THE EFFECTS OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE ON WORK RELATED OUTCOMES

By

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Abstract

Chronic obstructive pulmonary disease (COPD) is an important cause of morbidity and mortality worldwide. Some studies suggest that COPD may affect work, however this relationship remains poorly understood. Various methods are used in this thesis to investigate the impact of COPD on employment and work productivity.

Findings from the systematic review showed that patients with COPD had lower employment and higher sickness absence rates compared to those without COPD. From the cross-sectional analyses, breathlessness and occupational exposures to vapours, gases, dusts and fumes (VGDF) were identified as the main modifiable factors associated with unemployment and poor work productivity in COPD patients. Finally, few patients agreed to take part in the occupational intervention. Although most participating patients received a range of recommendations, these were not taken up by all. Potential benefits and suggestions for future occupational interventions were identified.

This work confirms that having COPD adversely affects patients' rates of employment and work productivity. Future interventions should focus on managing breathlessness and reducing occupational exposures to VGDF to improve work ability and work productivity among patients with COPD. The development of novel interventions should draw upon lessons learned from the feasibility study reported in this thesis.

I dedicate this thesis to my mama (maternal uncle), Dr Harpret S Binning (1969 – 2015), who set the standard for high academic achievement… he would have been very proud to see the completion of this work.

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AUTHOR CONTRIBUTIONS

KK was involved in recruiting the GP practices to the Birmingham COPD Cohort and carrying out the patient assessments. This included training and supervising the research assistants to conduct the assessments. KK was also involved in the data entry for the cohort study.

KK managed the cohort data collection for the occupational measures, and provided training to the research team to ensure accuracy and reliability of the collected data. Quality control of the occupational measures was also carried out by KK.

KK designed the feasibility study presented in this thesis, managed the submission of the project to the ethical committee, recruited the participants, managed the running of the intervention, recruited patients to the qualitative study and carried out the qualitative interviews. All data analyses (quantitative and qualitative) presented in this thesis were carried out by KK.

The work presented in this thesis was written by KK and supervised by Professor Peymané Adab and Dr Rachel Jordan.

LIST OF ABBREVIATIONS

ACE-JEM	Airborne chemical exposure job exposure matrix
ADO	Age, dyspnoea and airflow obstruction
ATS	American Thoracic Society
BD	Bronchodilator
BLF	British Lung Foundation
BLISS	Birmingham Lung Improvement Studies
BMI	Body mass index
BODE	Body-mass index, airflow obstruction, dyspnea and exercise capacity
CAT	COPD Assessment Test
CASCOT	Computer Assisted Structured Coding Tool
CI	Confidence interval
COPD	Chronic obstructive pulmonary disease
COPE	COPD occupation and work performance
ERS	European Respiratory Society
FEV_1	Forced expiratory volume in one second
FVC	Forced vital capacity
GLI	Global Lung Initiative
GOLD	Global Initiative for Obstructive Lung Disease
GP	General practitioner
HRQoL	Health related quality of life

HWP-1	Health and Work Productivity-One Survey
IQR	Interquartile range
JEM	Job exposure matrix
MRC	Medical Research Council
mMRC	Modified Medical Research Council
NHANES	National Health And Nutrition Examination Survey
NICE	National Institute for Health and Care Excellence
OH	Occupational health
OHI	Occupational health intervention
OR	Odds ratio
PIS	Patient information sheet
PPE	Personal protective equipment
PR	Pulmonary rehabilitation
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
QOL	Quality of life
RCT	Randomised controlled trial
RTW	Return to work
SD	Standard deviation
SGRQ	St George's Respiratory Questionnaire
SM	Self-management
SOC	Standard Occupational Classification
SPS	Stanford Presenteeism Scale

VGDF	Vapours, gases, dusts or fumes
WHO-HPQ	World Health Organization Health and Work Performance Questionnaire
WLQ	Work Limitations Questionnaire
WPAI	Work Productivity and Activity Impairment
6MWT	Six minute walk test

1. INTRODUCTION

1.1 The importance of work on health and wellbeing

There is increasing evidence that being in work is good for physical and mental health and wellbeing.[1] Being in work provides a feeling of self-worth[1] but also has economic advantages for both the individual and society. Evidence suggests that being out of work may be harmful for individuals.[2]

Those not in work are more likely to have higher mortality rates with a government commissioned review reporting 37% excess mortality in those who were unemployed (and not ill) compared to those in employment.[2] Unemployed people are also more likely to have poorer mental health (suicidal thoughts in unemployed vs. employed men: 21.7% vs. 13.8%),[3] and there is evidence to suggest that those who become unemployed are approximately twice as likely to experience a negative impact on their mental health (men: OR=2.05 (95% CI: 1.71-2.47); women: OR=1.72 (95% CI 1.39-2.12).[4] There is also evidence of increased health service utilisation in those unemployed (increased visits to the GP among men: adjusted OR=1.83 (95% CI 1.61-2.09).[5]

Conversely, work may also be associated with negative health outcomes. Within the UK, workplace exposures contribute to approximately 13000 deaths annually due to lung disease and cancer.[6] There is also evidence of the association between other occupational factors and poor health. For example, those in unstable employment (fixed term contract or temporary employment) are more likely to have higher levels of fatigue, back and muscular pains compared to those with a permanent job.[7] Furthermore, a recent labour force survey found approximately 1.2 million workers felt that their health condition was either caused or worsened by their work.[8]

Although sickness and disability still account for many of those who are not in work,[9] there is an agreement across a number of groups (e.g. all political parties, employers and disability groups) that those who are unwell or disabled should aim to remain in work or return to work as it is therapeutic; promotes recovery and rehabilitation and there are better health outcomes for patients.[2;10] It is therefore recognised that being in work outweighs the risks associated with working and the beneficial effects of being in work are greater than the negative of long-term sickness absence or unemployment,[1] with the proviso that the individual has a 'good job'. Such characteristics may include: fair pay; job security; personal development; job satisfaction; greater control/autonomy and non-discriminatory.[2]

1.2 Working with a chronic condition

Among those of working age, an estimated 15% are affected by a chronic condition or disability in the UK.[11] With the state pension age increasing, the UK workforce will be working longer to an older age[12]; which also increases the chance of developing a chronic condition. This, in addition to the current trajectory, therefore suggests that more people will be working with a chronic health condition in the future.[1]

Whilst there is a beneficial impact of working on the health and wellbeing of an individual, having a chronic illness is often associated with poor work ability. Employment rates in the UK are lower in those with a chronic condition (60.4%)

compared to the general population (73.5%).[13] Previous research has focused on the burden of common health conditions, such as musculoskeletal disorders and mental health conditions, on work productivity losses.[14-18] Consequently, there has been increasing attention to work-based interventions to help people stay in work for longer and prevent those with common health conditions progressing from short-term sickness absence to incapacity benefits and job loss.[15;19-21]

Of the main long-term health conditions, there is a growing interest in the impact of chronic obstructive pulmonary disease (COPD) on the ability to work. As COPD progresses patients are increasingly faced with a number of functional limitations, and as a result, can experience effects on their personal, social and work life.[22;23] Little is understood about the relationship between COPD and work, which may also explain the paucity of evidence assessing work-based interventions in patients with COPD as well as the lack of health interventions assessing working outcomes in COPD patients.

1.3 Definition and description of COPD

COPD is a progressive lung disease, characterised by airflow limitation. The most commonly used definition of COPD is by the Global Initiative for Chronic Obstructive Lung Disease (GOLD):

"Chronic Obstructive Pulmonary Disease (COPD), a common preventable and treatable disease, is characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases. Exacerbations and comorbidities contribute to the overall severity in individual patients." [24]

The airflow limitation is initially caused by chronic lung inflammation, leading to obstructive bronchiolitis (small airways disease) and emphysema (destruction of the lung parenchymal tissue).[24] The role and contribution of both conditions varies for each individual.[24] COPD is associated with a number of symptoms, disability and poorer quality of life.[25]

Although known to primarily impact on lung function, there is increasing evidence of the systemic consequences of COPD (particularly systemic inflammation),[26] which includes the frequently occurring co-existing illnesses (or co-morbidities) in patients with COPD.[27] However, it is unclear whether the associations between certain co-morbidities and COPD are due to the shared risk factors, such as smoking and poor physical activity, or caused by COPD itself.[28] Nevertheless, it is well recognised that the associated systemic consequences lead to poorer health outcomes, for example reduced quality of life and increased mortality.[27] Some of the most common comorbidities include: cardiovascular disease, cancer, diabetes, osteoporosis, depression/anxiety, muscle loss or dysfunction, anaemia and gastroesophageal reflux.[26;27]

1.4 The burden of COPD

COPD is one of the leading causes of morbidity and mortality worldwide[29;30]; affecting approximately 6-10% of the population worldwide.[31] Furthermore, both COPD prevalence and mortality are increasing[24;32;33]; much of which is due to the ageing global population as well as the continued use of tobacco worldwide.[34] The prevalence of diagnosed COPD in the UK is 1.8%,[35] however due to the known large under diagnosis of the condition,[36;37] the actual prevalence of COPD may be as much as twice as high.[25;37;38] Healthcare utilisation among COPD patients is high. It is estimated that 94000 of annual hospital admissions in the UK are due to COPD[39]; with COPD exacerbations as the second most common cause of accident and emergency visits.[40] In addition, those with more severe disease are more likely to experience increased risks of hospitalisation, with more than one third being readmitted into hospital within 30 days.[41] Consequently, COPD has a significant impact; costing the NHS in excess of £800m annually,[41] with costs associated with inpatient stays accounting for more than £240m alone.[42] However, these costs alone do not reflect the true burden of COPD; there are also significant indirect costs (largely due to lost productivity) to society. Indirect costs account for 27% to 61% of the total costs attributable to COPD.[43] In the US, it is estimated that COPD accounts for 16.4 million lost working days each year[44]; costing approximately $3.9bn in the US annually.[44] In the UK, the estimated societal cost of sickness absence due to COPD is £1.1bn.[45] With increasing morbidity among those with COPD, it is likely that these costs will increase too.

1.5 COPD symptoms, diagnosis, severity, COPD prognosis and exacerbations

COPD is associated with a number of respiratory symptoms: breathlessness (dyspnoea), chronic cough, sputum production and wheezing[25]; COPD patients may present with one or more of these symptoms. Chronic cough is often one of the first symptoms of COPD, and although to begin with it may be irregular, as the disease progresses patients experience daily coughing.[24] Breathlessness is an important

COPD symptom; associated with disability and anxiety.[24] Other symptoms patients may experience include fatigue, weight loss, waking at night and ankle swelling.[25]

The presentation of COPD is associated with considerable clinical heterogeneity, and therefore a number of indicators are used to make a clinical diagnosis. Currently, a COPD diagnosis is considered among patients who have a history of exposure to the risk factors associated with COPD (e.g. smoking) and those who present with one of the following respiratory symptoms: breathlessness, chronic cough or regular sputum production.[25] To confirm a diagnosis of COPD, patients are also required to meet the spirometry (lung function test) criteria for airflow limitation: post-bronchodilator FEV_1 (forced expiratory volume in one second)/FVC (forced vital capacity) <0.70.[25] The Global Initiative for Chronic Obstructive Lung Disease (GOLD) have also categorised the spirometric values using various cut-off points to indicate the categories of disease severity (Table 1-1), and this is currently used as the standard in categorising COPD according to the NICE (National Institute for Health and Care Excellence) guidelines.[24;25]

Table 1-1 Global Initiative for Chronic Obstructive Lung Disease (GOLD) classification disease severity staging

Disease severity	GOLD staging	Spirometry criteria
Mild	GOLD 1	$FEV_1/FVC < 0.70$ $FEV_1 \geq 80\%$ predicted
Moderate	GOLD 2	$FEV_1/FVC < 0.70$ $50\% \leq FEV_1 < 80\%$ predicted
Severe	GOLD 3	$FEV_1/FVC < 0.70$ $30\% \leq FEV_1 < 50\%$ predicted
Very severe	GOLD 4	$FEV_1/FVC < 0.70$ $FEV_1 < 30\%$ predicted

Although airflow obstruction is used to define disease severity, it is now increasingly recognised that FEV_1 alone does not fully describe the impact of COPD on patients' lives. Evidence demonstrates that dyspnoea (an important COPD symptom) better measures disease severity as well as gauging the level of impact.[46;47] In fact, GOLD advocates that in addition to evaluating the level of airflow obstruction, a formal symptomatic assessment should be conducted.[24] This has encouraged the development of a variety of multi-dimensional indices, incorporating different facets of disease severity, for example the BODE index[48] and the ADO index.[49] GOLD have also developed a composite measure, using a range of prognostic markers, to help better understand, describe and define the impact of COPD on the individual as well as guide management. It includes symptom impact (the CAT score), breathlessness, degree of airflow obstruction and risk of exacerbations.[24] There are a range of prognostic indices available, but there is insufficient evidence for the implementation of a particular prognostic index.[50]

Life expectancy decreases with increasing disease severity and among continuing smokers in patients with COPD. Among men, life expectancy for those with GOLD stage 2 and 3 or 4 is 1.2 years and 4.7 years lower than those without COPD.[51] Among male smokers with GOLD stage 2 and 3 or 4, a reduction in life expectancy of 2.2 years and 5.8 years was found when compared to those without COPD.[51]

COPD patients also experience exacerbations of their condition. A COPD exacerbation can be described as a "sustained worsening of the patient's condition from the usual stable state, which is beyond normal day-to-day variations that is acute in onset and may warrant additional treatment".[52] Symptoms include worsening cough, breathlessness, increased sputum production and change in sputum colour.[25] Annual exacerbation rates have been shown to vary from 0.5 to 3.5 per patient[53]; with 31% of reported exacerbations requiring hospitalisation.[54] COPD exacerbations contribute towards a worsening prognosis (increased risk of morbidity and mortality),[55;56] and an increased exacerbation frequency is associated with poorer quality of life.[57] Thus COPD exacerbations are considered as important events,[58] and therefore are often used as a marker of disease severity.

Co-morbidities also play an important role in the worsening prognosis of COPD; evidence suggests that mortality is largely due to non-respiratory related diseases for example coronary heart disease, cancer and stroke; with respiratory related cause of death only accounting for 8-9% of all deaths in patients with COPD over a 25 year follow-up.[59]

Due to the multi-dimensional nature of COPD, the GOLD committee encourages an independent assessment of the following in determining the patient's disease severity, health status and future risk of events: patient's symptoms, severity of airflow obstruction, exacerbation risk and the presence of co-morbidities.[24]

1.6 The treatment and management of COPD

Due to the progressive nature of the chronic condition, COPD cannot be cured; however the condition can be managed to delay the progression of the disease, for example preventing exacerbations and easing symptoms. The most effective advice to manage and alter the course of COPD is smoking cessation.[24;60;61] Correct pharmacological therapy (including correct inhaler technique) is advised to help with symptom management, exacerbation frequency and severity and improve general overall health.[24] Patients are also recommended annual influenza vaccinations and a single pneumococcal vaccination to reduce the risk of infections,[25] which lead to exacerbations.[62]

NICE advise that patients with more severe COPD (those with a recent hospitalisation due to COPD or MRC score$\geq$3) should be referred to pulmonary rehabilitation.[25] Pulmonary rehabilitation is a multi-faceted programme involving components such as exercise, education and behaviour change. Among those with COPD, it is an approach which aims to reduce COPD symptoms, improve health related quality of life and increase the physical and emotional involvement in everyday life.[24]

Self-management of COPD is also an important aspect of managing the disease and improving patient outcomes. Recent evidence from a systemic review demonstrated that supported self-management programmes were able to significantly reduce hospitalisations (OR=0.60; 95% CI 0.40 to 0.89) and improve health related quality of life (mean difference in SGRQ score -3.51; 95% CI -5.37 to -1.65) in COPD patients, compared to those receiving usual care.[63] In addition to the above, the important self-management health behaviours that need to be considered include early symptoms recognition; action planning (accessing treatments promptly during an exacerbation); breathing techniques; exercise; bronchial hygiene techniques; nutritional programmes and stress management.[64]

1.7 Risk factors associated with COPD

Although cigarette smoking is the main risk factor for COPD,[24] it is not the only explanatory factor. Other known risk factors include indoor and outdoor air pollution, respiratory infections and factors associated with low socioeconomic status.[24] Occupational exposures are also recognised as playing an important role in the development of COPD.[65-67] It is thought that the inhalation of particular gases and particles result in airway and lung inflammation, leading to the progression of COPD.[66]

1.8 Occupation as a risk factor for COPD

Fishwick and colleagues report that associations between chronic respiratory symptoms and workplace exposures have been suggested as early as the 15th century,[68] although documentation of the connection between 'dusty trades' and chronic bronchitis has been more prominent from the 19th century.[68;69] The inconsistent definitions of COPD and unreliable measure of exposures have led to a delay in the recognition of the causal link between occupational exposures and COPD. However, over recent years strong associations have been found between particular occupational groups and exposures to vapours, gases, dusts and fumes (VGDF) and the development of COPD. In particular, Margaret Becklake's seminal work indicated a causal link between workplace exposures to dust and fumes and COPD,[70] subsequently confirmed by a number of systematic reviews.[66;71;72]

Research in this field has either focused on examining: 1) specific industries or workforces – providing homogenous populations in terms of occupational exposures, or 2) general populations with varied populations and occupational exposures.[73] Although both types of studies have their respective advantages in assessing the impact of occupation on COPD, prospective data collection among a general population may be seen as advantageous as it allows the assessment of the total burden of occupational exposures on COPD[73] as well as reducing the problems related to the confounding of the "healthy worker effect"[68] (where lower morbidity and mortality is observed in the working population, as those who are more ill tend to leave work).

Based on a review by the American Thoracic Society (ATS), and a subsequent updated review it has been estimated that approximately 15% of COPD may be attributable to workplace exposures.[71;72] This risk (population attributable fraction (PAF): "*the fraction of cases in a population that arise because of certain exposures*")[74] has been cited as higher among non-smokers; using data from the NHANES survey, the estimated PAF due to occupation was 31.1% among non-smokers.[75]

It remains unclear which specific substances cause COPD as only a few studies have been conducted with the aim of measuring specific occupational exposures and their contribution towards the burden of COPD.[74] However, an increased prevalence of COPD has been found in those exposed to asbestos, cadmium, coal dust, quartz, sawdust, silica, solvents, welding fumes and wood dust.[69;76] Longitudinal studies have also shown exposure to cotton and grain dust as important risk factors in the development of chronic airflow limitation.[76;77] Additionally, high prevalence of COPD has been noted in specific occupations and industries, such as: construction;

leather/rubber/plastics manufacturing and workers; spray painters; welders; repair services and gas stations; food products and textiles.[75]

Although much of the previous literature has focused on the impact of occupation on the development of COPD, it is also important to understand the effect of COPD on employment and work performance. This is relatively new research area and is the focus of this thesis.

1.9 Measures of work ability or work productivity

There are 3 main measures of work ability. Employment is one of the main outcome measures when assessing the impact on work. Among those in work, worker productivity is also assessed. Historically, work productivity has predominantly been measured by assessing time taken off work for a scheduled working day(s) – "absenteeism". However more recently, there has been a focus on an emerging concept known as "presenteeism", focusing on an individual's work performance when at work.

1.9.1 Employment

According to the Office for National Statistics being in work is defined as:

"in paid employment at work for at least one hour over the reference week (or temporarily not at work during the reference period but have a formal attachment to their job) or, in self-employment at work for at least one hour over the reference week (or is a person with an enterprise who is temporarily not at work during the reference period for any specific reason)".[78]

This data is captured at population level through the Labour Force Survey (LFS), a periodical survey assessing the employment circumstances within the UK.

Respondents are questioned: *"Did you do any paid work in the 7 days ending Sunday the [date], either as an employee or as self-employed?"*.[79]

There is a risk of inaccurate reporting when collecting data on employment. As unemployed individuals within the UK are eligible for claiming benefits (e.g. job seekers allowance, housing benefit), individuals may chose not to disclose that they are in work in order to maintain their benefits income.[80] Within the research context, this may be reflected in imprecise higher unemployment rates.

1.9.2 Sickness absence

Sickness absence (or absenteeism) has been defined as "absence from work that is attributed to sickness by the employee and accepted as such by the employer".[81] Historically, sickness absence has been an important indicator of worker productivity and consequently, a method of measuring the financial impact on society and the economy. This may be officially recorded by the employer or self-reported by employees.

The Office for National Statistics provides estimates on UK sickness absence over a 12 month period. However, within research, varying recall periods have been used to measure sickness absence, for example, within COPD research this has ranged between one week and two years.[22;82]

Self-reported measurement of sickness absence is frequent in the literature but is known to be at risk of recall error[83]; and the greater the recall period, the more prone the data is to recall inaccuracy. Previous work in this field suggests that the tendency is for employees to underestimate their sickness absence rates.[83] Methods of reducing this error include collecting the data prospectively through diaries or reducing the recall period. However, prospective data collection can be an onerous task and a shorter recall period may result in skewed data i.e. towards zero sickness absence [83]. Social desirability bias is another potential issue related to the reporting of sickness absence. Respondents may feel the need to present themselves and their behaviour positively[84] and therefore, under-report their sickness absence rates.

Sickness absence data is also susceptible to occupational bias. Protocols and practices for sickness absence vary across occupations and work organisations; “these differences can contribute to error in estimating the effects of health on the work productivity of different groups”.[83(p75-p76)] For example, occupations which require careful consideration of the impact of an employee’s health on the health and safety of others, may have higher sickness absence, e.g. a sick nurse may be obliged to stay at home for the health and safety of patients.

1.9.3 Presenteeism

Presenteeism relates to a measurement of work productivity; a measure of an individual’s performance at work accounting for the impact of an illness or medical condition which may prevent him or her working at full capacity. The term has been defined as “the problem of workers’ being on the job but, because of illness or other medical conditions, not fully functioning”.[85] Although a relatively new concept, its potential impact on the productivity loss among workers has led to its increasing focus within the scientific literature. Evidence suggests that this “invisible, but significant drain on productivity”[85] may be a far greater problem than the impact of sickness absence alone.[86]

In some occupations decreased work performance can be assessed by quantifying work tasks, for example, measuring and comparing the number of items produced or the number of telephone calls handled over a period of time.[87] However this may be more difficult to assess in predominantly cognitive based occupations.[87] Consequently, to gauge and quantify work performance in a variety of occupations, a number of questionnaire-based presenteeism instruments have been developed. However, measuring presenteeism can be complicated. Within the literature presenteeism has been described using varying definitions, for example: “reduced productivity while at work”[88] and “reduced on-the-job effectiveness due to health problems”,[89] with a higher value – high presenteeism – indicating poorer work performance. Presenteeism has also been described as attending work when sick (sickness presenteeism).[90;91] Somewhat confusingly, presenteeism has also been defined and measured as “a good thing, with higher scores indicating higher performance and job productivity”.[92] An example of such a measure is the Stanford Presenteeism Scale (SPS-6), where decreased productivity is defined as “decreased presenteeism”.[93] The various measurement scales – ranging from simple single questions to more complex instruments – may provide an explanation for the varying definitions and directional effects, and currently, there is lack of agreement on the best tool to capture presenteeism.[92] Therefore, due to the varying definitions and the absence of a standard instrument to measure the phenomena, there may be a lack of clarity of what is actually being measured.[85] Examples of the more common instruments used to measure presenteeism include the WHO Health and Work Performance Questionnaire (WHO-HPQ),[94] The Work Limitations Questionnaire

(WLQ),[95] The Stanford Presenteeism Scale (SPS-32)[96] and the Work Productivity and Activity Impairment questionnaire (WPAI).[89]

One of the less complex and shorter tools is the WPAI questionnaire: a single question related to productivity requiring the respondent to score using a visual analogue scale. It has a short, 7 day recall period. Consequently, its simplicity may provide an explanation for the WPAI's frequent use within research, in particular, COPD research.

However for the purpose of this thesis, the Stanford Presenteeism Scale (SPS-6) was chosen amongst the numerous instruments to measure presenteeism based on some of its potential advantages. The SPS-6 is a shortened version of the SPS-32 and aims to capture the cognitive, emotional and behavioural aspects of work.[93] The questionnaire was developed to assess and combine two main aspects of presenteeism: work processes and working outcomes.[93] It is a relatively short questionnaire, consisting of 6 items, with a one month recall period – the past month. It is considered to be among the small number of tools possessing good psychometric properties (e.g. good level of measurement, validity and reliability).[97;98] However, defining presenteeism as fully productive/engaged with work may be considered as a shortcoming of the instrument when compared to other presenteeism questionnaires. Therefore, for the purpose of this thesis, presenteeism will be defined in keeping with the commonly used definition; decreased productivity signifying presenteeism (poor work performance), and thus a low SPS-6 score will be described as decreased productivity and high presenteeism.

1.10 The impact of COPD on employment and work productivity

There are limited and inconsistent data on the impact of COPD on employment and work productivity. Data from other countries suggests patients with COPD are less likely to report being in work when compared to those without any chronic conditions (OR: 0.41; 95% CI 0.24 – 0.71); which is lower than those with asthma (OR: 0.82; 95% CI 0.55-1.21) or other chronic conditions (OR: 0.86; 95% CI 0.68 – 1.08).[99] However the absolute risk may vary by country due to the diverse economies and employment rates. For example, data from a large cross-sectional study across Latin America demonstrated that 42.0% of those with COPD were in work,[100] whereas an international survey found only 29.0% of those with COPD of working age were in work.[22] Whilst it may seem intuitive that employment rates among those with COPD would vary according to disease severity, evidence for this is conflicting.[100-103] Increasing age,[100;102] being female,[100] lower educational level[100] and poorer health related quality of life[102] are factors which have also been noted to be significantly associated with being out of work among those with COPD in some studies, but this is not consistently shown among the limited evidence in this area.

Work-related factors may also play an important role. High occupational exposures to irritants or dusts seem to increase the risk of being out of work among those with COPD,[101] although evidence for this is limited and conflicting.[101;102] These inconsistencies may be explained by the variability in the method of measuring occupational exposures – self-report and professional judgement – although both methods may be considered crude and are susceptible to subjectivity and measurement error.

There is also some limited evidence which suggests that unfavourable work experiences and patients' perceived inability to work due to the disease may also be associated with lower employment rates; those whose employers commented negatively about their disease or felt that their employer did not adequately consider their disease, were less likely to be in work.[101] Furthermore, patients who thought that their work worsened their COPD were more likely to be out of work (OR: 5.1; 95% CI 2.87-9.04).[101]

Among those who remain in work, work productivity may also be affected by their disease. Data from a large Australian cross-sectional survey show that patients with COPD are more likely to take time off work compared to those without COPD (adjusted IRR (95% CI): 1.22 (1.04 – 1.43), and have a higher risk of absenteeism than those with other chronic conditions such as cancer (adjusted IRR: 1.11 (1.04 – 1.17) and arthritis (adjusted IRR: (95% CI): 1.07 (1.01 – 1.14)).[104] Although a number of studies concur that COPD adversely affects sickness absence,[104-108] the magnitude of the effect remains unclear. The amount of time off work has been shown to vary between studies,[22;45;107-117] and although this may be reflective of the differing economies, other inconsistencies have been noted within previous research, such as definition of absenteeism, varying recall periods and study sample sizes.

Fewer studies have assessed the impact of COPD on work performance (or presenteeism). There is inconsistent evidence about whether COPD patients are more likely to have poorer work performance compared to those without COPD.[22;104;111;112;116] Furthermore, a variety of scales have been used to measure presenteeism; making it difficult to compare the effect estimates between the studies.

A number of socio-demographic factors have been shown to be associated with increased sickness absence among those with COPD for example, lower age [118] and lower education level.[119] There is some evidence which suggests that although sickness absence is not associated with airflow obstruction,[118] it is more common among those with severe breathlessness.[22] There is also some inconsistent evidence of the negative impact of co-morbidities on sickness absence.[118;119] Overall, there is limited amount of evidence; of which there are small sample sizes and limited analyses assessing a range of clinical characteristics (such as breathlessness, health related quality of life and exacerbations) which may be associated or confounding work productivity.

Furthermore, currently no research has been conducted assessing which socio-demographic, clinical or occupational factors are associated with presenteeism among those with COPD. Although evidence from an unadjusted analysis, assessing the prevalence of presenteeism according to breathlessness (presenteeism prevalence: mild=5.2%; moderate=16.8%; severe=18.9%, p-values unreported), suggests disease severity could be important.[22]

1.11 Other factors which might affect employment and work performance

In other populations, various other work related factors have shown to be associated with poor work productivity, such as: poor control over work (e.g. employee's ability to schedule own work)[91;120]; job insecurity[121;122]; understaffing[121]; lack of supportive work culture (particularly supervisory support)[121-123]; reduced job satisfaction[121] and lack of time and resources.[91;122] There is conflicting evidence on the impact of shift work on sickness absence, although fixed evening work may be an important factor for an increased risk of absenteeism.[124] Types of employment seem to be associated with work productivity, for example those in paid employment (compared to self-employed) and those working in the public sector (compared to private sector) take more time off work.[125] Nature of occupation should also be considered, for example, those with a plant/process/machine operative background are 71.0% more likely to take time off work compared to those with a professional occupational background.[125]

Individual patient characteristics also show some importance. For example, individuals who possess neurotic characteristics (such as anxiety, worry and insecurity) are less likely to achieve their work tasks[126]; with emotional stability being positively associated with job performance.[127]

1.12 Mechanisms and potential ways in which COPD patients may be affected in the workplace

COPD patients are faced with a number of issues on a daily basis, which may also affect their ability to work. Dyspnoea (breathlessness) is a common symptom,[128] which in the work environment, may lead to a reduction in work load and therefore reduced work productivity. As a consequence, this may lead to a dyspnoea spiral[129]: a reduction in exertion to avoid dyspnoea may then reduce fitness levels and as a consequence, work tasks may become harder or patients may avoid tasks causing an earlier occurrence of dyspnoea.

Fatigue, another symptom experienced by COPD patients,[128] may limit work activities. Fatigue may increase with disease severity,[130] negatively affecting functional performance.[131] Therefore, as the condition progresses an activity may be more difficult to achieve. Similar to dyspnoea, patients may become part of a cycle where work tasks affect fatigue and fatigue affects the tasks. There is also some evidence for muscle wasting in COPD patients,[132] which may result in difficulty in carrying out manual work tasks, leading to further breathlessness and muscle fatigue. As the disease progresses, health-related quality of life deteriorates and there may be a greater impairment in the patient's ability to work.[133] As a means of avoiding this vicious cycle and complications, patients may opt for early retirement.

COPD is often associated with a number of co-morbidities such as cardiovascular disease, metabolic disorders and psychiatric disorders.[27] Co-morbidities may present themselves as a further challenge to working COPD patients. For example, increased levels of anxiety are associated with more severe breathlessness[134;135] and may impact on work productivity and possibly lead to further anxiety. Hence, co-morbidities may have an additional impact and lead to further problems at work for the patient.

Workplace exposures to vapours, gases, dusts and fumes (VGDF) have been identified as an important risk factor in the development of COPD.[68] However, further understanding about the characteristics of these exposures is required. Various 'non-specific exacerbating factors' may, for example, induce cough in the workplace; general irritant exposures, cold temperatures, increased physical activity or talking for prolonged periods.[136] An example, exposure to cleaning agents (bleach or air refreshing sprays) may also irritate the lungs and lead to an increase in respiratory tract symptoms[137] and COPD exacerbations. Furthermore, heavy manual and blue-collar work may be associated with work disability in respiratory disease patients.[138]

Respiratory morbidity and mortality is increased in the winter months.[139] Evidence suggests that the prevalence of COPD symptoms is greater in those working and living in cold environments.[140;141] Exposure to a cold environment at work, for example through breathing cold air, may therefore worsen respiratory symptoms and lead to reduced work productivity.[142]

Apart from the direct work environment, work productivity could also be affected indirectly. For example, poor self-management or non-adherence to medication or continuing to smoke may all affect disease control, possibly leading to poor work performance or time off work. Good self-management, for example regular medication use or infection control measures, can reduce symptom development and associated COPD exacerbations.[24;25;143] Infections, particularly respiratory infections, play an important role in COPD exacerbations. Influenza and pneumococcal vaccinations are recommended to patients as preventative measures for infection control.[25] Long-term antibiotics are also advised to some patients.[144]

1.13 Evidence for occupational health interventions among patients with COPD

Occupational interventions aimed at working COPD patients need to address a number of aspects, focusing on improving work capacity and better planning of ill health retirement. As patients are at risk of hospitalisation due to COPD exacerbations, interventions should also accommodate the possibility of return to work (RTW) which may need to be phased. However, currently there are no UK occupational programmes focusing on improving poor work performance for patients with COPD. Furthermore, there is a scarcity of research on interventions among patients with respiratory disease, particularly among working COPD patients.

1.14 Summary of research considerations

Having a chronic condition affects working outcomes.[145] This is also likely to be true for COPD patients. Disease related symptoms may affect functionality, for example fatigue and breathlessness, subsequently impacting on work performance, absenteeism and eventually job loss. Improving health through adopting a healthy lifestyle can generally improve health conditions and their associated symptoms.[145] However, some symptoms may require workplace adjustments, and therefore may need interventions to address work-related issues. There is a lack of evidence assessing the impact of workplace interventions but a need for a need for timely interventions, involving treatment, guidance and advice to help prevent long term sickness absence and unemployment.[1]

“Work should be accommodated to the condition and needs of the worker”.[145] To inform the development of targeted interventions, it is important to understand why a particular individual’s work ability may be affected. However, research into the factors associated with working outcomes among those with COPD is limited and conflicting and although occupational exposures may be an important predictor of work ability, current research within COPD populations lacks objective measurement. Furthermore, there is suggestive evidence that disease severity may affect presenteeism, however, currently no research has been conducted in this emerging field among a COPD population. In addition, although there are a number of European studies, there is paucity of evidence based within the UK COPD population, thus limiting the generalisability of findings.

1.15 Aims and objectives of the thesis

The overarching aim of this work is to investigate the impact of COPD on employment and work productivity by:

1. Conducting a systematic review to assess the impact of COPD on employment, absenteeism and presenteeism.
2. Conducting a cross-sectional analysis to assess which factors are associated with employment among patients with COPD.
3. Conducting cross-sectional analyses to assess which factors are associated with absenteeism and presenteeism in COPD patients.
4. Assessing the feasibility and acceptability of an occupational health intervention to improve work productivity among those with COPD.

1.16 Thesis outline

Chapter 2 consists of a systematic literature review which assesses the impact of COPD on employment, absenteeism and presenteeism. This chapter aims to consolidate the current evidence and clarify the impact of COPD and disease severity on employment and work productivity. The review should also identify the gaps in the current evidence and recommendations for future research.

Chapters 3 and 4 investigate which socio-demographic, clinical and occupational factors are associated with employment and work productivity among those with COPD. These chapters aim to address the paucity of evidence in this field and identify the modifiable factors associated with work ability and poorer work productivity to inform future interventions, and help improve working outcomes in COPD patients.

Chapter 5 assesses the feasibility and acceptability of an occupational health intervention consisting of an occupational health assessment, subsequent occupational health recommendations as well as feedback on current COPD self-management practices. The aim is to help patients better manage their COPD at work and improve their work productivity. Various methods are used to assess the feasibility and acceptability of the intervention, and this chapter aims to propose direction for future interventions aimed at working COPD patients.

Finally, chapter 6 contains a summary of the main and novel findings within this thesis, and their implications for policy, practice and future research.

2. A SYSTEMATIC REVIEW TO ASSESS THE EFFECTS OF COPD ON EMPLOYMENT, ABSENTEEISM AND PRESENTEEISM

2.1 Abstract

Background Chronic obstructive pulmonary disease (COPD) is one of the leading causes of morbidity and mortality worldwide and is associated with a high economic burden to society; of which the indirect costs account for a large proportion. In the UK, productivity losses due to sickness absence are estimated to cost £1.1bn. There is a range of evidence assessing the impact of COPD on work ability and work productivity, however this relationship is poorly understood.

Aim A systematic review of the evidence assessing the impact of COPD on employment, absenteeism and presenteeism

Methods The review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidance. Electronic databases CINAHL, EMBASE, MEDLINE, OSH references and the Cochrane Library were searched up to October 2015; identifying observational studies reporting employment, sickness absence and presenteeism in those with COPD.

Results Of the 30 studies which met the inclusion criteria, 13 assessed the impact on employment, 21 assessed the impact on absenteeism and 9 assessed presenteeism. The majority of evidence was from cross-sectional surveys. COPD patients had lower employment rates than those without COPD. Among those who

remain in work, patients with COPD were found to take more time off work than those without COPD. They were found to be more affected by poorer work performance than those without COPD, however evidence for this was limited and weak. The influence of disease severity on these outcomes was unclear, although of the limited evidence it appeared that increasing severity was associated with reduced likelihood of being in work. A number of methodological limitations were found amongst the evidence including the lack of adjusting for important confounders.

Conclusions This is the first systematic review assessing the impact of COPD and disease severity on employment, absenteeism and presenteeism. COPD patients have lower employment rates and more time off work than those without COPD. Further research assessing the impact on presenteeism, using validated presenteeism instruments and consistent reporting methods, is required. Robust studies are now needed to identify modifiable factors associated with these poorer working outcomes among those with COPD to help inform future interventions.

2.2 Background

Chronic obstructive pulmonary disease (COPD) is a progressive lung disease characterised by airflow obstruction.[25] It is the fourth leading cause of death worldwide[24;146] and is associated with high healthcare utilisation costs; costing the UK NHS more than £800 million annually.[41] The condition is also associated with indirect costs; in the UK, an estimated 44% of the COPD population are below retirement age, of which around one quarter are not in work due to their COPD.[45] Among those with COPD who are in employment, an estimated 5% of sickness absence is due to

COPD.[45] Estimated costs of productivity losses due to COPD range between £1.1 billion and £2.7 billion in the UK.[41;45]

A large US general population-based survey found that patients with self-reported COPD (69.2%) had significantly lower employment rates compared to those without COPD (77.2%), and that as their disease severity increased, patients were less likely to be in work (p for trend <0.01).[103]

A large multinational survey (the Confronting COPD survey) demonstrated the possible effects of COPD on absenteeism; which ranged from (mean) 0.4 days to 18.7 days off annually across different populations.[45;109;110;113-115;117] Researchers are now also considering the possible effects of COPD on “presenteeism” (poor work performance when at work), for which there are fewer studies.

Although there is a range of literature assessing the effect of COPD on work, the relationship is poorly understood. The lack of consistency of the data, research conducted in a variety of settings/populations and no previous systematic collation of the evidence encourages the need for a systematic review.

In doing so, this review will help to gain a better understanding of how COPD patients are affected as well as highlight the key areas where interventions may need to be focused to help improve working outcomes within this population.

2.3 Methods

Systematic review to evaluate the evidence for the effect of COPD on employment, absenteeism and presenteeism, conducted and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement.[147]

2.3.1 Eligibility criteria

Cohort or cross-sectional studies of COPD patients from any setting, which measured employment, absenteeism or presenteeism among COPD patients compared with participants without COPD were sought. To examine the effect of disease severity, studies among only COPD patients where there was a standardised measure of disease severity or impact of symptoms were also included.

2.3.2 Information sources and search strategy

A systematic search was conducted until October 2015 using CINAHL, EMBASE, MEDLINE, OSH references and the Cochrane Library electronic databases. The combination of keywords used were: (“chronic obstructive pulmonary disease” or “COPD” or “chronic obstructive airways disease” or “chronic obstructive lung disease” or “emphysema” or “chronic bronchitis”) and (“employment” or “absenteeism” or “day off” “sickness absence” or “presenteeism” or “work productivity” or “work performance” or “occupational health”). MeSH terms and text words were used. All relevant studies were included. Citation lists were scanned to identify additional relevant articles. Non-English language articles were excluded.

2.3.3 Study selection and data extraction

Two independent reviewers assessed all titles and abstracts and relevant full-text articles for inclusion and independently extracted data. Outcome measures of interest included: employment rates, absenteeism (mean number of days off; mean hours off; proportion of patients reporting time off work) and presenteeism (mean presenteeism score; number of hours affected by presenteeism; proportion of patients reporting presenteeism). Due to the various definitions, it was important to have a working definition of presenteeism for this review. One known definition of presenteeism is: "the problem of workers being on the job, but, because of illness or other medical conditions, not fully functioning"[85]; therefore studies measuring the impact of COPD on work performance or working limitations were included, irrespective of whether a validated presenteeism tool was used.

2.3.4 Risk of bias in studies

The methodological quality of the included studies was independently assessed by two reviewers using an adaptation of the Cochrane risk of bias method[148] and combination of questions from Crombie,[149] Ajetunmobi[150] and the CASP cohort tool[151]; which was piloted and adjusted as necessary. Risk of bias was classified as high, low or unclear.

2.3.5 Data synthesis

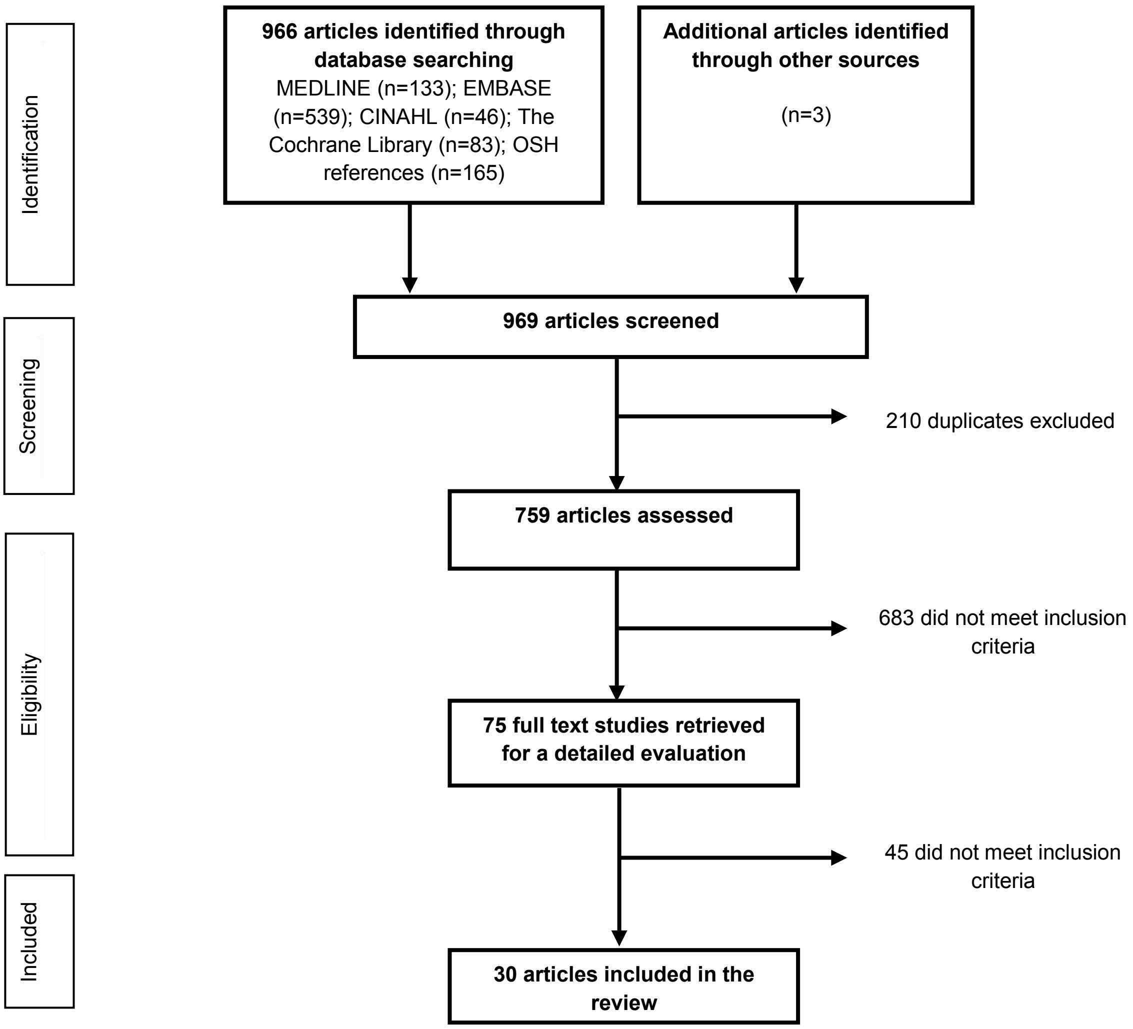
Due to the high heterogeneity amongst the papers and the data, the studies were tabulated and described, but not synthesised.

2.4 Results

2.4.1 Study selection

Of 969 citations, 75 full-text articles were retrieved and 30 studies finally met the inclusion criteria. A detailed diagram of this review process is presented in Figure 2-1 according to the PRISMA statement.[147] The effect of COPD on employment was assessed in 13 studies[99-103;152-159]; 21 assessed the effect of COPD on absenteeism,[22;104-108;111;112;116;118;152;153;158-166] whilst only 9 assessed the effect on presenteeism.[22;104;105;111;112;116;158;159;165]

Figure 2-1 PRISMA flow diagram



2.4.2 Study characteristics

Nine cohort studies and 21 cross-sectional studies were included with study periods ranging between 1967 and 2014. The studies were conducted across 16 countries, with the majority based in the USA and Europe. Eleven studies were general population-based, one occupation-based, six among employed populations, eight primary care population based and four were COPD population based studies only (identified through a range of methods).

Of the cohort studies, five were prospective and four were retrospective, with follow-ups ranging from 1 to 16 years and overall study sample sizes from 212 to 263622 (COPD samples ranged from 44 to 131811). Cross-sectional study samples ranged from 85 to 130880 (COPD samples ranged from 40 to 10711). Overall there was a greater male population in the cohort studies, but this varied in the cross-sectional studies (35.0% to 92.0%). Mean age varied from 37.9 to 68.0 years (for studies with characteristics for overall sample) and disease severity ranged from mild to severe, where reported. See Table 2-1 for summary of study characteristics and Table 2-2 for full study characteristics.

