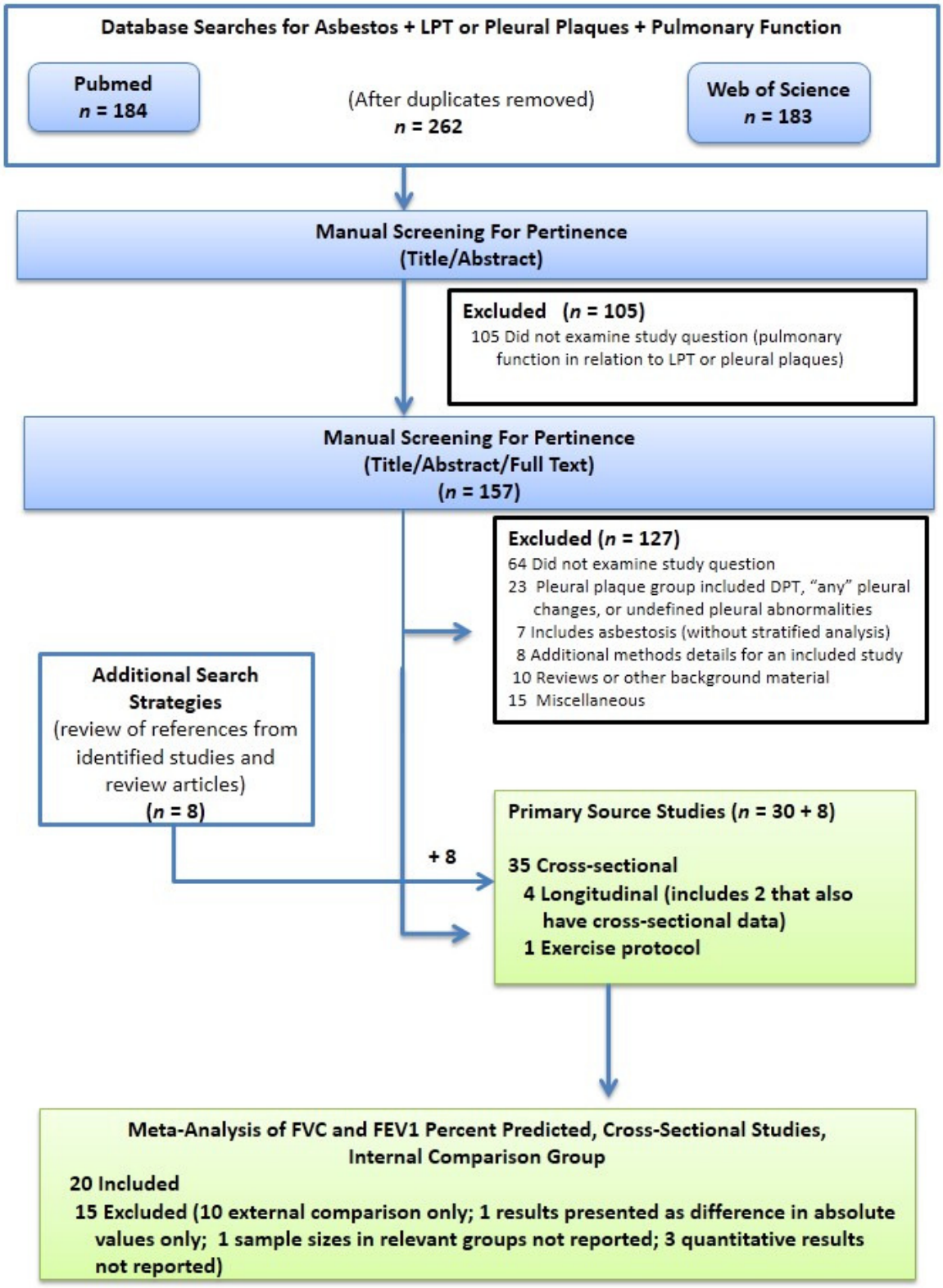


**Supplemental Figure 1.** Summary of literature search for studies of relation between LPT or pleural plaques and lung function.

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## Supplemental Table 1. Information abstracted for initial study evaluation

