OCCUPATIONAL LUNG DISEASE: OVERVIEW, RISK ASSESSMENT, DIAGNOSIS

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OCCUPATIONAL LUNG DISEASE

- NONMALIGNANT
- AIRWAYS DISEASE
- INTERSTITIAL LUNG DISEASE

  PULMONARY FIBROSIS

  USUAL INTERSTITIAL PNEUMONIA (UIP)

  HYPERSENSITIVITY PNEUMONITIS

  GRANULOMATOUS LUNG DISEASE

OCCUPATIONAL LUNG DISEASE

- MALIGNANT
- LUNG CANCER
- LARYNGEAL CANCER
- PLEURAL CANCER

  MALIGNANT MESOTHELIOMA

OCCUPATIONAL VS. NONOCCUPATIONAL LUNG DISEASE

- HOW DO YOU TELL THE DIFFERENCE?

- YOU TAKE AN OCCUPATIONAL HISTORY.

BERNARDINO RAMAZZINI

- *DE MORBIS ARTIFICUM DIATRIBA* 1713

- AIRWAYS DISEASE
- PNEUMOCONIOSIS
- CANCER

BERNARDINO RAMAZZINI

From the *Opera Omnia*, Geneva, 1717

IMPORTANCE OF THE OCCUPATIONAL HISTORY

- ESSENTIAL TO THE DIAGNOSIS OF OCCUPATIONAL DISEASE
- NATURE AND TYPE OF THE EXPOSURES
- INTENSITY OF EXPOSURE
- DURATION
- TEMPORAL ASSOCIATION WITH EXPOSURES
- LATENCY
- USE OF RESPIRATORY PROTECTION

OCCUPATIONAL LUNG DISEASE

- AIRWAYS DISEASE
- OCCUPATIONAL ASTHMA
- OCCUPATIONALLY-AGGRAVATED ASTHMA

- CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)
- CHRONIC BRONCHITIS

OCCUPATIONAL LUNG DISEASE: AIRWAYS DISEASE

OCCUPATIONAL ASTHMA

THE MOST COMMON CAUSE OF OCCUPATIONAL LUNG DISEASE IN *DEVELOPED* COUNTRIES.

- OCCUPATIONAL ASTHMA OFTEN GOES UNRECOGNIZED.

- OCCUPATIONAL ASTHMA SHOULD BE SUSPECTED IN EVERY NEW CASE OF ADULT-ONSET ASTHMA.

WORK-RELATED ASTHMA

- WORK-RELATED ASTHMA (WRA)

- OCCUPATIONAL ASTHMA
- OCCUPATIONALLY-AGGRAVATED ASTHMA

- SENSITIZER-INDUCED OA
- IRRITANT-INDUCED OA

Tarlo SM et al. Chest 2008;134:1S-41S.

OCCUPATIONAL ASTHMA: CATEGORIES

- OCCUPATIONAL ASTHMA WITH LATENCY
- ASTHMA CAUSED BY SENSITIZERS
  HMW, LMW, METALS
- OCCUPATIONAL ASTHMA WITHOUT LATENCY
- ASTHMA CAUSED BY IRRITANTS – NO LATENCY

- TEMPORAL ASSOCIATIONS WITH EXPOSURE

CHAN-YEUNG M, MALO J-L. NEJM 1995;333:107-111.

OCCUPATIONAL ASTHMA: DIAGNOSIS

- DIAGNOSIS OF ASTHMA
- RESPIRATORY SYMPTOMS
- SPIROMETRY
- POSITIVE BD RESPONSE:
- INCREASE FEV1 $\geq$ 200 ML AND $\geq$ 12%, AND/OR
- POSITIVE NONSPECIFIC INHALATION CHALLENGE
- SUPPORTIVE OCCUPATIONAL HISTORY
- TEMPORAL ASSOCIATION WITH EXPOSURE(S): KEY

OCCUPATIONAL LUNG DISEASE: AIRWAYS DISEASE

- CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)
- DEFINITIONS*
- SPIROMETRY-BASED: POST-BD FEV1/FVC < 0.70
- SYMPTOM-BASED: CHRONIC BRONCHITIS
- SELF-REPORTED MD DIAGNOSIS: CHRONIC BRONCHITIS, EMPHYSEMA, OR COPD

*EISNER MD ET AL. OFFICIAL STATEMENT. AJRCCM 2010;182:693-718.

