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National Institute for Occupational Safety and Health

An overview of occupational health surveillance in the United States: an evolving system of systems

Un aperçu de la surveillance en santé au travail aux États-Unis : une organisation de systèmes en évolution

Sara E. Luckhaupt, MD, MPH

Jacek Mazurek, MD, MS, PhD

Presented at Journées annuelles de santé publique
December 4, 2018
Montréal, Québec

Objectives

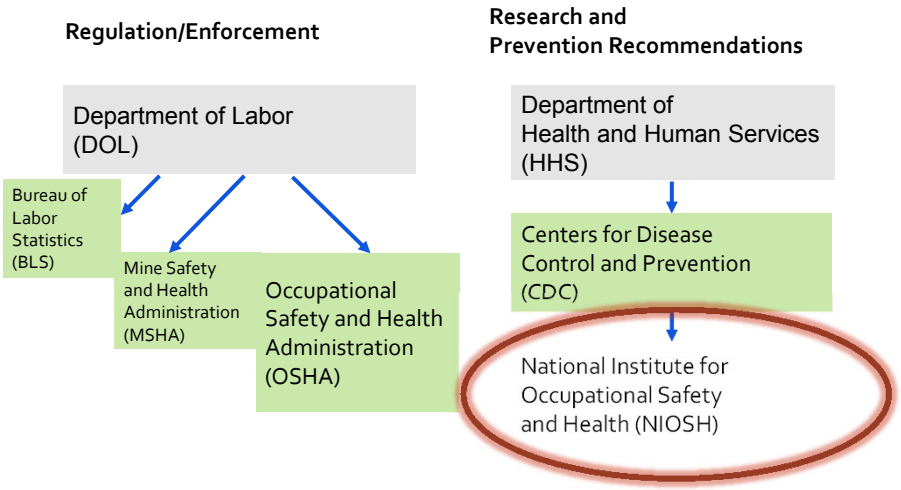
Dr. Luckhaupt

1. **Summarize** data sources used for occupational health surveillance in the US
2. **Describe** 3 different approaches to surveillance of chronic disease among workers
3. **Demonstrate** how to find US worker health data online

Dr. Mazurek

1. **Describe** the approach to surveillance of occupational lung disease in the US
2. **Describe** epidemiology and trends in mesothelioma mortality in the US

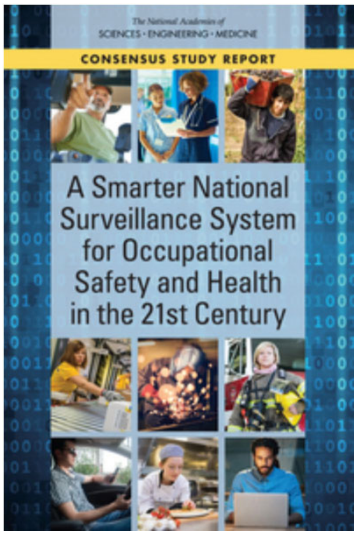
U.S. Occupational Safety & Health Framework: Federal Agencies



Recent Review of Occupational Health Surveillance in the US

- Coordinated by the National Academies of Sciences, Engineering, and Medicine (NASEM)
- Released in January, 2018

"The committee's vision for the future of OSH surveillance is a collaborative system of systems." (p. 5)



Data Sources for Occupational Health Surveillance

- Case reports of reportable conditions
  - From clinicians to state health departments (to NIOSH)
  - Limited set of conditions, which vary by state
    - Examples: Lead poisoning, Pesticide poisoning, Work-related asthma, Silicosis
- Employer records
  - OSHA recordable injuries and illnesses → BLS Annual Survey
  - Fatalities

Data Sources for Occupational Health Surveillance (cont.)

- Workers Compensation claims
  - Each state has a different system
- Medical and vital records
  - E.g., death certificates, disease registries, audiograms
- Surveys
  - Population-based (e.g., National Health Interview Survey)
  - Industry-specific (e.g., NIOSH Long-Haul Truck Driver Survey)

NIOSH Surveillance Program

- The NIOSH surveillance program performs and supports surveillance of:
  - Cases of deaths, injuries, illnesses, and hazards known to be related to work
  - Patterns of deaths, injuries, illnesses, and health behaviors among different groups of workers that suggest occupational risk factors

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How Many Deaths, Injuries, Illnesses *known to be related to work* Occur each Year?

