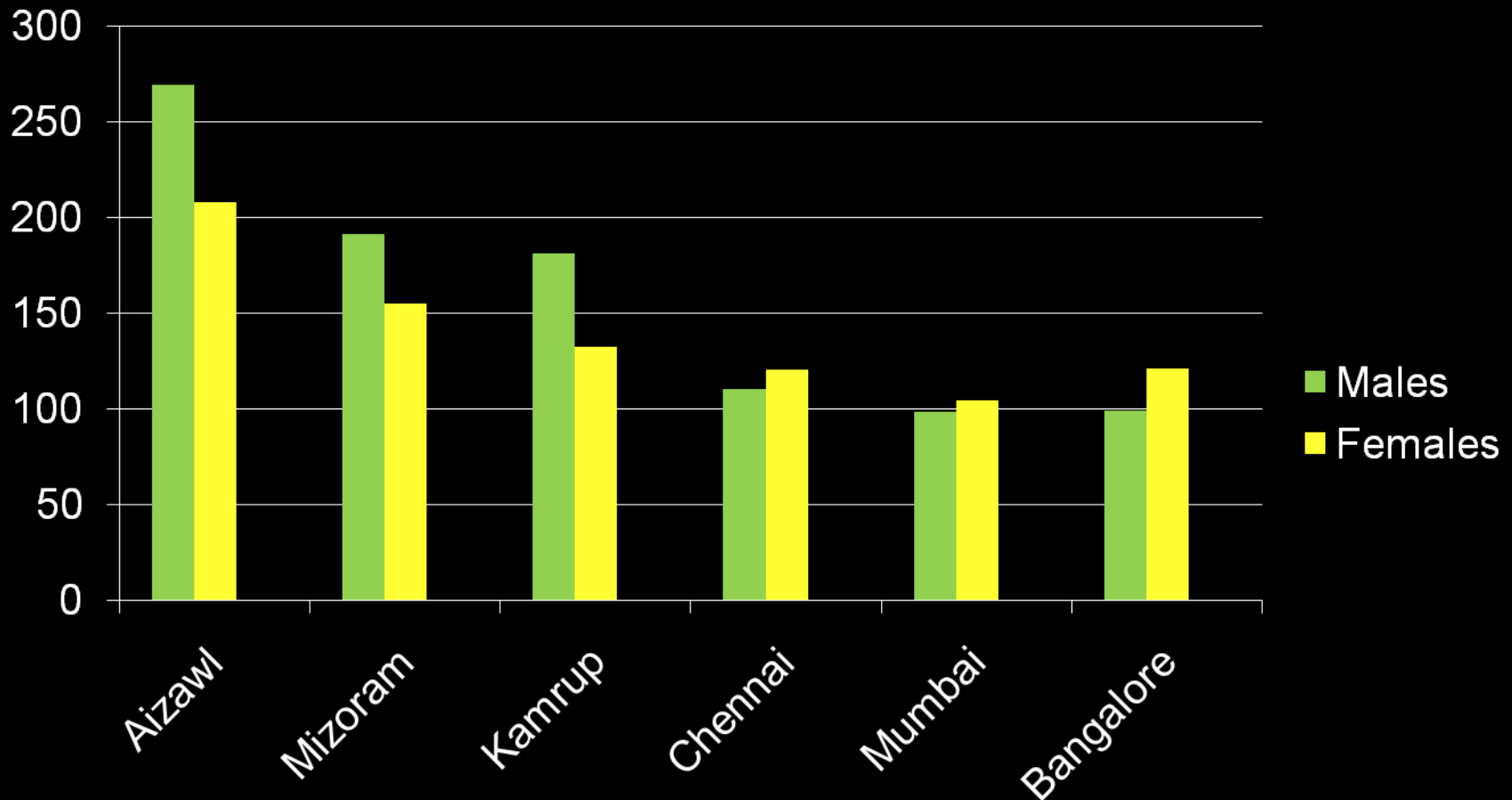
(Linear, Cumulative & no Threshold)

- **Natural radiation occurs from various sources**
 - **Earth, soil**
 - **Outer space**
- **Nuclear power plants and health issues**
 - **Cancer**
 - **Congenital anomalies**
 - **Accidents**

Radiation & Cancer

- Highest incidence in the north east
- No nuclear reactors in these states
- Incidence in Mumbai, Chennai, Bangalore, Ahmadabad and Delhi (cities with one or more nuclear reactors) – similar to other metropolitan cities with no reactors

Cancer incidence in India



Areas with no
nuclear reactors

Areas with 1/more
nuclear reactors

Karunagapally - Kerala

- High natural radiation
- Thorium sands
- Study conducted by Regional Cancer Centre, Trivandrum