| | Information abstracted | Notes regarding potential limitations |
|---|---|---|
| Study participants | Geographic location<br>Source of exposure<br>Age<br>Duration of exposure<br>Time since first exposure (TSFE)<br>Smoking history<br>Current or retired workers | A short time since first exposure (i.e., <10 yr) or no information on time since first exposure in a relatively young study population (i.e., mean age <40 yr) considered a limitation, with potential for "false negative" results (i.e., these studies would miss an association that would be observed with longer follow-up).<br>Imbalance in smoking prevalence between comparison groups (i.e., pleural plaque vs. no pleural plaque groups) that was not addressed in the analysis considered a limitation; impact on risk estimate would depend on direction of the imbalance; similar considerations for age, sex, and height if absolute values, rather than predicted values, of pulmonary function parameters were used. |
| Selection process | Source, recruitment process<br>Exclusion/inclusion criteria<br>Comparison group: source, recruitment, matching<br>Participation rates, final *n* | Clinic-based studies, studies based on recruitment for medico-legal evaluations, or general screening studies with very low participation rates (<20%) considered a limitation because of concerns this process would result in differential selection based on symptoms or other effects and exposure. |
| Measures: x-ray or HRCT | Type of x-ray views, number of readers, training<br>Standards for classifying findings [e.g., 25]<br>Blinding to exposure and medical history<br>Definition, size of pleural abnormality group | Use of only one reader or of different readers in different locations without discussion of training and reliability testing considered a limitation because of concerns of outcome misclassification resulting, in large studies, in attenuation of the association of LPT with lung function (direction of bias is difficult to assess with small sample sizes).<br>Lack of blinding to exposure history, medical history, and other readings considered a limitation. |
| Measures: spirometry | Protocol reference for administration of lung function tests; number of technicians, number of trials<br>Blinding to exposure and medical history<br>Reproducibility (and use of nonreproducible results)<br>Source of reference values or equations | Use of absolute values, rather than predicted values, of lung function parameters considered a limitation (even if adjustment for age, sex, and height was addressed in the analysis) because it is difficult to compare to the majority of studies reporting predicted values.<br>Lack of any details regarding procedures used in spirometry considered a limitation, but no study provided all of the desired details. |
| Analysis | Confirm that study includes analysis of the association between LPT and lung function measures with an appropriate comparison group<br>Prevalence of smoking or mean pack-yr by group; use of smoking variable in the analysis | Analysis of "external comparison" only (i.e., comparison to an unexposed referent group rather than an internal comparison to an exposed referent group) or studies that provided lung function results (percentage predicted) for LPT or pleural plaque group without a comparison group considered a limitation because of issues of the comparability of the populations.<br>No adjustment for smoking when there is either no indication of the degree of difference in smoking between groups or when there was a large difference in smoking between groups (e.g., smoking prevalence >10% higher or mean pack-yr >10 pack-yr higher in pleural plaque group) considered a limitation. |
| Other | Miscellaneous (e.g., discrepancies in sample size or reported results) | |

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## Supplemental Table 2. Cross-sectional studies excluded from meta-analysis of mean difference in percentage predicted FVC or $FEV_1$

| Reference, methods details | Results, reason for exclusion |
|---|---|
| *X-ray studies* | |
| **Bourbeau et al. (1990)** [24]<br>Quebec<br>Construction—insulators (union)<br>85% participation<br>X-rays: two B Readers, blinding not reported<br>Spirometry: Renzetti (1979) procedures with some details<br>Excludes costophrenic angle obliteration and profusion ≥1/0; adjusted for age, height, smoking, and parenchymal disease (based on Gallium-67 uptake quantitation) | **Mean difference (liters) in absolute value, pleural plaques compared with no pleural plaques:**<br>**Difference** **(SE)**<br>FVC −0.20 (0.09)<br>$FEV_1$ −0.35 (0.1)<br>Excluded because results presented for absolute difference rather than difference in percentage predicted; *n* for pleural plaques group after exclusions not reported (approximately 50). |
| **Rosenstock et al. (1988)** [25]<br>United States (Washington)<br>Plumbers and pipefitters<br>Participation rate 20% in Seattle, 7% in Tacoma<br>X-rays: two readers, blinded<br>Spirometry: procedure reference not reported, some details provided<br>Limited to profusion score 0/– or 0/0 | Mean difference in percentage predicted FVC approximately 98 and 94%, respectively in the no pleural disease and bilateral discrete groups).<br>Excluded because sample sizes in relevant groups not reported. |
| *HRCT* | |
| **Lebedova et al. (2003)** [26]<br>Czech Republic<br>Asbestos-processing plants<br>Approximately 30% of random selection from within groups defined on the basis of x-rays taken in 2000<br>HRCT: readers not reported; blinding not reported<br>Spirometry: European Respiratory Society and European Coal and Steel Community guidelines<br>Adjusted for smoking, chronic bronchitis, BMI, and ischemic heart disease | *p*-value from adjusted interaction model<br>**Pleural lesions** **Fibrosis** **Pleural—Fibrosis Interaction**<br>FVC 0.0019 0.0003 0.0580<br>$FEV_1$ 0.0057 <0.0001 0.1498<br>Excluded because quantitative results not presented |
| **Neri et al. (1996)** [27]<br>Italy<br>Exposed workers<br>119/161 participated, reasons for exclusion unlikely to be related to both exposure and outcome;<br>HRCT: two readers, blinded to exposure<br>Spirometry: ATS guidelines | States that "No significant difference of pulmonary function tests was observed between the subjects with pleural plaques detected on HRCT and workers with normal pleura in absence of parenchymal involvement."<br>Excluded because quantitative results not presented |
| **Staples et al. (1989)** [28]<br>California (based on author affiliation)<br>Exposed workers<br>Participation rate not reported<br>HRCT: two readers, blinded<br>Spirometry: procedure reference not reported, some details provided | Analysis of "normal" group (*n* = 76) divided into with and without plaques; VC and $FEV_1$ percentage predicted reported as "not significantly different" but quantitative results not reported.<br>Excluded because quantitative results not reported. |

