Supplementary Table S1: Search terms

(((((("pulmonary disease, chronic obstructive"[MeSH Terms] OR ("pulmonary"[All Fields] AND "disease"[All Fields] AND "chronic"[All Fields] AND "obstructive"[All Fields]) OR ("chronic"[All Fields] AND "obstructive"[All Fields] AND "pulmonary"[All Fields] AND "disease"[All Fields])) OR ("pulmonary disease, chronic obstructive"[MeSH Terms] OR "chronic obstructive pulmonary disease"[All Fields] OR ("chronic"[All Fields] AND "airway"[All Fields] AND "disease"[All Fields]) OR "chronic airway disease"[All Fields])) OR ("airway obstruction"[MeSH Terms] OR ("airway"[All Fields] AND "obstruction"[All Fields]) OR "airway obstruction"[All Fields])) OR ("Chronic Respiratory Disease"[Journal] OR ("chronic"[All Fields] AND "respiratory"[All Fields] AND "disease"[All Fields]) OR "chronic respiratory disease"[All Fields])) OR (“Lung function”[All fields] OR “Pulmonary function” [All fields]) OR ("bronchitis, chronic"[MeSH Terms] OR ("bronchitis"[All Fields] AND "chronic"[All Fields]) OR "chronic bronchitis"[All Fields] OR ("chronic"[All Fields] AND "bronchitis"[All Fields]))) AND (("Job exposure matrix"[All Fields] OR "JEM"[All Fields] OR "Job Exposure matrices"[All Fields]) OR (job [All Fields] AND exposure [All Fields] AND ("Matrix"[All field] OR "matrices"[All Fields])))

Supp1ementary Table S2: Occupational COPD JEM studies.

All studies included in this table have adjusted for smoking and age or otherwise taken smoking or age in to account.

Key:

CI: confidence interval; CNSLD: Chronic Non-specific Lung Disease; COPD: chronic obstructive pulmonary disease; FeCr: ferrochromium alloy; FeMn: ferromanganese alloy; FeSi: ferrosilicon alloy; FEV_1: forced expiratory volume in one second; FVC: forced vital capacity; GOLD=Global Initiative on Obstructive Lung Disease; GVSS: gases/vapours/sensitizers/organic solvents; ICD9: International Classification of Diseases 9th revision; JEM: job exposure matrix; LLN: lower limit of normal; OR: odds ratio; RR: relative risk; SiC: silicon carbide; Si-metal: silica metal; SiMn: silicon manganese alloy; SMR: standardized mortality ratio; VGDF: vapours/gases/dusts/fumes.

Reference (First author, year, country)	Study population	Study design	Exposure assessment method and pollutants types assessed	Outcome (risk estimates)	Measures of association
Paulin, 2015[53] **USA**	Gen. population Age 65 (mean)	Cross-sectional study N=1075 N=721 those with COPD	Likelihood of occupational exposure (longest held job) assigned using a JEM (BLANC) and self-reported reported exposure to VGDF.	COPD diagnosis: a. FEV_1/FVC <LLN and b. FEV_1/FVC <0.7	COPD was significantly associated with occupational exposure OR=1.44 (95% CI 1.04-1.97). When defined by LLN, OR=1.57 (1.18-2.10).
Toren, 2014[54] Sweden	Construction workers Subject aged 50-84yrs.	Longitudinal mortality cohort study of 354,718 male workers. Follow up period 1972-2011.	JEM developed for exposure from the 1970s (estimates made by industrial hygienists) for selected exposures which were merged in to four broad exposure groups; inorganic dusts, gases and irritants, fumes and wood dust.	Mortality risk of COPD. COPD diagnosis from ICD, 9th (codes 491,492 and 496) and 10th revision (J34-J44)	Significantly increased mortality due to COPD with exposure to VGDF (RR=1.32; 95% CI 1.18-1.47), fumes (RR=1.20; 1.07-1.36) and inorganic dust (RR=1.19; 1.07-1.33).
Dijkstra, 2014 [36]	Gen. Population	Cross-sectional	Occupational exposure assessed using 'ALOHA+ JEM' for;	FEV_1/FVC <70%	Higher non-significant risk for COPD associated with high

