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TITLE

Factors associated with work productivity among people with COPD: Birmingham COPD Cohort

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WHAT THIS PAPER ADDS

- Little is known about the most important modifiable factors which are associated with absenteeism and presenteeism (work performance) among people with COPD.
- In this UK primary care cohort, where approximately 18% of people with COPD were in work, those with worse dyspnoea were more likely to experience higher absenteeism and poorer work performance. Additionally, people with a history of higher occupational exposure to vapours, gases, dusts or fumes (VGDF) were more likely to experience poorer work performance.
- This is the first study to comprehensively assess which subject characteristics are associated with work productivity in people with COPD; indicating the need to focus on better symptom management and reducing workplace exposures to VGDF.

ABSTACT

Background Patients with COPD are more likely to take time off work (absenteeism) and report poor performance at work (presenteeism) compared to those without COPD. Little is known about the modifiable factors associated with these work productivity outcomes.

Aim To assess the factors associated with work productivity among COPD patients.

Methods Cross-sectional analysis of baseline data from a sub-sample (those in paid employment) of the Birmingham COPD Cohort Study. Absenteeism was defined by self-report over the previous 12 months. Presenteeism was assessed using the Stanford Presenteeism Scale (SPS-6). Logistic regression analysis was used to assess the effects of socio-demographic, clinical and occupational characteristics on work productivity.

Results Among 348 included participants, increasing dyspnoea was the only factor associated with both absenteeism and presenteeism (p for trend<0.01). Additionally, increasing history of occupational exposure to vapours, gases, dusts or fumes (VGDF) was independently associated with presenteeism (p for trend<0.01).

Conclusions This is the first study to identify important factors associated with poor work productivity among patients with COPD. Future studies should evaluate interventions aimed at managing breathlessness and reducing occupational exposures to VGDF on work productivity among patients with COPD.

INTRODUCTION

COPD is a progressive lung disease affecting 6-10% of adults worldwide[1] with a high morbidity and mortality burden.[2] Often diagnosed in middle age, a high proportion of those with COPD are of working age (~2/3 in the US[3] and 40% in the UK[4]), although paid employment rates are lower compared to the general population.[5]

There is some evidence that COPD patients who are in paid employment have higher rates of absenteeism (time off work) than those without COPD[6] or those with other chronic conditions such as asthma and cardiovascular disease.[7] Furthermore, studies from the US suggest that even when at work, some people with COPD have poor work performance (presenteeism) compared to those without COPD.[8] Indirect societal costs attributable to COPD (largely due to absenteeism) are high (~£2.7bn/year in UK[9]; $3.9bn in the US[10]). Studies based on other conditions suggest that presenteeism costs may exceed those associated with absenteeism.[11]

In the general population, poor work productivity (absenteeism and/or presenteeism) is more common among women[12] and those with a lower education level.[13] Occupational factors such as job insecurity,[14;15] longer working hours (>45h per week)[15] and reduced job satisfaction[14] are also important contributors. However, there may be additional disease specific factors associated with poor work productivity among COPD patients. The few available studies examining this question have inconsistent findings in relation to disease severity, co-morbidities and absenteeism.[16;17] No previous study has assessed the factors associated with presenteeism and the relative importance of disease related, sociodemographic and occupational factors in relation to poor work productivity is not known.

A better understanding of the modifiable factors influencing work productivity among COPD patients could inform future interventions, which in turn, could improve patients' work experience, thereby reducing the burden and societal costs related to COPD. The aim of this study was to evaluate factors associated with absenteeism and presenteeism, among working patients with COPD.

METHODS

Study design and participants

We undertook a cross-sectional analysis of baseline data from the Birmingham COPD Cohort.[18]

A total of 1889 patients with COPD from 71 primary care practices across the West Midlands, UK, were recruited to the Birmingham COPD Cohort Study during the period June 2012 to July 2014.[18] These included 1558 patients with a previous COPD diagnosis (from GP registers) and 331 newly identified COPD patients from a related case finding RCT.[19]

For this analysis 348 participants (existing and newly identified) from the cohort who reported they were in paid employment or self-employed at baseline were included.

