



Predicted relative prevalence estimates for obstructive sleep apnoea and the associated healthcare provision across the UK

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ABSTRACT

We surveyed the UK distribution of five factors commonly associated with obstructive sleep apnoea (OSA) to produce an overall risk map that could be used to predict relative prevalence estimates. The weighting and mapping of selected risk factors associated with OSA highlighted significant regional variation in predicted prevalence estimates. These data provide the first attempt to systematically map the UK for OSA and identify areas where the condition is likely to be more prevalent. The data show a significant mismatch between areas identified as having a high predicted prevalence estimate and the distribution of existing sleep centres.

INTRODUCTION

Obstructive sleep apnoea (OSA) is a major healthcare challenge in the UK. It is affecting an estimated 4% of middle-aged men, 2% of middle-aged women, and its strong association with obesity means that the prevalence has risen significantly over the last two decades.^{1 2} Similarly, the increased incidence of OSA with older age means the ageing population is also likely to increase the burden of OSA.

OSA is frequently associated with diabetes, cardiovascular disease, hypertension and depression, and there is an increased risk of road traffic accidents associated with sleepiness. OSA can impact significantly on quality of life and public health, and cause significant healthcare costs, particularly when the diagnosis is delayed. The efficient diagnosis and treatment of OSA should therefore form an important part of any public health strategy. Despite this, however, few of the prevalence data required for effective OSA management planning exist, and around 80% of OSA cases remain undiagnosed and untreated.

Predicting areas in which OSA is likely to be highly prevalent could help local health authorities formulate strategies to minimise these impacts, by allowing the comparison of actual diagnosis rates with predicted prevalence estimates to ensure that awareness campaigns and service provision are sufficient to meet the predicted needs of the local population.

To do this, we aimed to systematically survey and analyse five factors commonly associated with OSA—obesity, gender, age, hypertension and diabetes—in order to plot a map of relative predicted prevalence estimates for OSA across the UK. By overlaying these

Key messages

What is already known on this subject

- It has been established that obstructive sleep apnoea (OSA) is frequently associated with obesity, diabetes, age, hypertension and male gender. However, in contrast to those five associated factors, no systematic nationwide registry has collected data to identify regional prevalence estimates for OSA in the UK.

What this study adds

- This systematic analysis of five factors commonly associated with OSA maps and identifies, for the first time, relative predicted prevalence estimates for the whole UK. This dataset identifies regional variations and inequalities accessing local sleep services, emphasising the importance of developing future strategies to deliver healthcare and sleep service provision nationwide.

data with details of current available sleep services, we hypothesised that we would be able to compare predictions of OSA prevalence estimates with the distribution of current sleep service provision, thereby providing vital information to health authorities for the development and implementation of future healthcare strategies.

PATIENTS AND METHODS

In 2012 the British Lung Foundation (BLF) commissioned a specialist mapping company (Lovell Johns, UK) to create a set of maps showing the location of known sleep services in the UK and highlighting areas of potential high OSA risk, or 'hotspots'. Anticipating that the maps would be of greatest value to local healthcare commissioners and policymakers, the BLF requested that the maps be divided along local health authority boundaries (NHS Health Boards (HBs) in Scotland, NHS Local Health Boards (LHBs) in Wales, NHS Health and Social Care Trusts (HSCs) in Northern Ireland and NHS Clinical Commissioning Groups (CCGs) in England, with predicted CCG boundaries used where final boundaries were yet to be agreed).

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To identify the most appropriate data with which to develop the maps, advice was sought from key experts in sleep medicine through the BLF's OSA Advisory Group. Following peer group input and an item reduction phase, the five most common factors associated with OSA were identified as:

- ▶ Obesity: prevalence of sleep apnoea is directly correlated with obesity levels.
- ▶ Type 2 diabetes: recent reports have indicated that the majority of these patients have OSA.
- ▶ Age: OSA is more prevalent in older people.
- ▶ Hypertension: hypertension can be caused by OSA.
- ▶ Sex: OSA is more common in men than in women.

Results were stated as mean (SD) for normally distributed data and as median (IQR) for non-normally distributed data, unless otherwise indicated. Comparisons of data were made using unpaired *t* tests and correlation was described using the Pearson coefficient. Results with $p < 0.05$ were considered to be of significance.

RESULTS

We gathered data for 239 NHS administrative areas in the UK (213 CCGs in England, 14 HBs in Scotland, 7 LHAs in Wales and 5 HSTs in Northern Ireland) with a mean population of 261 604 (155 614), ranging from 20 110 (Orkney) to 1 203 870 (Greater Glasgow & Clyde).

