

# Smoking and socioeconomic factors linked to acute exacerbations of COPD: analysis from an Asthma + Lung UK survey

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## ABSTRACT

**Background** Understanding the factors driving acute exacerbations of chronic obstructive pulmonary disease (COPD) is key to reducing their impact on human health and well-being.

**Methods** 5997 people with COPD, mean 66 years, 64% female, completed an online survey between December 2020 and May 2021 about living with COPD, developed by the charity Asthma + Lung UK.

**Results** The 3731 (62.2%) survey participants reporting frequent ( $\geq 2$ /year) exacerbations were more likely to smoke (adjusted OR (AOR) 1.70, 95% CI 1.470 to 1.98), have lower annual household income ( $\leq$ £20 000 (AOR 1.72, 95% CI 1.36 to 2.17), live in a cold and damp home (AOR 1.78, 95% CI 1.50 to 2.11) and report previous occupational exposure to dust, fumes and chemicals. Smokers were more likely to report attending hospital to manage their most recent acute exacerbation of COPD compared with ex-smokers (AOR 1.25, 95% CI 0.99 to 1.59).

**Discussion** Strategies to improve COPD outcomes must address issues of deprivation and social justice.

## INTRODUCTION

Chronic obstructive pulmonary disease is highly prevalent, with at least 1.3 million people diagnosed in the UK, and rates increasing over the past decade. COPD is known to be less common in affluent populations. The gap in COPD mortality has widened dramatically in recent years, being five times higher in the lowest income decile than the highest in 2020 compared with twice as high in 2010.<sup>1 2</sup> Acute exacerbations of COPD (AECOPD) in patients lead to a higher risk of hospitalisation and mortality; increased exposure to infectious pathogens, environmental pollutants and poor physical fitness are established risk factors.<sup>3</sup> More than 50% of the cost of COPD is attributable to exacerbation management,<sup>3</sup> so prevention is an important issue for sustainability of health-care systems as well as for individual patients.

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Acute exacerbations of COPD are costly both in terms of patient quality of life and health service cost. Infections, poor cardiorespiratory fitness and environmental pollutants are known drivers of COPD exacerbations.

## WHAT THIS STUDY ADDS

⇒ This study adds to growing evidence that socioeconomic factors including poor housing conditions and low incomes may increase the frequency of acute exacerbations among people with COPD in the UK.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study highlights the need for more research and funding, addressing the harmful effects of social deprivation on COPD health within the UK.

Information about the impact of disparities in wealth and other specific housing, social and environmental factors is needed to drive efforts to address this.

We therefore made use of data from an online survey, conducted to investigate COPD patient experience, to examine which factors were associated with an increased risk of AECOPD.

## METHODS

The paper describes a secondary analysis using data from an online Asthma + Lung UK annual COPD survey conducted from December 2020 to May 2021.<sup>4</sup> This was advertised via social media, direct email messages to the charity's known supporter base and via its website. The full survey is available online (online supplemental file 1). Participants completing the questionnaire consented to their anonymised data being used for research purposes.

### Statistical analysis

Descriptive results are presented as number (%) and mean (SD) as appropriate. Logistic regression results are presented as adjusted ORs (AOR) with 95% CI. Responses to the survey question, 'In the past 12 months, how many exacerbations or "flare-ups" of your COPD symptoms have you had?' were grouped into 0–1 (infrequent) and  $\geq 2$  (frequent exacerbators), in line with current treatment guidelines. We also compared participants who did or did not report requiring hospitalisation for an AECOPD in the preceding year. All regression analyses included age, gender and smoking status as independent covariates. Ex-smokers, no previous occupational exposure to airborne pollutants, warm and dry housing and household income  $\geq \pounds 40\,000$  were used as reference categories for the multiple regression analyses.

### RESULTS

The initial sample included 8232 responses. After cleaning for outliers, removing duplicate and incomplete

responses, 5997 responses remained and were analysed. The sample population was majority female (64.4%), white ethnicity (99%) and ex-smokers (80.7%). Mean age was 66.2 (8.9) years (table 1).

The 3731 frequent exacerbators were more likely to be current smokers (AOR: 1.70, 95% CI 1.47 to 1.98), have low annual household (HH) incomes ( $\leq \pounds 20\,000$  (AOR: 1.72, 95% CI 1.36 to 2.17), live in cold and damp housing (AOR: 1.78, 95% CI 1.50 to 2.11), report previous occupational exposure to airborne pollutants (AOR: 1.12, 95% CI 1.00 to 1.25) and be male (AOR: 1.32, 95% CI 1.17 to 1.49) (table 2, figure 1).