Measures

At baseline, participants completed a series of questionnaires to obtain detailed information on their health, occupation, lifestyle and socioeconomic circumstances. They also had a range of measurements, including spirometry. Relevant measures included for the analysis in this paper are outlined in more detail below.

COPD and clinical characteristics:

Pre and post-bronchodilator spirometry, was carried out by trained researchers using the Spiroson-AS flowmeter (ndd, Switzerland) according to ATS/ERS 2005 standards,[20] and bespoke software (MRM). Post-bronchodilator spirometry was used to assess the severity of airflow obstruction (GOLD criteria[21]). The MRC respiratory questionnaire[22] was used to assess the level of dyspnoea, and respiratory quality of life was determined using the COPD Assessment Test (CAT).[23] The number of exacerbations over the previous 12 months was assessed by self-report (steroid or antibiotic treatment for an exacerbation in the previous 12 months).

Occupational characteristics and exposures:

We obtained data on current occupation using a questionnaire administered by trained research assistants, who used information on skill content and skill level to assign a 4-digit standard occupational classification (SOC 2010) code using the CASCOT (computer assisted structured coding tool) software.[24] A job exposure matrix (JEM)[25] (adapted to SOC 2010 codes by the author of the ACE JEM[25]) was used to assign the level of airborne exposure (none, low, medium or high) of occupational exposures to vapours, gases, dusts or fumes (VGDF) for each SOC code. The ACE JEM assigns occupational exposures to SOC codes independent of respiratory outcomes.

Where possible, validated questionnaires were used to collect information on: working hours[26]; job satisfaction[26]; job training over previous 12m (excluding health and safety training)[26]; supervising other employees[26]; type of contract[26]; length in current employment[26]; work involving walking/standing; work involving manual/physical work and usual shift pattern.

Work productivity measures

Absenteeism:

Participants who reported having taken any time off work during the previous 12 months were classified as exhibiting absenteeism. The reason (respiratory, other health problems or other) and duration of any absenteeism were also noted. Absenteeism was further categorised into "low" (0 to 5 days) or "high" ($\geq$ 6 days) using the average number of days off work among UK employees (4.4 days) to inform the cut-off.[27]

Presenteeism:

The Stanford Presenteeism Scale (SPS-6) was used to assess the impact of the participant's "chest problems" on their work performance over the previous month.[28] The scale results in scores between 6 and 30, with lower scores indicating a greater disease impact on work performance (i.e. poorer work performance and high presenteeism).[28] However, the scale does not have validated categories to define the level of presenteeism e.g. low, medium or high. Furthermore, the differences in SPS-6 scores are ambiguous, leading to a lack of clarity when interpreting the data. Consequently, the lower and upper quartiles of the distribution of presenteeism scores in the cohort population was used to categorise participants into those with high (SPS-6 score $\leq$19), or low (SPS-6 score $\geq$28) presenteeism.

Other measures

Validated questionnaires were used to collect information on smoking status, comorbidities (self-report of physician diagnosed disease) educational level and gross income. Information on age, sex, height and weight were obtained by trained research assistants. Social deprivation was measured using the Index of Multiple Deprivation (IMD) 2010 score based on participant home postcodes.[29]

Sample sizes

We had estimated that 200 COPD patients should be sufficient to detect a relative risk of 2.5 for absenteeism among those with more severe COPD compared to those with mild disease (80% power; 5% confidence), and that this sample size would allow us to detect standardised effect sizes of at least 0.45 for presenteeism, comparing the least with most severe COPD (80% power; 5% confidence). Thus we acknowledge that the study had power to detect only relatively large effect sizes, but we were limited by the size of the overall cohort.