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**Supplemental Table 3. Pleural plaques and lung function studies evaluation: cross-sectional x-ray studies, internal comparison**

| Reference, Population[a] | Selection, Comparison Group Definitions | X-ray Measures | Spirometry | Study Groups |
|---|---|---|---|---|
| **Bresnitz et al. (1993)** [34]<br>Philadelphia<br>Construction—elevator (union)<br>Mean (SD) age 52.2 (7.9) yr<br>Mean (SD) duration 27.1 (5.8) yr<br>36% current smokers | Screening program in 1988 through local chapter of the International Union of Elevator Constructors for 20+ yr.<br>Eligibility based on membership<br>*n* = 91 (*n* total eligible not available) | P-A view<br>Two independent B Readers (+ 3rd reader for consensus) (moderate agreement between readers).<br>Blinded to exposure, medical history, and other reading.<br>ILO (1980) | ATS, 1987 procedures, at least three values. NIOSH certified technician, sitting position.<br>86% of patients had three acceptable curves and all had at least one (none excluded for nonrepeatability), highest value used<br>% predicted based on Crapo et al. (1981)<br>$FEV_1$, FVC, $FEV_1$/FVC, $FEF_{2575}$ | Pleural thickening (15 bilateral, 5 unilateral),<br>Excluded: DPT, interstitial changes ≥1/0 |
| **Di Lorenzo et al. (1996)** [35]<br>Italy<br>Asbestos cement factory<br>Mean (SD) age 54.5 (6.5) yr[a]<br>Mean (SD) duration 23.5 (7.4) yr[a]<br>50% current smokers[a] | Recruited through union, *n* = 30 (out of 35) participated.<br>Eligibility criteria not described. | P-A, lateral and oblique views.<br>Two readers (radiologist and occupational physician); 100% concordance<br>Blinded to exposure status and to other reading.<br>ILO (1980) | ATS, 1987 procedures, no details<br>Absolute value and % predicted based on reference values from European Community for Coal and Steel (Quanjer and van Zomeren, 1983)<br>$FEV_1$, FVC, $FEV_1$/FVC, PEF, $FEF_{25}$, $FEF_{50}$, $FEF_{75}$ | Pleural plaques (*n* = 10)<br>Healthy exposed (no bronchial, parenchymal, or pleural disease, *n* = 9)<br>Excluded: Asbestosis (diffuse interstitial fibrosis, ≥s 1/1, *n* = 11) |

**Supplemental Table 3. Pleural plaques and lung function studies evaluation: cross-sectional x-ray studies, internal comparison**

| Reference, Population[a] | Selection, Comparison Group Definitions | X-ray Measures | Spirometry | Study Groups |
|---|---|---|---|---|
| **Dujić et al. (1993)** [45]<br>Croatia<br>Asbestos cement factory<br>Mean (SD) age 58.2 (10.1) yr[a]<br>Mean (SD) cumulative exposure 39.6 (12.3) f-yr[a]<br>62% current smokers[a] | Current and retired workers;<br>*n* = 344 total (284 out of 309 current workers, 92%; 58 out of 112 retired workers, 52%). | P-A view<br>Two ILO-trained readers (radiologists)<br>Blinded to exposure, clinical, and pulmonary function data<br>ILO (1980) | ATS, 1987 procedures, best of three acceptable values<br>% predicted based on Cotes (1975)<br>$FEV_1$, FVC, FEV%, $FEF_{2575}$, TLC, RV, $DL_{CO}$<br>Restriction: FVC <80% and FEV% ≥70%<br>Obstruction: $FEV_1$ <80%, FEV% <70% | Isolated pleural plaques (Plaque-like thickening at the lung pleura interface along the lateral thorax or either hemidia-phragm was 2+ mm ) (*n* = 55)<br>No radiographic change (*n* = 255)<br>Excluded (*n* = 37): Isolated parenchymal changes (profusion ≤1/1, *n* = 16), combined pleural and parenchymal disease (*n* = 17), DPT (*n* = 4) |
| **García-Closas and Christiani (1995)** [33]<br>Massachusetts<br>Construction—carpenters (union)<br>Mean (SD) age 51.9 (8.6) [a]<br>Mean (SD) duration 28.0 (8.5) [a]<br>24% current smokers[a] | Invited to participate by union, 1987–1988.<br>618 out of 3,897 active workers (16%) and 13 out of 375 retired workers (3%) participated<br>*n* = 631 | P-A view<br>Two B Readers<br>Blinded to exposure history (mixed with 1,200 other x-rays)<br>ILO (1980) | ATS, 1987 procedures, multiple technicians, at least three values; nonreproducible results and results with only one value excluded.<br>% predicted based on Crapo et al. (1981).<br>$FEV_1$, FVC, FEV% | Circumscribed plaque without obliteration of costophrenic angle) (*n* = 64, 10%)<br>No abnormalities (*n* = 457, 72%) |

**Supplemental Table 3. Pleural plaques and lung function studies evaluation: cross-sectional x-ray studies, internal comparison**