Table 2-1 Summary of study characteristics

Study characteristics	Employment n=13	Absenteeism n=21	Presenteeism n=9
Study design (n)			
Cohort	4	6	1
Cross-sectional	9	15	8
Total sample size range	85 - 263622	85 - 130880	314 - 90279
Setting: recruited population			
General population	7	6	3
Employed population	1	5	3
Primary care population	3	5	-
COPD only population	2	4	3
Occupation based population	-	1	-
Setting: country			
Australia	-	1	1
Canada	-	1	-
France	-	1	-
Latin America	1	-	-
Nordic countries	4	4	-
Poland	-	1	-
Spain	-	2	1
The Netherlands	2	2	-
USA	6	8	6
Cross-country survey	-	1	1
Mean age range for overall study population	37.9 – 68.0 (unreported for n=8)	59.9 – 68.0 (unreported for n=16)	Overall population mean age reported in only one study
Male % range for overall study population	40.1% - 66.7% (unreported for n=7)	35.0% - 100% (unreported for n=9)	35.0% - 53.4% (unreported for n=4)
Disease severity range in those with COPD for overall study population (FEV_1% predicted)	45.2 – 63.5 Moderate to severe (unreported for n=11)	45.2 – 81.1 Mild to severe (unreported for n=17)	Reported in only one study

Table 2-2 Study characteristics

Table 2-2: table of study characteristics

Author	Study design	Study aim	Country and setting	Population inclusion and exclusion criteria	Participants	Participants with lung disease	Comparator	Outcome measure		
								E	A	P
Cohort studies										
Lokke et al (2014)[154]	Retrospective matched cohort 12yr f/up	Evaluate the direct and indirect costs associated with COPD in Denmark	Denmark Patient records from national patient registry	Inclusion criteria: • COPD diagnoses on national registry between 1998-2010	**N = 263622** **Mean age (years):** unknown **Sex (male) (%):** unknown **FEV_1% predicted:** unknown	**COPD** (diagnosis on the national patient registry. Disease severity data unavailable): n=131811	**Without COPD:** n=131811 Matched on age, sex, educational level, residence and marital status.	X	-	-
Jansson et al (2013)[152]	Cohort 12 month f/up	Assess the relationship between societal costs and COPD	Sweden General population study (participants with COPD)	Inclusion: Participants recruited from the OLIN (obstructive lung disease in Northern Sweden) studies. Inclusion criteria: • COPD diagnosis based on GOLD spirometry criteria	**N = 244** **Mean age (years) (range)**: 68 (39-84) **Sex (male) (%)**: 52.0 **FEV_1% predicted:** unknown	**COPD** (using spirometry data and defined according to the GOLD criteria): n=244	**None**	X	X	-
Allen et al (2012)[105]	Retrospective cohorts (over 2 time periods)	Assess and manage the impact of COPD on the workforce	USA Employed population from large US-based company (Navistar)	Inclusion criteria: • Retrospective data of all continental US employees for a vehicle manufacturing company with a minimum of a 6 month continuous coverage in a health plan other than a health maintenance organization • Must have completed the survey for respective timeframe • Participants to have sufficient data to permit a merge into integrated database No clear exclusion criteria defined.	**N = 9861 (2001-2002 data)** **N = 10113 (2008-2009 data)** **Mean age (years)**: <u>2001-2002</u>: COPD: 54.8; Control: 54.8 <u>2008-2009</u>: COPD: 53.4; Control: 53.5 **Sex (male) (%)** <u>2001-2002</u>: COPD: 81.8; Control: 81.1 <u>2008-2009</u>: COPD: 16.7; Control: 75.8 **FEV_1% predicted:** unknown	**COPD** (a minimum of 2 reports within certain timeframe stating COPD) <u>2001-2002</u>: n=181 <u>2008-2009</u>: n=245	**Non-COPD** (no COPD diagnosis on medical reports) <u>2001-2002:</u> n=9680 <u>2008-2009:</u> n=9883 Matched on age, gender, salaried or hourly pay, length of employment and number of comorbidities using propensity scores	-	X	X
Nair et al (2012)[107]	Retrospective matched cohort study Up to 8yr retrospective f/up	Assess the direct and indirect costs associated with COPD in an employed US population and identify drivers of medical expenses including absenteeism	USA Employed population from claims database	Analysis of two datasets: Thomson Reuters MarketScan commercial claims and encounters (CCAE) and Health and Productivity (HPM) databases. Inclusion: • Employees ages 18-65 • ≥1 medical for COPD during 2000-2007 • continuous enrolment in CCAE database for ≥ 6 months prior to and at least 12 months after the index COPD medical claim date • Prescription for drug benefit • Drug data throughout study period • ≥12 months enrolment in HPM database following COPD medical claim date with eligibility for absenteeism or short-term disability Exclusion criteria not stated	**N = 55224** **Mean age (years) (SD):** COPD: 44.5; Non-COPD: 43.8 **Sex (male) (%):** COPD: 59; Non-COPD: 60 **FEV_1% predicted:** unknown	**COPD** (diagnosis based on a medical claim): n=27612	**Non-COPD** (no medical claims for COPD): n=27612 Matched to COPD patients by age, sex, risk score, index year, type of health plan, number of enrolment months following index date, geographic region, type of employment industry and presence of selected co-morbidities using propensity scores.	-	X	-

Table 2-2: table of study characteristics (continued)

Author	Study design	Study aim	Country and setting	Population inclusion and exclusion criteria	Participants	Participants with lung disease	Comparator	Outcome measure		
								E	A	P
Snider et al (2012)[157]	Cohort study 16 years	Impact of illness on employment and disability	USA General population study	Analysis of the Health and Retirement Study (HRS) (long-term panel of Americans approaching and past retirement age). Participants aged ≥51.	**N = 28863** **Mean age (years)**: unknown **Sex (male) (%)**: unknown **FEV_1% predicted:** unknown	**COPD** (self-report of physician diagnosis): n=4095	**Non-COPD:** n=24768	X	-	-
Darkow et al (2007)[106]	Retrospect-ive matched cohort study 90-365 days retrospect-ive f/up	Estimate work productivity loss due to disability in employees with COPD compared with matched employees without COPD, using healthcare and disability claims database	USA Employed population from nine multistate companies using a claims database	Data taken from a healthcare and disability database for 9 large companies. COPD inclusion: • Service date between 1st January 2001 to 31st March 2004 • COPD diagnosis on 1 inpatient medical claim or, • COPD diagnosis on one emergency department medical claim or, • COPD on a minimum of 2 outpatient medical claims within 360 days Employees excluded if: • Not aged between 40 and 63 (based on index date) • No continuous coverage in the health plan • Not actively employed for at least 90 after index date • Had diagnosis of: cystic fibrosis, lung cancer or tuberculosis between 1st Jan 2001 and 31st March 2004 • Employees had any claims indicating pregnancy during study period Employees had any workers' compensation claims between index date and end of f/up	**N = 4045** **Mean age (years) (SD)**: COPD: 52.1 (6.0) Control: 51.9 (6.0) **Sex (male) (%)** COPD: 51 Control: 51.9 **FEV_1% predicted:** unknown	**COPD** (defined according to medical records): n=1349 (matched from 1355)	**Controls** (defined as no evidence of COPD according to medical records): n=2696 (matched from 142115) Matched on age, geographic region, employer, length of employment and salary using propensity scores	-	X	-
Lund and Csonka (2003)[155]	Cohort study 2yr f/up	Identify the effects of organisational context on the process of transition from being in work to work disability	Denmark Employed population	Study based on the Danish National Work Environment Cohort Study; a random sample of patients taken from the Denmark population register. • Participants, aged 19-59 years, were re-interviewed for current study • Additional random sample added to cohort (aged 18 – 22 years) • Study on participants whose workplace also contributed to data No clear exclusion criteria defined.	**N = 3240** (excluding retirees) **Mean age (years)**: unknown **Sex (male) (%):** unknown **FEV_1% predicted:** unknown	**Chronic bronchitis** (self-reported; classified using MRC respiratory questionnaire): n=530	**No chronic bronchitis:** n=2710	X	-	-

Table 2-2: table of study characteristics (continued)

Author	Study design	Study aim	Country and setting	Population inclusion and exclusion criteria	Participants	Participants with lung disease	Comparator	Outcome measure		
								E	A	P
Jansson et al (2002)[162]	Cohort 12 month f/up	Assess the economic impact and societal burden for COPD, assess association between disease severity and societal costs and which costs are the key drivers	Sweden General population study (COPD participants)	Inclusion: Participants recruited from the OLIN (obstructive lung disease in Northern Sweden) studies. Patients with COPD were stratified by age and disease severity. Inclusion criteria: • FEV$_1$<60% of predicted values • A random sample from each stratum was taken in patients with FEV$_1$≥60% of predicted value	**N = 212** **Mean age (years)**: 64.4 **Sex (male) (%)**: 56.6 **FEV$_1$% predicted:** 62.0	**COPD** (using spirometry data and defined according to the British Thoracic Society criteria): n=212	**None**	-	X	-
Jedrychowski (1976)[108]	Cohort 6yr f/up	Assess sickness absence in those with and without chronic chest disease	Poland Occupation based study – fertilizer factory workers	Male workers from a fertilizer factory. Inclusion/exclusion criteria not clearly defined	**N = 248** **Mean age (years)**: unknown **Sex (male) (%)**: 100 **FEV$_1$% predicted:** unknown	**Chronic bronchitis** (diagnosis based on symptoms: chronic cough and phlegm for ≥ 3 consecutive months for at least 2 successive years): n=44/197 analysed	**Without chronic bronchitis:** n=153/197 analysed	-	X	-
Cross-sectional studies										
Solem et al (2013)[158]	Cross-sectional	Assess the burden of exacerbations and disease severity on HRQoL and work productivity	USA COPD primary care population with severe disease	Inclusion criteria: • >40 years • Severe/very severe COPD diagnosis 12m prior to most recent GP visit • Chronic productive cough ≥3 months • ≥1 moderate or severe COPD exacerbation (according to ATS/ERS exacerbation severity)	**N = 314** **Mean age (years):** 68.0 **Sex (male) (%):** 51.3% **FEV$_1$ % predicted:** 45.2	**COPD** (spirometry based on GOLD guidelines and data taken from patient's physician): n=314 Severe COPD: n=190 Very severe COPD: n=124	**None**	X	X	X
DiBonaventura et al (2012a)[112]	Cross-sectional	Assess impact of COPD on health related quality of life, work productivity and resource use among employed adults	USA General population based survey	Data taken from an internet based population study: the US National Health and Wellness Survey. Inclusion criteria for survey: ≥18 years Inclusion criteria for study: those in work and aged 40-64 assessed. No clear exclusion criteria defined.	**N = 20024** **Mean age:** not reported **Sex (male) (%)**: 53.4 (overall) COPD: 45.5 Non-COPD: 53.9 **FEV$_1$% predicted:** unknown	**COPD** (defined as self-reported physician diagnosed chronic bronchitis, emphysema or COPD using questionnaire): n=1112	**Non-COPD**: n=18912	-	X	X
DiBonaventura et al (2012b)[111]	Cross-sectional	Assess impact of COPD on HRQoL, work productivity and resource use in an older working population	USA General population based survey	Data taken from an internet based population study: the US National Health and Wellness Survey. Inclusion criteria for survey: ≥ 18 years Inclusion criteria for study: those in work and aged ≥65 years assessed. No clear exclusion criteria defined.	**N = 3358** **Mean age:** not reported **Sex (male) (%)**: COPD: 40.5 Non-COPD: 52.6 **FEV$_1$% predicted:** unknown	**COPD** (defined as self-reported physician diagnosed chronic bronchitis, emphysema or COPD using questionnaire): n=297	**Non-COPD**: n=3061	-	X	X

Table 2-2: table of study characteristics (continued)

Author	Study design	Study aim	Country and setting	Population inclusion and exclusion criteria	Participants	Participants with lung disease	Comparator	Outcome measure E	Outcome measure A	Outcome measure P
Cross-sectional studies										
Fletcher et al (2011)[22]	Cross-sectional	Assess impact of COPD on income, employment, work productivity and healthcare utilisation	Cross-country: Brazil, China, Germany, Turkey, US and UK COPD population recruited using mixed-methods in 6 counties	Inclusion criteria • 45 – 67 years • Self-reported physician COPD diagnosis, emphysema, chronic bronchitis or alpha 1-antitrpsin deficiency (A1AD) and prescribed respiratory medication in preceding 3 months. • Current or ex-smokers with minimal history of 10 pack years (exception to those with A1AD) Participants from Brazil and China who did not meet cigarette pack years history were included if they met the other inclusion criteria and were at risk of COPD via biomass exposure (defined as exposure to indoor open fire and using solid fuel for cooking/heating for > 6 months in lifetime) No clear exclusion criteria defined.	**N = 2426** with complete data **Age (years)**: 45 - 54: n=1029 (42.0%) 55 - 64: n=971 (40.0%) 65 - 67: n=426 (18.0%) **Sex (male) (%)**: 49 **FEV$_1$% predicted:** unknown	**COPD** (self-reported physician diagnosis): n=2426	**None**	-	X	X
Holden et al (2011)[104]	Cross-sectional	To describe the impact on absenteeism and presenteeism for a range of health conditions in working Australians	Australia Employed population from 58 large companies	Employees recruited from 58 large companies in urban and rural Australia. Large samples from health, education, government and finance organisations were recruited.	**N = 90279 (total responses)** **N = 78430 completed absenteeism** **N = 77455 completed presenteeism** (assessed subset, 0.4% of sample) **Age (years)**: 18 - 29 (17.0%) 30 – 44 (43%) 45 – 59 (37.0%) 60 – 70 (3.0%) **Sex (male) (%)**: 35 (overall population) **FEV$_1$% predicted:** unknown	**COPD** (self-report of COPD/bronchitis or emphysema): n=0.4% of total population (n~361)	**No COPD** n=unknown	-	X	X
Montes de Oca et al (2011)[100]	Cross-sectional	To assess the frequency of paid employment in the PLATINO population with and without COPD; to explore the main factors that influence having paid work in COPD subjects; to determine if COPD has an impact on employment	Latin America Population based survey	Recruitment based on 2 stage cluster sampling methods. Inclusion criteria: • Participants aged $\geq$ 40 years from the selected households invited to the study No clear exclusion criteria defined.	**N = 5314 with data (from 5571)** Characteristics not reported for whole sample (split by COPD and work status) **Age (years) (±SE)**: COPD (in work): 56.9 (0.55) COPD (not in work): 69.3(0.52) Non-COPD (in work): 51.1 (0.18) Non-COPD (not in work): 60.2 (0.35) **Sex (male) (%)**: COPD (in work): 64.7 COPD (not in work): 43.4 Non-COPD (in work): 49.9 Non-COPD (not in work): 20.8 **FEV$_1$% predicted (±SE):** COPD (in work): 79.7 (1.2) COPD (not in work): 78.7 (1.2) Non-COPD (in work): 98.2 (0.32) Non-COPD (not in work): 98.5 (0.47)	**COPD** (post-bronchodilator FEV$_1$/FVC <0.7): n=759	**Non-COPD** (GOLD criteria used to define not having COPD): n=4554	X	-	-

Table 2-2: table of study characteristics (continued)

Author	Study design	Study aim	Country and setting	Population inclusion and exclusion criteria	Participants	Participants with lung disease	Comparator	Outcome measure		
								E	A	P
Nielsen et al (2009)[163]	Cross-sectional	Assess associations between obstructive lung disease and healthcare and social service utilisation	Norway General population based survey -participants with respiratory symptoms	Data taken from population survey – Hordaland County Respiratory Health Survey. Inclusion criteria: • Patients self-reporting asthma, bronchitis, emphysema or COPD. Responders with OLD attended for spirometry No clear exclusion criteria defined.	**N = 161 with spirometry data (from 200)** **Age (years)**: 27 – 49 (41.0%) 50 – 69 (36.0%) $\geq$ 70 (23.0%) **Sex (male) (%)**: 44 **FEV_1% predicted (SD):** 81.1 (20.6)	**COPD pattern** (defined as $FEV_1/FVC<0.7$ irrespective of % predicted): n=50	**Other obstructive lung disease categories:** **Asthma pattern** (defined as $FEV_1/FVC\geq0.7$ and FEV_1 $\geq$ 80% of predicted): n=79 **Restrictive pattern** (defined as $FEV_1/FVC\geq0.7$ and FEV_1< 80% of predicted): n=32	-	X	-
Rodriguez Gonzalez-Moro et al (2009)[165]	Cross-sectional	Assess impact of COPD and its severity on physical disability and daily activities (including work)	Spain COPD population from respiratory clinics	Two surveys of the same design carried out. Recruitment from a public or private clinic by pneumologists. 5 consecutive patients from each clinic who met inclusion criteria: • > 40 years • Diagnosed with GOLD stage II (moderate) or GOLD stage III/IV (severe/very severe) • Not participating in another clinical trial • Able to read/understand documentation	**N = 3608 with COPD** **Mean age (years)**: Moderate COPD: 67.8 Severe/very severe: 69.6 **Sex (male) (%):** Moderate COPD: 88 Severe/very severe: 87.3 **FEV_1% predicted:** unknown	**COPD** (post-bronchodilator FEV_1/FVC <0.7): n=3608	**None**	-	X	X
de Miguel Diez et al (2008)[161]	Cross-sectional	Estimate annual cost for patients with stable COPD (primary care) and analyse the variables with ability to predict the cost of the disease	Spain Primary care COPD population	Patients selected consecutively by physicians in primary care. Inclusion criteria: • $\geq$ 40years • Diagnosed with COPD for a minimum of 12 months prior to recruitment. • Patients with a neurological or psychiatric illness (precluding their study assessment) or had an acute exacerbation of COPD in the previous month were excluded	**N = 10711** **Mean age (years) (SD)**: 64.1 (9.7) **Sex (male) (%)**: 75.6 **FEV_1% predicted (SD):** 57.4 (13.4)	**COPD** (diagnosed according to SEPAR criteria: FEV_1<80% of %predicted and post-BD FEV_1/FVC <0.7) : n=10711	**None**	-	X	-
Roche et al (2008)[164]	Cross-sectional	Assess impact of airflow obstruction on breathlessness, quality of life and absenteeism	France Primary care population	• Recruited from primary care (31 health prevention centres) • Aged $\geq$40 • Spirometry carried out on all participants • Sampling according to national age and sex distribution No clear exclusion criteria defined.	**N = 4764 with data (from 5008 surveyed)** **Mean age (years) (SD)**: 59.9 (10.1) **Sex (male) (%):** 92.6 **FEV_1% predicted:** $\geq$ 80% predicted: 59% 50% - 80% predicted: 36.1% >50% predicted: 4.8%	**Chronic bronchitis symptoms**: n=185	**No chronic bronchitis symptoms** n=4579	-	X	-
Kremer et al (2006)[101]	Cross-sectional	Understand the work experiences of people with COPD and main factors influencing being in work	The Netherlands Primary care COPD population	Recruited from 10 outpatient clinics and 25 GP practices. Inclusion criteria: • Doctor diagnosed COPD • Born 1940-1954 • Visited outpatient clinic in preceding year (criterion for clinics only) • Excluded patients with history of lung cancer	**N = 617 with data (from 637)** **Mean age (years)**: 54.3 **Sex (male) (%)**: 57.0 **FEV_1% predicted:** In work: 67.9 Not in work: 60.4	**COPD** (physician diagnosed): n=617	**None**	X	-	-

Table 2-2: table of study characteristics (continued)

Author	Study design	Study aim	Country and setting	Population inclusion and exclusion criteria	Participants	Participants with lung disease	Comparator	Outcome measure		
								E	A	P
Stein et al (2006)[166]	Cross-sectional	Examine impact of depression and chronic physical conditions on functional status and healthcare use	Canada Primary care population study	Data taken from a population based survey – the Canadian Community Health Survey: • 136 health regions in 10 provinces • Geographic regions were stratified • Recruited via random digit dialling and telephone questionnaire carried out • Aged ≥12 Study inclusion/exclusion criteria not clearly defined.	**N = 130880 (assessed subset of 3705)** **Age range (years)**: 12 – 50+ (overall population) **Sex (male) (%):** 49.3 (overall population) **FEV_1% predicted:** unknown	**COPD** (self-reported; lasted/expected to last for a minimum of 6 months and diagnosed by a healthcare professional): n=in a subset of 3705	**No COPD** n=not reported	-	X	-
Boot et al (2005)[160]	Cross-sectional	Assess associations of sick leave in workers with COPD and asthma with three components of the Model of Planned Behaviour	The Netherlands Primary care COPD/asthma population	Recruited via: advertisements in free local newspapers, posters (pharmacies, general practices and physical therapists) and patients of pulmonologists/occupational physicians/ medical advisors. Inclusion criteria: • Physician diagnosed obstructive lung disease • Employed/had been employed in last 12 months Exclusion criteria: • Acute co-morbidity • Unable to read or understand Dutch • Self-employed participants	**N = 165 (assessed subset of 64)** **Mean age (years) (SD)**: COPD high sick leave: 50.3 (8.7); COPD low sick leave: 51.8 (6.1) **Sex (male) (%):** COPD high sick leave: 72; COPD low sick leave 47 **FEV_1% predicted:** COPD high sick leave: 58.6 (16.2); COPD low sick leave: 69.0 (19.2)	**COPD** (FEV_1/FVC <70%): n=64	**None**	-	X	-
Orbon et al (2005)[102]	Cross-sectional (baseline of RCT)	Assess association between employment status and disease specific quality of life in COPD patients	The Netherlands Primary care COPD population	COPD patients from a RCT (recruited from 44 general practices) Inclusion criteria: • GP physician diagnosed COPD • Current/ex-smoker • Persistent cough/sputum/dyspnoea on most days of the week for ≥3 consecutive months per year over preceding 2 years • Post BD FEV1 40-90% and/or FEV1/FVC <88% (male) or <89% (female) of the predicted value Excluded: • Patients with post-BD FEV1<35% • History of asthma, allergic rhinitis or atopic rash • Severe comorbid conditions • >65years	**N = 210** **Mean age (years) (SD)**: 53.9 (6.8) (overall) Paid work: 50 (6.2) Voluntary non-paid work: 59.5 (5.5) Disabled for work: 54.5 (6.0) **Sex (male) (%):** 66.7 (overall) Paid work: 80.4 Voluntary non-paid work: 62.2 Disabled for work: 50.0 **FEV_1% predicted:** 63.5 (overall) Paid work: 65.2 Voluntary non-paid work: 59.1 Disabled for work: 64.1	**COPD** (diagnosis based on GP records and spirometry): n = 210	**None**	X	-	-

Table 2-2: table of study characteristics (continued)

Author	Study design	Study aim	Country and setting	Population inclusion and exclusion criteria	Participants	Participants with lung disease	Comparator	Outcome measure E	A	P
Boot et al (2004)[118]	Cross-sectional	Comparison of patients with and without sick leave who have either asthma or COPD and to investigate the effects of: signs and symptoms, functional limitations, work characteristics, psychosocial variables and adaptation on sick leave	The Netherlands Primary care COPD/asthma population	Recruited via: advertisements in free local newspapers, posters (pharmacies, general practices and physical therapists) and patients of pulmonologists/occupational physicians/ medical advisors. Inclusion/exclusion criteria: • Physician diagnosed asthma or COPD • Using prescribed bronchodilators • Employed or had been employed in last 12 months • Without acute co-morbidity • Able to read or understand Dutch	**N = 189 (assessed subset of 71)** **Mean age (years) (SD):** COPD sick leave: 47.8 (9.5); COPD no sick leave: 54.0 (6.3) **Sex (male) (%)**: COPD sick leave: 67; COPD no sick leave: 62 **FEV_1% predicted:** unknown	**COPD** (COPD confirmed using spirometry: FEV_1/FVC <70%): n=71	**None**	-	X	-
Wang et al (2003)[116]	Cross-sectional	Effect of chronic conditions on absenteeism, presenteeism and critical incidents	USA Employed population from 4 companies	Participants: one of 4 occupations recruited from 4 companies: reservation agents (airline company), customer service representatives (telecommunications company), executives (automobile manufacturer) and railroad engineers (railroad company. Telephone questionnaire.	**N = 2363 (assessed subset of ~40)** **Mean age (years) (SD)**: unknown **Sex (male) (%):** unknown **FEV_1% predicted:** unknown	**COPD/emphysema (%)** (self-reported and based on interviewer asking all conditions covered in the National Health Interview Survey checklist): n ~40 (1.7% of total population)	**No COPD/emphysema:** n = not reported	-	X	X
Eisner et al (2002)[99]	Cross-sectional	Examine impact of asthma and COPD on health status and work disability	USA Population based survey	Data taken from a population based study: the California Work and Health Survey • Majority recruited using the random digit dialling method in 1998, 1999 and 2000 • ≥18 years	**N = 3805 (3243 of usual employment age 18-64)** **Mean age (years) (SD)**: COPD: 54.7 (18.1) Asthma: 42.2 (16.3) Other chronic conditions: 50.3 (16.6) No chronic conditions: 36.5 (14.4) **Sex (male) (%)** COPD: 41 Asthma: 47 Other chronic conditions: 45 No chronic conditions: 56 **FEV_1% predicted:** unknown	**Of usual employment age:** **COPD** (self-report of a physician's diagnosis of a chronic lung disease like emphysema or chronic bronchitis via telephone questionnaire): n=113	**Of usual employment age:** **Asthma:** n=274 **Other chronic conditions:** n=1354 **No chronic conditions:** n=1502	X	-	-
Mannino et al (2002)[156]	Cross-sectional (4 time points)	Assessing national data to determine COPD prevalence, COPD associated	USA General population based survey	Data from the national health surveys conducted by CDC's National Center for Health Statistics.	**N = unknown** **Mean age (years) (SD)**: unknown **Sex (male) (%):** unknown **FEV_1% predicted:** unknown	**COPD** (self-reported): n=unknown	**No COPD:** n = unknown	X	-	-

Table 2-2: table of study characteristics (continued)

Author	Study design	Study aim	Country and setting	Population inclusion and exclusion criteria	Participants	Participants with lung disease	Comparator	Outcome measure E	A	P
		activity and functional limitations, self-reported prevalence and healthcare utilisation								
Sin et al (2002)[103]	Cross-sectional	Determine relationship between COPD and its severity and being in work	USA General population based survey	Data taken from a population based survey: the Third National Health and Nutrition Examination Survey (NHANES III) • Aged: 18 – 64 years	**N = 12436** **Mean age (years) (SD)**: 37.9 (13.2) (overall population) **Sex (male) (%): 46.5** COPD: 58.5 Non-COPD: 47.4 **FEV_1% predicted:** unknown	**COPD** (self-reported chronic bronchitis/emphysema diagnosis): n=1073	**No COPD** (did not answer yes to chronic bronchitis or emphysema): n=11363	X	-	-
Ward et al (2002)[159]	Cross-sectional	Assess degree of work disability and lost income due to respiratory disease	USA General population based survey - participants with respiratory symptoms	Data taken from a population based survey – the National Health Interview Survey (1993 – 1994). • Age range: 25 – 75+ • Data from persons answering positive have a respiratory condition No clear study inclusion/exclusion criteria defined.	**N = 8855** (with respiratory conditions) **Mean age (years)**: unknown **Sex (male) (%):** 40.1% **FEV_1% predicted:** unknown	A self-report of (using a questionnaire): **Chronic bronchitis**: n=1582 **Emphysema**: n=947	A self-report of: **Allergic rhinitis**: n=3306 **Asthma**: n=2632 **Other lung disease**: n=388	X	X	X
Julin and Wilhelmsen (1967)[153]	Cross-sectional	Assess frequency of COPD in a random sample population applying clinical/epidemiological methods to differentiate between bronchial asthma and chronic bronchitis	Sweden Chronic bronchitis/bronchial asthma population	A sub-sample for the purpose of this study was assessed, which included those with bronchial asthma and chronic bronchitis. Main sample was selected was based on a large random sample, aged 16-64 years. Stratified 2 stage sample: age of housing and location in the city.	**N = 85** **Mean age (years)**: unknown **Sex (male) (%)**: Chronic bronchitis: 52.4 Bronchial asthma: 27.9 **FEV_1% predicted:** unknown	**Chronic bronchitis** (diagnosis made my medical experts based on symptom questionnaire and anamnestic examination): n=42	**Bronchial asthma** (diagnosis made my medical experts based on symptom questionnaire and anamnestic examination): n=43	X	X	-

2.4.3 Methodological quality of the studies

The methodological quality varied (Table 2-3). Most studies did not compare responder with non-responder characteristics, therefore making it difficult to determine non-response bias. There was a high risk of misclassification of lung disease in 15 studies as these populations were characterised based on self-report alone.[22;99;104;105;108;111;112;116;153;155-157;159;164;166] Although some studies used reliable data sources to classify patients with COPD, only 10/30 (33.3%) studies used clear spirometry criteria to define lung disease and disease severity.[100;102;118;152;158;160-163;165] There was uncertainty about the reliability and validity of the outcome measures (absenteeism and presenteeism) for approximately one third of the studies as it was unclear whether standardised questionnaires were used.[101;118;152;153;160-165]

Of the five prospective cohort studies, four had good follow-up rates.[108;152;155;162] Lack of controlling for confounders, an important predictor of bias in observational studies, was a problem in many (n=13) studies.[22;101;102;108;152;153;158-161;163-165] A further 14 studies reported controlling for some relevant confounders, however, omitted important factors e.g. smoking status and co-morbidities (statistical modelling varied widely).[99;100;103-107;111;112;116;154;156;157;166] Generalisability of the study results to a COPD population was either unclear or limited amongst 25 studies.[99;100;102;104-108;111;112;116;118;152-161;163;165;166] For example, studies including only male workers, those from a specific occupational background or a specific disease severity had limited external validity.

Table 2-3 Methodological quality of the included articles

Table 2-3: table of the methodological quality of the included articles (risk of bias: high/low/unclear)									
	Selection of population			Lung disease	Outcome measures		Loss to follow-up	Selective reporting	Controlling for confounders
Bias	Generalisability	Selection bias	Non-response bias	Misclassification	Validity and reliability	Recall bias	Loss to follow-up	Reporting bias	Confounding
Author									
Cohort studies									
Lokke et al (2014)[154]	Unclear Some baseline characteristics are unknown e.g. disease severity and smoking status	Low Database used	N/A	Low Diagnoses are all registered on database based on ICD-10	Low Employment data taken from central database	N/A	N/A	Low	High Although many socio-demographic factors matched, other important factors e.g. co-morbidities and smoking status not adjusted for.
Jansson et al (2013)[152]	High Unequal distribution of disease severity	Unclear how original sample was chosen/recruited.	Low High participation rate (89%) and no significant differences between participants and non-participants	Low Spirometry and GOLD guidelines used to define COPD	Unclear Not clear where questions are taken from (unclear if standardised)	Low Data collected every 3 months by telephone to reduce recall error	Low	Low	High No adjustment for confounders
Allen et al (2012)[105]	Unclear Some important baseline characteristics unknown	Low (although large population, population taken from 1 company)	Unclear Many did not complete survey and were not included	High Self-report of physician diagnosis	Low Sickness absence data from database and presenteeism measured using standardised questionnaire	Low	N/A (retrospect ive)	Low	High Smoking status not accounted for
Nair et al (2012)[107]	Unclear Baseline characteristics e.g. smoking status and disease severity are unknown	Low 2 databases used for population	N/A	Low Classified according to medical claims	Low Absenteeism data taken from database	Low	N/A	Low	High Although many confounders accounted for, all relevant co-morbidities and smoking status not adjusted for
Snider et al (2012)[157]	Unclear Although nationally representation, unclear whether representative of COPD patients – demographics unknown	Low	Unclear	High Self-report of physician diagnosis	Low	Low	Unclear	Low	High Adjusted for a number of confounders, however disease severity and smoking status not adjusted for. Model 2 adjusted for income, but this is directly related to employment (reverse causation)
Darkow et al (2007)[106]	Unclear Some important baseline characteristics unknown. Also limited range in occupations	Low Database used	N/A	Low Classified based on 3 possibilities	Low Outcome measures taken from database	Low	N/A	Low	Low Follow-up length differed between groups but was adjusted for

Table 2-3: table of the methodological quality of the included articles (risk of bias: high/low/unclear)

	Selection of population			Lung disease	Outcome measures		Loss to follow-up	Selective reporting	Controlling for confounders
Bias	**Generalisability**	**Selection bias**	**Non-response bias**	**Misclassification**	**Validity and reliability**	**Recall bias**	**Loss to follow-up**	**Reporting bias**	**Confounding**
Lund and Csonka (2003)[155]	Unclear Limited baseline characteristics known	Unclear Additional sample included	Unclear Characteristics of non-responders unknown	High Self-report	Low	Low	Low	Low	Low
Jansson et al (2002)[162]	Low	Unclear How was sample chosen/recruited	High 38 non-contactable patients Although not significant, those not participating had less severe disease and higher socio-economic status	Low Spirometry	Unclear Not clear where questions are taken from (unclear if standardised)	Low Data taken from patients every 3 months by telephone to reduce recall error	Low	Low	Low Range of confounders accounted for
Jedrychowski (1976)[108]	High Male workers only Fertilizer factory workers	Unclear Not clear how population was chosen	Unclear Lack of detail on non-participants	High Symptom based assessment	Low Data collected prospectively	Low Prospective collection and taken from work records	Low	Low	High Univariate analysis and no adjustment
Cross-sectional studies									
Solem et al (2013)[158]	Restricted to those with severe disease	High Although physicians were randomly selected and were advised to randomly select up to 4 patients from their COPD list, patients may not be random selection.	N/A	Low Disease severity and diagnosis based on physician spirometry.	Low WPAI questionnaire used	Low 7 day recall period	N/A	Low	High No adjustment for confounders
DiBonaventura et al (2012a)[112]	Unclear Disease severity distribution and occupational characteristics unknown. Recruited via internet, therefore may be restricted to those with IT skills.	High Recruited via internet	High Low response rate	High Self-report	Low WPAI questionnaire used	Low 7 day recall period	N/A	Low	High Adjusted for a range of confounders Although sample stratified (working age), did not adjust for age and other co-morbidities
DiBonaventura et al (2012b)[111]	Unclear Disease severity distribution and occupational characteristics unknown. Recruited via internet, therefore may be restricted to those with IT skills.	High Recruited via internet	High Low response rate	High Self-report	Low WPAI questionnaire used	Low 7 day recall period	N/A	Low	High Adjusted for a range of confounders Although sample stratified (≥65 years), did not adjust for age and other co-morbidities

Table 2-3: table of the methodological quality of the included articles (risk of bias: high/low/unclear) (continued)

	Selection of population			Lung disease	Outcome measures		Loss to follow-up	Selective reporting	Controlling for confounders
Bias	**Generalisability**	**Selection bias**	**Non-response bias**	**Misclassification**	**Validity and reliability**	**Recall bias**	**Loss to follow-up**	**Reporting bias**	**Confounding**
Fletcher et al (2011)[22]	Low	High Variety of methods used, some of which may not be random selection	High Initial response was low	High Self-report	Low WPAI questionnaire	Low 7 day recall period	N/A	High % scores for presenteeism and mean time off work not provided	High P-values not assessed and no adjustments
Holden et al (2011)[104]	Unclear Although generalisable to Australian population, unclear if generalisable to COPD patients e.g. unknown disease severity distribution; age distribution skewed towards younger population	Low	High Low response rate	High Self-report	Low	Low	N/A	Presenteeism scores and mean days off work not detailed	Adjusted for many except smoking status
Montes de Oca et al (2011)[100]	Unclear Whole sample characteristics unreported	Low	Unclear High response rate (83.0%) but non-responders not compared	Low Spirometry	Low	Low	N/A	Low	High/low Range of confounders assessed for some analyses, but not all
Nielsen et al (2009)[163]	Unclear Other baseline characteristics not reported e.g. comorbidities, socioeconomic status	Low	Low	Low (although did not take % predicted into account for COPD pattern patients)	Unclear	High	N/A	Low	High Risks not calculated and confounders not adjusted for
Rodriguez Gonzalez-Moro et al (2009)[165]	High >male High mean age	High Doctor selecting patients, therefore may not be random selection	Unclear Lack of detail on declining participants	Low Spirometry	Unclear Lack of detail for questions related to sick leave	High 12 month period	N/A	Low	High Risks not calculated and no mention of adjusting
de Miguel Diez et al (2008)[161]	High Older population; >males	Low But if patient had acute exacerbation they were excluded and not rescheduled	Unclear Do not know how many were initially approached	Low Spirometry	Unclear What were questions and how was information obtained?	Unclear How absenteeism data was obtained and questions asked	N/A	Low	High No adjustment for confounders
Roche et al (2008)[164]	Low	Low Various centres for recruitment	Low High response rate	High Self-reported	Unclear Sickness absence questions may be based on validated questionnaire, but	High 12 month recall period	N/A	High Only chronic bronchitis as independent predictor stated	High No adjustment for confounders

Table 2-3: table of the methodological quality of the included articles (risk of bias: high/low/unclear) (continued)

	Selection of population			Lung disease	Outcome measures		Loss to follow-up	Selective reporting	Controlling for confounders
Bias	**Generalisability**	**Selection bias**	**Non-response bias**	**Misclassification**	**Validity and reliability**	**Recall bias**	**Loss to follow-up**	**Reporting bias**	**Confounding**
					was not clear				
Kremer et al (2006)[101]	Low	Low	Unclear Initial response was 47%. No comparison of characteristics	Low Spirometry	Unclear Details of questions not provided	Low Due to nature of the questions	N/A	Low	High No adjustment for confounders
Stein et al (2006)[166]	Unclear COPD population characteristics unknown	Low	Low High response rate (National survey)	High Self-report	Low (National survey)	Low	N/A	Low	High Smoking status not adjusted for
Boot et al (2005)[160]	Unclear Small sample size; fewer females. Disease severity and occupational distribution not provided.	High Various methods used to recruit, however healthcare professional (HCP) may have introduced selection bias	Unclear Not detailed how many patients HCP originally approached	Low Spirometry used (trained technicians)	Unclear Not detailed whether sick leave questions were standardised/validated	High Two year recall period	N/A	Low	High No adjustment for confounders
Orbon et al (2005)[102]	High >males Excluding those with severe disease Fewer patients with co-morbidities Disease severity distribution unknown	High Excluded severe patients or those with other severe conditions	Unclear	Unclear Spirometry, but different criteria used	Low	Low Due to nature of questions	N/A	Low	High Univariate analysis only – no adjustments
Boot et al (2004)[118]	High Small sample size; fewer females; patients with less severe disease.	High Various methods used to recruit, however healthcare professional (HCP) may have introduced selection bias	Unclear Not detailed how many patients HCP originally approached	Low Spirometry used (trained technicians)	Unclear Not detailed whether sick leave questions were standardised/validated	High Although answer is yes/no, recall period is 12 months	N/A	Low	Low
Wang et al (2003)[116]	High Certain jobs/companies included. Total sample baseline characteristics unknown. Small COPD sample size	Unclear Unclear how participating companies were selected.	Unclear Response rate among those contacted varied between companies	High Self-report	Low	Low 4 week period	N/A	Low	High Adjusted for a range of confounders however, smoking status not accounted
Eisner et al (2002)[99]	Unclear No information on disease severity. Comparison groups different age range	Low Population survey	Unclear Response rate 55-57%. Lack of detail comparing characteristics of participants vs. non-participants.	High Self-report	Low Questions based on validated national survey	Low Due to nature of questions	N/A	Low	High Adjusted for many, but not co-morbidities or disease severity

Table 2-3: table of the methodological quality of the included articles (risk of bias: high/low/unclear) (continued)

	Selection of population			Lung disease	Outcome measures		Loss to follow-up	Selective reporting	Controlling for confounders
Bias	**Generalisability**	**Selection bias**	**Non-response bias**	**Misclassification**	**Validity and reliability**	**Recall bias**	**Loss to follow-up**	**Reporting bias**	**Confounding**
Mannino et al (2002)[156]	Unclear Lack of detail on sample baseline characteristics	Low Population based survey	Unclear	High Self-report	Low Population survey	Low	N/A	Low	High Adjusted for age only
Sin et al (2002)[103]	Low	Low Population survey - NHANES	Unclear No details provided	High/low Although based on self-report, the disease severity was based on GOLD criteria	Low	Low Due to the nature of question	N/A	Unclear Disease severity distribution was not documented in characteristics	High Did not adjust co-morbidities
Ward et al (2002)[159]	Unclear Baseline characteristics unclear	Low NHIS – population survey	Unclear No details on original response rates	High Self-report	Low Population based survey	Low	N/A	All data as %. SS not tested for and p-values not calculated	High No adjustment for confounders
Julin and Wilhelmsen (1967)[153]	Unclear Baseline characteristics unclear	Unclear Lack of detail on sub-sample selection	Unclear Although main study under-represented patients with other disease and disabilities.	High Symptoms used as criteria	Unclear Not explained	High 90 day recall period	N/A	Methods unclear	High Statistical significance and confounders not assessed

2.5 Results of studies

2.5.1 Employment

One prospective cohort study,[157] one retrospective cohort study[154] and six cross-sectional studies[99;100;103;153;156;159] compared employment rates among COPD patients compared to those without COPD (Table 2-4), of which six consisted of large sample sizes.[99;100;103;154;157;159] The prospective cohort study collected data over 16 years among a working age population and the data from the retrospective cohort study was collected over a 12 year period from a primary care population (patients from national patient register). Among the six cross-sectional studies, five were general population-based[99;100;103;156;159] and one was a smaller study consisting of a chronic bronchitis/asthma sub-sample; initially recruited from a general population.[153]

Consistently across five of these studies, patients with COPD had significantly lower employment rates than those without COPD,[99;100;103;154;157] those with asthma[99] and other chronic conditions[99]; with ORs ranging from 0.4 (95% CI: 0.2 – 0.7) (COPD patients compared to those with no chronic conditions)[99] to 0.8 (95% CI: 0.7 – 1.00) (COPD patients compared to those without COPD).[100] Mannino et al's[156] age-adjusted estimates for each of the four time points (cross-sectional) (years 1980 to 1996) consistently demonstrated lower employment rates among those with COPD compared to those without (p-values unreported), although the study failed to adjust for other relevant confounders.

Evidence from the remaining cohort study found the presence of chronic bronchitis at baseline to be independently and significantly associated with having a disability pension after two years follow-up (OR 1.8; 95% CI 1.01-3.21).[155] These findings were supported by a smaller cross-sectional study; unadjusted prevalence rates were higher among those with chronic bronchitis compared to bronchial asthma.[153] Also, once out of work, COPD patients were more likely to remain unemployed (>5 years since regular employment) compared to those with no chronic conditions (OR: 2.92; 95% CI: 1.35 – 6.29).[99]

A ninth study enquired whether the patient's inability to work was attributed to their lung condition; patients with self-reported emphysema (27.4%) were the most affected when compared to those with chronic bronchitis (0.6%) and asthma (4.8%) (p-values unreported).[159]

Six studies assessed the relationship between COPD disease severity and employment (Table 2-5).[100-103;152;158] Three studies found that with increasing severity of airflow obstruction, COPD patients were less likely to be in work (p<0.01),[101;103;158] although this was not confirmed in the other two studies.[100;102] The sixth study (cohort study) supported the negative impact of disease severity on employment; patients were more likely to retire early with increasing airflow obstruction.[152]

However, it was difficult to compare the study findings due to the heterogeneity in methods, samples and outcome measures: samples were recruited from a variety of settings (outpatients' clinics,[101] primary care setting[101;102;158] and from the general population[100;103;152]; one study excluded severe COPD patients[101] whereas another excluded those with mild to moderate airflow obstruction[158]; of the limited studies reporting overall sample distribution of disease severity, one study showed an unequal distribution[100]; and only Sin et al's study adjusted for relevant confounders.[103] Additionally, in one study it was unclear how spirometry was conducted as a measure of severity (e.g. information on whether spirometry was conducted post-bronchodilator and the number of attempts to calculate the final reading).[101]

Table 2-4 The effect of COPD on employment

Results table 2-4: the effect of COPD on employment									
Author, date	**Study design and follow-up period/study period**	**COPD description**	**Comparator**	**Outcome**	**Outcome definition/criteria**	**Results COPD**	**Results comparator**	**Effect size or p value**	**Analysis/ adjustment**
Cohort studies									
Lokke et al (2014)[154]	Matched cohort study Population from the national patient registry (NPR) 1998 - 2010	COPD diagnosis on the NPR n = 131811	Without COPD n=131811	Employment	% with income from employment	16.7%	23.8%	**P<0.01**	Bootstrapped Cochran-Armitage test Matched for: age, sex, education level, residence and marital status.
Snider et al (2012)[157]	Cohort study Population from the HRS 1992-2008	Physician diagnosis of COPD n = 4095	Without COPD n = 24768	Employment	Probability of working for pay (%) (SD) Probability of working for pay among those under 65 years (%) (SD)	21.0% (40.7%) 38.9% (48.8%)	39.7% (48.9%) 64.0% (48.0%)	**Adjusted OR (95% CI) 0.58 (0.50 – 0.67)** (model 1) **Adjusted OR (95% CI) 0.65 (0.57-0.75)** (model 2) **P<0.001**	Adjusted for: age, age squared, age upon entering the panel, age upon entering the panel squared, sex, ethnicity, BMI, BMI upon entering the panel and various health conditions. Model 2 also included: income and household assets
Lund and Csonka (2003)[155]	Cohort study Employed population 2 yr f/up: 1995 – 1997	Chronic bronchitis (symptoms MRC questionnaire) n=530	Without chronic bronchitis n=2710	Work disability	Disability retirement pension / sick leave benefits for > 10 weeks /receiving sick leave benefits for > 15 weeks	530 (16.4%)	2710 (83.6%)	**OR (95% CI) 1.8 (1.01 to 3.21)**	Adjusted for: age, sex, health, smoking status, work environment, organisational context, company size and public/private sector. Note: different information in text compared to table

Results table 2- 4: the effect of COPD on employment (continued)

Author, date	Study design and follow-up period/study period	COPD description	Comparator	Outcome	Outcome definition/criteria	Results COPD	Results comparator	Effect size or p value	Analysis/ adjustment
Cross-sectional studies									
Montes de Oca et al (2011)[100]	Cross-sectional Population based survey 2003 - 2004	COPD (spirometry based on GOLD criteria) n = 759	Without COPD n = 4554	Employment in previous 12 months	Worked for pay Mean + SE number of months for pay? Mean + SE number of days (per week) worked for pay? Mean + SE usual number of hours worked (per day) for pay? Health problems stop you from working for payment (yes, no, no response)?	317 (41.8%) 10.5 ± 0.17 5.85 ± 0.08 8.97 ± 0.17 27 (3.6%) 2399 (52.7%) 1960 (43.0%)	2602 (57.1%) 10.9 ± 0.06 5.71 ± 0.03 8.75 ± 0.06 196 (4.3%) 289 (38.1%) 443 (58.4%)	**Adjusted OR = 0.83 (0.69 – 1.00)** **P = 0.02** (adjusted for survey design) **P = 0.09** (adjusted for survey design) **P = 0.23** (adjusted for survey design) **P<0.0001** (adjusted for survey design)	Multivariable analysis: age, sex, education, MRC and co-morbidity score Most analyses not adjusted for relevant confounders
Eisner et al (2002)[99]	Cross-sectional Population based survey 1998- 2000	Self-reported diagnosis of chronic lung disease like emphysema or chronic bronchitis n=113	No chronic conditions n=1502 Other chronic health conditions (non-respiratory) n=1354 Asthma n=274	Employment rates	Working or employed Prolonged labour nonparticipation (no regular job for >5y) Inability to work due to long-term condition	52 (46.5%) 23 (20.8%) 32 (28.1%)	No chronic conditions (NCC): 1067 (71.1%) Other chronic conditions (OCC): 896 (66.2%) Asthma: 185 (67.6%) No chronic conditions: 62 (4.2%) Other chronic conditions: 106 (7.9%) Asthma: 19 (6.9%) No chronic conditions: 18 (1.2%) Other chronic conditions: 125 (9.2%) Asthma: 20 (7.5%)	OR (95% CI): (no chronic conditions (NCC) as ref group): COPD vs. NCC: **OR=0.41 (0.24 – 0.71)** OCC vs. NCC: **OR=0.86 (0.68– 1.08)** Asthma vs. NCC: **OR=0.82 (0.55 – 1.21)** COPD vs. NCC: **OR=2.92 (1.35 – 6.29)** OCC vs. NCC: **OR=1.09 (0.69 – 1.73)** Asthma vs. NCC: **OR=1.23 (0.58 – 2.59)** COPD vs. NCC: **OR=19.5 (8.17 – 46.5)** OCC vs. NCC: **OR=5.84 (2.95 – 11.58)** Asthma vs. NCC: **OR=5.53 (2.29 – 13.36)**	Multiple logistic regression. Adjusted for: age, sex, ethnicity, education and smoking status. Did not adjust for co-morbidities or disease severity.
Mannino et al (2002)[156]	Cross-sectional General population based survey	Self-reported COPD n= unknown	Without COPD n= unknown	Employment rates	Adults who report being employed (4 time points): 1980-1982 1985-1987 1990-1992 1994-1996	 49.7% 53.8% 57.8% 57.5%	 59.7% 62.2% 64.0% 64.6%	Not calculated	Age adjusted only. Did not adjust for a wide range of confounders.

Results table 2- 4: the effect of COPD on employment (continued)

Author, date	Study design and follow-up period/study period	COPD description	Comparator	Outcome	Outcome definition/criteria	Results COPD	Results comparator	Effect size or p value	Analysis/ adjustment
Sin et al (2002)[103]	Cross-sectional General Population based survey 1966 – 1970	Self-reported COPD (chronic bronchitis or emphysema) n=1073	Without chronic bronchitis or emphysema n=11363	Employment rates	Working in past 2 weeks	69.21%	77.24%	Adjusted results: -**3.9% (-1.3 to -6.4)** reduction in probability of being in work. **P=0.032**	Adjusted for: sex, age, education, ethnicity, marital status, family size, area of residence, current smoker. Co-morbidities not adjusted for.
Ward et al (2002)[159]	Cross-sectional General Population based survey 1993 – 1994	Chronic bronchitis: n=1582 Emphysema: n 947	Allergic rhinitis: n = 3306 Asthma: n = 2632 Other lung disease: n = 388	Inability to work	Unable to work % (any cause) Inability to work due to respiratory symptoms %	Chronic bronchitis: 18.4% Emphysema: 62.9% Chronic bronchitis: 0.6% Emphysema: 27.4%	Allergic rhinitis: 6.8% Asthma: 25.2% Other lung disease: 47.1% Allergic rhinitis: 0.1% Asthma: 4.8% Other lung disease: 14.2%	Not calculated	Chronic bronchitis and emphysema not combined. Increased risk of misclassification through using other lung disease group
Julin and Wilhelmsen (1967)[153]	Cross-sectional Chronic bronchitis/ bronchial asthma population 1964- 1965	Chronic bronchitis n = 42	Bronchial asthma n = 43	Early retirement	Prevalence of premature pension	17.0%	12.0%	Not calculated	No adjustment for confounders

Table 2-5 Employment according to disease severity among patients with COPD

Results table 2-5: employment according to disease severity among patients with COPD								
Author, date	**Study design and follow-up period/study period**	**COPD description**	**Outcome definition/criteria**	**Category**	**Results**		**Effect size or p value**	**Analysis/ adjustment/ comments**
Cohort study								
Jansson et al (2013)[152]	Cohort study (1yr f/up) General population based study 2009-2010	COPD (based on GOLD guidelines) n=244	Retired	% patients who have engaged in early retirement according to disease severity Mild Moderate Severe Very severe	 0.22% 4.12% 6.90% 15.2%		**P<0.001**	No adjustment for confounders Kruskal-Wallis test for differences between disease severity
Cross-sectional studies								
Solem et al (2013)[158]	Cross-sectional Primary care COPD population with severe disease 2011-2012	COPD (spirometry based on GOLD guidelines) n=314	Employment status at the time of survey	Employment prevalence according to disease severity Severe COPD Very severe COPD	 37 (19.5%) 13 (10.5%)		**P<0.03**	No adjustment for confounders
Montes de Oca et al (2011)[100]	Cross-sectional Population based survey 2003 - 2004	COPD (spirometry based on GOLD criteria) n=759 Employed: n=317 (41.8%) Not employed: n=442 (58.2%)	In paid employment in past 12 months	Employment prevalence according to disease severity GOLD stage 1 2 3 and 4 Mean FEV1 % predicted + SE	Employed 194 (61.2%) 106 (33.4%) 17 (5.4%) 78.7+ 1.2	Not employed 257 (58.1%) 150 (33.9%) 35 (7.9%) 79.7± 1.2	**P = 0.29** (adjusted for survey design) **P = 0.55** (adjusted for survey design)	Descriptive statistics, Mann Whitney and Wald test Authors carried out multivariable regression: disease severity and FEV_1 % pred were not associated with employment status
Kremer et al (2006)[101]	Cross-sectional COPD population 2000 - 2001	Physician diagnosed COPD: n=617 Employed: n=320 (51.9%) Stopped working: n=259 (42.0%) Never worked: n=37 (6.0%)	Employment status	Mean FEV1 % predicted according to employment status Employed Stopped working	 67.9% 60.4%		**P < 0.001**	Descriptive statistics and appropriate significance test. Lung function data not available for all patients. ORs not calculated for employment and disease severity relationship
Orbon et al (2005)[102]	Cross-sectional Primary care COPD population	Physician diagnosed COPD: n=210 Paid work: n=97(46.2%) Voluntary non-paid work: n=45 (21.4%) Disabled for work: n=68 (32.4%)	Employment status: paid work, voluntary non-paid work, disabled for work	Mean FEV1 % predicted (SD) according to employment status Paid work Voluntary work Disabled for work	 65.2 (16.8) 59.1 (18.7) 64.1 (20.5)		**P = 0.181** (NS differences in FEV_1 % predicted)	Descriptive statistics and univariate analysis. No adjustment for confounders. Unclear if all working age patients from the initial study were included in this analysis.