OCCUPATIONAL LUNG DISEASE: COPD

- COPD
- RISK FACTORS:
- SMOKING
- VAPORS, GASES, DUSTS, FUMES (VGDF)

  ALONE

  TOGETHER WITH SMOKING

  ALPHA-1-ANTITRYPSIN DEFICIENCY

COPD: EPIDEMIOLOGY

- POPULATION ATTRIBUTABLE FRACTION (PAF) SMOKING:
- MAJORITY OF ESTIMATES LESS THAN 80%*
- PAF WORKPLACE EXPOSURE TO VAPORS GASES DUSTS FUMES (VGDF):
- OVERALL: 15% – 19.2%**

*EISNER MD ET AL. AJRCCM 2010;182;693-718

**HNIZDO E ET AL. AM J EPIDEMIOL 2002;156:738-746

**ATS STATEMENT. AM J RESPIR CRIT CARE MED 2003;167:787-797

VGDF, SMOKING, AND COPD

SYNERGY

OCCUPATIONAL LUNG DISEASE: COPD

- INTERACTIVE EFFECTS OF VGDF AND SMOKING ON COPD RISK:*
- STUDY OF 1202 SUBJECTS AGES 40-65 WITH COPD
- OCCUPATIONAL HISTORY, SPIROMETRY
- ODDS RATIO (OR) VGDF: 1.98, 95% CI 1.26-3.09
- OR EVER SMOKER: 6.41, 95% CI 4.58-9.82)
- OR VGDF + SMOKER: 14.1, 95% CI 9.33-21.2)

*BLANC PD ET AL. THORAX 2009;64:6-12.

OCCUPATIONAL LUNG DISEASE: COPD

- EDITORIAL, MS JAAKKOLA*
- *SMOKE AND DUST GET IN YOUR EYES: WHAT DOES IT MEAN IN THE WORKPLACE?*
- "IT SEEMS CLEAR THAT BEING A SMOKER CAN NO MORE MEAN THAT THE INDIVIDUAL DOES NOT HAVE OCCUPATIONAL COPD, AS SMOKERS APPEAR TO BE AT AN EVEN HIGHER RISK OF DEVELOPING WORK-RELATED COPD THAN NON-SMOKERS."

*JAAKKOLA MS. THORAX 2009;64:1-2.

OCCUPATIONAL LUNG DISEASE: COPD

- DIAGNOSIS
- RESPIRATORY SYMPTOMS: SHORTNESS OF BREATH, COUGH, PHLEGM, WHEEZE
- SPIROMETRY:
- POST-BRONCHODILATOR FEV1/FVC < 0.70
- EMPHYSEMA: LOW DLCO
- OCCUPATIONAL COPD: SUPPORTIVE OH