Statistical analysis

Univariate and multivariable logistic regression analyses were undertaken in STATA version 13.0 to assess: (1) the risk of having high levels of absenteeism ($\geq$6 days) and (2) the risk of having poor work performance (SPS-6 score ≤19). Statistically and clinically important variables were included in the models. The first model included known clinically important covariates: age, sex, smoking status, GOLD stage and number of co-morbidities. Using the likelihood ratio test, the contributions of the statistically significant clinical and occupational covariates identified in the univariate analyses were assessed.

Additional analyses

The relationship between absenteeism and presenteeism was assessed by correlation and comparing the pre-defined categories.

Sensitivity analyses explored using various cut-off points to denote high absenteeism (4, 5, 7 and 8 days), and presenteeism (SPS-6 score $\leq$18, as suggested by previous research,[30] or using the median: SPS-6 score $\leq$24). A separate analysis of specific COPD related absenteeism was also conducted.

RESULTS

Characteristics of the participants

Of the 7176 eligible patients, 1889 (26.3%) consented to taking part in the Birmingham COPD Cohort Study; of whom 348 (18.4%) were employed and form the subgroup we studied (Figure 1).

Sociodemographic and clinical characteristics

A high proportion of the participants were male (62.4%), of working age (<65 years: 71.3%) and ever-smokers (91.3%) (Table 1). The majority were either overweight or obese (68.5%) and had ≥1 co-morbidity (83.0%). The most common co-morbidities included cardiovascular disease (45.5%), allergies (39.9%), depression (24.0%) and gastrointestinal disease (21.8%).

Based on the MRC dyspnoea score, health related quality of life and level of airflow obstruction, most participants had mild to moderate COPD, although over half reported one or more exacerbations in the previous year (supplementary Table S1).

Occupational characteristics

Participants were from a range of occupational backgrounds and industries/organisations (see Table 1 and supplementary Table S2). The majority (79.5%) had no or low occupational exposures to VGDF (Table 1). In a sub-sample of 91 participants where the information was available, approximately 20% were self-employed. The majority of participants had jobs which involved either walking/standing (82.3%) or manual/physical work (57.4%). Most participants had a permanent job role (n=281; 85.7%) and worked a regular daytime schedule (n=234; 71.8%).

There were some differences in characteristics between men and women, particularly in type of comorbidities (more cardiovascular disease in men) and occupational factors (men more likely to be self-employed, work ≥37 hours and higher workplace VGDF exposure).

There were also some differences in characteristics between those of working age (<65 years) and those ≥65 years: older workers were more likely to have a lower level of education (51.5% vs. 71.9%), work less than 20 hours per week (8.9% vs. 35.2%) and work in the following occupational backgrounds: caring, leisure and other services (10.7% vs. 14.2%) sales and customer service (4.6% vs. 7.1%) and elementary (14.5% vs. 19.2%). However there was no difference between the groups in terms of the proportion who were self-employed.

Table 1 Sociodemographic, lifestyle and clinical characteristics of the participants in the occupational sub-cohort

Sociodemographic, lifestyle and clinical characteristics	Participants with COPD in paid employment n=348
Sex	
Male	217 (62.4%)
Female	131 (37.6%)
Age categories (years)	
38 – 49	38 (10.9%)
50 – 59	122 (35.1%)
60 - 64	88 (25.3%)
≥65	100 (28.7%)
Smoking status	
Never smoked	28 (8.7%)
Ex-smoker	161 (50.0%)
Current smoker	133 (41.3%)
Education level	
Degree or higher level	53 (19.8%)
A level/AS level or equivalent	26 (9.7%)
GCSE, CSE, O level or equivalent	84 (31.3%)
No formal qualification	105 (39.2%)
Disease severity (GOLD stage criteria)	
Mild	117 (34.8%)
Increasing severity ↓ Moderate	171 (50.9%)
Severe and very severe	48 (14.3%)
Co-morbidities	
Cardiovascular disease	140 (45.5%)
Diabetes	33 (10.7%)
Gastrointestinal disease	72 (21.8%)
Cancer	27 (8.7%)
Depression	74 (24.0%)
Osteoarthritis	32 (10.5%)
Rheumatoid arthritis	24 (8.0%)
Allergies (hayfever, eczema and other)	87 (69.6%)
Occupational background (SOC 2010)	
Managers, directors and senior officials	40 (11.7%)
Professional	40 (11.7%)
Associate professional and technical	29 (8.5%)
Administrative and secretarial	34 (10.0%)
Skilled trade	42 (12.3%)
Caring, leisure and other services	40 (11.7%)
Sales and customer service	18 (5.3%)
Process, plant and machine operatives	44 (12.9%)
Elementary	54 (15.8%)
Exposures to VGDF	
Increasing airborne occupational exposure ↓ None	154 (45.4%)
Low	114 (33.6%)
Medium and high	71 (20.9%)