According to the Bureau of Labor Statistics (BLS), each year, there are:

- ~5,000 deaths due to fatal traumatic occupational injuries
- ~3 million non-fatal occupational injuries and acute illnesses

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But what about work-related chronic diseases?

Estimating the Burden of Work-related Chronic Diseases

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Estimating the Burden of Work-related Chronic Diseases

- In the US, there is no single national surveillance system that collects data on cases of all work-related chronic diseases
  - So, we need to pull together data from various sources
- There are few diseases for which 100% of cases are attributable to work (exception=pneumoconiosis)
  - So, one way to estimate burden is to combine multiple pieces of information for each disease

Surveillance of Chronic Disease among Workers

- Approach #1
  - Estimate the burden of work-related chronic diseases based on:
    - Disease Incidence in the population
    - Occupational Attributable Fractions, based on:
      - Population prevalence of occupational exposure
      - RR for exposure

List of Chronic Diseases

known to be related to work (at least some of the time)

Cancer

- Lung (& bronchus)
- Mesothelioma
- Bladder
- Leukemia
- Laryngeal
- Melanoma (skin)
- Sinonasal & nasopharynx
- Kidney (& renal pelvis)
- Liver

Non-cancer

- Pneumoconiosis
- Asthma
- COPD
- Tuberculosis
- Coronary Heart Disease
- Hepatitis B
- Hepatitis C
- Hearing Loss

List of Chronic Diseases

known to be related to work (at least some of the time)

Cancer

- Lung (& bronchus): 5-10%
- Mesothelioma: 75-98%
- Bladder: <1%
- Leukemia: 2%
- Laryngeal: 1-3%
- Melanoma (skin): 3-8%
- Sinonasal & nasopharynx: 12-19%
- Kidney (& renal pelvis): <1%
- Liver: <1%

Non-cancer

- Pneumoconiosis: 100%
- Asthma: 11-26%
- COPD: 22%
- Tuberculosis: 5%
- Coronary Heart Disease: 8-21%
- Hepatitis B: <1%
- Hepatitis C: <1%
- Hearing Loss: 2-11%

Attributable fraction (AF): based on % of population exposed and relative risk (RR)

Calculation of Cases Attributable to Work

of cases of *Disease A* attributable to work =

Proportion of cases of *Disease A* that is caused by a particular exposure or risk factor (Attributable Fraction (AF))

X

Total number of cases of *Disease A* occurring in the population

Calculation of Cases Attributable to Work

Example: Coronary Heart Disease (CHD) attributable to work stress

# of cases of *CHD* attributable to work =

Attributable Fraction (AF): 4.0 to 9.7%

X

Total number of cases of *CHD* occurring in the population:

533,022 (age 20-69)

= 21,321 to 51,703

How Many Deaths, Injuries, Illnesses *known to be related to work* Occur each Year?

According to the Bureau of Labor Statistics (BLS), each year, there are:

- ~5,000 deaths due to fatal traumatic occupational injuries
- ~3 million non-fatal occupational injuries and acute illnesses

And NIOSH estimates that there are an additional:

- ~450,000-700,000 new cases of work-related chronic disease

Limitations to Burden Estimates

- Based on a limited number of conditions (17) that have strong evidence of associations with specific occupational exposures

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Limitations to Burden Estimates

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- Difficult to account for interactions between occupational and personal risk factors

Another Approach to Studying Chronic Disease among Workers

- The NIOSH surveillance program performs and supports surveillance of:
  - Cases of deaths, injuries, illnesses, and hazards known to be related to work
  - Patterns of deaths, injuries, illnesses, and health behaviors among different groups of workers that suggest occupational risk factors

Surveillance of Chronic Disease among Workers

- Approach #2
  - Explore patterns in deaths from various causes among different groups of workers using vital records
    - National Occupational Mortality Surveillance (NOMS)

National Occupational Mortality Surveillance (NOMS)

- **Objective:** Identify diseases that may be related to work because a higher proportion of deaths occur in a certain group of workers than expected
  - Measure of association = Proportionate mortality ratio (PMR)

National Occupational Mortality Surveillance (NOMS)

- **How:** Collect, code, and analyze death certificate data that include Industry and Occupation and Cause of Death
  - **Partners:** State Vital Statistics offices, National Center for Health Statistics (part of the CDC)
  - **Years of data available:** 1999, 2003–2004, 2007–2013
  - **State participation:** varies from year to year (10-19 states/yr)