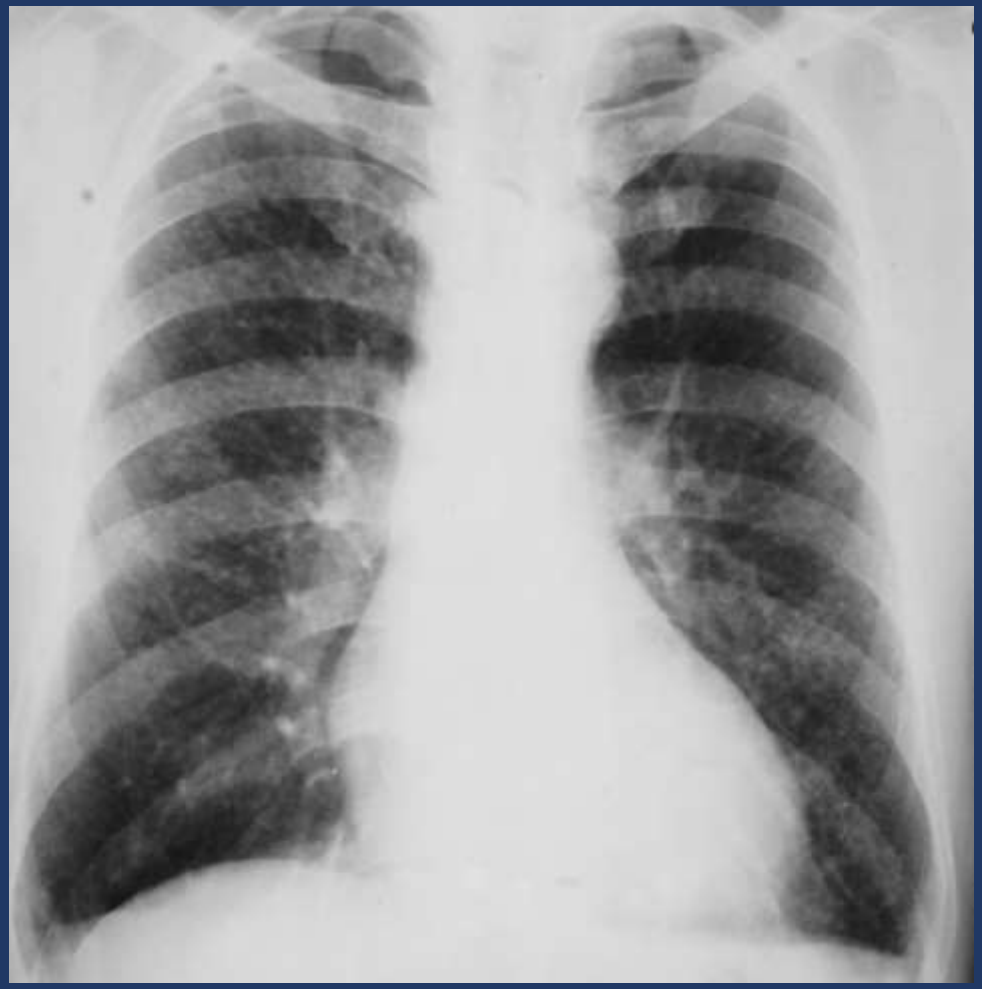
OCCUPATIONAL LUNG DISEASE

- INTERSTITIAL LUNG DISEASE
- PULMONARY FIBROSIS
- PNEUMOCONIOSES
- SILICOSIS
- ASBESTOSIS
- COAL WORKERS' PNEUMOCONIOSIS
- TALCOSIS