There was significant regional variation in predictive prevalence estimates for OSA (figure 1). Areas of relatively high

predicted prevalence estimates were Wales, the North East and large parts of East Anglia and Lincolnshire. Large urban areas in England and Scotland and a number of counties around London were among the areas with the lowest predicted prevalence estimates. Although age did not correlate with diabetes ($R^2 = 0.078$) or obesity ($R^2 = 0.097$), there was a close relationship between age and hypertension ($R^2 = 0.753$, $p < 0.001$).

The total number of identified sleep units was 289, with only 50 centres offering polysomnography (confirmed) and the other centres offering limited respiratory studies, pulse oximetry screening or continuous positive airway pressure. In 76 centres it was not possible to determine which diagnostic modality was offered. There was a wide range of available sleep centres per CCG health area, ranging from no sleep centres in 66 CCG health areas to 9 in one large urban area; on average, there were 1.2 (1.3) centres per health authority area. People in areas without sleep centres but who lived close to an urban area had a shorter travel distance to access sleep services. Others, specifically more rural areas or islands, had far greater distances to travel to the nearest available sleep service.

DISCUSSION

This research systematically analysed five factors commonly associated with OSA for the whole UK to identify and predict, for the first time, estimated OSA prevalence throughout the country. The maps reveal regional variations that are markedly different from those for obesity and economic deprivation.

Problem areas

The results reveal a concerning mismatch between predicted healthcare requirements and service delivery. Furthermore, most UK sleep centres are established in large urban areas characterised by younger populations that suffer from limited comorbidities. Patients in non-urban areas, close to large centres, are linked with sleep centres by existing infrastructure and public transport. However, patients in more remote rural areas face the problem of long travel distances to their nearest centre.

'Hotspots' of potentially high prevalence have, in the past, been similarly identified for conditions other than sleep disorders. Such exercises have seen NHS healthcare delivery strategies adjusted accordingly to try and address the healthcare needs identified. However, sleep medicine is still evolving and, despite an increasingly obese and ageing population with an intensifying likelihood of developing comorbidities such as diabetes and hypertension, the UK's need for a nationwide delivery strategy for sleep service provision has not yet been adequately addressed. The current provision of sleep services in the UK does not meet the healthcare requirements of the population and varies remarkably.

Regional variation

In England, the number of diagnostic sleep studies per 1000 population varies remarkably from 0.1 to 7.8 (60-fold; this compares with 10–780 sleep studies per 100 000 population).³ Although the number of sleep studies in the UK has increased in most of the health areas since 2004,⁴ this still represents the highest variation in service provision in any branch of respiratory healthcare, and is a reflection of both a low rate of symptom recognition and referral from primary care, and a lack of services to which patients can be referred. It indicates a need to improve understanding of the prevalence of OSA, raise awareness of the healthcare burden and consequences of the condition, assess the capacity of sleep services and promote

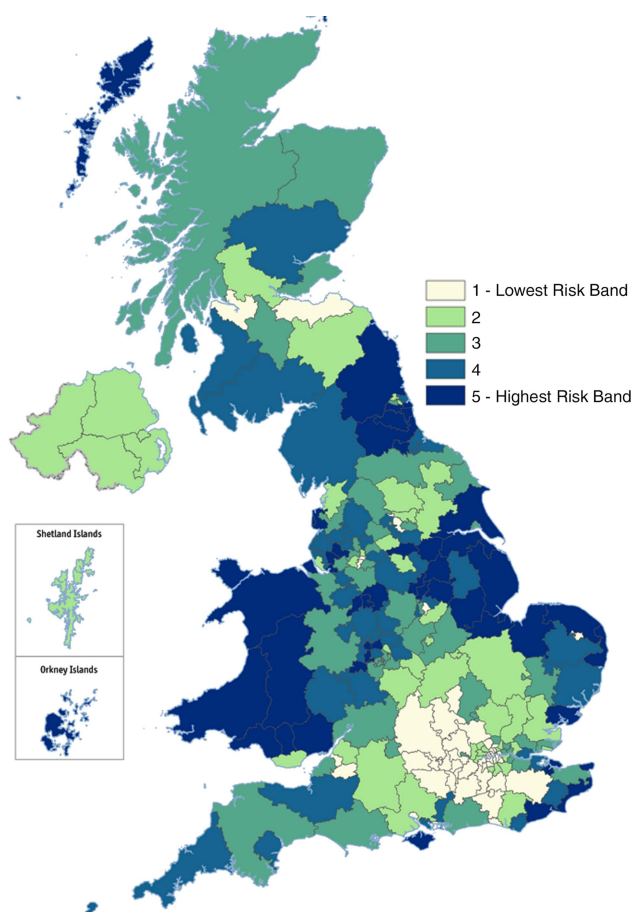


Figure 1 Weighted accumulated relative predicted prevalence estimates for obstructive sleep apnoea; areas are displayed as health authority area. The legend indicates the relative risk band in quintiles (1–5), darker colours indicating higher predicted prevalence estimates.

alternative strategies to deliver healthcare for sleep conditions in the UK.