Absenteeism

Absenteeism data were available for 270 (77.6%) participants. Overall 44.3% (n=154) reported work absence in the previous 12m, ranging from 1 to 365 days (mean 27.9 (SD 63.9), median 7 (IQR 3 to 21)), and 59 (17.0%) reported COPD related absenteeism. In the total working population with complete data (n=270), 216 had low (0 to 5 days) and 54 (16.7%) high absenteeism ($\geq$6 days) with mean 10.4 (SD 41.3) and median 0 (IQR 0 to 4) absence days.

Presenteeism

There were 301/348 (86.5%) participants with data on presenteeism with mean (SD) and median (IQR) SPS-6 scores 23.5 (5.0) and 24.0 (19 to 28), respectively. 77 participants were categorised as having little/no presenteeism and 82 participants as high presenteeism.

Relationship between absenteeism and presenteeism

Data on both absenteeism and presenteeism were available for 249 (71.6%) participants and measures were weakly correlated (r= -0.14; p=0.03). Comparison of dichotomised categories showed non-concordance in 34% (n=85) of participants. Thus, 13% (n=33) with high absenteeism, had low presenteeism when at work and 21% (n=52) with high presenteeism had little or no absenteeism.

Factors associated with absenteeism

High all-cause absenteeism was more common in those with ≥1 comorbidity, and there were positive dose-response relationships with increasing breathlessness (p for trend<0.01); CAT score (poorer quality of life) (p for trend=0.08); airflow obstruction (p for trend=0.38) and number of exacerbations (p for trend<0.01). High absenteeism was also more likely among women, ever smokers and those with lower income levels, and also among those with professional occupations, with occupations which always/usually involved walking/standing and had length of employment $\geq$5 years, although none of these differences were statistically significant. Compared to those working 30 hours or more per week, participants reporting between 20 to less than 30 hours work per week were more likely to experience high absenteeism (p<0.05), whereas participants working less than 20 hours per week were less likely to have high absenteeism (not significant). There was no apparent relationship between occupational exposures to VGDF or job satisfaction and absenteeism (see supplementary Table S3).

In the final multivariable model, age (50 – 59 years), increasing dyspnoea (p for trend<0.01) and working hours (20 to <30 hours) were significantly associated with high absenteeism (Table 2). No association was found between absenteeism and airflow obstruction or any other clinical factors.

Additional analyses

Irrespective of the cut-off points used to denote high absenteeism, the overall patterns of associations remained as for the main analysis. The patterns also remained when considering COPD-related absenteeism, although the relationship with airflow obstruction (severe to very severe adjusted OR=3.63; 95% CI: 1.18-11.15) and being female (OR=2.11; 95% CI: 1.02-4.35) became statistically significant, whilst the association with age and working hours became non-significant.

