Asthma admission rates and patterns of salbutamol and inhaled corticosteroid prescribing in England from 2013 to 2017

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ABSTRACT

Asthma exacerbations are a common reason for hospital admission. We sought to identify whether patterns of inhaler prescribing are significantly associated with regional asthma admission rates. Asthma admission rates were obtained for English Clinical Commissioning Group (CCG) regions from 2013/2014 to 2016/2017. Raw prescribing data were obtained from OpenPrescribing.net, based on monthly general practice-level data published by the National Health Service Business Services Authority. Data were analysed using a linear mixed effects model. The ratio of salbutamol to inhaled corticosteroid prescriptions within a CCG was positively associated with asthma admission rates, independently of median age, asthma prevalence and socioeconomic deprivation.

INTRODUCTION

There is wide regional variability in admission rates for chronic respiratory conditions. The relationship between socioeconomic deprivation and increased admissions is well established,[1 2] but the impact of potentially modifiable characteristics such as local patterns of prescribing are less well understood. There is some evidence that a high ratio of inhaled corticosteroid (ICS) to total asthma medication use is associated with reduced exacerbations in primary care.[3 4]

We aimed to assess the relative impact of demographic characteristics, patterns of prescribing and the quality of primary care asthma provision in determining asthma admission rates across English Clinical Commissioning Group (CCG) regions.

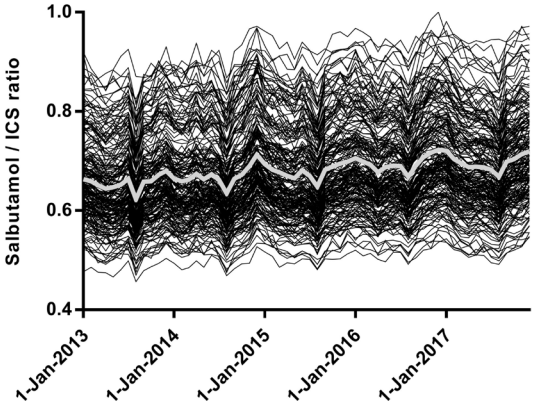

Figure 1 Salbutamol to ICS ratio in English CCGs over a 5-year period. Monthly data for individual CCG are indicated by thin black lines; data for England as a whole is indicated by a thick grey line. CCG, Clinical Commissioning Group; ICS, inhaled corticosteroid.

METHODS

Data sources and preparation

Asthma prevalence data and Quality and Outcome Framework (QOF) scores were obtained from National Health Service (NHS) Digital for each CCG.[5] Five out of the original 209 CCGs ceased to exist during the study period due to boundary changes—these were excluded from the analysis. Among the QOF indicators, we focused on AST003, the percentage of patients with asthma who had an asthma review in the preceding 12 months since this was considered most likely to impact on admissions. The Index of Multiple Deprivation (IMD) is a composite measure of economic and social deprivation.[6] Annual asthma admission numbers were provided by Asthma UK, based on data from NHS Digital.

Prescribing data were obtained from OpenPrescribing.net, based on data from the NHS Business Services Authority.[7] Monthly CCG-level data were extracted for ICS and combination ICS/long-acting β_2 agonist prescriptions, grouped by the total quantity of ICS per inhaler in units of beclometasone dipropionate (BDP) equivalent (μg). Budesonide was considered to be equipotent with standard BDP; Fluticasone propionate, mometasone, ciclesonide and fine-particle beclometasone (Qvar and Fostair) to have double the potency of standard BDP; and Fluticasone furoate 92 µg od to be equivalent to fluticasone propionate 250 µg two times per day.[8 9] Data were similarly extracted for inhaled salbutamol prescriptions. Terbutaline was not included in the analysis since this accounted for only 3% of total short-acting β_2 agonist prescriptions, and equipotent doses with salbutamol are not established in national guidelines. Monthly salbutamol and ICS use for each CCG were calculated (g), as well as the ratio of salbutamol to ICS use.

Statistical analysis

Statistical analysis was performed using Prism 7 (GraphPad Software, La Jolla, California, USA) and R V.3.5.0 (The R Foundation for Statistical Computing). Longitudinal analysis using the lme4 library (https://cran.r-project.org/web/packages/lme4/) in R was performed using four annual data points per CCG (2013/14 – 2016/17). Linear mixed effects models were constructed with the dependent variable being the annual rate of asthma admissions per 100 000 population. Candidate explanatory variables (fixed effects) were median age, asthma prevalence, AST003 (%), salbutamol/ICS ratio and IMD.