NOMS Data Access

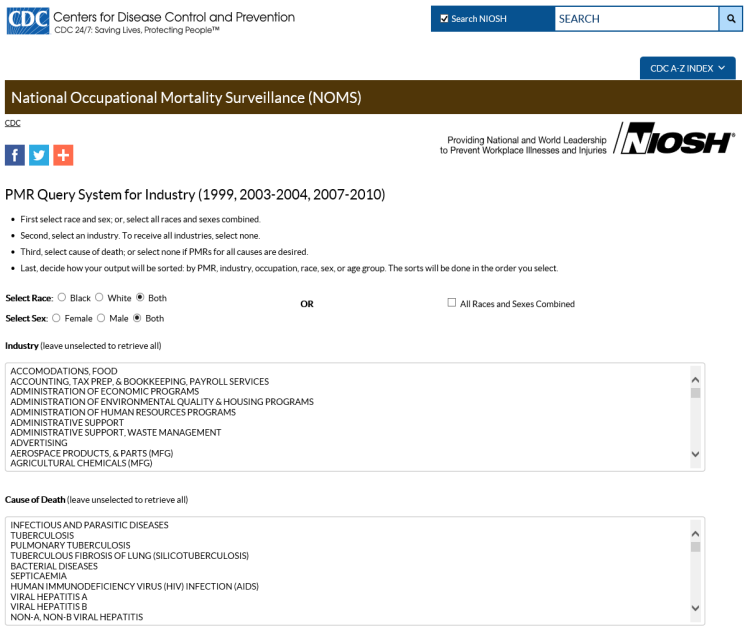
- NOMS Query website:

https://www.cdc.gov/niosh/topics/noms/query.html

PMRs available for:

- –308 Industry groups
- –487 Occupation groups
- –243 Causes of death (ICD-10 categories)

- Special analyses upon request



Example of Output from NOMS Query Site

PMRs for deaths due to lung cancer

PMR>100= higher than expected

All Races/Sexes Combined	18-90	LOGGING [0]027, [8]230, [9]230	MN TRACHEA, BRONCHUS AND LUNG [0]C33-C34, [9]162	115	572	p<0.01	106	125
All Races/Sexes Combined	18-90	FISHING, HUNTING, & TRAPPING [0]028, [8]031, [9]032	MN TRACHEA, BRONCHUS AND LUNG [0]C33-C34, [9]162	125	267	p<0.01	110	140
All Races/Sexes Combined	18-90	MINING (EXC OIL AND GAS EXTRACTION) [0]038-039, 047-049, [8]040-041, 050, [9]040-041, 050	MN TRACHEA, BRONCHUS AND LUNG [0]C33-C34, [9]162	122	2751	p<0.01	118	126
All Races/Sexes Combined	18-90	METAL MINING [0]039, [8]040, [9]040	MN TRACHEA, BRONCHUS AND LUNG [0]C33-C34, [9]162	98	234		86	111
All Races/Sexes Combined	18-90	COAL MINING [0]038, [8]041, [9]041	MN TRACHEA, BRONCHUS AND LUNG [0]C33-C34, [9]162	131	1549	p<0.01	126	137
All Races/Sexes Combined	18-90	OIL AND GAS EXTRACTION [0]037, [8]042, [9]042	MN TRACHEA, BRONCHUS AND LUNG [0]C33-C34, [9]162	107	1106	p<0.05	101	113

Surveillance of Chronic Disease among Workers

- Approach #3
  - Explore patterns in various health outcomes among different groups of workers through population-based surveys
    - E.g., National Health Interview Survey (NHIS)

US Worker Health Data Available Online

- Link: https://wwwn.cdc.gov/Niosh-whc/

NIOSH Worker Health Charts

WORKER HEALTH CHARTS

Promoting productive workplaces through safety and health research NIOSH

CDC > NIOSH

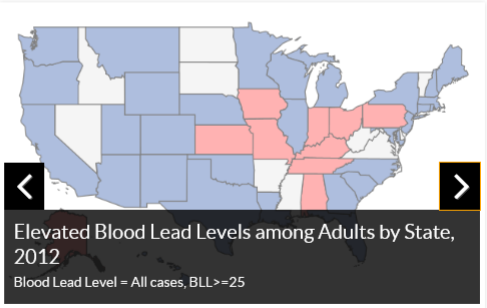
Overview

Using worker health information gathered by NIOSH and the Bureau of Labor Statistics, here you can create your own charts to assess current rates, distribution, and trends in workplace injuries, illnesses and deaths. Click here to learn more about data sources.