| Reference, Population[a] | Selection, Comparison Group Definitions | X-ray Measures | Spirometry | Study Groups |
|---|---|---|---|---|
| **Hilt et al. (1987)** [38]<br>Norway<br>Asbestos-exposed workers<br>Mean (SD) age 67.3 (8.4) yr[a]<br>Mean (SD) duration 3.6 (3.8) yr[a]<br>39% current smokers[a] | County-wide screening of asbestos-exposed workers ($n$ = 21,483), referred for reexamination if abnormalities found on x-ray ($n$ = 1,431); 1,372 (96%) participated.<br>Exclusions: 141 with obstructive lung disease, lung cancer, sarcoidosis, other lung diseases as primary diagnosis and 591 other (non-asbestos) reasons for lung disease<br>$n$ = 634 | P-A + lateral views<br>Department radiologist followed by one B Reader<br>Blinding not described<br>Reference for definitions not cited | Procedure reference not given; no details (other than upright position).<br>Reference values based on asymptomatic men from Oslo, based on study using random sample of Oslo population<br>$FEV_1$, FVC, FEV%,<br>FVC <90% predicted,<br>FVC <80% predicted,<br>$FEV_1$ <80% predicted | Pleural plaques only ($n$ = 363, 57%)<br>Fibrosis with or without plaques ($n$ = 83, 13%)<br>No abnormalities, previous exposure ($n$ = 98, 15%)<br>No abnormalities, no reported exposure ($n$ = 90, 14%) |
| **Järvholm and Sandén (1986)** [6]<br>Sweden (Gothenburg)<br>Shipping industry<br>Mean (SD) age 54.9 (5.8) yr<br>Mean duration 26 yr<br>0% current smokers | General screening 1977–1979 ($n$ = 3,904 participated; total $n$ not reported). $N$ = 202, included if male, ages 40–65 and never smoked, no other known or suspected lung disease on chest x-ray, no other asbestos exposure before shipyards, no change of jobs during shipyards, ≥20 years time since first exposure<br>Insufficient exposure data ($n$ = 1) | P-A + lateral views<br>One reader (from group of three chest physicians)<br>Blinding not described | Procedure reference not given; Best of three values; Trained nurses ($n$ not reported). Tested before x-ray<br>% predicted based on Berglund et al. (1963)<br>$FEV_1$, FVC | Thiringer et al. (1980): Circumscribed thickening not extending to the apices or with connection to costophrenic sinuses, or ≥3 mm thickness on diaphragm if no calcification, or <5 mm thick and no calcifications with a marked edge at top and bottom ($n$ = 87) |
| **Järvholm and Larsson (1988)** [23]<br>Sweden (Gothenburg)<br>Asbestos-exposed workers<br>62% ages 50–59 yr[a]<br>43% current smokers[a]<br>89% >5 yr continuous exposure[a] | General screening, 1976 ($n$ = 4,268). Included if:<br>Men, ages 40–65 years, no other known or suspected lung disease, no cardiac disease<br>$n$ = 1,233 | P-A + lateral views<br>One reader (from group)<br>Blinding not described | Procedure reference not given; best of two values. A trained assistant<br>% predicted based on Berglund et al. (1963)<br>$FEV_1$ | Thiringer et al. (1980): Calcifications typically localized on the diaphragm or chest wall, or typically localized elevations on the diaphragm, ≥3 mm thick, with a sharp edge, or well-demarcated thickenings on chest wall ≥5 mm wide ($n$ = 130)<br>No pleural plaques ($n$ = 1,103) |

**Supplemental Table 3. Pleural plaques and lung function studies evaluation: cross-sectional x-ray studies, internal comparison**

| Reference, Population[a] | Selection, Comparison Group Definitions | X-ray Measures | Spirometry | Study Groups |
|---|---|---|---|---|
| **Miller et al., 1992** [41]<br>United States and Canada<br>Insulation workers<br>Mean (SD) age 57<br>80% current and exsmokers<br>Mean (SD) pack-yr 40.6 (26.2) | Cohort established 1967 (Selikoff and Hammond, 1979); 1981 to 1983 screening<br>Participation rate reported as approximately 40%. No difference in subsequent mortality between participants and nonparticipants.<br>*n* = 2,611 (*n* = 2,270 with duration ≥30 yr, plus 341 who joined with less than this duration) | P-A and lateral views<br>One B Reader<br>Blinded to occupational and medical history<br>ILO (1980) | ATS, 1987 procedures; standing position, ≥3 acceptable readings<br>% predicted based on random sample evaluated in the same laboratory controlling for smoking and age (Miller et al., 1986)<br>FVC | Pleural plaques (circumscribed and diffuse; diffuse = costophrenic angle obliteration)<br>**Limited to 0/– or 0/0 profusion score): *n* = 203 no pleural thickening, *n* = 121 circumscribed pleural plaques**, *n* = 7 diffuse pleural plaques |
| **Miller et al. (2013)** [40]<br>United States (four states)<br>Mean (SD) age 62.1 (9.5) yr<br>Mean (SD) duration 28.0 (10.6)<br>21% current smokers | Screening program through unions, 1997–2004 (for medicolegal evaluation)<br>Total *n* = 6,932; women, nonwhites, and missing smoking, x-ray, spirometry, or diffusing capacity data excluded<br>*n* = 4,003 | P-A and lateral views<br>One B Reader<br>Blinded to occupational and medical history<br>ILO (1980) | ATS, 1987 procedures (details not reported but equipment, techniques, technicians noted to be same as in teaching hospitals)<br>% predicted based on Crapo et al. (1981)<br>FVC | **Circumscribed only (*n* = 290)**<br>**Diffuse only (*n* = 10)**<br>**Circumscribed and diffuse (*n* = 16)**<br>Diaphragm only (*n* = 83)<br>Costophrenic angle (*n* = 1) |
| **Ohlson et al. (1985)** [37]<br>Sweden<br>Asbestos cement plant<br>Mean age 59.1 yr[a]<br>Mean fiber-yr 20.9 (range: 0–48)[a] | Screening offered in 1976 (after plant closed), participation rate 96%<br>Excluded if:<br>Retired, former smokers, female, <10 yr employment<br>Original group *n* = 125 exposed workers and 76 referents (for external comparison).<br>At follow-up: *n* = 75 exposed, 56 referents. 6 cases and 3 referents had died (cause of death for 5 of the 6 cases known, not related to asbestos), 32 cases and 9 referents had changed smoking status and were excluded. | P-A, lateral and oblique views<br>One qualified reader (member of National Pneumoconiosis Panel)<br>Blinding not described<br>ILO (1980) | Procedure reference not reported; sitting position; best of three values (within 5%).<br>One trained technician<br>Reference values from Berglund et al. (1963)) $FEV_1$, FVC | Pleural plaques (not defined) (*n* = 42, 34%) |