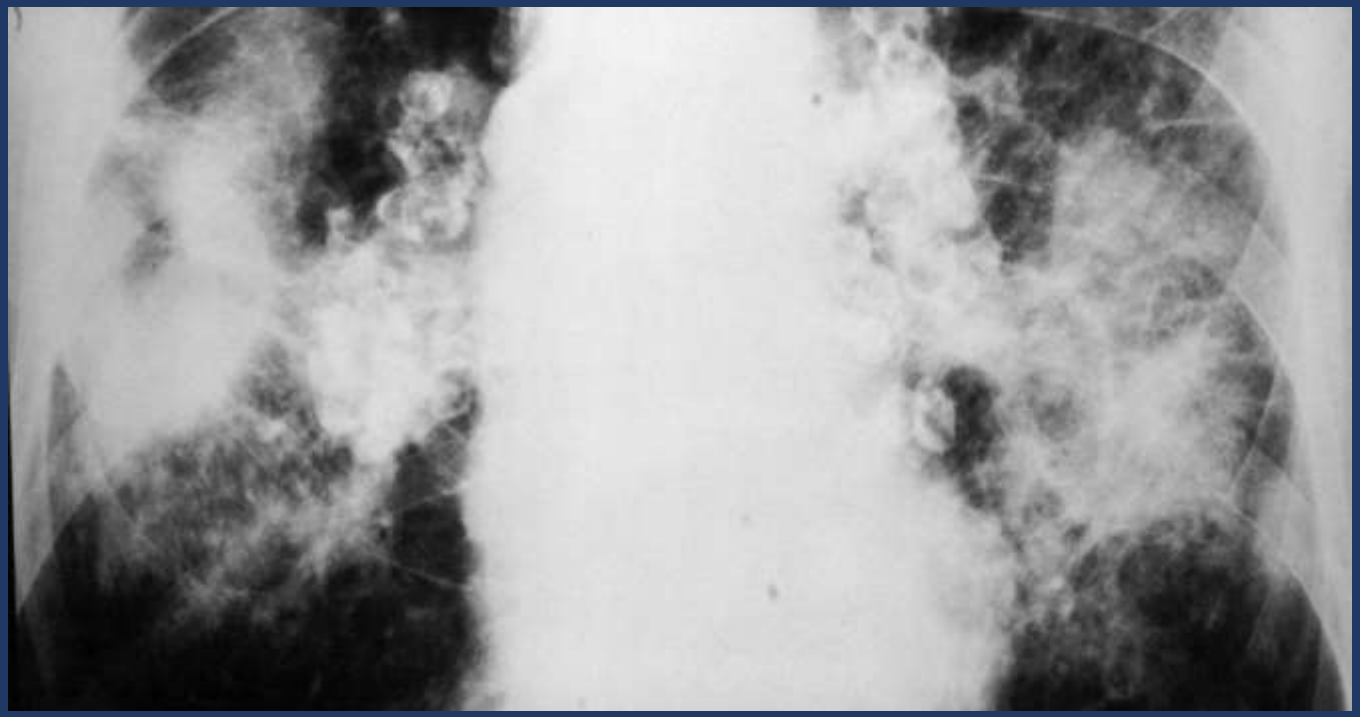
OCCUPATIONAL LUNG DISEASE: PNEUMOCONIOSIS

- SILICOSIS
- SIMPLE
- COMPLICATED:
- HILAR LYMPHADENOPATHY
- EGGSHELL CALCIFICATIONS
- PROGRESSIVE MASSIVE FIBROSIS (PMF)

SIMPLE SILICOSIS: ILO 1/1



COMPLICATED SILICOSIS: PMF



OCCUPATIONAL LUNG DISEASE: PNEUMOCONIOSIS

- ASBESTOSIS

- PLEURAL FIBROSIS

  PLEURAL PLAQUE

  CALCIFICATION

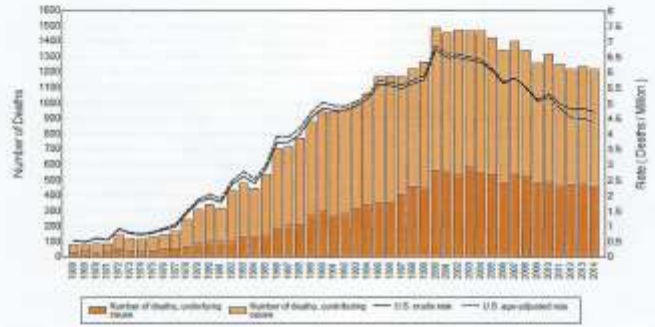
  DIFFUSE PLEURAL THICKENING
- ROUND ATELECTASIS

OCCUPATIONAL LUNG DISEASE: ASBESTOSIS DEATHS U.S. 1968-2014

CDC Centers for Disease Control and Prevention

NIOSH

Asbestosis: Number of deaths, crude and age-adjusted death rates, U.S. residents age 15 and over, 1968–2014



Note:

See Appendix (https://wwwn.cdc.gov/eworld/Appendix) for information about data sources, methods, ICD codes, and limitations.

Source:

Mortality multiple cause-of-death data from National Center for Health Statistics, National Vital Statistics System.

Population estimates from the United States Bureau of the Census.

Citation:

ASBESTOSIS: ILO 1/0

OCCUPATIONAL LUNG DISEASE: PNEUMOCONIOSIS

- RISK FACTORS
- DOSE: PROBABILITY, INTENSITY, FREQUENCY, AND DURATION OF EXPOSURE
- LATENCY
- CO-EXPOSURES: MCINTYRE POWDER
- DIAGNOSIS
- OCCUPATIONAL HISTORY
- CHEST X-RAY/ILO CLASSIFICATION SYSTEM
- LUNG BIOPSY ?

OCCUPATIONAL LUNG DISEASE: UIP

- INTERSTITIAL LUNG DISEASE
- USUAL INTERSTITIAL PNEUMONIA
- ADULT WITH NEW ILD OF APPARENTLY UNKNOWN CAUSE
- AGE $\geq$ 60 YEARS
- SHORTNESS OF BREATH
- CRACKLES ON PHYSICAL EXAM
- USUAL INTERSTITIAL PNEUMONIA: CT SCAN, HISTOPATHOLOGY

OCCUPATIONAL LUNG DISEASE: UIP

- IDIOPATHIC PULMONARY FIBROSIS (IPF)

- “IDIOPATHIC” CREATES A CONUNDRUM

IDIOPATHIC PULMONARY FIBROSIS

- DIAGNOSIS*
- EXCLUSION OF OTHER CAUSES
- “WE RECOMMEND … A DETAILED HISTORY OF MEDICATION USE AND ENVIRONMENTAL EXPOSURES AT HOME, WORK, OTHER PLACES”;
- “WE RECOMMEND SEROLOGIC TESTING TO EXCLUDE CONNECTIVE TISSUE DISEASE.”

*RAGHU G ET AL. OFFICIAL STATEMENT. AJRCCM 2018;198:e44-e63.