The Netherlands	Age 26-86 (mean 52), males and females	1479 persons with and 8529 without COPD	biological dust, mineral dust, gases & fumes, all pesticides, aromatic solvents, chlorinated solvents, other solvents and heavy metals.		exposure to solvents (OR=1.78; 95% CI 0.61-5.23) and low exposure to pesticides (OR=1.68; 0.44-6.44)
Doney, 2014 [9] **USA**	Gen. population Age 45-84 yrs.(mean 61), males and females	Cross-sectional study N=3667	Two methods: (i) Self-reported exposure (current or last job) to VGDF (ii) JEM (NIOSH) – exposure scores (low, medium and high) for VGDF and dusts.	a. Airflow limitation FEV_1/FVC <LLN (N=196) b. Chronic bronchitis symptoms (3 or more months of chronic productive cough per year in 2 or more years. (N=280) c. Self-reported Physician diagnosed COPD (N=98) d. Wheeze (last 12 months)	Higher risk estimates obtained for airflow limitation; self-reported exposure to VGDF (OR=2.13; 95% CI 1.21-3.74) and JEM high dust exposure (OR=2.35; 1.10-5.04). No significant association between airflow limitation and JEM VGDF.
Rodriguez, 2014 [37] **Spain**	Gen. population (hospitals) Age, mean 68 yrs., males and females.	Cross-sectional study N=338	Occupational histories (interviews) used to derive cumulative lifetime exposure (none, low or high exposure years) for mineral dusts, biological dusts and gas/fume. (ALOHA JEM), coding using ISCO-88	a. Chronic bronchitis symptom (regular cough with phlegm at least 3 months a year) b. Dyspnoea: MRC scale (3 or 4) c. COPD: GOLD stage III+ d. Post-bronchodilator FEV_1.	Chronic bronchitis: high exposure to gas/fume OR=1.9 (95% CI 0.9-3.8). No association between occupational exposure and airflow obstruction.
Hansell, 2014 [6] **New Zealand**	Gen. Population Age 25-74 yrs., males and females.	Cross-sectional study N=1017 completed questionnaires of which N=750 completed lung function.	i. Self-reported exposure (yes/no) to 18 specific substances /jobs: solvents, wood dust, detergents, petrol, soldering, welding, asbestos,, pigments, anhydrides, insecticides, aldehydes, quartz, metal dust, aluminium dust, plastic manufacture, paint manufacture, diisocyanates, and hairdressing. ii. ALOHA JEM – exposure	a. COPD: FEV_1/FVC<LLN (N=83) b. Chronic bronchitis symptoms (cough and sputum for 3 months each year) (N=87) c. Self-reported doctor diagnosis of COPD / chronic bronchitis/ emphysema (N=112)	Chronic bronchitis symptoms associated with self-reported exposure in hairdressing, paint manufacturing, insecticides, welding, detergents and with the JEM for gases/fume exposures. Highest risk for hairdressers OR=6.91; 95% CI 2.02-23.0.

			assigned to biological dust, mineral dust, gas/fumes and VGDF iii. Cumulative exposure derived from job duration and exposure intensity.		No significant association with COPD (LLN) or doctor diagnosed COPD.
Pallasaho, 2014 [39] **Finland**	Gen. Population Age 20-69yrs (mean 53), males and females. N=4080 (whole population at risk) N=3911 (population at risk excluding symptomatic)	Cohort (longitudinal) 11 year follow-up postal study)	i. JEM (ALOHA) used to assign exposure to (longest held job) to biological dust, mineral dust and gas/fume. ii. Self-reported exposure (current or previous) to 'dust, gases or fumes'	Physician diagnosed COPD i.e. self-reported (*'ever diagnosed as having COPD by a doctor?') (N=140)*	Self-reported exposure associated with COPD: OR=2.41(95% CI 1.71-3.41) JEM (high exposure) associated OR=1.90 (1.04-3.46)
Kreuzer, 2013 [38] **former East Germany**	58,982 men employed in former uranium mine with at least 6 months employment between 1946 and 1989.	Mortality study- deaths from non-malignant respiratory disease (NMRD). Follow up period 1946-2008, 2336 deaths from NMRD including 715 from COPD.	i. Exposure to silica and radon assessed using a JEM. ii. Cumulative retrospective exposure estimated for respirable dust and Silica	RR for cause of death coded using ICD-10 including COPD (J40-44) and cumulative silica exposure.	No increase in mortality from COPD and cumulative exposure to Silica.
Johnsen, 2013 [15] **Norway**	Workplace based: Silicon Carbide (SiC) production plant workers	Longitudinal survey (1997-2003).	i. Personal dust exposure data used to construct a quantitative JEM. ii. Each employee assigned dust exposure concentration value for each year of	Spirometry and annual self-administered questionnaires	Dust exposure associated with an increased yearly decline in FEV1.

