

How much fine particulate do you inhale if you live with a smoker who smokes indoors?



www.smokefreehomes.network

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Second-hand smoke (SHS) in homes

- Variety of projects measuring SHS over past 8 years
 - All 'baseline' or 'pre-intervention' data
 - 203 smoking homes (1,007,723 minutes)
 - 28 non-smoking homes (40,599 minutes)
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- Does feedback of air quality information encourage smoking parents to make their home smoke-free?
 - How large is the difference in air quality between smoke-free and smoking homes?
 - How long does SHS linger in household air?
 - How does SHS compare to outdoor air pollution?



PM_{2.5} = Particulate less than 2.5 micrometers in size

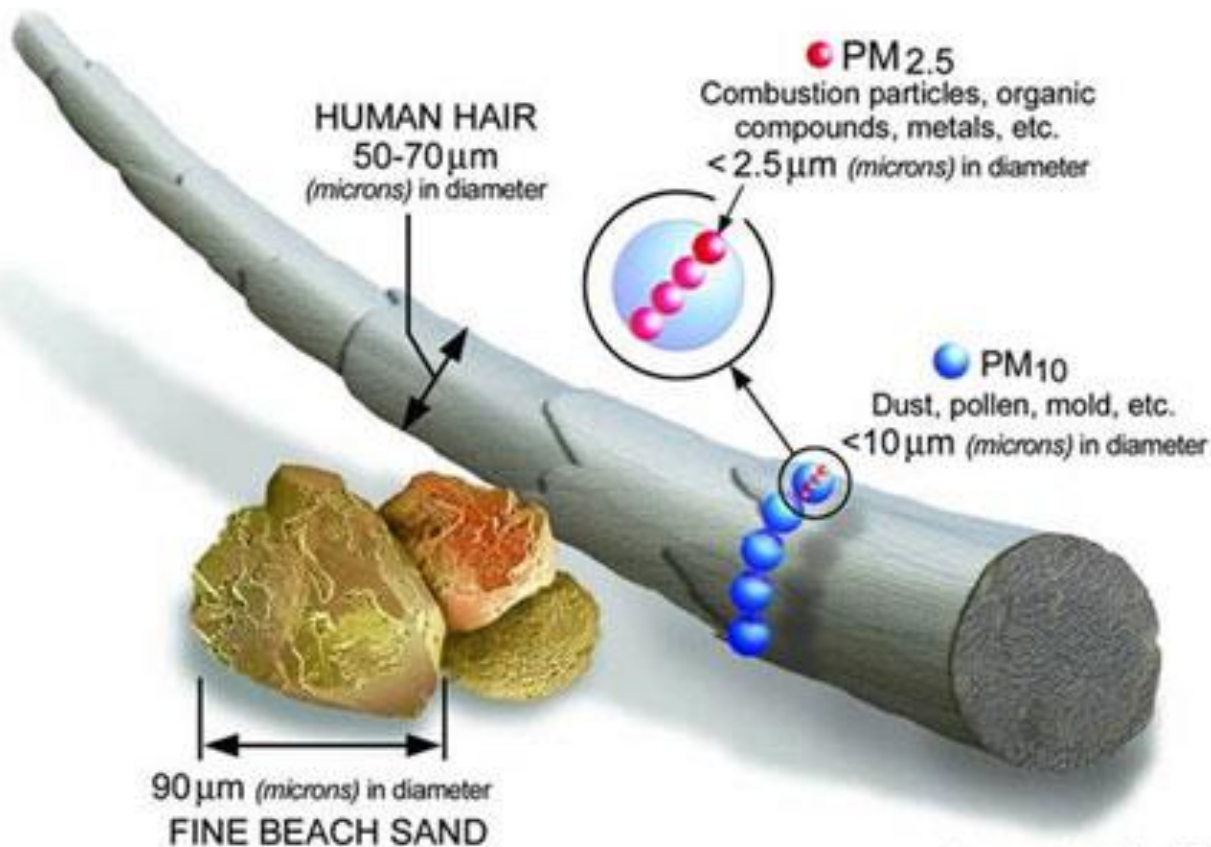


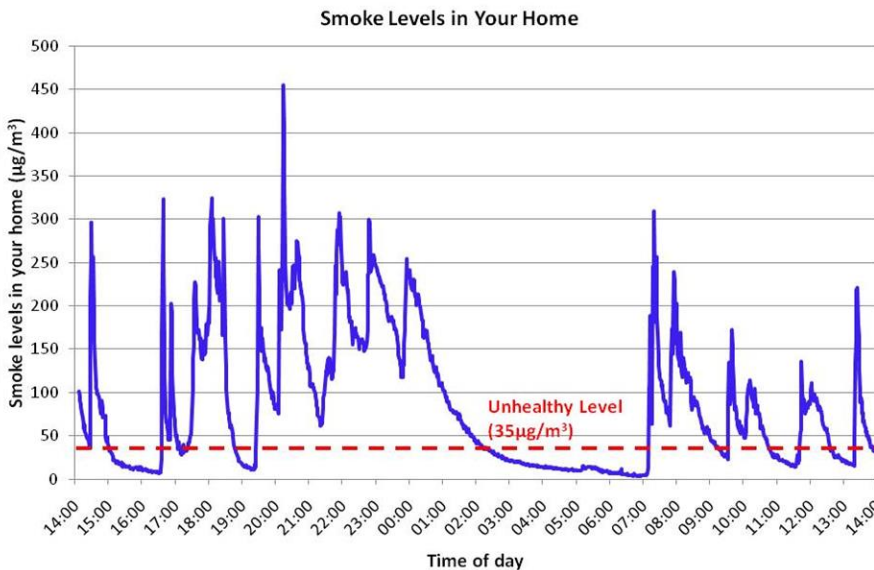
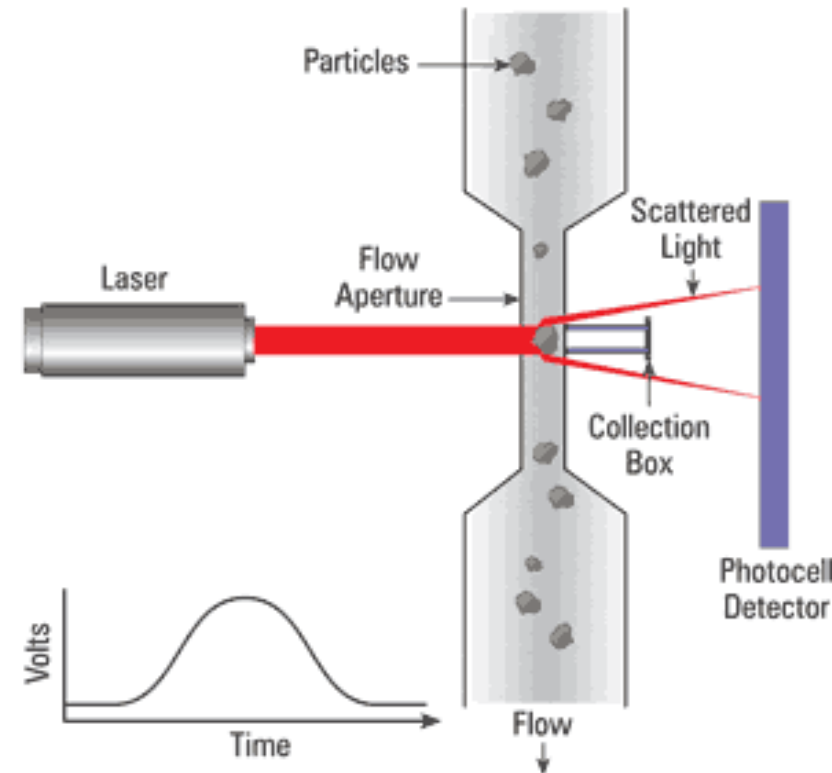
Image courtesy of the U.S. EPA

- Small particles that are inhaled in to the deep areas of the lung
- Lots of epidemiological evidence that PM_{2.5} air pollution is linked to respiratory and cardiovascular health effects
- WHO guidance value of 25 μg/m³

