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Original Article

Practice Appointment Rates for High-risk Asthmatics: What could be the Predictor(s)?

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Abstract

Practice appointment rates could have a significant impact on national health care costs and services offered by doctors. In this respect a study was designed to determine the relationship between practice appointments and possible predictors in high-risk asthmatics. An observational retrospective analysis of the predictors for the practice appointments in asthmatic patients with at least one hospital admission between years 1994-1998 was carried out. This study was performed in a local district general hospital and consenting practices in the UK. 115 asthmatics, aged over 5 years, admitted to the hospital for asthma exacerbations, between years 1994-1998, were enrolled in the study. Multivariate ridge regression was used to build the final model. Analysis revealed that the predictors age and the number of prednisolone rescue courses could remain in the final model ($p=0.002$, $r=0.46$).

As a conclusion, frequent oral steroid users and elderly asthmatics were found to have higher practice appointment rates. This is highly likely due to a more severe asthma condition as well as age-related problems in these groups of patients. These findings represent the importance of asthma management in unstable asthmatics and elderly patients in primary care level.

Keywords: Asthma; Practice Appointment; Predictors; Elderly; Prednisolone.

Introduction

The management of asthma within primary care is a considerable burden on the health care services. According to a report published in the UK in 1995/1996, £671.7 million was spent on asthma, with 91% (£614 million) in primary care. Of this primary care spend, 91% (£557 million) was for prescribed asthma medicines and 9% (£57 million) for GP consultations. The estimated number of primary care consultations due to asthma in the same period of time (1995/1996) was about six million and the number of patients was approximately 2.5 million. This number of consultations included 2.6% of the total GP consultations (1, 2).

Several studies carried out in the secondary care level, have investigated relationships between asthma events and demographic (3-10) or socio-economic characteristics (11-13) of asthmatic patients. However, there is no conclusive information in this regard. On the other hand, to reduce the primary care costs of health services, an identification of the asthma primary care events and their predictors could be beneficial. A report published by the National Asthma and Respiratory Training Centre (14) remarks that specific targeting of patients with a previous asthma hospitalisation (as high-risk group) could be cost efficient. In this respect, we designed a study to investigate the relationship between practice appointment rates (PAs) and the possible predictors in

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asthmatics with at least one admission to hospital (high-risk asthmatics). This relationship was described by building a model, using an innovative analysis method called "ridge regression analysis". This method can reduce the misleading impact of interactions between predictors in the "least squares regression analysis" (15, 16).

Experimental

Methods

Retrospective analysis of the predictors for PAs (per month) by asthmatic patients, aged over five years, during the years 1994-1998 has been performed. The distribution of the number of PAs/month was very skewed. A square root (SQRT) transformation provided a normal distribution, confirmed by the Kolmogorov-Smirnov test (17). This transformed data were used in data analysis instead of the original values.

Data collection

A list of patients hospitalized between years 1994 to 1998 was obtained from the clinical information office of the hospital, after the local ethics committee approved the study. All asthma admissions were recorded based on the international classification of diseases [ICD-10^{th} revision, codes J45.0-J45.9]. The patients' demographic details i.e. age, sex, ethnicity, home address and their GPs' name and address as well as medical information including the allergy status and a history of eczema/hay fever were extracted from the hospital medical records.

Consents were obtained from 33/128 (25.8%) GPs to access their patients' medical records in practices. This covered 115 (26.1%) asthmatic patients out of 440 asthmatics admitted to the hospital during the years 1994-1998. Information about the number of home visits (HVs) and prednisolone rescue courses (PRCs) were collected from practice records.

Information about the Jarman score (JS), an indicator of the potential workload on services offered by GPs (18) and Townsend index (TI), an indicator of material deprivation (18), defined on basis of 1991 census, was obtained from the Manchester Information and Associated Services (MIMAS). The JS for practices and TI for patients were assigned via their postal address.

Home visits included visits by the GPs during the day or night. It was not possible to distinguish the practice appointments due to different reasons in all practices. Therefore, a practice appointment is defined as an attendance at the practice for any reason including prescription collecting, asthma consultations and appointments for other reasons e.g. vaccination or nursing staff consultations. The number of the PAs was used as a proxy of health services utilisation in the primary care sector and GP consultation rates for asthma.