IDIOPATHIC PULMONARY FIBROSIS:DIAGNOSED

- OCCUPATIONAL EXPOSURES*

EXPOSURE	POOLED OR	95% CI	POOLED PAF (%)	95% CI
VGDF	2.0	1.2-3.2	26	10-41
DUSTS				
METAL	2.0	1.3-3.0	8	4-13
WOOD	1.7	1.3-2.2	4	2-6
AGRICULT	1.6	0.8-3.0	4	0-12
SILICA	1.7	1.2-2.4	3	2-5

*BLANC PD ET AL. OFFICIAL STATEMENT. AJRCCM. 2013;199:1312-1334.

IDIOPATHIC PULMONARY FIBROSIS

- CONCLUSION*
- “OUR FINDINGS SUGGEST THAT OCCUPATIONAL EXPOSURES CONTRIBUTE SUBSTANTIALLY TO THE BURDEN OF DISEASE OTHERWISE CONSIDERED IDIOPATHIC AND LABELED “IPF.”
- EXPOSURE MISCLASSIFICATION MAY OBSCURE EXPOSURE-ASSOCIATED PAFs FOR IPF, SUCH AS ASBESTOS IN METAL AND WOOD INDUSTRIES.

*BLANC ET AL. AJRCCM. 2019.

OCCUPATIONAL LUNG DISEASE

- GRANULOMATOUS LUNG DISEASE
- PULMONARY BERYLLIUM DISEASE (PBD)
- HYPERSENSITIVITY PNEUMONITIS*
- COBALT-INDUCED LUNG DISEASE (SOMETIMES)
- SARCOIDOSIS*