**CANCER INCIDENCE IN RELATION TO OUTSIDE HOUSE
RADIATION LEVEL**

KARUNAGAPPALLY TALUK (2001-2004)



Out Rad. (mGy/yr)

Maximum 37.167

Range of

Median 1.835-3.059

AAR

M-122.1 F-86.9

Out Rad. (mGy/yr)

Maximum 76.475

Range of

Median 3.212-5.277

AAR

M-115.9 F-78.0

Out Rad. (mGy/yr)

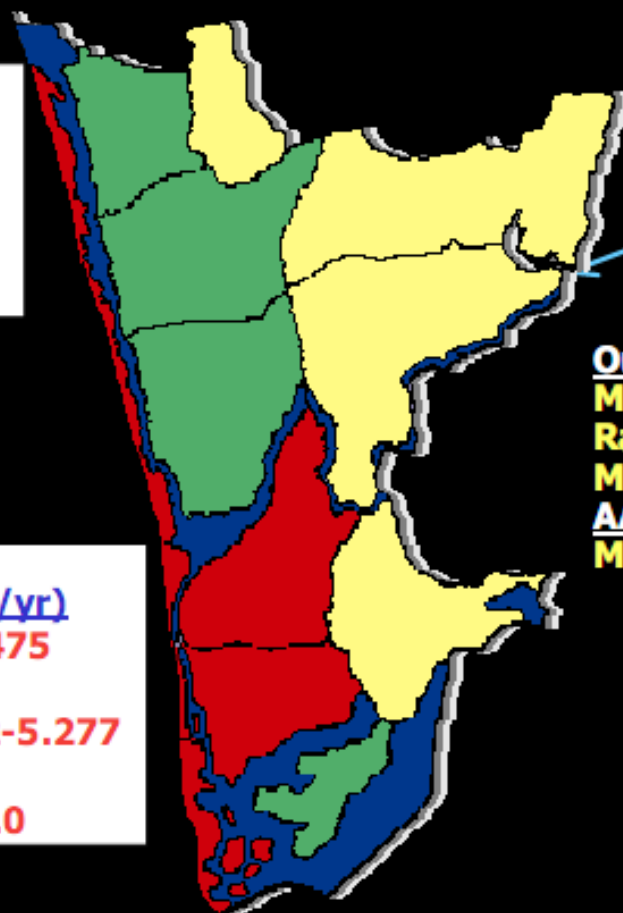
Maximum 29.825

Range of

Median 0.918-1.377

AAR

M-127.9 F-101.8



Eldorado (Canada) Uranium workers

- 17660 uranium workers followed for several decades
- Compared with general Canadian population
- Lower mortality rates from all causes and all cancers
- Lower incidence of cancers
- “healthy worker” effect?

French nuclear power plants

- Study conducted in 20 km radius of 29 nuclear installations in France
- Incidence rates comparable to national incidence rates as reference (cancer, cong. Anomalies, sterility)
- No increase in childhood Leukemia seen

Finnish nuclear power plants

- Three approaches
 - ecological analysis at municipality level
 - residential cohorts defined from census data
 - case-control analysis with individual residential histories
- Compared to normal Finnish population
- No increase in childhood leukemia or other cancers in areas next to the Finnish power plants

