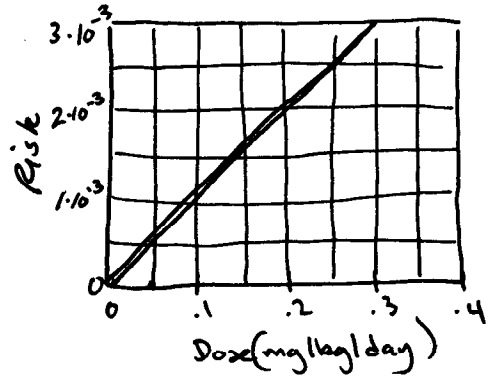
4.1 Carcinogenic VOC. dose-response shown. 70kg people; $20 m^3$/day air with 10^{-3} mg/m3 over 70 yrs. What is risk?



Potency = slope

$= \frac{0.001}{0.1 \text{ mg/kg/d}} = 0.01 (\text{mg/kg/d})^{-1}$

$= 1 \cdot 10^{-2}$ / mg/kg/d

$CDI \text{ (chronic daily intake)} = \frac{(10^{-3} \text{mg/m}^3)(20 \text{m}^3/\text{d})}{70 \text{kg}} = 0.000285 \text{ mg/kg/d}$

$\text{Risk} = CDI * \text{Potency} = (0.000285 \text{ mg/kg/d})\left(\frac{1 \cdot 10^{-2}}{\text{mg/kg/d}}\right) = 2.9 \cdot 10^{-6}$

∴ In a population of 1 million, you would expect (2.9 ≈ 3) 3 individuals to contract cancer from this exposure.

4.3 Rat data

	Tumor	No Tumor
Exposed	a: 30	b: 470
Not Exposed	c: 10	d: 290

$\text{Relative risk} = \frac{\frac{a}{a+b}}{\frac{c}{c+d}} = \frac{\frac{30}{500}}{\frac{10}{300}} = 1.8$

$\text{Attributable risk} = \frac{a}{a+b} - \frac{c}{c+d} = \frac{30}{500} - \frac{10}{300} = 0.0267$

$\text{Odds ratio} = \frac{ad}{bc} = \frac{(30)(290)}{(10)(470)} = 1.85$

Relative risk 1.8 suggest an association between exposure & risk (of tumors)

Attributable risk 0.03 suggest an association between exposure & risk, but value is small and may contract tumor from something else.

Odds ratio supports relative risk conclusion

8 Drinking water standard 2,3,7,8, TCDD $3 \cdot 10^{-8}$ mg/L

Use EPA exposure factors. Determine lifetime risk

Table 4.10

$$CDI = \frac{(2\ l/d)(3 \cdot 10^{-8}\ mg/L)(350\ d/yr)(30\ yr)}{70\ kg \cdot 365\ d/y \cdot 70\ yr} = 3.5 \cdot 10^{-10}\ mg/kg\ td$$

Potency – Table 4.9

$1.56 \cdot 10^{5}$

$$Risk = CDI \cdot Potency = 3.5 \cdot 10^{-10}\ mg/kg/d \cdot \frac{1.56 \cdot 10^{5}}{mg/kg/d} = 5.5 \cdot 10^{-5}$$

∴ In a population of one million would expect 55 excess cancers from Dioxin exposure.

4.15 Find conc. of various compounds meeting acceptable risk

a) benzene, oral, 10^{-5} risk, slope = $2.9 \cdot 10^{-2}$

$Risk = CDI \cdot Potency$

$10^{-5} = CDI \cdot 2.9 \cdot 10^{-2}$ → $CDI = \frac{10^{-5}}{2.9 \cdot 10^{-2}} = \frac{2\ L/d \cdot C\ mg/L \cdot 350\ d/yr \cdot 30\ yr}{70\ kg \cdot 365\ d/yr \cdot 70\ yr}$

solve for $C = 0.03\ mg/L$

b) TCE, risk = 10^{-6}, slope = $1.3 \cdot 10^{-2}$

Same approach

$C = 6.6 \cdot 10^{-4}\ mg/m^3$

c) benzene, air 10^{-5}, slope = $2.9 \cdot 10^{-2}$

Same approach

$C = 2.9 \cdot 10^{-4}\ mg/m^3$

d) Vinyl chloride in water, 10^{-4}, slope 2.3

Solve for $C = \frac{10^{-4} \cdot 70 \cdot 365 \cdot 70}{2 \cdot 350 \cdot 30 \cdot 2.3} = 3.7 \cdot 10^{-3}\ mg/L$

4.30 $10 \cdot 10^6$ people. 10^{-4} risk

$$\text{cancer rate} = \frac{(10 \cdot 10^6)(10^{-4})}{70\,\text{yr}} = 14.3 \text{ cancer/yr}$$

@ 10^{-5} risk = 1.43 cancer/yr.

∴ reducing risk "saves" 12.9 cancer/yr.

$$\text{cost:} \quad \frac{(\$/\text{yr})(10 \cdot 10^6)}{12.9} = \frac{\$0.77 \cdot 10^6}{\text{cancer avoided}} = \$770{,}000 \text{ per cancer.}$$