Worker Health Charts (WHC) make data exploration easier and more efficient.

WHC is unique because it allows quick analysis of work-related safety and health data that may be difficult to find or are not charted elsewhere. To get started, click on one of the data sources below.

If you have questions about using WHCs, the data sets, or the charts you produce, please contact us at: WHC.niosh@cdc.gov



Exposures
- Acute Pesticide-Related Illnesses
- Elevated Blood Lead Levels
- General Exposures(NHIS-OHS)
- Psychosocial Occupational Exposures(NHIS-OHS)

Health and Safety Behaviors
- Health Behaviors (BRFSS)
- Health Behaviors (NHIS)
- Workplace Health Promotion(NHIS-OHS)

Health Status
- Health Status (BRFSS)
- Health Status and Physical Activity Limitations (NHIS)
- Healthcare Utilization/Access (BRFSS)
- Healthcare Utilization/Access (NHIS)

Illnesses and Conditions
- All Nonfatal Injuries & Illnesses
- Carpal Tunnel Syndrome(NHIS-OHS)
- Chronic Conditions (BRFSS)
- Chronic Conditions (NHIS)
- Low Back Pain(NHIS-OHS)
- Musculoskeletal Health (BRFSS)
- Musculoskeletal Health (NHIS)
- Severe Nonfatal Injuries & Illnesses

Injuries
- All Nonfatal Injuries & Illnesses
- Fatal Injuries
- Severe Nonfatal Injuries & Illnesses

Working Conditions and Employment Benefits
- Work Organization(NHIS-OHS)
- Working Conditions and Employment Benefits (NHIS)

U.S. Workforce
- Workforce Population

Charts by Data Sources
- Behavioral Risk Factor Surveillance System (BRFSS), 2013-2015
- Bureau of Labor Statistics (BLS)
- National Health Interview Survey (NHIS), 2004 - 2013
- NHIS Occupational Health Supplement (NHIS-OHS), 2015
- Adult Blood Lead Epidemiology & Surveillance (ABLES)
- Sentinel Event Notification System for Occupational Risk (SENSOR)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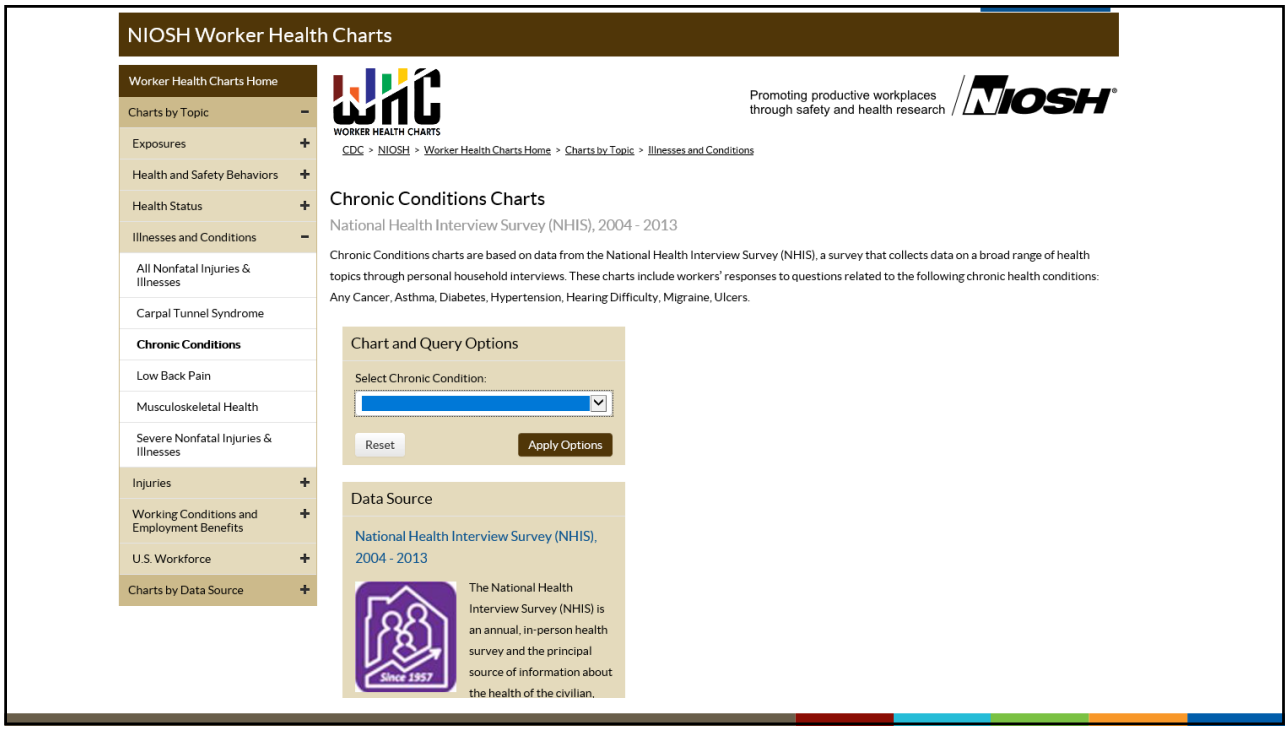
NIOSH Worker Health Charts
Worker Health Charts Home
Charts by Topic
Exposures
Health and Safety Behaviors
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Carpal Tunnel Syndrome
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U.S. Workforce
Charts by Data Source
WORKER HEALTH CHARTS
Promoting productive workplaces through safety and health research
NIOSH
CDC > NIOSH > Worker Health Charts Home > Charts by Topic > Illnesses and Conditions
Chronic Conditions Charts
National Health Interview Survey (NHIS), 2004 - 2013
Chronic Conditions charts are based on data from the National Health Interview Survey (NHIS), a survey that collects data on a broad range of health topics through personal household interviews. These charts include workers' responses to questions related to the following chronic health conditions: Any Cancer, Asthma, Diabetes, Hypertension, Hearing Difficulty, Migraine, Ulcers.
Chart and Query Options
Select Chronic Condition:
Reset
Apply Options
Data Source
National Health Interview Survey (NHIS), 2004 - 2013
Since 1957
The National Health Interview Survey (NHIS) is an annual, in-person health survey and the principal source of information about the health of the civilian.