	456 employees aged 20-55years.		follow-up.		
Darby, 2012 [10] **UK**	Gen. Population (random population plus hospital) Age >55 years (mean 71years), males and females.	Cross-sectional study Random population sample N= 2001 questionnaire respondents (mean age 69yrs.). N= 571 underwent lung function N=252 (Any COPD which may include concomitant asthma)	i. Self-reported exposure to VGDF(ever exposed) ii. Response to specific exposure checklist iii. Exposure assigned using JEM (BLANC)	a. COPD: GOLD I+ (N=197 cases) b. Self –reported physician diagnosis of any COPD (COPD, emphysema or chronic bronchitis with or without concomitant asthma) (N=216 cases) c. Self-reported physicians diagnosis of any COPD excluding chronic bronchitis (N=149 cases)	VGDF exposure not significantly associated with COPD, OR=1.4 (95% CI 0.91-2.15). Intermediate or high JEM exposure OR=0.88 (0.58-1.34) Self-reported exposure and any COPD (excluding chronic bronchitis) OR=3.66 (2.31-5.79). JEM exposure (high) and any COPD (excluding chronic bronchitis) OR=1.55 (0.94-2.54)
Mehta, 2012 [40] **Switzerland**	Random sample of 9561 participants recruited (18-62yrs) Baseline survey in 1991, follow-up in 2001-2003. Analysis restricted to 8047 non-asthmatics.	Prospective cohort study (multi-centres)	Exposure assigned using a general population based JEM. Current job reported at baseline survey standardised using ISCO-88 and linked to the ALOHA JEM. Exposure assigned to biological dust, mineral dust, gas/fumes and VGDF.	Adjusted incidence rate ratios (IRR) of COPD estimated. COPD defined using GOLD and LLN (stage I and II+)	High level of occupational exposure to biological dust, mineral dust, gas/fumes and VGDF associated with increased incidence of COPD (Stage II+) for both GOLD and LLN.
Nordby, 2011 [23] **8 European countries**	Workplace based: cement production plants	Cross-sectional study Data collected at start of a 4 year prospective cohort)	i. Full shift personal dust sampling (N=2670) and historical exposure questionnaire used to derive JEM ii. Job categories for JEM;	a. Airflow limitation: FEV_1/FVC <0.7 and FEV_1/FVC <LLN b. Self-reported symptoms; i. Coughing, ii. Chronic bronchitis	Elevated OR for symptoms and airflow limitation but not for chronic bronchitis. Of the symptoms higher risk estimates for coughing, wheezing

		study N=4265 completed the questionnaire and performed spirometry. 24 cement plants in 8 European countries	production, cleaning, maintenance, foreman and laboratory iii. Exposure questionnaires and spirometry completed by 4265 participants.	iii. Wheezing and dyspnoea, iv. Coughing, wheezing and dyspnoea	and dyspnoea. Laboratory workers OR=3.2 (95% CI 1.2-8.6), Production workers OR=2.7 (1.2-5.8). FEV_1/FVC <LLN and job as foreman OR=4.3 (1.3-1.4).
Govender, 2011 [41] **South Africa**	Gen. Population (hospital-based) Mean age 61yrs, males and females	Case-control study N=212 (102 referents)	i. Self-reported (interviews) occupational exposure for up to 10 jobs. Additional questions on employment in industries associated with development of COPD. ii. Exposure estimate for biological dust, mineral dust and gas and fume using the ALOHA JEM. iii. Cumulative exposure obtained by multiplying the square of JEM scores 0, 1 and 2 (none, low, high) with duration	COPD diagnosis : GOLD III+	Self-reported high dust exposure for COPD OR=5.9 (95% CI 2.6-13.2). JEM derived high cumulative biological dust exposure OR for COPD: 2.1 (1.1-4.2).
Bugge, 2011 [22] **Norway**	Workplace based: N=1687 worker employed in 1913-2003 in Norwegian Silicon Carbide industry	Mortality study	Cumulative exposure to quartz, Cristobalite, SiC particles and SiC fibres.	SMR and IRR for obstructive lung disease (mortality)	SMR for obstructive lung disease increased at the highest level of cumulative exposure for the following: total dust, respirable dust, Fibre, SiC dust, Quartz and Cristobalite.
Soyseth, 2011 [24]	Workplace based:	Cohort (longitudinal: 5year follow up) assessed	JEM developed and used to assign dust exposures for each	Respiratory questionnaire and airflow limitation for FEV_1/FVC <0.7 and	Smelters producing FeSi, Si-metal, FeMn, SiMn and FeCr with significant OR for airflow