Results table 2-5: employment according to disease severity among patients with COPD (continued)

Author, date	Study design and follow-up period/study period	COPD description	Outcome definition/criteria	Category	Results	Effect size or p value	Analysis/ adjustment/ comments
Sin et al (2002)[103]	Cross-sectional General Population based survey 1966 – 1970	Self-reported COPD (chronic bronchitis or emphysema) (GOLD criteria used to define disease severity) n = 1073	In paid employment in past 2 weeks	% reduction in work force participation according to disease severity compared to those without significant airflow obstruction Mild Moderate Severe	 3.4% 3.9% 14.4%	**P for linear trend <0.01**	Adjusted for: sex, age, education, ethnicity, marital status, family size, area of residence, current smoker. Disease severity distribution among population not detailed. Number of participants with spirometry data not detailed. Sensitivity analysis excluding housework as primary occupation found similar trends.

2.5.2 Absenteeism

Twelve studies measured absenteeism[104;105;107;108;111;112;116;153;159;163;164;166] and one study assessed disability (long term and short term)[106] in patients with COPD compared to those without COPD (Table 2-6); of which the majority were large studies[104-107;111;112;159;164] that were carried out in either an employed population,[104-107] a general population[111;112;159] or primary care population.[164] Seven studies were based in the US[105-107;111;112;116;159]; of which three were cohort studies.[105-107]

Five cross-sectional studies reported information on the proportion of COPD patients affected by sickness absence[111;112;153;159;163]; ranging from 3.6% to 21.0%.[112;153] Recall periods amongst these studies however varied, from seven days to four years. Three out of these five studies assessed differences in sickness absence prevalence rates; of which all three large cross-sectional studies found no difference in sickness absence rates over the past week between those with and without COPD.[111;112;163] Prevalence rates in Darkow et al's retrospective cohort study were measured according to disability days (short-term, long term and the combination of the two); the study found a significantly increased risk of disability (for all outcome measures) in those with COPD compared to those without.[106] Unlike the cross-sectional studies, outcome measures in Darkow et al's[106] study were not based on self-report and therefore there was a low risk of recall error.

Two cross-sectional studies assessed the risk of absenteeism in those with COPD compared to those without, for which there were conflicting results (IRR=1.22; 95% CI: 1.04 – 1.43[104] and OR=0.96; 99.5% CI: 0.51 – 1.84.[166] Holden et al's[104] significant finding, held true after adjusting for a range of important confounders, some of which were not considered by the other study (e.g. occupational characteristics).[166] Although, the differing recall periods (1 month[104] vs. 1 week[166]) and varying COPD samples (n: 361[104] vs. 3705[166]) may also explain the inconsistency in results.

Nine studies compared the amount of time taken off work (days/hours) among patients with COPD compared to those without COPD.[105-108;111;112;116;159;164] Three out of four cohort studies (with participants from an employed population[106;107] and an occupation based study (fertilizer factory workers)[108]) found patients with COPD had significantly more time off work; of which the largest study, which matched for a number of important factors, had an 8 year follow-up (IRR: 1.53).[107] The fourth cohort study (matched) also demonstrated COPD patients significantly take more time off work than those without COPD, however this was found in only one of the two time periods that were assessed.[105] Similarly, four out of the five cross-sectional studies found patients with COPD taking significantly more time off work,[111;112;116;164] although they did not adjust for some important confounders (for example Roche et al[164] reported unadjusted OR=6.0; 95% CI: 2.8-12.7).

The mean number of days off among patients with COPD (over 12 months) ranged from 1.6 (projected) to 12.0 (calculated) days.[107;159] Although Nair et al's cohort study may provide a more reliable estimate – on average 1 day per month/per patient – as COPD diagnosis and sickness absence rates were taken from medical reports and the company database, respectively.[107]

The relationship between disease severity and absenteeism was assessed in eight[22;118;152;158;160-162;165] (Table 2-7); of which two cohort[152;162] and two cross-sectional studies[118;158] found no significant associations between airflow obstruction and sickness absence after adjusting for range of confounders in two of the studies.[118;162] Although 2 large and one smaller cross-sectional study showed a significant association ($p<0.05$) between airflow obstruction and sickness absence, these studies did not adjust for confounders.[160;161;165] The sixth large cross-sectional study also indicated that absenteeism may be associated with increasing severity, however breathlessness (using MRC scale) was used as a measure of disease severity.[22] Furthermore, the authors did not analyse beyond descriptive statistics.

Table 2-6 The effect of COPD on absenteeism

Results table 2-6: the effect of COPD on absenteeism									
Author, date	**Study design Follow-up period/study period**	**COPD description**	**Comparator**	**Outcome definition/ criteria**	**Category**	**Results COPD**	**Results comparator**	**Effect size or p value**	**Analysis/adjustment/ comments**
Cohort studies									
Allen et al (2012)[105]	Retrospective cohorts (over 2 time periods) Employed population Between 6 to 12 months of data 2001-2002 and 2008-2009	Records linked participants to two or more separate diagnosis of COPD 2001: n = 181 2008: n = 245	Without COPD n=9680 n=9883	• Hourly absenteeism • Short-term disability (STD) • Long-term disability (LTD (based on compensation records)	Difference in sickness absence hours per employee per year Difference in number of STD incidents /100 employees /yr Difference in number of LTD incidents /100 employees /yr	No individual data; only the difference between the groups 2001 – 2002: 9 hours 2008 – 2009: 8 hours 2001 – 2002: 13.4 incidents 2008 – 2009: 1.97 incidents 2001 – 2002: 1.5 incidents 2008 – 2009: 0.25 incidents		**P=0.02** **P=0.31** **P < 0.01** **P < 0.01** **P = 0.09** **P = 0.45**	T-test Matched on age, gender, whether salaried or hourly pay, length of employment and number of comorbidities using propensity scores Adjustments made for differences in age, gender and salaried/hourly pay carried out. Full dataset not provided. Do not know % of employees affected. Unable to determine definition of STD and LTD. Not adjusted for smoking status.
Nair et al (2012)[107]	Retrospective matched cohort study Employed population Up to 8yr retrospective f/up 2000 - 2007	COPD n = 27612	Without COPD n = 27612	Absenteeism hours per month (normalised to 30 days) (overall sickness absence)	Mean hours per month Mean number of COPD related hours per month Mean days per month Mean number of COPD related STD days	5.6 hours 0.3 hours 1.0 days 0.3 hours	3.8 hours 0 hours 0.6 days 0 hours	**IRR=1.21** **P<0.0001** **IRR: 1.53** **P<0.0001**	Propensity score matching and negative binomial regression. Matched to COPD patients by age, sex, risk score, index year, type of health plan, number of enrolment months following index date, geographic region, type of employment industry and presence of selected co-morbidities using propensity scores. % reporting absenteeism not provided Smoking status not adjusted for. Do not define STD
Darkow et al (2007)[106]	Retrospective matched cohort study Employed population 90-365 days f/up 2001 - 2004	COPD n=1349	Without COPD n=2696	• Short-term disability (STD) • Long-term disability (LTD) • Any disability (AD) • Respiratory disease related disability	Disability rates adjusted for length of follow-up and co-morbidities (%) STD LTD AD Mean days (disability days adjusted for co-morbidities and f/up) STD LTD (adjusted for f/up only) AD	21.8% 2.4% 22.8% 51.3 days 76.4 days 58.6 days	7.0% 0.4% 7.3% 44.0 days 85.9 days 44.9 days	**OR= 2.11 (1.64 – 2.71)** **OR =4.21 (1.93 – 9.16)** **OR =2.15 (1.68 – 2.75)** **P=0.16 (NS)** not reported	Multivariate analysis and logistic regression Matched on age, geographic region, employer, length of employment and salary using propensity scores. Follow-up length and co-morbidities adjusted for in regression analysis. Disability not well defined. LTD data unavailable when adjusted for comorbidities as numbers too few. AD is influenced by large number for LTD.

Results table 2-6: the effect of COPD on absenteeism (continued)

Author, date	Study design Follow-up period/study period	COPD description	Comparator	Outcome definition/ criteria	Category	Results COPD	Results comparator	Effect size or p value	Analysis/adjustment/ comments
					Respiratory related disability N (%) STD LTD	 92 (6.8%) 10 (0.7%)	 18 (0.7%) 0 (0%)	 **P=0.01**	
Jedrychowski (1976)[108]	Cohort Occupation based study 6 yrs f/up 1967-1972	Chronic bronchitis n=44	Without chronic bronchitis n=153	• Working days • Spells (undefined) (sickness absence due to chest disease)	Days 0 1-6 7-12 13-18 19-30 31+ Mean days Spells 0 1-2 3-4 5+ Mean spells	n/N (%) 2/44 (4.5%) 5/44 (11.4%) 3/44 (6.8%) 6/44 (13.6%) 7/44 (15.9%) 21/44 (47.7%) 34.86 2/44 (4.5%) 18/44 (40.9%) 6/44 (13.6%) 18/44 (40.9%) 3.79	n/N (%) 27/153 (17.6%) 25/153 (16.3%) 29/153 (19.0%) 19/153 (12.4%) 28/153 (18.3%) 25/153 (16.3%) 17.39 27/153 (17.6%) 75/153 (49.0%) 27/153 (17.6%) 24/153 (15.7%) 2.38	**P < 0.05** **P < 0.05**	Little detail Chi^2 test No adjustment for confounders. Not clear if statistics are correct. Only analysed completers (n=197)
Cross-sectional studies									
DiBonaventura et al (2012a)[112]	Cross-sectional General population based survey 2009	COPD n=1112	Without COPD n=18912	Sickness absence due to lung health over previous week (WPAI questionnaire)	% of work time missed in last 7 days (adjusted) Mean hours missed in a week (unadjusted)	3.60% 2.57 hours	3.42% 1.34 hours	**P=0.72** **P<0.001**	Adjusted for sex, employment type, ethnicity, education, income, health insurance, smoking status, BMI and asthma diagnosis Age and co-morbidities not adjusted for
DiBonaventura et al (2012b)[111]	Cross-sectional General population based survey 2009	COPD n = 297	Without COPD n = 3061	Sickness absence due to lung health over previous week (WPAI questionnaire)	% of work time missed in last 7 days (adjusted) Mean hours missed in a week (unadjusted)	4.81% 1.88 hours	1.80% 0.77 hours	**P=0.06** **P<0.001**	Adjusted for sex, employment type, ethnicity, education, income, health insurance, smoking status, BMI and asthma diagnosis. Age and co-morbidities not adjusted for
Holden et al (2011)[104]	Cross-sectional Employed population 2004-2005	Self-report of COPD/ bronchitis or emphysema n=361 (calculated)	Without COPD n=unreported	Sickness absence over previous 4 weeks (WHO-HPQ)	Risk of absenteeism for patients with COPD	-	-	**IRR=1.22 (1.04 -1.43)**	Adjusted for age, sex, marital status, number of children, education level, annual income, treatment seeking behaviour, number of co-morbidities, occupation, industry, public/private sector, job security, contractor, rate of workplace accidents, hours worked (in past 4 weeks), supervisory role and hours expected to work in 7-day week by their employer. Did not adjust for smoking status. Did not solely focus on COPD patients.

Results table 2-6: the effect of COPD on absenteeism (continued)									
Author, date	**Study design Follow-up period/study period**	**COPD description**	**Comparator**	**Outcome definition/ criteria**	**Category**	**Results COPD**	**Results comparator**	**Effect size or p value**	**Analysis/adjustment/ comments**
Nielsen et al (2009)[163]	Cross-sectional General population based survey 1996 - 1997	COPD pattern n=50	Asthmatic pattern n=79 Restrictive pattern n=32	Sick leave payment in previous 12 months	% with sick leave	**COPD pattern** 10%	**Asthmatic pattern** 28% **Restrictive pattern** 16 %	**P=0.04** (sick leave more frequent in those with asthma)	One way ANOVA test. Did not adjust for confounders. Spirometry not available for all patients. Sick leave definition unclear. No information on mean days off (was this collected and not reported?)
Roche et al (2008)[164]	Cross-sectional Primary care population	Self-reported chronic bronchitis symptoms n =185	Without chronic bronchitis symptoms n=4579	Missed working days in the last year	Mean days off + SD (chronic bronchitis symptoms)	5.56± 15.45	1.75± 16.54	**OR= 6.0 (2.8 – 12.7)**	Descriptive statistics, ANOVA, unpaired t-test and logistic regression. Not clear but appears no adjustment for confounders. Used a number of populations to conduct analyses. However, data not shown for all analyses.
Stein et al (2006)[166]	Cross-sectional Primary care population 2003	Self-reported COPD n=in a subset of 3705	No COPD n=not reported	Sickness absence in the prior week due to illness or disability	Weighted % (99.5% CI)	2.4% (1.4% - 4.3%)	NS	**OR=0.96 (99.5% CI: 0.51 – 1.84)**	Adjusted for: age, sex, education, income, number of chronic physical conditions and alcohol dependence. Small proportion used for analysis. Short recall period for absenteeism. Smoking status not adjusted.
Wang et al (2003)[116]	Cross-sectional Employed population	Self-reported COPD n~40	Without COPD n=not reported	Sickness absence over previous 30 days (HPQ) (sickness absence due to condition)	Annual excess days (SE)	19.4 (8.9)	-	**P <0.05**	Analysis of covariance. Adjusted for age, sex, occupation, education and other conditions. Smoking status not accounted for. Small COPD sample.
Ward et al (2002)[159]	Cross-sectional General population based survey 1993 - 1994	Chronic bronchitis: n=1582 Emphysema: n=947	Allergic rhinitis: n = 3306 Asthma: n = 2632 Other lung disease: n = 388	• Missed time from work in past 2 weeks due to illness • Missed days in past 2 weeks due to illness	% who missed work Mean number of work loss days – yearly projection	Chronic bronchitis: <5% Emphysema: <5% Chronic bronchitis: 1.5 Emphysema: 1.3	Allergic rhinitis: <5% Asthma: <5% Other lung disease: <5% Allergic rhinitis: 0.8 Asthma: 2.1 Other lung disease: 3.7	Not calculated	% reporting absenteeism not provided. Chronic bronchitis and emphysema not combined. Increased risk of misclassification through using other lung disease group
Julin and Wilhelmsen (1967)[153]	Cross-sectional Chronic bronchitis/bronchial asthma population 1964- 1965	Chronic bronchitis n=42	Bronchial asthma n=43	Absenteeism for more than 90 days during a 4 year period	% affected	21%	30%	Not calculated	Long recall period – at risk of inaccurate reporting. No adjustment for confounders

Table 2-7 Absenteeism according to disease severity among patients with COPD

Author, date	Study design and follow-up period/study period	COPD description	Outcome definition/criteria	Category	Results	Effect size or p value	Analysis/ adjustment
Results table 2-7: absenteeism according to disease severity among patients with COPD							
Cohort studies							
Jansson et al (2013)[152]	Cohort General population based study 12 months 2009-2010	COPD (based on GOLD guidelines) n=244	Sick leave over the previous year	Average number of days absent Mild Moderate Severe Very severe	 1.14 0.71 0.00 22.6	**P=0.31 (NS)**	No adjustment for confounders Kruskal-Wallis test for differences between disease severity
Jansson et al (2002)[162]	Cohort General population based study 12 months 1999	COPD (GOLD criteria) n=212	Annual lost productivity due to absence from work (overall)	Mean days absent FEV_1% $\geq$80% (mild) FEV_1% 60 – 79% (moderate) FEV_1% 40 – 59% (severe) FEV_1% <40% (very severe) Weighted mean days off % who were affected	 0.63 0.44 0.72 2.79 0.66 7.4%	**P >0.05 (NS)**	Adjusted for various confounders. Sickness absence definition unclear (e.g. general or COPD related) and whether it was standardised.
Cross-sectional studies							
Solem et al (2013)[158]	Cross-sectional Primary care COPD population with severe disease 2011-2012	COPD (spirometry based on GOLD guidelines) n=314	WPAI questionnaire Work time missed due to COPD over the previous week	Mean hours missed according to disease severity (SD) Severe Very severe	 8.0 (19.7) 12.0 (17.4)	Not significant	No adjustment for confounders
Rodriguez Gonzalez-Moro et al (2009)[165]	Cross-sectional COPD population 2007 - 2008	COPD (GOLD criteria): n=3608 Moderate COPD: n=1596 Severe COPD: n=2012	Sick leave in the past year (overall)	% who missed work according to disease severity Moderate Severe/very severe Mean days off according to disease severity Moderate Severe/very severe	 12.1% 7.9% 30.5 (95% CI: 22.8 – 38.2) 61.1 (95% CI: 42.2 – 73.9)	**P=0.0001** (for prevalence and mean days off)	Appropriate bivariant analysis No adjustment for any confounders

Results table 2-7: absenteeism according to disease severity among patients with COPD (continued)

Author, date	**Study design and follow-up period/study period**	**COPD description**	**Outcome definition/criteria**	**Category**	**Results**		**Effect size or p value**	**Analysis/ adjustment**
Fletcher et al (2011)[22]	Cross-sectional survey COPD population 2009	COPD: n = 2426 Mild: n = 849 Moderate: n = 1012 Severe: n = 521	WPAI questionnaire Sickness absence due to lung health over previous week	% missed work (95% CI) Mild Moderate Severe	 2.2% (1.2 – 3.2) 8.3% (5.2 – 11.5) 7.6% (2.1 – 13.0)		Not calculated	Mean time off work not provided.
de Miguel Diez et al (2008)[161]	Cross- sectional Primary care COPD population 2003	COPD n=10711 Mild: n=1967 Moderate: n=2495 Severe: n=348	Disability leave over the previous 12 months (overall)	Median days off Mild Moderate Severe Mean days off (95% CI) Mild Moderate Severe	 4.38 5.69 4.48 7.22 (6.39 – 8.05) 9.75 (8.77 – 10.73) 11.02 (7.27 – 14.77)		**P<0.001** (association between disease severity and absenteeism)	Descriptive statistics and ANOVA. No adjustment for confounders. Disability leave not clearly defined. Mean absenteeism data is skewed.
Boot et al (2005)[160]	Cross- sectional Primary care COPD/asthma population	COPD (confirmed using spirometry): n=64 Low sick leave: n=17 (26.6%) High sick leave: n=47 (73.4%)	Sickness absence (absent for 2 or more consecutive days) over 2 years: High sick leave: ≥ 3 episodes in any year or 1 episode > 1 month in duration Low sick leave: ≤ 2 episodes per year	Mean FEV_1 % predicted (SD) according to sick leave Low sick leave High sick leave	 69.0 (19.2) 58.6 (16.2)		**P < 0.05**	Descriptive statistics and logistic regression. No confounders adjusted for. Mean sick days/distribution not assessed. Sick leave over 2 years: risk of recall error.
Boot et al (2004)[118]	Cross-sectional Primary care COPD/asthma population	COPD (spirometry) n=71 Sickness absence: n=45 (63.4%) No sickness absence: n=26 (36.6%)	Self-reported sickness absence in past 12 months (at least 2 consecutive days) (overall)	 Disease severity Mild Moderate Moderate Severe	No sickness leave 3 (12.0%) 17 (65.0%) 4 (15.0%) 2 (8.0%)	Sick leave 9 (19.0%) 21 (48.0%) 15 (33.0%) -	**P > 0.05** (NS in disease severity between groups)	Final model adjusted for: complaints/limitations, work characteristics, age and adaptation Found no relationship between disease severity and sickness absence.

2.5.3 Presenteeism

One retrospective cohort[105] and five cross-sectional studies[104;111;112;116;159] assessed the effect on work productivity in those with and without COPD (Table 2-8). Studies consisted of large samples and were based on employed people[104;105;116] or a general population,[111;112;159] although Wang et al[116] had a small COPD sample (n=40).

When measured using the WPAI questionnaire, COPD patients were significantly more likely to report presenteeism compared to those without COPD ($p<0.001$).[111;112] A study which used the WHO-HPQ also suggested that COPD patients may be at an increased risk of presenteeism (IRR=1.43; 95% CI: 0.98 – 2.10), although these differences just failed to reach statistical significance.[104] Allen et al's matched-cohort study, which assessed presenteeism over two time periods also demonstrated a significant association between COPD and presenteeism ($p<0.05$) but only for one time period.[105]

Ward et al's findings suggest that among COPD patients, those with emphysema (43.5%) may be more affected than chronic bronchitis patients (3.4%), although it should be noted that classification of lung disease was based on self-report.[159]

Three studies assessed the relationship between disease severity and presenteeism (Table 2-9), all of which signalled a greater impact on work performance with increasing disease severity,[22;158;165] although only one study found this association to be statistically significant.[165] Among these studies disease severity and work performance was measured using different methods (airflow obstruction and breathlessness). Furthermore, the lack of adjustment for confounders in all three studies suggests that these findings should be interpreted with caution.

Table 2-8 The effect of COPD on presenteeism

Results table 2-8: the effect of COPD on presenteeism									
Author, date	**Study design and follow-up period/study period**	**COPD description**	**Comparator**	**Instrument and outcome definition/criteria**	**Category**	**Results COPD**	**Results comparator**	**Effect size or p value**	**Analysis/adjustment/ comments**
Cohort studies									
Allen et al (2012)[105]	Retrospective cohorts (over 2 time periods) Employed population 2001-2002 and 2008-2009	Records linked participants to >2 separate diagnosis of COPD 2001: n = 181 2008: n = 245	Without COPD n = 9680 n = 9883	WLQ and HWP-1 questionnaires Scales measure overall work effectiveness	Mean presenteeism scores	WLQ: 2001 – 2002: 7.7 2008 – 2009: 4.0 HWP-1: 2001 – 2002: 27.1 2008 – 2009: 12.7	WLQ: 2001 – 2002: 5.8 2008 – 2009: 4.5 HWP-1: 2001 – 2002: 18.8 2008 – 2009: 11.5	**P<0.05** **P>0.05** **P<0.05** **P>0.05**	T-test (cross-sectional analysis) Matched on age, gender, whether salaried or hourly pay, length of employment and number of comorbidities using propensity scores.
Cross-sectional studies									
DiBonaventura et al (2012a)[112]	Cross-sectional General population based survey 2009	COPD n = 1112	Without COPD n = 18912	WPAI questionnaire Presenteeism due to lung health over previous 7 days	Mean % presenteeism (adjusted) Mean number of hours due to presenteeism (unadjusted)	19.28% 9.76 hours	14.59% 4.97 hours	**P<0.001** **P<0.001**	Adjusted for sex, employment type, ethnicity, education, income, health insurance, smoking status, BMI and asthma diagnosis. Would have been useful to assess number affected, and the range of the scores. Did not state the presenteeism parameters.
DiBonaventura et al (2012b)[111]	Cross-sectional General population based survey 2009	COPD n = 297	Without COPD n = 3061	WPAI questionnaire Presenteeism due to lung health over previous 7 days	Mean % presenteeism (adjusted) Mean number of hours due to presenteeism (unadjusted)	12.6% 4.82 hours	8.71% 2.59 hours	**P=0.01** **P<0.001**	Adjusted for sex, employment type, ethnicity, education, income, health insurance, smoking status, BMI and asthma diagnosis. Age and co-morbidities not adjusted for.
Holden et al (2011)[104]	Cross-sectional Employed population 2004-2005	Self-report of COPD/bronchitis or emphysema): n=361 (calculated)	Without COPD n= unknown	WHO-HPQ Overall performance in previous 4 weeks	Risk of presenteeism for COPD patients	-	-	**IRR=1.43 (95% CI: 0.98 – 2.10) (NS)**	Adjusted for age, sex, marital status, number of children, education level, annual income, treatment seeking behaviour, number of co-morbidities, occupation, industry, public/private sector, job security, contractor, rate of workplace accidents, hours worked (past 4 weeks),supervisory role and hours expected to work day/week by their employer. Did not adjust for smoking status. Did not solely focus on COPD patients.

Results table 2-8: the effect of COPD on presenteeism (continued)

Author, date	Study design and follow-up period/study period	COPD description	Comparator	Instrument and outcome definition/criteria	Category	Results COPD	Results comparator	Effect size or p value	Analysis/adjustment/ comments
Wang et al (2003)[116]	Cross- sectional Employed population	Self-reported COPD n~40	Without COPD n= unknown	HPQ Presenteeism due to condition in previous 4 weeks	Annual excess days (SE)	27.5 (15.6)	-	**P > 0.05 (NS)**	Analysis of covariance. Adjusted for age, sex, occupation, education and other conditions. Smoking status not accounted for. Small COPD sample.
Ward et al (2002)[159]	Cross- sectional 1993 - 1994	Chronic bronchitis: n = 1582 Emphysema: n =947	Allergic rhinitis: n = 3306 Asthma: n = 2632 Other lung disease: n = 388	Condition is the main cause of work limitation	% affected	Chronic bronchitis: 3.4% Emphysema: 43.5%	Allergic rhinitis: 1.4% Asthma: 19.1% Other lung disease: 30.1%	Not calculated	Not assessed as a validated presenteeism measure. Chronic bronchitis and emphysema not combined. Increased risk of misclassification through using other lung disease group.

Table 2-9 Presenteeism according to disease severity among patients with COPD

Author, date	Study design and study periods	COPD description	Comparison groups	Outcome definition/criteria	Category	Results	Effect size or p value	Analysis/ adjustment/ comments
Results table 2-9: presenteeism according to disease severity among patients with COPD								
Cross-sectional studies								
Solem et al (2013)[158]	Cross-sectional Primary care COPD population with severe disease 2011-2012	COPD (spirometry based on GOLD guidelines) n=314	Disease severity Severe: n=190 Very severe: n=124	WPAI questionnaire Presenteeism due to COPD over the previous week	Mean % according to disease severity (SD) Severe Very severe	 36.1 (27.1) 46.7 (31.1)	Not significant	No adjustment for confounders
Rodriguez Gonzalez-Moro et al (2009)[165]	Cross-sectional COPD population 2007 - 2008	COPD (GOLD criteria) n=3608	Disease severity Moderate COPD: n=1596 Severe COPD: n=2012	COPD impact on work in past 4 weeks Work impact questions taken from item 4 of SF-36. Specific questions not detailed	% work time reduced Moderate Severe % do less of what one wishes to do Moderate Severe % quit doing some tasks Moderate Severe % difficulty on doing the job Moderate Severe	 44.6% 64.7% 60.8% 78% 48.7% 68.4% 51.0% 72%	**P = 0.0001** **P = 0.0001** **P = 0.0001** **P = 0.0001**	Chi squared test with no adjustment (difference in proportions) Not a validated presenteeism measure
Fletcher et al (2011)[22]	Cross-sectional COPD population 2009	COPD n = 2426	Disease severity Mild: n = 849 Moderate: n = 1012 Severe: n = 521	WPAI questionnaire Presenteeism due to lung health over previous week	% affected (95% CI) Mild Moderate Severe	 5.2 (3.7 – 6.7) 16.8 (12.6 – 19.6) 18.9 (10.4 – 27.3)	Not calculated	Mean presenteeism scores not reported

2.6 Discussion

2.6.1 Main findings

Although the prevalence of employment among COPD patients varied from 16.7% to 69.2%,[103;154] there was clear evidence that employment rates among patients with COPD were lower compared to those without COPD. This was supported by a 16 year cohort study,[157] a large matched retrospective cohort study[154] as well as four large cross sectional studies.[99;100;103;156] There is some evidence to suggest that as disease severity increases patients are less likely to be in work, however the strength of the evidence was weak; consisting of a number of methodological issues.

There were some inconsistencies when comparing the proportion of participants with sickness absence in those with COPD compared to those without; the recall periods (1 week to 4 years) and time of data collection (1964 to 2012) within the evidence varied widely. Although when measuring disability-related work loss, there was clear evidence from a relatively recent cohort study that COPD patients are approximately twice as likely to have a short term disability and more than 4 times more likely to have long term disability compared to those without COPD.[106]

Strong evidence from 1 cohort study[107] in addition to some evidence from 2 other cohort studies[106;108] demonstrated that patients with COPD take more time off work compared to those without COPD. A fourth cohort study also supported this, but for only one of the two time periods assessed.[105] Additionally, four cross-sectional studies supported these results, although they did consist of some methodological weaknesses.[111;112;116;164] A reliable estimate was found in Nair et al's study: COPD patients taking an average of 12 days off per year compared to 7.2 days off in those without COPD.[107]

The evidence for associations between disease severity and absenteeism was unclear. It was difficult to compare study findings due to: methodological weaknesses of some of the literature e.g. small sample sizes, lack of adjusting for confounders; heterogeneity between studies e.g. measure of disease severity (FEV_1/FVC ratio or GOLD staging), measure of absenteeism (any sick leave or high vs. low sick leave).

For the third outcome measure, presenteeism, the majority of the cross-sectional evidence suggested that when at work, patients with COPD have poorer work performance than those without COPD, however, due to the various scales used to measure presenteeism it was difficult to quantify these differences. The cohort study reported inconsistency in results over the two time periods (similar to the absenteeism results), however it should be noted that there were imbalances in the male to female ratio over both time periods, which may have provided biased estimates.[105] There was inconclusive evidence on the effect of disease severity on work performance. Only three studies assessed this association[22;158;165]; of which two used a standardised presenteeism instrument,[22;158] possessing a short recall period, and none adjusted for the effect of confounding.

2.6.2 Strengths and limitations of the review

This appears the first systematic review to assess the effect of COPD on employment, absenteeism and presenteeism. The search strategy included a variety of methods to gain access a wide range of literature. However, it was restricted to the inclusion of English publications (although only two non-English publications were identified as potentially relevant to the review).

A standardised tool was not available to evaluate the methodological strength of the evidence, and instead a variety of methods were used to develop the tailored risk of bias tool. However, to our knowledge, there is currently no gold-standard tool to assess the biases within cross-sectional studies.

2.6.3 Strengths and limitations of the evidence included in the review

There was high heterogeneity amongst the included studies, making it difficult to compare and synthesise the results. For example, absenteeism was measured using various recall periods and reasons (e.g. overall/COPD related absenteeism). Inconsistencies in the reporting of outcome data was also noted, for example, absenteeism was measured by any or some of the following: % affected; hours; days and reporting of an effect size e.g. risk ratio. Presenteeism was measured using various instruments, and a few measured work performance without the use of a standardised presenteeism instrument.

Although the COPD population inclusion criteria were flexible – including self-reported COPD patients – this approach may have inevitably increased the risk of misclassifying the disease, and therefore including articles with a diluted COPD population.

There were some well-conducted observational studies included in this review, which either matched or adjusted for a range of important covariates. However, adjustment for confounders or important confounders was an identified issue among many studies, making it difficult to interpret the reported effect sizes. Additionally, some studies did not go beyond descriptive statistics and hence, reported no effect size.

An objective of this review was also to examine the effect of COPD disease severity on all working outcomes. However, as this was not always measured, it was difficult to conclude on such associations.

The studies included in this review were conducted over a number of countries, yet no study solely assessed a UK COPD population. Fletcher et al's large cross-sectional cross-country study included a UK COPD population, but combined the data from each country into one estimate.[22] This is important to consider as the welfare and social settings may differ between countries. Many studies also displayed limited external validity, for example some studies included a skewed study population such as high male populations or those working in certain occupations/industries.

2.6.4 Comparison with other reviews

Whilst working on this systematic review, two relevant reviews were published: 1) a literature review focusing on the indirect costs of COPD in the US,[43] and 2) a systematic review assessing the global impact of non-communicable diseases on macro-economic productivity.[167]

Patel et al's[43] review involved assessing the impact on employment, absenteeism and presenteeism among the US COPD population. Despite differences in review methods, inclusion criteria and restriction to US studies only, the main results were similar. The authors also found lower employment rates among those with COPD compared to those without. They found that COPD patients with more severe disease, emphysema and comorbid asthma were more likely to be out of work compared to those with mild disease and chronic bronchitis. The estimates related to the impact on absenteeism and presenteeism were identified as disparate, although only 2 articles assessed presenteeism. The authors also appreciated the methodological weaknesses of the existing studies.

Chaker et al's[167] review, however, assessed a wide range of health conditions, and therefore did not provide an in-depth commentary on the impact on COPD patients. Nevertheless, the authors found that COPD patients had a “higher chance of working fewer hours and of poorer work performance” and that COPD accounted for approximately 8.5 days lost work days per year.[167] Overall, the results were broadly comparable with this review’s findings, although little was discussed on the impact on employment and the impact of COPD disease severity on the various working outcomes. There was a difference in the estimated lost working days between

Chaker et al's[167] review (based on 2 studies) and this review (based on one study): 8.5 vs. 12.0 days off per year. These differences in findings may be accounted by the differences in review inclusion criteria (Chaker et al's[167] estimate was based on studies not included in this review), methodological quality of the studies used to derive the estimate as well as potential variations in the definition "lost working days" – the review lacked clarity as to whether the lost days were attributed to absenteeism alone.[167]

2.6.5 Implications for future research

There were a number of methodological weaknesses within the current literature and thus, the following are required for future studies: prospective studies with matched controls or better control of confounders; use of validated scales; methods of data collection to minimise recall error (e.g. routine data on sickness absence, or data from company records) and robust methods in diagnosing lung disease (i.e. spirometry data).

The effect of COPD on presenteeism is an emerging area of research. Future studies should measure work performance using an agreed and standardised questionnaire and recall periods, to allow comparisons between studies.

The effect of disease severity on working outcomes was unclear. More studies with reliable methods to measure lung disease and work outcomes are needed. However, it is known from existing literature that the extent of airflow obstruction may not truly reflect the impact of COPD on patients, and therefore measuring disease severity through other measures, such as breathlessness, may be more important in assessing the impact on working outcomes in patients with COPD.

From this review it is also unclear how COPD phenotype (e.g. emphysema or chronic bronchitis) affects working outcomes. Future research should use information from physician records rather than self-reported data, which may help reduce misclassification and clarify associations.

Lastly, this review identified the scarcity of observational research based in the UK. Future research should focus on this to help develop a better understanding of the implications of COPD in the local working population.

2.6.6 Conclusions

COPD is associated with a significant cost to society and from this review there is consistent evidence from observational studies to show that patients with COPD have lower employment rates and take more time off work compared to those without COPD. To reduce this burden, there is a need for reliable data in this area to better understand the effect of COPD on working outcomes.

Although it appears COPD affects work performance, this review highlighted there is insufficient evidence to support the effect of COPD on presenteeism. More studies with robust methods are required in this area.

Being in work is good for both the physical and mental health and wellbeing of patients, and so there is also a need to understand how we may be able to keep COPD patients in work and reduce their sickness absence rates. The next step, therefore, would be to understand the reasons for these significant differences by assessing which factors may contribute to the lower employment rates and greater time off work in COPD patients; which would also include assessing the impact of disease severity (particularly as there is inconclusive evidence about this association). Identifying the factors which are associated with these working outcomes may provide information on how interventions can be targeted to COPD patients to help improve their work ability and productivity; which would not only benefit society, but also patients themselves.

3. THE ASSOCIATION BETWEEN COPD AND EMPLOYMENT: A CROSS-SECTIONAL ANALYSIS OF DATA FROM THE BIRMINGHAM COPD COHORT

3.1 Abstract

Background Employment rates among those with COPD are lower compared to those without COPD. Little is known about the factors which affect COPD patients' ability to work. We aimed to identify modifiable factors associated with being in work among working age COPD patients.

Methods A cross-sectional analysis of the baseline data of the Birmingham COPD Cohort study to assess the associations between socio-demographic, clinical and occupational characteristics and employment among working age COPD patients, using logistic regression.

Results Of the 1889 recruited to the cohort study, 608 were of working age (<65 years) of whom 248 (40.8%) were in work. Individual factors associated with a lower probability of being in work were increasing age (p for trend<0.01), decreasing educational level (p for trend<0.05), increasing BODE score (p for trend<0.01) and high occupational exposure to vapours, gases, dusts and fumes (VGDF) (OR=0.32; 95% CI 0.12 – 0.85). Exploration of the components of the BODE index revealed that only the breathlessness component was significantly associated with employment status.

Conclusions This is the first UK study assessing the impact of COPD on employment among patients in primary care. COPD patients who are more breathless and have a higher exposure to VGDF are less likely to be employed. Future interventions should focus on managing breathlessness and reducing occupational exposures to VGDF to improve the work capability among patients with COPD.

3.2 Introduction

COPD is a progressive lung disease characterised by airflow obstruction,[25] affecting 6-10% of the global population.[31] In the UK, an estimated 44% of the COPD population are of working age, of which around one quarter are not in work due to their COPD.[45] These estimates are higher in the US: of the 69.0% of working age,[168] more than one third are not in work due to their COPD.[113] There is insufficient evidence assessing the national economic impact of work loss due to COPD in the UK, however other estimates suggest COPD attributed work loss costs the US economy $18.5 billion annually.[43]

The systematic literature review in the previous chapter (chapter 2) confirms the burden of COPD on employment. Although the employment rates among those with COPD varied widely – between 16.7% and 69.2% – there was strong evidence that patients with COPD have lower employment rates compared to those without COPD. They are also less likely to be in work compared to asthma patients or those with other-co morbidities.[99] There was also some evidence to suggest that when out of work, COPD patients are less likely to re-enter the labour market compared to those with no chronic conditions.[99]

Remaining in work or returning to work is advised for those who develop a health condition,[1] and to help improve work ability amongst these patients it has been suggested that early interventions should be put in place.[1;10] However, before planning intervention strategies to address the low employment rates among patients with COPD, there is a need to understand what factors may affect employment amongst this group.

Of the limited evidence, there are conflicting findings about the factors associated with employment among patients with COPD. Adjusted analyses indicate contradictory evidence related to the impact of current smoking status on being in work.[100;101] Occupational exposures may also play a role,[101] although evidence for this is limited and conflicting.[101;102] Furthermore, as highlighted in chapter 2, there is inconclusive evidence related to the impact of disease severity on employment among those with COPD. Unadjusted estimates indicate that breathlessness may be an important factor associated with employment,[22;100] although there is insufficient evidence to support this finding as yet. There is also some evidence which suggests that co-morbidities among patients with COPD may contribute towards work disability,[101] although an adjusted analysis found that this was not a significant factor contributing to unemployment.[100]

However, the few available studies contain a number of methodological weaknesses. Furthermore, socio-demographic profiles of these patients may differ compared to that of the UK COPD population and motivation to remain in work may vary in different settings. Therefore, a cross-sectional analysis of the Birmingham COPD Cohort baseline data is presented in this chapter to evaluate which factors are associated with being employed among patients with COPD.

3.3 Methods

3.3.1 Study design

Cross-sectional analysis of baseline data from the Birmingham COPD Cohort

3.3.2 Setting: the Birmingham COPD cohort

The Birmingham COPD Cohort is a unique primary care cohort, with a planned 3 year follow-up.[169] 71 GP practices were recruited within the West Midlands, UK, from which 1889 patients were recruited to the cohort; including both existing COPD patients (from GP registers) and newly diagnosed COPD patients (from a linked case-finding RCT[170]). Patients were recruited from June 2012 to July 2014.

3.3.3 Population

For these analyses patients with a COPD diagnosis (existing and newly diagnosed patients) who were of working age (<65 years) were included. Existing COPD patients were those with a clinical diagnosis of COPD on the GP register. The newly identified COPD cases were defined according to the current NICE guidance (FEV_1/FVC<0.7, in the presence of relevant respiratory symptoms: dyspnoea, wheeze, chronic cough or phlegm).[170]

3.3.4 Exposures: factors affecting employment status

A number of clinical and physiological measures were carried out at baseline.

Socio-demographic characteristics: Validated questionnaires were used to collect information on age, sex, smoking status, highest educational level achieved and gross household income. Height and weight measurements were obtained by trained research assistants. Social deprivation was measured using the Index of Multiple Deprivation (IMD) 2010 score[171] based on individual patient postcodes. Co-morbidities were a self-reported physician diagnosis of: CVD, diabetes, gastro-intestinal disease, diabetes, cancer, depression, osteoarthritis, rheumatoid arthritis, hayfever, eczema and allergies.

Clinical characteristics: Participants completed questionnaires on breathlessness (the MRC score)[172]; symptom impact (CAT score)[173]; and exacerbations (self-reported steroid or antibiotic treatment for an exacerbation in the previous 12 months). Pre and post-bronchodilator spirometry, according to the ATS/ERS 2005 guidelines,[174] was carried out by the research assistants who received intense training based on a modified version of the ARTP spirometry course. Airflow obstruction was determined using the post-bronchodilator results; % predicted FEV_1 was calculated using GLI reference equations[175] and GOLD staging criteria[24] used for severity of airflow obstruction. Patients also completed an exercise capacity test, which assessed the number of sit-to-stand repetitions patients completed in one minute (carried out post bronchodilator): counting the number of times the patient stood from a seated position, without using their arms to stand up.

The BODE index was adapted using the sit-to-stand test as a proxy for the exercise capacity element of the BODE (in place of the 6 minute walk test). Cut-off points were derived from the research by Ozalevli et al,[176] which assessed the correlation between the 6 min walk test and the sit-to-stand test.

Occupational characteristics: SOC (standard occupational classification) 2010 codes were generated for the longest held occupation by trained research assistants using the CASCOT (computer assisted structured coding tool) software.[177]

For accurate and standardised SOC coding, one researcher (KK) delivered a standardised training programme to all research assistants. The training programme provided instructions on software navigation, the factors to consider when coding occupations (job title and job tasks) and practice sessions for coding a range of occupations. RAs were directed to contact the researcher (KK) in the event of ambiguous patient occupations (which were difficult to code) for advice on the correct SOC code.

For quality control, the occupational coding by each research assistant was assessed by identifying and telephoning a random sample of 25 to 30 patients (seen by each research assistant). Blind to the patient's occupational history and SOC code originally generated by the research assistant, the researcher (KK) obtained the relevant occupational details from each patient and used this information to independently generate a SOC code. Patient SOC codes generated by the researcher and research assistant were compared. Any discrepancies in coding were rectified by the researcher, and research assistants were informed and explained about the correct coding for such occupations.

An unpublished job exposure matrix (JEM) was used to assign the risk (none, low, medium and high) of occupational exposures to vapours, gases, dusts and fumes (VGDF) for each SOC code. This was developed based on previous work[178] by the main author (through personal communication). Self-reported employment type (employed for wages/self-employed) was collected in a subset of patients.

3.3.5 Outcome measure

Self-report of whether the patient was in any current paid employment (full-time or part-time) at the baseline visit was obtained by the research assistant.

3.3.6 Sample size

As this study was nested within the Birmingham COPD Cohort, no formal sample size calculations were carried out. Instead a convenience sample was used for this analysis.

3.3.7 Ethical approval

The Birmingham COPD Cohort received ethical approval from the National Research Ethics Service Committee West Midlands - Solihull (ref: 11/WM/0304).

3.3.8 Statistical analysis

Univariate and multiple logistic regression were undertaken in STATA version 13.0. An initial model consisted of known clinically important covariates: age, sex, smoking status and number of co-morbidities. Using the likelihood ratio test, we assessed the additional contribution of significant covariates identified in the univariate analysis:

education level, MRC score, CAT score, number of exacerbations, exercise capacity, the BODE index and exposures to VGDF.

Initially, the BODE index (a composite measure) was chosen to describe disease severity. We then assessed the individual components within the BODE index in a further model.

Sub-group analysis: In a subset of patients for whom there were data, the impact of employment type (employed/self-employed) on being in work was additionally assessed (adjusted for all covariates in the final model).

3.4 Main results

3.4.1 Characteristics of the participants

Of the 7176 eligible patients, 1889 (26.3%) patients were recruited to the cohort study. 608 (32.2%) were of working age, and form the group that was studied in this chapter, of whom 248 (40.8%) reported being in work (Figure 3-1).

Figure 3-1 Participant flow chart for the recruitment to the Birmingham COPD Cohort study

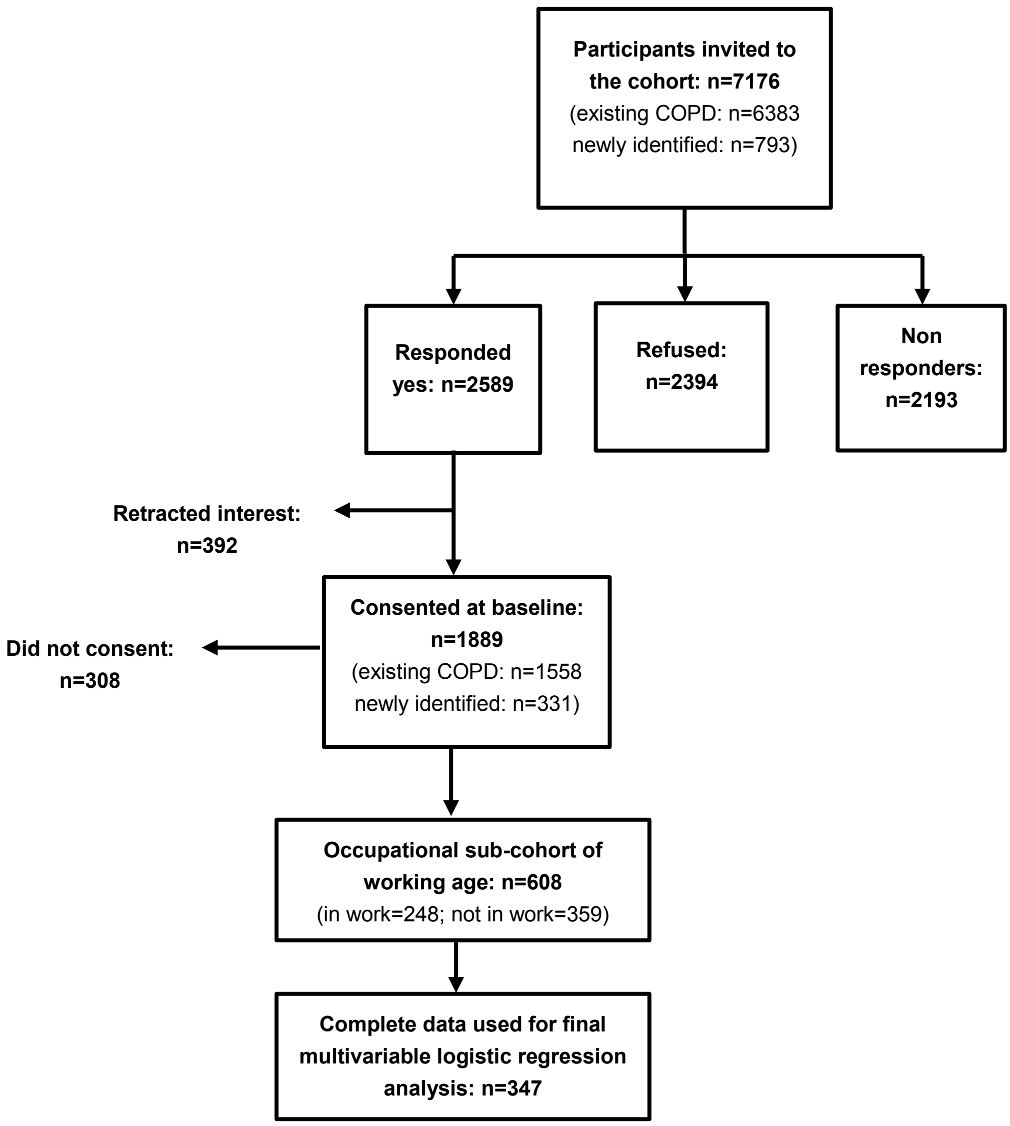


Table 3-1 describes the baseline characteristics of those of working age. Approximately 50% of the participants were aged 60-64 years, current smokers and had no formal educational qualification. The majority of patients were either overweight or obese (70.4%) and had at least one co-morbidity (85.3%).There was a range of disease severity (including dyspnoea, impact on quality of life and airflow obstruction). Approximately 50% were from a manual occupational background (skilled trade; process/plant/machine operatives; elementary) and many patients (66.9%) had either no or low occupational exposures to VGDF.

Table 3-1 Baseline characteristics among those of working age recruited to the Birmingham COPD Cohort study

Characteristics	Participants of working age N=608
Socio-demographic characteristics	
Sex	
Female (%)	265 (43.6%)
Male (%)	343 (56.4%)
Age categories	
38 – 49	68 (11.2%)
50 – 59	253 (41.6%)
60 - 64	287 (47.2%)
Smoking status	
Never smoked	42 (7.5%)
Ex-smoker	239 (42.8%)
Current smoker	278 (49.7%)
Education level	
Degree or higher level	58 (12.0%)
A level/AS level or equivalent	36 (7.5%)
GCSE, CSE, O level or equivalent	140 (29.1%)
No formal qualification	248 (51.5%)
Gross household income	
£28081-£45241+	91 (16.2%)
£18721-£28080	72 (12.8%)
£9361-£18720	111 (19.7%)
<£2600-£9360	173 (30.7%)
Prefer not to say	116 (20.6%)

Table 3-1Baseline characteristics among those of working age recruited to the Birmingham COPD Cohort study (continued)

Characteristics	Participants of working age N=608
IMD score quintiles	
1	91 (15.0%)
Increasing deprivation 2	93 (15.4%)
3	136 (22.5%)
4	132 (21.8%)
5	153 (25.3%)
BMI categories	
Normal (18.5-24.9)	156 (26.8%)
Underweight (<18.5)	16 (2.8%)
Overweight (25 - 30)	205 (35.2%)
Obese (30+)	205 (35.2%)
Clinical characteristics	
Number of co-morbidities	
0	89 (14.6%)
1-2	250 (41.1%)
3+	269 (44.2%)
MRC	
1	125 (21.4%)
Increasing breathlessness 2	103 (17.7%)
3	130 (22.3%)
4 to 5	225 (38.6%)
CAT score	
Increasing symptom impact Low (high QOL)	66 (14.0%)
Medium	174 (36.8%)
High	166 (35.1%)
Very high (poor QOL)	67 (14.2%)
Disease severity (GOLD stage criteria)	
Mild	175 (30.2%)
Moderate	287 (49.5%)
Severe to very severe	118 (20.3%)
Exacerbations in the last 12 months	
0	228 (41.5%)
1 – 2	202 (36.8%)
3+	119 (21.7%)
Sit-to-stand repetitions quintiles	
1	80 (16.2%)
Increasing exercise capacity 2	80 (16.2%)
3	109 (22.0%)
4	119 (24.0%)
5	107 (21.6%)
BODE index score quartiles	
1	185 (40.2%)
Increasing severity 2	129 (28.0%)
3	95 (20.7%)
4	51 (11.1%)

Table 3-1 Baseline characteristics among those of working age recruited to the Birmingham COPD Cohort study (continued)

Baseline characteristics	Participants of working age N=608
Occupational characteristics	
Occupational background (SOC 2010)	
Managers, directors and senior officials	40 (6.8%)
Professional	55 (9.3%)
Associate professional and technical	39 (6.6%)
Administrative and secretarial	57 (9.6%)
Skilled trade	113 (19.1%)
Caring, leisure and other services	48 (8.1%)
Sales and customer service	31 (5.3%)
Process, plant and machine operatives	113 (19.1%)
Elementary	95 (16.1%)
Exposures to VGDF in longest held job	
None	196 (32.9%)
Increasing occupational exposure ↓ Low	202 (34.0%)
Medium	124 (20.8%)
High	73 (12.3%)
Employment status	
Employed	359 (59.1%)
Not employed	248 (40.9%)

3.4.2 Univariate analysis

Participants who were female, older, current smokers, had a lower level of education, a lower gross household income and a higher deprivation score were less likely to be in work (although not all effects were statistically significant) (Table 3-2). Dose response relationships were found between a number of clinical characteristics and a reduced probability of being in work: increasing breathlessness (p for trend<0.01); poorer quality of life (p for trend<0.01); increasing airflow obstruction (p for trend<0.01); increasing number of exacerbations (p for trend<0.01); decreasing exercise capacity (p for trend<0.01) and worsening prognosis (BODE index; p for trend<0.01). Participants with high exposures to VGDF were less likely to be in work compared to those who were exposed to no VGDF in their work environment (OR=0.36; 95% CI 0.19 – 0.65). A dose response relationship was also found for increasing VGDF exposure and the reduced likelihood of being in work (p for trend<0.01).