**Supplemental Table 3. Pleural plaques and lung function studies evaluation: cross-sectional x-ray studies, internal comparison**

| Reference, Population[a] | Selection, Comparison Group Definitions | X-ray Measures | Spirometry | Study Groups |
|---|---|---|---|---|
| **Oliver et al. (1988)** [31]<br>Pennsylvania<br>Railroad workers<br>Mean age 65 yr[a]<br>Mean duration 35 yr[a]<br>26% current smokers (among full sample) | Screening study, *n* = 383.<br>*n* = 377 white men<br>Excluded if:<br>Interstitial fibrosis (≥0/1, *n* = 6)<br>Diffuse pleural thickening (*n* = 10)<br>Unreadable x-rays (*n* = 2)<br>*n* = 359 | P-A and lateral views<br>One B Reader + one A or B Reader<br>Blinding not described<br>ILO (1980) | Renzetti (1979) procedures, ≥3 tests.<br>% predicted based on Crapo et al. (1981)<br>$FEV_1$, FVC, $DL_{CO}$ | Plaque-like thickening at the lung-pleura interface along the lateral chest wall tangentially or along the en face rib margin, ≥2 mm, or typical plaque-like thickening along either hemidiaphragm (*n* = 81, 23%)<br>No plaques(*n* = 278, 77%) |
| **Schwartz et al. (1990)** [39]<br>Iowa<br>Sheet metal workers union,<br>Mean (SD) age 57.0 (8.0) yr<br>Mean (SD) duration 32.7 (6.7) yr<br>31% current smokers<br>Mean pack-yr 28 | 12 union locals<br>1,223 out of 2,646 (46%) participated;<br>Included if:<br>Employed ≥25 yr<br>*n* = 1,211 with x-rays | P-A view<br>One experienced reader (+10% validation study)<br>Blinded to exposure history<br>ILO (1980) | Renzetti (1979) procedures, seated, without repeatability requirement (18% would have been excluded).<br>Average of the two largest values.<br>FVC (see Table 9—Schwartz) | Circumscribed plaque, without obliteration of costophrenic angle (*n* = 260, 21.5%); includes 31% with asbestosis ≥1/0<br>Diffuse (*n* = 74, 6%)<br>Normal (*n* = 877, 72%) |
| **Singh et al. (1999)** [21]<br>Australia<br>Asbestos-exposed (various sources)<br>Mean (SD) age 64.1 (2.3) yr[a]<br>Duration not reported<br>8% current smokers[a] | Cohort seen in outpatient clinic because of asbestos exposure, 1994–1995<br>Excluded if:<br>Clinical or x-ray evidence of asbestosis or other interstitial lung disease, asthma, emphysema, lung cancer, pleural effusions, neurologic or myopathic disorder likely to weaken respiratory muscles<br>*n* = 26 | Views not reported<br>One experienced reader<br>Blinding not described<br>ILO (1980)<br>No abnormalities (*n* = 7, 27%) | Reference not reported, details not provided.<br>% predicted based on various references<br>TLC, VC, RV | **LPT = costal and/or diaphragmatic plaques with no involvement of costophrenic angle (*n* = 12, 46%)**<br>DPT = costophrenic angle obliteration and thickening with or without calcification of the costal and/or diaphragmatic pleura (*n* = 7, 27%) |

**Supplemental Table 3. Pleural plaques and lung function studies evaluation: cross-sectional x-ray studies, internal comparison**

| Reference, Population[a] | Selection, Comparison Group Definitions | X-ray Measures | Spirometry | Study Groups |
|---|---|---|---|---|
| **Weill et al. (2011)** [30]<br>Montana (Libby)<br>Community-based<br>Mean (SE) age 60.07 (0.53) yr[a]<br>64% ever smokers | Community screening, includes former workers at vermiculite mine and mill, family members, and other area residents;<br>*n* = 7,307<br>Excluded if:<br>No chest x-ray (*n* = 639)<br>Age <25 or >90 yr or missing spirometry (*n* = 817)<br>Other (nonvermiculite) exposure likely (*n* = 1,327)<br>No consensus x-ray reading, missing smoking data or missing exposure pathway data (*n* = 127)<br>*n* = 4,397 | P-A view<br>Two out of three B Readers consensus<br>Blinding not described<br>ILO (1980) | ATS, 1995 procedures, three acceptable (two reproducible) tests or one or two acceptable tests.<br>% predicted based on Knudson et al. (1983).<br>$FEV_1$, FVC, $FEV_1$/FVC | |
| **Zavalić and Bogadi-Sare (1993)** [36]<br>Croatia<br>Shipyard workers<br>Mean (SD) age 45.1 (5.2) yr[a]<br>Mean (SD)duration 21.5 (14.1) yr[a]<br>Smoking data not reported | Excluded 51 with other confirmed diseases could affect pulmonary function<br>No changes (*n* = 101)<br>Pleural plaques only (*n* = 68)<br>Parenchymal fibrosis (*n* = 130; *n* = 42 only parenchymal fibrosis)<br>No DPT, effusion, mesothelioma or lung cancer. All plaques were bilateral. | P-A and oblique views<br>Agreement based on two out of three readers (independent readings; two occupational health specialists and a radiologist)<br>Blinding not described<br>ILO (1980) | Procedure reference not provided. Best of three values<br>% predicted based on Quanjer et al. (1993) $FEV_1$, FVC, $FEV_1$/FVC, $MEF_{25}$, $MEF_{50}$, $MEF_{75}$ | Pleural abnormality excluding DPT, costophrenic angle obliteration, or interstitial disease (profusion ≥1/0) (*n* = 482, 11%)<br>DPT and costophrenic angle obliteration, no interstitial disease (*n* = 33, 1%)<br>Interstitial disease (profusion ≥1/0) (*n* = 40, 1%)<br>No abnormality (*n* = 4,065; 92%)<br>(total = 4,620, bigger than 4,397) |