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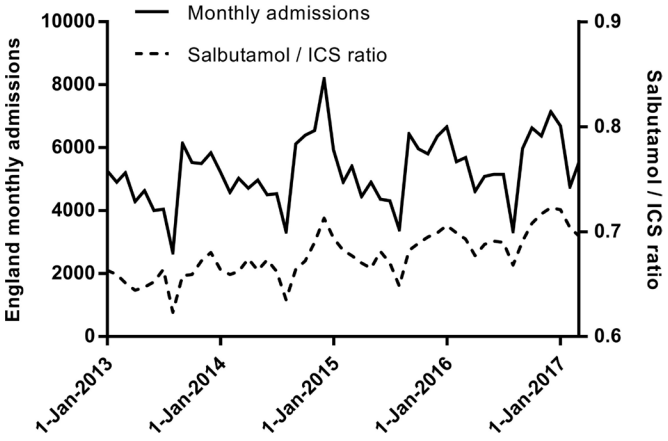

Figure 2 Temporal relationship between monthly asthma admission rates and the ratio of salbutamol to ICS prescribing in England. ICS, inhaled corticosteroid.

RESULTS

In 2016/2017, annual asthma admissions per 100 000 ranged from 53 (Rushcliffe) to 278 (Bradford City). The salbutamol/ICS ratio ranged from 0.518 (South Warwickshire) to 0.944 (Hardwick). Figure 1 shows the trend in salbutamol/ICS ratio in English CCGs from 2013 to 2017. Figure 2 illustrates the seasonal variability in asthma admissions and salbutamol/ICS ratio, both of which peaked in the winter months. There was a national increase in salbutamol/ICS ratio from 0.656 in 2013 to 0.698 in 2017.

Table 1 shows a linear mixed effects model of annual asthma admission rates per 100 000 in English CCGs, using longitudinal data from 2013/2014 to 2016/2017. Asthma admission rates fell by approximately 2 per 100 000 for every 1-year increase in median age and rose by 18 per 100 000 for every one percentage point increase in asthma prevalence. Admission rates rose by approximately 2 per 100 000 for every unit increase in the Index of Multiple Deprivation but were not significantly affected by asthma QOF scores. An increase of 0.1 in the salbutamol/ICS ratio was associated with a rise in admission rates of 7 per 100 000.

DISCUSSION

We have shown that the ratio of salbutamol to ICS prescriptions is positively associated with asthma admission rates, after accounting for median age, asthma prevalence and socioeconomic deprivation. The salbutamol/ICS ratio has slowly increased over the past 5 years in England, suggesting an increasing reliance on reliever therapy and a possible deterioration in population-level asthma control. The salbutamol/ICS ratio consistently rises during the winter months and shows a close temporal relationship with asthma admission rates, suggesting that the response to deteriorating asthma control tends to be an increased use of salbutamol in preference to ICS. We did not observe significant relationships between asthma QOF scores and admission rates, suggesting that annual reviews alone may not be sufficient to reduce admissions. Purdy *et al* also found no association between QOF scores and admissions,[2] while Fleetcroft *et al* found that improved access to General Practice was associated with reduced asthma admissions.[10] Better primary care management of asthma is likely to reduce admissions, but QOF metrics may not capture the key drivers of this improvement.

The main strength of this study is the use of a large population-based dataset covering the whole of England over a 4-year period and the availability of detailed prescribing data. An important limitation is that salbutamol and ICS prescriptions were obtained in aggregate, so it was not possible to distinguish between prescriptions for patients with asthma and chronic obstructive pulmonary disease (COPD). However, asthma has approximately three times the prevalence of COPD, so it is likely that the trends we observed were driven predominantly by prescribing for asthma. We were not able to separately assess the effects of salbutamol and ICS prescriptions as they were positively correlated and could not be entered into the same model due to the lack of independence. Therefore, we used the ratio of salbutamol to ICS to capture the effects of salbutamol use relative to ICS. It is probable that a number of other factors not included in our model, such as smoking prevalence, air pollution levels and pollen counts also had an effect on asthma admission rates, but these were beyond the scope of our study.

We conclude that the salbutamol/ICS ratio is an important predictor of asthma admission rates. Prospective studies are needed to determine whether population-based interventions targeting this can reduce admission rates.

Table 1 Linear mixed effects model of annual asthma admission rates per 100 000 in English CCG regions

Predictor	Estimate of fixed effect (95% CI)	P value
Median age (years)	−2.10 (−3.04 to −1.17)	<0.0001
Asthma prevalence (%)	18.47 (13.02 to 23.91)	<0.0001
IMD	1.87 (1.38 to 2.36)	<0.0001
Salbutamol/ICS ratio	71.73 (36.50 to 106.07)	<0.0001
Asthma QOF score (AST003)	−0.24 (−0.94 to 0.46)	0.491

ICS, inhaled corticosteroid; IMD, Index of Multiple Deprivation; QOF, Quality Outcomes Framework.

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