Table 3-2 Univariate and multivariable analysis of socio-demographic, clinical and occupational characteristics associated with being employed among working age COPD patients

Baseline characteristics	Number (%) employed N =248	Unadjusted ORs (95% CI) for being employed	Adjusted ORs (95% CI) for being employed
Sex			
Male (%)	147 (42.9%)	1.0	1.0
Female (%)	101 (38.3%)	0.83 (0.60 – 1.15)	0.60 (0.36 – 1.01)
Age categories			
38 – 49	38 (55.9%)	1.0	1.0
50 – 59	122 (48.4%)	0.74 (0.43 – 1.27)	0.55 (0.24 – 1.26)
60 - 64	88 (30.7%)	0.35 (0.20 – 0.60)	0.28 (0.12 – 0.65)
Smoking status			
Never smoked	19 (45.2%)	1.0	1.0
Ex-smoker	103 (43.1%)	0.92 (0.47 – 1.78)	0.98 (0.37 – 2.60)
Current smoker	106 (38.3%)	0.75 (0.39 – 1.44)	0.79 (0.29 – 2.10)
Education level			
Degree or higher level	40 (69.0%)	1.0	1.0
A level/AS level or equivalent	21 (58.3%)	0.63 (0.27 – 1.50)	0.65 (0.23 – 1.90)
GCSE, CSE, O level or equivalent	64 (45.7%)	0.38 (0.20 – 0.72)	0.55 (0.25 – 1.25)
No formal qualification	68 (27.5%)	0.17 (0.09 – 0.32)	0.43 (0.19 – 0.97)
Gross household income			
£28081-£45241+	78 (85.7%)	1.0	
£18721-£28080	51 (70.8%)	0.40 (0.18 – 0.88)	
£9361-£18720	33 (29.7%)	0.07 (0.03 – 0.14)	
<£2600-£9360	16 (9.3%)	0.02 (0.01 – 0.04)	
Prefer not to say	54 (46.6%)	-	
IMD score quintiles			
1	53 (58.2%)	1.0	
Increasing 2	52 (55.9%)	0.91 (0.51 – 1.63)	
deprivation 3	52 (38.5%)	0.45 (0.26 – 0.77)	
4	49 (37.1%)	0.42 (0.25 – 0.73)	
5	41 (26.8%)	0.26 (0.15 – 0.45)	
BMI categories			
Normal (18.5-24.9)	66 (42.3%)	1.0	
Underweight (<18.5)	4 (25.0%)	0.45 (0.14 – 1.47)	
Overweight (25 - 30)	94 (45.9%)	1.15 (0.76 – 1.76)	
Obese (30+)	72 (35.1%)	0.74 (0.48 – 1.13)	
Clinical characteristics			
Number of co-morbidities			
0	44 (50.0%)	1.0	1.0
1-2	118 (47.2%)	0.89 (0.55 – 1.45)	1.14 (0.52 – 2.49)
3+	86 (32.0%)	0.50 (0.29 – 0.77)	0.70 (0.32 – 1.57)

Table 3-2 Univariate and multivariable analysis of socio-demographic, clinical and occupational characteristics associated with being employed among working age COPD patients (continued)

Baseline characteristics		Number (%) employed N =248	Unadjusted ORs (95% CI) for being employed	Adjusted ORs (95% CI) for being employed
MRC				
Increasing breathlessness	1	79 (63.2%)	1.0	
	2	59 (57.3%)	0.78 (0.46 – 1.33)	
	3	67 (51.5%)	0.62 (0.38 – 1.02)	
	4 to 5	36 (16.0%)	0.11 (0.07 – 0.18)	
CAT score				
Increasing symptom impact	Low (high QOL)	42 (63.6%)	1.0	
	Medium	88 (50.6%)	0.58 (0.33 – 1.05)	
	High	52 (31.3%)	0.26 (0.14 – 0.47)	
	Very high (poor QOL)	13 (19.7%)	0.14 (0.06 – 0.31)	
Disease severity (GOLD stage criteria)				
	Mild	91 (52.0%)	1.0	
	Moderate	111 (36.7%)	0.58 (0.40 – 0.85)	
	Severe to very severe	38 (32.2%)	0.44 (0.27 – 0.71)	
Exacerbations in the last 12 months				
	0	106 (46.5%)	1.0	
	1 – 2	91 (45.1%)	0.94 (0.65 – 1.38)	
	3+	34 (28.6%)	0.46 (0.29 – 0.74)	
Sit-to-stand repetitions quintiles				
Increasing exercise capacity	1	67 (62.6%)	1.0	
	2	69 (58.0%)	0.82 (0.48 – 1.41)	
	3	45 (41.3%)	0.42 (0.24 – 0.73)	
	4	26 (32.5%)	0.29 (0.16 – 0.53)	
	5	15 (18.8%)	0.14 (0.07 – 0.27)	
BODE index score quartiles				
Increasing severity	1	116 (62.7%)	1.0	1.0
	2	63 (48.8%)	0.57 (0.36 – 0.90)	0.84 (0.48 – 1.47)
	3	25 (26.3%)	0.21 (0.12 – 0.37)	0.38 (0.19 – 0.74)
	4	5 (9.8%)	0.06 (0.02 – 0.17)	0.10 (0.03 – 0.33)
Occupational characteristics				
Occupational background (SOC 2010)				
	Managers, directors and senior officials	27 (67.5%)	1.0	
	Professional	33 (60.0%)	0.84 (0.35 – 1.98)	
	Associate professional and technical	20 (51.3%)	0.57 (0.23 – 1.43)	
	Administrative and secretarial	28 (49.1%)	0.45 (0.19 – 1.06)	
	Skilled trade	28 (24.8%)	0.27 (0.12 – 0.58)	
	Caring, leisure and other services	26 (54.2%)	0.57 (0.23 – 1.38)	
	Sales and customer service	10 (32.3%)	0.18 (0.06 – 0.54)	
	Process, plant and machine operatives	33 (29.2%)	0.29 (0.13 – 0.63)	
	Elementary	35 (36.8%)	0.22 (0.10 – 0.49)	

Table 3-2 Univariate and multivariable analysis of socio-demographic, clinical and occupational characteristics associated with being employed among working age COPD patients (continued)

Baseline characteristics		Number (%) employed N =248	Unadjusted ORs (95% CI) for being employed	Adjusted ORs (95% CI) for being employed
Exposures to VGDF in longest held job				
	None	94 (48.0%)	1.0	1.0
Increasing occupational exposure	Low	86 (42.6%)	0.80 (0.54 – 1.19)	0.93 (0.51 – 1.71)
	Medium	47 (37.9%)	0.66 (0.42 – 1.05)	0.91 (0.43 – 1.91)
	High	18 (24.7%)	0.36 (0.19 – 0.65)	0.32 (0.12 – 0.85)
Employment type*				
	Employed	52 (43.7%)	1.0	
	Self-employed	12 (57.1%)	1.72 (0.67 – 4.39)	

***subset of patients completed information on employment type

3.4.3 Multivariable analysis

After mutual adjustment, age, education level, BODE index and occupational exposures to VGDF remained the significant covariates independently associated with employment status (Table 3-2). Females were less likely to be in work compared with males, although this did not reach statistical significance.

3.4.4 Exploring importance of components of the BODE index

Table 3-3 presents a further analysis exploring the relative importance of the different components of the BODE index after adjustment for all other important covariates. Only the dyspnoea component of the BODE index was independently associated with employment (p for trend<0.01). Point estimates of airflow obstruction and exercise capacity were suggestive of possible weak trends; of which exercise capacity demonstrated a larger effect. The BMI component within BODE was not significantly associated with employment.

When each component was added sequentially to the final model predicting employment (in place of the composite BODE index), only the dyspnoea component improved it (LR test<0.01).

Table 3-3 Exploring the BODE components in the final model

The BODE index components	Adjusted ORs*	CIs	P-value	
B: BMI				
>21	1.0	Reference	-	
≤21	0.80	0.33 – 1.92	0.61	
O: airflow obstruction (FEV$_1$ % predicted)				
≥65	1.0	Reference	-	P for trend=0.60
50 – 65	0.95	0.47 – 1.89	0.88	
35 – 49	0.83	0.39 – 1.77	0.63	
≤35	0.82	0.25 – 2.71	0.75	
D: dyspnoea (mMRC score)				
mMRC 0-1	1.0	Reference	-	P for trend<0.01
2	1.18	0.64 – 2.18	0.59	
3	0.23	0.08 – 0.62	<0.01	
4	0.36	0.15 – 0.85	0.02	
E: exercise capacity (sit-to-stand repetitions)				
≥26	1.0	Reference	-	P for trend=0.09
21-25	0.84	0.40 – 1.77	0.65	
16-20	0.80	0.38 – 1.71	0.57	
≤15	0.41	0.16 – 1.03	0.06	

*Adjusted for: age, sex, smoking status, education level, number of co-morbidities and exposures to VGDF

3.4.5 Effect of employment type

Data on employment type were available in a subset of patients (n=140; 23.0%). After adjustment, patients with a self-employed occupational background were more likely to be in work compared to those who were employed for wages (OR=3.84; 95% CI 0.55 – 26.88), although the confidence intervals were wide.

3.5 Discussion

3.5.1 Key results

This is the first study in the UK to explore the association between socio-demographic, clinical and occupational characteristics and the ability to work among patients with COPD. The main findings showed that nearly 60% of working age COPD patients were not in work and that being older, having a lower educational level, worse breathlessness and high occupational exposures to VGDF were independently associated with the reduced probability of being in work.

Compared with a recent UK labour force survey among a working age population (16-64 years), this COPD study sample had higher unemployment rates than the general population, those with a long term health condition and those with a disability[179]; which is consistent with previous work.[99]

The socio-demographic factors – age and educational level – which were independently associated with employment within this study are consistent with other published research in this area,[100] and are well recognised factors affecting employment in the general population.[180;181] Although recent UK employment trends show that there has been a rise in the proportion of women and a fall in the proportion of men that are now in work, employment rates among women remain lower than men.[182] This is supported by the findings in this study: women with COPD were less likely to be in work. Although this was not significant, a larger sample size may have clarified this relationship.

Smoking status has been shown to be associated with employment status in the UK; those who are unemployed are nearly twice more likely to smoke.[183] Although our findings were not statistically significant, the point estimates were indicative of a weak similar trend, which again might be clarified with a larger sample size.

It was surprising to find that the presence of multiple co-morbidities was not independently associated with being in work, especially as in the unadjusted analyses it appeared to be an important factor. Although this finding is consistent with those reported in other studies of patients with COPD,[100;102] the direction of the point estimates and width of the confidence intervals suggest that multiple co-morbidities may be an important factor affecting employment which might also be clarified with a larger sample.

This is the first study to use a standardised and objective measure of exposure to VGDF (the JEM) within a model assessing factors associated with employment status among COPD patients. Previous research methods have used self-report[101] and professional judgement[102] as measures of determining workplace exposures. This variation in measurement may lend some explanation for the conflicting results of the role of occupational exposures in employment among COPD patients.[101;102]

An interesting finding was that of the several clinical factors describing disease severity, only breathlessness was strongly and independently associated with employment, and was the only component which significantly contributed to the final model. The other measures of disease severity within the composite BODE measure – airflow obstruction and exercise capacity – were less important. However, although not statistically significant, they did indicate weaker trends, and a larger sample size may have increased the precision of the results.

Findings from previous studies have revealed conflicting results between the association of airflow obstruction and employment status.[100-103] These differences may be explained by the methodological differences between the studies as well as the measurement used to describe disease severity (e.g. using GOLD staging or mean FEV_1 % predicted). There has been little work assessing the impact of other measures of disease severity, for example symptoms and the degree of breathlessness.

It is now accepted that airflow obstruction does not fully capture the impact of COPD on patients' lives[184;185] and this study confirms that symptoms are more important in determining whether or not a patient is in work.

In a sub-group analysis employment type was suggestive of being associated with being in work, however our analysis did not have sufficient power to detect significant differences.

3.5.2 Study limitations

As this is a cross-sectional study, it was not possible to determine causality. Factors such as income and deprivation were significantly associated with employment in the unadjusted analyses. However, these are particularly susceptible to reverse causation and therefore were not included in the adjusted models. Workplace exposures to VGDF may also have preceded COPD diagnosis and may be an important factor in the development of COPD. Some data were based on self-report e.g. number of co-morbidities and exacerbations; possibly introducing errors in prevalence rates and diluting the findings. Additionally, there was a low response rate for some measures (smoking status; exercise capacity; exacerbations), which may have led to less reliable estimates. It was interesting to explore the BODE prognostic index, however we used a modified version – replacing the 6MWT with the sit-to-stand test as a measure of exercise capacity, and this requires further validation.

3.5.3 Implications for practice and research

These findings reveal some important differences among patients with COPD who are in work compared to those not in work, suggesting that there are possible opportunities to modify certain factors to improve work capability. Breathlessness was the most important clinical factor identified; therefore it suggests the need for healthcare professionals to work alongside patients and focus on improving the management of breathlessness in those with COPD, in particular among the working age population. The UK NICE guidelines for COPD[25] provide guidance for healthcare professionals on the management of breathlessness. This may involve providing advice on better medication management (e.g. the correct inhaler usage), advice on smoking cessation and referral to pulmonary rehabilitation (for example, among those that have a MRC score $\geq$3), or self-management advice. Within the workplace, patients (alone or in conjunction with their employer) may want to consider modifying aspects of their job which may otherwise exacerbate their breathlessness, for example, carrying heavy loads, regular use of stairs or tasks which involve lifting and bending.

The second important modifiable factor identified was high workplace exposures to VGDF. This suggests that employees should potentially undergo an occupational health (OH) risk assessment to determine the level of exposure to VGDF in their working environment and thus, for OH services to advise accordingly on how those in high exposure jobs may be able to modify their job role, job tasks or working environment. In the workplace, it may be difficult to justify conducting a risk assessment in COPD patients alone, and therefore it is suggested for all employees to receive a risk assessment and potentially benefit from reductions in workplace exposures to VGDF.

Although being in work is associated with better health among patients with COPD, there is a need for prospective longitudinal studies to establish the temporal relationships between disease severity, occupational exposures to VGDF and employment. Further research is also required to determine the effectiveness of managing breathlessness and reducing workplace exposures on work capability among patients with COPD.

3.6 Conclusions

This study demonstrates the high levels of unemployment among those with COPD. Two potentially modifiable factors associated with the reduced probability of being in work were identified: increased breathlessness and history of higher workplace exposures to VGDF. Future interventions should focus on improving the management of breathlessness and reducing workplace exposures to VGDF in order to help improve the work capability in those with COPD.

4. THE ASSOCIATION BETWEEN COPD AND WORK PRODUCTIVITY: A CROSS-SECTIONAL ANALYSIS OF DATA FROM THE BIRMINGHAM COPD COHORT

4.1 Abstract

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 identify and quantify the factors associated with work productivity among COPD patients.

Methods Cross-sectional analyses of baseline data from the Birmingham COPD Cohort study including participants who were in paid employment. Absenteeism was defined by self-report of time off work over the previous 12 months. Presenteeism was assessed using the Stanford Presenteeism Scale (SPS-6) questionnaire. Logistic regression analysis was used to assess the effects of sociodemographic, clinical and occupational characteristics on work productivity, adjusted for key covariates.

Results 348 patients in the cohort were in work at baseline. Increasing breathlessness (p for trend<0.01) was the only clinical factor associated with both absenteeism and presenteeism. Additionally, increasing occupational exposures to

vapours, gases, dusts and fumes (VGDF) (p for trend<0.01) was independently associated with presenteeism.

Conclusions This is the first study to identify the most important modifiable factors which lead to poor work productivity among patients with COPD. COPD patients who are more breathless take more time off work. In the workplace, those who are more breathless and have higher occupational exposures to VGDF are more likely to perform poorly. Future interventions should focus on managing breathlessness and reducing occupational exposures to VGDF to improve the work productivity of COPD patients.

4.2 Introduction

COPD is a common progressive lung disease affecting 6-10% of the global adult population,[31] with a high morbidity and mortality burden.[29;30] COPD is usually diagnosed in middle age, and a high proportion of those with the disease are of working age (around two thirds in the US[168] and 40% in the UK[45]). However, among these, lower proportions are in paid employment compared to the general population (see chapter 2). Indirect societal costs attributable to COPD (largely due to sickness absence) are high, estimated at between £1.1bn and £2.7bn annually in the UK[41;45] (~2003 costs for Britton et al[45]) and $3.9bn in the US (2010 costs).[44]

From the literature identified in the systematic review of Chapter 2, it was confirmed that COPD patients who are in paid employment have higher rates of absenteeism (time off work) than those without COPD. There was also evidence that the risk of absenteeism was greater in those with COPD than those with other chronic conditions such as asthma and cardiovascular disease.[104] However, the extent of the effect on COPD patients, for example, the proportion of patients affected and the annual average days off work, was unclear. As found in chapter 2, this may be due to the varying recall periods, sample sizes, countries/settings and inconsistency in the measurement of absenteeism in previous research.

There is also some limited evidence that even when at work, some patients with COPD may have poor work performance (presenteeism) compared to those without COPD, and although results were conflicting,[104;105;111;112;116] there is evidence in other diseases that costs associated with presenteeism may be of greater concern than costs associated with absenteeism or even health care.[86;186]

In the general population, poor work productivity (absenteeism and/or presenteeism) is more common among women,[187] those with a lower education level,[188] self-reported poor health[91] and who over-commit to their work.[122] Occupational factors such as job insecurity,[121;122] longer working hours (>45h per week)[122] and reduced job satisfaction[121] are also important among those with poor work productivity.

However, only a few studies have focused on the factors associated with poor work productivity among COPD patients; and none of these have assessed the factors associated with presenteeism. Among the available studies the findings are inconsistent. Chapter 2 highlighted the unclear associations between disease severity and sickness absence. There is also limited and inconsistent evidence of the impact of comorbid conditions on work productivity in COPD patients.[118;119]

In addition to methodological weaknesses, heterogeneity between studies may provide some explanation for the difference in findings, for example variations in defining work productivity or absenteeism.[118;119;160] Furthermore, due to the paucity of evidence, it is not clear to what extent poor work productivity is attributable to disease related factors, rather than sociodemographic and occupational factors.

A better understanding of the modifiable factors that might influence work productivity among COPD patients could inform and focus future interventions, which in turn, could influence a better work experience for patients and employers, as well as contribute to reducing the burden and societal costs related to COPD. The aim of this cross-sectional study was to evaluate factors associated with absenteeism, and presenteeism among working patients with COPD.

4.3 Methods

4.3.1 Study design and participants

A cross-sectional analysis of baseline data from the Birmingham COPD Cohort.

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.[169] These included 1558 patients with a previous COPD diagnosis (from GP registers) and 331 newly identified COPD patients from a related case finding RCT.[170]

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

4.3.2 Exposure measures

At baseline, all cohort participants completed a series of questionnaires to obtain detailed information on their health, occupation, lifestyle and socioeconomic circumstances. They also underwent examination and 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, according to ATS/ERS 2005 guidelines,[174] was carried out by trained researchers using the ndd Easy One spirometer (ndd, Switzerland). The degree of airflow obstruction was categorised using GOLD stage criteria.[24] Breathlessness (MRC score) was assessed from responses to the MRC respiratory questionnaire[172] and respiratory quality of life determined using the CAT.[173] 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: Occupational data (current occupation) were obtained through an interview-administered questionnaire by trained research assistants. Patients were asked details about their current job title, job tasks as well as the name and nature of the company they work for to ascertain their correct occupation. Research assistants used this information to generate a 4-digit SOC (standard occupational classification) 2010 code – a method used to classify and group occupations according to skill level and content – using the CASCOT (computer assisted structured coding tool) software.[177] Quality assessment of the SOC data was carried out by one researcher through contacting a random sample of patients for each research assistant, obtaining occupational data and generating a SOC code for each patient. This code was then compared to the patient's original SOC code generated by the research assistant.

A job exposure matrix (JEM)[178] (adapted to 2010 codes) was used to assign the risk (none, low, medium and high) of occupational exposures to vapours, gases, dusts and fumes (VGDF) for each SOC code.

Where possible, validated questionnaires were used to collect information on: working hours[189]; job satisfaction[189]; job training over previous 12 months (excluding health and safety training)[189]; supervising other employees[189]; type of contract[189]; length in current employment[189]; work involving walking/standing; work involving manual/physical work and usual shift pattern.

4.3.3 Work productivity measures

Absenteeism: Patients who reported having taken any time off work during the previous 12 months were classified as exhibiting absenteeism. The reason (i.e. respiratory or other health problems or other) and duration of any absenteeism were also noted. Absenteeism was further categorised into "low" (reporting 0 to 5 days) or "high" (defined as $\geq$ 6 days off work), based on the average number of days off work reported in UK employees (4.4 days).[125]

Presenteeism: The Stanford Presenteeism Scale (SPS-6) was used to assess the impact of the patient's "chest problems" on their work performance over the previous month.[93] The scale results in scores between 6 and 30, with lower scores indicating a greater impact on work performance due to COPD (i.e. poorer work performance and high presenteeism).[93] The lower and upper quartiles of the distribution of presenteeism scores in the cohort population was used to categorise patients into those with high (SPS-6 score ≤19), or low (SPS-6 score ≥28) presenteeism.

4.3.4 Other measures

Validated questionnaires were used to collect information on smoking status, 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 individual patient postcodes.[171] Co-morbidities were self-reported physician diagnoses of: cardiovascular disease, gastro-intestinal disease, diabetes, cancer, depression, osteoarthritis, rheumatoid arthritis, hayfever, eczema or skin allergies.

4.3.5 Sample size

As this study was nested within the Birmingham COPD Cohort, no formal sample size calculations were carried out. Instead, a convenience sample was used for the analyses.

4.3.6 Ethical approval

The Birmingham COPD Cohort received ethical approval from the National Research Ethics Service Committee West Midlands - Solihull (ref: 11/WM/0304).

4.3.7 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 (≥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.

4.3.8 Additional analyses

The relationship between absenteeism and presenteeism was assessed by correlation (as continuous data) and comparing the pre-defined categories.

The effect on absenteeism was explored using various cut off points to denote high levels of sickness absence: 4, 5, 7 and 8 days, and a separate analysis of specific COPD related sickness absence was conducted.

The effect on presenteeism was also explored using two further cut off points to define poor work performance: SPS-6 score $\leq$18, as suggested by previous research,[190] and using the median score (SPS-6 score $\leq$24).

4.4 Results

4.4.1 Characteristics of the participants

Of the 7176 eligible patients identified, 1889 (26.3%) consented to taking part in the Birmingham COPD Cohort study; of whom 348 (18.4%) were employed and eligible for the analyses in this study (Figure 4-1).

4.4.1.1 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 4-1). The majority were either overweight or obese (68.5%) and had $\geq$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 MRC dyspnoea score, health related quality of life and level of airflow obstruction, most patients had mild to moderate COPD, although over half reported one or more exacerbations in the previous year.

4.4.1.2 Occupational characteristics

Patients were from a range of occupational backgrounds, and the majority had either no or low occupational exposures to VGDF (79.5%). In a sub-sample of 91 patients where the information was available, approximately 20% were self-employed. The majority of patients had jobs which involved either walking/standing (82.3%) or manual/physical work (57.4%).

Figure 4-1 Participant flow chart for the recruitment to the Birmingham COPD Cohort study

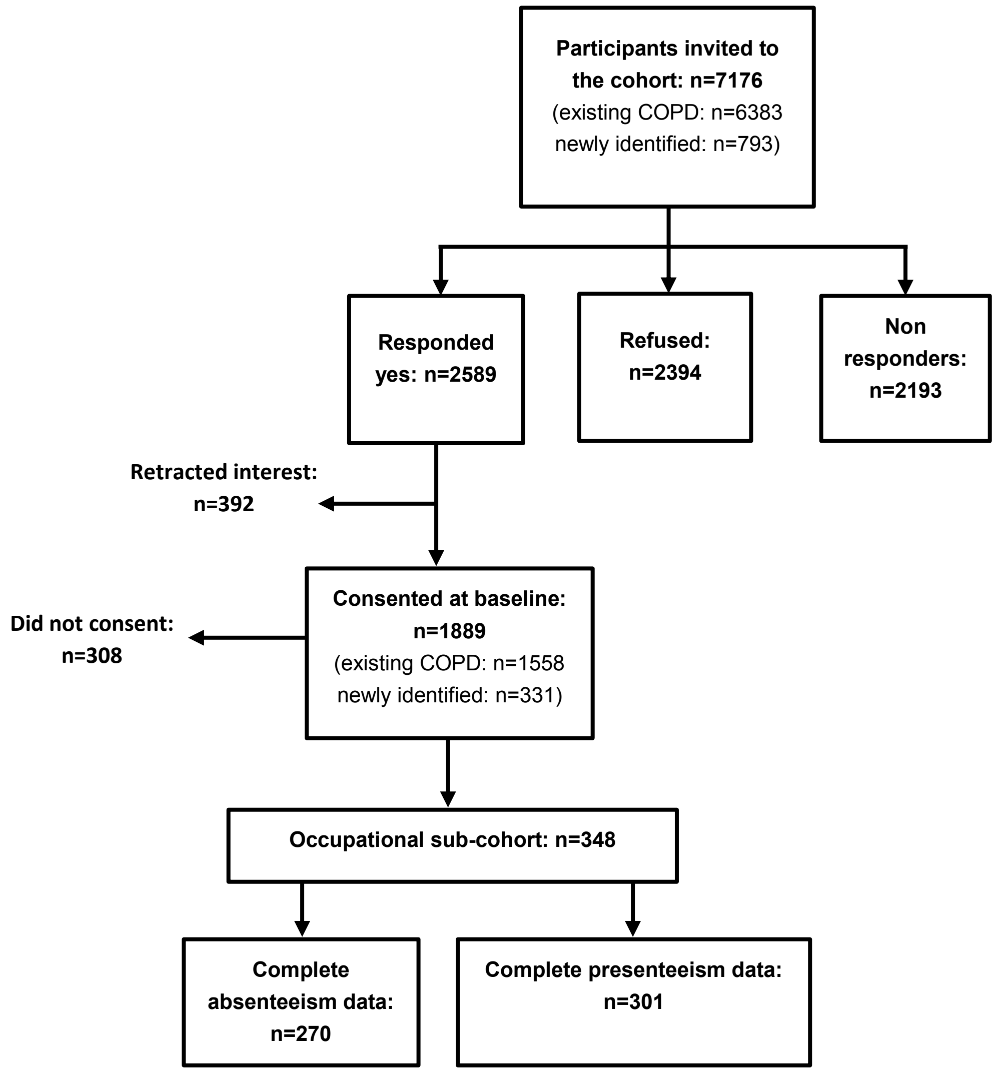


Table 4-1 Characteristics of the patients in the occupational sub-cohort

Characteristics	Patients 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%)
Gross income (before tax)	
£28081 – £45241>	63 (19.8%)
£18721 - £28080	59 (18.6%)
£9361 - £18720	80 (25.2%)
<£2600 - £9360	67 (21.1%)
Prefer not to say	49 (15.4%)
IMD score quintiles	
1	77 (22.3%)
Increasing 2	76 (22.0%)
deprivation 3	71 (20.6%)
4	72 (20.9%)
5	49 (14.2%)
BMI	
Normal (18.5-24.9)	100 (29.9%)
Underweight (<18.5)	5 (1.5%)
Overweight (25 - 30)	125 (37.4%)
Obese (30+)	104 (31.1%)
Clinical characteristics	
Number of co-morbidities	
0	59 (17.0%)
1-2	164 (47.1%)
3+	125 (35.9%)
Cardiovascular disease	140 (45.5%)
Diabetes	33 (10.7%)
Gastrointestinal disease	72 (21.8%)

Table 4-1 Characteristics of the patients in the occupational sub-cohort (continued)

Characteristics	Patients with COPD in paid employment n=348
Cancer	27 (8.7%)
Depression	74 (24.0%)
Osteoarthritis	32 (10.5%)
Rheumatoid arthritis	24 (8.0%)
Allergies (hayfever, eczema and other)	125 (39.9%)
MRC score	
1	101 (30.6%)
Increasing breathlessness 2	94 (28.5%)
3	85 (25.8%)
4	28 (8.5%)
5	22 (6.7%)
CAT score	
Increasing symptom impact <10	58 (21.6%)
10 - 20	133 (49.4%)
21-30	64 (23.8%)
>30	14 (5.2%)
Disease severity (GOLD stage criteria)	
Mild	117 (34.8%)
Increasing severity Moderate	171 (50.9%)
Severe	40 (11.9%)
Very severe	8 (2.4%)
Exacerbations in the last 12 months	
0	151 (46.6%)
1 – 2	127 (39.2%)
3+	46 (14.2%)
Occupational characteristics	
Occupational background (SOC 2010)	
Managers, directors and senior officials	39 (11.6%)
Professional	41 (12.2%)
Associate professional and technical	27 (8.0%)
Administrative and secretarial	36 (10.7%)
Skilled trade	41 (12.2%)
Caring, leisure and other services	40 (11.9%)
Sales and customer service	17 (5.0%)
Process, plant and machine operatives	43 (12.8%)
Elementary	53 (15.7%)
Exposures to VGDF	
None	154 (45.7%)
Increasing occupational exposure Low	114 (33.8%)
Medium	54 (16.0%)
High	15 (4.5%)
Employment status*	
Employed	72 (79.1%)
Self-employed	19 (20.9%)

Table 4-1 Characteristics of the patients in the occupational sub-cohort (continued)

Characteristics	Patients with COPD in paid employment n=348
Working hours	
Full time (≥37 hours)	161 (54.6%)
Part time (<37 hours)	134 (45.4%)
Job involving walking/standing	
Never/rarely	58 (17.7%)
Sometimes	89 (27.1%)
Usually/always	181 (55.2%)
Job involving manual/physical work	
Never/rarely	140 (42.7%)
Sometimes	116 (35.4%)
Usually/always	72 (22.0%)
Job satisfaction score quartiles	
1	76 (27.1%)
2	82 (29.3%)
3	53 (18.9%)
4	69 (24.6%)
Training received at work in previous 12m	
0 days to <1 day	184 (57.7%)
1 to <2 days	27 (8.5%)
2 to <5 days	56 (17.6%)
≥5 days	52 (16.3%)
Supervise other employees	
No	220 (67.7%)
Yes	105 (32.3%)
Work pattern	
Regular daytime schedule	234 (71.8%)
Regular evening shift	10 (3.1%)
Regular night shift	7 (2.2%)
Rotating shift	36 (11.0%)
Another schedule	39 (12.0%)
Type of contract	
Permanent	281 (85.7%)
Temporary – with no agreed end date	39 (11.9%)
Fixed period – with an agreed end date	8 (2.4%)
Length of current employment	
< 5 years	79 (24.1%)
5 – 10 years	63 (19.3%)
≥10 years	185 (56.6%)

*subset of patients completed information on employment type

4.4.2 Absenteeism

Absenteeism data were available on 270 (77.6%) of the occupational sub-sample. Overall 44.3% (n=154) reported ≥1 day off work in the previous 12 months, of whom 59 (17.0%) reported COPD related absenteeism. Among those with reported absenteeism, days off work ranged from 1 to 365; mean (SD) and median (IQR) days off were 27.9 (63.9) and 7 (3 to 21). The mean (SD) and median (IQR) days off work in the total working population with complete data (n=270) were 10.4 (41.3) and 0 (0 to 4) respectively. 216 had low levels of absenteeism (0 to 5 days) and 54 (16.7%) high absenteeism (≥6 days).

4.4.3 Presenteeism

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

4.4.4 Relationship between absenteeism and presenteeism

The two measures were weakly correlated (r= -0.14; p=0.03). Categorised data (Table 4-2) showed that approximately 34% (n=85) of patients might be considered as non-concordant i.e. although 13% had high sickness absence, when at work they functioned well; whereas 21% had poor work performance, but had little or no time off work.

Table 4-2 Relationship between absenteeism and presenteeism

	Low presenteeism (SPS-6 score ≥20)	High presenteeism (SPS-6 score ≤19)
Low sickness absence (0 to 5 days)	148 (59.4%)	52 (20.9%)
High sickness absence (≥ 6 days)	33 (13.3%)	16 (6.4%)

4.4.5 Factors associated with absenteeism

There was a tendency for high all-cause absenteeism to be more common among women, ever smokers and those with lower income levels, although none of these trends were statistically significant (Table 4-3). High sickness absence was more common in those with ≥1 comorbidity, and there were positive dose-response relationships with increasing breathlessness (p for trend<0.01); increasing CAT score (poorer quality of life) (p for trend=0.08); increasing airflow obstruction (p for trend=0.38) and increasing number of exacerbations (p for trend<0.01).

Those with a professional occupational background, with occupations which always/usually involved walking/standing and length of employment ≥5 years were more likely to report high levels of absenteeism, although effects were not statistically significant.

There was no apparent relationship between occupational exposures to VGDF or job satisfaction and absenteeism.

After adjustment for covariates, only increasing levels of breathlessness was significantly associated with higher levels of absenteeism (p for trend<0.01) (Table 4-3). No trend was found between absenteeism and airflow obstruction or any other clinical or occupational factors.

4.4.5.1 Additional analyses

Irrespective of the cut-off points used to denote high absenteeism, the overall patterns of associations remained, with increasing dyspnoea being the only statistically significant feature associated with high absenteeism levels. The patterns also remained when considering COPD-related absenteeism, however the relationship with airflow obstruction (severe to very severe adjusted OR=3.92; 95% CI: 1.28-11.99)) and being female (OR=2.16; 95% CI: 1.05-4.45) became statistically significant.

Table 4-3 Association between socio-demographic, clinical and occupational characteristics and risk of high absenteeism among COPD patients

Characteristics	Number (%) with high absenteeism n=54	Unadjusted ORs (95% CI) for risk of high absenteeism	Adjusted 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)	1.39 (0.62 – 3.10)
Age categories			
38 – 49	3 (10.7%)	1.0	1.0
50 – 59	25 (26.9%)	3.06 (0.85 – 11.04)	4.66 (0.88 – 24.75)
60 - 64	11 (17.2%)	1.73 (0.44 – 6.75)	2.20 (0.37 – 12.97)
≥65	15 (17.7%)	1.79 (1.48 – 6.69)	2.91 (0.51 – 16.71)
Smoking status			
Never smoked	2 (10.0%)	1.0	1.0
Ever smoker	50 (21.3%)	2.43 (0.55 – 10.84)	2.33 (0.40 – 13.76)
Education level			
Degree or higher level	10 (23.8%)	1.0	
A level/AS level or equivalent	6 (33.3%)	1.60 (0.48 – 5.37)	
GCSE, CSE, O level or equivalent	12 (16.7%)	0.64 (0.25 – 1.64)	
No formal qualification	19 (24.4%)	1.03 (0.43 – 2.48)	
Gross income (before tax)			
£28081 – £45241>	8 (13.8%)	1.0	
£18721 - £28080	10 (20.8%)	1.64 (0.59 – 4.57)	
£9361 - £18720	10 (15.9%)	1.18 (0.43 – 3.28)	
<£2600 - £9360	13 (25.5%)	2.14 (0.81 – 5.68)	
Prefer not to say	10 (27.0%)	-	
IMD score quintiles			
1	7 (12.1%)	1.0	1.0
2	12 (20.3%)	1.86 (0.68 – 5.12)	1.43 (0.43 – 4.81)
3	13 (22.4%)	2.10 (0.77 – 5.74)	1.72 (0.53 – 5.53)
4	13 (21.1%)	1.94 (0.70 – 5.36)	0.89 (0.25 – 3.24)
5	10 (28.6%)	2.91 (0.99 – 8.56)	2.20 (0.57 – 8.49)
BMI			
Normal (18.5-24.9)	16 (20.8%)	1.0	
Underweight (<18.5)	0 (0%)	0	
Overweight (25 - 30)	25 (23.6%)	1.18 (0.58 – 2.39)	
Obese (30+)	13 (16.7%)	0.77 (0.34 – 1.72)	
Clinical characteristics			
Number of co-morbidities			
0	3 (6.7%)	1.0	1.0
1+	51 (22.7%)	4.10 (1.22 – 13.79)	2.91 (0.74 – 11.41)
Cardiovascular disease	29 (25.7%)	1.92 (1.01 – 3.62)	
Diabetes	5 (19.2%)	0.97 (0.35 – 2.73)	
Gastrointestinal disease	12 (23.5%)	1.32 (0.63 – 2.74)	
Cancer	6 (26.1%)	1.49 (0.55 – 3.99)	

Table 4-3 Association between socio-demographic, clinical and occupational characteristics and risk of high absenteeism among COPD patients (continued)

Characteristics	Number (%) with high absenteeism n=54	Unadjusted ORs (95% CI) for risk of high absenteeism	Adjusted ORs* (95% CI) for risk of high absenteeism
Depression	15 (26.3%)	1.61 (0.80 – 3.23)	
Osteoarthritis	5 (20.0%)	1.01 (0.36 – 2.85)	
Rheumatoid arthritis	3 (21.4%)	1.21 (0.30 – 4.19)	
Allergies (hayfever, eczema and other)	22 (45.8%)	1.38 (0.73 – 2.61)	
MRC Dyspnoea score			
1	13 (15.5%)	1.0	1.0
2	6 (17.5%)	0.44 (0.16 – 1.23)	0.57 (0.17 – 1.88)
3	16 (23.9%)	1.71 (0.76 – 3.87)	2.33 (0.86 – 6.32)
4 - 5	17 (54.8%)	6.63 (2.64 – 16.67)	9.04 (2.85 – 28.68)
CAT score			
Low (high QOL)	7 (14.3%)	1.0	
Medium	25 (23.4%)	1.83 (0.73 – 4.58)	
High	16 (27.5%)	2.27 (0.89 – 6.23)	
Very high (poor QOL)	2 (40.0%)	4.0 (0.56 – 28.40)	
Severity of airflow obstruction (GOLD stage criteria)			
Mild	16 (17.2%)	1.0	1.0
Moderate	27 (20.0%)	1.20 (0.61 – 2.38)	0.89 (0.37 – 2.12)
Severe to very severe	8 (24.2%)	1.54 (0.59 – 4.03)	1.17 (0.36 – 3.80)
Exacerbations in the last 12 months			
0	9 (7.0%)	1.0	
1 – 2	32 (32.7%)	6.46 (2.91 – 14.36)	
3+	11 (36.7%)	7.72 (2.83 – 21.09)	
Occupational characteristics			
Occupational background (SOC 2010)			
Managers, directors and senior officials	7 (21.2%)	1.0	
Professional	9 (26.5%)	1.34 (0.43 – 4.14)	
Associate professional and technical	6 (24.0%)	1.17 (0.34 – 4.06)	
Administrative and secretarial	5 (17.9%)	0.81 (0.23 – 2.90)	
Skilled trade	7 (22.6%)	1.08 (0.33 – 3.54)	
Caring, leisure and other services	5 (17.9%)	0.81 (0.23 – 2.90)	
Sales and customer service	2 (16.7%)	0.74 (0.13 – 4.20)	
Process, plant and machine operatives	5 (15.2%)	0.66 (0.19 – 2.35)	
Elementary	7 (17.1%)	0.76 (0.24 – 2.45)	
Exposures to VGDF			
None	26 (20.8%)	1.0	1.0
Low	16 (18.2%)	0.85 (0.42 – 1.69)	1.15 (0.49 – 2.73)
Medium to high	11 (21.2%)	1.02 (0.46 – 2.26)	1.27 (0.45 – 3.54)
Employment status**			
Employed	11 (23.4%)	1.0	
Self-employed	4 (26.7%)	1.19 (0.33 – 4.28)	

Table 4-3 Association between socio-demographic, clinical and occupational characteristics and risk of high absenteeism among COPD patients (continued)

Characteristics	Number (%) with high absenteeism n=54	Unadjusted ORs (95% CI) for risk of high absenteeism	Adjusted ORs* (95% CI) for risk of high absenteeism
Working hours			
Full time (≥37 hours)	25 (19.2%)	1.0	
Part time (<37 hours)	22 (20.2%)	1.06 (0.56 – 2.01)	
Job involving walking/standing			
Never/rarely	8 (16.7%)	1.0	
Sometimes	13 (19.4%)	1.20 (0.46 – 3.18)	
Usually/always	33 (21.9%)	1.40 (0.60 – 3.28)	
Job involving manual/physical work			
Never/rarely	25 (21.6%)	1.0	
Sometimes	17 (18.9%)	0.85 (0.43 – 1.69)	
Usually/always	12 (20.0%)	0.91 (0.42 – 1.97)	
Job satisfaction score quartiles			
1	11 (19.0%)	1.0	
2	12 (17.1%)	0.88 (0.36 – 2.18)	
3	9 (19.6%)	1.03 (0.39 – 2.77)	
4	12 (22.2%)	1.22 (0.49 – 3.06)	
Training received at work in previous 12m			
0 days to <1 day	27 (18.4%)	1.0	
1 to <2 days	5 (23.8%)	1.39 (0.47 – 4.12)	
2 to <5 days	8 (18.2%)	0.99 (0.41 – 2.36)	
≥5 days	11 (23.4%)	1.36 (0.61 – 3.00)	
Supervise other employees			
No	38 (21.6%)	1.0	
Yes	16 (18.6%)	0.83 (0.43 – 1.59)	
Work pattern			
Regular daytime schedule	43 (22.8%)	1.0	
Regular evening shift	1 (12.5%)	0.49 (0.06 – 4.05)	
Regular night shift	0 (0%)	0	
Rotating shift	5 (17.2%)	0.71 (0.25 – 1.97)	
Another schedule	4 (12.1%)	0.48 (0.16 – 1.41)	
Type of contract			
Permanent	49 (21.5%)	1.0	
Temporary – with no agreed end date	3 (9.4%)	0.38 (0.11 – 1.29)	
Fixed period – with an agreed end date	2 (33.3 %)	1.83 (0.32 – 10.27)	
Length of employment			
< 5 years	10 (17.5%)	1.0	
≥5 years	44 (21.2%)	1.26 (0.59 – 2.69)	

*Adjusted for: age, sex, smoking status, social deprivation (IMD score), number of co-morbidities, MRC score, airflow obstruction and occupational exposures to VGDF

**subset of patients completed information on employment type

4.4.6 Factors associated with presenteeism

In unadjusted analyses, there were non-significant trends towards higher presenteeism (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).

Increasing breathlessness (p for trend<0.01), increasing CAT score (lower QoL (p for trend<0.01) and increasing number of exacerbations (p for trend<0.05) were all associated with poor work performance (Table 4-4).

Patients with an elementary or caring/leisure/other services occupational background were significantly more likely to report poor work performance compared to managers/directors/senior officials. 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).

After adjustment for covariates, increasing breathlessness (p for trend<0.01) and increasing exposures to VGDF (p for trend<0.01) remained independently associated with poor work performance. The presence of co-morbidities and current smokers increased risk of reporting poor work performance, although these effects did not reach significance.

4.4.6.1 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 significant.

Table 4-4 Association between socio-demographic, clinical and occupational characteristics and risk of poor work performance among COPD patients

Characteristics	Number (%) with poor work performance (SPS-6 score ≤19) n=82	Unadjusted ORs (95% CI) for risk of having poorer work performance	Adjusted 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)
Education level			
Degree or higher level	13 (50.0%)	1.0	
A level/AS level or equivalent	3 (20.0%)	0.25 (0.06 – 1.10)	
GCSE, CSE, O level or equivalent	21 (52.5%)	1.11 (0.41 – 2.97)	
No formal qualification	26 (59.1%)	1.44 (0.54 – 3.83)	
Gross income (before tax)			
£28081-£45241+	12 (38.7%)	1.0	
£18721-£28080	17 (60.7%)	2.45 (0.86 – 6.98)	
£9361-£18720	17 (60.7%)	2.45 (0.86 – 6.98)	
<£2600-£9360	20 (52.6%)	1.76 (0.67 – 4.61)	
Prefer not to say	12 (44.4%)	-	
IMD score quintiles			
1	13 (35.1%)	1.0	1.0
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)
BMI			
Normal (18.5-24.9)	24 (48.0%)	1.0	
Underweight (<18.5)	0 (0%)	0	
Overweight (25 - 30)	27 (51.9%)	1.17 (0.54 – 2.54)	
Obese (30+)	28 (54.9%)	1.32 (0.60 – 2.88)	
Clinical characteristics			
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)
Cardiovascular disease	39 (57.4%)	1.70 (0.88 – 3.28)	
Diabetes	6 (42.9%)	0.75 (0.25 – 2.28)	
Gastrointestinal disease	13 (50.0%)	0.97 (0.42 – 2.25)	
Cancer	9 (64.3%)	1.94 (0.62 – 6.10)	

Table 4-4 Association between socio-demographic, clinical and occupational characteristics and risk of poor work performance among COPD patients (continued)

Characteristics	Number (%) with poor work performance (SPS-6 score ≤19) n=82	Unadjusted ORs (95% CI) for risk of having poorer work performance	Adjusted ORs* (95% CI) for risk of having poorer work performance
Depression	15 (57.7%)	1.54 (0.65 – 3.63)	
Osteoarthritis	5 (41.7%)	0.71 (0.22 – 2.37)	
Rheumatoid arthritis	8 (80.0%)	4.58 (0.94 – 22.38)	
Allergies (hayfever, eczema and other)	30 (41.1%)	0.79 (0.38 – 1.68)	
MRC			
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 - 5	23 (92.0%)	16.67 (3.53 – 78.81)	18.11 (2.93 – 112.21)
CAT score			
Low (high QOL)	12 (31.6%)	1.0	
Medium	26 (47.3%)	1.94 (0.82 – 4.61)	
High – very high (poor QOL)	24 (80.0%)	8.67 (0.82 – 4.61)	
Severity of airflow obstruction (GOLD stage criteria)			
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 – very severe	11 (50.0%)	1.22 (0.45 – 3.31)	1.03 (0.26 – 4.09)
Exacerbations in the last 12 months			
0	35 (44.9%)	1.0	
1 – 2	24 (48.0%)	1.13 (0.56 – 2.31)	
3+	18 (78.3%)	4.42 (1.49 – 13.11)	
Occupational characteristics			
Occupational background (SOC 2010)			
Managers, directors and senior officials	6 (33.3%)	1.0	
Professional	9 (47.4%)	1.8 (0.48 – 6.81)	
Associate professional and technical	3 (25.0%)	0.67 (0.13 – 3.41)	
Administrative and secretarial	7 (58.3%)	2.8 (0.62 – 12.67)	
Skilled trade	14 (58.3%)	2.8 (0.78 – 9.99)	
Caring, leisure and other services	14 (70.0%)	4.67 (1.19 – 18.35)	
Sales and customer service	4 (30.8%)	0.89 (0.19 – 4.11)	
Process, plant and machine operatives	8 (57.1%)	2.67 (0.63 – 11.28)	
Elementary	17 (68.0%)	4.25 (1.17 – 15.45)	
Exposures to VGDF			
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 to high	21 (67.7%)	3.34 (1.37 – 8.17)	4.34 (1.26 – 14.93)
Employment status**			
Employed	14 (56.0%)	1.0	
Self-employed	5 (50.0%)	0.96 (0.20 – 4.54)	

Table 4-4 Association between socio-demographic, clinical and occupational characteristics and risk of poor work performance among COPD patients (continued)

Baseline characteristics	Number (%) with poor work performance (SPS-6 score ≤19) n=82	Unadjusted ORs (95% CI) for risk of having poorer work performance	Adjusted ORs* (95% CI) for risk of having poorer work performance
Working hours			
Full time (≥37 hours)	36 (52.2%)	1.0	
Part time (<37 hours)	39 (54.9%)	1.12 (0.57 – 2.17)	
Job involving walking/standing			
Never/rarely	11 (42.3%)	1.0	
Sometimes	18 (46.2%)	1.17 (0.43 – 3.18)	
Usually/always	52 (57.8%)	1.87 (0.77 – 4.51)	
Job involving manual/physical work			
Never/rarely	32 (48.5%)	1.0	
Sometimes	30 (53.6%)	1.23 (0.61 – 2.50)	
Usually/always	19 (57.6%)	1.44 (0.62 – 3.35)	
Job satisfaction score quartiles			
1	18 (60.0%)	1.0	
2	19 (47.5%)	0.60 (0.23 – 1.57)	
3	16 (66.7%)	1.33 (0.44 – 4.09)	
4	22 (51.2%)	0.70 (0.27 – 1.80)	
Training received at work in previous 12m			
0 days to <1 day	41 (48.8%)	1.0	
1 to <2 days	7 (70.0%)	2.45 (0.59 – 10.11)	
2 to <5 days	20 (64.5%)	1.91 (0.81 – 4.47)	
≥5 days	13 (50.0%)	1.05 (0.44 – 2.53)	
Supervise other employees			
No	52 (51.5%)	1.0	
Yes	28 (52.8%)	1.06 (0.54 – 2.05)	
Work pattern			
Regular daytime schedule	62 (54.4%)	1.0	
Regular evening shift	3 (50.0%)	0.84 (0.16 – 4.33)	
Regular night shift	0 (0%)	0	
Rotating shift	5 (45.5%)	0.70 (0.20 – 2.42)	
Another schedule	10 (52.6%)	0.93 (0.35 – 2.47)	
Type of contract			
Permanent	69 (52.3%)	1.0	
Temporary – with no agreed end date	9 (47.4%)	0.82 (0.32 – 2.15)	
Fixed period – with an agreed end date	3 (75.0%)	2.74 (0.28 – 27.02)	
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)

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

**subset of patients completed information on employment type

4.5 Discussion

4.5.1 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 patients (17.6%) reporting ≥6 days sickness absence over the previous 12 months. Whilst absenteeism was high, we found low presenteeism rates, suggesting that when at work, COPD patients are generally functioning well.