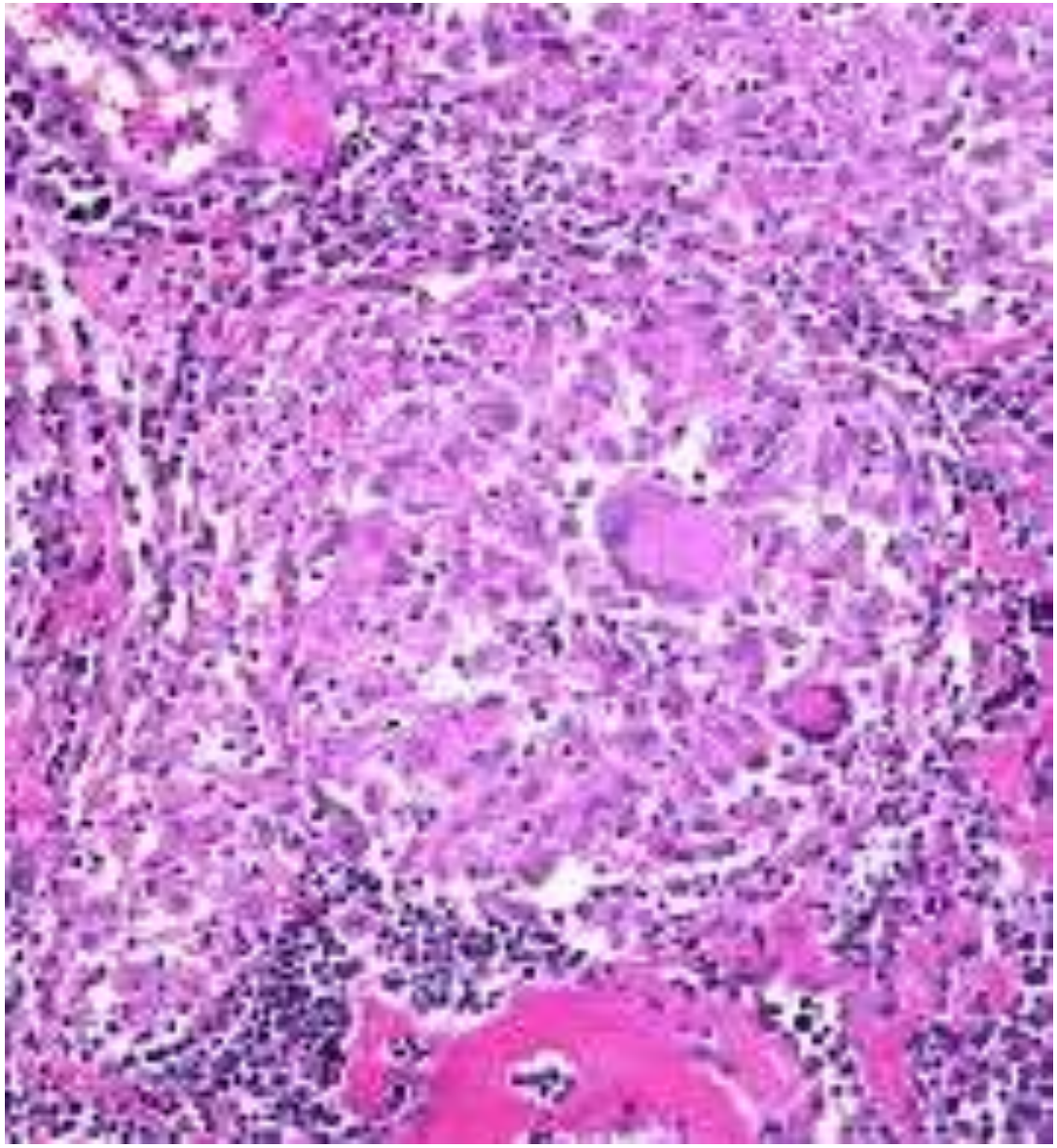
- IMMUNOLOGICALLY-MEDIATED
- MORE COMMON IN NON-SMOKERS*

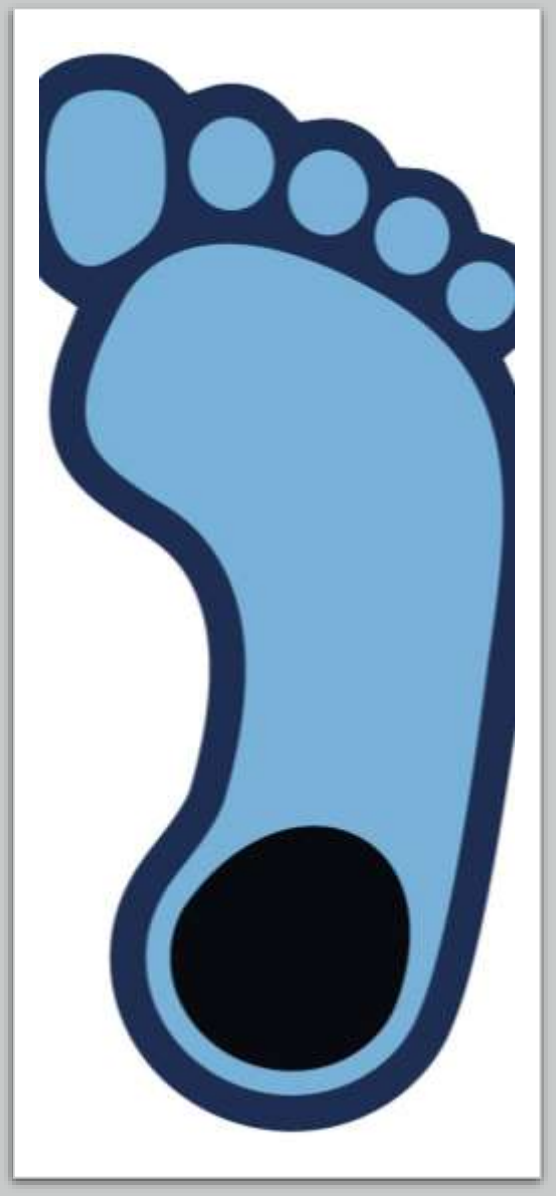
OCCUPATIONAL LUNG DISEASE: SARCOIDOSIS

- DIAGNOSIS
- ATS CLINICAL PRACTICE GUIDELINES:*
- COMPATIBLE CLINICAL PRESENTATION
- NONNECROTIZING GRANULOMAS
- EXCLUSION OF ALTERNATIVE CAUSES OF GRANULOMATOUS DISEASE

* CROUSER ED ET AL. OFFICIAL STATEMENT. AJRCCM 2020;201:e26-e51.

GRANULOMATOUS LUNG DISEASE: SARCOIDOSIS





OCCUPATIONAL LUNG DISEASE: SARCOIDOSIS

IDIOPATHIC?

OCCUPATIONAL LUNG DISEASE: SARCOIDOSIS

- OCCUPATIONAL/ENVIRONMENTAL EXPOSURES
- ASSOCIATIONS
- WORLD TRADE CENTER DUST

  pH $\geq$ 10, CRUSHED CONCRETE, GYPSUM, SVF

  FIRST RESPONDERS, COMMUNITY MEMBERS
- SILICA/SILICATES
- METAL DUSTS

OCCUPATIONAL LUNG DISEASE: SARCOIDOSIS

- SILICA/SILICATES
- DIATOMACEOUS EARTH PLANT (RAFNSSON, 1998)
  SARCOIDOSIS: OR 13.2, 95% CI 2.0-140.9
- SWEDISH IRON FOUNDARIES (VIHLBORG, 2017)
  SARCOIDOSIS: SIR 3.94, 95% CI 1.07-10.08
- SWEDISH CONSTRUCTION WORK (JONSSON, 2019)
  SARCOIDOSIS: RR 1.83, 95% CI 1.14-2.95
- WTC RESPONDERS MMTP (CROWLEY, 2011)
  PEAK ANNUAL INCIDENCE 54/100,000 2003-2004