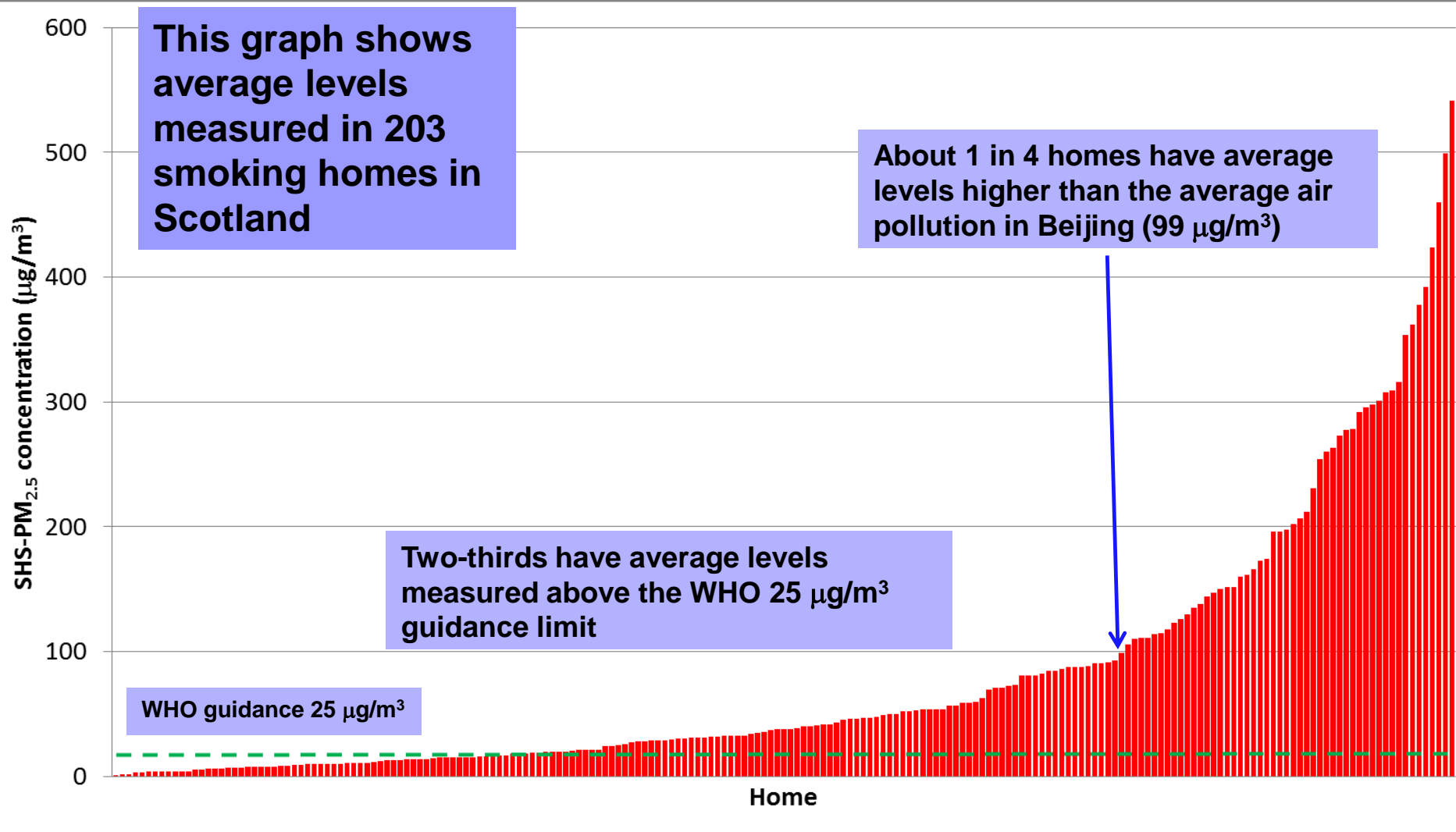


How do we measure SHS?

- PM_{2.5} as a marker of SHS



Not all smoking homes are the same...