Both absenteeism and presenteeism were more common with greater levels of self-reported breathlessness. Although there was no significant association with other socio-demographic or clinical characteristics and all-cause absenteeism, being female and increased severity of airflow obstruction were additional factors associated with COPD related sickness absence. Occupational related factors were not associated with absenteeism, whereas there was a clear association between higher exposures to VGDF and greater presenteeism.

A large number of patients (~35%) reported only high absenteeism or high presenteeism; demonstrating the importance of using both outcome measures in identifying patients with poor work productivity.

4.5.2 Findings in relation to other studies

The finding that on average, patients with COPD had taken 10.4 days sick leave in the previous 12 months (compared with the national average of 4.4 days[125]), is in keeping with findings from other studies that show that patients with COPD have higher rates of absenteeism.[107;108;111;112;116;164]

Conversely, the results of this study indicate that on average, COPD in the primary care population has little impact on work performance when comparing the average SPS-6 presenteeism score (mean (SD) 23.5 (5.0)) to employees reporting no disability (mean score (SD): 23.5 (3.8)),[93] those with arthritis (mean SPS-6 score (SD) 13.3 (5.2))[191] and employees within the medical profession (mean SPS-6 score: 17.3).[192] Furthermore, data among those with cystic fibrosis suggests other respiratory disease has little impact on work performance (mean SPS-6 score 25.1).[193]

However, patients with more severe dyspnoea do experience more presenteeism. The observed relationship between increasing dyspnoea and absenteeism and presenteeism confirm similar findings reported in a large international cross-sectional survey.[22] Although there are conflicting results from other studies on the association between airflow obstruction and absenteeism,[118;152;158;160-162;165] our findings confirm a significant relationship between increasing airflow obstruction and COPD related absenteeism, but not all-cause absenteeism.

Other studies have reported that the presence of co-morbidities and smoking are associated with poor work productivity in the general population,[116;186;194-196] in those with health conditions[194;197-199] and amongst patients with COPD.[119;200] Whilst both absenteeism and presenteeism findings showed similar trends, the results were not statistically significant.

Clear associations between exposure to VGDF and absenteeism (respiratory related) 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).[201] This was not observed in this 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) have been shown to be associated with work productivity in other studies.[121-123] These associations were not observed in this sample, possibly due to the limited sample size, or the cross-sectional nature of the study.

Research suggests that although there is a strong association between sickness absence and presenteeism, presenteeism may be a stronger predictor of poor health compared to absenteeism,[121] and therefore, may better measure the health of employees; lending to suggest that the two measure different facets of work productivity. However, within this emerging field of research, confusingly the terms presenteeism (measure of work performance) and sickness presenteeism (work attendance when ill) have been used inter-changeably.[121;202-204] This, in addition to the heterogeneous evidence (e.g. various instruments measuring presenteeism) and varying definitions of presenteeism, reduces the clarity of the relationship between the two measures. This analysis demonstrated that although there is a correlation between absenteeism and presenteeism, measuring absenteeism alone does not capture all patients with high presenteeism; approximately 1/5 of patients had poor work performance but there was limited impact on sickness absence.

4.5.3 Strengths and limitations

This is the first study internationally to assess the impact of COPD on work productivity in a primary care population mainly with mild to moderate COPD, and to assess factors that contribute to poor work performance. Participants included those from a wide range of backgrounds and occupations, with mainly mild to moderate COPD. The study also has limitations. There were a high number of never smokers in this group of patients; hence, other respiratory conditions within this population, such as chronic asthma, cannot be excluded. The cross-sectional nature precludes the ability to draw inferences on causality. Whilst compared to other studies, this study included a large sample of patients, the wide confidence intervals for a number of estimates indicate that there was insufficient power to clarify associations. For example, whilst there was a trend towards poorer work productivity among those with a greater number of co-morbidities or lifestyle behaviours (smoking), the relationships were not statistically significant. Factors such as income and exacerbations (absenteeism model only) were important in the unadjusted analyses, however, as they are susceptible to reverse causation they were not included in the fully adjusted models.

Sickness absence rates were based on self-report; which are susceptible to under-reporting due to recall error[205] and social desirability bias[84]; hence, the effect estimates may not accurately reflect the true impact of COPD on absenteeism. Some other covariates were also based on self-report e.g. number of co-morbidities; possibly introducing errors in prevalence rates and diluting the findings. Additionally, there was a low response rate for number of days off work and some other measures (e.g. smoking status and job satisfaction), which may have led to less reliable estimates. Evidence suggests that employment type (employed/self-employed) is associated with sickness absence,[125;203] however this measure was only completed in a subset of patients and therefore had limited power in the final analyses.

4.5.4 Implications for practice and research

Some important and potentially modifiable clinical differences were identified. Firstly, breathlessness was identified in both analyses. It is therefore suggested to healthcare professionals to work alongside patients and focus on improving the management of breathlessness in COPD working patients. The UK NICE guidelines for COPD provide guidance for healthcare professionals on the management of breathlessness.[25] In the workplace, patients may want to consider assessing aspects of their job role which may exacerbate their breathlessness, for example tasks involving lifting and bending. It may be beneficial to conduct this assessment with occupational health (OH) services, who are better equipped to provide solutions to symptom management. OH services may also consider oxygen therapy; which may play a role in reducing breathlessness amongst patients who experience desaturation on physical activity.

Increasing exposures to VGDF was the second modifiable factor we identified; it is suggested that employees undergo an OH assessment to determine the level of exposure to VGDF in their working environment. OH services can advise accordingly on how those in jobs with exposures to VGDF may be able to modify their job role, job tasks or working environment to reduce exposure. It is suggested for all employees to receive an occupational risk assessment and potentially benefit from reductions in workplace exposures to VGDF.

Additionally, it is suggested that healthcare professionals identify current smokers and provide clear guidance on the benefits of smoking cessation, and the various options available. This advice would help patients manage their breathlessness and prevent the occurrence of exacerbations.

There is a need for prospective longitudinal studies to establish the temporal relationships between disease severity, occupational exposures to VGDF and work productivity. Further research to determine the effectiveness of managing breathlessness and reducing workplace exposures on the work productivity among patients with COPD is also recommended.

There is a risk of misinterpreting populations to have better health when assessing the impact on sickness absence alone.[121] Furthermore, presenteeism may be more costly to employers than absenteeism alone,[86;186] and so it is suggested that future research assesses the impact on presenteeism in addition to absenteeism for a holistic assessment of the effect on work productivity.

In conclusion, patients with COPD are affected in the working environment and on average, take more time off work in a year than the general population. We found a number of modifiable factors associated with poorer work productivity and therefore it is suggested that future interventions focus on improving the management of breathlessness and reducing workplace exposures to VGDF to help improve sickness absence rates and work performance in those with COPD.

5. FEASIBILITY OF DELIVERING AN OCCUPATIONAL HEALTH INTERVENTION AIMED AT IMPROVING WORK PRODUCTIVITY, AMONG WORKING COPD PATIENTS

5.1 Abstract

Background There is evidence that COPD patients have poorer working outcomes than those without COPD. Occupational health (OH) interventions have been effective in improving work productivity in other chronic conditions. However, little is known about the feasibility and acceptability of such interventions among those with COPD.

Methods Nested within a primary care COPD cohort (n=1889), the study included all those who were in work (n=309). Eligible patients were invited for an assessment with an OH practitioner. The aim was to explore and identify workplace factors that may contribute to their work performance or exacerbate their condition, and to suggest approaches to minimise any respiratory symptoms and improve work capability. Patient’s self-management practices were also assessed. Recommendations were sent to the patient, and with their permission, to their GP and employer. Qualitative interviews (n=19) were conducted to explore the acceptability of the intervention among those who took part in the study as well as those who did not.

Results Of those eligible, 35 (11.3%) agreed to take part, 109 (35.3%) declined and 153 (49.5%) did not respond. Barriers to taking part in the study included: patients

reporting they are fine at work; lack of time; concern about employer involvement; travel/distance to assessment and negative patient perceptions or attitudes towards COPD. Most (80.0%) participating patients received OH recommendations and all received self-management recommendations. The most common OH recommendations included modifications to job tasks/work methods/physical aspects of the job and to seek OH advice and education. However, only half reported to be likely to take up the OH recommendations. Qualitative interviews were conducted in those taking part in the intervention as well as those who did not; in which the acceptability of the intervention was explored and future considerations for OH assessments were discussed.

Conclusions This is the first study to assess the feasibility of delivering an OH intervention to patients with COPD working in diverse occupations. Uptake rates were very low. Although modifiable factors in the work environment that could improve their symptoms and condition were identified for the majority who were assessed, only half would be likely to take these up. The current format of the study was identified as unsuccessful; however from the results we are able to provide direction for future interventions to encourage an improved uptake rate and a holistic management of working COPD patients.

5.2 Background

5.2.1 COPD and work

There is increasing evidence that being in work is good for physical and mental health and wellbeing.[1] Being in work provides a feeling of self-worth[1] and has economic advantages for both the individual and society. In contrast, being out of work may be harmful with increased risk of premature mortality and poorer mental health outcomes.[3;206] Similarly, following illness or disability, there is evidence that remaining in or returning to work is therapeutic, promotes recovery and rehabilitation and is associated with better health outcomes for patients.[2;10] However, despite the beneficial impacts of working on health, as discussed in the preceding chapters, COPD affects a number of work-related outcomes, including employment, absenteeism and presenteeism.

5.2.2 Government intervention to improve work-related outcomes

In 2008, the Black report – focusing on tackling work-related issues (e.g. sickness absence and return to work) among the working age population – challenged prevalent views that “it is inappropriate to be at work unless 100% fit and that being at work normally impedes recovery”.[1] It recognised that an all-inclusive shift in attitude is required among employees, employers and GPs; focussing on what the individual is able to do as opposed to what they are unable to do.[1;10] GPs are usually the first point of contact for those who are unwell, and they often act as the gatekeepers to incapacity benefits.[207] However, they often feel “ill-equipped” to offer work-related advice.[1]

The Government's response to this report included setting out a plan to change perspectives on 'health and work', which included the introduction of the fit note (from the former sick note): promoting the idea that "being in work is good for health" by helping GPs switch their focus to the individual's capacity,[10] helping to improve communication between all stakeholders and promoting workplace adaptions. The strategy also incorporated a National Education Programme for GPs to address the concerns of GPs by helping to improve their knowledge, confidence and skills for work-related advice.[10] Subsequent to the introduction of the fit note, in 2010, some promising outcomes have been noted which include positive GP attitudes and improved GP consultations for patients.[208] There are also suggestive trends of an increase in GPs providing advice for workplace adjustments as well as reductions in certified sickness absence (although not all were significant).[209]

Whilst there is increasing research to test methods of improving employment outcomes, a gap remains in the evidence on how remaining or returning to work maybe best achieved. Thus, there is a need for studies to assess the effectiveness of interventions aimed at improving work related outcomes[1] so that successful interventions based on well-evaluated and robust evidence can be provided to the working age population.[10]

5.2.3 Occupational health interventions and interventions to improve work related outcomes among patients with COPD and those with chronic disease

Given the impacts of COPD on work and work performance, occupational interventions aimed at working COPD patients need to address a number of aspects, focusing on improving work capacity and better planning of ill health retirement. As patients are at risk of hospitalisation due to COPD exacerbations, interventions should also accommodate the possibility of return to work (RTW) which may need to be phased.

Currently there are no UK occupational programmes focusing on improving poor work performance for patients with COPD. Furthermore, there is a scarcity of research about workplace interventions among working COPD patients. The limited research that has been undertaken focuses on particular work settings and how to improve work performance in all employees (including those with COPD), rather than taking a COPD disease focus and considering common features that impact on work in a variety of workplaces.

The evaluation of a workplace intervention across four factories in Sweden, suggested some promising results.[210] A workplace intervention, comprising of screening, individual feedback and generic self-management advice, targeting those with a range of chronic problems, including COPD was implemented. People with COPD were offered a clinical examination by occupational health (OH) services, including spirometry and if appropriate, advice on smoking cessation and referral to rehabilitation and treatment for symptoms. Over three years, they observed a reduction in smoking rates and an improvement in HRQoL among employees in the intervention factories, compared to employees in a control company, and some reduction in sickness absence. However, the intervention was not targeted at only those with COPD, and it is not clear whether the benefits were different for particular disease groups. Furthermore, the study was confined to a limited number of workplaces which included predominantly male middle aged, blue collar workers, and therefore may not be representative of a COPD working population.

There are examples of interventions to improve work performance in other chronic conditions. Occupational intervention studies have been undertaken in relation to musculoskeletal disorders,[211] neck pain[212] or after a major event such as a myocardial infarction[213;214] or cancer.[215;216] Systematic literature reviews and randomised controlled trials in these areas identified some evidence of benefit with respect to the effect on work outcomes. However, intervention components and methods varied widely and some were specific to the particular chronic condition. Results from studies were also variable, with conflicting evidence about whether interventions were effective in improving occupational performance. For example, a systematic review assessing workplace interventions to reduce work disability among sick-listed employees found workplace interventions were more effective in improving time until first return to work among those with musculoskeletal disorders, but did not show a considerable effect among those with mental health conditions.[211] In cancer patients, multidisciplinary multi-component interventions have been shown to be more effective in improving return to work rates, compared to psychological, physical activity or medical interventions.[215]

However, a number of common characteristics from successful interventions were identified to be effective in both reducing sickness absence rates and improving RTW outcomes. First, multi-component interventions (including, for example, self-management education and workplace adaptations) were consistently shown to be more effective than single component interventions.[211;215-217]

Another important component included an all-inclusive multi-disciplinary approach (e.g. involving employee, employer, supervisor and health care professional) and carrying out an individualised assessment of the patient.[211;215;217] This is particularly evident from Schandelmaier et al's[217] systematic review and meta-analysis, where return to work co-ordination programmes (involving a co-ordinator/team who co-ordinates relevant services and communication among all involved stakeholders) showed a consistent positive benefit on working outcomes despite the heterogeneity between intervention components.

Self-management, as part of a multi-disciplinary intervention, through encouragement of physical activity (only in some studies, where relevant to the disease), and education about the disease appeared to be important components, particularly among cancer patients.[215;216] A promising component related to the method of patient education, was addressing the negative health beliefs and illness perceptions of patients; leading to improved RTW rates in myocardial infarction patients.[213]

Occupational assessments, which might include assessing the work, working conditions and work environment and identifying barriers for returning to work were identified as possible important components but not always addressed in research.[213;215;216] Ergonomic modifications were particularly important for patients with cancer, musculoskeletal disorders and neck pain,[211;212;215;216] although these types of interventions may have limited relevance for working COPD patients. However, an important overarching theme identified from the literature was the need to address work related issues, such as assessment of the environment and workplace accommodations (shift hours, modified work tasks). OH services support and improved communication between employer and health professionals was also identified as important, but often deficient in many studies.[212;213;215;216]

Chronic conditions which may affect work capability in a similar way to COPD include diabetes and asthma. There is some evidence that health promotion interventions improve occupational outcomes for diabetic patients,[218;219] but there are few studies of specific occupational interventions in this patient group. Among the few available studies, the main focus of interventions was education about the disease and self-management with an aim to improve diet and physical activity. In one RCT, disability days and working days lost were significantly reduced in the intervention group compared to the control group, perhaps mediated by the weight loss achieved by the participants.[219] From the occupational health perspective, little attention has been given within UK national guidance on approaches to managing diabetes in the workplace,[220] although information from other sources focuses on conducting risk assessments (such as risk of hypoglycaemic episodes) and assessing fitness for work (e.g. if job tasks can be carried out by the patient safely) in this patient group.[221;222] Recommendations about specific workplace adjustments for diabetic patients appear to be scarce. For asthmatics, a number of workplace asthmagens have been identified which may lead to worsening of symptoms, and guidelines advise avoidance of such exposures.[223]

One randomised controlled trial assessed the impact of a self-management intervention on work absenteeism among individuals with asthma.[224] Patients were recruited from outpatient clinics. The intervention included individual patient education by specialist trained nurses, and physio-therapeutic counselling (breathing and relaxation techniques and daily peak flow monitoring) by physiotherapists. The study showed a significant reduction in work absence among the intervention compared to the control group (relative risk=0.47; 95% CI 0.24 – 0.92), suggesting that individualised education with a multidisciplinary approach to empower patients about their condition may increase work productivity.[224]

Summary: From the available evidence, it appears that few interventions assess patients holistically in the work environment. This is important to consider, as a number of factors which are disease, as well as non-disease related, may affect an individual's ability to work. Promising intervention components appear to be: a multi-disciplinary approach; promotion of self-management; considering the effect of the work/work environment on disease (workplace triggers); and remediation of any factors identified.

5.2.4 The impact of COPD on work related outcomes

As discussed in chapter 1, a number of factors may affect work performance among people with COPD. These include the presence of symptoms (e.g. breathlessness, fatigue), workplace exposures, poor self-management and the complexities associated with managing co-morbidities alongside COPD. These factors may impact on work performance in a variety of ways, such as patients avoiding certain work tasks, working at a reduced pace or sickness absence induced by the aggravation of symptoms.

Findings from the cross sectional analyses (chapter 3 and chapter 4) identified two important factors affecting work related outcomes among patients with COPD. Firstly, increased breathlessness was significantly associated with lower employment, higher absenteeism and presenteeism. Furthermore, those with high exposures to vapours, gases, dusts and fumes (VGDF) in the workplace were less likely to be in work and were more likely to experience presenteeism.

Thus, interventions aiming to improve work productivity among COPD patients need to focus on reducing breathlessness and workplace exposures to VGDF.

5.3 Aim and rationale for this study

The aim of this study was to assess the feasibility and acceptability of an occupational health assessment (focussing on exploring how the patient's work may impact their lung health) and identification of a suitable personalised intervention(s) aimed at improving work productivity, among patients with COPD who are in work. The approach developed and used in this study was unique, in that patients were approached based on their COPD diagnosis, rather than using a specific workplace or workplace exposure(s) to identify them.

5.4 Study objectives

A number of objectives were set:

<u>Feasibility of an OH assessment</u>

1. To assess the feasibility of identification of patients
2. To assess the feasibility of delivering an occupational health assessment among patient with COPD and their employers
3. To assess the acceptability of undertaking an occupational health assessment among working COPD patients

<u>Nature and applicability of the recommendations</u>

4. To assess the range and type of recommendations and workplace adjustments identified through an occupational health assessment for patients with COPD

5. To explore the facilitators and barriers to engagement with any recommendations arising from the occupational health assessment amongst employers and COPD patients
6. To assess the acceptability of the identified recommendations and identify barriers towards implementation (involving: patients, employers and the patient's GP)

Measuring the impact of the recommendations

7. To gain an initial assessment of the effect of the occupational health intervention on workability (e.g. presenteeism and absenteeism)
8. To assess the feasibility of a range of outcome measures that could be used for a future trial

5.5 Methods

5.5.1 Study setting and participants

The 3-year Birmingham COPD Cohort study[169] recruited COPD patients (n=1889) from 71 GP practices within the West Midlands, UK, between June 2012 and July 2014. Cohort patients consisted of those with an existing COPD diagnosis (from the GP COPD register) as well as those who were newly identified to have COPD through a related case-finding RCT.[170] A number of clinical and physiological measures were carried out at baseline. Patients also completed questionnaires at 6 monthly intervals and returned for a 3 year face-to face assessment.

This COPE (COPD Occupation and work PErformance) feasibility study – an OH intervention among working COPD patients – was nested within the Birmingham COPD Cohort study, and is the study which is presented in this chapter.

The COPE study was undertaken from April 2014 to April 2015. Patient OH visits (intervention) took place at the University of Birmingham from May to October 2014, the qualitative interviews were conducted between November 2014 and February 2015 and follow-up data were collected 6 months post OH assessment.

5.5.2 Identification of eligible patients

The questionnaires completed at baseline and at 6-monthly intervals in the cohort study included occupational measures: patient's current working status, sickness absence and work performance. All patients identified to be in employment in April 2014 were eligible for the COPE feasibility study. This was determined using their most recent questionnaire data.

5.5.3 Measures of employment, absenteeism and work performance

Employment status: Data on employment status was collected at baseline (research assistant administered questionnaire); patients self-reported whether they were in any current paid employment (full-time or part-time). Any changes to employment status were captured in the 6-monthly postal questionnaires.

COPD related sickness absence: At baseline, patients self-reported any time taken off work in the previous 12 months, the duration and the reason for sickness absence (i.e. respiratory related, other health problems or other reasons). Patients in work were also provided daily diary cards to complete, and return monthly; this involved daily documentation of respiratory symptoms and work attendance/absence. Reasons for any work absences were provided (i.e. holiday, respiratory related, other health problems, scheduled time off or other reasons).

Presenteeism: The Stanford Presenteeism Scale (SPS-6) was used to assess the impact of the patient's "chest problems" on their work performance over the previous month at baseline.[93] The scale generates scores between 6 and 30, with a lower score indicating poorer work performance (high presenteeism) due to COPD.[93]

5.5.4 Inviting eligible patients

Initially, those whose work performance was most affected were invited to take part. To assess this, a combination of measures were used: baseline sickness absence (over previous 12 months), baseline presenteeism (SPS-6 questionnaire) and prospective sickness absence (using daily diary card data). This involved inviting patients with: 1 or more days per year sickness absenteeism for lung disease or, 1 or more days off due to lung disease as collected prospectively from daily diary cards or a low presenteeism score. A low presenteeism score was defined based on a score below the lowest quartile in the sample.

Invitations were initially ordered, so that those further down the list would only be invited if the initial groups declined. However, due to the low response rates all cohort working patients were eventually invited.

Patients who had died, withdrawn their participation from the cohort study or expressed not to be contacted regarding other studies related to the Birmingham COPD Cohort study were not included.

5.5.5 Patient recruitment

Eligible patients were sent a patient information sheet (PIS) (appendix 1) with a reply slip (appendix 2), detailing the patient's interest in taking part (yes/no) with the opportunity to select from an available list or comment about their personal reason for declining participation. Those that did not reply within 2 to 3 weeks were sent a reminder which included a one-page brief summary letter (appendix 3) of the COPE feasibility study in addition to the PIS.

Participants who consented were contacted by the researcher (KK) to discuss the study in more detail and to arrange an appointment at the University to meet with the occupational health (OH) practitioner for an OH assessment. Travel costs for all patients were covered by the research team.

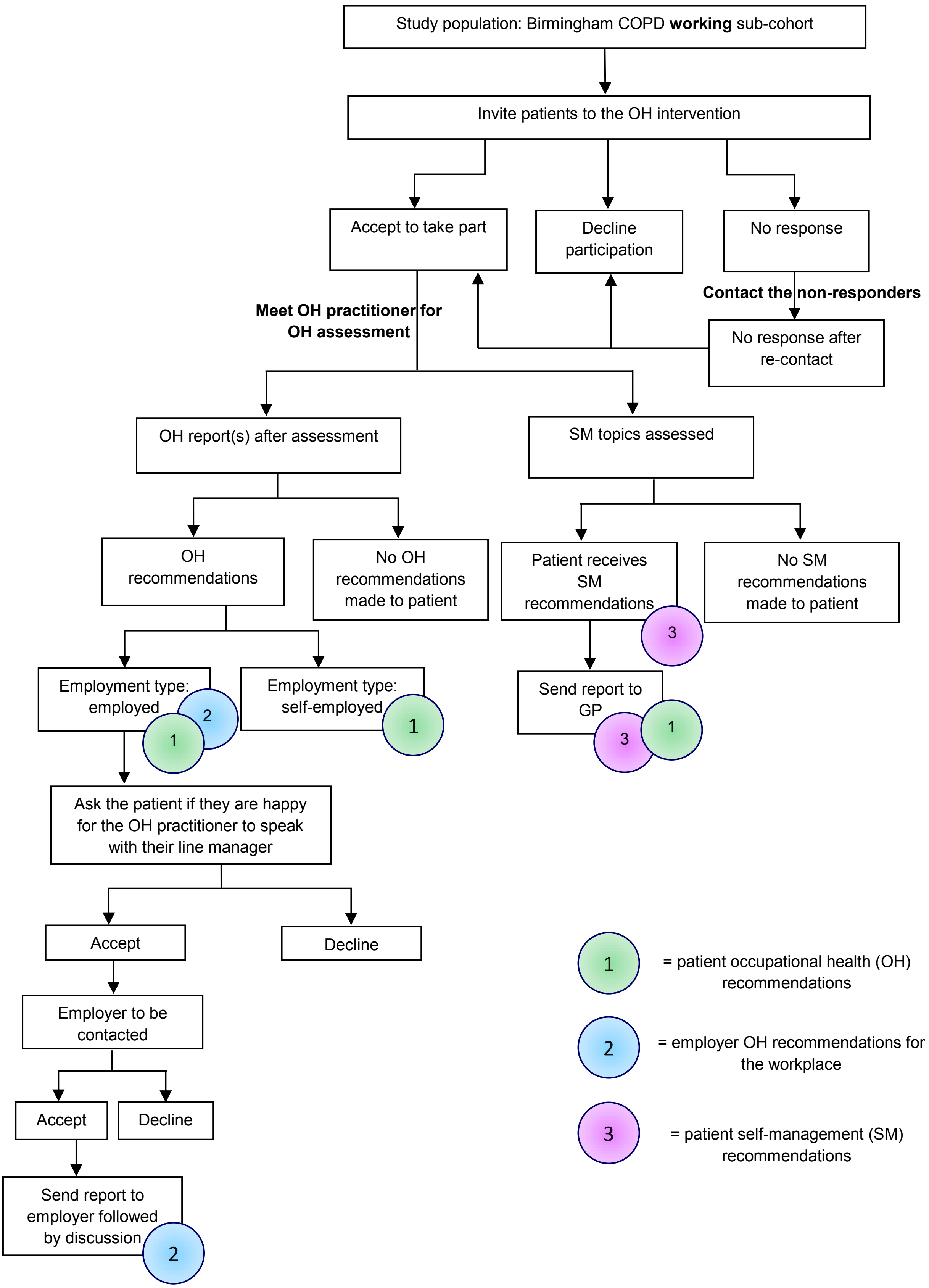
5.5.6 Sample size

As this was a feasibility study, no formal sample size calculations were conducted. Instead, a pragmatic approach was taken with the aim of recruiting up to 60 patients.

5.5.7 Intervention

The intervention consisted of an occupational health assessment, a COPD self-management assessment and the generation of a number of reports with recommendations (related to these assessments) (Figure 5-1).

Figure 5-1 Occupational health intervention participant flow



5.5.7.1 The OH assessment

Participants attending the OH assessment were met by the researcher (KK) and seen by the OH practitioner for ~60 minute assessment of the patient's work and workplace, with the aim of identifying any potential modifications which could improve their work performance/capability.

Advice from the OH practitioner (with >20 years OH experience) about generic OH assessments was used to develop a semi-structured tool to standardise the OH assessments (see appendix 4); focusing on factors which may exacerbate the symptoms of a COPD patient within their working environment. As a result, the following areas were explored when assessing patients:

1. Nature of the job and industry (e.g. tasks, work hours, shift pattern, exposure to airborne chemical pollutants, work load, wearing respirators)
2. Issues with managing their condition in the workplace (e.g. workplace triggers that exacerbate symptoms)
3. Work environment (e.g. working in cold environments)
4. Work practices (e.g. ergonomics, manual handling, physical nature of the job)
5. Barriers to completing tasks (e.g. fatigue, breathlessness)
6. Access to occupational health services and reporting of symptoms

5.5.7.2 Self-management assessment

The NICE COPD self-management guidelines[25] were used as a framework to assess the patient's reported practices and identify areas for greater attention. This involved assessing 8 areas of self-management (Table 5-1) using the patient's responses from the previously administered Birmingham COPD Cohort questionnaires.

Table 5-1 Self-management advice areas based on NICE recommendations

NICE recommendations[25]	Questions assessed within the cohort questionnaires	Response to question, triggering self-management advice	Self-management advice inserted in the recommendation letter to the patient*
Smoking cessation advice	Do you still smoke now?	Yes	"Support to help you with smoking cessation"
Adherence to current therapy	Do you try to take your inhalers or medicines exactly as you have been instructed by a doctor or nurse? Sometimes people don't take their medications exactly as prescribed. For each statement, please rate to what extent they apply to you:	No to any statement	"Support with taking inhalers regularly"
Referral to pulmonary rehabilitation if functionally disabled by COPD (MRC $\geq$ 3) or recent hospital admission	In the last 12 months have you been admitted to hospital for your lung problems? During the last 12 months did you ever attend casualty or A&E for your lung problems? MRC score	Yes to either question or MRC $\geq$ 3	"Referral for pulmonary rehabilitation"
Infection control measures	Have you received the flu jab in the last 12 months?	No	"Ensuring you have flu vaccination next autumn"
Managing exacerbations	Have you been given written advice on what to do if your symptoms get worse?	No	"A plan for what to do when your symptoms get worse"
Stress management	In the past 2 weeks, have you been bothered by: 1. Little interest or pleasure in doing things 2. Feeling down, depressed or hopeless	Yes to either statement	"Approaches for managing stress"
Dietetic assessment	BMI	BMI $\geq$ 25	"Referral to a dietician"
Exercise	Have you been told by a doctor or nurse to try to do some physical activity? Report the amount of physical activity the patient does (data taken from the International Physical Activity Questionnaire (IPAQ))	No to question or if patient reports reduced activity levels	"Approaches to support you doing more physical activity"

* Patients are advised that their self-management practices have been considered based on their responses to questions from the cohort questionnaires, in relation to the recommendations for self-management of COPD in the national guidelines (National Institute for Health and Clinical Excellence). Patients are also advised that the self-management recommendations highlighted in their report should be discussed with their GP or practice nurse at their next appointment.

5.5.7.3 The reports

Potentially, there was a maximum of three reports produced following each patient assessment: the patient report, employer report and GP report (Figure 5-1).

Individualised report for patient

The information from the OH assessment was used by the OH practitioner to make OH recommendations on the following six areas: (1) avoiding substances/materials (2) modification of job tasks/methods/physical aspects of the job (3) modifications of the work environment (4) modifications to the work organisation (5) use of personal protective equipment (PPE) and (6) referral to OH services and education.

The researcher (KK) produced an individualised report for each patient combining the occupational health and self-management recommendations. Example reports for 2 patients can be found in appendix 5.

To further encourage optimum self-management, each patient was provided a British Lung Foundation patient information leaflet (COPD: living with chronic obstructive pulmonary disease), which provided simple guidance in an easy to read format (appendix 6).

Recommendations for the employer/line manager/health and safety officer

A second report – generic workplace recommendations for the patient's employer – was first provided to patients who consented to receive this report; offering them with the opportunity to make an informed decision before employer involvement in the study (see appendix 7 for example report). The report aimed to provide employers with suggestions on the possible changes which could be made within the workplace to promote the wellbeing of their workforce; particularly focusing on those with respiratory symptoms. Employees remained anonymous within this report.

Patients were asked at the follow-up telephone call (~3 weeks after posting the report(s)), whether they would consent to involve their employer. Of those agreeing, invitation letters (appendix 8) were sent to their employers for participation in the COPE study. The generic OH report was sent to the employers who agreed to participate.

Recommendations report for the GP

A copy of the patient's report (containing OH and self-management recommendations) was sent to the patient's GP for those consenting to this. It was anticipated that the self-management recommendations would be explored by the patient in consultation with their GP; highlighting potential areas for the GP to help the patient achieve better management of their disease and symptoms.

5.5.8 Outcome measures

5.5.8.1 Primary outcome measures

The main aim of the study was to assess the feasibility and acceptability of the intervention, which included: determining the OHI uptake rates; assessing the reasons for declining participation; assessing the range of recommendations; assessing the likelihood of the uptake of the OH recommendations; exploring the patient's reasons for not implementing the recommendations; determining the employer uptake rates; exploring the employer's reasons for declining the workplace recommendations and uptake of the workplace adaptations recommendations by the employer (~ 3 month follow-up). The following measures were therefore used:

Patient satisfaction questionnaire: A semi-structured questionnaire (appendix 9) was administered over the telephone, ~3 weeks subsequent to sending the patient's report(s). The first part of the questionnaire was developed using questions from the Royal College of General Practitioners patient satisfaction questionnaire.[225] The latter half involved assessing the usefulness and potential barriers to implementation of each recommendation suggested by the OH practitioner. Patients were asked the following questions for each recommendation they received:

1. Would this recommendation help other individuals with COPD who do a similar job as your current job?
2. Would this recommendation help you to manage your COPD at work?
3. Are you likely to implement the proposed recommendation at work? If not, why not?

Employer feedback: Among the employers who agreed to take part in COPE, a follow-up telephone call was planned to discuss the generic OH recommendations for the workplace, to determine the usefulness of the suggestions and potential barriers to implementing the recommendation.

Patient interviews: There are various functions of qualitative research, which include: 1) contextual, describing the nature of what exists, 2) explanatory, assessing associations between what exists, 3) evaluative, appraisal of the effectiveness of what exists, and 4) generative, developing theories, strategies or actions.[226] It is concerned with experiences of people and the meanings related to these experiences, and therefore "generally deals with talk or words rather than numbers".[227(p3)] Thus, as qualitative research considers a dimension which often cannot be explored by quantitative research, it was used to explore in greater detail the patient's views and experiences.

A purposive sample of patients who took part in the OH intervention (aiming for up to 15) were invited to take part in semi-structured interviews to explore their experiences of the occupational health intervention, its relevance and the interaction between COPD and work. Interviews were conducted approximately 3 months after attending the OH assessment. Up to five patients who declined or did not respond to taking part in the feasibility study were also invited to explore their reasons for declining. Participants were chosen to include a wide range of patients according to their socio-demographic, occupational and clinical characteristics and range of OH recommendations. The interview schedule involved a number of key areas to be explored with the patient: 1) factors affecting participation in the research study, 2) experience and feedback on the OH intervention, 3) health at work and 4) self-management and COPD annual reviews (see appendix 10 and 11 for the interview schedules). Interview questions were modified based on previous interviews and patient responses. Interviews took place either at the patient's home or by telephone, based on patient preference. All interviews were audio-recorded and transcribed verbatim using Microsoft Word by an administrative assisant. Eventual sample size for the qualitative interviews was determined by reaching data saturation – where no new concepts arise from the data.[228]

5.5.8.2 Other outcome measures

Questionnaires were administered pre and post intervention and we assessed scores of the following quantitative outcome data:

- Respiratory symptoms: from the St George's respiratory questionnaire (SGRQ-C)[229]
- Symptom impact on quality of life: from the COPD Assessment Test (CAT)[173]
- Work productivity: based on sickness absence over previous 6 months (absenteeism) and the Stanford Presenteeism Scale-6[93] (presenteeism)

GP feedback: GPs of the patients who participated in COPE were contacted to conduct a short semi-structured telephone interview to explore the usefulness of the OH and self-management recommendations in managing COPD patients (see appendix 12 for brief interview schedule).

5.5.9 Data analysis

This was a mixed methods study. The quantitative data involved descriptive statistics and was undertaken in STATA 13.0.

Qualitative interviews: The role of the researcher (KK) was consistently considered (reflexivity) for all interviews. Patients were informed by the researcher (KK), prior to the interview, that a non-judgemental approach would be adopted throughout the interview. This was maintained throughout the interviews to encourage patients to feel comfortable about expressing their opinions.

A rapport had been established with most of the interview participants (those attending the OH visit). For those that did not participate, the researcher (KK) devoted time to develop a rapport prior to commencing the telephone interview. Developing a rapport was important to consider so that patients felt encouraged to be open about sharing their opinions, particularly with sensitive topic areas such as their working environment and their employer.

Data were analysed using the thematic analysis approach: a commonly used approach in health research which "groups the data into themes, and examines all cases in the study to make sure that all manifestations of each theme have been accounted for and compared".[227(p69)] Thematic analysis was undertaken by the researcher (KK). Independently, both supervisors and a qualitative researcher assessed two transcripts (with rich data) for emerging themes and compared the findings with the main researcher's (KK) developed themes.

5.5.10 Ethical approval and informed consent

Ethical approval was obtained from the NRES (National Research Ethics Service) Committee West Midlands – Edgbaston. Written informed consent was obtained from patients after a full explanation of the study (appendix 13). Patients participating in the qualitative interviews were provided with a patient information sheet (appendix 14 and 15) prior to their telephone interview. At the time of interview, the researcher (KK) provided each patient with a full explanation of the interview and an opportunity to ask any questions. The consent form (appendix 16) was read out over the telephone, signed and dated by the researcher (KK) and then posted to the patient with instructions on completing the form.

5.6 Results

5.6.1 The COPE feasibility study uptake rates

Initially, 109 patients were contacted to take part in the feasibility study; of whom 19 (17.4%) consented. In response to these low uptake rates, the patient selection strategy was adjusted – inviting all working patients (n=309). Uptake rates remained low (Figure 5-2), and among the 44 patients (14.2%) who agreed to take part, only 35 (overall uptake rate: 11.3%) were translated in to a patient visit. The majority of patients either declined participation (n=109; 35.3%) or did not respond (n=152; 49.2%) to the invitation letter.

5.6.2 Reasons for declining participation

All patients who responded provided a reason for declining participation by either choosing one of the available options on the reply slip or by writing in the free text area. The majority of patients (n=54) selected “I am fine at work”. Some patients reported having already made adjustments in their work place (n=8), whereas some expressed concerns about employer involvement (n=5), despite this aspect of the study being voluntary. Approximately 1/3 of patients used the free text area to express their reason for declining and these were grouped into the main identified themes: self-employed; retiring soon; do not have lung problems or COPD.

5.6.3 Comparison of the characteristics of patients agreeing, declining and not responding to take part

Table 5-2 provides a description of the characteristics of patients who agreed to take part, declined or did not respond. Patients who took part in the COPE feasibility study compared with those who declined were more likely to be male (74.3% vs. 56.0%), slightly older (mean age: 61.9 vs. 60.9), have more severe disease (greater breathlessness; more airflow obstruction; greater number of co-morbidities), have a poorer quality of life (CAT score≥21: 33.3% vs. 26.5%), have poorer work performance (mean SPS-6 score: 22.3 vs. 24.2) and greater sickness absence (≥8 days off: 23.3% vs. 19.2%).

Non-responders compared with all responders (whether or not agreeing to take part) were more likely to be: younger, current smokers, have milder disease and lower sickness absence when compared to those participating in the feasibility study. The mean IMD score was higher for the non-responders compared with all responders, indicating slightly greater deprivation among the non-responders.

Figure 5-2 Participant flow chart for the recruitment to the COPE feasibility study

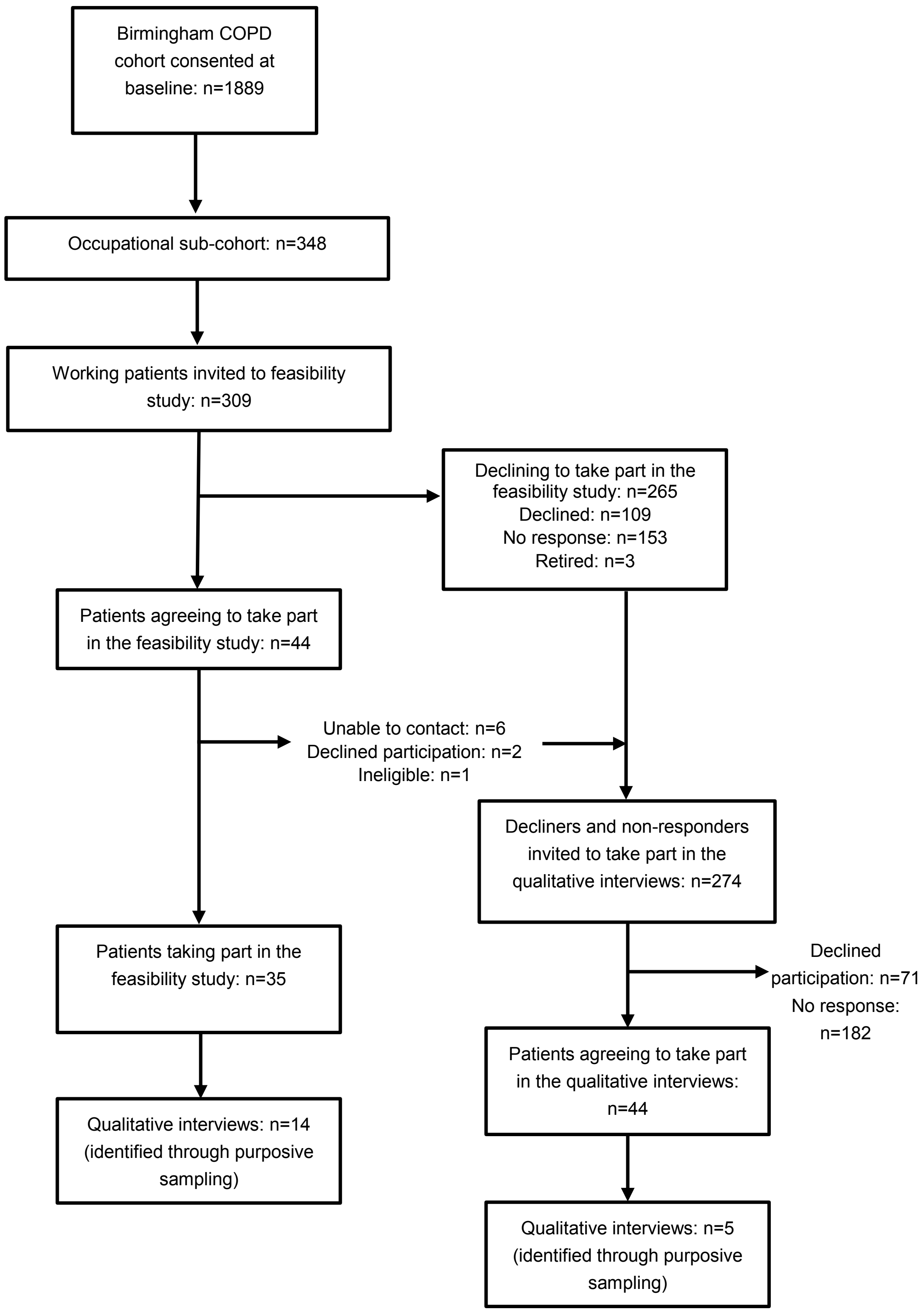


Table 5-2 Comparison of characteristics of patients agreeing, declining and not responding to take part in the feasibility study

Comparison of characteristics of patients agreeing, declining and not responding to take part	Patients seen for an OH assessment N = 35	Patients declining to take part in COPE N = 109	Non-responders N = 152
Socio-demographic characteristics			
Male	26 (74.3%)	61 (56.0%)	97 (63.8%)
Female	9 (25.7%)	48 (44.0%)	55 (36.2%)
Mean age (SD)	61.9 (8.2)	60.9 (7.8)	58.2 (8.2)
Smoking status			
Never	2 (5.9%)	10 (9.7%)	12 (8.8%)
Ex-smoker	20 (58.8%)	54 (52.4%)	61 (44.9%)
Current smoker	12 (36.0%)	39 (37.9%)	63 (46.3%)
Mean IMD score (SD)	25.2 (11.6)	24.8 (16.0)	28.7 (16.2)
Clinical characteristics			
MRC dyspnoea score			
1	7 (20.6%)	31 (29.3%)	46 (32.6%)
2	10 (29.4%)	38 (35.9%)	32 (22.7%)
3	8 (23.5%)	25 (23.6%)	37 (26.2%)
4-5	9 (26.5%)	12 (11.3%)	26 (18.4%)
Disease severity			
GOLD stage 1	9 (26.5%)	36 (34.0%)	57 (38.8%)
GOLD stage 2	18 (52.9%)	57 (53.8%)	70 (47.6%)
GOLD stage 3-4	7 (20.6%)	13 (12.3%)	20 (13.6%)
CAT score			
0-10	6 (20.0%)	23 (27.7%)	20 (18.2%)
11-20	14 (46.7%)	38 (45.8%)	52 (47.3%)
21-40	10 (33.3%)	22 (26.5%)	38 (34.6%)
Number of co-morbidities			
0	6 (17.1%)	17 (15.6%)	24 (15.8%)
1-2	14 (40.0%)	55 (50.5%)	73 (48.0%)
3+	15 (42.9%)	37 (33.9%)	55 (36.2%)
Number of exacerbations			
0	15 (44.1%)	47 (44.3%)	65 (47.8%)
1-2	14 (41.2%)	44 (41.5%)	50 (36.8%)
3+	5 (14.7%)	15 (14.2%)	21 (15.4%)
Occupational characteristics			
Occupational exposures to VGDF			
None	11 (31.4%)	55 (51.4%)	58 (39.2%)
Low	13 (37.1%)	34 (31.8%)	56 (37.8%)
Medium	9 (25.7%)	12 (11.2%)	29 (19.6%)
High	2 (5.7%)	6 (5.6%)	5 (3.4%)
Employment type			
Employed	26 (74.3%)	19 (73.1%)	15 (79.0%)
Self-employed	9 (25.7%)	7 (26.9%)	4 (21.0%)
Mean SPS-6 score (SD)	22.3 (4.4)	24.2 (5.1)	23.0 (5.1)
Sickness absence (over previous 12 months)			
0 days	16 (53.3%)	60 (63.8%)	69 (61.1%)
1-7 days	7 (23.3%)	16 (17.0%)	27 (23.9%)
8+ days	7 (23.3%)	18 (19.2%)	17 (15.0%)

5.6.4 Summary of occupational health recommendations

Among the 35 patients who had an occupational health assessment, the majority (n=28: 80.0%) received at least one OH recommendation: ranging from 1 to 8 per patient. The median number of recommendations was 2 (IQR: 1 to 3) per patient.

Table 5-3 Summary statistics of occupational health recommendations

Summary statistics of OH recommendations	N=35
Received OH recommendations (n, %)	28 (80.0%)
Distribution of recommendations per patient	
Range	0 to 8
Mean (SD)	2.4 (1.9)
Median (IQR)	2 (1 to 3)
OH recommendation areas	
Avoid substances/materials	8 (22.9%)
Modification of job tasks/work methods/physical aspects of the job	16 (45.7%)
Modification of the work environment	11 (31.4%)
Modification to the work organisation	7 (20.0%)
Use of personal protective equipment	11 (31.4%)
Referral to OH services and education	17 (48.6%)

Although there were a range of recommendations (Table 5-3), 17 (48.6%) patients were advised to seek OH service input and education and 16 (45.7%) had recommendations to modify their job tasks/work methods/physical aspects of their job. Eleven (31.4%) patients were advised to use personal protective equipment and 11 (31.4%) received recommendations to modify their working environment. Table 5-4 outlines some examples for each recommendation; individual recommendations for each patient can be found in appendix 17.

Table 5-4 Workplace recommendation examples

Recommendation area	Patient examples	
	Occupation	Recommendations
Avoid substances/materials	Cleaner	Avoid using strong cleaning agents particularly in confined spaces or in poorly ventilated areas
Modification of job tasks/work methods/physical aspects of the job	Truck washer	To avoid lifting and carrying large heavy equipment (e.g. 25L containers)
Modification of the work environment	Car mechanic	Workshop should be heated, particularly in the winter months
Modification to the work organisation	Bricklayer	Schedule jobs and work activity to avoid continuous work (e.g. working >2 hours without a break)
Use of personal protective equipment	Plumber	To wear a dust respirator when conducting all cleaning activities after completion of job tasks
Referral to OH services and education	Museum attendant	Those with respiratory problems should contact OH services who can advise on the need for routine health surveillance, any workplace adjustments and monitor the effects of work on health

5.6.5 Patterns associated with the number of recommendations

An exploratory analysis was carried out to compare participant characteristics with the mean number of recommendations (Table 5-5). However, as the number of participants was small, it was not possible to assess for statistical significance. Furthermore, although there was overlapping between some of the characteristics between the participants, the results could not be adjusted for confounding. Therefore the patterns identified below should be interpreted with caution.

A higher number of recommendations were given to male participants compared to females (2.6 vs. 1.8), those with severe breathlessness (MRC 1 vs. MRC 5: 2.1 vs. 4.7), those with more severe airflow obstruction (GOLD stage 1 vs. GOLD stage 3 to 4: 1.8 vs. 2.7), and patients who had experienced $\geq$3 exacerbations in the previous year compared to those who had no exacerbations (3.8 vs. 2.7).

Occupational characteristics were also related to the number of recommendations received: those with higher exposures to VGDF in the workplace had a greater number of recommendations compared to those with no exposures (3.1 vs. 1.6); and those self-employed had more recommendations than those with paid employment (3.4 vs. 2.0). Interestingly, patients who reported taking ≥ 1 day off work in the previous 12 months had a greater number of recommendations when compared to those who had no time off work (2.5 vs. 1.9).