Chronic Conditions Charts

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Chart and Query Options

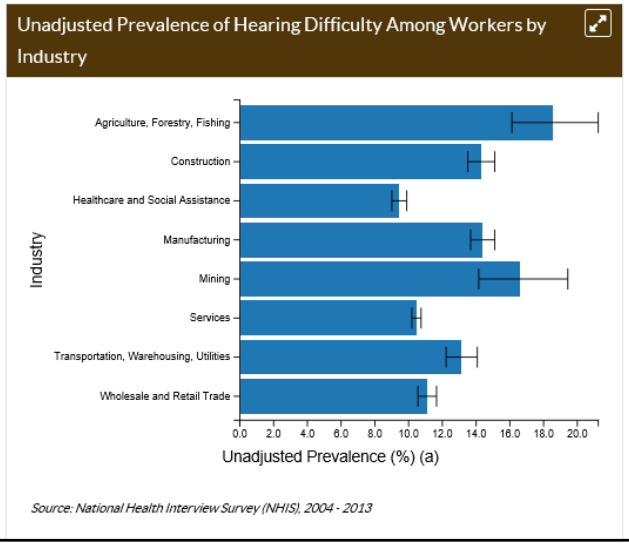
Select Chronic Condition: Hearing Difficulty

Select Chart: Prevalences by Industry

Select Value to Chart: Unadjusted Prevalence

Industry Drilldown:

Reset | Apply Options



Source: National Health Interview Survey (NHIS), 2004 - 2013

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Select Chart: Prevalences by Industry

Select Value to Chart: Unadjusted Prevalence

Industry Drilldown:

Reset | Apply Options

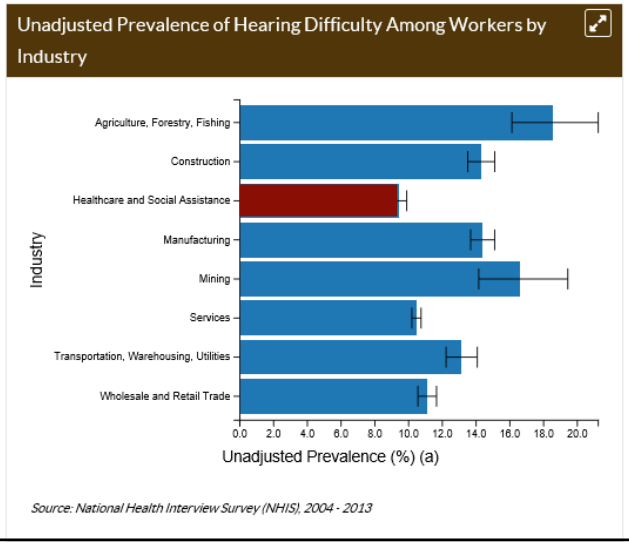

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Chart and Query Options

Select Chronic Condition:

Hearing Difficulty

Select Chart:

Prevalences by Industry

Select Value to Chart:

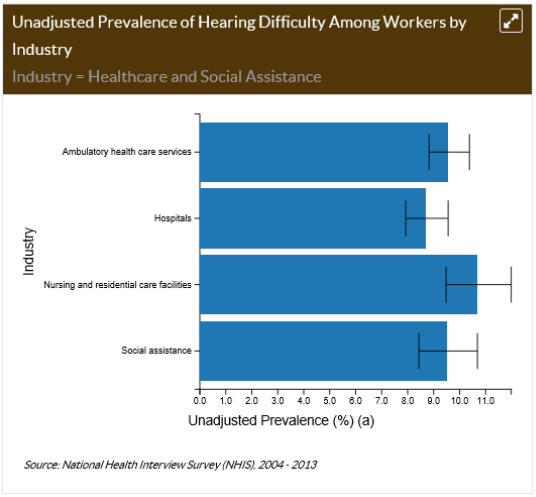
Unadjusted Prevalence

Industry Drilldown:

Healthcare and Social Assistance

Reset

Apply Options



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Conclusions

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- Few occupational diseases are reportable
- Few chronic diseases are 100% attributable to occupation
- NIOSH uses many different approaches to estimate the burden of work-related health conditions
- Many of the worker health estimates we generate are available online

Acknowledgements & Contact Info

- Marie Haring Sweeney
- Matthew Groenewold
  - And the rest of the Burden study team
- Andrea Steege
  - And the rest of the NOMS team
- Toni Alterman
  - And the rest of the NHIS team
- Rebecca Tsai & Jun Ju
  - And the rest of the WHC team

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Extra Slides

Calculation of Cases Attributable to Work

of cases of *Disease A* attributable to work =

Proportion of cases of *Disease A* that is caused by a particular exposure or risk factor (Attributable Fraction (AF))

X

Total number of cases of *Disease A* occurring in the population

Calculation of Attributable Fraction (AF)

Proportion of cases of *Disease A* that is caused by a particular exposure or risk factor (AF) =

Proportion of the general population with a particular occupational exposure (associated with *Disease A*)

X

Relative risk of *Disease A* (Risk in the exposed/risk in the unexposed (RR))

Calculation of Attributable Fraction (AF)

Example: Coronary Heart Disease (CHD) attributable to work stress

Proportion of cases of *CHD* that is caused by work stress (AF) =

Proportion of the general population with work stress: 31.7%

X

Relative risk of *CHD* (Risk in the exposed/risk in the unexposed (RR)): 1.13 to 1.34

= 4.0 to 9.7%

Calculation of Cases Attributable to Work

Example: Coronary Heart Disease (CHD) attributable to work stress

# of cases of *CHD* attributable to work =

Attributable Fraction (AF): 4.0 to 9.7%

X

Total number of cases of *CHD* occurring in the population: 533,022 (age 20-69)

= 21,321 to 51,703

Attributable Fraction (AF)

$$AF = \frac{P(E)(RR-1)}{1+P(E)(RR-1)}$$

where P(E) is the proportion of the general population with a particular occupational exposure and RR is the relative risk of disease (i.e., risk in the exposed/risk in the unexposed).

List of Chronic Diseases

known to be related to work (at least some of the time)

Cancer

- Lung (& bronchus): Arsenic, asbestos, chromium, diesel, ETS, nickel, PAHs, radon
- Mesothelioma: Asbestos
- Bladder: beta-naphthlamine, o-Toluidine
- Leukemia: Benzene, 1,3 butadiene, ionizing radiation
- Laryngeal: Acid mists, asbestos
- Melanoma (skin): Solar radiation
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- Kidney (& renal pelvis): Trichloroethylene
- Liver: Vinyl chloride

Non-cancer

- Pneumoconiosis
- Asthma: Asthmagens
- COPD: Vapors, gas, dust, & fumes
- Tuberculosis: Contact with TB-infected person, silica
- Coronary Heart Disease: ETS, noise, shiftwork, work stress
- Hepatitis B: Needlestick injury
- Hepatitis C: Needlestick injury
- Hearing Loss: Noise