Norway	Smelting Age 20-55 yrs. (mean age at 5 year follow up 46yrs), males and females. 3924 employees investigated in 24 smelters	annually	employee Dust exposure for smelter producing operations by; (a) FeSi, Si-Metal, (b) FeMn/ SiMn/FeCr or (c) SiC only and job type; line operator, non-line operator and unexposed. JEM estimated geometric means dust exposure in each job category	$FEV_1/FVC<LLN$	limitation. Both line operators and non-line operators (compared with unexposed individuals) significant OR for airflow limitation.
Johnsen, 2010 [26] **Norway**	Workplace based: N=2620 employees working in different smelters	Longitudinal study	JEM developed using personal dust exposure measurements.	Annual spirometry and questionnaire for 5 year. Annual decline in FEV_1 related to dust exposure No risk estimates for COPD and occupational exposures	The annual decline in FEV_1 increased with increasing dust exposures. This association was significant in SiMn/FeMn/FeCr smelters and amongst non-smokers in FeSi/Si-metal smelter.
Skorge, 2009 [42] **Norway**	Gen. Population (community study) Age 15-70 yrs., males and females.	Cohort (11 year longitudinal) study N=2401 attended clinical examination	Questionnaire – information on all jobs held from 1985-1996/97 ALOHA JEM used to classify all coded jobs for exposure to biological dust, mineral dust, gas or fume. Three exposure categories; (i) no job with exposure. (ii) at least one job with low exposure, but no high exposure and (iii) at least one job with high exposure.	Self reported symptoms a. Chronic cough (Cough >3months or more during the year.) b. Morning cough c. Phelgm when coughing d. Dyspnea grade 2 e. Attacks of dyspnea f. Wheezing Risk estimates also for asthma defined as 'treated by a doctor or hospitalised for asthma'	High exposure to biological dust was significantly related to higher incidence of chronic and morning cough in men: OR=2.48 (95% 1.2-5.2).
Jacobsen, 2009 [14]	Workplace based:	Cohort study (6	Personal dust sampling at	(a) Chronic bronchitis; expectoration on most days	Female woodworkers' bronchitis

Denmark	Woodworkers Age 17-68 yrs. (mean at baseline 38yrs), males and females.	year follow-up) N=1674 (297 referent) participated in the follow up.	baseline and follow (total 2352 measurements) JEM used to calculate cumulative dust exposure during-follow up period.	during ≥3months consecutively for ≥2 yrs. N=60/1230 (b) Daily coughing N=182/1049 (c) Wheeze ever N=145/1277	OR=8.85 (95%CI 1.1-71.4) and daily cough OR=2.81 (1.29-6.09) but no relation to wood dust exposure for male wood workers.
Blanc, 2009 [31] **USA**	Gen. Population (members of a healthcare delivery organisation) Age 40-65 yrs. (mean 58yrs). males and females	Case-control study N=1504 (302 referents)	i. Self-reported exposure to VGDF (for longest held job) ii. JEM defined exposure probability (low, intermediate or high) for 'substances associated with chronic air way disease' (BLANC JEM)	(a) COPD: Physician diagnosed and (b) GOLD stage II+ (N= 742 classified as COPD)	Self-reported VGDF exposure (longest held job, self- reported) associated with COPD : Significant OR=2.11 (95% CI 1.59-2.82) JEM (for 'high 'probability of exposure): Significant OR=2.77 (1.46-3.52).
Blanc, 2009[30] **USA**	Gen. Population Age 55-75	Case-control study N=1942 (1709 referents) N=138 Lung function assessed N= 134 COPD alone	i. Self-reported exposure to VGDF for the longest held job and ii. Classification of longest held job using a JEM (BLANC) i.e. each subject classified as having low, moderate or high probability of COPD-related exposure.	Self-reported physician diagnosis: a. All COPD: chronic bronchitis or emphysema (N=233 cases) b. COPD Alone c. Gold I+ (N=78; referent=1652) for minimal smokers (never up to 10 packs per yr.)	VGDF (self-reported) associated with COPD alone: OR=2.1(95% CI 1.4-3.0).
Rodriguez, 2008 [43] **Spain**	Gen. Population (hospital- based) Age 40-91 yrs. (mean 66 yrs.). Males	Cross-sectional study N=185	Lifetime occupational history: interview questionnaire exposure assigned using ALOHA JEM (biological dust, mineral dust, gas/fume. Occupational exposure analysis: (a) Lifetime, defined as ever having worked in a job with	FEV1 <30% predicted, FEV1≥30 to <50% predicted and FEV1≥50 to <70% predicted. Relative risk estimates given with FEV1≥70% predicted (ref) Respiratory symptom	Working in a job with high exposure to mineral dust or to any dust, gas or fume associated with FEV_1<30% predicted (mineral dust: OR=11.4 (95% CI 1.4-95.0); dust gases or fumes OR=6.9 (1.1-44.7). High exposure to biological dust associated with chronic sputum