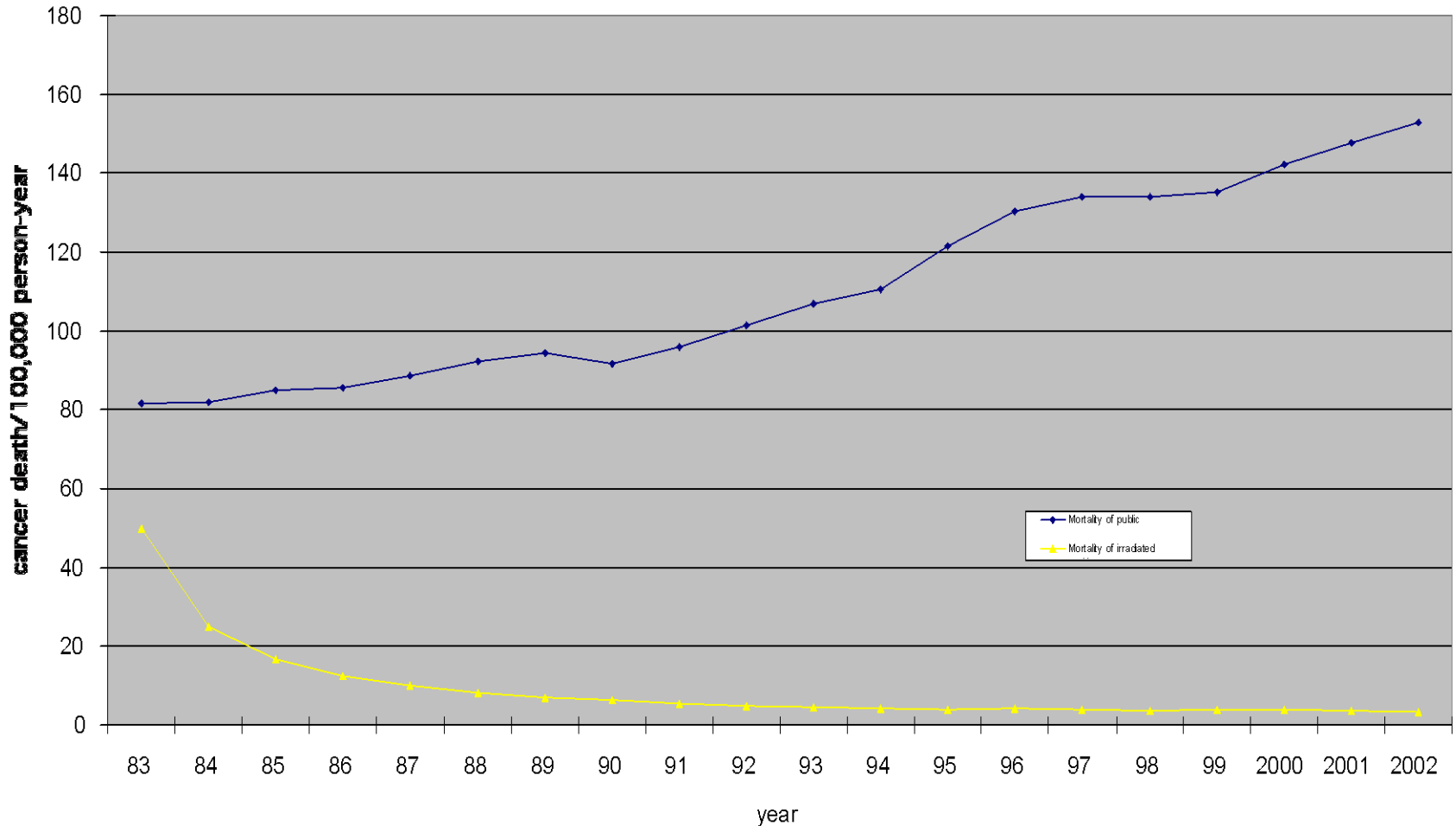
Finnish nuclear power plants - 2

- **15,619 Finnish nuclear reactor workers studied**
- **No increase in cancer incidence**
- **No association between cancer incidence and cumulative radiation dose**

Radiation exposure in Taiwan

- A Co-60 source was mixed in metal scrap, melted and drawn into steel bars which were used in the construction of 1700 apartments for about 10,000 residents in 1982-84.
- Residents were irradiated at least for 9 years, some up to 20 years
- Annual dose in the first year 1983 was from about 50 mSv/y, up to 600 mSv/y
- Total averaged dose started at 0.4 Sv, and went up to 6 Sv.

Taiwan – observed vs expected cancer deaths



Luan YC, et al. The true health effects of radiation

Taiwan incident - conclusions

- Chronic radiation exposure may actually be beneficial to humans
- Lower incidence of cancers compared to expected
- Lower incidence of congenital anomalies compared to expected.

ACCIDENTS

Fukushima



Chernobyl



ACCIDENTS : FACTS

Category	Fukushima Daiichi	Chernobyl
Related deaths	<i>No deaths so far due to radiation</i>	<i>A UN report places the total confirmed deaths from radiation at 64 as of 2008. Disputes continue about how many will eventually die</i>
Long-term health damage	Not yet known, but risks to human health are thought to be low	Among the residents of Belarus, the Russian Federation and Ukraine, there had been up to the year 2005 more than 6,000 cases of thyroid cancer reported in children and adolescents who were exposed at the time of the accident, and more cases can be expected during the next decades
Current status	Officials say radiation leaks are continuing and could eventually exceed those at Chernobyl. The priority is restoring adequate coolant to the fuel ponds and the reactors themselves	The damaged reactor is now encased in a concrete shell. A new containment structure is due to be completed by 2014

Why tame the Nuclear Power?