**Supplemental Table 4. Pleural plaques and lung function studies evaluation: cross-sectional HRCT studies, internal comparison**

| Reference, population[a] | Selection, Comparison Group Definitions | HRCT measures | Spirometry |
|---|---|---|---|
| **Clin et al. (2011)** [32]<br>France<br>Exposed workers (retired or inactive)<br>Mean (SD) age 64.6 (5.4) yr[a]<br>72% duration ≥30 yr[a]<br>TSFE not reported<br>6.4% current smokers[a]<br>Pack-yr not reported | Various recruitment strategies (letters, union, advertisements) for medical surveillance program<br>4,812 recruited, excluded: 312 missing data;<br>873 inadequate CT quality, 57 extreme spirometry values, 227 asbestosis or other interstitial abnormalities<br>*n* = 2,743<br>Isolated pleural plaques (*n* = 403, 14.7%)<br>Normal (*n* = 1,802, 65.7%)<br>(excluding 123 with pleural plaques with and other nonspecific abnormalities [e.g., emphysema, bronchiectasis], 41 with diffuse pleural thickening, and 374 with other nonspecific abnormalities) | Independent reading by two (out of panel of seven) readers<br>Blinded to asbestos exposure and smoking | Procedure reference not reported.<br>Multiple locations.<br>% predicted based on Quanjer et al. (1993) European reference equations.<br>Extreme values excluded (*n* = 57) |

**Supplemental Table 4. Pleural plaques and lung function studies evaluation: cross-sectional HRCT studies, internal comparison**

| Reference, population[a] | Selection, Comparison Group Definitions | HRCT measures | Spirometry |
|---|---|---|---|
| **Oldenberg et al. (2001)** [43]<br>Germany<br>Exposed workers:<br>Mean age not reported<br>Mean duration 30.7 yr<br>TSFE not reported<br>76.2% of those with pleural plaques, and<br>68.2% of those without plaques, current or ex-smokers<br><br>Additional study details provided in personal communication from Xavier Baur to L. Kopylev, 3/13/2014). | Registry of asbestos-exposed workers (n~500,000); included highly exposed subjects with no other lung disease, who had pleural plaques or without pleural or pulmonary asbestos-associated changes.. Approximately 2/3 I nregistry undergo periodic exams. This study conducted in Bocham area.<br>*n* = 43<br>Authors stated no subjects showed signs of parenchymal abnormalities<br>Pleural plaques only (*n* = 21, 48.8%)<br>Normal (*n* = 22, 51.2%) | HRCT: reading procedures not described, blinding not reported. | Spirometry procedures and references not described.<br><br>$FEV_1$,FVC, $FEV_1$/VC%, $MEF_{25}$, $MEF_{50}$, $MEF_{75}$ |
| **Rui et al. (2004)** [44]<br>Italy<br>Mean (SD) age 53 (7) yr[a]<br>Mean (SD) duration 30 (6) yr[a]<br>TSFE not reported[a]<br>22% smokers (<15 pack-yr), 42% smokers (≥15 pack-yr), 36% non-smokers[a]<br>42% current workers<br><br>Additional study details provided in personal communication from Francesca Rui to L. Kopylev, 3/15/2014). | Workers referred to an occupational medicine clinic 1991-2000; included those with history of asbestos exposure; had two spirometry tests performed at least one year apart; had radiological examination performed; no signs of interstitial fibrosis, emphysema, bronchiecstasis, pleurisy, TB, or other significant lung, cardiac, skeletal or systemic disease. Included only those workers with pleural plaques on x-ray who were further referred for HRCT.<br>*N* = 103<br>Pleural plaques described by location (unilateral/bilateral, diaphragmatic) and presence of calcification; defined as "circumscribed areas of thickening of the parietal pleura in thoracic cage and/or diaphragm"<br>Pleural plaques only (*n* = 36, 35%)<br>Normal (*n* = 67, 65%) | One reader for x-ray and HRCT, blinding not reported. | Spirometry procedures not referenced.<br><br>Reference values from CECA71<br><br>$FEV_1$, VC, TLC |