Table 2 Association between socio-demographic, clinical and occupational characteristics and risk of high absenteeism among COPD participants

Characteristics	Number (%) with high absenteeism n=54	Univariate model ORs (95% CI) for risk of high absenteeism	Final multivariable model ORs* (95% CI) for risk of high absenteeism
Sex			
Male (%)	29 (17.1%)	1.0	1.0
Female (%)	25 (25.0%)	1.62 (0.89 – 2.96)	2.02 (0.83 – 4.90)
Age categories			
38 – 49	3 (10.7%)	1.0	1.0
50 – 59	25 (26.9%)	3.06 (0.85 – 11.04)	6.04 (1.04 – 35.04)
60 - 64	11 (17.2%)	1.73 (0.44 – 6.75)	3.02 (0.46 – 19.61)
≥65	15 (17.7%)	1.79 (1.48 – 6.69)	3.74 (0.56 – 24.89)
Smoking status			
Never smoked	2 (10.0%)	1.0	1.0
Ever smoker	50 (21.3%)	2.43 (0.55 – 10.84)	5.71 (0.48 – 68.09)
IMD score quintiles			
1	7 (12.1%)	1.0	1.0
Increasing deprivation ↓ 2	12 (20.3%)	1.86 (0.68 – 5.12)	1.16 (0.30 – 4.57)
3	13 (22.4%)	2.10 (0.77 – 5.74)	1.54 (0.43 – 5.58)
4	13 (21.1%)	1.94 (0.70 – 5.36)	1.16 (0.28 – 4.80)
5	10 (28.6%)	2.91 (0.99 – 8.56)	1.69 (0.40 – 7.22)
Number of co-morbidities			
0	3 (6.7%)	1.0	1.0
1+	51 (22.7%)	4.10 (1.22 – 13.79)	2.36 (0.56 – 9.94)
MRC Dyspnoea score			
1	13 (15.5%)	1.0	1.0
Increasing breathlessness ↓ 2	6 (17.5%)	0.44 (0.16 – 1.23)	0.46 (0.12 – 1.78)
3	16 (23.9%)	1.71 (0.76 – 3.87)	2.11 (0.72 – 6.24)
4 and 5	17 (54.8%)	6.63 (2.64 – 16.67)	13.83 (3.78 – 50.56)
Severity of airflow obstruction (GOLD stage criteria)			
Mild	16 (17.2%)	1.0	1.0
Increasing severity ↓ Moderate	27 (20.0%)	1.20 (0.61 – 2.38)	1.00 (0.39 – 2.58)
Severe and very severe	8 (24.2%)	1.54 (0.59 – 4.03)	1.84 (0.54 – 6.27)
Usual working hours			
≥30 hours	33 (19.1%)	1.0	1.0
20 to <30 hours	15 (36.6%)	2.45 (1.17 – 5.13)	2.92 (1.07 – 7.97)
<20 hours	3 (7.5%)	0.34 (0.10 – 0.34)	0.27 (0.06 – 1.25)

*Multivariable model includes: sex, age, smoking status, social deprivation (IMD score), number of co-morbidities, MRC score and airflow obstruction

Factors associated with presenteeism

In the univariate analyses (Table 3), increasing breathlessness (p for trend<0.01), CAT score (lower QOL (p for trend<0.01) and number of exacerbations (p for trend<0.05) were all associated with poor work performance (higher presenteeism). There were also non-significant trends towards poorer work performance among current smokers, those with a lower educational level, a lower income, a higher deprivation score, those who were overweight or obese and those with ≥1 comorbidity (OR=1.53; 95% CI 0.67 – 3.49). Those with jobs which usually/always required walking/standing or manual/physical work were more likely to report poor work performance (although associations were not statistically significant). A positive dose-response relationship was noted between increasing exposure to VGDF and increased probability of reporting poor work performance (p for trend<0.01). In contrast, those employed for ≥5 years were less likely to experience poor work performance (non-significant) (see supplementary Table S4). No apparent associations were found between working hours and poor work performance.

In the final multivariable model, increasing dyspnoea (p for trend<0.01) and exposures to VGDF (p for trend<0.01) remained independently associated with poor work performance (Table 3). The presence of co-morbidities and being a current smoker increased the risk of reporting poor work performance, although these effects did not reach statistical significance.