OCCUPATIONAL LUNG DISEASE: SARCOIDOSIS

- THE CONUNDRUM OF 'IDIOPATHIC'
- EXCLUSION OF OTHER DIAGNOSES
- PULMONARY BERYLLIUM DISEASE (BeLPT)
  HYPERSENSITIVITY PNEUMONITIS (SSIgGs)
  GRANULOMATOUS LUNG DISEASE ATTRIBUTABLE TO METALS (AL, TI, ZR) (ELEMENTAL ANALYSIS)
- OCCUPATIONAL/ENVIRONMENTAL HISTORY

OCCUPATIONAL LUNG DISEASE

- MALIGNANT
- LUNG CANCER

  NSCLC, SCLC
- CANCER OF THE PLEURA

  MALIGNANT MESOTHELIOMA
- CANCER OF THE LARYNX

OCCUPATIONAL LUNG DISEASE: LUNG CANCER

- FROM A PUBLIC HEALTH PERSPECTIVE
- LUNG CANCER IS THE MOST COMMON CANCER IN CANADA (OTHER THAN NMSC).
- LUNG CANCER IS THE MOST COMMON OCCUPATIONAL MALIGNANCY.

- TAKALA J. ELIMINATING OCCUPATIONAL CANCER. EDITORIAL. INDUSTR HEALTH, 2015.

OCCUPATIONAL LUNG CARCINOGENS: ONTARIO

- PRIORITY CARCINOGENS*
- ASBESTOS
- RESPIRABLE CRYSTALLINE SILICA (RCS)
- DIESEL ENGINE EXHAUST
- WELDING FUMES
- NICKEL
- ENVIRONMENTAL TOBACCO SMOKE

*CANCER CARE ONTARIO, OCRC, TORONTO, ON:2017.

ASBESTOS AND LUNG CANCER

ASBESTOS

- ACCOUNTS FOR 55-85% OF ALL OCCUPATIONAL LUNG CANCER DEATHS*

- ONTARIO: LUNG CANCER INCIDENCE

  PAF 7.8-8.9%**

*FURUYA S ET AL. INT J ENVIRON RESEARCH PUBL HLTH 2018 DOI:10.3390/IJERPH15051000.

