ANALYSIS OF THE POTENTIAL POPULATIONS AT RISK FROM THE CONSUMPTION OF FRESHWATER FISH CAUGHT NEAR PAPER MILLS

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April 23, 1990

INTRODUCTION:

OTS, OSW, and OW have conducted a detailed human and ecological risk assessment of environmental loadings of dioxin from bleached pulp and paper mills. In that analysis only maximum lifetime cancer risk and average lifetime cancer risk to the hypothetically exposed individual was estimated for various exposure scenarios. No estimation of potential population risk, especially to sensitive subgroups, was provided in the analysis. Since draft publication of these results, we have identified populations of Asians, and tribal Native Americans that reside along the banks of the Columbia River in Oregon. The State government indicates that there are eight bleached pulp and paper mills that directly discharge to the Columbia River. The State also indicates that freshwater fish caught from the Columbia river are the main source of animal protein for these people. They consume an average of 100 to 150 grams of fish flesh each day over the course of the year. These individuals are much more likely to catch and consume fish that has been contaminated with dioxin from the effluent discharged from the mills than other populations in the area. The Native Americans number about 15,000, and the Asians number about 30,000 people.

In addition to these subpopulations exposed by diet to dioxin, we have estimated that approximately 610,000 people living in the vicinity of pulp and paper mills have family incomes at or below the poverty level. These individuals are also expected to derive a significant portion of animal protein from both subsistence and sports fishing in rivers near paper mills. Subsistence fishermen consume about 100 grams of fish per day/[1], and sports fishermen consume about 69 grams fish per day/[2].

For purposes of the assessment of potential cancer risk, we have employed monitoring data of dioxin contamination in fresh water fish caught in the vicinity of bleached pulp and paper mills. This was developed by the Environmental Research Laboratory in Duluth Minnesota as part of the National Bioaccumulation Study of freshwater fish in the U.S. The range of detected TCDD equivalent concentration in the edible fish fillet was from 0.1 ppt - 24 ppt. The weighted average fillet concentration was 6.5 ppt (6.5 pg/gm). For purposes of estimating incremental lifetime cancer risk to the most exposed individual, a fillet concentration of 24 ppt was used. The weighted average dioxin concentration in the fillet of 6.5 ppt was used to derive the approximate average lifetime risk to subsistence and sports fishermen. The average exposure and average lifetime risk was used to estimate the annual cancer incidence in these sensitive subpopulations. In addition a human body weight of 70 kilograms was assumed to compute estimates of excess cancer risk.

CONCLUSIONS:

It is currently not possible to directly measure the association between the chronic dietary intake of dioxin contaminated freshwater fish, and the occurrence of specific forms of cancer in the exposed populations. The epidemiologic studies of these populations with a high dependency for subsistence fishing as a source of dietary animal protein have not been conducted. Therefore we have mathematically estimated lifetime excess cancer risk to the population residing near the Columbia River, as well as to low-income populations living in the vicinity of other mills in the U.S. This analysis is not intended to replace any previous risk assessments involving the human consumption of fish that has been contaminated with dioxin from the effluent discharged from paper mills, but is merely to illustrate that methodologies can be developed to estimate total populations at risk in the U.S.

The following are the results:

	Pop.	MIR[a]	AVG Risk[b]	Cancer Inc.[c]
Native Americans	15,000	8.6 X 10^{-3}	1.5 X 10^{-3}	0.33
Asian Americans	30,000	8.6 X 10^{-3}	1.5 X 10^{-3}	0.67
Total Risk	45,000	8.6 X10^{-3}	1.5X 10^{-3}	1.0
Low income families	610,000	5.4X 10^{-3}	1.0 X 10^{-3}	9.3

(a) MIR is the maximum individual risk, and is associated with the highest fish consumption rate and the highest dioxin concentration in fish caught near paper mills.

