



## High prevalence of obstructive lung disease in non-smoking farmers: The Irish farmers lung health study



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### ABSTRACT

**Background:** Mortality rates within the Irish farming community are increasing, whilst that of the general population falls. The aim of this cross-sectional study was to determine the prevalence of respiratory disease amongst Irish farmers.

**Methods:** All study participants were farming volunteers attending an agricultural exhibition. Data collected by questionnaire included baseline demographics, respiratory history, presence of respiratory symptoms and occupational exposures. Spirometry was performed on all participants.

**Results:** Data from 372 farmers was analysed. The majority were male (76%) with median age of 55 years. 61% were never smokers. 13% were previously diagnosed with airway disease (Chronic Obstructive Pulmonary Disease (COPD)/Asthma/Inhaler use) with 14% reporting hayfever/allergies. Almost two-thirds reported one or more chronic respiratory symptom. Forty-four (12%) had obstructive spirometry using fixed FEV<sub>1</sub>/FVC < 0.70 criterion and 29 (7.8%) using FEV<sub>1</sub>/FVC < 5% lower limit of normal. The majority, two-thirds, were never smokers. Amongst never smokers with obstruction (13%), there was a significantly higher proportion with a prior diagnosis of airway disease and hayfever/allergies. There was no significant association between specific occupational exposures and obstruction.

**Conclusion:** The majority of Irish farmers are never smokers. They have a high prevalence of respiratory symptoms. 13% of never smokers have airflow obstruction (FEV<sub>1</sub>/FVC < 0.70). The presence of airflow obstruction is significantly associated with self-reported allergy history and prior airway disease. Further studies are needed to identify the workplace factors accounting for these findings.

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### 1. Introduction

An estimated 25% of adults over 40 years of age have airflow limitation [1] with a worldwide prevalence of 10% [2]. Whilst the risk of airflow limitation secondary to smoke exposure is well established, there is increasing recognition of other risk factors such as air pollution and occupational exposures [1]. Respiratory

disease associated with agriculture was one of the first recognised occupational hazards. As far back as 16th century, the potential complications of inhaling dry grain dust were described [3]. Hypersensitivity pneumonitis occurring in agricultural environments is well described but recent studies have shown its prevalence is declining in the UK and Ireland [4], with a reported prevalence of <3% [5]. This most probably reflects changes in farming practices notably a decrease in the production of hay in favour of silage [4]. In fact airflow limitation is more common amongst agricultural workers [6–8]. This, in addition to high rates of respiratory symptoms [9,10], likely impacts most on farmers' respiratory health.

In Ireland, almost 200,000 people are employed by the primary agriculture sector accounting for 5% of total population employment [11]. Overall, farmers are perceived to be healthier than the

**Abbreviations:** COPD, Chronic Obstructive Pulmonary Disease; FEV<sub>1</sub>, Forced Expiratory Volume in one second; FVC, Forced Vital Capacity; LLN, lower limit of normal; SMR, Standardised Mortality Ratio; GOLD, Global Initiative of Chronic Obstructive Lung Disease; ATS, American Thoracic Society; ERS, European Thoracic Society.

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average population due to their outdoor lifestyle and the physical nature of their work with numerous studies finding overall reduced mortality rates in this cohort when compared with the general population [12,13]. However, a 2013 study analysing mortality trends in Irish farmers over the last decade found that all-cause mortality in this subpopulation is increasing with a standardised mortality ratio (SMR) of 182.5 in 2006 compared with 132.4 in 2000. Farmers were found to be 5.1 times more likely to die from any cause than salaried employees. This was mainly attributed to increased circulatory disease (SMR 215.9 vs. 31.9) and cancers (SMR 156.6 vs. 44.3) as well as increased workplace accidents [14]. However, there appears to be little published data on the prevalence of respiratory disease in the Irish farming population. In view of these findings and the high rates of airflow limitation and chronic respiratory symptoms reported in farmers from other countries, we undertook the Irish Farmer's Lung Health Study to determine the prevalence of respiratory disease and airflow limitation in the Irish farming population.

## 2. Methods and materials

### 2.1. Design

This cross-sectional study was conducted by the Respiratory Department of the Galway University Hospitals Group, Ireland. It was carried out over two consecutive days in September 2013 at the Irish National Ploughing Championship. The National Ploughing Championship is an annual agriculture and trade show which attracts in the region of 190,000 visitors per year, the majority of whom are farmers and agriculture workers. All study participants were farming volunteers who were attending the event. Ethical approval to conduct the study was granted by the Ethics Committee of Galway University Hospital.