**Supplemental Table 4. Pleural plaques and lung function studies evaluation: cross-sectional HRCT studies, internal comparison**

| Reference, population[a] | Selection, Comparison Group Definitions | HRCT measures | Spirometry |
|---|---|---|---|
| **Soulat et al. (1999)** [42]<br>France<br>Nitrate fertilizer plant (asbestos insulation)<br>(former workers)<br>Mean (SE) age 65.2 (0.6) yr<br>Mean (SE) duration 12.9 (0.6) yr<br>Mean (SE) TSFE 38.9 (0.5) yr<br>19% current smokers<br>Mean (SE) 22.6 (1.6) pack-yr | 350 ex-workers identified through retirement association; 254 potentially exposed, still living;<br>*n* = 170 participants<br>Pleural changes defined by size and appearance: normal, focalized, and diffuse thickening (*n* =84 without parenchymal changes).<br>Parenchymal abnormalities were interpreted on the basis of previous studies (Yoshimura et al., 1986; Aberle et al., 1988)<br>N=84 pleural thickening only;<br>No abnormalities (*n* = 51) | One reader, blinded to patient history and x-ray results | Spirometry procedures not referenced.<br>Reference values from Quanjer et al.,1993 |
| **van Cleemput et al. (2001)** [22]<br>Belgium<br>Asbestos cement factory<br>Mean (SD) age 43.5 (2.2) yr<br>Mean (SD) duration 25.0 (1.4) yr<br>Mean (SD) cumulative exposure 26.3 (12.2) fiber-yr/mL<br>85% ever smokers<br>Mean pack-yr 10.9 yr<br>100% current workers | Included if:<br>Born between 1945 and 1954<br>Hired between 1965 and 1969<br>Worked ≥2yr<br>*n* = 73 (out of 88 identified workers; 3 of 15 nonparticipants had plaques)<br>Pleural plaques seen in 26% of exposed workers by x-ray, and in 70% by HRCT. None of the exposed workers had asbestosis or profusion scores above 1/0 | CT scans (reading protocol not stated)<br>X-rays: ILO (1980) three independent readers, blinded to exposure status | European procedures<br>Quanjer et al. (1993) (details not reported)<br>Percentage predicted based on Quanjer et al. (1993)<br>$FEV_1$, $FEV_1$/VC, PEF%, $MEF_{25}$, $MEF_{50}$, $MEF_{75}$, TLCO (transfer fraction for CO) |

TSFE = time since first exposure.

[a]Descriptive data for pleural plaque (or LPT) group; when not noted as such, data is for full study sample.

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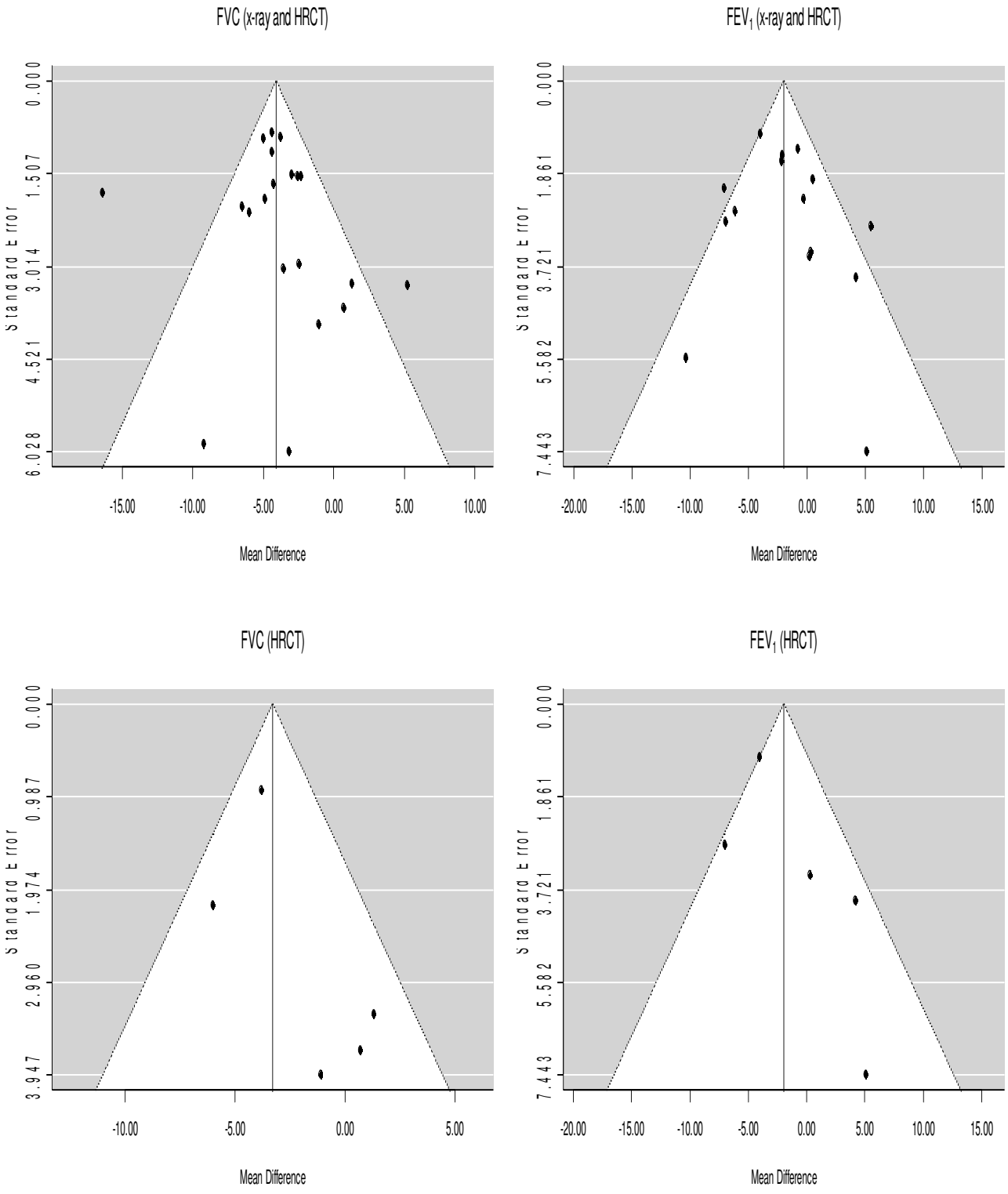
## Supplemental Table 5. Longitudinal studies examining FVC or $FEV_1$

