

Basic Course in Occupational and Environmental Medicine, Part III Orlando, Florida, October 30, 2011

Occupational Cancer Risk: Exposure and Assessment

Basic Epidemiology Course

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Occupational Cancer Refresher

- Carcinogens
- Types of cancer
- Numbers

EPA: 2005 Classifications

Group	Classifications
A	Carcinogen to humans
B	Likely to be carcinogen to humans
C	Suggestive evidence of carcinogenic potential
D	Inadequate information to assess carcinogen potential
E	Not likely to be carcinogenic to humans

EPA : Carcinogenic

Criteria	Definition
1	there is strong evidence of an association between human exposure and either cancer or the key precursor events of the agent's mode of action but not enough for a causal association, <i>and</i>
2	there is extensive evidence of carcinogenicity in animals, <i>and</i>
3	the mode(s) of carcinogenic action and associated key precursor events have been identified in animals, <i>and</i>
4	there is strong evidence that the key precursor events that precede the cancer response in animals are anticipated to occur in humans and progress to tumors, based on available biological information

OSHA: 29 CFR 1990

Category	Definition
I	The substance meets the definition of a potential occupational carcinogen in (1) humans, or (2) in a single mammalian species in a long-term bioassay where the results are in concordance with some other scientifically evaluated evidence of a potential carcinogenic hazard, or (3) in a single mammalian species in an adequately conducted long-term bioassay, in appropriate circumstances where the Secretary determines the requirement for concordance is not necessary.
II	The substance meets the criteria set forth in 1990.112(a), but the evidence is found by the Secretary to be only "suggestive", or the substance meets the criteria set forth in 1990.112(a) in a single mammalian species without evidence of concordance.

OSHA Regulated Carcinogens

- asbestos
- 4-Nitrobiphenyl
- alpha-Naphthylamine
- Methyl chloromethyl ether
- 3,3'-Dichlorobenzidine (and its salts)
- bis-Chloromethyl ether
- beta-Naphthylamine
- Benzidine
- 4-Aminodiphenyl
- Ethyleneimine
- beta-Propiolactone
- 2-Acetylaminofluorene
- 4-Dimethylaminoazobenzene
- N-Nitrosodimethylamine
- Vinyl chloride
- Inorganic arsenic
- Cadmium
- Benzene
- Coke oven emissions
- 1,2-dibromo-3-chloropropane
- Acrylonitrile
- Ethylene oxide
- Formaldehyde
- Methylenedianiline
- 1,3-Butadiene
- Methylene Chloride

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Preventing Exposure

- Levels of prevention in the workplace
 - Engineering controls
 - Work Practice controls
 - Administrative controls
 - Personal Protective Equipment (PPE)

Assessing Risk of Exposure

- Screening
 - Disease is serious, consequences are severe
 - Treatment is more effective in earlier stages
 - Detectable preclinical phase (DPCP)
 - DPCP is fairly long and prevalent
- Sensitivity
- Specificity

Assessing Risk of Exposure

- Personal risk assessment / Patient history
 - Occupations
 - Onset, Length
 - Chemicals / Processes
 - Carcinogenic?
 - Intensity of exposure
 - Other Explanations?

Assessment of the Exposed

- Observation
- Palpation
- Lab work
- Imaging
- Histology

Causality

- Hill's criteria
 - Strength of association
 - Consistency
 - Specificity
 - Temporality
 - Biological gradient
 - Plausibility
 - Coherence
 - Experiment
 - Analogy

Epidemiological Measures

- | MEASURES OF COMPARISON | ESTIMATES OF COMPARISON |
|--|--|
| <ul style="list-style-type: none">▪ Absolute Measures<ul style="list-style-type: none">▪ Risk Difference▪ Population Attributable Risk▪ Relative Measures<ul style="list-style-type: none">▪ Relative Risk | <ul style="list-style-type: none">▪ Odds Ratio |

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Two-by-two table

		Outcome		
		Present	Absent	
Exposure	Present	A	B	A+B
	Absent	C	D	C+D
		A+C	B+D	A+B+C+D

Risk Difference

- Excess risk associated with exposure
- $RD = R_e - R_u$
- $RD = a/(a+b) - c/(c+d)$
- Interpretation: The probability of disease is x% higher among the exposed group.

Risk Difference

- $RD = a/(a+b) - c/(c+d)$

		Renal Cell Carcinoma		
		Present	Absent	
Lead	Present	71	63	134
	Absent	916	1235	2151
		987	1298	2285

Relative Risk

- Increased/decreased risk of disease for exposed compared to unexposed
- $RR = R_e/R_u$
- $RR = \frac{a/(a+b)}{c/(c+d)}$
- Interpretation: The risk of disease among the exposed group is x times higher than among the unexposed.

Relative Risk

- $RR = \frac{a/(a+b)}{c/(c+d)}$

		Lung cancer		
		Present	Absent	
Male Sex	Present	305	4108	4413
	Absent	9	280	289
		314	4388	4702

Population Attributable Risk

- Reduction in incidence given the exposure was removed from the population
- $PAR = \frac{RR-1}{RR}$
- Interpretation: If the exposure was eliminated, x% of cases would be prevented.

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Population Attributable Risk

- $PAR = \frac{RR-1}{RR}$
- If $RR = 1.30$, calculate PAR.

Odds Ratio

- Increased/decreased risk of exposure for diseased compared to non-diseased
- $OR = \text{odds}_d / \text{odds}_u$
- $OR = ad/bc$
- Interpretation: The odds of being exposed are x times greater among the diseased compared to the non-diseased.

Odds Ratio

- $OR = ad/bc$

		NHL		
		Present	Absent	
TCE	Present	590	443	1033
	Absent	599	539	1138
		1189	982	2171

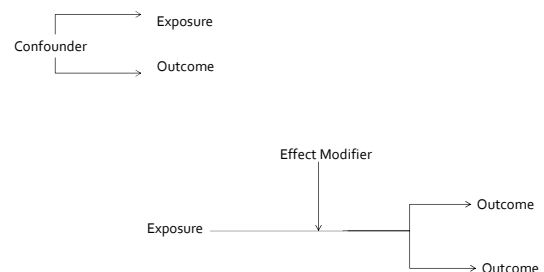
Why this, not that?

- | | |
|--|---|
| <ul style="list-style-type: none"> ▪ Relative Risk <ul style="list-style-type: none"> ▪ Temporality ▪ Prospective cohort ▪ Retrospective cohort ▪ Experimental | <ul style="list-style-type: none"> ▪ Odds Ratio <ul style="list-style-type: none"> ▪ No temporality ▪ Case-control ▪ Cross-sectional |
|--|---|

Why not everyone?

- Personal characteristics
 - Age, gender, genetics, immune response, etc.
- Habits
 - Smoking, drinking
- Dose
- Timing
- Other
 - medications

Confounding vs. Effect Modification



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Questions



xkcd.com