International comparison

Polysomnography is available in 50 UK sleep centres, which is equivalent to one centre for every 1.25 million citizens. The number of citizens per sleep centre is around 10 times higher than in the USA where 2461 accredited sleep centres offering polysomnography cater for a population of just over 310 million.⁵

Limitations of the study

The data for the five factors associated with OSA used in this analysis might not be complete. However, a GP register was available nationwide for several conditions including diabetes and hypertension, but could be limited by the access to the service. Age, gender and obesity distribution were reliably populated from statistical surveys. Our data are therefore consistent with current nationwide datasets and are the most complete compendium.

The collated dataset of UK sleep centres is the best collection currently available. However, this was not an exhaustive survey of sleep centres and will reflect omissions from input sources. The data on level of service may be inconsistent due to the differing definitions of services used by these sources and will require permanent updates.

A significant challenge when determining estimates for predicted prevalence was to develop a robust method for combining the identified risk factors into an appropriately weighted cumulative 'factor score'. Although the weighting of different variables is a valid statistical method, there is patchy evidence for the presumed difference in the importance of each factor for the development of OSA; the weighting method was devised on expert advice rather than on conclusive evidence. Similarly, the fact that some diseases such as hypertension and diabetes are not independent of age or obesity complicates the matter.

CONCLUSIONS

These data identify significant variations and inequalities in provision of sleep services within the UK. Remote areas might benefit from establishing outreach clinics from network provision of healthcare with tertiary services, national awareness campaigns and, potentially, the use of modern media and systematic screening to avoid delays in diagnosis and treatment of a highly prevalent disorder.

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THORAX

Wide variation in UK sleep disorders services which doesn't match need

And demand is set to rise in tandem with increasing population age and girth

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The provision of services to treat an increasingly common sleep disorder linked to serious ill health varies widely across the UK and does not match current need, indicates research published online in Thorax.

Furthermore, demand is set to rise as the population's age and girth increase, both of which are risk factors for the disorder, known as obstructive sleep apnoea or OSA for short.

OSA is a condition that disrupts breathing during sleep, usually as a result of the relaxation of the muscles and soft tissues in the throat which relax and collapse to block the airway for 10 or more seconds. It affects an estimated 4% of middle aged men and 2% of middle aged women, and is associated with obesity and increasing age. But it is thought that 80% of cases remain undiagnosed.

Because OSA disrupts breathing during sleep, it usually interferes with the quality and length of sleep as well, leading to daytime sleepiness and the risk of accidents as well as other health problems associated with poor quality sleep.

The researchers used British Lung Foundation data, to identify the location of sleep disorder centres in all four UK countries.

To uncover hotspots with the highest predicted rates of OSA, they used prevalence data for the five most common factors associated with OSA - obesity, type 2 diabetes, older age, high blood pressure, and gender - in the populations served by 239 different NHS administrative areas in all four UK countries.

They then mapped the predicted prevalence rates of OSA onto the location of sleep disorder centres and found "a concerning mismatch" between them.

Wales, the North East of England, large parts of East Anglia and Lincolnshire were the areas with the highest predicted rates of the condition, while large conurbations in England and Scotland and several counties around London were among the areas with the lowest predicted rates.

The number of sleep centres across the UK totalled 289, only 50 of which offered full diagnostic assessment of sleep problems (polysomnography), equivalent to one centre for every 1.25 million citizens - a ratio that is around 10 times higher than in the USA.

And these centres were not evenly distributed either. For example, 66 of the 213 clinical commissioning group areas in England had no sleep centre at all, yet there were nine in one large conurbation.

The evidence shows that the number of diagnostic sleep studies per 1000 of the population varies 60-fold across the UK - the highest variation of any branch of respiratory healthcare, the study authors point out.

"[This] is a reflection of both a low rate of symptom recognition and referral from primary care, and a lack of services to which patients can be referred," they write.

"Sleep medicine is still evolving, and despite an increasingly obese and ageing population with an intensifying likelihood of developing [other conditions] at the same time such as diabetes and [high blood pressure], the UK's need for a nationwide delivery strategy for sleep service provision has not been adequately addressed," they add.

"The current provision of sleep services in the UK does not meet the healthcare requirements of the population and varies remarkably," they conclude.