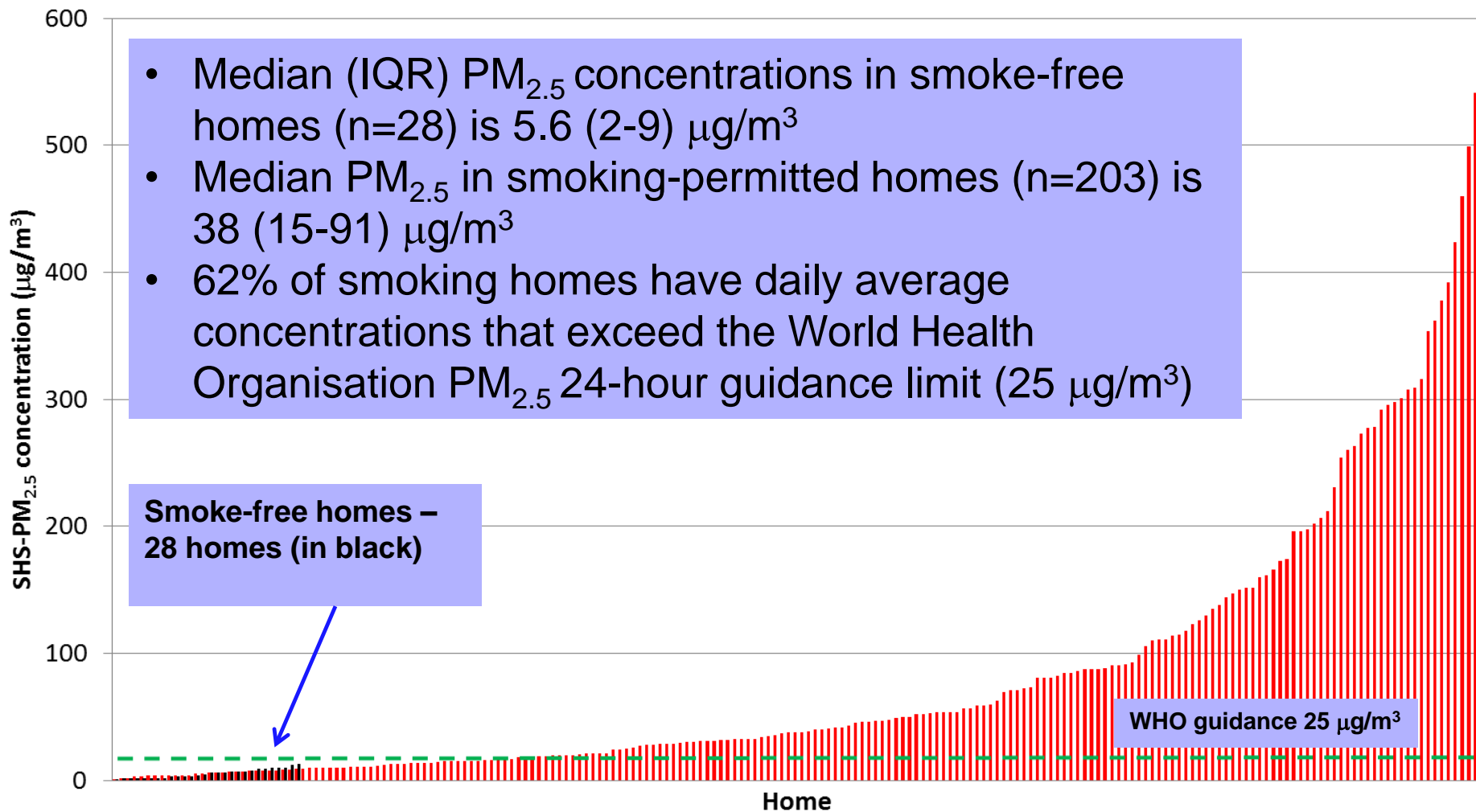
Smoke-free homes are about x7 lower

- Median (IQR) PM_{2.5} concentrations in smoke-free homes (n=28) is 5.6 (2-9) µg/m³
- Median PM_{2.5} in smoking-permitted homes (n=203) is 38 (15-91) µg/m³
- 62% of smoking homes have daily average concentrations that exceed the World Health Organisation PM_{2.5} 24-hour guidance limit (25 µg/m³)

Smoke-free homes –
28 homes (in black)



WHO guidance 25 µg/m³



Daily PM_{2.5} dose

- Time-activity data for typical person
 - 2 year old child
 - 11 year old school child
 - 40 year old working adult
 - 70 year old housebound adult

- Living in:
 - Smoking permitted home
 - Smoke-free home

- Compared to adult living in smoke-free home in Beijing (high outdoor air pollution)

- Used Monte Carlo modelling of different time-activity and concentrations to generate mean, 5th and 95th percentile of distributions



Daily inhalation of PM_{2.5} by scenario

Table 3 Inhalation intake estimates for each exposure scenario

Scenario	Intake ($\mu\text{g}/\text{day}$)	Percentage of intake from home
2-year-old child SF home	34 (2.4–127)	49 (2.3–97)
2-year-old child smoking home	298 (54–971)	91 (61–100)
11-year-old child SF home	45 (3.3–163)	40 (1–95)
11-year-old child smoking home	291 (55–909)	97 (47–100)
40-year-old adult SF home	59 (4.2–217)	37 (1–93)
40-year-old adult smoking home	334 (62–1046)	84 (39–100)
70-year-old housebound adult SF home	27 (0.7–118)	100 (100–100)
70-year-old housebound adult smoking home	479 (77–1630)	100 (100–100)
Adult urban polluted; SF home	572 (147–1200)	46 (28–64)

Mean with 5th and 95th centile values in parenthesis.

PM, particulate matter; SF, smoke-free.