Table 5-5 Relationship between patient characteristics and number of recommendations

Patient characteristics	Mean number of recommendations (SD)
Socio-demographic characteristics	
Male	2.6 (2.1)
Female	1.8 (1.0)
Smoking status	
Never	3.0 (1.4)
Ex-smoker	1.7 (1.5)
Current smoker	3.8 (1.8)
Clinical characteristics	
MRC dyspnoea score	
1	2.1 (2.0)
2	2.0 (1.2)
3	2.1 (1.7)
4	2.2 (2.2)
5	4.7 (2.9)
Disease severity	
GOLD stage 1	1.8 (2.0)
GOLD stage 2	2.4 (1.5)
GOLD stage 3-4	2.7 (1.9)
CAT score	
0-10	1.5 (1.9)
11-20	2.4 (1.5)
21-40	3.0 (2.5)
Number of co-morbidities	
0	2.8 (2.3)
1-2	2.9 (2.2)
3+	1.7 (1.3)
Number of exacerbations	
0	2.7 (1.8)
1-2	1.7 (1.6)
3+	3.8 (2.4)
Occupational characteristics	
Occupational exposures to VGDF	
None	1.6 (1.9)
Low	2.5 (1.5)
Medium – high	3.1 (2.2)
Employment type	
Employed	2.0 (1.4)
Self-employed	3.4 (2.7)
Sickness absence (over previous 12 months)	
None	1.9 (1.7)
≥ 1 day	2.5 (1.7)

5.6.6 Occupational health assessment feedback

Among the 28 patients who received recommendations, 25 (89.3%) completed the telephone follow-up and three were non-contactable. Amongst the responders, there were a total of 75 recommendations (range 1-8).

22 (88.0%) patients reported that this was their first occupational health assessment. Among the 3 who reported having previously visited an OH professional, all reported that the COPE assessment was: 1) more detailed and 2) more useful compared to their previous OH assessment experience.

5.6.6.1 Patient satisfaction of the assessment

16 (64.0%) patients reported that they felt in better control of their work as a result of the OH assessment (Table 5-6). The majority (n=20: 71.4%) felt that they understood what changes were required and most reported that they would recommend an OH assessment to their colleagues (n=21: 75.0%).

Table 5-6 Patient satisfaction questionnaire results

Patient satisfaction questions about the OH assessment	Strongly agree or agree	Neither agree nor disagree	Disagree or strongly disagree
I feel in better control of work	16 (57.1%)	5 (17.9%)	4 (14.3%)
I now understand the change which need to be made	20 (71.4%)	4 (14.3%)	1 (3.6%)
I would recommend an OH assessment to my colleagues	21 (75.0%)	1 (3.6%)	3 (10.7%)

5.6.6.2 Uptake of recommendations

Table 5-7 provides a summary of the feedback for each patient interviewed at the follow-up. The majority of patients (n=23: 82.1%) reported that all of their individual recommendations would help other patients with COPD who have a similar job. Twenty (71.4%) patients reported that all or most of their recommendations would theoretically help them to manage their COPD at work. The remaining 5 (17.6%) patients expressed that the recommendations would not be useful in helping them manage their COPD at work.

Fifteen (53.6%) patients reported that they were likely to implement all or some of the OH recommendations, but overall, only 28 (37.3%) of the recommendations were reported to be likely to be implemented. Reasons for not implementing recommendations were grouped into themes (Table 5-8). Five patients reported more than 1 reason.

Table 5-7 Uptake of recommendations

Patient	Number of recommendations per patient	Would recommendation help others with COPD who have a similar job?	Would this recommendation help you to manage your COPD at work?	Are you likely to implement the proposed recommendation?	Reasons for not implementing the recommendation(s)
1	6	6 (100%)	6 (100%)	3 (50%)	“Already doing this” n=3
2	8	8 (100%)	8 (100%)	1 (12.5%)	“Already doing this”: n=6 Impractical: n=1
3	2	2 (100%)	2 (100%)	1 (50%)	Need to consult manager
4	2	2 (100%)	2 (100%)	2 (100%)	
5	2	2 (100%)	2 (100%)	1 (50%)	“Already doing this”
6	5	5 (100%)	5 (100%)	0 (0%)	“Already doing before meeting”: n=3. Not practical: n=2
7	2	2 (100%)	2 (100%)	1 (50%)	“Doing before the assessment”
8	2	2 (100%)	2 (100%)	0 (0%)	“Only few year left until retirement, don't want to get involved at work”
9	2	2 (100%)	0 (0%)	0 (0%)	“I already manage myself well”
10	3	3 (100%)	3 (100%)	3 (100%)	
11	3	3 (100%)	0 (0%)	0 (0%)	“Employer will get rid of me”: n=2 Not applicable: n=1
12	3	3 (100%)	3 (100%)	0 (%)	“Retiring soon and if I am not capable of doing my job, I won't have a job" n=2 Not practical: n=1
13	3	2 (66.7%)	0 (0%)	0 (0%)	Not applicable: symptoms are not exacerbated at work
14	4	4 (100%)	3 (75%)	0 (0%)	“Doing before assessment”: n=2. Not practical: n=1. Symptoms not affected: n=1
15	3	3 (100%)	2 (66.7%)	2 (66.7%)	Not applicable: does not do this task
16	2	2 (100%)	2 (100%)	2 (100%)	
17	1	1 (100%)	1 (100%)	1 (100%)	
18	1	0 (0%)	0 (0%)	0 (0%)	“OH department not supportive”
19	4	4 (100%)	4 (100%)	2 (50%)	“Already doing this”: n=1 Not practical: n=1
20	1	1 (100%)	1 (100%)	0 (0%)	“Already doing this”
21	2	2 (100%)	2 (100%)	2 (100%)	
22	2	2 (100%)	0 (0%)	0 (0%)	Does not have an OH department - "no one to go to": n=2
23	5	5 (100%)	5 (100%)	3 (60%)	Not practical: n=2
24	3	3 (100%)	3 (100%)	2 (66.7%)	Not practical
25	4	4 (100%)	2 (50.0%)	2 (50.0%)	Not applicable: does not do task and does not want management to know health status

Table 5-8 Main reasons for not implementing workplace recommendations

Reasons for not implementing recommendations	Number of patients (%)
Patient implemented recommendation prior to assessment	8 (32.0%)
Recommendation not practical	7 (28.0%)
Patient concerned about consequences of employer involvement	4 (16.0%)
No OH department or does not feel supported by OH services	2 (8.0%)
Recommendation was not applicable	5 (20.0%)

An exploratory analysis was also carried out to compare uptake and type of recommendation. Table 5-9 indicated there was a range of recommendations which were likely to be implemented. However, when comparing to those less likely to be taken up, patterns were more skewed and there was less uptake of the recommendations related to *modifying job tasks/work methods/physical aspects of the job* (n=19: 40.4%). These were often described as “not applicable”, “not practical” or were already in place prior to the OH assessment. However, due to the small sample size, these patterns and inferences should be interpreted with caution.

Table 5-9 Patterns between uptake and type of recommendation

Number of recommendations	Avoid substances/ materials	Modification of job tasks/work methods/ physical aspects of the job	Modification of the work environment	Modification to the work organisation	Use of personal protective equipment	Referral to OH services and education	Total number of recommen dations
Patient likely to implement recommendation	2 (7.1%)	6 (21.4%)	8 (28.6%)	2 (7.1%)	4 (14.3%)	6 (21.4%)	28
Patient unlikely to implement recommendation	6 (12.8%)	19 (40.4%)	4 (8.5%)	3 (6.4%)	5 (10.6%)	10 (21.2%)	47
Main reasons for not implementing							
Already in place prior to assessment	4 (22.2%)	8 (44.4%)	2 (11.1%)	1 (5.6%)	2 (11.1%)	1 (5.6%)	18
Not practical	2 (22.2%)	3 (33.3%)	-	1 (11.1%)	2 (22.2%)	1 (11.1%)	9
Not applicable	-	6 (66.7%)	1 (11.1%)	-	-	2 (22.2%)	9

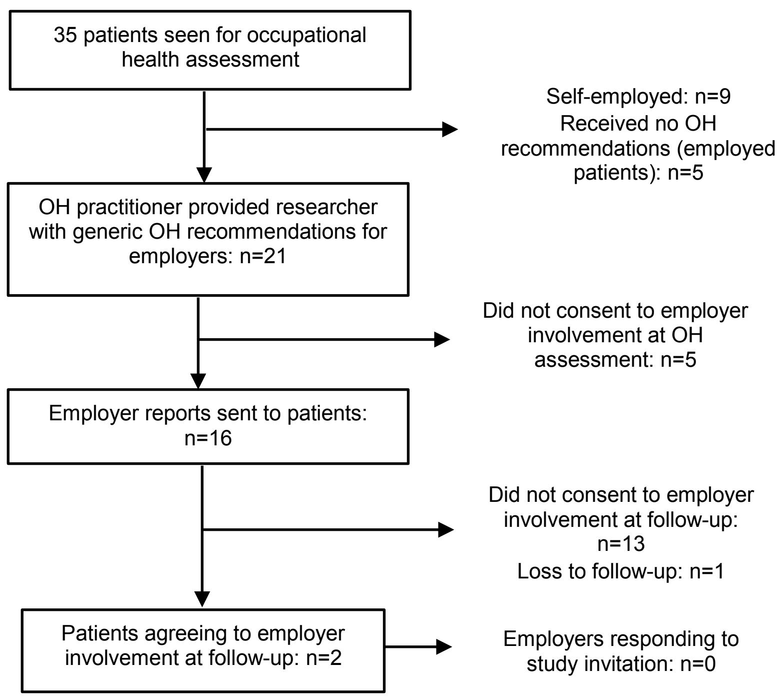
5.6.7 Employer involvement

Of the 35 patients assessed, 9 were self-employed, 5 received no OH recommendations, and a further five declined the offer of employer involvement at the stage of OH assessment (Figure 5-3).

Among the 16 patients receiving an employer OH recommendations report, only 2 agreed that their employer could be contacted. Another two patients expressed to the researcher (KK) that they had approached their line manager themselves and the OH recommendations had been implemented.

A study invitation letter was posted to the 2 employers of the consenting participants, however there was no response.

Figure 5-3 Employer participation in the COPE feasibility study flow chart



5.6.8 Self-management recommendations

All COPE feasibility study participants received ≥1 self-management recommendation, ranging from 1 to 6 recommendations per patient (mean=3; SD=1.4).

The most common recommendations were for patients to explore with their GP, referral to a dietician (n=26; 74.3%), plan for worsening symptoms (n=22; 62.9%) or approaches to managing stress (n=14; 40.0%) (Table 5-10). Other recommendations included discussion on smoking cessation (n=13; 37.1%); approaches to support doing more physical activity (n=10; 28.6%); referral to pulmonary rehabilitation (n=9; 25.7%); and uptake of flu vaccination (n=7; 20.0%). Although only 3 patients had a recommendation to discuss inhaler usage with their GP, this data was unavailable for 14 (40.0%) patients. Overall, data completion was high (>90.0%) for all self-management recommendation data, excluding data on the flu vaccination (unavailable for 9 (25.7%) patients).

Table 5-10 Self-management recommendations

Self-management recommendations	N (%) N=35
Smoking cessation advice	13 (37.1%)
Support on inhaler usage	3 (8.6%)
Referral to pulmonary rehabilitation	9 (25.7%)
Flu vaccination	7 (20.0%)
Plan for worsening symptoms	22 (62.9%)
Advice on approaches to manage stress	14 (40.0%)
Referral to a dietician	26 (74.3%)
Approaches to support increased physical activity	10 (28.6%)

5.6.9 Pre and post intervention outcome measures

Data on outcomes was available for the majority (85.7%) of those assessed. Differences were not tested for statistical significance as this was a feasibility study and there was insufficient power to do so. Overall, absenteeism rates and quality of life measures were higher (indicating poorer QoL) and there was little change in presenteeism post-intervention, compared to the pre-assessment period (Table 5-11). However these were point estimates, and lack of adequate power limits our ability to draw any meaningful conclusions.

Table 5-11 Secondary outcome measures pre and post intervention

Secondary outcome measures	Pre-OH assessment (n=35)	Post-OH assessment (n=30)	Mean difference within individuals (n=30)
Mean days off over previous 6 months (SD)	3.0 (6.7)	4.8 (9.8)	+2.3 (10.9)
Median days off over previous 6 months (IQR)	0 (0 to 3.0)	0 (0 to 5.0)	0 (0 to 3.5)
Mean SPS-6 score (SD)*	23.4 (4.5)	22.7 (5.5)	-0.07 (4.8)
Mean CAT score (SD)**	9.4 (7.0)	11.2 (8.6)	+1.1 (4.4)
Mean SGRQ-C score (SD)**	37.3 (20.8)	39.2 (23.0)	+5.3 (17.6)
SGRQ-C impact score (SD)**	21.9 (20.8)	24.5 (23.6)	+4.7 (18.5)
SGRQ-C activity score (SD)**	44.3 (25.0)	48.0 (31.1)	+2.9 (16.0)
SGRQ-C symptoms score (SD)**	58.8 (21.8)	62.7 (18.6)	+4.8 (15.1)
Outcome measures in those with recommendations			
Mean days off over previous 6 months (SD)	3.8 (7.3)	5.4 (10.3)	+2.6 (11.6)
Median days off over previous 6 months (IQR)	0 (0 to 3.0)	0 (0 to 5.0)	0 (0 to 5.0)
Mean SPS-6 score (SD)*	23.2 (4.3)	22.4 (5.6)	-0.5 (5.1)
Mean CAT score (SD)**	10.2 (7.3)	11.3 (8.7)	+0.8 (4.3)
Mean SGRQ-C score (SD)**	40.6 (19.9)	39.2 (23.0)	-5.3 (17.7)
SGRQ-C impact score (SD)**	23.8 (21.1)	26.6 (24.0)	+4.2 (18.7)
SGRQ-C activity score (SD)**	46.9 (23.1)	52.3 (30.2)	+4.5 (15.3)
SGRQ-C symptoms score (SD)**	60.7 (19.9)	62.3 (18.9)	+5.4 (15.3)

*SPS-6 questionnaire: lower scores indicate worse work performance

**CAT score and St Georges' Respiratory Questionnaire (SGRQ): higher scores indicate a greater (worse) impact of COPD

5.6.10 Interviews with GPs of participating patients

Of the 14 GPs that were contacted, the majority (n=9; 64.3%) refused to take part in the telephone interview. Five GPs did not respond to the messages left by the researcher (KK). Thus, no GP interviews took place.

5.6.11 Qualitative interviews with patients 3 months post-intervention

A total of 19 semi-structured interviews were carried out: 14 among patients who took part in the OH intervention and 5 patients who declined or did not respond to taking part in the feasibility study. Interviews were all carried out by the same researcher (KK), and lasted between 35 to 80 minutes. Most interviews (n=16) were conducted over the telephone and the remaining at the patient's home (n=3).

5.6.11.1 Characteristics of the participants

The characteristics of the interview participants are summarised in Table 5-12. 13 (65.0%) were male with a mean age of 61.9 years (SD: 7.1) and mean MRC score of 2.4 (SD: 1.3). The participants were from a range of occupational backgrounds. Of those who took part in the feasibility study, participants possessed a range of OH recommendations (0 to 8).

Table 5-12 Characteristics of those taking part in the qualitative interviews

Participants	Age	Sex	MRC score	Occupation	Number of recommendations	Feasibility study status
P1	64	Male	2	Managing director for engineering company	2	Participated
P2	63	Female	2	Coffee shop manager	1	Participated
P3	59	Male	5	Bricklayer	8	Participated
P4	50	Male	1	HGV driver	4	Participated
P5	55	Male	3	Relief caretaker	5	Participated
P6	80	Male	2	Technical manager	3	Participated
P7	59	Male	2	Labourer	2	Participated
P8	61	Female	2	Secretary for local MP	0	Participated
P9	65	Male	1	Plumber	5	Participated
P10	68	Female	3	Museum attendant	2	Participated
P11	61	Male	1	Visiting lecturer	0	Participated
P12	64	Male	4	Truck washer	6	Participated
P13	50	Female	5	Cash officer (supermarket)	3	Participated
P14	68	Male	4	Cleaner	2	Participated
P15	57	Female	1	Duty manager	n/a	Non-participant
P16	68	Female	2	Hotelier	n/a	Non-participant
P17	55	Male	-	Printer engineer	n/a	Non-participant
P18	63	Male	1	Project manager	n/a	Non-participant
P19	66	Male	3	Foreman duct erector	n/a	Non-participant

5.6.11.2 Qualitative findings

Five themes regarding the acceptability and barriers of the OH intervention were identified from the qualitative interviews: 1) motivating factors to take part in the feasibility study, 2) factors affecting non-participation, 3) factors influencing adjustments for COPD in the workplace, 4) future considerations for occupational health assessment, and 5) intervention outcomes. See Table 5-13 for identified themes, sub-themes and codes.

Table 5-13 Summary of the identified themes from the qualitative interviews

Theme	Sub-theme	Code
Theme 1: motivating factors to take part in the feasibility study	Outward incentives: driven by altruistic views	Helping other COPD patients
		Increasing COPD knowledgebase
		Supportive of research
	Inward incentives: driven by personal gain	Positive impact on own health
		Improve understanding/knowledge about COPD
		Help with future employment
		Occupational exposures
Theme 2: factors affecting non-participation	Work related factors	Taking time off
		Concerned about employer involvement
	Personal factors	Perception/attitude towards COPD
		Individual characteristics
		Smoking
	Study related factors	Information sheet lacked clarity
		Location of the assessment/travel or distance to the University
		Participation in other research
Theme 3: future considerations for occupational health assessments	Content	Educating and empowering patients
		In-depth health check
		The perspective of other COPD patients
	Practicalities in delivering the intervention	Timing of OH assessment
		Targeted approach to identifying suitable patients
	Professional delivering the intervention, their level of expertise and personal characteristics	OH background/external
		Doctor/GP
		Practice nurse/COPD nurse
		Personal characteristics
	Employer involvement	
Theme 4: factors influencing occupational adjustments for COPD	Control over work	Flexibility in working hours/days
		Flexibility in work tasks
	Outlook on symptoms at work	Self-adjustment to manage symptoms at work
		Ignore symptoms
		Denial of symptoms
	Reluctance of sharing health issues with the employer	Separation of work and life
		Impact on self-esteem
	Working relationships	Positive relationships at work
		Negative working relationships
	View on the impact of the working environment	Awareness of impact of the working environment on health
Theme 5: intervention outcomes	Internal changes	Increased awareness
		Reassurance
	External changes	Adjustments in working practices
		Impact on self-management

5.6.11.2.1 Theme 1: motivating factors to take part in the feasibility study

Two main factors were identified which motivated patients to take part in the COPE feasibility study: altruism and personal gain.

<u>Outward incentives: driven by altruistic views</u>

Altruism motivated the majority of patients to participate in the study. For a few, it was the only motivating factor as it was thought that there would be little or no personal benefit from participating. Many patients proposed the beneficial impact for other COPD patients by their participation.

> [P18: male, 63 years, project manager] "*Well if it can help your research and other people to improve their lives then I am happy to participate in something like that. It is all part of trying to be a good citizen.*"

A few patients expressed the importance of developing and increasing the knowledge base on COPD, with one patient emphasising the importance of achieving this through participating in qualitative research as opposed to quantitative research:

> [P10: female, 68 years, museum attendant] *"To get feedback from people who are actually suffering from the disease, rather than do a thing called statistical research, and anything that can be given that informs about living with COPD has got to be a good thing."*

A few patients were generally supportive of research, and either previously or concurrently, were involved in other health research. Thus, being accustomed to research processes may have encouraged participation.

> [P14: male, 68 years, cleaner] *"I am doing a test now with ***** University to see if they can deal with degenerative eye problems, so I am doing one for you and one for ***** University."*

Inward incentives: driven by personal gain

In some patients participation was incentivised by the various perceived personal benefits. One consideration was the beneficial impact on the patient's own health. In fact, a few patients believed this was to be achieved through the monitoring of their health/health check or help with COPD symptom management at the OH assessment.

> [P1: male, 64 years, managing director] *"A bit selfishly because if there is any possibility of me personally getting an improvement then I will try and assist in whatever way I can."*

Importantly however, many participants demonstrated or even articulated their lack of understanding about COPD and consequently, a number of patients cited that by participating they sought to improve their knowledge and therefore develop a better understanding of the condition. For example, one patient was extremely concerned about definition of the term 'COPD', insisting that his condition was not chronic. As a result, he attended the occupational health assessment to seek answers:

> [P14: male, 68 years, cleaner] "*…people are saying COPD, now that means the "C" means chronic. Now there is obviously a lot of more people out there with a condition that is in the chronic situation, whereas mine is not chronic, but I have got COPD probably."*

One patient attended the assessment with the belief it would help with securing future employment, and was the only patient with a work-related reason for taking part.

> [P11: male, 61 years, visiting lecturer] *"If I had got a potential employer what they could do to help me, just getting employment."*

One patient (non-responder) expressed keenness to take part in the study due to the workplace exposures; commenting that his environment at work had negatively affected his health. However, due to his late expression of interest, he was unable to receive an OH assessment:

> [P19: male, 66 years, foreman duct erector] "*I think it is a really good idea because I do work in a nasty environment which I think has affected my health. I do think it is a very good idea that's why I am okay to carry on now…"*

5.6.11.2.2 Theme 2: factors affecting non-participation

Work, personal and study related factors were seen as important barriers affecting participation in the COPE feasibility study.

Work related factors

Many patients suggested 'time' as one of the main barriers to participation; commenting on difficulties in taking time off work. A few mentioned this may be a particular issue for those in full time employment (compared part-time workers), or those with rigid working hours. In fact, one of the non-participating patients stated that his "*strange working hours*" prevented study participation, and otherwise, was very interested in taking part.

> [P10: female, 68 years, museum attendant] *"Time is a big factor if somebody is working full-time."*

Suggestions such as, offering an out of hours service as well as altering the invitation letter to emphasise the limited burden on the patient's time, were made to address this issue. Although for self-employed or small business owners it was seen that time is of the essence; implying that work may be prioritised differently for such patients compared to those employed for wages.

The negative financial consequences of taking time off work were also raised, with provision of financial incentives for participation suggested as a potential solution. Time barriers were also discussed in relation to a general lack of time in today's climate; disruption of cancelling and rearranging prior commitments; and the various other priorities an individual may have and therefore difficulties in committing to the study.

Some patients stressed the concern (their own, or that of other patients) about reading the potential for employer involvement within the invitation letter; feeling uncomfortable or even fearful of the employer's reaction, and therefore the potential targeting for dismissal. Furthermore, a few raised concerns about the stigma associated with having COPD and it negatively affecting the employer's opinion of their work capacity. In fact, the fear of employer involvement was the main reason for not taking part for one of the five non-participants:

> [P17: male, 55 years, printer engineer] *"I could be putting my job on the line …. because of knowledge of my health condition and that is why I imagine other people, erm, other patients have declined the offer because of that reason also."*

It was suggested for future studies to exclude employer involvement as a method to improve the uptake rate.

Personal factors

Negative attitudes towards COPD were suggested as a reason for non-participation by some patients; these included views such as feeling embarrassed about having COPD, in denial or frightened to find out more about COPD – this included the implications of having the disease, its progressive nature and therefore how to best manage the condition. Although one patient identified this may be a reason for non-participation, s/he strongly stressed the importance of accepting the diagnosis:

> [P3: male, 59 years, bricklayer] *"If you've got COPD, you've got it and it's no good trying to hide it or being ashamed of it…it's a lot better to talk to people about what you have got rather than just curl up in a ball and feel sorry for yourself…or just not do anything."*

For one patient, this negative view was precipitated by past difficult health experiences and therefore did not want to remember his/her childhood by focussing on ill health as a result of taking part in the study.

Some patients discussed the recognition of having a 'health condition' but not having a 'health problem'**.** Therefore through self-adjustment and learning to function well with the condition or believing they did not have ill health, patients may have felt it was unnecessary to attend the OH assessment.

Another important point raised by a few patients was related to current lifestyle behaviours, particularly smoking. For the fear of being judged, smokers may have preferred not to participate. It was also implied that some smokers may be unwilling to abstain from smoking and hence, would be reluctant to meet a professional about their health for the fear of hearing they are not managing their own health appropriately.

> [P10: female, 68 years, museum attendant] *"I am particularly thinking of people who perhaps still smoke. Smoking at one time was ... people got angry with you for smoking and not giving up and I think perhaps it might be something to do with that."*

Individual personality characteristics could also have influenced patients. Intrigue encouraged one patient to participate, whereas suspicion (about the handling of personal information), shyness and lack of self-confidence were identified as reasons to deter patients. It was suggested to soften the invitation letter for the more introvert patient, however, the practicalities of how this could be achieved were not discussed. A few patients suggested that some patients are not interested or curious to find out more about COPD or their health, and thus little can be done for such cases:

> [P14: male, 68 years, cleaner] *"It's like taking a horse to water, you can't make him drink it. You can take him there but you ain't going to make him drink it, so it's the same with information on breathing."*

Study related factors

The travel to the University, albeit via a taxi offered by the study, was raised as a potential barrier by a few patients. The distance may have deterred patients, particularly women. It was also suggested that some patients may feel uncomfortable about visiting unfamiliar areas or a large city, such as Birmingham. For one patient, this was the only shortcoming of the study; describing the drive to the University as stressful.

> [P12: male, 64 years, truck washer] *"Travelling bit could be something which would put people off… females do not like travelling into city centres and going into strange areas where they don't know."*

Additionally, the room in which the assessment was carried out was described as not conducive or relaxing; which was thought to possibly arouse suspicion amongst study participants. A remedial proposal was a familiar environment; a few patients suggested for the assessments to be conducted locally: the patient's home or their local GP practice.

A few patients conveyed that the invitation letter lacked clarity in the following areas: the purpose of the study, the length of the OH assessment and the proposed questions or information required from the patient at the assessment.

> [P9: male, 65 years, plumber] *"I was a bit apprehensive thinking about how much time it was going to take and exactly how it was going to pan out."*

A number of suggestions were provided to improve the letter: use of lay terms, as some patients may have found the letter "too medical"; to clearly state that the study is about COPD and to specify the purpose of the interview, its direct relevance to the patient and the benefits of participating. One patient mentioned that it would be beneficial to know that the issues related to COPD are not unique to the patient alone. One self-employed patient (non-participant) suggested omitting the word “employed” from the patient information sheet; believing that he would not reflect a working COPD patient, and therefore felt discouraged from participating.

Conversely, a few patients found the information simple and easy to understand, and questioned why patients chose not to participate, suggesting an assumed obligation to participate in the related studies.

One patient found the regular patient contact from the main research study (cohort 6 monthly questionnaires) onerous and believed this may have discouraged participation in any related studies:

> [P14: male, 68 years, cleaner] *“Oh, ***** ****, not again, I have got to fill that form in again”, you know, and people do get cheesed off, although it is for their benefit, they still get cheesed off.”*

5.6.11.2.3 Theme 3: future considerations for occupational health assessments

Patients discussed their views on a number of aspects which should be considered when designing and delivering future occupational health interventions. This included views on: the content of the OH intervention; the practical aspects to consider when delivering such an intervention; the importance of involving the employer and the expertise and characteristics of the individual delivering the intervention.

Assessment content

Many participants believed that COPD patients could benefit from a modified OH assessment, by incorporating other features as part of the intervention. One feature, highlighted by a number of patients, was educating and empowering COPD patients through providing guidance on the management of their condition.

> [P6: male, 80 years, technical manager] *"How to deal with it [COPD] and how do I limit its advancement... Well now I've got it, what do I do about it?... I expected to be given a little more guidance on how to manage my condition..."*

An option, discussed with a subset of patients, was to include an abbreviated OH assessment as part of the COPD annual review: a COPD management review conducted at the patient's GP practice. Patients cited that this potential incorporation would be beneficial by: helping patients develop a better understanding of their COPD; encourage a regular assessment of the impact of COPD on work (and vice versa); facilitate in fostering a better relationship with the GP/nurse and help foresee any potential work related issues due to ill health. Although, one patient suggested an annual assessment would be too frequent and to alternate the year of assessment. A few patients, with milder disease, appreciated the benefits of such an assessment for other COPD patients, but believed it would not be personally applicable because of their good health.

A few favoured extending the OH assessment into a detailed health check, to help patients develop a better understanding of their overall health:

> [P11: male, 61 years, visiting lecturer] *"I thought there would be some more breathing tests with regards to myself…or on physically what I could do"*

Another important feature, raised by a few patients, was the importance of discussing or hearing the perspective(s) of other COPD patients. It was thought that this would: create greater awareness that the condition/situation is not unique to the individual; guidance on managing life with COPD from those with experience and to learn the truth about the prognosis of COPD.

> [P3: male, 59 years, bricklayer] *"Have a good talk to somebody about it, preferably somebody who's got it...somebody who is more advanced than you are, they can actually tell you what is going to happen or what can happen."*

<u>Professional delivering the OH assessment, their level of expertise and personal characteristics</u>

Some thoughts were shared on the various professionals that may be best placed to conduct an OH assessment. The type and expertise of the professional conducting the OH assessment were discussed in relation to the feasibility of wider implementation, the patient's own confidence in the findings, and likely impact on employers. Although some patients expressed the importance of seeing a professional with OH experience, a number of patients favoured an external OH service; finding an internal OH service (linked to the employer) impersonal. Patients were cautious about OH services that are related to the employer and expressed concerns about personal information filtering to the line manager. Indeed, one patient's views on the use of an external OH service were influenced by the lack of confidentiality displayed by the employer's recommended OH service:

> [P17: male, 55 years, printer engineer] "*The company and releasing information that it may get into the wrong hands...information, with it being duplicated, for me, is not a show of confidence in information being, err, basically sent around… It certainly became knowledge in verbal conversation between managers and workforce… managers knew of the conditions, yes. So I felt, err, it was compromised …into the employer's hand which then throws a lack of confidence in the, erm, the erm, general assessments.*"

As an alternative, a number of patients identified the GP as a promising candidate to carry out an OH assessment, with the aim of providing this feedback to the employer.

> [P3: male, 59 years, bricklayer] *"So this is something for the doctors to do, look at the patients as a patient, what's up with them."*

It was believed that a letter from the 'doctor' would carry greater weight. However, a few patients believed that information from the GP would not be easily received by the employer. Furthermore, concerns were raised about the GP's limited capacity to conduct such an assessment due to their limited time and significant workload. One patient's reluctance of sharing her real concerns was due to her apathetic GP.

Some patients identified the nurse as a potential candidate. The ease of discussing health information with the nurse largely influenced this choice. Other reasons included reducing the GP's burden and it was thought that it would be more efficient to visit the nurse than the GP.

> [P5: male, 55 years, relief caretaker] *"The nurse… when you talk to her and she does your breathing test, she could go through it. That would free up the doctor then, wouldn't it?"*

However it was raised that a nurse may be inexperienced to perform this role.

A number of patients lacked trust or confidence in their GP practice, however the need for the potential candidate to possess comprehensive knowledge of COPD was clear. It was suggested that a medical professional either delivered the assessment or worked alongside an OH professional. One patient was reassured about the OH assessment and recommendations by mistakenly considering the OH practitioner to be a medical practitioner. However, a few patients were pessimistic about employers acting on feedback from medical expertise. In fact, one patient was doubtful about the employer actively engaging with any professional for OH advice:

> [P13: female, 50 years, supermarket cash officer] *"I am not sure because they have ignored my doctor and now they have ignored an Occupational Health Therapist so I don't know what would make them sit up and take notice. I couldn't tell you. I mean that's two that's in a profession, you know, they have ignored, so I can't answer. I don't know who they would take notice of, no."*

A few patients described the positive impact of certain personal characteristics of the professional delivering the OH assessment on their overall experience. A few patients appreciated the OH professional's positive demeanour, with another patient describing the conduct of the assessment as casual and hence did not feel pressurised to share personal information; demonstrating the contribution of good communication to a positive patient experience.

> [P7: male, 59 years, labourer] *"I thought it was very good. You can talk to him easily, I find him quite easy to talk to and get on with and yourself."*

<u>Practical considerations in delivering the intervention</u>

Some patients felt that an OH assessment was suitable for only certain circumstances among those with COPD, or that it was more helpful at particular periods in the course of the disease. Some patients suggested adopting a targeted approach to identifying suitable patients for OH assessment. One approach was based on disease severity and the aggravation of symptoms in the workplace. Another suggestion was based on the work environment; proposing that an assessment might be more appropriate for those in a large working environment or certain industries:

> [P15: female, 57 years, duty manager] *"…it is mainly environment really. What kind of environment they are working. Like I say, if factory… extractor fans and stuff like that. Even down to posture really…"*

Many patients discussed the ideal timing of conducting an assessment; indicating that it would be beneficial "early on". Some patient felt this was based on the patient's age, whereas other patients described this "early on" period in-line with the time of diagnosis:

> [P13: female, 50 years, supermarket cash officer] *"When you are first diagnosed, because you can learn things, erm, what rights you have got at work and how you can go about things… rather than wait until you are struggling and then have to work for years like I did without finding out anything about work."*

Importantly, a few patients stated the importance of considering the acceptance period – "coming to terms" with COPD – prior to offering patients an OH assessment.

In contrast, one patient suggested that an assessment would be most beneficial in those who are significantly affected by their COPD:

> [P8: female, 61 years, secretary for local MP] "*Wait until you [COPD patient] is struggling and then take part and that helps."*

Employer involvement

Although many patients discussed the issues related to the fear of employer involvement, a number of patients recognised the importance of involving the employer and informing them of an employee's COPD status to encourage 1) appropriate workplace adjustments, 2) educate the employer about the employees' health and 3) for the safety of other employees. One patient's view on withholding health information from the employer was altered after a negative health experience. He later realised the advantages of informing the employer:

> [P19: male, 66 years, foreman duct erector] *"I did try to hide my symptoms for some time, mainly for fear of losing my job, you know what I mean. But then eventually I had to tell them anyway because I, erm, ended up in hospital. I couldn't breathe like, I had to go back and explain to them [employer] but they*

> *was nice, you know, really good to me afterwards, so probably it was just a silly thing not to tell them, you know… He [employer] makes sure I have got the right equipment and makes sure that I don't have to do heavy work. If I don't feel well I can go home any time. If it's cold I don't hang around outside I can go in the office and do work in the office."*

5.6.11.2.4 Theme 4: factors influencing adjustments for COPD in the workplace

A number of issues were raised by the interviewed patients, which impacted on their ability to influence workplace adjustments or discuss the impact of work on their health with the employer. These included the employee's: control over their work; attitude towards sharing health information with their employer; relationship with employer and other employees; outlook on their own symptoms at work and awareness of the impact of the working environment on their health.

<u>Control over work</u>

Flexibility in working hours or work tasks was important in helping patients manage their COPD symptoms. This was most prevalent among the self-employed or small business owners, who displayed greater autonomy in selecting and delegating certain work tasks:

> [P18: male, 63 years, project manager] "*Driving late at night makes me fatigued because I get tired….. so I get somebody else to do that, I pay somebody to do that."*

<u>Attitudes towards sharing health information with the employer</u>

Many patients were reluctant to disclose personal information with their employer or colleagues for additional reasons other than those discussed in theme 2 (e.g. fear of job loss). One reason cited was the importance of maintaining a division between work and life and keeping health matters private, for example:

> [P5: male, 55 years, relief caretaker] *"I work with them, I don't want to socialise with them. Things like that* [COPD] *I keep to myself"*.

Another reason, expressed by a few patients, was the detrimental impact on self-esteem, and that sharing information about their health condition with the employer may be interpreted as a weakness, particularly among the older workers who may have a different approach to working with health problems.

> [P10: female, 68 years, museum attendant] "*It might be a question of pride as well, I don't know, you know, as I say I don't think it is just the COPD, I think it might be anything, you know. Particularly the old people, we have kind of been brought up to that you just get on with it sort of thing."*

Although, it was clear from the interviews that this lack of discussion did not always mask the health issue(s).

<u>Working relationships</u>

Positive working relationships were associated with better engagement with the employee's health needs. For example, working as a team made it easier to influence change in the working environment, particularly if the management demonstrated reluctance to workplace change. Some employers were described as very helpful, sympathetic and supportive which were favourable for working adjustments. For one patient, this was due to his 20 year service with the company. It was also found that positive working relationships as well as team work made it easier to put forward workplace suggestions to the management in the event of poor health.

> [P4: male, 50 years, HGV driver] *"They have changed one or two things but we keep complaining about it and there are times we wouldn't stand down."*

Small company owners (including some self-employed participants) displayed empathy and understanding of their employees' health due to their own health condition; providing occupational adjustments without hesitation for those with a general or similar health issue, as the health experiences of colleagues were appreciated and better understood.

Conversely, patients with negative or passive working relationships reported employers to be less likely to focus on their health needs and workplace adjustments:

> [P3: male, 59 years, bricklayer] *"All they want is work going out of the door and they aren't bothered about your health."*

<u>Outlook on symptoms at work</u>

Some patients were conscious of their symptoms at work and were proactive in independently making workplace adjustments without the employer's input e.g. avoidance of certain tasks.

> [P17: male, 55 years, printer engineer] *"I think if I come to manual lifting…and carrying heavy components ….then I find I can sometimes be out of breath… if I stand in that dust cloud then it will obviously bring worse conditions for me…so I tend to stay away from hands on and handling of…erm…equipment."*

Interestingly, one patient (small company owner) observed that his smoking employee was more responsive to the impact of workplace exposures on symptoms and was more malleable to the suggested occupational recommendations than the non-smoker.

Some patients, however, ignored their symptoms at work, occasionally reporting their reasons. These included beliefs that symptoms will self-correct; assumption there were no suitable intervention(s) available to treat symptoms; infrequency of symptoms or the infrequency of demanding job tasks which were thought to aggravate symptoms; fear of the implications of involving the employer if symptoms were reported, and not wanting to take time off work because of symptoms among those who were self-employed. One patient attributed his symptoms to the work environment and his smoking, and not an aggravation of his health condition:

> [P9: male, 65 years, plumber] *"I used to have coughs and wheezing and I never really took much notice to it and I just put it down to the job and that I used to smoke."*

Conversely, a few patients rejected the notion that their COPD symptoms were affected in the working environment, even though they were contradictory in their interviews by discussing the minor workplace adjustments that had been made.

> [P5: male, 59 years, relief caretaker] *"It hasn't affected me so far and because it hasn't affected me I don't see why they should know. Once it does start affecting my work, then obviously I would tell them…Some things I am limited on... So I try and avoid those as much as possible."*

Awareness of the implications of the working environment on health

Some patients alluded to their own or their employer's lack of awareness or knowledge of workplace exposures and its subsequent impact on health; providing a further explanation for the absence of seeking OH advice.

In contrast, a few patients discussed the importance of health and safety procedures and protocols in the workplace as a means of identifying occupational hazards. In fact, one patient was convinced that any problems associated with occupational exposures were avoided as a result of receiving training for health and safety in the workplace:

> [P15: female, 57 years, duty manager] "*There is only certain cleaning agents we use because of health and safety…so, I have done health and safety courses… been on them. Yes, that's why I have not had any problems with stuff like that.*"

5.6.11.2.5 Theme 5: intervention outcomes

Many patients discussed the various benefits of taking part in the COPE feasibility study. This included personal changes, such as feelings of reassurance about their COPD, as well as changes to practices and behaviour, such as implementing changes to their working and self-management practices. Very few patients reported no benefit from taking part in the study.

<u>Personal (internal) changes</u>

As a result of participating in the study, many patients developed a greater awareness of the relationship between COPD and work. This included: an increased awareness of the impact of the workplace on COPD symptoms; consolidating previous knowledge; and becoming generally better informed. Consequently, patients cited that they were “thinking a lot more” about their COPD at work.

> [P2: female, 63 years, coffee shop manager] *“It helped me a lot. I realise it wasn't old age creeping on, that there was actually something wrong and that it is just not case of having to manage it”*

The OH assessment provided an outlet for patients to discuss their health status and work. The various positive benefits of this were discussed: helped to alleviate anxiety; helped to provide answers about the condition; reduced agitation and just generally helped patients feel better about themselves and their COPD. Consequently, this helped to provide reassurance to a number of patients in a few of ways: 1) other working COPD patients experience similar problems, 2) their current working practices and any self-adjustments previously made in the workplace were appropriate, and 3) the implications and prognosis of COPD.

> [P10: female, 68 years, museum attendant] *"I have realised that my problems aren't unique to me, and when you are part of a big club it makes you feel better."*

External changes

As a result of the intervention, some workers initiated changes in the work environment or their working practices, for example using safer equipment and implementing regular breaks between work tasks. In fact, a few self-employed patients/small business owners extended the OH recommendations to benefit their employees.

> [P12: male, 64 years, truck washer] *"It made me conscious of giving the guys a little bit more of a break…erm…and saying, yes okay we will get stuck in for an hour and then we will have a cup of coffee"*

Another workplace change included some patients adjusting their exposures to vapours, gases, dusts and fumes by reducing or avoiding certain workplace exposures.

However, some patients either made no changes or rejected some of the recommendations. One reason included the lack of use or applicability of the recommendation(s). Patients generally found PPE unsuitable in the work environment; with one patient rejecting the recommendation of using goggles in the workplace due to the lack of practicality.

Interestingly, a few expressed much of the recommendations provided in the OH feedback report were a repetition of the information they had shared about their current work practices at the assessment with the OH practitioner.

A number of patients cited the personalised self-management recommendations useful and took steps to achieve the self-management recommendations; of which a few discussed the report with the GP. The information encouraged one patient to feel "enlightened" about their condition. It was also found to be more detailed than the information previously provided by the GP. The patients also positively commented on the BLF self-management booklet, particularly finding the advice on managing breathlessness useful.

> [P6: male, 80 years, technical manager] *"I have never had one of those...best bit of information I have received since I've been aware of my condition…I do a lot of the recommendations based in this publication…breathing aspects. I certainly do try to and keep the airways clear."*

Conversely, many patients were indifferent about the self-management information. Some reasons discussed included idleness, lack of time/opportunity to read the information and the view that self-management could only be confronted once *'the other things are under control'*. Furthermore, those with less severe disease felt that the self-management recommendations or BLF booklet were not currently appropriate or applicable.

5.7 Discussion

This is the first study to assess the feasibility of delivering a standardised occupational health intervention to a heterogeneous sample of patients with COPD with varying disease severity and working in diverse occupations.

5.7.1 Uptake of intervention

Patient uptake rates to the COPE feasibility study were very low (11.3% of those invited), with younger patients, females, current smokers, those with milder disease and better work productivity more likely to decline or to not respond to taking part. Targeting those with lower work productivity using historic data on absenteeism and presenteeism was not successful, although there was a limited sample to draw from.

These findings are in keeping with evidence that there is reluctance for COPD patients to undertake rehabilitation. Non-participation rates for pulmonary rehabilitation (PR) have been cited up to 50%,[230] despite the clinical benefits of attending such programmes, such as improving quality of life in those with COPD.[231]

Similar to this study, there is evidence that smokers are also less likely to attend PR than non-smokers (OR=0.3; 95% CI 0.1 – 0.9).[232] This may be a consequence of the self-blame that some COPD patients experience, by attributing the cause of their COPD to smoking. Patients may therefore feel discouraged to take up health-related interventions due to their low expectations of the care provided to manage their condition as well as the fear of hearing “it’s your own fault”.[233]

5.7.2 Facilitators and barriers to uptake

Two main factors were identified to influence the patients' decision to participate in the study: 1) altruistic views, such as helping other COPD patients, increasing the COPD knowledgebase and being supportive of research and, 2) personal benefit, such as anticipating a positive impact on one's own health and developing a better understanding of the condition. Only two patients provided an occupational reason as a motivating factor to take part. These findings – personal benefit and hoping to help others – are consistent with studies in other areas.[234-236] However, these reasons relate to participation in a research study, and do not translate to view on the uptake of an OH assessment intervention.

In terms of intervention uptake, most decliners did not see the relevance of the intervention, as they did not perceive they had a problem that needed to be addressed. This was either that they did not perceive having a health problem, or that they did not recognise problems with work, sometimes because they felt workplace adjustments were already in place. Occasionally they were concerned about employer involvement.

However, employer involvement was raised as a significant concern among the interviewed participants, with patients citing employers' main concern being work productivity rather than employee health, and job loss as one of the feared consequences of involving the employer. This was despite employer involvement being considered important for workplace adjustments to be implemented. These views are consistent with those of the general population, where there is generally reluctance among employees to disclose health information to employers.[237]

Similarly, among a population with work-related asthma symptoms, patients preferred to persist with respiratory symptoms at work out of fear of the financial consequences (e.g. job loss) associated with sharing health matters.[238]

Practical issues related to lack of time or inconvenience of the venue were also cited as reasons for non-attendance, reflecting low motivation to attend, which is similar to the situation for many other predominantly lifestyle focused interventions.[230;239;240]

Many participants suggested that negative perceptions or attitudes towards COPD (e.g. difficulty in accepting COPD) may contribute to non-participation. As COPD progresses, patients' lives are increasingly affected; with symptoms and functionality worsening over time and resulting in poorer health, reduced quality of life and loss of independence.[24] These changes are thought to trigger a grieving process characterised by: denial ("I have no problem"); resistance ("I want my life back"); sorrow ("all is hopeless") and acceptance ("if I adapt to my disease I will have less symptoms and a better quality of life").[241] In fact, the denial stage can last many years in patients with COPD,[242] especially as functionality losses and impairments start mildly and gradually worsen over time.[24] Patients' views of engaging with health interventions and how they view managing their disease may therefore be partly driven by their position in the grieving process. For example, at the initial denial stage, patients may experience having 'no problem', irrespective of whether a problem exists, and may therefore be unwilling to adopt behaviour changes for 'non-existing' issues.

The grieving process resonated with views of some of the interviewed patients, who mentioned the importance of accounting for the acceptance stage when delivering interventions in patients with COPD. The stage of the grieving process may therefore provide insight into patients declining to take part in the intervention (possibly explaining the high “I am fine at work” response). It may also explain why some patients may ignore their symptoms whilst others are able to implement self-adjustments to manage their symptoms in the workplace. Knowledge about the patient’s psychological barriers prior to initiating behaviour change through an OH intervention could therefore be beneficial.

5.7.3 OH recommendations and uptake of OH recommendations

The majority (80.0%) of patients who attended the assessment received some occupational recommendations. Although a range of recommendations were made, *modifications to job tasks/work methods/physical aspects of the job* and *referral to OH services and education* were recommended the most. This suggests that OH assessments are likely to identify potential modifications for most patients with COPD who are in work. Whilst the exploratory analysis suggested that the likelihood to benefit may be maximised by targeting those with certain characteristics (more severe disease, smokers and those working in occupations with high VGDF exposure), this needs further verification as the limited sample size in this study precludes drawing firm conclusions.

However, whilst many recommendations were made, only 37% of these were reported to be implementable by patients, either because the suggested modifications were already in place, or the recommendations were perceived to be impractical or not applicable. The impractical nature of recommendations, particularly in relation to use of personal protective equipment (PPE), has been cited as a general problem among workers[243]; with a lack of training in using PPE and good safety within the organisation identified as factors associated with reduced PPE compliance.[244] Training on the importance of using PPE has been shown to impact positively on regulating health and safety.[245] However, only a few participants alluded to the awareness of health and safety regulations in the workplace; possibly influencing their attitude towards such OH recommendations.

This study found that the ideal workplace adjustment (as recommended by OH) may not align with patient preference or practicality, which is in keeping with other evidence focusing on adjusting behaviours in the workplace.[246] This highlights the importance of patient feedback and possible workplace or on-site visits (if feasible) prior to providing OH recommendations, as methods of improving recommendation uptake.

5.7.4 Self-management recommendations

Unlike the OH recommendations, all participating patients received a minimum of one self-management recommendation. Nevertheless, similarly to the OH recommendations, over half of the interviewed patients did not use these recommendations, either because they lacked motivation or did not perceive they would benefit.

The ability to self-manage COPD is important; interventions focussing on helping patients better self-manage their disease have shown positive patient outcomes, which in turn translate to better work related outcomes. For example, a recent systematic review found highly supportive self-management interventions led to a significant reduction in hospital admissions compared to those receiving usual care among those with COPD (OR=0.60; 95% CI 0.40-0.89).[63] Nevertheless, poor adherence to a therapeutic regimen is common among COPD patients for various reasons such as illness perceptions, depression and lack of social support.[247] In fact, COPD patients often have a poor understanding of their symptoms.[248] All of which may explain why some interviewed patients reported that their COPD did not require enhanced self-management. Additionally, COPD patients are often affected by other co-morbidities; adding further complexity to their therapeutic regimens.[247]

5.7.5 The psychological impact: an outcome of participating in the COPE feasibility study

It is known that patients often seek reassurance [249] and more information about their condition from healthcare professionals,[250] and some of the motivating factors to participate in this study suggest that this was also true amongst this patient group. Even among those who did not plan to implement any of the recommendations following the intervention, many expressed benefits such as increased awareness of the relationship between COPD and work as well as feelings of reassurance about the condition and current practices to manage their COPD in the work environment.

5.7.6 Other measures and their feasibility

As patients were not randomly allocated to receive the intervention and there was no control group, no conclusion can be drawn in terms of intervention effect, and the possible effect size. Nevertheless, this study has demonstrated the feasibility and acceptability of undertaking relevant measures in a definitive trial.

5.7.7 Future considerations for OH assessments in COPD patients

The findings from the qualitative interviews suggest that COPD is a complex experience among working individuals. The findings demonstrate that a study of this approach may not be successful as only a small number of patients wanted to take part. However, a number of factors were identified which may be useful when considering to deliver an OH intervention among COPD patients in the future, such as OH content, expertise and characteristics of individual(s) delivering the intervention, employer involvement and changes in current UK policy.

<u>OH intervention content to include patient empowerment and education</u>

Education on the management of COPD was important for the participants, and was seen as a key factor in patient empowerment. A number of patients expected a self-management assessment or feedback at the face-to-face OH visit. Some patients also recommended incorporating a COPD self-management and/or health check component to the intervention as a means of improving the OH assessment. In fact, a number of patients described their struggles with managing their breathlessness during the qualitative interviews, and some expressed their appreciation of the ‘tips for managing breathlessness’ highlighted in the COPD self-management leaflet.

These findings are in keeping with the literature, related to COPD patients often feeling the need for more information about their condition.[23] However, they do not necessarily receive accurate information about the disease and its management and there is evidence of the ineffective transfer of knowledge about COPD from healthcare professional to patient.[233]

Expertise and characteristics of individual(s) delivering an OH intervention

Whilst there were mixed views on the most appropriate professional to conduct an OH assessment, there were some constructive suggestions for future testing and implementation. The incorporation of an abbreviated OH assessment as part of the COPD annual review was welcomed by a number of participants, and might help overcome the low uptake rates and incorporate both OH assessment and self-management advice delivered by the same professional in one visit. Recent data (2013/2014) shows that approximately 80% of COPD patients had an annual review in the previous 12 months.[251] However, concerns about poor patient-GP communication and relationships, limited time and the lack of experience and expertise of practice staff all need to be considered and addressed.[252-254]

Furthermore, participants articulated the desired skill set required for the professional that should ideally deliver an OH assessment intervention. These include possession of comprehensive COPD knowledge, OH background and good communication skills, and preferably someone external and unrelated to their employer.

