# Increasing incidence of asbestosis worldwide, 1990 to 2017: Results from the Global Burden of Disease Study 2017

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# 1 Detailed material and methods

## 1.1 Study data

The number of incident cases and the age-standardized incidence rates (ASIRs) from 1990 to 2017 were collected from the Global Health Data Exchange (GHDx) query tool (http://ghdx.healthdata.org/gbd-results-tool). The general methods used in the GBD study have been published previously[1]. Briefly, incidence estimates for the asbestosis are produced using a standard DisMod-MR 2.1 approach. Incidence was extracted from systematic reviews, inpatient hospital reports, and claims data. In the GBD study 2017, the International Classification of Diseases (ICD) 9 (500-505.9) and ICD 10 (J60-J65.0 and J92.0) were used to code the diseases and then estimate their incidence.

## 1.2 Statistical analysis

Firstly, we categorized 195 countries and territories into five regions (low, low-middle, middle, high-middle, and high) according to the socio-demographic index (SDI) used in GBD study. As a summary measurement that identifies which countries or other geographic areas sit on the spectrum of development, SDI is expressed on a scale of 0 to 1. Furthermore, all countries were divided into 21 areas based on geography, such as Central Asia. The ASIR (per 100,000 population) is calculated as follows: $\text{ASIR} = \frac{\sum_{i=1}^{A} a_i w_i}{\sum_{i=1}^{A} w_i} \times 100{,}000$, where $\alpha$ is the age-specific rates ($a_i$, where $i$ denotes the $i^{th}$ age class) and w is the number of population (or weight) ($w_i$) in the same subgroup. We fitted a logarithm of the ASIR with year using generalized linear regression models, $i.e., y = \alpha + \beta\chi + \varepsilon$, where $y = \ln(\text{ASIR})$, and $\chi = (\text{calendar year})$.



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Secondly, we employed the Joinpoint regression analyses to examine the incidence trends. This technique fits a series of joined straight lines to the trend of ASIR[2]. Logarithmic transformation of the rates was performed with computation of the standard errors based on binomial approximation. To determine the direction and magnitude of the recent trends, the average annual percentage changes (AAPCs) and the respective 95% confidence intervals (CI) were evaluated for the overall period. The AAPC is a geometric weighted average of various APCs obtained by connection point trend analysis software through connection point regression analysis, and its weight is equal to the length of each segment within a specified time interval[3]. In describing the change, the terms "increase" or "decrease" were used when the AAPC was statistically significant; otherwise, the term "stable" was used. In Joinpoint analyses, APCs and 95% CI were calculated to measure the secular and current trends. All analyses were performed using the R Statistical Software (Version 3.4.3).

**Reference**

1 Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017[J]. Lancet (London, England), 2018, 392(10159): 1789-1858.

2 Clegg L X, Hankey B F, Tiwari R, et al. Estimating average annual per cent change in trend analysis[J]. Statistics in medicine, 2009, 28(29): 3670-3682.



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3 Wong M C S, Goggins W B, Wang H H X, et al. Global incidence and mortality for prostate cancer: analysis of temporal patterns and trends in 36 countries[J]. European urology, 2016, 70(5): 862-874.

# 2 Supporting information figures

Fig. S1. The percentage change in absolute number of asbestosis between 1990 and 2017.

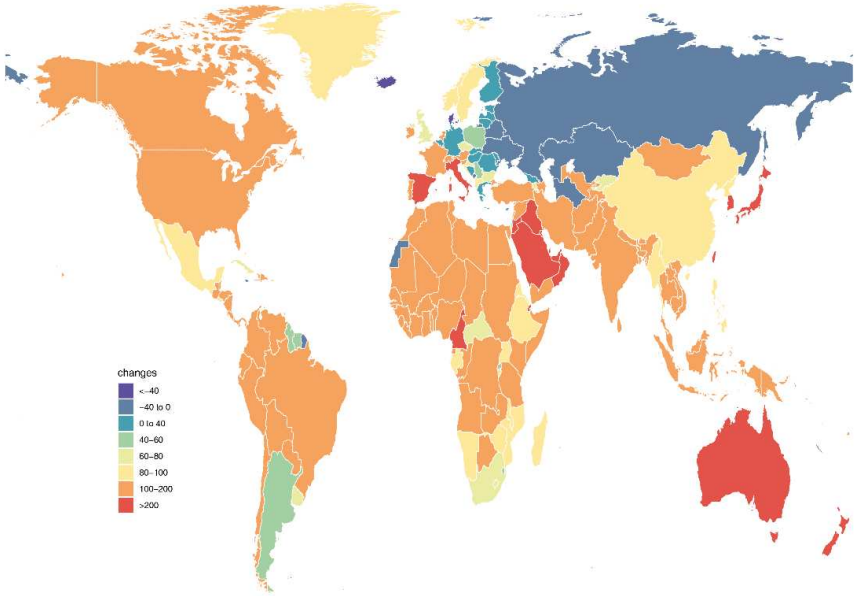
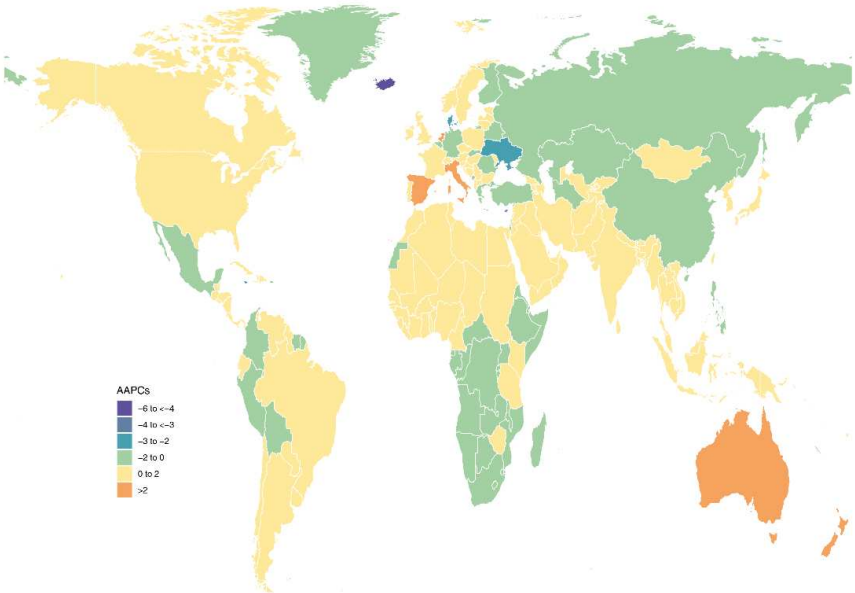