** OCRC. BURDEN OF OCCUPATIONAL CANCER ONTARIO. TORONTO:2019.

OCCUPATIONAL LUNG DISEASE: LUNG CANCER

- RISK FACTORS
- DOSE
- LATENCY
- DOSE-RESPONSE RELATIONSHIP
- CO-EXPOSURES: SMOKING

ASBESTOS-RELATED LUNG CANCER: DOSE-RESPONSE RELATIONSHIP

- HEIN M ET AL. OCCUP ENVIRON MED 2007
- SOUTH CAROLINA TEXTILE WORKERS

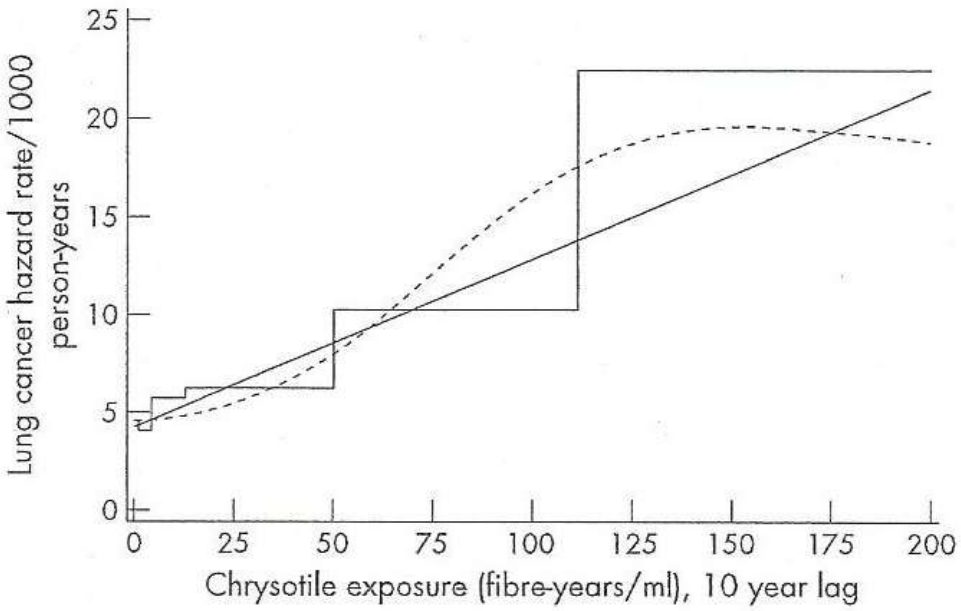


Figure 1 Estimated lung cancer mortality for white males, 60–64 years of age as a function of cumulative exposure to chrysotile (10-year lag) based on the model described in table 5 (linear relative risk model, solid curve; restricted cubic spline model, dashed curve; categorical model, step function).

SILICA-RELATED LUNG CANCER: DOSE RESPONSE RELATIONSHIP

- LIU ET AL. COHORT STUDY 34,018 SILICA WORKERS – LUNG CANCER DEATHS. AM J EPIDEMIOL 2013
- 546 LUNG CANCER DEATHS
- DOSE-RESPONSE RELATIONSHIPS BY QUARTILE:
- 0.01-<1.12 MG/M3-YRS: HR 1.26, 95% CI 0.98-1.60
- 1.12-<2.91 MG/M3-YRS: HR 1.54, 95% CI 1.16-2.05
- 2.91-<6.22 MG/M3-YRS: HR 1.68, 95% CI 1.26-2.24
- ≥6.22 MG/M3-YRS: HR 1.70, 95% CI 1.23-2.34

OCCUPATIONAL LUNG CANCER: ASBESTOS, SILICA, AND SMOKING

OCCUPATIONAL LUNG CANCER: SMOKING

- **ASBESTOS**
- *NGAMWONG Y ET AL. PLOS ONE AUGUST 14, 2015*
- META-ANALYSIS OF 10 CASE-CONTROL AND 7 COHORT STUDIES COMPARING LUNG CANCER PATIENTS: (A-, S-) WITH (A+, S-), (A-, S+), AND (A+, S+).
- FINDINGS: *ADDITIVE SYNERGISM BETWEEN ASBESTOS AND CIGARETTE SMOKE FOR LUNG CA - CASE-CONTROL AND COHORT STUDIES.*

OCCUPATIONAL LUNG CANCER: SMOKING

- **SILICA**
- CANADA: POPULATION-BASED CASE-CONTROL STUDY IN 8 PROVINCES (KACHURI ET AL, 2013)
- SYNERGY INDEX: S=2.38, 95% CI 1.35-4.21
- MULTIPLICATIVITY INDEX: V=3.59, 95% CI 1/51-8.49
- CHINA: COHORT STUDY OF WORKERS IN METAL MINES, POTTERY FACTORIES (LIU ET AL, 2013)
- JOINT EFFECT GREATER THAN ADDITIVE, LESS THAN MULTIPLICATIVE

OCCUPATIONAL LUNG CANCER

- RISK ASSESSMENT
- ENABLES MONITORING AND EARLY DETECTION
- LOW DOSE CHEST CT SCREENING
- NLST (U.S.): ≥ 20% DECLINE IN LUNG CANCER DEATHS (2010)
- ONTARIO: LUNG CANCER SCREENING PILOT

  ELIGIBILITY CRITERIA: AGE 55 TO 74; 20 YEARS OF DAILY CIGARETTES

OCCUPATIONAL LUNG DISEASE

- CONTINUES TO EVOLVE
- COVID-19 PNEUMONIA
- AT RISK*
- HCW, PARAMEDICS; SALES, SERVICE WORKERS; POLICE, FIREFIGHTERS
- MEATPACKING; MINING; MIGRANT LABOR
- TIMELY RECOGNITION OF COVID PNEUMONIA AS AN OCCUPATIONAL LUNG DISEASE IS IMPORTANT.

*COLLEGIUM RAMAZZINI. OCCUP ENVIRON MED 2020; 77:732-733.

OCCUPATIONAL LUNG DISEASE: TAKE HOME

- OCCUPATIONAL LUNG DISEASE IS PREVENTABLE.
- RECOGNITION OF RISK HELPS DRIVE PREVENTION.
- PRIMARY
- SECONDARY
- RECOGNITION OF OCCUPATIONAL ATTRIBUTION ENABLES PROPER TREATMENT.