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Reductions in PM_{2.5} exposure of changing to SF home

- For a 2 year old child the mean reduction in daily intake is likely to be **79%** (95% CI 28-99%)
- For an 11 year old child the mean reduction in daily intake is likely to be **76%** (95% CI 23-99%)
- For an adult the mean reduction in daily intake is likely to be **74%** (95% CI 19-99%)
- For an elderly housebound adult the mean reduction in daily intake is likely to be **86%** (95% CI 40-100%)
- To achieve this scale of reductions in PM_{2.5} daily intake for non-smokers we'd need to ban most vehicles and most industrial emissions in the UK....



The screenshot shows a BBC News article from April 26, 2013. The article title is "Edinburgh sees increase in number of polluted streets". The sub-headline reads: "Environmentalists are calling for 'urgent action' after an increase in the number of Edinburgh streets affected by transport pollution." The article text states that an additional six miles of streets in Edinburgh have been deemed officially polluted. It lists tourist areas like Princes Street, George Street, and the Royal Mile as included. It also mentions that Gorgie Road, London Road, and parts of Easter Road are also included. The article notes that the city council is extending its air pollution problem zones to include Inverleith Row and Glasgow Road, and that the Cowgate, Grassmarket, and parts of Gorgie Road and Easter Road will be added to the central zone.

Edinburgh sees increase in number of polluted streets

Environmentalists are calling for "urgent action" after an increase in the number of Edinburgh streets affected by transport pollution.

There are now an additional six miles of streets that have been deemed officially polluted in the capital.

Tourist areas Princes Street, George Street, most of the Royal Mile and the Grassmarket are all now included.

Edinburgh City Council said it was looking at ways to cut pollution in the busiest parts of the city.

Gorgie Road, London Road and some of Easter Road also make up the additional six miles of polluted streets.

The city council is extending its existing three air pollution problem zones: central, St Johns Road and Great Junction Street and adding two new ones at Inverleith Row and Glasgow Road.

The Cowgate, the Grassmarket, most of Gorgie Road, London Road and the top of Easter Road will be added to the central zone.

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- UN to scrutinise tram complaint



Summary

- Smoking-permitted homes have $PM_{2.5}$ concentrations about 7-10 times higher than smoke-free homes
- Many non-smokers living with a smoker inhale a similar mass of $PM_{2.5}$ as a non-smoker living in a heavily polluted city such as Beijing
- Non-smokers living in smoking households would experience reductions of over 70% in their daily inhaled $PM_{2.5}$ intake if their home became smoke-free.
- The reduction is likely to be greatest for the very young and for older members of the population because they typically spend more time at home.
- Achieving smoke-free homes likely to have much greater benefits for children living in smoking households than any improvement in outdoor air quality that can be achieved in Scotland



Further details and acknowledgements

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Research paper

Fine particulate matter concentrations in smoking households: just how much secondhand smoke do you breathe in if you live with a smoker who smokes indoors?

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ABSTRACT

Objective Using data on fine particulate matter less than 2.5 μm ($\text{PM}_{2.5}$) concentrations in smoking and non-smoking homes in Scotland to estimate the mass of $\text{PM}_{2.5}$ inhaled by different age groups.

Methods Data from four linked studies, with real-time measurements of $\text{PM}_{2.5}$ in homes, were combined with data on typical breathing rates and time-activity patterns. Monte Carlo modelling was used to estimate daily $\text{PM}_{2.5}$ intake, the percentage of total $\text{PM}_{2.5}$ inhaled within the home environment and the percentage reduction in daily intake that could be achieved by switching to a smoke-free home.

Results Median (IQR) $\text{PM}_{2.5}$ concentrations from 93 smoking homes were 31 (10–111) $\mu\text{g}/\text{m}^3$ and 3 (2–6.5)

35 $\mu\text{g}/\text{m}^3$ 'unhealthy for sensitive groups' 24 h limit⁴ or the 25 $\mu\text{g}/\text{m}^3$ 24 h (10 $\mu\text{g}/\text{m}^3$ annual) WHO⁵ guidance limits for $\text{PM}_{2.5}$. While researchers and policymakers have used these data to communicate the effects of SHS on indoor air quality, there has tended to be a disconnect between public perception of SHS-derived $\text{PM}_{2.5}$ and the hazard of outdoor air pollution.

Public interest in outdoor air quality is high, particularly when specific weather-related or industrial air pollution events occur.⁶ National and international air quality guidance is based on substantial epidemiological literature, showing that high concentrations of air pollution can increase the risk of respiratory and/or cardiovascular ill health.^{7 8} PM

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