Fig. S2. The average annual percentage change in ASIR of asbestosis from 1990 to 2017.



# 3 Supporting information tables

**Table S1. The incident cases and ASIR of asbestosis in 1990 and 2017, and it's temporal trends from 1990 to 2017.**

| Regions | 1990 | | 2017 | | 1990-2017 |
|---|---|---|---|---|---|
| | Incident cases No.×$10^3$(95%UI) | ASIR per 100,000 No.(95%UI) | Incident cases No.×$10^3$ (95%UI) | ASIR per 100,000 No.(95%UI) | AAPC No.(95%CI) |
| Global | 4.34(3.49,5.49) | 0.10(0.08,0.13) | 9.40(7.65,11.7) | 0.12(0.10,0.15) | 0.57(0.52 to 0.62) |
| Low-SDI | 0.41(0.32,0.52) | 0.11(0.09,0.14) | 0.87(0.66,1.13) | 0.11(0.09,0.14) | -0.08(-0.19 to 0.02) |
| Low-middle-SDI | 0.51(0.39,0.67) | 0.08(0.06,0.10) | 1.08(0.81,1.45) | 0.08(0.06,0.11) | 0.23(0.11 to 0.36) |
| Middle-SDI | 1.03(0.80,1.36) | 0.09(0.07,0.12) | 2.03(1.55,2.69) | 0.09(0.07,0.12) | -0.20(-0.33 to -0.08) |
| Middle-high-SDI | 0.73(0.56,0.99) | 0.07(0.06,0.10) | 1.30(0.95,1.74) | 0.07(0.05,0.10) | -0.27(-0.44 to -0.09) |
| High-SDI | 1.64(1.34,2.05) | 0.13(0.1,0.16) | 4.09(3.43,4.86) | 0.18(0.16,0.22) | 1.59(1.47 to 1.70) |

ASIR, age standardized incidence rate; UI, uncertainty interval; CI, confidence interval; AAPC, average annual percentage change.



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**Table S2. Joinpoint analyses of trends in asbestosis incidence, by SDI regions, from 1990 to 2017.**

| Regions | Trend 1 | | Trend 2 | | Trend 3 | | Trend 4 | |
|---|---|---|---|---|---|---|---|---|
| | Period | APC | Period | APC | Period | APC | Period | APC |
| Global | 1990-1994 | -0.43(-0.56,-0.30) | 1994-2003 | 0.80(0.76,0.85) | 2003-2011 | 0.34(0.28,0.39) | 2011-2017 | 1.06(0.09,1.13) |
| Low-SDI | 1990-1999 | -0.68(-0.75,-0.61) | 1999-2005 | 0.20(0.02,0.37) | 2005-2011 | -0.52(-0.70,-0.34) | 2011-2017 | 1.36(1.23,1.50) |
| Low-middle-SDI | 1990-1997 | -0.74(-0.90,-0.58) | 1997-2005 | 0.41(0.25,0.57) | 2005-2012 | 0.00(-0.21,0.20) | 2012-2017 | 2.01(1.73,2.28) |
| Middle-SDI | 1990-1993 | -1.58(-1.96,-1.19) | 1993-2011 | -0.38(-3.09,-0.30) | 2011-2014 | 1.03(0.23,1.82) | 2014-2017 | 1.93(1.53,2.33) |
| Middle-high-SDI | 1990-2001 | -0.52(-0.61,-0.42) | 2001-2004 | -1.70(-0.41,-0.35) | 2004-2011 | -0.15(-0.39,0.09) | 2011-2017 | 1.84(1.59,2.08) |
| High-SDI | 1990-1995 | 0.75(0.57,0.93) | 1995-2003 | 2.49(2.38,2.60) | 2003-2012 | 1.21(1.13,1.30) | 2012-2017 | 0.64(0.47,0.82) |

APC, annual percentage change



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