Among the 532 (8.9%) of survey respondents who reported a hospital attendance to manage their most recent AECOPD, 117 (22%) were current smokers. Smokers were more likely to report hospitalisation compared with ex-smokers (AOR: 1.25, 95% CI 0.99 to 1.59). Both low income and cold and damp housing covariates were numerically higher in those reporting

**Table 1** Sociodemographic characteristics of the survey respondents sample including percentage of the sample demographics in each exacerbation group

Demographics	All participants n=5997	$\geq 2$ exacerbations in past 12 months n=3731	0–1 exacerbations in the past 12 months n=2266
Age (mean SD)	66.2 $\pm$ (8.9)	–	–
Age started smoking (mean SD)	15.7 $\pm$ (4.9)	–	–
Female	3858 (64.3%)	2338 (62.6%)	1520 (67.0%)
Male	2139 (35.7%)	1393 (37.4%)	746 (33.0%)
<b>Ethnicity</b>			
White	5910 (98.5%)	3696 (99.0%)	2179 (97.0%)
Mixed	43 (0.7%)	21 (0.6%)	22 (1.0%)
Asian, Asian British	36 (0.4%)	12 (0.3%)	24 (1.1%)
Black, black British	8 (0.13%)	2 (0.1%)	6 (0.9%)
<b>Household income</b>			
$\leq \pounds 20\,000$	3061 (51.0%)	2037 (54.5%)	1025 (45.2%)
$\pounds 20\,000$ – $\pounds 30\,000$	1229 (20.5%)	722 (19.3%)	507 (22.3%)
$\pounds 30\,001$ – $\pounds 40\,000$	450 (7.5%)	250 (6.7%)	200 (8.8%)
$\geq \pounds 40\,001$	343 (5.7%)	183 (5.1%)	160 (7.2%)
Rather not say	913 (15.2%)	539 (14.4%)	374 (16.5%)
<b>Smoking status</b>			
Ex-smoker	4845 (80.8%)	2874 (77.1%)	1971 (86.9%)
Current	1152 (19.2%)	857 (22.9%)	295 (13.1%)
<b>Housing conditions</b>			
Warm and dry	4494 (74.9%)	2642 (70.8%)	1852 (82.2%)
Cold and damp	809 (13.4%)	591 (15.8%)	215 (10.0%)
Cold	470 (7.8%)	339 (9.0%)	77 (4.4%)
Damp	227 (3.9%)	159 (4.4%)	68 (3.4%)
<b>Occupational exposure to dust, fumes and chemicals</b>			
Yes	3010 (50.1%)	1965 (52.6%)	1045 (46.1%)
No	2987 (49.9%)	1766 (47.4%)	1221 (53.9%)

**Table 2** Factors associated with increased number of exacerbations among survey population

Variable	Model 1: age, sex tobacco and income	Model 2: age, sex, tobacco and housing	Model 3: all variables
	OR and CI	OR and CI	OR and CI
Gender female	Ref	Ref	Ref
Male	<b>1.38 (1.23 to 1.54)</b>	<b>1.32 (1.18 to 1.48)</b>	<b>1.32 (1.17 to 1.49)</b>
Age	<b>0.97 (0.96 to 0.97)</b>	<b>0.97 (0.96 to 0.98)</b>	<b>0.97 (0.96 to 0.98)</b>
Smoking status (current)	<b>1.68 (1.45 to 1.95)</b>	<b>1.77 (1.53 to 2.06)</b>	<b>1.70 (1.47 to 1.98)</b>
Ex-smokers	Ref	Ref	Ref
Occupational exposure to dust, fume and chemicals	–	–	<b>1.12 (1.00 to 1.25)</b>
No occupational exposure to dust, fumes and chemicals	–	–	Ref
Age started smoking	–	–	1.001 (0.990 to 1.012)
Housing: warm and dry	–	Ref	Ref
Housing: cold and damp	–	<b>1.83 (1.54 to 2.17)</b>	<b>1.78 (1.50 to 2.11)</b>
Housing: cold	–	<b>1.69 (1.37 to 2.09)</b>	<b>1.61 (1.30 to 2.00)</b>
Housing damp	–	<b>1.52 (1.13 to 2.05)</b>	<b>1.49 (1.01 to 2.00)</b>
HH income: ≤£20 000	<b>1.82 (1.45 to 2.30)</b>	–	<b>1.72 (1.36 to 2.17)</b>
HH income: £20 001– £30 000	<b>1.32 (1.03 to 1.68)</b>	–	<b>1.27 (0.99 to 1.63)</b>
HH income: £30 001– £40 000	1.11 (0.83 to 1.48)	–	1.08 (0.81 to 1.44)
HH income: ≥£40 000	Ref	–	Ref
HH income: rather not say	<b>1.46 (1.13 to 1.88)</b>	–	<b>1.40 (1.08 to 1.82)</b>

Bold type indicates significance at ≤0.05 level.  
HH, household.

hospitalisation, but these differences were not statistically significant (online supplemental file 1).