Data analysis

The data obtained were analysed using SPSS package (version 10). The analysis process was performed in three main stages:

Preliminary analysis

Preliminary statistical analyses were used to identify the predictors which were highly likely associated with the PAs. The Mann-Whitney test was used to analyse any association between binary predictors i.e. gender, allergy status, history of hay fever/eczema, ethnicity (South Asian and Caucasian), the Townsend index (affluent or deprived), and the Jarman score (low or high workload GPs) with the SQRT of the PAs. Likewise, linear regression analysis was used to test the possible relationship between the continuous predictors i.e. age, the number of PRCs/year and the number of HVs/month with the SQRT of the PA (19). All associations with a $p<0.2$ were considered to be used in the multivariate regression analysis (20).

Interaction evaluation

To determine any significant interaction between the eligible predictors (identified by the preliminary analysis), the Mann-Whitney test, the chi-square test and the Kendall's rank correlation analysis (for interactions between non-normally distributed variables with several ties) were used (19). A level of $p<0.05$ was considered as the significance level for each interaction.

Multivariate ridge regression analysis

Due to significant interactions between predictors, the ridge regression was applied instead of the ordinary regression analysis to build the final model. The significance level was $p<0.05$.

Results and Discussion

Data for 115 asthmatic patients were obtained from their practice and hospital records. The mean (sd) and the median (interquartile range) of PAs/month were 1.01(0.70) and 0.90 (0.47-1.41), respectively. Data on the predictors (demographic and medical information) for these patients are presented in table 1.

Table 1. Demographic and medical history of 115 asthmatic patients with a history of asthma hospitalisation during the years 1994-1998

Age (mean±sd)	27.8±20.4 years
Sex	
Male	47(40.9%)
Female	68(67.8%)
Ethnicity	
South Asians	37(32.2%)
Caucasians	78(67.8%)
Jarman score*	
Patients registered in High-workload GPs	60(52.2%)
Patients registered in Low-workload GPs	48(41.7%)
Unknown	7(6.1%)
Townsend score**	
Deprived	57(49.6%)
Affluent	51(44.3%)
Unknown	7(6.1%)
Allergy status	
Yes	54(47.0%)
No	61(53.0%)
History of Eczema/Hay fever	
Yes	39(33.9%)
No	76(66.1%)
Home visits/month (*mean±sd: 0.07±0.33*)	
With home visits	37(32.2%)
Without home visits	75(65.2%)
Unknown	3(2.6%)
Prednisolone rescue courses/year (*mean±sd: 0.81±1.41*)	
With prednisolone rescue courses	57(49.6%)
Without prednisolone rescue courses	54(47.0%)
Unknown	4(3.4%)

* Divided based on the median=20.23
** Divided based on the median=1.99

Table 2. The results of the preliminary analyses used to determine the predictors associated with the SQRT of the practice appointments

Predictor	P value (CC[c])
Age	0.006 (r=0.27)
Sex	0.24
Ethnicity	0.10
Allergy	0.13
Eczema/hay fever	0.47
Townsend index	0.05
Jarman score	0.13
Number of HVs[a]/month	0.95 (r=-0.007)
Number of PRCs[b]/year	<0.0001 (r=0.36)

a: Home visits
b: Prednisolone rescue courses
c: Correlation coefficients

Results of the preliminary analyses

The results of the preliminary analyses to identify the eligible predictors for entering into the multivariate analysis are presented in table 2. There were directly significant relationships between the PRCs and age with the SQRT of the PAs. In addition, a borderline positive association between the SQRT of the PAs with the Townsend index was observed, so that patients from more deprived areas could have a higher number of PAs. There were also non-significant associations with a $p<0.2$ between the SQRT of the PAs and the Jarman score, ethnicity and allergy status (table 2). Therefore these six predictors (TI, JS, ethnicity, allergy status, age and the number of PRCs) were eligible to enter the multivariate regression analysis. Two remaining predictors, sex and history of eczema/hay fever, were highly unlikely to have a relationship with the PAs ($P>0.2$).