### 2.2. Questionnaire

The questionnaire, compiled by the investigators, incorporated questions related to baseline demographics, self-reported past respiratory history, self-reported respiratory symptoms, farmyard practices (e.g. farming type, type of feed used, and chemical exposures) as well as exposure to known risk factors for respiratory disease, including tobacco smoke and burning of fossil fuels. The questionnaire was delivered face-to-face by data collectors with participants asked to provide a yes or no answer to the questions posed.

### 2.3. Outcome definitions

A never smoker was defined as a person who denied having ever smoked in their lifetime. Previous respiratory history included self-reported physician diagnosis of Asthma, Chronic Obstructive Pulmonary Disease (COPD) or Emphysema, Hayfever/Allergies, Farmer's Lung, Tuberculosis or Sarcoidosis at any stage in their lifetime. The prescription of inhaled medications was also deemed indicative of a prior diagnosis of airways disease.

Participants were also asked to report whether or not they experienced cough, dyspnoea, wheeze, nasal congestion, sinus headache, anosmia, rhinorrhoea or post-nasal drip on a daily or intermittent basis. For the purpose of analysis, investigators grouped symptoms into three distinct categories: 1) Upper Respiratory Tract, which included nasal congestion, sinus headache, anosmia, rhinorrhoea and post-nasal drip 2) Dyspnoea and/or Wheeze and 3) Cough.

To assess occupational exposures, farming practices were grouped into three categories: 1) Type of Farming – Livestock/

Arable/Mixed; 2) Type of feed used – Hay/Haylage/Silage/Dry Grain; and 3) Chemical exposures – chemical spraying (e.g. pesticides) on the farm.

Participants also reported whether they burned fossil fuels in the home in particular wood and turf and if they wore personal protective equipment during their work on the farm.

### 2.4. Spirometry

Onsite height and weight was recorded followed by spirometry measurement carried out by trained respiratory scientists using calibrated *Microlab*<sup>TM</sup> spirometers. All recordings were subsequently reviewed by a consultant respiratory physician. We used a fixed FEV<sub>1</sub>/FVC ratio of <0.70 to define airflow limitation as recommended by the Global Initiative of Chronic Obstructive Lung Disease (GOLD) [15]. In addition we evaluated the FEV<sub>1</sub>/FVC <5% lower limit of normal (LLN) using Hankinson et al. reference equations [16]. Only those which were deemed acceptable and reproducible in line with ERS/ATS spirometry guidelines [17] were included in analysis.

### 2.5. Presentation of results and statistical analysis

Descriptive statistics are presented as counts and percentage for categorical data and mean ± standard deviation (SD) for continuous variables, unless otherwise stated. The primary outcome measure was airflow obstruction on spirometry (Fixed FEV<sub>1</sub>/FVC <0.70). Secondary outcomes included FEV<sub>1</sub>, % predicted FEV<sub>1</sub>, FVC, % predicted FVC and respiratory symptoms. Respiratory symptoms were grouped into upper respiratory tract, lower respiratory tract or cough as outlined previously. Further, those with a history of Asthma or COPD or inhaled therapy were grouped as "prior airways disease". Initial analysis was carried out in the whole cohort with subsequent analysis in the never smoker cohort only.

Chi-squared test or Fishers Exact test, where appropriate, were used to compare categorical variables between groups (airflow obstruction vs. normal spirometry; presence or absence of respiratory symptoms). Between group comparisons of continuous data were carried out using one way analysis of variance (ANOVA) and Kruskal Wallis test, for parametric and non-parametric data respectively.

Univariate logistic regression analysis was performed to identify any association between individual variables and categorical outcomes. Multivariate analysis was performed using logistic regression. Age and gender were included in the model as were all variables whose p value was <0.25 on univariate analysis. These included BMI, Prior airway disease, Hayfever/allergies, Burning of turf, Arable farming, Use of dry grain, silage and haylage feed, Lower respiratory tract symptoms and Upper respiratory tract symptoms.

Multiple linear regression analysis was used to identify associations between variables and continuous secondary outcome measures.

Findings were deemed statistically significant at p value < 0.05. All statistical analyses were performed using Stata version 13 (StataCorp. 2011. Stata Statistical Software: Release 13. College Station, TX: StataCorp LP).

## 3. Results

### 3.1. Baseline demographics and respiratory health

In all, 400 volunteers completed questionnaires and spirometry. Data from 11 non-farmers was excluded. A further 17 were discounted due to: incomplete data (n = 8) and inadequate spirometry (n = 9). Data from the remaining 372 was included in analysis.

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