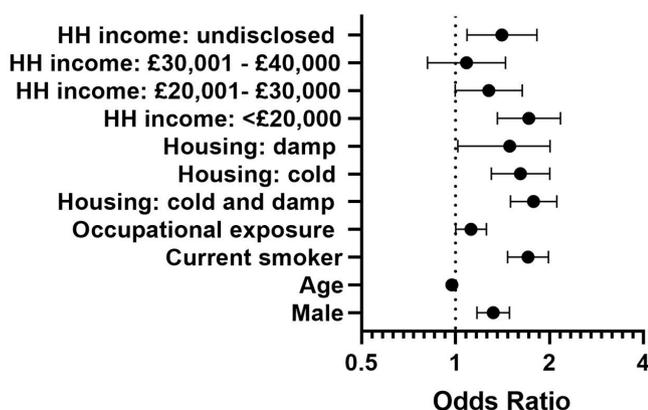
## DISCUSSION

This large online survey of the experience of people living with COPD provides important contemporary data on the role that socioeconomic factors may play

in AECOPD. We found that low income, poor housing quality, past occupational exposure to airborne pollutants and current smoking were all significantly associated with higher AECOPD frequency. Current smoking was also associated with an increased risk of AECOPD requiring hospitalisation.

A key objective in COPD care is to reduce the frequency of AECOPD, both to improve patients' quality of life and to limit as far as possible the avoidable use of finite healthcare resources. However, there is a huge unmet care need among patients with COPD within the UK, with a large proportion of patients missing out on important COPD care such as self-management plans, vaccinations, pulmonary rehabilitation and smoking cessation,<sup>5,6</sup> all of which are proven interventions for reducing AECOPD. The COVID-19 pandemic has worsened this unmet need further, as people with respiratory disease have had trouble accessing healthcare.<sup>7–9</sup> Asthma + Lung UK survey data show that over 75% COPD patients report not receiving basic care during 2020/2021.<sup>4</sup> Switching to a digital by default model, further risks excluding deprived and older patients.

Despite the known link between housing quality and health (particularly excess winter deaths), and the 2015 National Institute for Healthcare and Excellence guidance that recommends that healthcare providers assess housing quality and make referrals where necessary,<sup>10</sup> the effect of housing quality on COPD health has been little studied. Current guidance for housing temperature in



**Figure 1** Sociodemographic, housing and annual household (HH) income factors (AOR, 95%CI) associated with ≥2 exacerbations in the past 12 months among the survey population. Occupational exposure = yes to occupational exposure to dust, fumes and chemicals. Ex-smokers, no occupational exposure, warm and dry housing and HH income >£40,000 were used as reference categories for the analysis.

the winter is a minimum of 18°C,<sup>10</sup> but this may not be sufficient for people with COPD. A 2008 paper reported that greater time spent with an indoor temperature  $\geq 21^\circ\text{C}$  was associated with better self-reported health status in people with COPD.<sup>11</sup> Of note, data from the Office for Health Improvement and Disparities show that in 2018 2.4 million people in England were living in fuel poverty.<sup>1</sup> More than 70% of survey participants fell below the UK median household income of £31 004, and the impact of housing conditions on AECOPD reflects that, though the link with cold / damp housing was independent of income.

It is well established that austerity policies, which have reduced both social and healthcare support, have had significant impact on the most vulnerable in society, in particular people living with long-term health conditions.<sup>12</sup> Our findings underline this, with poorer survey respondents almost twice as likely to be in the frequent exacerbator group. This is especially relevant as fuel poverty is increasing, and the results illustrate several aspects of the structural violence (where ‘violence is built into the structure and shows up as unequal life chances’<sup>13</sup>), to which people with COPD are subject.<sup>14</sup>

The survey also highlights an important link between smoking, AECOPD frequency and hospitalisations, adding further urgency to the need for strategies to deliver the UK government’s smokefree2030 ambition.<sup>15 16</sup>

The survey design has some limitations. First, it required some digital literacy, which may have excluded a portion of the COPD population in the UK. Second, there is likely to have been some degree of responder and recall bias. Third, we did not independently validate household income or housing conditions, and we were unable to triangulate index of deprivation as we did not have postcode data. However, we believe that the use of household income as a measure of SES is a robust approach. In addition, the survey population was overwhelmingly white, so caution is needed extrapolating to other ethnic groups, and positive efforts to capture their experience are needed in the future. Finally, the studied cohort are likely to be individuals who were motivated to engage with online surveys and the Asthma + Lung UK charity. These factors may limit generalisability of the findings and may have led to an underestimate of the true impact on SES and housing quality on AECOPD.

In conclusion, these data add to the growing evidence that socioeconomic status, in particular poor housing conditions, are linked to increased frequency of AECOPD. Addressing social deprivation, with a multi-agency approach at national and local government level and across health and social care is essential to reduce inequalities and treat the causes of the causes of AECOPD in the UK. In doing so, this will improve the sustainability of healthcare and improve the lives of people with COPD across the UK.

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**Contributors** NSH, PW, AC and AL designed the study. PW and AL analysed the data and PJW produced the first draft to which all authors contributed. All authors have reviewed and approved the final version. NSH is the guarantor.

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**Patient consent for publication** Not applicable.

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**Data availability statement** Data are available on reasonable request. Anonymous research data will be shared with third parties via request to Asthma + Lung UK.

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