			high exposure to gases, dusts or fume (b) Cumulative exposure to dusts, gases or fumes defined as number of years the patient worked in a high exposure job.	questionnaire (Ferris 1978, ATS) a. Chronic cough b. Sputum production c. Wheeze d. Dyspnoea	production OR=4.3 (1.6-12), dysponea OR=2.7 (1.1-6.7).
Jacobsen, 2008 [27] **Denmark**	Workplace based: Furniture industry (woodworkers) Mean age at baseline 38yrs, males and females.	Cohort (6 year follow-up) study N=1031 (235 referents)	Personal wood dust sampling at baseline and follow-up (total of 3572 measurements). JEM used to calculate cumulative dust exposure during-follow up period	$FEV_1/FVC<0.7$	Cumulative wood dust exposure not associated with airflow limitation. Risk higher in women than men. For women highest wood dust exposure OR=3.86 (95% CI 0.62-23.70).
Weinmann, 2008[32] **USA**	Gen. Population Age ≥45 yrs. (mean 66 yrs.)	Case-control study N=744 (356 referents)	Expert exposure assessment (NIOSH) aided by subject questionnaire i.e. for each job: yes/no response to whether job involved routine (at least weekly) exposure to eight pollutant (mineral dust, metal dusts and fumes, organic dust, irritant gases or vapours, sensitizers, organic solvents, diesel exhaust and environmental tobacco smoke) and three composite measure (any dust, GVSS and any dust, GVSS or diesel fume exposure)	COPD diagnosis: a. FEV_1/FVC <LLN or b. If met criteria based on an algorithm developed for the study based on ICD9	Overall significant OR=1.5 (95% CI 1.1-2.1) Occupational exposure most strongly associated with COPD for diesel exhaust, irritant gases and vapours, mineral dust and metal dust.
Matheson, 2005 [44] **Australia**	Gen. Population (community) Age 45-70 yrs.	Two stage Cross-sectional study N=1213 (550-814	ALOHA JEM used to assign exposures using participant's lifetime occupational histories.	COPD defined as either a. Airflow obstruction; Mild ($FEV_1/FVC<70\%$), Moderate ($FEV_1/FVC<70\%$	Biological dust and COPD OR=2.70 (95% CI 1.39-5.23). Risk higher in women than men. No significant risk for COPD for

	males and females,	referents)	Exposure assigned to biological dust, mineral dust and gases/ fumes Cumulative exposure (yrs.) calculated.	and FEV_1<80% predicted). b. Symptoms; morning cough, chronic cough, morning phlegm, chronic bronchitis (phlegm, most days for 3months of a year and at least 2 yrs.). Dyspnoea, chronic obstructive bronchitis (mild airflow obstruction with chronic sputum production), COPD (chronic bronchitis or symptomatic emphysema) and emphysema	mineral dusts or gases/fumes
Sunyer et al, 2005[45] **EU**	Gen. population Aged 20-45. 4079 males and 4461 females (27 study centres)	Randomly selected in 1991-1993, 9 year follow up period. Total of 3202 men and 3279 women twice completed lung function measurements	All jobs held during follow-up. Occupations then grouped in to 15 wider categories. Exposure to (a) biological dust (b) mineral dust and (c) gas and fumes assigned using the ALOHA JEM. Exposure classification for risk estimates: None, low and high.	Incidence (RR) for: a. Airway obstruction, $FEV_1/FVC<0.7$. b. Chronic phlegm (most days for at least 3 months/yr.) c. Change in lung function /yr.	Incidence of chronic phlegm increased in men exposed to high levels of mineral dust RR=1.94 (95% CI 1.29-2.91). No significant increase in airway obstruction for occupational pollutants.
Daroowalla, 2005[50] **USA**	Workplace based: Nylon flock workers – flock production and application.	Cross-sectional study 262 workers invited to participate in study (1998). 219 participated (133 production and 86 application workers)	Job histories of 219 current workers linked to a JEM derived from measured exposure to respirable dust and fibres. Cumulative and current exposure estimated for each worker.	Predicted prevalence ratio (PPR) values for the following; a. SOB-troubled when hurrying on level ground or walking up slight hill or having to walk slower than people of one own age on level ground b. Cough- cough on most days, 3 or more consecutive months per	Cough + Phlegm had the most significant prevalence ratios e.g. 4.7 for >10 weeks of blow downs. The prevalence ratios for high cumulative exposure were lowers than for medium exposure.

				year. c. Cough +phlegm –phlegm on most days 3 or more consecutive months per year. d. Wheeze- the report of one's chest sounding wheezing that made one feel short of breath. e. Systemic symptoms -3or 4 episodes of fever or flu-like achiness in the last 12 months. f. Mucous membrane irritation	
de Meer, 2004 [46] **The Netherlands**	Gen. Population (community) Age 20-71yrs (mean 45yrs). Males and females	Cross-sectional study N=1906	350 Job titles (present or job quitted because of respiratory symptoms) assigned exposure to mineral dust, gas/fume, and organic dust using the ALOHA JEM. Jobs classified in to three groups; not exposed, low exposure or high exposure. Low and high were combined.	a. Chronic bronchitis – daily morning phlegm or cough for 3 months in the past 3 months. b. Current wheeze –wheeze or asthma past 12 months c. Current asthma – wheeze or asthma past 12 months +BHR d. Bronchial hyper responsiveness (BHR)	Mineral dust exposure associated with chronic bronchitis OR=2.22 (95% CI 1.16-4.23).
Bergdahl, 2004[28] **Sweden**	Workplace based: construction workers Cohort of 317,629 male construction workers followed from 1971 to 1999. 116,894 controls	Cohort mortality	i. Inorganic dust (asbestos, MMMF, cement dust, quartz) ii. Gases and irritants (epoxy resins, isocyanates, organic solvents) iii. Fumes (asphalt, diesel exhaust, metal) and iv. Wood dust v. Any airborne exposure Occupational JEM developed by	Age adjusted mortality (RR) in COPD among never smokers. Total 523 deaths due to COPD.	Increased mortality from COPD with exposure to Inorganic dusts RR=1.16 (95% CI 1.05-1.28), fumes RR=1.22 (1.04-1.42) and any airborne exposure RR=1.12 (1.03-1.22). Fraction of COPD amongst smoked attributable to any airborne exposure was 10.7% and 52.6% amongst never-smokers.