A plausible alternative proposal for delivery of an OH assessment, I suggest, is to incorporate this as part of a pulmonary rehabilitation programme, encouraging a holistic assessment of the patient with a focus on their COPD related health needs. By improving self-efficacy, patients are empowered to modify their behaviours[255] and respond effectively to particular events, for example the management of exacerbations.[256] Therefore, this incorporation may encourage successful workplace behaviour adjustments. Incorporating an OH aspect to PR may also promote a targeted approach (as suggested by a number of patients) to identifying those more affected by their disease – UK NICE guidance recommends referral to pulmonary rehabilitation in those with a recent hospitalisation due to an acute COPD exacerbation or those with a MRC score $\geq$3.[25] However, it would first be necessary to overcome the low uptakes to PR. Although one economical method, shown to improve attendance to health appointments, includes shifting the patient's role from a passive to an active recipient through commitment. Examples include verbal commitment, with patients repeating the date and time of their appointment, and written commitment, with patients writing the details of their future appointments instead of a professional.[257]

Employer involvement in future interventions

The study findings indicate that employer involvement through a patient-driven approach may not be successful, despite a few patients reporting independently discussing the OH recommendations with employers. Future interventions may therefore wish to consider excluding direct employer involvement, leaving the dissemination of any recommendations at the discretion of the patient. However, issues related to the reluctance of informing the employer of health conditions still remain.

Managerial support is recognised as important for successful workplace adjustments in those with chronic health conditions.[145] However, employers often lack understanding about disabilities and therefore may associate disability with physical impairments instead of those with a chronic or mental health condition.[258] From the employer's perspective, there is a need to address a number of factors for the adequate management of health conditions in the workplace: trust between the employee and employer; knowledge of the health condition and its impact on work and the need for employees to be open and take responsibility of their condition within workplace.[259]

Direction for future policy

Future policies need to focus on raising awareness of long term conditions, including COPD, in the workplace, and their impacts on work ability and work productivity. The needs and concerns of both patients (e.g. fear of job loss) and employers (e.g. lack of understanding about the impact of chronic conditions on work) need to be taken into account if we are to find solutions to managing COPD at work and gaining the best out of the workforce.

5.7.8 Study limitations

The main limitation of this study was the small sample size. Therefore, any patterns assessed among those who received recommendations should be interpreted with caution. Furthermore, we observed a possible non-response bias; for example, non-participants were more likely to be female, current smokers and have milder disease than those participating in the study. Although the absence of randomisation and a control group makes it difficult to draw conclusions about the impact of the intervention on patients, the purpose of this study was to explore the feasibility of such an OH intervention. There was no employer involvement in the study and therefore, the facilitators and barriers of the OH recommendations from the employer's perspective are unknown. It would have been useful to collect quantitative outcome data on the usefulness of the self-management recommendations among all the participating patients. Although a few qualitative transcripts were assessed by other academics (including an experienced qualitative researcher), a more rigorous method would involve two data analysts independently assessing all transcripts. Lastly, although the main researcher (KK) consistently considered reflexivity during the interviews, interviewed patients may have felt reluctance to express their views openly due to the researcher's role and commitment in the study.

5.8 Conclusions

This is the first study to assess the feasibility and acceptability of a standardised occupational health assessment in those with COPD. Uptake rates were very low, with younger individuals, smokers and those with milder disease declining or not responding. Although the majority of the patients who were seen received some OH recommendations, only half took up some or all of the recommendations. Modifications to job tasks/work methods/physical aspects of the job and to seek OH input and education were recommended the most. All patients received self-management recommendations, although not all were willing to take these up. However, many patients reported benefits of an increased awareness and reassurance about COPD and the interaction between COPD and work due to the

OH intervention. Future interventions may wish to consider the patient's position in the grieving process to understand whether patients have accepted their COPD diagnosis before initiating behavior change. Attaching the OH assessment as part of a pulmonary rehabilitation programme or embedding it within routine annual reviews are potential options that could be further explored. We found that employer involvement in this format is not feasible, although there is a need to raise awareness of the impact of COPD among employers. There is now a need for future interventions to develop on this work, and test the effectiveness of including OH assessments in improving employment rates and work productivity among working COPD populations.

6. DISCUSSION

The overall aim of this work was to investigate the relationship between COPD, employment and work productivity. To achieve this, four research studies were carried out, detailed in chapters 2 to 5. First, a systematic review of the literature was conducted to collate the current evidence and assess how COPD and its associated severity impacts on employment, absenteeism and presenteeism. Subsequently, two cross-sectional analyses were conducted, assessing which socio-demographic, clinical and occupational factors contribute to the lower employment rates and reduced work productivity among those with COPD. Finally, these findings were used to inform an experimental study outlined in chapter 5. This involved investigating the feasibility and acceptability of a novel intervention, aimed at improving the management of COPD within and outside the work environment, with the ultimate intention to impact on work productivity.

This final chapter aims to summarise the work within this thesis, discuss the main findings, and provide direction for clinical practice and future research in this field.

6.1 Summary of the evidence

6.1.1 Chapter 2: A systematic review assessing the effect of COPD on employment, absenteeism and presenteeism

Prior to the work presented in this thesis, evidence on the impact of COPD on employment and work productivity was limited and conflicting. The systematic review has clarified some of these issues and highlighted areas for further work. There was clear evidence of lower employment rates among those with COPD compared to similar populations without COPD. Among those in paid employment, patients with

COPD were found to take more time off compared to those without COPD, although there was inconclusive evidence as to whether sickness absence prevalence rates (episodes) differed significantly between COPD and non-COPD patients. Fewer studies were found assessing the impact of COPD on work performance, but available evidence suggests that COPD patients face greater impairment at work compared to those without COPD. The small volume of literature and inconsistencies in the measurement and reporting of this outcome did not allow quantification of these results.

The review also indicated that among those with COPD, increased disease severity was associated with a reduced probability of being in work. However, there was inconclusive evidence on the impact of disease severity on work productivity. Methodological weaknesses, mainly the lack of adjustment for relevant confounders, limited firm conclusions being drawn. The paucity of evidence among a UK working COPD population was also highlighted by the review.

6.1.2 Chapter 3: The association between COPD and employment; cross-sectional analysis of data from the Birmingham COPD Cohort

I used data from the Birmingham COPD Cohort to report employment rates among COPD patients of working age (40.0%), which is lower than those reported in the general population (73.5%), those with a long-term condition (59.6%) and those with a disability (46.1%).[179] I also found that being older (p for trend<0.01), having a lower educational level (p for trend<0.05), worse reported breathlessness (mMRC score 0-1 vs. mMRC score 4: OR=0.36; 95% CI 0.15 – 0.85) and high workplace exposures to VGDF (none vs. high JEM derived VGDF: OR=0.32; 95% CI 0.12 – 0.85) were independently associated with a reduced probability of being in work.

Whilst previous studies have suggested that disease severity may be an important contributor to unemployment among COPD patients,[22;101;103;158] this is the first study to report the significant impact of reported breathlessness (a subjective measure of disease severity) on unemployment after adjusting for a range of relevant confounders. Other measures of disease severity, including increasing airflow obstruction and the presence of comorbidities, were not significant independent predictors of being employed. These results therefore clarify the inconsistencies noted in previous research,[22;100-103;119;152;158] and suggest that reported breathlessness is a better indicator of being out of work compared to other measures.

6.1.3 Chapter 4: The association between COPD and work performance; a cross-sectional analysis of data from the Birmingham COPD Cohort

In this chapter I found that in the COPD cohort population who were employed, sickness absence prevalence (proportion of the working population reporting $\geq$1 day in 12 months) was lower (44%) compared to data from the general population (48%)[260] and those with long-term conditions (55%).[261] However, on average, patients with COPD took more time off work annually (10.4 days) compared to the UK national average (4.4 days)[125]; concurring with the findings from the systematic review.

Using a multivariable logistic regression analysis, I assessed which characteristics were associated with high sickness absence durations (defining high sickness absence as $\geq$ 6 days off work). Increasing breathlessness (MRC score 1 vs. MRC score 4-5: OR=9.04; 95% CI 2.85 – 28.68) was the only independent relevant factor identified, although increasing airflow obstruction and being female were also important factors when analyses were restricted to those with COPD-specific sickness absence. The findings help clarify the inconsistencies between disease severity and absenteeism noted in previous literature.[22;118;152;158;160-162;165]

In contrast to the findings of the systematic review suggesting poorer work performance among those with, than those without COPD, the average presenteeism scores in our study population were similar to those reported in populations with no disability[93] and better than those with arthritis,[191] indicating that when at work, COPD patients are generally functioning well. However, our analysis did not contain a non-COPD comparator population to allow adjustment for potential confounding factors.

One of the unique features of this study was that we were able to examine presenteeism and absenteeism within the same population, and in this chapter I demonstrated that these measures are not interchangeable. One in five patients with presenteeism scores indicative of poor work performance had little or no recent absenteeism.

Another novel aspect of this study was identification of factors associated with poor work performance, including increasing reported breathlessness, and high workplace exposures to VGDF (none vs. high JEM derived VGDF: OR=4.34; 95% CI 1.26 – 14.93).

Evidence from previous research suggested a trend between increasing breathlessness and presenteeism,[22] however, this is the first study to confirm the association among COPD patients. Previous studies among COPD patients were small and methodologically limited, with contradictory findings of the impact of airflow obstruction on work performance.[22;158;165] However using a validated presenteeism instrument and adjusting for important confounding factors, I found that airflow obstruction was not associated with poor work performance.

6.1.4 Chapter 5: Feasibility of delivering an occupational health intervention aimed at improving work productivity, among working COPD patients

Finally, these findings were used to inform the development of a feasibility study (OH intervention consisting of an OH assessment and feedback on improving current self-management practices), with the aim of helping patients to manage their COPD better at work.

Intervention uptake was low (11.3%). A range of physical, psychological and practical barriers affecting non-participation were identified. Participating patients viewed employer involvement negatively; >90% declined permission to involve the employer in the study (with the aim to improve the working environment), even with reassurance about anonymity.

Nevertheless, amongst those who did participate, a number of potential benefits were observed. Everyone received recommendations for either workplace modifications or for improving their disease self-management, suggesting that their management could be further optimised. However, only half of these were perceived to be implementable. Many also gained in other ways, including reassurance, feeling of empowerment and gaining greater awareness. Patient empowerment is considered important for behaviour change[262] and improving the quality of life and other health outcomes among those with a chronic condition.[263-265] It involves equipping patients with the knowledge, skills and self-awareness of identifying and achieving their own goals,[262] and thus, positively influence their own health.[266] Group sessions or face-to-face interventions have been found to be effective in increasing patient empowerment.[267;268] Some of these elements were also part of the OH intervention (e.g. face-to-face interaction and educating patients on COPD and the relationship between COPD and work), which may partly explain the findings of the positive psychological impact among the majority of the participating patients.

Whilst the intervention tested was not found to be feasible, the study provided important information to inform the development of future OH interventions, including insights into the content, groups who should be targeted, timing of such interventions in relation to the course of the disease, type of occupation and pattern of work, and characteristics of those who could deliver such interventions, seeking opportunities to embed the intervention within existing structures.

6.2 Measures of disease severity in predicting occupational outcomes among those with COPD

The findings of these analyses consistently demonstrate that reported breathlessness is a better measure of the impact of COPD on employment and work productivity than any other single measure of disease severity.

Historically, airflow obstruction (predominately measured by FEV_1) was used to define the overall severity of COPD. However over the years, there has been an increasing recognition of the unclear or weak correlations between airflow obstruction and the various aspects of health, such as health related quality of life and prognosis.[47;269] Furthermore , there is evidence that other single measures, such as exercise capacity, may better assess the impact on health than $FEV_{1.}$[270]

Consequently, there has been a rise in the development of multi-dimensional prognostic indices as a means of capturing the various aspects of disease severity into one measure,[271] for a better assessment of the impact of COPD on the individual. The testing of these indices, combined with the known heterogeneity of COPD, has led to the acceptance that such multi-dimensional instruments better predict important clinical outcomes (e.g. mortality,[48] hospitalisations[272] and COPD exacerbations[273]) and thus COPD prognosis, than FEV_1 alone. Many of these measures include breathlessness as one of the components. Furthermore, over the recent few years it has been recognised that the degree of reported breathlessness is a better predictor of mortality than airflow obstruction.[47]

The findings in chapter 3 were in keeping with this; the modified BODE index better measured the impact of COPD on the likelihood of being in paid employment than airflow obstruction. Subsequently, various components of the modified BODE index were explored. Although there was a non-significant trend associated with increasing airflow obstruction, the breathlessness component was the main driver of the effect on employment. Furthermore, this was validated by the consistent evidence across all three outcome measures (employment, absenteeism and presenteeism) assessed in this thesis.

However, research in this field is lagging; although a few studies have incorporated measures of dyspnoea into their assessment of COPD and statistical modelling,[22;100;118] airflow obstruction has been the main measure of disease severity among the majority of studies.

Due to the clear evidence presented in this thesis, a strong suggestion is that future statistical models should consider including other important measures of disease severity, particularly breathlessness, in addition to airflow obstruction. An alternative suggestion is the use of a multi-component prognostic index (instead of individual factors depicting aspects of disease severity), which contains breathlessness, such as the BODE index[48] or the ADO score[49] which has been validated in primary care populations. This may be more suited to models requiring adjustment for COPD prognosis, as the use of a composite index should help avoid the problems of reduced statistical power occurring with adjustment for a number of individual covariates.

6.3 The importance of exposure to vapours, gases, dusts and fumes in COPD

The causal role of occupational exposures in the development of COPD is well documented[71;72]; although the effect of such exposures on employment and work productivity among those with diagnosed COPD was less clear.[101;102;118;274] This is due to the paucity of evidence in this area, as well as the lack of reliable measurements of occupational exposures.

A few previous studies did suggest that occupational exposures to VGDF are associated with adverse working outcomes. For example, such exposure has been shown to increase the risk of respiratory related work disability (mainly defined as changing or leaving job due to lung disease) in those with COPD (low risk VGDF vs. high risk VGDF: adjusted OR=1.6; 95% CI 0.8 – 3.0),[275] asthma (none vs. high VGDF exposure: adjusted OR=3.5; 95% CI 1.4 – 9.0)[276] and the general population (none vs. high VGDF exposure: adjusted OR=3.4; 95% CI 1.8 – 6.6)[276] as well as respiratory related sickness absence among those with asthma (none vs. high VGDF exposure: adjusted OR=1.96; 95% CI 1.06 – 3.64) and respiratory symptoms (none vs. high VGDF exposure: adjusted OR=2.20; 95% CI 1.01 – 4.77).[201] These highlighted studies include prospective longitudinal studies,[275;276] with large,[201;276;277] randomly selected participants from the general population (reducing the risk of selection bias),[201;275-277] all of which have used a standardised method of assessing the risk of occupational exposures to VGDF (although varying job exposure matrices were used).[201;275-277] However, these studies were based on self-report of respiratory disease, and therefore at risk of misclassification.[201;275-277] Furthermore, important socio-demographic (e.g. education or socio-economic status), co-morbidities and clinical characteristics among those with respiratory disease (e.g. disease severity distribution) were often unreported; thus, lacking clarity in the generalisability of the sample population to those with respiratory disease. Some studies included younger participants (aged<45 years),[201;276;277] which may preclude generalisability of the impact on work disability to those of working age ($\leq$65 years). They also suffered from methodological limitations related to the lack of adjustment of all important confounders, such as co-morbidities, educational level and disease specific characteristics (although one study adjusted for asthma symptom score[276]).

Although the cross-sectional nature of this work precludes inferences on the causal role of VGDF on work ability and work productivity, many of these limitations (adjusting for all important confounders, spirometry defined COPD or based on GP records, range of socio-demographic, clinical and occupational characteristics within study sample) were addressed in this thesis. Furthermore, given that the majority of participants had been in their job roles for many years, whereas the measures of work productivity were recent, a temporal relationship was likely. Additionally, the 4 level job exposure matrix within this thesis included an additional level (medium exposure level to VGDF), which was deficient in the exposure matrices in the other studies (mainly based on 3 levels, such as, none, low and high or, low, intermediate and high),[201;275-277] and therefore may be considered as potentially more discriminatory to VGDF exposures in the workplace than other matrices, as well as providing evidence of a dose response relationship.

The findings in this thesis (using lung function data, a standardised job exposure matrix and adjusting for all relevant confounders) that high exposures to VGDF were associated with the reduced probability of being in work and an increased risk of poor work performance, were in keeping with the emerging body of literature as well as addressing the gap in knowledge of the impact among COPD patients. Weak trends were also associated with high rates of sickness absence, but the study lacked power to detect significant differences, should they exist.

With occupational exposures to VGDF identified as a significant factor associated with unemployment (chapter 3), poor work productivity (chapter 4) and increased risk of work disability[275] in patients with COPD, it is important that this is considered in future studies to take account of the potential adverse impact of occupational exposures on working patients with COPD.

6.4 A model for other chronic diseases

Poorer working outcomes are not observed in COPD patients alone. Chapter 1 and the systematic review in chapter 2 highlighted that having any long-term health condition is associated with adverse working outcomes compared to those with no chronic conditions. With an ageing UK population and an ageing workforce, chronic disease, is likely to become more prevalent in the labour market,[278] and as a consequence, lower employment rates and reduced productivity are likely to increase among these patients. To address this projected increase in poor working outcomes, interventions among those with chronic disease should be underpinned by the factors affecting these individuals.

Although the work presented in this thesis is in relation to one particular chronic disease – COPD – it demonstrated the assessment of factors (socio-demographic, clinical and occupational) which are also relevant to those with other chronic health conditions. Therefore, this work could be used as a model for research into the effects of other chronic conditions on work, with the assessment of similar clinical and occupational factors, particularly characteristics which are specific and relevant to the disease. This should account for patients' perceived limitations (e.g. subjective markers of disease severity) in relation to their condition in addition to clinically measured outcomes depicting disease severity. As observed in this work, a subjective measure of disease severity (patient reported breathlessness) better predicted the impact on work than an objective measurement (airflow obstruction, measured by spirometry). This suggests the importance of assessing commonly reported symptoms, such as pain,[279] physical limitations[280;281] or fatigue,[282] among chronically ill patients, as potential indicators of occupational or disease outcomes.

It is also important to consider the impact of multimorbidity on occupational outcomes. Workers are likely to be affected by more than one health condition,[145] and multimorbidity is projected to increase among the UK population.[279] In the working population in this study, 83% reported having at least one co-morbidity in addition to COPD. There is much evidence that multimorbidity is associated with adverse occupational outcomes[145;283] as well as increased functional difficulties and poorer quality of life.[284] Therefore, in addition to disease-specific measures, assessment of multimorbidity should also be incorporated within future studies that assess factors impacting on work productivity.

6.5 Future interventions aimed at improving work-related outcomes among those with COPD

There are two main approaches that could be used for improving work-related outcomes among those with COPD: disease-focused or workplace-focused approach. More commonly, the latter approach has been used, whereby interventions targeting either the whole workforce, or those with chronic conditions are evaluated in larger workplaces. These interventions have the potential to be rolled out to other large employers, and often use systems and processes that are more commonly available in such workplaces. For example, collaboration between the employer, employee and occupational health services for a worksite assessment, workplace modifications and a return to work plan for the patient (in those taking time off work), including an expected return date.[211] Among those with chronic health conditions, this may also include health promotion advice such as smoking cessation and physical activity.[210] Disease focused interventions have mainly been used for chronic diseases such as cancer or heart disease, where people with these conditions are supported to return to work after recovery from an "event". For example, important intervention components among those returning to work after a myocardial infarction (MI) include: knowledge about MI and its associated symptoms, addressing patient perceptions of MI and discussing the importance of medication and lifestyle behaviours (e.g. physical activity).[213] Among cancer patients returning to work after their diagnosis, interventions may include education (e.g. about the condition and nutrition) coping strategies (for managing stress and fatigue), counselling, physical activity and a multidisciplinary endeavour to support the patient to return to work.[215]

It could be argued that both approaches possess strengths as well as weaknesses; these are discussed further below. However, in this thesis, a disease-focused approach has been used and was more appropriate given the population studied. Reported breathlessness, which is potentially modifiable with interventions such as pulmonary rehabilitation, was identified as a risk factor for all occupational outcomes. Furthermore, all patients who took part in the occupational feasibility study had at least one area of their care that could have been improved (self-management recommendations), and most had workplace modifications that if implemented, could have impacted on their disease. Therefore a disease-focused intervention, delivered by an external professional (independent of the employer), seems viable and could be explored further. Whilst the approach used in this thesis was not feasible, other ways of delivering such an intervention are worth pursuing. This would encourage a targeted approach to symptom management, tailored to the needs of COPD patients, as well as the use of clinical expertise to encourage behaviour change. Patients may also feel more confident to discuss their individual health needs and the associated problems encountered in the working environment, without fear of the repercussions on their employment. Furthermore, the multi-component nature of the disease would benefit from specialist expertise and supported management in the overall management of COPD patients for improved health outcomes, such as quality of life.[63]

However, specific workplace adaptations, such as the reduction of occupational exposures, may be more challenging to implement using this approach. For this, a workplace-focused approach might be more suitable. Such an approach could potentially encourage the entire workforce to benefit. However, a workplace-focused approach is unlikely to be individualised (e.g. a generalised and non-specific assessment of the patient’s condition) due to the differing health conditions, lifestyles and risks of disease within the workforce,[1;179] and therefore the approach could be less effective in improving specific disease related issues associated with adverse working outcomes (such as breathlessness). However, individuals may benefit from broader health promotion or occupational advice such as smoking cessation, or the use of personal protective equipment in the work environment.

It could be debated whether workplace occupational health services could deliver disease-specific assessment and recommendations for the workplace. However, as supported from evidence presented in this thesis, patients may be reluctant or unwilling to discuss their disease as well as their lifestyle behaviours in this format. Therefore, the targeting of particular patient groups (e.g. those with more severe disease) and the timing of the intervention (e.g. subsequent to acceptance of the diagnosis of COPD) could be challenging factors to address in a workplace-focused approach. From the employer’s perspective, this may involve greater resources and therefore greater costs to the organisation in the short-term. Although benefits may be observed in the long-term, such as reduced absenteeism, increased work productivity, improved staff morale and a positive company image.[285]

6.6 Strengths and limitations of the thesis

Few studies have examined the effects of COPD on occupational outcomes within a primary care population assessing a range of socio-demographic, clinical and occupational characteristics, accounting for a wide range of potential confounders with objective measures of disease severity (particularly spirometry defined COPD). Furthermore, this is the first UK study to assess these effects. However, there are a number of limitations. Sickness absence rates were not verified and may not accurately reflect the true prevalence. Participation in the Birmingham COPD Cohort was low (26.3% uptake), and therefore some findings may be affected by responder bias. It is known that those participating in research are likely to be different from non-participants, for example, they are likely to be healthier and hold differing views on health compared to non-participants (e.g. current smokers are less likely to participate in research).[286] Those taking part in the cohort study were more likely to be male and of White ethnicity compared to non-participants. Therefore, those with COPD and in employment might be under-represented within this cohort; with the sub-cohort containing a biased sub-set of working patients with COPD. This may limit the generalisability of the study results to male COPD patients, specific occupations which are more common among men, as well as healthier COPD patients. Although these weaknesses may affect prevalence rate estimates, the associations observed with this work remain valid.

A novel element of the Birmingham COPD Cohort, and a strength of this work, is the addition of the newly identified COPD patients; allowing for the inclusion of those with milder disease (GOLD stage 1 prevalence rates in those newly identified vs. existing

COPD patients: 61.8% vs. 24.5%; MRC score 1-2 prevalence rates in those newly identified vs. existing COPD patients: 64.8% vs. 37.8%). However, as baseline research visits were carried out at the patient's GP practice, housebound patients were excluded. These patients may have more severe COPD, and therefore may be under-represented in this cohort.

Of the patients with an existing COPD diagnosis (from the GP register) who were in work at baseline, airflow obstruction was confirmed in only 283 (84.2%) patients (according to the fixed ratio definition in UK guidelines: $FEV_1/FVC<70\%$). Although this may be partly explained by variation in lung function measurements due to issues related to repeatability of lung function measures[287] and variations in bronchodilator response (reversibility) between spirometry tests,[288] it may also suggest misdiagnosis among some of the patients. Therefore, some of the included patients may not have COPD according to the clinical definition within UK guidelines. However, as these patients have been labelled with a diagnosis, and are potentially receiving treatment and self-management guidance for COPD, they were included in the final analysis.

Lastly, the cross-sectional nature of the analyses in this work precludes causal associations to be established. This limitation could be addressed once the Birmingham COPD Cohort three year follow-up is complete. Furthermore, this work lacked a comparator group (non-COPD patients). Nevertheless, the work presented in this thesis has revealed some important findings with relevance for future policy, clinical practice and future research.

6.7 Considerations for the overall management of COPD patients

In the UK, NICE provide evidence based guidance for the management of COPD.[25] The main aim of promoting COPD self-management is to "prevent exacerbations through lifestyle adaption and to allow patients to acquire the skills to treat their exacerbation at an early stage".[39] Hence, the guidance recommends a number of strategies, some of which include smoking cessation, medication management and an action plan for worsening symptoms (recommendation areas are highlighted in chapter 5).[25] However, evidence from the feasibility study highlighted that there was suboptimal management of COPD among all participating patients, as each patient was provided with at least one additional self-management recommendation (with several recommendations provided to many patients). It can be argued due to the small study sample size (n=35) it is difficult to extrapolate and generalise the findings to the wider COPD population. However, findings from chapter 4 concur with these results. It is also likely that those who agreed to take part in the feasibility study represent a more motivated group that attend annual reviews, suggesting that the findings are more likely to underestimate the problem of sub-optimal management.

Smoking cessation is the single most cost effective method in improving the adverse outcomes in patients with COPD, irrespective of disease severity and has also been demonstrated to slow the progression of COPD by preventing lung function from worsening.[60;289] Yet, a high proportion (n=133; 41.3%) of those in work remained current smokers. Furthermore, as highlighted in chapter 1, increased exacerbations are associated with poorer health outcomes, such as increased mortality, increased morbidity and a poorer quality of life.[55;57] Self-management guidance focuses on the importance of preventing exacerbations. However, among this working population, approximately 14% of patients experienced $\geq$3 exacerbations in the previous 12 months requiring treatment with antibiotics or steroids. These results suggest that better COPD management is required amongst these patients.

Self-management has been defined as “the patient’s ability to manage the symptoms, treatment, physical and social consequences and lifestyle changes inherent in living with a chronic condition”[290]; a shared definition among all chronic conditions. For which a collaborative endeavour between patients and healthcare professionals is necessary to ultimately encourage behaviour change within patients.[1;291]

However, findings from chapter 5 indicated patients were actively seeking to find out further information about the disease and its management, demonstrating potential knowledge deficiencies. Some patients also expressed their concerns about their passive relationships with their GPs, and the lack of concern displayed by their GP towards their condition. However, knowledge about COPD is important for behaviour change and the management of the disease among patients; highlighting the importance of the healthcare professional’s role in helping patients achieve positive health outcomes.[255]

It appears much work is still needed to improve the overall self-management and health of patients with COPD, particularly among the working population. There is a need for healthcare professionals to focus on the recommended strategies highlighted in the NICE guidelines to improve self-efficacy of patients, particularly guidance for smoking cessation.

6.8 Recommendations for policy

The relationship between COPD and work outcomes merits greater attention and should be considered as a matter of concern for all stakeholders. Patients, healthcare professionals and employers need to be informed of the adverse impact of COPD on work ability and work productivity. This is in preparation to help patients to remain in or return to work as well as supporting patients to manage their breathlessness and promote the reduction of exposures to VGDF in the workplace. Whilst policy to restrict or reduce workplace exposures would be important for those with an existing COPD diagnosis, it could potentially have wider beneficial effects on the workforce e.g. among those with other respiratory diseases, respiratory symptoms as well as in those with undiagnosed COPD.

Part of the UK government's strategy to help those with health conditions and disabilities remain in or return to work is to educate healthcare professionals, so they are better informed and confident to provide advice to patients.[10;292] One recommendation from this thesis, is that these strategies also incorporate informing healthcare professionals of the impact of COPD on work, and the importance of improving the management of breathlessness among these patients.

I also recommend that the UK government should raise awareness among employers about COPD, and the impact of occupational exposures on employment and work productivity, to encourage workplace accommodations. This could potentially be carried out and tested alongside the government's COPD public health initiative – a proposed strategy aiming to raise the awareness among employers of the risks associated with smoking and VGDF in lung damage and the development of COPD.[10]

Lastly, the GP's role is considered "pivotal" in 'health and work', as they are usually the first healthcare professional patients meet when taking sickness absence from work, and are in an influential position to provide guidance about remaining in or returning to work.[1;10] Therefore, GPs should be encouraged to discuss with patients the effects of COPD on work, to increase the awareness among patients of the potential adverse outcomes of the disease.

Activities for increased awareness should also include embedding such information within the current literature provided to COPD patients e.g. leaflets related to living with COPD, and patient friendly websites. Although leaflets, such as those from the British Lung Foundation (BLF) (appendix 6), may contain limited information on the impact of work on COPD (occupational exposures contributing to further lung damage), this could be modified to include information on the consequences of COPD on work ability and work productivity.

6.9 Recommendations for practice

Reported breathlessness was identified as a consistent clinical factor affecting work related outcomes in all analyses presented in this thesis. This suggests that there are potential opportunities to modify work ability and work productivity among those with COPD. The UK NICE guidelines for COPD provide guidance for healthcare professionals on the management of breathlessness, such as better medication management, smoking cessation, referral to pulmonary rehabilitation and oxygen therapy.[25] Healthcare professionals, particularly those within primary care, should therefore identify breathless working patients (preferably using the MRC questionnaire), and work alongside these patients to encourage better management of their symptoms. Additionally, as identified in the feasibility study, some patients may benefit from written information on the management of breathlessness, which should also be considered by healthcare professionals.

Occupational exposure to VGDF was also identified as a modifiable factor that impacts on work ability and work productivity among COPD patients. This suggests the importance for COPD patients to undergo occupational health (OH) assessment to determine the level of exposure to VGDF in their working environment. OH services may be able to suggest modifications or workplace accommodations among those identified with high exposure jobs. In practice, such assessment may not be feasible for all working COPD patients due to the low provision of OH services; an estimated 3% – 15% of all UK companies provide OH support (dependent on definition of OH support).[293] Furthermore, the approach taken in the feasibility study to assess and intervene to reduce exposures to VGDF in the work place did not appear to be feasible. However, exposures to VGDF remains a clear issue among working COPD patients and therefore other approaches should be considered to assess and reduce such occupational exposures.

One potential solution may include providing all stakeholders (patients, employers and GPs) access to information on the level of exposure to VGDF for the patient’s job role (as an alternative to a risk assessment by OH services). For this, a validated job exposure matrix could be linked to the CASCOT software (freely accessible online), and a VGDF occupational risk (none, low, medium or high) could therefore be presented alongside each job title. This may facilitate employees, employers or GPs to initiate or seek advice for the appropriate modifications required to patients’ job role, job tasks or working environment to reduce exposure.

A formal assessment of workplace exposures to VGDF could also be incorporated as part of the workplace risk assessment, which currently all employers are legally required to carry out.[294] This may be a feasible solution, particularly amongst employers/companies who have limited or no access to OH support.

6.10 Recommendations for research

Although recommendations for future research were made in relation to each study, this is a summary of the main points to be considered for future research.

Much of the evidence assessing the relationship between COPD and work (including chapters 3 and 4) is limited to cross-sectional studies, which precludes drawing inferences on causality. Of the small number of longitudinal studies, the majority assessed the impact on absenteeism, and consisted of methodological limitations, such as diagnosing COPD based on self-report. There is therefore a need for robust prospective longitudinal studies to establish the temporal relationships between disease severity, occupational exposures to VGDF and employment/work productivity.

Although the findings (e.g. time off work) were compared to other studies and national datasets, this study did not contain a comparator population. Future observational studies should contain a non-COPD population to allow for a better comparison of outcome measures between those with COPD and those without; allowing for consistency in the measurement of exposures and outcome measures, statistical adjustment and subsequent statistical significance of any group differences.

In the cross-sectional studies (chapter 3 and 4) there was a low level of data completeness for some of the measures; a known issue in observational research. Data from health records, where possible and relevant, might also improve data accuracy (e.g. co-morbidities and exacerbations).

The systematic review identified the use of varying presenteeism instruments in this field of research, as well as the inconsistency in the reporting of results. Such heterogeneity led to difficulties in quantifying and comparing the results between studies, as well as assessing the true impact of COPD on work performance – which was also true for the studies reporting the impact on absenteeism. There should be an agreement on consistent measurements and reporting methods of these measures, to allow for comparison between studies

Due to the consistent significant findings of the importance of breathlessness, I recommend that future statistical models should consider including other measures of disease severity, particularly breathlessness, or the use of a prognostic index instead of assessing airflow obstruction alone. Statistical models may also consider testing for the confounding impact of VGDF.

Lastly, I recommend further research to determine the effectiveness of managing breathlessness and reducing workplace exposures on work ability and work productivity among patients with COPD. One possible approach is to investigate the impact of an OH component as part of a pulmonary rehabilitation programme, where patients are referred because of their breathlessness. However, inconvenient timings and venue locations have been identified as barriers to the uptake of such programmes. To increase accessibility and uptake, future programmes should consider providing weekend options, particularly for working patients, and venues local to the patients.

6.11 Conclusions

There is a need to help patients with COPD remain in or return to work and among those in work, to help improve their work productivity. With the state pension age rising, there is a need to hasten the response of addressing these issues. The studies presented in this thesis provide valuable information for developing a strategy to help improve the low employment and high sickness absence rates in those with COPD:

- Breathlessness is the single most important clinical factor associated with unemployment and poor work productivity.
- High exposure to VGDF is the key occupational factor associated with unemployment and poor work productivity.
- It is important to raise the awareness of these two issues amongst patients, clinicians and employers.
- Findings from the feasibility study, particularly the low uptake rates suggest that the study was unsuccessful in its current format. However, patients identified self-management as an essential element for the general management of COPD.
- Future interventions could test the impact of an OH assessment as part of a pulmonary rehabilitation programme on working outcomes, to encourage a holistic approach to the management of the multidimensional nature of COPD.
- The thesis also provides important insights into an important chronic disease in relation to work, which could be the basis for the study of other common chronic diseases.

APPENDIX 1. COPE FEASIBILITY STUDY: PARTICIPANT INFORMATION LETTER

UNIVERSITY OF BIRMINGHAM

BLISS

Birmingham Lung Improvement Studies

The COPD, Occupation and Work Performance Feasibility Study: patient information letter

7th May 2014

Dear,
Study ID:

Thank you for your continued support and participation in the BLISS Birmingham Cohort Study which looks at the health of patients with COPD.

As part of the larger study we are interested in getting a better understanding of the way COPD may impact on work among those who are in employment. We are writing to you as you have let us know that you are working, and we wanted to invite you in this part of the study.

Please read this patient information sheet, which will give you more information so that you can make an informed decision about whether or not you would like to take part. We would very much appreciate your help.

Please complete the enclosed reply slip and return it in the pre-paid envelope supplied.
If anything is unclear or you would like further information please contact our lead research nurse Kiran Kalirai at the University of Birmingham: Telephone: [redacted]
or email: [redacted]
We look forward to hearing from you.
Yours sincerely,

[redacted] [redacted]

Professor Peymane Adab	**Kiran Kalirai**
(Lead investigator)	**(Lead research nurse)**

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COPE patient information letter V5.0 25/03/2014

UNIVERSITY OF BIRMINGHAM

BLISS

Birmingham Lung Improvement Studies

The COPD, Occupation and Work Performance Feasibility Study: patient information letter

What is this study about?

The Birmingham COPD Cohort Study is a medical research study that will include over 2000 people with chronic obstructive pulmonary disease (COPD). This additional study will look at how COPD affects your work and how your work affects your COPD.

Why is the study being done?

We know that of those with COPD in the UK, approximately 40% are of working age of whom about a quarter are not able to work. COPD may affect work capability but no research has been carried out in the UK to assess this effect.

To gain more understanding of the relationship between COPD and work we plan to invite some patients to meet an occupational health practitioner. Ultimately, this will enable us to find out more about the relationship between work and COPD which may help develop interventions in the workplace to support those with COPD to have a better work experience.

What if I do not want to take part?

You are under no obligation to take part in this study; your medical care will not be affected in any way. If you do not want to take part, please fill in the reply slip and return it in the addressed pre-paid envelope provided, as soon as possible.

What will I have to do if I choose to take part?

For the purpose of this study, you have been identified as someone with COPD who is in work. If you agree to take part we will ask you to complete some brief questionnaires about your COPD and your work. These questionnaires will also be repeated at the end of 6 months. You will be invited to talk with an occupational health practitioner (OHP) who will assess whether, and how your COPD affects your work. After the interview, the OHP will prepare a report which will include recommendations (if applicable) for you

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COPE patient information letter V5.0 25/03/2014

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Birmingham Lung Improvement Studies

The COPD, Occupation and Work Performance Feasibility Study: patient information letter

and your employer on possible changes to your work practice, for instance by making recommendations for adjustments either in the workplace or in your work process. You can use the report how you wish.

There will also be the opportunity for your workplace to be assessed by an expert in work and health and for recommendations to be given to your employer to improve your work environment. We will discuss this option at the time of the report but be assured that your employer will not be contacted unless you agree. The aim is to make the work environment better for you if it is affecting your ability to work.

If you decide to go ahead with letting your employer know, we will then contact your employer to see if they would like to meet the OHP to discuss any recommendations on how your work environment can be improved.

After the first month we will post out a questionnaire to find out your initial thoughts on the process, then after a few months we may contact you to invite you to take part in an interview. The purpose of the interview is to find out more about whether any intervention at work did take place and to see if this has improved your ability to work, but it will remain your choice whether or not you wish to take part in this.

We are very mindful about confidentiality, and will keep all your information confidential.

We will also review how you are getting on with managing your lung health. This will be assessed by looking at some of the information you provided in the previous cohort questionnaires. Any potential areas which could be reviewed in consultation with your GP will be highlighted and summarised for both yourself and your GP. In addition, you

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have the option for your GP to receive your occupational health recommendations. Again, this is entirely up to you.

What happens at the end of this study?

We will analyse all the data to assess how this may be used to help the working lives of people with COPD. Please let us know if you would like to receive a report about this.

What are the possible disadvantages and risks of taking part in this study?

The main disadvantages of taking part are the time and travel involved to meet the OHP. However, we can arrange for the OHP to meet you at a time and place suitable for you. Your travels expenses will be reimbursed.

What are the possible benefits of taking part?

By exploring the feasibility of an occupational health assessment we can work out how future research in this area can be undertaken which can then help to inform services to keep patients with COPD in work as well as create a better working environment. This is a completely new area of research and this project will be the first ever world-wide to consider the effects of COPD on work.

Furthermore, if you participate in the study, you will have the benefit of meeting with the OHP and to receive recommendations specific to you and your workplace, and also the opportunity to have a tailored report to your GP on aspects of your COPD that could be better managed.

What do I need to do now?

First of all, we ask you to decide whether you would like to participate or not. If you chose to do so, please return the consent form in the pre-paid envelope provided, as

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soon as possible. If not, then please return the reply slip so we know you do not wish to take part.

What if I have more questions or do not understand something?

If you have more questions, or you do not understand something in this information letter, please contact our lead research nurse Kiran Kalirai (details are on the next page).

What happens now if I decide to take part?

Once we receive your reply, we will contact you to discuss this study further and arrange for you to meet the OHP at a time and place suitable for you.

What happens if I change my mind during the study?

You can withdraw from the study at any time without any pressure and it will not affect your usual care from your GP in any way. If you decide to withdraw, you can contact Kiran Kalirai or leave a message with the BLISS study team.

Will my taking part in the study be kept confidential?

All your personal identifying information (such as name and address) will be kept separately from other health and medical information we have for you. No one outside the study team can access your personal information. However, if you consent to take part in the research any of your medical records may be audited by people from regulatory authorities to check the study is being carried out correctly. Your GP will be notified of your participation in the study. All data will be held on secure computers that block unauthorised access (e.g. by hackers) and are password protected. All paperwork will be kept in a locked cabinet in a locked room (where the researcher is based).

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If you are happy to take part in the interviews, your name will not be tape-recorded, it will be removed from the interview transcripts and you will be assigned a unique ID number to maintain confidentiality of your identity.

<u>Direct quotes may be used in publications but these will be numbered and anything which could identify you will be removed.</u> Nothing that you say at the interview will be fed back to the occupational health physician as coming from you.

Data Protection Act 1998

The information you give us in the interviews will only be used for the purposes of the study. The information, including audiotapes, will be kept securely for a period of 10 years after the study ends and then will be destroyed.

Who is running the study?

This study is being carried out by the University of Birmingham. The study is funded by the UK National Institute for Health Research through the Department of Health and has been approved by the South Birmingham Research Ethics Committee.

What if I am unhappy with the study?

If you find that you are unhappy with the study or its conduct, please contact Kiran Kalirai in the first instance, who will listen and deal with your concerns. If you wanted independent advice you can contact the University's Research Governance and Ethics Manager, Dr. Sean Jennings (E-mail: [redacted] Phone: [redacted]).

What happens to the results of the research study?

Once we have analysed the results we will publish them in medical journals. We will also publish the results on our website. You will not be identified in any publication.

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The COPD, Occupation and Work Performance Feasibility Study: patient information letter

Any queries or further information please contact:

Miss Kiran Kalirai

The Public Health Building

University of Birmingham, Edgbaston, Birmingham. B15 2TT.

Website: http://www.haps.bham.ac.uk/publichealth/research/bliss.shtml

Thank you for taking the time to read this

APPENDIX 2. COPE FEASIBILITY STUDY: PARTICIPANT REPLY SLIP

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The COPD, Occupation and Work Performance Feasibility Study: patient information letter

REPLY SLIP

Please return this reply slip in the pre-paid envelope to:

Miss Kiran Kalirai
Institute of Occupational and Environmental Medicine.
University of Birmingham, Edgbaston, Birmingham. B15 2TT.

I **would** like to take part in the study ☐

My name and address:..

My telephone or mobile number: ....

or

I would **prefer not** to take part in the study ☐

If you prefer not to take part, please do let us know why. We are really interested in your thoughts.

I would prefer not to take part in the study because:

1. This study does not interest me ☐
2. I don't think the occupational health practitioner can help me as I have made adjustments ☐
3. I am worried about the information getting back to my employer ☐
4. I do not need help as I am fine at work ☐
5. Other reasons ☐
6. I prefer not to say ☐

Please let us know: ....

Thank you for taking your time to complete the reply slip

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APPENDIX 3. COPE FEASIBILITY STUDY: PARTICIPANT SUMMARY LETTER

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The COPD, occupation and work performance feasibility study: patient information letter summary

Who we are: We are researchers from BLISS at the University of Birmingham. We are undertaking a new study which looks at the health of working COPD patients.

What we aim to do: Our aim is to understand more about the relationship between COPD and work.

How we will achieve this: We are inviting some patients to meet an occupational health practitioner (OHP). This will enable us to find out whether changes could be made to the workplace to support patients with respiratory problems and to have a better work experience.

What we ask patients to do: Those who agree to take part, will be asked to complete some questionnaires at the start and the end of the study (6 months later) and to have one visit with the OHP. After this visit, we will send patients the OHP's workplace recommendations report. We will also review how patients are getting on with managing their lung health. <u>Please remember</u>, patients can use these reports however they wish.

Patients may also have the opportunity:

- For their employer to be contacted by the OHP with the view of improving the work environment (to be discussed at the visit)
- For their GP to be contacted with potential self-management areas for review
- To take part in an interview to discuss their views on the process and the reports

What happens if I change my mind about taking part: If you agree to take part and you change your mind during the study, you can contact us at any time to let us know you no longer want to take part.

What to do next: If you are potentially interested, please read the attached patient information letter for further information. Please return the reply slip in the pre-paid envelope to indicate whether or not you would like to participate; if we do not hear from you we will send you another reminder in the next 4 weeks.

IF YOU WOULD LIKE FURTHER INFORMATION PLEASE CONTACT KIRAN KALIRAI ON:

[redacted]

Thank you

COPE: PIL summary 2014 V1.0 02/04/2014

APPENDIX 4. OCCUPATIONAL HEALTH ASSESSMENT TOOL

Current symptoms and work	At work do you experience any symptoms due to your COPD?
	Does your work affect these lung symptoms?
	Do your lung symptoms affect your work?
Symptom management at work	Do you do anything in the workplace to manage your symptoms or your COPD?
Current workplace triggers	Are you exposed to any vapours, gases, dusts or fumes in your current work?
	Do any exposures/substances/materials at work worsen your symptoms e.g. leave you feeling short of breath, make you cough or make you feel tired at work?
	Do any job tasks/work methods/tools at work worsen your symptoms e.g. leave you feeling short of breath, make you cough or make you feel tired at work?
	Are there any physical aspects of your job which worsen your symptoms e.g. leave you feeling short of breath, make you cough or make you feel tired at work?
	Are there any other factors at work which can make your COPD worse?
Working demand/pattern	Do you work shifts?
	How many hours do you work per week?
	Does your shift pattern or working hours affect your health?
	In your job, has the work demand or shift patterns worsened your COPD symptoms (*leave you feeling short of breathe, make you persistently cough or make you feel tired?)*
Work environment	Is the work environment generally dust-free?
	Do you work in a cold environment or exposed to draughts?
	Is your work mainly outdoors?
	In your job, has the work environment worsened your COPD symptoms (*leave you feeling short of breathe, make you persistently cough or make you feel tired?)*
	In your view, can any changes or modifications to your work or work environment be made to improve your COPD at work?
Equipment and training	Has your employer suggested you work any personal protective equipment (PPE) for certain work tasks? (for example masks) **IF YES:** do you use them? **IF NO:** do you feel the need for PPE for certain work tasks?
Working relationships	Does your line manager know about your COPD? **IF NO**: Why not?
	IF YES: Have with spoken with your employer about work how work affects your COPD
	Have any changes been made to your work or working environment because of your COPD? **IF YES**: What are they?
Occupational support from work	Does your current workplace have an occupational health service? **IF YES:** have you received any occupational health services support for your COPD at your current workplace?
	Does your employer give you advice on how work may affect lung health?
	Have you received any occupational health services support for your COPD at a previous workplace? **IF YES**: has this advice helped you at work?

APPENDIX 5. COPE FEASIBILITY STUDY: EXAMPLE PATIENT REPORTS

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The COPE feasibility study: health and work feedback

Patient address

Dear Mr *** ***,

Study ID: ******

Thank you for your time and coming to see the occupational health (OH) practitioner on 21st May 2014. In this report you will find:

1. Recommendations based on your discussion with the OH practitioner, to help you manage your symptoms and feel better at work
2. Recommendations on how you may be able to better manage your lung health

OH recommendations

Job tasks/work methods

- Alternatives to the use of wire wool for cleaning copper pipes should be considered e.g. abrasive pads, particularly when cleaning for prolonged periods and very old pipes which may be coated with various metals, paints etc.
- Could also consider using mechanic pipe cleaning tools e.g. monument pipe cleaners

Substances/ materials

- Soldering activities can generate fumes which can cause respiratory irritation/sensitisation. The fume levels can be reduced by using:
  a) Plastic instead of copper fitting
  b) Use of solder ring joint or crimp fitting

Work environment (indoor/outdoor, temperature humidity)

- Dusty work areas should be screened to avoid the spread of dust in to your work environment

Physical aspects of your job

- Wherever possible, physical work should be avoided e.g. carrying radiators and breaking up cast iron baths

Use of personal protective equipment

- Need to wear a dust respirator when conducting all cleaning activities after completion of job tasks e.g. end of each day

COPE Study: health and work patient feedback V2.0 25/03/2014

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The COPE feasibility study: health and work feedback

<u>Self-management recommendations</u>

I have also assessed how you are getting on with managing your COPD from your responses to questions (as part of the BLISS programme) in relation to recommendations for care of patients with COPD in the national guidelines (National Institute for Health and Clinical Excellence). Based on your responses, I would suggest that you discuss the following issues with your GP or practice nurse when you next have an appointment:

- ✓ Ensuring you have flu vaccination next autumn
- ✓ Referral to a dietician
- ✓ We don't have information on your inhaler usage. We suggest you discuss this with your GP

Please also see the enclosed leaflet by the British Lung Foundation. It provides tips on what you can do to achieve better management of your lung health.

I plan to provide your GP with a copy of this information for you both to discuss further. However, before doing so, I need to find out whether you are happy for this and the occupational recommendations to be sent to your GP. I will contact you in the next few weeks regarding this. Please be assured, we will not send this information unless you are happy for us to do so.

If you have any questions about the information in this letter or about the BLISS study, please do not hesitate to contact us.

Thank you again for your time and support in the BLISS study.

Yours sincerely

Prof Peymane Adab	Kiran Kalirai
(Lead investigator)	(Lead research nurse)

COPE Study: health and work patient feedback V2.0 25/03/2014

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The COPE feasibility study: health and work feedback

Patient address

Dear Mr *** ***,

Study ID: ******

Thank you for your time and coming to see the occupational health (OH) practitioner on Wednesday 14th May 2014. In this report you will find:

1. Recommendations based on your discussion with the OH practitioner, to help you manage your symptoms and feel better at work
2. Recommendations on how you may be able to better manage your lung health

OH recommendations

Recommendations for preventing the worsening of COPD symptoms when conducting building work:

Job tasks/work methods/tools

- Avoid dusty tasks e.g. putting cement into mixers, making up plaster, paper stripping and any occasional demolition work. If these tasks cannot be avoided, then a suitable respirator (mask) should be used for the duration of the task
- Where possible, avoid tasks which require regular bending or working below waist level e.g. when laying bricks below waist height. Consider sitting on a stable stool when working at lower levels for prolonged periods and avoid storing materials at ground level
- Avoid lifting heavy items e.g. bags of cements, carrying too many bricks/blocks at a time and 'loading out' i.e. carrying building material from storage to build area
- Consider using mechanical lifting aids e.g. trolleys or telehandlers when moving large loads

Physical aspects of your job

- Physical work should be delegated to other staff/contractors e.g. digging out footing in new builds

Work environment (indoor/outdoor, temperature humidity)

- Where possible avoid outdoor work on damp /frosty days. Consider re-scheduling work with client(s) to avoid working in cold conditions

Work organisation

- Schedule jobs which enable pacing of work to avoid continuous work e.g. working more than 2 hours without a break

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The COPE feasibility study: health and work feedback

Use of personal protective equipment

- Check and ensure that you have the right type of face mask (respirator) for the different tasks. For example, masks recommended for dusty jobs are not likely to provide protection when painting, varnishing and using thinners.