Results of the interaction evaluation

Interaction assessments revealed that there were multi-collinearities between the eligible predictors entered for the multivariate regression analysis (table 3). The TI and JS had a significant direct association. The proportion of the South Asians amongst patients with a

Table 3. The significant interactions between those predictors eligible to be included in the multivariate regression analysis

Interaction	p value
TI* and JS**	<0.0001
TI and Ethnicity	<0.0001
TI and Allergy status	0.037
JS and Ethnicity	<0.0001
JS and Allergy status	0.008
Ethnicity and Allergy status	<0.0001

* Townsend Index; **Jarman Score

higher TI and a higher JS was significantly high. There was also an inversely significant interaction between allergy status and TI as well as allergy status and JS. In addition, most of the patients with a history of allergy were from the Caucasian ethnic group.

Multivariate ridge regression model

The six predictors of JS, TI, age, ethnicity, allergy status, the number of home visits/month and the number of PRCs/year were entered into a multivariate ridge regression analysis, where SQRT of the PAs/month was the outcome variable.

This analysis method led to a model with p=0.002 and r=0.46, in which number of the PRCs/year and age could remain as the significant predictors. The final model is shown as equation 1.

$$SQRT\ (PA) = 0.70 + [0.06 \times PRCs] + [0.003 \times Age]$$

or

$$PA = [0.70 + (0.06 \times PRCs) + (0.003 \times Age)]^2$$

(Equation 1)

where SQRT (PA) is 'square root of the number of practice appointments per month', PRCs is 'the number of prednisolone rescue course per year', 0.70 is the constant and 0.06 and 0.003 are the regression coefficients for the predictors PRCs and age respectively. This equation shows that patients with higher number of the PRCs as well as elderly asthmatics could have a higher practice appointment rate.

The final results have revealed that PAs for high-risk asthmatic patients could be directly related with the number of PRCs and age. In other words, frequent oral steroid users and elderly patients could use the primary care services more than asthmatics without these characteristics.

The high number of PRCs could be an indicator of unstable asthma, the severity of asthma or higher morbidity rates. Previous reports have shown that asthmatics with a history of prednisolone rescue courses had a higher risk of severe life-threatening or near-fatal asthma attacks (21, 22). Likewise, Li et al. (23) and Lieu et al. (24) in studies on hospitalized asthmatics found that systemic steroid use was associated with hospitalization. It is also reported that a high number of oral steroid courses could be a sign of poor prophylactic asthma management (25) and is associated with a higher risk of emergency room visits (26). Studies confirming a higher primary care utilization by patients with frequent oral steroid usage are lacking. However, there are some studies that have reported that a higher rate of practice appointment or medical consultation could be significantly related to the severity of asthma symptoms and morbidity (27, 28).

Gill et al. (29) in a study on patients with a high rate of consultations have reported a higher tendency for frequent GP consultations by elderly patients. Also, Heywood et al. (30) in a retrospective case-control study observed that very frequent attendees are older than the average adult population. They also reported a high level of physical and psychological ill health for very frequent attendees. Both these studies used frequent GP consulters, irrespective of their illness or disease diagnosis. Perhaps age-related complications in the elderly patients for instance deteriorated physiologic function of their organs, concurrent health problems, polypharmacy and poor compliance (31-33) are involved in their higher practice appointment rates.

Although previous studies have observed a direct association between practice appointments or GP visits by patients and female gender (30, 34, 35), low social class (36-38) and minority ethnic groups (39-41), these were not confirmed by our findings. Atopy, eczema and a positive history of allergy have also been identified as risk factors for asthma severity, acute attacks and hospital admissions due to asthma (42, 43). However a significant relationship between these risk factors and practice appointments was not obtained in this study. These dissimilarities could be due to different socio-demographic characteristics of the study populations. It should also be contemplated that patients studied in this investigation were from a high-risk group of asthmatics with a history of at least one hospitalization. These patients could have a different health care utilization pattern.

Conclusion

This study has revealed that asthmatic patients with frequent oral steroid use as well as older asthmatics could have a higher number of practice appointments and primary care utilization. These could be due to more severe asthma in frequent oral steroid users and age-related difficulties in elderly asthmatics. Further studies are required to highlight the specific needs of these groups, considering their psychological and social problems.

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