			scoring (scale 0-5) exposure factors.		
Trupin, 2003 [11] **USA**	Gen. Population (community) Age 55-75yrs. Males and females	Cross-sectional study N=188	Two methods: i. Self-reported occupational exposure to VGDF for longest held job (ECHRS questions –'*have you ever worked in a job which exposed you to vapours, gas, dust or fume?'* ii. List of 15 exposures considered a priori risk factors for COPD which were subsequently grouped in to 3 categories (combustion by products, inorganic dusts and fumes and organic dusts) - (BLANC JEM) Exposure classification: low (ref), intermediate and high	a. COPD: Self-reported physician's diagnosis of chronic bronchitis or emphysema. (N=189) b. Any COPD: Self-reported physicians diagnosis of emphysema, COPD and /or chronic bronchitis with or without contaminant diagnosis of asthma (N=377)	Self-reported exposure to VGDF associated with COPD: OR=2.0 (95% CI 1.6-2.5) High (OR=1.9; 1.2-3.2) and intermediate (OR=1.5; 1.04-2.20) JEM exposure associated with COPD:
Fritschi, 2003[25] **Australia**	Workplace based: Aluminium smelters 1615 male employees of two smelters conducted in 1995. Age range 16-68	Cross-sectional survey	Full job history provided by each subject. Company individual air monitoring data available. A task exposure matrix developed to produce individual quantitative measures of cumulative exposure to (a) fluorides (b) sulphur dioxide (c) inspirable dust (d) benzene soluble fraction of coal tar pitch	Prevalence ratio for reported (a) work-related wheeze, (b) chest tightness and (c) rhinitis by quartiles of cumulative exposure for different airborne pollutants. Subjects underwent spirometry and asked about respiratory symptoms (over past 12	After adjusting for smoking and age, subjects with the highest cumulative exposure to fluoride and inspirable dust were 2-4 times more likely to report work-related wheeze and chest tightness.

	(mean 37.8)		volatiles (BSF) and oil mist.	months)	
Mastrangelo, 2003[47] **Italy**	Gen. Population (community) Age 20-44 yrs. Males	Case-control study N=429 (298 referents) 131 COPD cases	Individuals assigned to one of the 16 job titles (ever worked in): farmers, welders, carpenters, painters, cotton textile workers, construction, refractory brick workers, bakers, shoe industry workers, metal workers, foundry workers, masseurs, chemical industry workers, truck drivers and miner. Years spent in each recorded. Offices workers (referent group). Subjects then classified using a JEM (designed for the 16 jobs) as ever exposed to biological dust or mineral dust or gas /fumes). JEM Exposure classification; none, low and high.	COPD definition: shortness of breath >2 yrs. and /winter phlegm and FEV_1>80% predicted, only minimally reversible with bronchodilators and without marked changes during hospital observation period.	Job title associated with significant risk of COPD: Farmers, welder, carpenters, construction workers, painters, cotton textile workers, refractory brick workers and foundry workers. Farmers with highest risk of COPD, OR=15.1 (95% CI 3.2-71.6). Mineral dust: OR=3.80 (1.21-12.0), Gas /vapour/fume: OR=5.83 (1.82-18.6) and biological dust: OR=8.86 (2.29-34.3).
Zock, 2001[48] **14 Industrialised countries**	Gen. population study 13,253 men and women aged 20-44yr. Male:5819, Females: 6335	Cross-sectional	i. VGDF (self-reported exposure) current job or last held job ii. VGDF (JEM): exposure classification none, low , high to biological dust, mineral dust and gas/fumes 'Subjects classified in to 10 occupation groups with high probability of exposure to	a. Chronic bronchitis defined (i) as regular phlegm for at least 3 months in each yr. and (ii) regular cough and phlegm production for at least 3 months each year. b. Air flow obstruction – FEV1. c. Non-specific bronchial responsiveness (NSBR) defined as 20% decrease in FEV1 associated with methacholine dose ≤8µmol	Occupational exposure to VGDF (estimated by JEM) associated with chronic bronchitis among current smokers only. Self-reported exposure to VGDF associated with chronic bronchitis (phlegm) in all smoking groups