| Reference, methods details | Results |
|---|---|
| **Ohlson et al. (1985)** [37]<br>Sweden<br>Asbestos cement plant<br>4 yr follow-up; no continuing exposure<br>96% participation<br>X-ray: one qualified reader, blinding not reported<br>Spirometry—procedure reference not given, some details<br>**Related reference: Ohlson et al. (1984)** | From Table 6<br>**Mean adjusted decline (compared with baseline assessment)**<br>**Pleural plaques (*n* = 24)** / **No pleural plaques (*n* = 50)** / **Mean difference in amount of loss**<br>FVC: 6.34 / 6.74 / 0.40<br>$FEV_1$: 6.43 / 7.39 / 0.96<br>Adjusted for height, age, tracheal area, cumulative exposure, and smoking. |
| **Rui et al. (2004)** [44]<br>Italy<br>Referrals to an occupational medicine clinic<br>3.7 yr follow-up<br>Participation rate not reported; participants had evidence of pleural plaques on x-ray and subsequent referral for HRCT<br>HRCT: 1 reader, blinding not reported.<br>Spirometry: procedure reference, some details | From Table 2<br>**Mean (SD) percentage predicted, by group**<br>First examination: Plaques (*n* = 36) / No Plaques (*n* = 67)<br>Last examination: Plaques (*n* = 36) / No Plaques (*n* = 67)<br>Mean reduction (95% CI) for those with Plaques*<br>VC: 91 (10) / 97 (10) / 90 (10) / 96 (11) / -3.4 (-7.9, 1.0)<br>$FEV_1$: 97 (13) / 103 (12) / 95 (14) / 102 (13) / -1.5 (-7.1, 4.0))<br>*Adjusted for smoking habit and seniority |
| **Ostiguy et al. (1995)** [48]<br>Canada<br>Copper refinery; asbestos removal and TLVs not exceeded over study period<br>7 yr follow up<br>Loss to follow-up not reported<br>X-rays: two experienced readers, blinded;<br>Spirometry: Renzetti (1979) procedures, some details | From Table 7<br>**Mean(SEM) Annual Loss (mL/yr)**<br>**Pleural plaques (*n* = 51)** / **No pleural plaques (*n* = 211)** / **Mean difference in rate of loss**<br>FVC: 31 (12) / 15 (6) / 16 mL/yr |
| **Sichletidis et al. (2006)** [47]<br>Greece (residential exposure); no continuing exposure<br>15 yr follow-up<br>78% follow-up<br>X-rays: two experienced readers, blinding not reported<br>Spirometry procedure reference not given, some details | From Table II<br>**Mean (SD) among people with pleural plaques (*n* = 18)**<br>**1988** / **2003** / **Difference, 2003 minus 1988**<br>FVC % predicted: 94.74 (17.98) / 80.12 (13.76) / −14.62<br>$FEV_1$ %predicted: 93.43 (13.56) / 89.1 (10.84) / —4.33 |

**Supplemental Figure 2. Funnel plots for main analyses**



**Additional Details of Study Evaluation**

Three of the included studies did not have the required data on lung function for the overall pleural plaque and no plaque groups, but did provide these data broken down by another variable (exposure level or size of pleural plaque); for these three studies, data were pooled across categories (weighted by number of individuals in each category) before inclusion in the analysis [6 36 37]. Miller, et al. [40] used 1980 ILO guidelines, but presented data for circumscribed pleural plaques and plaques on the diaphragm separately. The combination (weighted average) of these two groups was used in the analysis. Additionally, Ohlson, et al. [37] only reported the overall number of individuals with and without pleural plaques, rather than numbers within each category of exposure; thus, the number of individuals within each category was imputed as proportional to the numbers in the entire study group.

Three studies did not provide standard deviations or standard errors for respiratory measures [37 38 41]. In addition, two studies [30 31] reported overall standard deviations, but did not present variance estimates for the smoking-adjusted results [males only results for Weill et al. [30]] used in the meta-analyses. For these five papers, standard deviations were imputed as the linear average of reported standard deviations in other studies, weighted by sample size, across the pleural plaque and no pleural plaque groups. For Järvholm and Larsson [23], only data on smokers (in both the pleural plaque and no pleural plaque groups) were used, because no information was included on the number of former smokers and nonsmokers.