- Enslave technology to serve immortality
- We tame technology to improve
 - quality of life
 - Ratio of benefit to risk

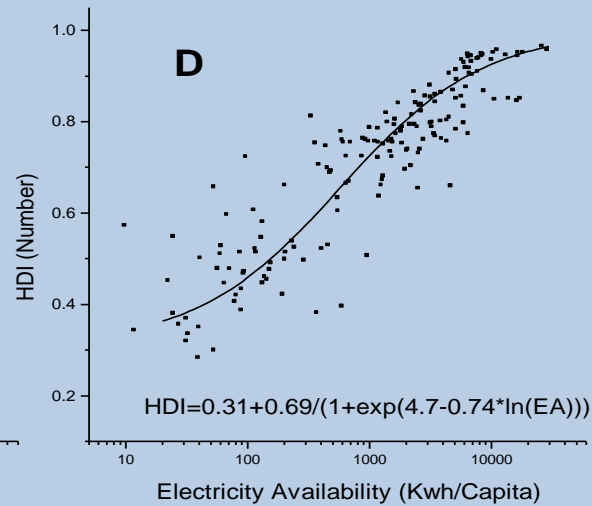
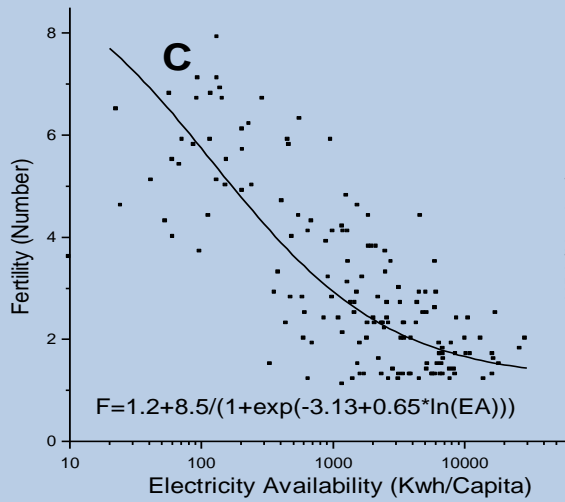
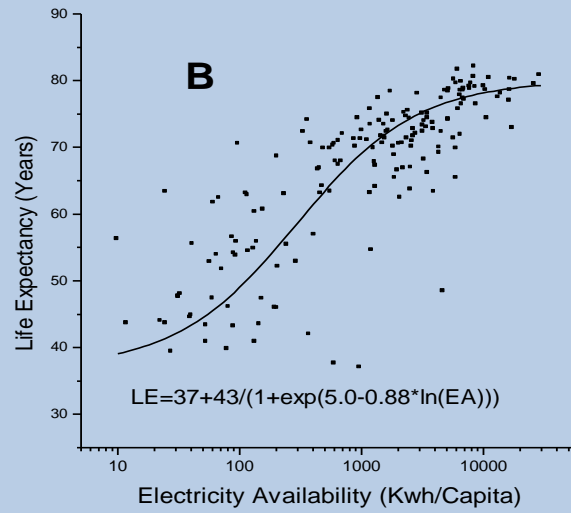
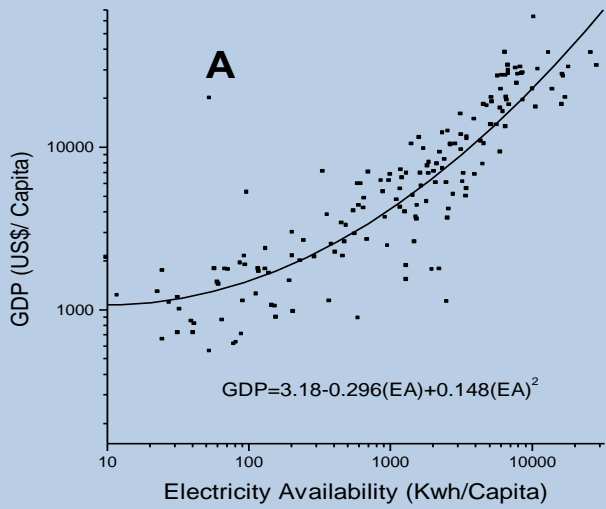


Figure 5. Correlation amongst Human Development Indicators

Continuous lines are the analytical fits for the scatter plots. Fit expressions are given near the X axis.

Worldwide Severe Accidents, Aggregate Fatalities and Normalized Fatalities for all Energy Options during 1969-2000

Energy Chain	No. of Accidents	Total Fatalities	Normalised Fatalities (per GWa)
Coal-global	1221	25107	0.876
Coal with China excluded	177	7090	0.690
Oil	397	20283	0.436
Natural Gas	125	1978	0.093
Hydro	11	29938	4.265
*Hydro-2	10	3938	0.561
Nuclear	1	33	0.06**

Nagasaki Before and after



Nagasaki Hypocenter



Chernobyl : Now



Thank you