			VGDF': Agriculture, construction, metal heating, other metal, textiles, paper, cleaning, wood, chemical, food processing,	d. Asthma – attacks pf asthma in the previous 12 months, having been awakened by attack of SOB at any time in the previous 12 months or current use of asthma medication	
Romundstad, 2000 [49] **Norway**	Workplace based: Aluminium industry 5627 men who had worked ≥6 months at two plants. Follow period from 1962 to 1995	Cohort Study (historical) Mortality Cancer incidence	JEM used to investigate association between cumulative exposures to the following agents and cancer incidence; a. total particulate PAH, b. Total fluorides (gases and particulates) and c. Asbestos	Cause of death included Chronic Obstructive Lung Disease (Bronchitis, Emphysema and Asthma)	For the highest (>5.0mg/m3-year) cumulative fluoride exposure SMR for COLD=1.31 (95% CI 0.68-2.29)
Albin, 1998[7] **Sweden**	Workplace based: Construction workers (application of insulation wool) Data from national health check-ups in 1983-93. Male construction workers.	Cross-sectional study (N= 96,004) and longitudinal (N=26,298).	i. Self-reported exposure (yes/no), average daily exposure (>2h in past yr.) and duration (>5 years) to: Insulation wool, Silica dust, Asbestos and Isocyanates. ii. JEM developed by a hygienist based partly on measured dust and fibre exposures (1978-90). Exposure classification; high, not high and no exposure	a. Persistent cough during past 12 months b. VC (yearly change) c. FEV_1 (yearly change)	High recent exposure to insulation wool, silica and asbestos all associated with persistent cough over past 12 months.
Sunyer, 1998[13] **Spain**	Gen. Population (community) Age 20-44 yrs. Males and females	Cross-sectional N=1735	Subjects classified based on current job or job changed due to health problems i. Self-reported exposure to VGDF (yes/no) ii. JEM (350 job titles) for	Symptoms: a. Morning cough b. Cough>3mo c. Morning phlegm d. Phlegm>3mo e. Airflow limitation	Subjects without symptoms of asthma: Cough >3months and phlegm>3months associated with high exposure to biological dust OR=1.9 (95% CI 1.0-3.7) and

			biological dust, mineral dust and gas/fumes (exposure levels: none , low, high) *'ad hoc JEM' (ALOHA)* iii. Second (self-reported) population JEM based on proportion exposed to VGDF - <10% none exposed, 10-49% low , >50% high)	(FEV_1/FVC <0.7) f. Asthma Risk estimates for respiratory symptoms and lung function with and without symptoms of asthma	OR=2.0 (1.1-3.8) Self-reported exposure to VGDF and ad hoc JEM (high exposure) associated with cough>3months and phlegm >3months. Population specific JEM associated with cough .3months, phlegm >3 months and FEV_1/FVC <0.7
Hobbesland, 1997[52] **Norway**	Workplace based: Mortality study – Ferroalloy workers. Cohort of 14,730 men employed for the first time in 1933-1990 for at least 6 months in 1 of 12 plants. Male workers	Cohort mortality study. Deaths observed during 1962-1990.	Duration of work and exposure to amorphous silica estimated using a JEM. JEM based on measured personal dust exposure performed during 1974-1990.	SMR for non-malignant respiratory disease. • Bronchitis, emphysema and asthma (combined) • All non-malignant respiratory diseases • Pneumoconiosis • Pneumonia	SMR for bronchitis, emphysema and asthma; 1.2 (95% CI 0.93-1.61). SMR for all non-malignant respiratory disease also not elevated.
Post, 1994[8] **The Netherlands**	General population study. Morbidity of 878 Men examined in 1960. Total mortality N=425	Longitudinal: 25 year follow up (from 1960to 1985). Incidence rate of chronic non-specific lung disease (CNSLD):the Zutphen Study	i. Occupational history obtained using self-administered questionnaires and indicated to which of 27 chemicals agents they had been exposed in jobs held. ii. Population exposure JEM for 10 specific exposures; welding fume, solder fumes, pesticides, asbestos, oils, wood dust, solvents, paints, coal tar and dust	Occupation exposure and a. Total mortality (N=425) b. CNSLD mortality (RR) c. CNSLD incidence (RR) CNSLD mortality -(ICD codes 490-496) CNSLD morbidity defined as (a) episodes of respiratory symptoms (regular cough and phlegm for longer than 3 months or episodes of	