<u>**Self-management recommendations**</u>

I have also assessed how you are getting on with managing your COPD from your responses to questions (as part of the BLISS programme) in relation to recommendations for care of patients with COPD in the national guidelines (National Institute for Health and Clinical Excellence). Based on your responses, I would suggest that you discuss the following issues with your GP or practice nurse when you next have an appointment:

- ✓ Support to help you with smoking cessation
- ✓ Referral for pulmonary rehabilitation
- ✓ A plan for what to do when your symptoms get worse
- ✓ Approaches for managing stress
- ✓ Referral to a dietician
- ✓ Approaches to support you doing more physical activity
- ✓ We don't have information on your inhaler usage. We suggest you discuss this with your GP
- ✓ We don't have information on your flu vaccination. We suggest you discuss this with your GP

Please also see the enclosed leaflet by the British Lung Foundation. It provides tips on what you can do to achieve better management of your lung health.

I plan to provide your GP with a copy of this information for you both to discuss further. However, before doing so, I need to find out whether you are happy for this and the occupational recommendations to be sent to your GP. I will contact you in the next few weeks regarding this. Please be assured, we will not send this information unless you are happy for us to do so.

If you have any questions about the information in this letter or about the BLISS study, please do not hesitate to contact us.

Thank you again for your time and support in the BLISS study.

Yours sincerely

Prof Peymane Adab	Kiran Kalirai
(Lead investigator)	(Lead research nurse)

COPE Study: health and work patient feedback V2.0 25/03/2014

APPENDIX 6. BRITISH LUNG FOUNDATION LEAFLET: LIVING WITH COPD

APPENDIX 7. COPE FEASIBILITY STUDY: EXAMPLE EMPLOYER REPORT

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The COPE feasibility study: health and work feedback

Dear <employer/line manager/health and safety officer>,

Thank you for responding to agree to take part in the COPE feasibility study. As explained, please find enclosed the specific recommendations for your workplace which are based on our interview with your employee. We would like to remind you that your employee was not assessed for fitness to work. Also, we wanted to remind you that these recommendations are suggestions, not mandatory.

Dr Sadhra will aim to contact you within a fortnight of sending this letter. There is no compulsion to take up this meeting and/or his suggestions. The meeting would be an opportunity for us to know your views, whether the suggestions are feasible and the practicalities faced to implement such suggestions.

If you have any questions about this information or about the BLISS study, please do not hesitate to contact us.

Many thanks for your time

Yours sincerely

[redacted]	[redacted]	[redacted]
Dr Steven Sadhra	Prof Peymane Adab	
(Occupational health practitioner)	(Lead investigator)	(Lead research nurse)

<u>OH Recommendations</u>

Job tasks/work methods/tools

- Alternative methods to manual cleaning of tanks should be considered e.g. automated cleaning. The current cleaning process involves the use of chemicals as well as physical work including brushing and climbing steps, which can take up to 1.5 hours

Work organisation

- The work schedule and delivery journey should be reviewed to minimise the number of occasions the driver needs to sleep overnight in the vehicle cabin, particularly during the winter months

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The COPE feasibility study: health and work feedback

Use of controls measures/personal protective equipment

- Local ventilation systems (LEVs) are installed to collect dust during filling of tanks with cement but these may not be 100% effective in capturing all the displaced dust. Therefore, respirators (face masks) should be worn at all times when filling and discharging cement from tanks. Any disposable masks should be replaced regularly.
- Health and Safety team should be consulted to ensure that:
    a. The correct respirator is used for cement dust
    b. Respirator is cleaned, stored and used correctly
- The programme for maintenance of ventilation extraction systems at the cement filling stations should be reviewed to ensure that they are working efficiently which will help to minimise the dependency on dust respirators

Occupational health services and education

- It is important for all vehicle drivers who transport cement to report any respiratory symptoms to the local occupational health department, who can advise on workplace adjustments if needed.
- It is important for employees to attend the annual appointments offered by the occupational health department for any routine respiratory surveillance.

COPE Study: workplace feedback V2.0 25/03/2014

APPENDIX 8. COPE FEASIBILITY STUDY: EMPLOYER INFORMATION LETTER

UNIVERSITY OF BIRMINGHAM

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Birmingham Lung Improvement Studies

The COPE feasibility study: health and work

BLISS details

Dear <employer/line manager/health and safety officer>,

One of your employees is voluntarily taking part in a research study on work and respiratory health at the University of Birmingham. As part of this study, they have been seen by one of our occupational health practitioners who discussed with them their work environment, job tasks and work organisation in order to understand how work may impact on their lung health. The main purpose of the discussion was to identify and make recommendations about how their local work environment may be further improved to benefit their health.

Another part of this research study, is to explore the views of employers and to assess whether such recommendations would be useful and feasible to implement in a range of work settings. We are therefore writing to you to ask if you would be willing to take part in this study and to be interviewed by our occupational health practitioner. Please read the enclosed information leaflet which provides further details. If you agree to take part, we will send you a report outlining some recommendations for you to consider implementing within your workplace. We will then arrange a time for interview, where we could discuss these recommendations with you, to better understand your perspective on whether you feel these suggestions are useful and could be implemented in your workplace. We would also be interested to learn about any potential barriers there might be to implementing such changes. We look forward to hearing from you.

Yours sincerely

Prof Peymane Adab	Kiran Kalirai
(Lead investigator)	(Lead research nurse)

COPE Study: employer letter V1.0 25/03/2014

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The COPD, occupation and work performance feasibility study: employer information letter

What is this study about?

The COPE study is part of the larger Birmingham Lung Improvement Studies, a medical research programme focusing on people with chronic obstructive pulmonary disease (COPD). This study will look at how the work environment may affect COPD and how having COPD affects work.

Why is the study being done?

We know that of those with COPD in the UK, approximately 40% are of working age of whom about a quarter are not able to work. COPD may affect work capability but no research has been carried out in the UK to assess this effect.

To gain more understanding of the relationship between COPD and work we are inviting some patients to meet an occupational health practitioner. We are also inviting employers to take part in an interview to explore their views of the feasibility of implementing various workplace interventions to support those with COPD to have a better work experience.

What if I do not want to take part?

You are under no obligation to take part in this study and any workplace recommendations are not mandatory. If you do not want to take part, please fill in the reply slip and return it in the addressed pre-paid envelope provided, as soon as possible.

What will I have to do if I choose to take part?

If you agree to take part we will send you a number of recommendations that we would like you to consider, which if implemented, could improve the lung health of your employees. We would then like the opportunity for an occupational health practitioner (OHP) to discuss these recommendations with you. The interview will last up to 30

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The COPD, occupation and work performance feasibility study: employer information letter

minutes, and will explore your views of the recommendations. In particular we would like to know whether you find these suggestions helpful, and whether you think they are feasible to implement. We would also like to know about any barriers to implementing these recommendations.

What happens at the end of this study?

We will analyse all the data to assess how this may be used to help the working lives of people with COPD. Please let us know if you would like to receive a report about this.

What are the possible disadvantages and risks of taking part in this study?

The main disadvantage of taking part is the time to have an interview with the OHP.

What are the possible benefits of taking part?

By exploring the feasibility of implementing changes in the workplace and the views of employers, we can work out how future research in this area can be undertaken to create a better working environment for patients with COPD.

Furthermore, if you participate in the study, you will have the benefit of receiving recommendations specific to your workplace, which if implemented, could improve the health and work productivity of your employees.

What do I need to do now?

First of all, we ask you to decide whether you would like to participate or not. If you chose to do so, please return the consent form in the pre-paid envelope provided, as soon as possible. If not, then please return the reply slip so we know you do not wish to take part.

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The COPD, occupation and work performance feasibility study: employer information letter

What if I have more questions or do not understand something?

If you have more questions, or you do not understand something in this information letter, please contact our lead research nurse Kiran Kalirai (details are on the next page).

What happens now if I decide to take part?

Once we receive your reply, we will send you some recommendations from the OH practitioner specific to your workplace, and we will contact you to arrange for you to meet the OHP at a time and place suitable for you.

What happens if I change my mind during the study?

You can withdraw from the study at any time without any pressure. If you decide to withdraw, you can contact Kiran Kalirai or leave a message with the BLISS study team.

Will my taking part in the study be kept confidential?

All your personal identifying information and details of your workplace will be kept separately from the interview data. No one outside the study team can access your personal information. All data will be held on secure computers that block unauthorised access (e.g. by hackers) and are password protected. All paperwork will be kept in a locked cabinet in a locked room (where the researcher is based).

Nothing that you say at the interview will be fed back to your employees or other staff.

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The COPD, occupation and work performance feasibility study: employer information letter

Data Protection Act 1998

The information you give us in the interviews will only be used for the purposes of the study. The information will be kept securely for a period of 10 years after the study ends and then will be destroyed.

Who is running the study?

This study is being carried out by the University of Birmingham. The study is funded by the UK National Institute for Health Research through the Department of Health and has been approved by the NRES Committee West Midlands - Solihull.

What if I am unhappy with the study?

If you find that you are unhappy with the study or its conduct, please contact Kiran Kalirai in the first instance, who will listen and deal with your concerns. If you wanted independent advice you can contact the University's Research Governance and Ethics Manager, Dr. Sean Jennings (E-mail: [redacted], Phone: [redacted]).

What happens to the results of the research study?

Once we have analysed the results we will publish them in medical journals. We will also publish the results on our website. You will not be identified in any publication.

Any queries or further information please contact:

Miss Kiran Kalirai

Department of Public Health, Epidemiology & Biostatistics

University of Birmingham, Edgbaston, Birmingham, B15 2TT

[redacted]

Website: http://www.haps.bham.ac.uk/publichealth/research/bliss.shtml

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The COPD, occupation and work performance feasibility study: employer information letter

Thank you for taking the time to read this

REPLY SLIP

Please return this reply slip in the pre-paid envelope to:

Miss Kiran Kalirai
The Public Health Building
University of Birmingham, Edgbaston, Birmingham. B15 2TT.

I **would** like to take part in the study ☐

My name and address:..

My telephone or mobile number: ....

or

I would **prefer not** to take part in the study ☐

If you prefer not to take part, please do let us know why. We are really interested in your thoughts.

I would prefer not to take part in the study because:

1. This study does not interest me ☐
2. I don't think the company needs any further occupational health recommendations ☐
3. The company already receives occupational health advice ☐
4. Other reasons ☐
5. I prefer not to say ☐

Please let us know: ....

....

Thank you for taking your time to complete the reply slip

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APPENDIX 9. SEMI-STRUCTURED PATIENT SATISFACTION QUESTIONNAIRE

We would like to know your views on the occupational health assessment that you had on <XX/XX/2014>

Was this the first occupational health assessment that you have had? Yes/No

If yes, in what way did this assessment differ from your previous experience?

Similar detail to previous experience/ more detailed than previous experience / less intensive or detailed than previous experience

Similar in terms of usefulness to previous experience / more useful than previous experience / less useful than previous experience

For each of the statements below, please rate how you feel about them, as a result of the assessment:

	Strongly agree	**Agree**	**Neither agree/nor disagree**	**Disagree**	**Strongly disagree**	**Don't know**
Your satisfaction of the outcome of the assessment						
I feel in better control of my health at work						
I now understand the changes which need to be made to improve my health and wellbeing at work						
I would recommend an occupational health assessment to my colleagues						

Suggested changes implemented at work?	**Yes**	**No***	**Partially***	***If you have answered *no* or *partial implementation*, please briefly explain why**
Implementing the OH practitioner's suggestions at work				
<<SPECIFIC RECOMMENDATIONS FOR EACH INDIVIDUAL PATIENT WILL BE STATED>>				

APPENDIX 10. QUALITATIVE INTERVIEW SCHEDULE FOR PARTICIPATING PATIENTS

Topic guide for those taking part

Introduction

Thanking participant for their time and a brief explanation of the reason for the interview. Obtain verbal and written consent for the audio-recording.

About the process

I am interested to hear about your thoughts on being invited to the assessment.

1. What would you change about this?
2. What changes could we make to the invitation process so the study appeals more to patients?
    - Prompts: the invitation letter

We really appreciate that you came to the assessment. However, there were a number of patients who did not want to take part in this study.

1. Do you have any ideas why they didn't want to?
    - Probe: what may have put them off from taking part?

Some patients that we have interviewed have mentioned something about working hours clashing with committing to the study.

1. What are your thoughts on this?
2. How could we address this in our invitation letter?

In our invitation letter we mention that an aspect of the study is to possibly involve the employer, however, this would only be with the consent of the patient

1. How did you feel about this?
2. How may have this made other patients feel
3. How could possible employer involvement have worried the non-participating patients?

I am interested to find out how has the assessment with Steve has helped you……

1. Do you feel you now have a better understanding of the relationship between COPD and work?

I am interested to find out about your thoughts on when this assessment should be carried out. So….

1. At what point do you think this having this OH assessment would have been useful?
    - For example, when you first started experiencing breathing symptoms
2. And what about other patients? At what point would an OH assessment be useful for patients with COPD?

Patients with COPD have annual reviews with their GP. At the GP visit, a number of things are assessed, for example how patients are getting on with self-managing their COPD.

Patient topic guide V2.0 14/10/2014

I am interested in finding out about your thoughts on how useful would a mini OH assessment be as part of your COPD annual review with your GP?

- Would this be useful for other patients with COPD?

If a GP did carry out a mini OH assessment (somewhat similar to yours with Steve's) as part of the annual COPD review, and suggested some changes...

1. How do you think this would be received by your employer compared to if an OH practitioner wrote to your employer and suggested changes
2. What are your thoughts for other COPD patients/employers

Who else may be best placed to carry out an OH assessment with the intention of sending recommendations to your employer?

Now I will be asking you some questions about the assessment

1. Did you receive some feedback after your OH assessment?

I am really interested to hear how useful you found the feedback given to you at the assessment?

Positive aspects of the assessment

Which aspects of the feedback did you find the most effective and why?

Can you please tell me about any change you have made to your working practice because of the feedback?

- Prompts: go through recommendations one by one...

- Probe: what other changes have you made as a result of the meeting?

Negative aspects of the assessment

1. Can you please tell me the about the suggestions by the OH practitioner that you were unable to implement at work?
    - Probe: why
2. What else may have been covered in the assessment, which has not be detailed in the report....?
3. How thorough was the OH practitioner in assessing all your job tasks and the effect these may have on your respiratory symptoms
4. Which job tasks may not have been addressed during the assessment?

I am really interested to hear of any negative experiences you may have had from the visit?

What changes would you make to the face-to-face assessment?

- Probe: why

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Involving the employer

You may remember at the time of consent and when I contacted you regarding the OH report we asked if we may contact your employer.

1. What were your thoughts about this? – were you happy for us to contact them?
    - I am interested to hear why you felt reluctant to involve your employer

Many patients didn't want their employer involved in this study, even though they would remain anonymous

1. What are your thoughts on why patients may have declined to this part of the study?
2. What changes would you suggest to us that may have made patients feel more comfortable or confident about involving their employer?

Prompts: an opt out/in option on consent form

How important is it to involve the employer to help implement the OH recommendations?

1. So can you implement them without any assistance?

What issues do you think patients may be faced with if their employer is involved?

Does your employer know about your COPD?

- If yes, how has this helped you at work?
- If not: I am interested in finding out about why you have not shared this with your employer?

In fact, some patients do feel reluctant about sharing this type of information with their employer

1. Do you know why they may feel like this?

Summary of the experience

Overall, how beneficial did you find meeting with the occupational health professional?

On reflection, would you suggest an occupational health assessment to be beneficial for other working patients with a lung condition?

- How could an OH assessment help patients with a lung condition?

I am now going to talk a little more about annual reviews and also COPD self-management:

1. How does your work/job affect how you manage your lung health?

You may remember we sent out some self-management: there was some information ina letter and also a BLF booklet

2. How useful did you find the self-management information that was provided to you

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a. Prompt: recommendations letter
b. Prompt: BLF leaflet

If not read: why?

3. Were you able to discuss these recommendations with your GP?
    a. Prompt: if not, are you planning to?
    b. Prompt: if yes, how did you and your GP use the information to improve the self-management of your lung health?
4. Do you regularly visit your GP to manage your lung health?
    a. Prompt: if not, why?
    b. Prompt: if yes, how often. What is covered at the visit?
5. Do you see your GP for a COPD annual review:
    a. Prompt: if yes, what is covered
6. What would you like to gain out of a COPD annual review with your GP, for example, do you have any suggestions on what should be covered in an annual review but might not be?
7. I am interested to hear your views and suggestions on what healthcare professionals could do to help you manage your lung health better.
    a. Prompt: what would help you to feel more in control of your lung health?
    b. Prompt: what would help you to feel more in control of your lung health at work?

Additional information

Is there anything else you would like to tell me that we have not covered today?

Closure

Thank the participant for their time and interview and that their views and opinions are valuable.

Patient topic guide V2.0 14/10/2014

APPENDIX 11. QUALITATIVE INTERVIEW SCHEDULE FOR NON-PARTICIPATING PATIENTS

Topic guide for non-responders/declining to take part

Introduction

Thanking participant for their time and a brief explanation of the reason for the interview. Obtain verbal and written consent for the audio-recording.

View on the study and OH assessments

I am interested to hear about your thoughts on being invited take part in an occupational health assessment [provide patient with the information sheet and reply slip as a reminder of what was posted].

Declining to take part: I understand that you chose not to take part in this study. Would it be possible for you to tell us why you decided this?

Could you suggest any changes to the invitation process which may have made you or any other patient more likely to reply?

- Prompts: the invitation letter
- Could we have done anything else differently?

A lot of people chose not to take part in this study. What are your thoughts on why they may have decided this?

Could you suggest any changes to the invitation process which may have made you or any other patient more likely to reply?

What are your thoughts about us contacting your employer in order to help implement any occupational health recommendations with the aim of improving your health at work?

- Prompt: how does that make you feel?
- Prompt: what do you think your employer's view would be?
- Prompt: Are the recommendations more likely to be implemented if your employer is already involved?

What are your thoughts about your company or manager inviting you for an occupational health assessment with an OH professional?

Which would you prefer: to be approached by your company OH department or to seek independent OH advice from an external OH professional?

- Prompt: why would you choose this option?

Have you ever had an occupational health assessment previously?

- Prompt: if yes, what did involve?
- Prompt: do you feel your lung health was covered within this assessment?

From your experience and knowledge, what do you think an OH assessment generally involves?

Patient topic guide V2.0 11/11/2014

Could you suggest any key areas on what you feel may be useful in an OH assessment for patients with COPD/breathing problems?

What are your thoughts on a mini OH assessment by your GP?

- Prompts: would this approach be more acceptable for involving your employer?

Health and work

I am also interested to find out about your health at work.

Firstly, could you please tell me about your job role and what tasks it involves?

Are there any tasks or exposures at work, for example ...(mention a task/exposure which patient has discussed in previous question)... which might leave you feeling out of breath/breathless?

Are there any particular tasks/exposures at work which may make you cough more (e.g. being around the photocopier)?

Is there anything you do at work which may make you feel fatigued?

Generally, can you think of anything at work which may trouble your lung health/breathing problems (for example, exposures which lead to a chest infection)?

I am interested to find out any previous adjustments you may have made to your work (in this job or any previous jobs) to help manage your lung health. An example may be that you pace your work so you don't get tired or you avoid certain cleaning agents that may affect your cough.

Annual review and self-management questions:

1. How does your work/job affect how you manage your lung health?
2. Do you regularly visit your GP to manage your lung health?
   a. Prompt: if not, why?
   b. Prompt: if yes, how often. What is covered at the visit?
3. Do you see your GP for a COPD annual review:
   a. Prompt: if yes, what is covered
4. What would you like to gain out of a COPD annual review with your GP, for example, do you have any suggestions on what should be covered in an annual review but might not be?
5. I am interested to hear your views and suggestions on what healthcare professionals could do to help you manage your lung health better.
   a. Prompt: what would help you to feel more in control of your lung health?
   b. Prompt: what would help you to feel more in control of your lung health at work?

Additional information

Is there anything else you would like to tell me that we have not covered today?

Closure

Thank the participant for their time and interview and that their views and opinions are valuable.

Patient topic guide V2.0 11/11/2014

APPENDIX 12. SEMI-STRUCTURED INTERVIEW TOPIC GUIDE WITH GENERAL PRACTITIONERS

Semi-structured interview with GPs

The following provide the areas we may be discussing during our telephone interview. You may find it useful to have a look at one of the COPE feasibility reports we sent out to you before our interview.

- Would you find occupational health (OH) recommendations from an OH team useful in helping you manage your COPD patient?
    - If no, why?
    - If yes, how would you use such OH recommendations?
- Do you usually conduct an annual review for your COPD patients?
- If so, would this information (OH recommendations) be useful during the review?
- What self-management information about the patient may be useful during your consultation/review of your COPD patients?
- What other information would be more helpful in reviewing your patient and how would you use this?

GP topic guide V1.0 02/10/2014

APPENDIX 13. COPE FEASIBILITY STUDY: CONSENT FORM

BLISS
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UNIVERSITY OF BIRMINGHAM

The COPE feasibility study: consent form

Practice ID: **Study ID:**

	Please initial boxes
I have read the attached information concerning my participation in this study and have had the opportunity to discuss and ask questions. All my questions have been answered in a satisfactory way and I give my consent voluntarily to participate in this study.	☐
I know that I can, at any time and without giving a reason, withdraw my participation in the study and that my future care and management will not be affected.	☐
I give my permission to authorise personnel from the research team to access my individual responses from the BLISS questionnaires.	☐
I understand I will remain anonymous in published material and that any information which may potentially identify me will not be used.	☐
I give my permission to authorise personnel from the research team to inform my General Practitioner of my participation in this study and any relevant results from the BLISS questionnaires.	☐
I give my permission to authorise personnel from the research team to inform my General Practitioner of the occupational recommendations provided by the Occupational Health Practitioner.	☐
I understand that once I have received the occupational recommendations, personnel from the research team will contact me and ask for my permission to forward these details to my employer.	☐
I would be interested in taking part in the interviews linked to this study.	☐

……………………………………… ……………………… ………………………………………
Name of Patient (CAPITALS) Date Signature

……………………………………… ……………………… ………………………………………
Name of Researcher (CAPITALS) Date Signature

3 copies: 1 - Study office; 2 - Patient; 3 - Patient file

COPE Feasibility Study Consent Form V2.0 13/01/2014

APPENDIX 14. QUALITATIVE INTERVIEW: PATIENT INFORMATION SHEET FOR THOSE PARTICIPATING IN THE INTERVENTION

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The COPE feasibility study: interview information sheet

You are being invited to take part in an interview as part of the COPE feasibility study. Before you decide if you are willing to be interviewed it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends and relatives if you wish. Ask us if there is anything that is not clear or if you would like more information.

What is the purpose of the interview study?

The purpose of the interview study is to find out your views about your visit with the occupational health practitioner and the report with recommendations.

Why have I been chosen?

As you have met with the occupational health practitioner and have received a report, and because you indicated that you would be interested in taking part in the interview part of the study, we are inviting you to take part. We would like to find out more about your views of the process and how it could have been improved. We hope to interview about 20 - 30 patients who attended the occupational health assessment.

What do I have to do?

We are asking you to be interviewed by the Lead Research Nurse (Kiran Kalirai) in your home or other place convenient for you. We expect each interview to last approximately 45 minutes. The interviews will be tape recorded. Any costs you may incur will be reimbursed.

Do I have to be interviewed?

It is up to you to decide whether or not to take part. If you decide to take part we will contact you to make an appointment. At the interview we will ask you to sign a consent form. If you do decide to take part, you are still free to withdraw at any time and without giving a reason. This will not affect the care you receive.

What are the possible benefits of taking part?

The information we get from this study will help us to understand how people with COPD feel about occupational health assessment. This will help us decide whether a larger trial is worth setting up.

COPE Study: patient information leaflet for qualitative interview V2.0 13/01/2014

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The COPE feasibility study: interview information sheet

Will my taking part in this study be kept confidential?

Your name will not be on the tape and we will remove your name from the interview transcripts to keep your identity confidential. Direct quotes may be used in publications but these will be numbered and anything which could identify you will be removed. Nothing that you say will be fed back to the doctors and nurses involved in your care as coming from you.

What if I have more questions or do not understand something?

If you have more questions, or you do not understand something in this information letter, please contact the Lead Research Nurse (see contact details below). Alternatively, you can speak with your GP. If you would like independent advice on participating in research studies, you can contact the Patient Advice and Liaison Service (PALS) at Queen Elizabeth Hospital Birmingham (0121 371 3280, PALS@uhb.nhs.uk).

Data Protection Act 1998

The information you give us in the interviews will only be used for the purposes of the study. The information will be kept securely for a period of 10 years after the study ends and then will be destroyed.

Further details

If you would like more information you can contact **Kiran Kalirai** by:

If you agree to be interviewed you will be given a copy of this information sheet and a signed consent form for you to keep.

Thank you for your time

COPE Study: patient information leaflet for qualitative interview V2.0 13/01/2014

APPENDIX 15. QUALITATIVE INTERVIEW: PATIENT INFORMATION SHEET FOR THOSE NOT TAKING PART IN THE INTERVENTION

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The COPD, Occupation and Work Performance Feasibility Study: the views of people who chose not to take part

We invite you to give us your views as part of the COPE feasibility study. Before you decide if you are willing to do this it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends and relatives if you wish. Ask us if there is anything that is not clear or if you would like more information.

What is the purpose of the study?

The purpose of the study is to find out your views about:

- The relationship between COPD and work
- COPD patients receiving an occupational health assessment and,
- What could be done to help COPD patients better manage their lung symptoms (at work and home).

Why have I been chosen?

We are really interested to hear the views of those patients who did not take part in the initial study: a meeting and assessment with the occupational health practitioner. Many patients chose not to take part. Although you are fully entitled not to give us any reasons, we would be grateful to learn the main reasons why people declined.

Your views are important to us and we would like to know about what you think about the study, how it could have been improved and how working COPD patients are affected. We hope to talk to about 5 patients who did not take part in the occupational health assessment.

What do I have to do?

We are asking you to be interviewed by the Lead Research Nurse (Kiran Kalirai) in your home or other place convenient for you. We expect each interview to last approximately 45 minutes. The interviews will be tape recorded. Any travel costs you may incur will be reimbursed.

Qualitative study PIL V2.0 11/11/2014

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Do I have to be interviewed?

It is up to you to decide whether or not to take part. If you decide to take part we will contact you to make an appointment. At the interview we will ask you to sign a consent form. If you do decide to take part, you are still free to withdraw at any time and without giving a reason. This will not affect the care you receive.

What are the possible benefits of taking part?

The information we get from this study will help us to understand how people with COPD feel about occupational health assessment. This will help us decide whether a larger trial is worth setting up.

Will my taking part in this study be kept confidential?

Your name will not be on the tape and we will remove your name from the interview transcripts to keep your identity confidential. Direct quotes may be used in publications but these will be numbered and anything which could identify you will be removed. Nothing that you say will be fed back to the doctors and nurses involved in your care as coming from you.

What if I have more questions or do not understand something?

If you have more questions, or you do not understand something in this information letter, please contact the Lead Research Nurse (see contact details below). Alternatively, you can speak with your GP. If you would like independent advice on participating in research studies, you can contact the Patient Advice and Liaison Service (PALS) at Queen Elizabeth Hospital Birmingham (0121 371 3280, PALS@uhb.nhs.uk).

Data Protection Act 1998

The information you give us in the interviews will only be used for the purposes of the study. The information will be kept securely for a period of 10 years after the study ends and then will be destroyed.

Further details

If you would like more information you can contact **Kiran Kalirai** by:

[redacted]

Qualitative study PIL V2.0 11/11/2014

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If you agree to be interviewed please return the reply slip below.

REPLY SLIP

Please return this reply slip in the pre-paid envelope to:

Miss Kiran Kalirai
The Public Health Building
University of Birmingham, Edgbaston, Birmingham. B15 2TT.

I **would** like to take part in the study ☐

My name and address:..

My telephone or mobile number: ....

or

I would **prefer not** to take part in the study ☐

My name:...

Thank you for taking your time to complete the reply slip

Qualitative study PIL V2.0 11/11/2014

APPENDIX 16. QUALITATIVE INTERVIEW: CONSENT FORM

BLISS
Birmingham Lung Improvement Studies

UNIVERSITY OF BIRMINGHAM

The COPE feasibility study: interview consent form

Practice ID: **Study ID:**

	Please initial boxes
I have read the attached information concerning my participation in this study and have had the opportunity to discuss and ask questions. All my questions have been answered in a satisfactory way and I give my consent voluntarily to participate in this study.	
I understand that my participation is voluntary and that I can, at any time and without giving a reason, withdraw my participation in the study and that my future care and management will not be affected.	
I agree for this interview to be recorded.	
I agree to take part in this study.	
I agree to the use of anonymous quotes	

I agree to take part in the above study

....	....	....
Name of Patient (CAPITALS)	Date	Signature
....	....	....
Name of Researcher (CAPITALS)	Date	Signature

3 copies: 1 - Study office; 2 - Patient; 3 - Patient file

COPE Study Consent Form: qualitative interview V1.0 13/01/2014

APPENDIX 17. PATIENT WORKPLACE RECOMMENDATIONS

Patient	Occupation	Number of recommendations	Recommendations
1	Truck washer	6	**Substances/materials** • Handling (diluting, mixing and use) of strong acidic cleaning solution e.g. cleaning using aluminium oxide (spray), should be prevented or minimised as this is a respiratory irritant **Job tasks/work methods/physical aspects of the job** • Cleaning in confined spaces with poor ventilation can generate a high level of irritating cleaning agents as well as oils and greases from surfaces. Indoor cleaning activities using blasting machines should be avoided • Cleaning using large brushes (attached to heavy hoses) particularly for prolonged periods must be avoided or delegated to other employees e.g. when cleaning larger trailers • Avoid lifting and carrying/moving large heavy tubs containing cleaning solution (e.g. 25 litre containers) **Work organisation** • To review the cleaning schedule for each job and discuss with the client, to avoid the need for high intensity cleaning over a short period of time **Personal protective equipment** • A suitable respirator should be worn when supervising or inspecting indoor cleaning operations e.g. cleaning of warehouses which may involve the use of high pressure hoses and chemical cleaning agents.
2	Bricklayer	8	**Job tasks/work methods/physical aspects of the job** • Avoid dusty tasks e.g. putting cement into mixers, making up plaster, paper stripping and any occasional demolition work. If these tasks cannot be avoided, then a suitable respirator (mask) should be used for the duration of the task • Where possible, avoid tasks which require regular bending or working below waist level e.g. when laying bricks below waist height. Consider sitting on a stable stool when working at lower levels for prolonged periods and avoid storing materials at ground level • Avoid lifting heavy items e.g. bags of cements, carrying too many bricks/blocks at a time and 'loading out' i.e. carrying building material from storage to build area • Consider using mechanical lifting aids e.g. trolleys or telehandlers when moving large loads • Physical work should be delegated to other staff/contractors e.g. digging out footing in new builds **Work environment** • Where possible avoid outdoor work on damp /frosty days. Consider re-scheduling work with client(s) to avoid working in cold conditions **Work organisation** • Schedule jobs which enable pacing of work to avoid continuous work e.g. working more than 2 hours without a break **Personal protective equipment** • Check and ensure that you have the right type of face mask (respirator) for the different tasks. For example, masks recommended for dusty jobs are not likely to provide protection when painting, varnishing and using thinners
3	HGV tank driver	2	**Occupational health services and education** • It is important that all vehicle drivers who transport cement report any respiratory symptoms to the local occupational health department, who can advise on workplace adjustments, if needed • It is also important for employees to attend the annual appointments offered by the occupational health department for any routine respiratory surveillance
4	Healthcare assistant at GP practice	2	**Work environment** • To report to the line manager about the need for regular cleaning of the office and work surfaces, to avoid the build-up of dust **Occupational health services and education** • Need to report any respiratory symptoms at work to the local occupational health team, who can advise on workplace risk assessments and improvements to the work environment
5	Senior care assistant	2	**Substances/materials** Cleaning agents such as 'Chloroclean' can generate mists which can cause respiratory

Patient	Occupation	Number of recommendations	Recommendations
			irritation. You should avoid handling (making-up solutions and applying) strong cleaning agents and entering rooms whilst deep cleaning is being conducted by other staff particularly in areas which are not well ventilated **Occupational health services and education** • You should report any respiratory problems at work to the occupational health team/care home manager so that the care home can review its cleaning and manual handling practices particularly for carers with existing respiratory problems.
6	Plumber	5	**Substances/materials** • Soldering activities can generate fumes which can cause respiratory irritation/sensitisation. The fume levels can be reduced by using: ▪ Plastic instead of copper fitting ▪ Use of solder ring joint or crimp fitting **Job tasks/work methods/physical aspects of the job** • Alternatives to the use of wire wool for cleaning copper pipes should be considered e.g. abrasive pads, particularly when cleaning for prolonged periods and very old pipes which may be coated with various metals, paints etc. Could also consider using mechanic pipe cleaning tools e.g. monument pipe cleaners • Wherever possible, physical work should be avoided e.g. carrying radiators and breaking up cast iron baths **Work environment** • Dusty work areas should be screened to avoid the spread of dust in to your work environment **Personal protective equipment** • Need to wear a dust respirator when conducting all cleaning activities after completion of job tasks (e.g. at end of each day)
7	Cleaner	2	**Substances/ materials** • Most cleaning chemicals are respiratory irritants which can worsen symptoms of those with existing respiratory problems. Where possible avoid using strong cleaning agents particularly in confined spaces or in poorly ventilated areas **Occupational health services and education** • It is important to inform management of respiratory symptoms at work so that: a) Work methods can be reviewed to minimise exposure to chemicals (cleaning agents and dusts) which may be due to: ▪ the over use of cleaning agents by colleagues ▪ cleaning being conducted in poorly ventilated areas b) Your respiratory symptoms are not worsened by the cleaning tasks
8	Labourer (using machine to test vehicle components)	2	**Work environment** • Individuals with existing respiratory problems may be affected by work processes conducted by others in their vicinity. It is therefore important to review the layout of tasks to ensure that those with respiratory symptoms are not working closely to tasks conducted by other colleagues who use substances which may cause respiratory irritation or sensitisation e.g. painting and solvent cleaning operations **Personal protective equipment** • Workers with existing respiratory problems who are required to wear respirators may find the use of disposable mask impedes their breathing. For these individuals, air-fed respirators should be provided.
9	Museum attendant	2	**Job tasks/work methods/physical aspects of the job** • Working in a museum requires daily walking, carrying and moving objects and climbing stairs (no lift) which may exacerbate respiratory symptoms of individuals with existing respiratory problems. Work should be regularly reviewed to minimise these activities, particularly climbing stairs and one off events (e.g. organising particular events), which require additional physical effort **Occupational health services** • Individuals with respiratory problems should contact occupational health services who can advise on the need for routine health surveillance, any workplace adjustments and monitor the effects of work on health
10	Cash officer at supermarket	3	**Work environment** • You currently choose to have your coffee/lunch break in your car which avoids the need to climb stairs to reach the canteen. In winter months this may worsen your symptoms. Although your manager is happy for you to take your breaks at your workstation, this is not ideal. You should ask your manager to create a separate area for breaks on the same floor, but away from your work station. It is important that official work breaks are away from the work desk/area which will help you to relax **Occupational health services and education** • A number of positive changes have been made recently by your manager which should reduce respiratory symptoms at work. These changes include changes to your role and the work environment, with the aim to minimise climbing of stairs, lifting,

Patient	Occupation	Number of recommendations	Recommendations
			carrying and bending. It is important that you monitor and report the effects of these changes on tiredness and your respiratory symptoms to the company occupational health team
11	Pupil guide	3	**Job tasks/work methods/physical aspects of the job** • Children can misbehave which may cause you stress and anxiety and in-turn, may flare up your respiratory symptoms. We understand that this situation only occurs occasionally. However, it is important that you monitor such episodes and inform your employer so that they can assess the group of children that you work with • Your job is not physically demanding but handling children's bags and climbing stairs in the school can aggravate respiratory symptoms. Although you are aware of this and take your time when conducting such activities, sometimes time pressure may require you move quickly. We therefore suggest that you monitor and report any worsening of symptoms to your employer **Occupational health services and education** • You should make contact with your employer occupational health team so that they can monitor your respiratory symptoms at work, and provide advice on any changes which may be needed in the future
12	Senior care assistant	3	**Job tasks/work methods/physical aspects of the job** • Although your current role mainly involves assessment of potential service users in their homes, occasionally you may be required to help move service users. This should be avoided, particularly when working in a confined environment which is poorly ventilated **Work organisation** • Climbing stairs can also aggravate symptoms. It is recommended that a pre-visit assessment is conducted to understand the layout of the house environment and rooms used by the service user **Occupational health services and education** • It is important that you report any flare-up of respiratory symptoms (when visiting the homes) to your employers so that suitable measures are identified to minimise future exacerbations
13	Technical manager (electric automation company)	3	**Job tasks/work methods/physical aspects of the job** • Climbing stairs at work can aggravate respiratory symptoms. It would be helpful to organise work to avoid/minimise the use of stairs • Although your work is largely office based, you are occasionally required to lift/carry small objects e.g. alternators (weight 2-5Kg), which you stated does not cause you problems. However, you must ensure the carrying of objects is minimised by using the correct lifting aids. This will also reduce risk of injuries e.g. shelf trolley, keg truck, trolleys with suction cups **Occupational health services and education** • Given that you work in a small company with no access to occupational health services, it is important for you to monitor any work related activities which worsen your respiratory symptoms and report these to your GP
14	Car mechanic	4	**Substances/ materials** • Exposure to diesel fumes should be minimised by the following: a) Turning engine off when not required b) Installing air vents in walls and ceiling(s) c) Fitting tail pipe exhaust extraction systems or by attaching filters to tail pipes **Job tasks/work methods/physical aspects of the job** • Avoid blowing dust out of brake pads/clutch housing. Instead, use break cleaning equipment which prevents dust from escaping. • Manual handling of heavy car components should be avoided. Although lifting hoists are used, removal and alignment of certain car parts will still require supporting heavy car components e.g. gear box. **Work environment** • The workshop should be heated, particularly in the winter months. A cold work environment can aggravate respiratory symptoms especially when working in enclosed spaces with diesel exhaust fumes
15	Finance director	3	**Job tasks/work methods/physical aspects of the job** • Lifting and carrying of boxes/parcels should be avoided particularly in confined spaces or when climbing stairs. Where possible mechanical aids should be used and work should be organised to minimise the carrying distances e.g. use of trolleys **Work environment** • Small offices (with limited ventilation) with a number of photocopiers and printers can generate a dry environment. Some printers may produce irritant gases. This environment can aggravate existing respiratory symptoms. It is recommend that the ventilation in such offices is improved, with the aim of improving the humidity and avoid the build-up of airborne irritants

Patient	Occupation	Number of recommendations	Recommendations
			• Offices should have sufficient ventilation. Where natural ventilation (opening of windows) is not sufficient, then mechanical ventilation should be installed to deliver the adequate volume of air. For this, the following should be taken into account: room size, number of occupants and office equipment e.g. computers and printers
16	Manager of mental service unit	2	**Work environment** • Working in small poorly ventilated offices (with computer and printers) can produce a dry hot environment as well as a build of chemical irritants, which can cause discomfort for those with existing breathing problems. The ventilation needs (fresh air requirements) should be reviewed, and account for: room size, number of occupants and office equipment (computers and printers). Mechanical ventilation may be needed when natural ventilation is insufficient **Work organisation** • Cleaning agents used by other staff may aggravate respiratory problems. This may occur when cleaning is being carried out near you or when you enter an area which has been recently cleaned. Wherever possible, work should be organised so that cleaning activities are not conducted around you and that areas being cleaned are well ventilated during and after cleaning (opening of windows, switching on wall mounted fans)
17	Manager in a coffee shop	1	**Occupational health services and education** • Based on the consultation it appears that your current job task do not worsen your breathing problems. However, as COPD is a progressive condition, it is important that you inform your employer if and when your breathing symptoms become worse at work. High paced work as well as lifting and carrying of items can aggravate breathing problems
18	Midwife	1	**Occupational health services and education** • You should inform the occupational health team of your COPD diagnosis so that the team are able to consider the need for routine respiratory surveillance, monitor the effects of work on health and if required, make reasonable workplace adjustments.
19	HGV driver	4	**Substances/ materials** • Precautions should be taken to minimise the exposure to chemical substances at work including: wood dusts, diesel vapours and fumes • Equipment for cleaning the trailer should be selected to minimise the generation of dust. The use of brushes should be avoided and instead, vacuum systems should be used (with appropriate filters) **Job tasks/work methods/physical aspects of the job** • Occasionally there is a need to manually load and unload vehicles. This can flare up breathing problems, particularly if this involves bending and carrying articles or when holding/supporting items above shoulder height. You should discuss the need for mechanical lifting aids in advance of deliveries with both the employer and the client (delivery site) **Occupational health services and education** • If work activities such as cleaning, lifting and handling timber cause any respiratory symptoms (e.g. cough, shortness of breath), then these should be reported to the company occupational health department or your GP
20	Handyman	1	**Personal protective equipment** • Some work tasks, such as cleaning in confined spaces (e.g. cabins) can generate dust and irritant cleaning chemicals which can aggravate breathing problems (e.g. cough, shortness of breath). We understand that cleaning is usually conducted without any ventilation extraction systems and respiratory masks. If the only control option is to use a respirator (mask) then you need to ensure that it fits well and does not cause any discomfort with your breathing. Different types of mask are available, and this should be discussed with your employer.
21	Managing director for engineering company	2	**Job tasks/work methods/physical aspects of the job** • Manual handling tasks can aggravate respiratory symptoms and is a common cause of injuries to upper limbs and lower back. Manual handling of articles (lifting, lowering, carrying pushing or pulling) should be avoided and instead, lifting aids and trolleys should be used, particularly when delivering components to clients e.g. transporting metal articles from vehicle to client premises. **Personal protective equipment** • Although your exposure to chemicals (dusts and fumes) is infrequent e.g. when visiting/ supervising staff in the engineering work shop, short high exposures to chemicals given off from metal working and in metal cleaning processes can aggravate respiratory symptoms. It recommended that a breathing mask is used when attending the engineering workshop
22	Cleaner	2	**Occupational health services and education** • The cleaning chemicals that you use may contain substances which can irritate the respiratory tract and worsen your breathing symptoms. If and when you experience

Patient	Occupation	Number of recomme ndations	Recommendations
			worsening of breathing symptoms you must report this to the occupational health department, who can review the cleaning substance and cleaning methods to minimise the effects of chemicals on your respiratory health. The occupational health department can also advise you on the need to use a respirator (mask), type of respirator and when to use it • We recommend that you refer yourself to the company occupational health department and make them aware that you have been diagnosed with COPD. The occupational health department can advise you on the need for routine respiratory surveillance (respiratory questionnaires or lung function testing on site) and monitor any effects of work on your respiratory health. This will also help the company to meet its legal health and safety obligations.
23	Caretaker (school)	5	**See highlighted for recommendation type** • During summer months the cleaning, sanding varnishing of school floors generates airborne chemicals which can trigger breathing problems. The nature of the work (amount of material used, speed of work, physical nature of job) suggests that exposure to solvents and dust particles are likely to be high and the work physically demanding. You have experienced worsening of breathing problems when conducting these tasks which are likely to worsen further with repeated exposure. We recommend that these activities should only be conducted: a) In a well-ventilated area **(work environment)** b) With frequent breaks taken away from the work areas **(work organisation)** and, c) With suitable respirators, to protect against airborne dust and solvent vapours. Advice should be sought on the best type of respirator for the chemical substances which may be inhaled during cleaning and varnishing **(personal protective equipment)** **Substances/materials** • If your symptoms continue to worsen, despite following the above recommendations, then cleaning and polishing activities should be avoided. ***Occupational health services and education*** • You should inform your employer of any respiratory symptoms experienced whilst conducting any work related tasks. This is important so that they are able to monitor the effect of work on your lung health and make any necessary work place adjustments. This will also help your employer to meet their legal requirements e.g. under the Control of Substances Hazardous to Health Regulations 2002 (as amended).
24	Plasterer	3	**Job tasks/work methods/physical aspects of the job** • Majority of tasks related to the construction industry involve manual handling, lifting, carrying and working below waist which can all aggravate existing breathing problems. As it is technically difficult to use lifting aids in domestic buildings e.g. to transport bags of cement, plaster board, we recommend that you consider employing an assistant (apprentice) who can conduct such activities and to support you with the manual aspects of your work. This will also help to broaden the scope of the work (contracts) that you can take on as well as enable you to delegate the activities which can worsen your breathing problems and cause tiredness **Work environment** • Tasks such as removing and mixing plaster will generate dust and it is well known that dust (construction dust) can aggravate breathing problems such as COPD. Dust can be reduced by damping and working in a ventilated area. **Personal protective equipment** • However in enclosed spaces, these methods may not be sufficient to reduce the dust generated, and there will be a need to additionally use respiratory protection. A suitable respirator (dust mask) should be used when exposed to plaster dust. There are two types of dust masks: a) A disposable filter type b) A battery powered positive pressure respirator Type (b) does not impede breathing as it delivers filtered air over the face, whereas the disposable type mask can restrict breathing and which can become uncomfortable. We recommend that you trial the use of a positive pressure breathing mask and assess if this helps you with your breathing
25	Patrol person (roadside repairs)	3	**Job tasks/work methods/physical aspects of the job** It is understood that you currently provide 'level 3' road side vehicle repair/recovery service which usually involves attending to vehicles that require: complex diagnostics, longer time to repair and are at greater likelihood of requiring vehicle recovery. Observations whilst waiting for vehicle recovery require additional safe practices e.g. assessing traffic conditions, lighting, road surface etc. which can be stressful. A number of tasks performed during such roadside repairs can aggravate existing breathing problems which include manual handling

<table>
<tr><th>Patient</th><th>Occupation</th><th>Number of recommendations</th><th>Recommendations</th></tr>
<tr><td></td><td></td><td></td><td>(tyre removal), working below waist level (lifting and moving tools and inspecting vehicles), excessive force (using a hammer to remove nut bolts without key) as well as exposure to diesel vapours and fume (which can irritate the lungs). There is also the possibility of exposure to chemicals released from deployment of vehicle air bags, as well as asbestos dust from the vehicle brakes
• Please remember not to blow dust out of brake drums or clutch housing. Instead use the properly designed brake cleaning equipment
• The exposure to pollutants, the amount of manual handling and anxiety could be reduced by conducting low level of repair work (level 1 or 2) which should be discussed with the occupational health department. This is particularly important if work related tasks are making breathing problems worse or causing tiredness
• It is also important that the correct lifting equipment is used
Personal protective equipment
• It is important that a suitable breathing mask (respirator) is used when exposed to chemicals (asbestos, diesel fume, oil mists, leaks from air-conditioning systems), particularly in confined spaces.</td></tr>
<tr><td>26</td><td>Customer service (concierge officer)</td><td>2</td><td>Job tasks/work methods/physical aspects of the job
• The use of brushes/brooms to clean floors should be avoided; instead, vacuum cleaners (with suitable filters) should be used
Occupational health services and education
You mentioned that you have been diagnosed with asthma by your GP and that over the past 8 years you have visited the company occupational health department once to raise concerns with breathing problems. You found the consultation with OH nurse was not helpful, and have not visited the occupational health department since
• It is important that you inform your local occupational health department of any breathing problems which you believe may be aggravated by your current daily work tasks and the work environment which may include cleaning operations (exposure to cleaning agents and dusts) as well as activities which involve manual handling e.g. furniture removal. The OH department can then assess whether any breathing problems experienced are work-related and the need for any workplace modifications</td></tr>
<tr><td>27</td><td>Lollipop man</td><td>2</td><td>Work organisation
• If breathing symptoms worsen further during winter month we suggest changing work schedules to avoid working during cold spells. So for example, limiting work to evenings only during winter months, or refraining from work during colder spells.
Occupational health services and education
• It is important that the occupational health department are made aware of your COPD and any worsening of your symptoms so they can recommend any suitable workplace adjustments, if needed. Any health matters discussed with occupational health should be confidential, and information should only be disclosed to third parties with your consent.</td></tr>
<tr><td>28</td><td>Driver (working for tool hire company)</td><td>4</td><td>See highlighted for recommendation type
• Sprays such as WD40 can irritate the lungs and worsen breathing. Such sprays should be used in a well-ventilated area (substances/materials) and a mask should be worn particularly when spraying in confined spaces (personal protective equipment)
• It is also important to discuss alternatives to WD40 or other cleaning agents with your employer, which are less likely to give off chemicals during the cleaning of metal components. Non-aerosol versions of WD40 are available, which may reduce the amount of airborne chemicals generated when applying the lubricant remover (substances/materials)
Personal protective equipment
• If you find using a disposable breathing mask uncomfortable, then a positive pressure air fed respirator should be used, particularly when working in areas with volatile chemicals or dusts, for example: during cleaning or tool maintenance activities
Occupational health services and education
• Manual handling e.g. lifting and moving of metal panels and equipment, can worsen breathing problems. When you experience breathing problems (e.g. breathlessness) after moving such objects, it is important that you inform your line manager and/or the occupational health department so that any workplace adjustments can be made. This may include scheduling of your work so to:
a) avoid lifting of heavy goods or,
b) provision of additional manpower for lifting operations</td></tr>
</table>

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