Spatial and Spatio-temporal Epidemiology 19 (2016) 28–36

Contents lists available at ScienceDirect

Spatial and Spatio-temporal Epidemiology

journal homepage: www.elsevier.com/locate/sste

Investigating trends in asthma and COPD through multiple data sources: A small area study

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ARTICLE INFO

Article history:
Received 15 November 2015
Revised 13 May 2016
Accepted 17 May 2016
Available online 11 June 2016

Keywords:
Space-time analysis
Detection
Asthma and COPD

ABSTRACT

This paper investigates trends in asthma and COPD by using multiple data sources to help understanding the relationships between disease prevalence, morbidity and mortality. GP drug prescriptions, hospital admissions, and deaths are analysed at clinical commissioning group (CCG) level in England from August 2010 to March 2011. A Bayesian hierarchical model is used for the analysis, which takes into account the complex space and time dependencies of asthma and COPD, while it is also able to detect unusual areas. Main findings show important discrepancies across the different data sources, reflecting the different groups of patients that are represented. In addition, the detection mechanism that is provided by the model, together with inference on the spatial, and temporal variation, provide a better picture of the respiratory health problem.

1. Introduction

Asthma and chronic obstructive pulmonary disease (COPD) are the most common chronic respiratory conditions worldwide, contributing to heavy social and economic burden (World Health Organization, 2012).

The number of people suffering from asthma in 2014 was estimated to be 334 million around the world (World Health Organization, 2014) and this number is projected to rise to 400 million by 2025. Around 250,000 deaths per year are caused by the disease, with the majority of them considered to be preventable (Masoli et al., 2004). COPD has a lower prevalence of 64 million people but much higher mortality, with 3 million deaths annually, an estimated 6% of all deaths worldwide. COPD is predicted to become the third leading cause of death by 2030 (World Health Organization, 2014). In the UK, asthma affects 1 in 5 households, and COPD is the fifth leading cause of death after cancer and cardiovascular disease (Masoli et al., 2004).

Asthma and COPD have similarities in symptoms and treatment and there may be considerable overlap between these conditions making them difficult to distinguish clinically (Drazen et al., 2015). Asthma commonly starts in childhood and is often allergic in origin, while a large proportion of COPD is caused by smoking and the condition starts in mid to later life. Common symptoms in both conditions are shortness of breath and wheeze, with worsening of symptoms with respiratory infections, with similarities in treatments of bronchodilators, steroids and antibiotics for infections. Triggers for exacerbations, the major determinants of admissions and possibly deaths are likely to be influenced by infectious disease trends and by common environmental factors with a spatio-temporal structure, such as air pollution (Eeftens et al., 2012).

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http://dx.doi.org/10.1016/j.sste.2016.05.004

A study of trends of these chronic respiratory diseases is important, as it allows a better understanding of the characteristics of the disease, to determine whether health policies or preventive measures are effective, and to identify high-risk populations that might require additional care and treatments. A challenge, however, is the choice of data to use for asthma and COPD analyses. Studies on mortality (Sin et al., 2006) investigate only the highest degree of severity and findings may differ from those for hospital admissions particularly for asthma (Hansell et al., 2003), which is a more heterogeneous condition. Most studies have used data from secondary and tertiary care, such as hospital admissions and emergency care data, but these will not capture milder cases seen in primary care. It is estimated that only 20% of asthmatic patients and less than half of COPD patients suffer from severe symptoms (Lindebeg et al., 2006).

A useful addition to asthma and COPD research is the use of General Practice (GP) drug prescription data which consist in the numbers of items that are prescribed in England by GPs and are dispensed anywhere in UK or Europe. GP drug prescriptions can be very relevant for asthma and COPD as these are long-term conditions that are controlled by regular medication. These capture patients of any severity of the disease, from mild to severe, and hence they can provide a general picture of the respiratory health of the population at small area level. Only a few authors have used GP drug prescriptions to investigate asthma and COPD trends (Hansell et al., 2003; Laurent et al., 2009; Naureckas et al., 2005; Sofianopoulou et al., 2013; Vegni et al., 2005).