Additional analyses

In the analyses focussing on the effect of the two alternative cut off points to denote poor work performance (SPS-6 score: <18 and <24) the overall patterns remained the same, although not all were statistically significant.

Table 3 Association between socio-demographic, clinical and occupational characteristics and risk of poor work performance (presenteeism) among COPD participants

Baseline characteristics	Number (%) with poor work performance (SPS-6 score ≤19) n=82	Univariate model ORs (95% CI) for risk of having poorer work performance	Final multivariable model ORs* (95% CI) for risk of having poorer work performance
Sex			
Female (%)	28 (48.3%)	1.0	1.0
Male (%)	54 (53.5%)	1.23 (0.65 – 2.35)	0.71 (0.28 – 1.81)
Age categories:			
38 – 49	10 (52.6%)	1.0	1.0
50 – 59	27 (49.1%)	0.87 (0.31 – 2.47)	0.36 (0.08 – 1.68)
60 - 64	18 (56.3%)	1.16 (0.37 – 3.62)	1.15 (0.22 – 6.11)
≥65	27 (50.9%)	0.93 (0.33 – 2.67)	0.41 (0.08 – 2.12)
Smoking status			
Never smoked	6 (42.9%)	1.0	1.0
Ex-smoker	39 (47.0%)	1.18 (0.38 – 3.71)	2.28 (0.44 – 11.69)
Current smoker	32 (60.4%)	2.03 (0.62 – 6.70)	3.39 (0.64 – 17.99)
IMD score quintiles			
1	13 (35.1%)	1.0	1.0
Increasing deprivation 2	21 (52.5%)	2.04 (0.82 – 5.10)	2.56 (0.76 – 8.63)
3	20 (60.6%)	2.84 (1.08 – 7.51)	3.01 (0.85 – 10.68)
4	16 (55.2%)	2.27 (0.84 – 6.15)	2.15 (0.54 – 8.54)
5	11 (57.9%)	2.54 (0.82 – 7.89)	2.22 (0.45 – 11.00)
Number of co-morbidities			
0	12 (42.9%)	1.0	1.0
1+	70 (53.4%)	1.53 (0.67 – 3.49)	2.15 (0.67 – 6.86)
MRC			
Increasing breathlessness 1	20 (40.8%)	1.0	1.0
2	15 (34.9%)	0.78 (0.33 – 1.81)	0.83 (0.28 – 2.48)
3	21 (55.3%)	1.79 (0.76 – 4.22)	2.65 (0.88 – 7.95)
4 and 5	23 (92.0%)	16.67 (3.53 – 78.81)	18.11 (2.93 – 112.21)
Severity of airflow obstruction (GOLD stage criteria)			
Increasing severity Mild	23 (45.1%)	1.0	1.0
Moderate	46 (56.8%)	1.60 (0.79 – 3.24)	1.08 (0.40 – 2.90)
Severe and very severe	11 (50.0%)	1.22 (0.45 – 3.31)	1.03 (0.26 – 4.09)
Exposures to VGDF			
Increasing occupational airborne exposure None	27 (38.6%)	1.0	1.0
Low	34 (60.7%)	2.46 (1.20 – 5.06)	3.50 (1.25 – 9.79)
Medium and high	21 (67.7%)	3.34 (1.37 – 8.17)	4.34 (1.26 – 14.93)
Length of employment in current workplace			
< 5 years	26 (61.9%)	1.0	1.0
≥5 years	55 (48.7%)	0.58 (0.28 – 1.20)	0.45 (0.15 – 1.29)

*Multivariable model includes: sex, age, smoking status, social deprivation (IMD score), number of co-morbidities, MRC score, airflow obstruction, occupational exposures to VGDF and length of employment

DISCUSSION

Key results

In this primary care working COPD population with predominantly mild to moderate airflow obstruction, there were relatively high rates of absenteeism, with over one in six participants (17.6%) reporting ≥6 absence days over the previous 12 months. In contrast we found low presenteeism rates, suggesting that when at work, COPD patients generally function well.