(b) Average lifetime cancer risk is the excess cancer risk based on the average fish consumption rate for subsistence and sports fishermen, and the weighted average dioxin concentration in fish caught near paper mills.

(c)Cancer incidence is the estimated number of cancer cases per year within the defined exposed population. This was computed using average lifetime risk.

1/ U.S. Environmental Protection Agency (1988). Risk Assessment for Dioxin Contamination Midland, Michigan. Region 5. EPA-905/4-88-005.

2/Estimated consumption by the U.S. Food and Drug Administration, assuming substitution of average U.S. population daily consumption of red meat with fish.

Calculations of Risk

1. Native Americans

Assumptions:

a. MEI consumes 150 gms fish/day.
b. Average consumption is 100 grms fish/day.
c. 70 kilogram person.
d. Lifetime exposure.
e. Max. dioxin concentration in fish fillet = 24 pg/gm.
f. Weighted average dioxin in fish fillet = 6.5 pg/gm.
g. Population of 15,000.
h. Risk Specific Dose of Dioxin = lifetime cancer risk of one in a million is: 0.006 pg/kg/day.

Max. Daily Dose= (150 gms/day X 24 pg/gm) / 70 kg person
= 51.43 pg dioxin/kg/day

MIR =[(51.43 pg/kg/day) / (0.006 pg/kg/day)] X 10^{-6}
MIR = 8.6 X 10^{-3}

Avg. Daily Dose= (100 gms/day X 6.5 pg/gm)/ 70 kg person
= 9.28 pg dioxin/kg/ day

Avg. lifetime risk = [(9.28 pg/day)/(0.006 pg/kg/day)] X 10-6
= 1.5 X 10^{-3}

Annual Cancer Incidence = (Avg risk * population)/ 70 year lifespan
= (1.5 X 10^{-3} * 15,000)/ 70 yrs
= 0.33

2. Asian Americans

Assumptions are the same as with Native Americans. The population size is 30,000.

Max. Daily Dose = 51.43 pg dioxin/kg/day.
MIR = 8.6×10^{-3}

Avg. Daily Dose = 9.28 pg dioxin/kg/day
Avg. lifetime risk = 1.5×10^{-3}

Annual Cancer Incidence = $(1.5 \times 10^{-3} * 30{,}000)/70$ yr lifespan
= 0.67

3. <u>Low income families.</u>

Assumptions:

a. MEI consumes 100 gms fish/day.
b. Average consumption is 69grms fish/day.
c. 70 kilogram person.
d. Lifetime exposure.
e. Max. dioxin concentration in fish fillet = 24 pg/gm.
f. Weighted average dioxin in fish fillet = 6.5 pg/gm.
g. Population of 610,000.
h. Risk Specific Dose of Dioxin = lifetime cancer risk of one in a million is: 0.006 pg/kg/day.

Max Daily Dose = (100 gms/day) X (24 pg dioxin/gm)/ 70 kg person
= 34.28 pg dioxin/kg/day

MIR = {(34.28 pg/kg/dy)/(0.006 pg/kg/dy)} $\times 10^{-6}$
= 5.7×10^{-3}

Avg. Daily Dose = (69 gms/day) X (6.5 pg/gm)/70 kg person
= 6.41 pg dioxin/kg/day

Avg. lifetime risk = { (6.41 pg/kg/dy)/(0.006 pg/kg/dy)} $\times 10^{-6}$
= 1.0×10^{-3}

Annual Cancer Incidence ={ $(1.0 \times 10^{-3}) * (610{,}000)$}/ 70 year lifespan
=9.3

The Bottom Line:

• The "Forest through the trees" is that the environmental loadings of dioxin from the mills may result in high levels of risk to humans.

• The analysis of the regulatory options suggests that this particular industrial source category fits the mold for a regulatory pollution prevention initiative through use of the CWA, TSCA, and RCRA.

* could require substantial reduction in the overall use of chlorine
* BACT seems to be oxygen delignification