In addition, the geographical trends of asthma and COPD have only been studied by a few authors. Hansell et al. (2003) found COPD mortality, hospital admissions and GP prescriptions for COPD were higher in urban areas and northern regions of England, but less clear patterns were seen for asthma in comparisons using age-sex standardised event ratios. Holt et al. (2011) analysed hospitalisations within a Bayesian hierarchical framework, while other examples include Centers for Disease Control and Prevention (2008), Joo et al. (2007), Lipton and Banerjee (2006) and Nandram et al. (2000). Sofianopoulou et al. (2013) explored geographical patterns of GP drug prescriptions, considering the Newcastle and North Tyneside area in the UK as a study region. Studies (Hacking et al., 2011; Hansell et al., 2003; Wells and Gordon, 2008) suggest that there is a significant difference of morbidity and mortality within and between regions of the UK over the last 40 years. This needs to be taken into account in order to both provide reliable statistical estimates, as well as to help public health policy makers more clearly identify target areas with great needs and improve disease prevention and treatment.

The objective of this study is to investigate trends in asthma and COPD at the population level across England by using multiple data sources to help understanding the relationships between disease prevalence, morbidity and mortality. We explore spatial and temporal patterns of GP drug prescriptions, hospital admissions and deaths, and we evaluate if different behaviours can be seen for different data sources which underline different condition severity. We also focus on the detection of unusual areas, i.e. characterised by a temporal trend which deviates from the general one, suggesting the presence of a policy or an emerged localised factor. In this analysis we combine information on asthma and COPD, given the similarities in these conditions, issues distinguishing between them (Drazen et al., 2015) and the fact that the GP prescription dataset used does not provide information on diagnosis.

The remainder of the paper is structured as follows. Section 2 describes the study design and the data sources used for the analysis, and Section 3 describes the statistical modelling framework. In Section 4 the results of the study are presented, followed by a discussion, and finally, Section 5 summarises the main findings of the paper, and suggests recommendations for future research.

2. Data sources

To gain a better understanding of asthma and COPD, we make use of three different data sources: (*i*) General practice (GP) drug prescription data of treatments used for these conditions, which capture patients with mild to severe symptoms and will give a general picture of the disease prevalence across the study region; (*ii*) Hospital Episode Statistics (HES) admissions with primary diagnosis of asthma or COPD; (*iii*) mortality data with asthma and COPD disease as cause of death. The latter two data sources will inform on cases characterised by higher severity. We are going to describe each data source in the rest of this section.

2.1. GP drug prescription data

The Prescription Cost Analysis (PACT) data are accessed from the NHS Business Services Authority. These include the monthly prescriptions of all drugs from 8003 general practices across England from August 2010 onwards at a monthly temporal resolution. In this study we use the prescriptions on Salbutamol, Ventolin and Clenil Modulite,with corresponding British National Formulary (BNF) codes 1011R0AAAPAP, 0301011R0BEAIAP and 0302000C0BPABBF respectively. These account for more than 90% of the total prescription of short acting beta2-agonist (SABA), a class of drugs that relieves patients from bronchospasm which characteristically occurs in acute symptoms (Drazen et al., 2015). Every GP is part of a local clinical commissioning group (CCG), which is the authority responsible for local healthcare services including local hospitals and NHS services, according to the 2012 Health and Social Care Act. GPs of the same CCG collaborate to evaluate local needs, monitor services, set priorities and make area-specific decisions to promote healthcare services for local residents. This suggests that GPs within the same CCG should share similarities. Therefore, the available GP data are aggregated at CCG (211 in England) level to be used for the analysis. The PACT data also contain the number of patients registered within each GP, with information on age group and sex. These are also aggregated at CCG level and they are used for the calculation of the expected number of drugs which will be the offset for the analysis of GP drug prescriptions.