This study clarifies the most important factors affecting absenteeism and presenteeism in a broadly representative cohort of COPD patients from a UK primary care setting, where previous studies have shown inconsistency in the factors associated with absenteeism and no studies have assessed the factors associated with presenteeism.

The only common risk factor significantly associated with both absenteeism and presenteeism was the level of dyspnoea. Working between 20 and 29 hours and age 50 – 59 years were associated with higher levels of absenteeism. No other markers of disease severity or other factors examined were associated with all-cause absenteeism, though being female and increased severity of airflow obstruction were additional factors associated with COPD-related absenteeism. There was however, a clear association between higher exposures to VGDF and greater presenteeism.

Although 6.4% of participants had both high absenteeism and presenteeism, over a third had only either high absenteeism or high presenteeism; suggesting these measures reflect different aspects of work productivity.

Findings in relation to other studies

Our finding that participants with COPD had a mean of 10.4 absence days in the previous 12 months (compared with the UK national mean of 4.4 days[27]), confirms the higher rates of absenteeism among people with COPD reported in other studies.[6;8]

Conversely we found that on average, presenteeism levels were low (mean SPS-6 score 23.5; SD 5.0) compared to those with arthritis (mean SPS-6 score 13.3; SD 5.2)[31] and comparable to employees reporting no disability (mean SPS-6 score 23.5; SD 3.8),[28] and patients with cystic fibrosis (mean SPS-6 score 25.1).[32]

The observed relationship between increasing dyspnoea and absenteeism and presenteeism confirm similar findings reported in a large international cross-sectional survey.[33] Our findings suggest a significant relationship between increasing airflow obstruction and COPD related absenteeism, but

not all-cause absenteeism, which may explain conflicting results from other studies exploring this association.[16;34]

Our findings that age and working hours are associated with the risk of sickness absence are consistent with research in the general population. Data from the Office for National Statistics indicate increases in sickness absence with increasing age, until the state pension age, which is followed by a decline in sickness absence rates.[27] Furthermore, whilst there is evidence to suggest that those working <30 hours per week have more days off work compared to full time workers,[35] employees working much fewer hours (<16 hours) have lower sickness absence rates[27;36] – similar to the trends observed in our study.

Other studies have reported that the presence of co-morbidities and smoking are associated with poor work productivity in the general population,[11;37] in those with health conditions[37;38] and amongst patients with COPD.[17] We found similar trends, but these associations were not statistically significant, possibly because of the small numbers of non-smokers and high proportion with co-morbidities relative to the sample size.

Clear associations between exposure to VGDF and respiratory related absenteeism have been demonstrated among an asthmatic population (OR=1.96; 95% CI 1.06 – 3.64), and those with respiratory symptoms (OR=2.20; 95% CI 1.01 – 4.77).[39] This was not observed in our study sample, although the wide CIs suggest there may not have been sufficient power to detect any effects. In contrast, we found that increasing exposure to VGDF was associated with greater presenteeism, which has not been previously reported in patients with COPD. A number of other occupational characteristics (such as job satisfaction, working hours, lack of supportive work culture and size of organisation) that have been shown to be associated with work productivity in other studies[14;15] were not observed in our sample, possibly due to the limited sample size, or the way these characteristics were assessed.

Definitions and instruments used to assess absenteeism and presenteeism vary widely within this emerging field of research, and the various terms defining presenteeism have often been used inter-changeably.[14] Although there is correlation between absenteeism and presenteeism, the latter may be a stronger predictor of poor health,[14] and we demonstrated that the two measures assess different facets of work productivity.

In a separate analysis, examining the factors associated with the likelihood of being employed among patients with COPD, we found the same characteristics as those identified in this study (increasing dyspnoea and workplace exposures to VGDF) were important.[40] This suggests there may

be a continuum; from impact on work productivity among those in paid employment, to unemployment among the most severely affected.

