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Linear regression analysis of Hospital Episode Statistics predicts a large increase in demand for elective hand surgery in England

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Summary *Introduction:* We integrated two factors, demographic population shifts and changes in prevalence of disease, to predict future trends in demand for hand surgery in England, to facilitate workforce planning.
Methods: We analysed Hospital Episode Statistics data for Dupuytren's disease, carpal tunnel syndrome, cubital tunnel syndrome, and trigger finger from 1998 to 2011. Using linear regression, we estimated trends in both diagnosis and surgery until 2030. We integrated this regression with age specific population data from the Office for National Statistics in order to estimate how this will contribute to a change in workload over time.
Results: There has been a significant increase in both absolute numbers of diagnoses and surgery for all four conditions. Combined with future population data, we calculate that the total operative burden for these four conditions will increase from 87,582 in 2011 to 170,166 (95% confidence interval 144,517—195,353) in 2030.
Discussion: The prevalence of these diseases in the ageing population, and increasing prevalence of predisposing factors such as obesity and diabetes, may account for the predicted increase in workload. The most cost effective treatments must be sought, which requires high quality clinical trials. Our methodology can be applied to other sub-specialties to help anticipate the need for future service provision.

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Introduction

Hand surgery is an important interface sub-speciality encompassing orthopaedics and plastic surgery. The importance of hand surgery is well recognised as much of the function of the upper limb and thus personal and economic productivity is dependent upon the hand's proper functioning, thus there is an overt need for a properly planned, comprehensive, hand surgery service.[2]

Financial pressures on health services worldwide make knowledge of likely future service use important for planning. It has been acknowledged that there may be some shortcomings in hand disease service provision and that effective future planning is essential to ensure high standards are maintained.[1]

Much has been made of population demographic shifts, particularly the ageing population, leading to increases in workload. However, changes in prevalence of diseases over time will also contribute to an increase or decrease in workload. It is possible that there will be a disproportionate increase in surgical procedures commonly required in elderly people, those with diabetes, and the obese, and this must be met with adequate service provision and planning.[3] Workforce planning is integral to this, and there has been much recent interest in a supply-demand model for surgical training.[4]

In this paper we integrate two factors — demographic population shifts and changes in prevalence of disease — in order to predict future trends in demand for hand surgery in England. The Hospital Episode Statistics (HES) record all diagnoses and procedures performed within the NHS in England. We firstly analyse this HES data for four common hand surgery conditions — Dupuytren's disease, carpal tunnel syndrome, cubital tunnel syndrome, and trigger finger — from 1998 to 2011. Using linear regression, we estimate trends in both diagnosis and surgery for these conditions until the year 2030. We then integrate these estimates with age specific population data in order to estimate how this will contribute to a change in workload over time. It is hoped that this research will facilitate the planning of future service provision, and guide the allocation of funding for much needed research into optimal treatments for these conditions. Furthermore, our methodology can be applied to other sub-specialties to help anticipate the need for future service provision.

Materials and methods

Hand disease data was collected from the Hospital Episodes Statistics (HES) website for England (www.hesonline.nhs.uk). Primary diagnosis according to ICD-10 criteria and primary intervention and operation data according to OPCS-4 were extracted for Dupuytren's disease, carpal tunnel syndrome, cubital tunnel syndrome, and trigger finger from 1998 to 2011. Data for the 0—14 age group was removed from all analyses in order to exclude congenital cases.

Corresponding operations were identified for each primary disease; for Dupuytren's disease 'palmar fasciectomy', 'digital fasciectomy', 'revision of palmar fasciectomy', 'revision of digital fasciectomy', and 'division of palmar fascia' (needle fasciotomy) were recorded. For the other conditions 'carpal tunnel release', 'revision of carpal tunnel release'; 'cubital tunnel release'; and 'release of constricted tendon' were recorded. The available data for operative procedures spanned 2000—2011.

Population data was collected from the Office of National Statistics website for England (www.statistics.gov.uk), according to age groups matching HES data (15—59, 60—74, 75+) for 1998—2011, and projected population figures for each age group in 2015, 2020, 2025, and 2030. The percentage of the population in each age group was calculated. The proportion of males in the projected population figures was compared to current figures using the paired *T*-test, in order to rule out a change in the proportions of males and females confounding results for those conditions with differing sex-specific incidences.

We undertook univariate linear regression on the diagnosis rates per person of the population for each hand disease from 1998 to 2011, and calculated 95% confidence intervals. We then extrapolated this data to 2030, calculating diagnosis rates for each age group and also as a total of all age groups.

Next, we performed univariate linear regression on the operation rates per person of the population for each hand disease from 2000 to 2011, and calculated 95% confidence intervals. We then extrapolated this data to 2030, calculating operation rates for each age group and also as a total for all age groups. The mean and 95% confidence intervals at 2015, 2020, 2025, and 2030 were recorded. Next, these results were multiplied by the predicted number of people in each population age group for 2015, 2020, 2025, and 2030 to show the predicted workload in the future.

To establish whether increased operative management, as opposed to non-operative management, of these common hand conditions could account for some increased workload, we calculated the ratio of number of operations per diagnosis for each condition. Finally, to test whether the introduction of a maximum 18 week wait from referral to treatment policy in the NHS in 2008 artificially increased the number of diagnoses and/or operations, we performed univariate linear regression of pre-and post-2008 data with analysis of covariance of the slopes.

All statistical calculations were performed GraphPad Prism version 5.00 for Windows (GraphPad Software, San Diego California USA, www.graphpad.com).

Results

Population statistics

The population of England increased between 1998 and 2011 from 48,820,600 to 52,655,389 people, and this is predicted to continue to 2030 (60,409,534 people) (Figure 1). The proportion of the population in younger age groups (0—14 and 15—59) are predicted to decrease (2011: 17.54% and 59.83%; 2030: 17.33% and 55.19%respectively), whilst the proportion of people in older age groups (60—74 and 75+) are predicted to increase (2011: 14.68% and 7.96%; 2030: 16.30% and 11.18% respectively). The proportion of men and women is not predicted to significantly change ($p = 0.69$).