				wheezing) reported to a physician; or (2) a diagnosis of CNSLD by a clinical specialist	
Burkhart, 1993[29] **USA**	Workplace based: Construction workers	Literature review of health risks (including COPD) to labourers in construction	Exposures estimates for construction labourers exposed to different substances (from National Exposure Survey conducted by NIOSH 1988, 1990)	• PMR for selected causes of death including COPD (from NIOSH occupational coded mortality surveillance data 1984-1986.) • SMR for COPD (black and white male workers (California 1979-1981)	Adjusted SMR for white and black construction workers; SMR=1.20 (95% CI 0.89-1.58) and SMR=1.48 (0.74-2.65) respectively.
Hsairi, 1992 [33] **France**	Gen. Population (community) Age 25-59 (mean 43). Males and females French Cooperative study PAARC performed in 1975	Cross-sectional N=13,553 (6803 men)	i. Self-reported exposure, '*Are (were) you exposed to dust, gases and /or chemical fumes*? In most recent occupation. ii. JEM (British JEM-Pannett) – Two indices of exposure (a) intensity and (b) probability each graded; none, low or high).	Respiratory symptoms: a. Chronic cough b. Chronic bronchitis (Chronic phlegm) c. Dyspnoea 2+ d. Wheezing any time e. Asthma (*Ever had attacks of breathlessness with wheezing)*	Self-reported exposure (for both men and women) associated with chronic cough, chronic bronchitis and dyspnoea JEM based exposure was only associated with dyspnoea (men and women). Study investigates personal factors which may influence perception of exposure and states that gender and education should be included as determinants of recall
Bakke, 1991[51] **Norway**	Gen. Population (community) Age 18-73 yrs. (mean 42 yrs.). Males and females	Cross-sectional (two- phased) N=714 (438 referents)	Questionnaire –all jobs held plus past or present exposure (yes/no) to the following seven agents and work processes; asbestos, quartz, wood dust, metal gases, aluminium, welding and soldering Job titles coded and assigned to one of three exposure groups	a. Airflow limitation (FEV_1/FVC <0.7), (N=714) b. Obstructive lung disease- asthma or chronic bronchitis lung disease. Chronic obstructive lung disease – history of chronic cough; phlegm when coughing; breathlessness or	Overall air flow limitation non-significant for all chemical agents and work processes.

			(none. moderate and high)	wheezing or both ; and a ratio of FEV/FVC<0.7	
Heederik, 1990[35] **The Netherlands**	Random sample of 1088 men selected. Of these 878 (aged 40-59)	Longitudinal – 25 year follow-up (1960-1985) - Zutphen study Follow study – during follow up morbidity status (CNSLD) determined	Occupations coded in 1960 and used to generate exposures using JEM (British JEM-Pannett). IDR determined for occupational groups and occupational exposures Occupational groups: White collar workers, blue collar workers, farmers, furnace workers, engineering metal workers, wood and paper workers, textile workers and tailors, construction workers, other production workers, transport workers and warehouse workers Occupational exposures: Solvents, heavy metals, organic dust, mineral dust, fumes, adhesive, paints, cold, heat, outdoor, exposure to dusts, fumes, gases.	CNSLD -Incidence Density Ratio (IDR). Incidence of CNSLD defined as the first year in which the diagnosis of CNSLD was established CNSLD criteria: Episodes of respiratory symptoms such as regular cough and phlegm for longer than 3 months or episodes of wheezing or SOB reported by the survey physician or Diagnosis of CNSLD including chronic bronchitis or emphysema by a clinical specialist.	Blue collar workers had a significantly elevated IDR compared to white collar workers 1.82 (95% CI 1.35- 2.46). Heavy metals, mineral dust and adhesives had a significantly elevated IDR. 30% of the population had at least one exposure to dusts, fumes or gases in their occupation and had a significantly elevated IDR of 1.4 (1.07-1.85) compared to non-exposed workers
Heederik, 1989[34] **The Netherlands**	Gen. Population 1266 men invited to take part in 1985, 939 participated. Age 65- 84 yrs. (mean 72). Males	Cohort study Started 1960 followed up for 25 yrs. N=811	Exposure level assigned using a JEM (PANNETT) for the longest held job. Exposure graded as no exposure, low and high level of exposure. Low exposure was considered as no exposure i.e. leaving non, high exposure	a. Respiratory symptoms, CNSLD diagnosis and treatment and job (N=811) b. Respiratory symptoms, CNSLD diagnosis and treatment and specific exposure after exclusion of anyone ever been treated for asthma (N=677) c.	Exposure to the following associated with significant CNSLD; organic dust, organic solvents, paint, heat and working outdoors.

(Zutphen study)	12 Occupations categories; Agricultural workers, metal workers, wood worker, textile worker, food production worker, paper worker, construction worker, painter, transport and warehouse worker Exposure: ‘fumes, organic dust, mineral dust, heavy metals, organic solvents, heat, cold, working outdoors, adhesives, paints.	Respiratory symptoms: a. Wheezing and or asthma (n=182 cases) b. SOB (n=78) c. Cough and sputum (n=70) d. Ever treated for: emphysema or bronchitis. (n=119) Asthma (n=57) e. CNSLD diagnosis by physician