Strengths and limitations

This is the first study to assess the impact of COPD on work productivity and characteristics associated with poor work performance, in a primary care population with predominantly mild to moderate COPD. Participants included those from a wide range of backgrounds and occupations and we had data on a wide range of socio-economic, clinical and occupational factors. However, due to low participation in the Birmingham COPD Cohort Study (26.3%), the study sample may not be completely representative of the full range of patients with COPD who are in paid employment, although observed associations should still hold.

Approximately one quarter (n=80; 23.4%) of the sub-cohort were in occupational groups managers/directors/senior officials and professionals, which is lower than the UK national rate (31.0%).[41] These occupational groups are associated with lower sickness absence rates.[27] Furthermore, the Birmingham COPD Cohort is based within the West Midlands: a region with higher unemployment rates (5.6% vs. 4.7%) than the UK national average.[42] These higher rates may impact on workers' economic insecurity,[43] particularly the fear of job loss; leading to some sub-cohort workers opting to take less time off work.[44]

A novelty of the Birmingham COPD Cohort, and this sub-cohort, is the inclusion of the newly identified COPD patients; an under-represented population in previous COPD cohort studies. This has provided the opportunity to include patients who are younger, with less severe disease, who are more likely to be in paid employment than those on the GP registries with an existing COPD diagnosis.[45] Furthermore, a novel finding of this study was the relationship between higher occupational exposure to VGDF and poorer work performance, using a standardized JEM to measure the level of airborne exposures in the workplace.[25]

The study also has limitations. The cross-sectional nature precludes the ability to draw inferences on causality. Whilst compared to other studies, we included a large sample of participants, the wide confidence intervals for a number of estimates indicate that there was insufficient power to clarify associations. Factors such as income and exacerbations (absenteeism model only) were important in the univariate analyses, however, as they are susceptible to reverse causation they were not included in the final models.

Absenteeism was based on self-report; which is susceptible to under-reporting due to recall error[46] and social desirability bias.[47] This could affect the estimate of absenteeism rates, but is unlikely to

bias the observed relationship between absenteeism and other factors. Some other covariates e.g. number of co-morbidities; were also based on self-report, possibly introducing errors in prevalence rates and diluting the findings. Additionally, there was a low response rate for number of absenteeism days and some other measures (e.g. smoking status, job satisfaction), which may have led to less reliable estimates. Data on employment type (employed/self-employed) was available in only a small sub-sample of the population and could not be assessed in the final analysis, although other studies have shown this to be associated with absenteeism.[27]

Implications for practice and research

Our finding that level of dyspnoea is associated with work performance highlights the importance of improving the management of breathlessness in COPD patients, particularly those in employment. Workplace adaptations with guidance from occupational health (OH) services, self-management advice, referral to pulmonary rehabilitation and smoking cessation advice could support symptom management.

OH assessment and advice (altering job role, job tasks or work environment) could also help modify exposures to VGDF and contribute to improved work productivity.

Further studies, including longitudinal studies that assess both absenteeism and presenteeism are needed to confirm our findings. Intervention studies are also needed to assess the effectiveness of interventions for managing dyspnoea and reducing workplace exposures on work productivity among patients with COPD.

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Author contributions

The BLISS research team

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PA and DAF are co-PIs for the BLISS programme which was conceived in consultation with REJ, KKC, JGA and RS, and with BGC, AD, SG, KJ, SJ, JM, MRM, RR, SSi and AMT as co-investigators. PA led the cohort study, RJ the TargetCOPD trial, and JGA the occupational sub-cohort. AE oversaw programme management and APD was the research fellow for the cohort.

KKR oversaw the occupational measures for the cohort, conducted the data analysis and drafted the manuscript with advice from PA and REJ. SSS developed the job exposure matrix. AJS and SSi advised on data analysis. PA had responsibility for the final content. All authors reviewed and approved the final submission.

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