

Objectives

Tonsillectomy, grommet insertion and adenoidectomy are only permissible in the UK when specific criteria are met.^{1,2} Children from deprived backgrounds are more likely to require tonsillectomy.³ Our aim was to assess correlation between tonsillectomy and deprivation plus tonsillectomy and related infections.

Design

Retrospective observational study of data provided by Information Service Division between 1996/7 and 2016/17. Socio-economic background was determined by Scottish Index of Multiple Deprivation (SIMD) score.

Setting and Participants

Complete national data for all patients under 16 years old admitted to Scottish NHS hospitals.

Main outcome measures

Admission to hospital for ENT procedures and ENT-related infections.

Results

60,456 tonsillectomies were performed during the study period, significantly fewer following the introduction of SIGN guidelines. Children from the most deprived areas were 72.0% more likely to receive tonsillectomy than the least deprived. Significantly increased rates of tonsillitis were observed following the introduction of SIGN guidelines. The most deprived children were 59% more likely to be admitted with quinsy than the least deprived.

Conclusion

Tonsillectomy rates are highest in the most deprived. Complications of throat infection appear to be increasing following the introduction of SIGN and NICE guidelines.

Key Points:

- The rate of tonsillectomy has significantly reduced since the introduction of SIGN guidelines
- Children from the most deprived areas have the highest rate of tonsillectomy
- The proportion of children from each deprivation quintile having tonsillectomy remained the same before and after the introduction of SIGN guidelines
- Children from the most deprived areas are significantly more likely to be admitted to hospital for acute tonsillitis and quinsy
- Tonsillectomy rate in children under 4 has been increasing over the last 10 years

Introduction

The department of health has identified tonsillectomy, grommet insertion and adenoidectomy as procedures of low clinical value and there are now substantial restrictions on these procedures.⁴ Recurrent tonsillitis results in morbidity, negatively impacts quality of life and in children results in absence from school and extra-curricular activities.⁵ Recurrent tonsillitis can be treated with tonsillectomy if the patient fulfils criteria in the Scottish Intercollegiate Guideline Network (SIGN) guidelines.¹ In a 20-year nationwide cohort study investigating the trends in tonsillectomy, a 48% decrease in tonsillectomy rates was found between 1993/94 and 2015/16 in Scotland. There has been a corresponding increase in acute admissions to hospital with severe tonsillitis, quinsy and deep neck space infection (DNSI).^{6,7}

The Scottish Index of Multiple Deprivation (SIMD) tool is used by the Scottish government to measure the relative level of deprivation based on seven domains: income, education, employment, health, housing, crime and access to services.⁸ Based on these domains, postcode areas in Scotland are scored and ranked from 1 (most deprived) to 6976 (least deprived). The tool can be used when comparing key indicators of deprivation in small geographical areas. There is limited literature regarding the role of socio-economic deprivation in common ENT procedures such as tonsillectomy, grommet insertion and adenoidectomy. In 1994, Bisset et al. demonstrated higher rates of tonsillectomy and lower rates of grommet insertion in association with deprivation.³ There has been little evaluation of the role of deprivation in the development of complications of ENT disorders such as quinsy and DNSI.

Our primary aim was to assess the rates of tonsillectomy, grommet insertion and adenoidectomy in Scottish children and whether there is an association with deprivation. In addition, we looked at the rates of acute hospital admission for complications of ENT infections in association with deprivation.

Materials and methods

The SIMD rank is calculated based on patients' postcode as described above. For the purpose of this study the rank was divided into 5 groups –1 being the most deprived and 5 being the least deprived - with the exception of the quinsy and DNSI data which was only available in deciles. Data regarding ENT procedures and hospital admissions came from the Information Services Division (ISD) Scotland. National population data over a 20-year period for tonsillectomy and over a 16-year period for grommet insertion and adenoidectomy was available.

Data relating to tonsillectomy, tonsillitis, quinsy and deep neck space infection in paediatric patients (under 16 years old) was available for all Scottish residents visiting non-obstetric and non-psychiatric hospitals in Scotland. Information relating to the financial year, sex of the patients, age group and SIMD quintile was included over a 20-year period. A second data set relating to children aged 16 or less admitted for grommet insertion and adenoidectomy contained similar data points – financial year, sex of patients, age group and SIMD quintile – but was only available for a 16-year period. The data set included where adenoidectomy and grommet insertion occurred in the same surgery episode however this was omitted from the analysis and only individual surgeries were included.

Statistical analysis was carried out using RStudio 1.1.463 (RStudio Team, 2016) and the AER (Kleiber and Zeileis, 2008) package. A Poisson regression model was fitted for tonsillectomy, adenoidectomy and grommet rate using the model parameters; financial year, sex, age group and SIMD quintile. The data was tested for over-dispersion. Dispersion was found to be significantly greater than 1 therefore a Quasi-Poisson regression model was fitted. A standard 5% significant level was used. The baseline year for the Quasi-Poisson regression model was set as 1999/00 for tonsillectomy and 2001 for adenoids and grommets. Correlation analysis was used to look at the relationship between tonsillectomy and related infections – tonsillitis, quinsy and DNSI. Results are reported with reference to the STROBE guidelines.

Results

A total of 60,456 tonsillectomy operations were carried out in Scotland between 1996/97-2016/17 and in the period 2001-2016, a total of 10,707 adenoidectomies and 32,842 grommet insertion surgeries were performed in children under 16. As **Table 1** demonstrates, financial years prior to the introduction of the SIGN guidelines have a significantly higher tonsillectomy rate; in 1996/97 the rate is estimated to be 48% higher than in 1999/00. In recent years more very young children are having tonsillectomy. The 0-4 age group from 1997 to 2007 was one of the smallest two rates, yet in the subsequent ten years rose to the largest mean tonsillectomy rate as demonstrated in **Figure 1**. Tonsillectomy rate in females was significantly higher than males ($P < 0.001$); the model estimates that the female tonsillectomy rate was 26.5% higher than males. Financial year, sex, age group and SIMD quintile were all significant predictors of tonsillectomy [**Table 2.**]

Tonsillectomy rates were highest in the most deprived quintile and then followed in order of deprivation to the lowest rates in the least deprived quintile. The rates in SIMD quintiles 1, 2, 3 and 4 were all significantly higher than SIMD quintile 5 ($P < 0.001$) as demonstrated in **Figure 2**. The model estimates that the children from the most deprived areas were 72.0% more likely to receive tonsillectomy than the least deprived areas. Although it is clear that the number of tonsillectomies performed dropped following the introduction of the SIGN guidelines, the deprivation breakdown remained the same throughout the full period. The most deprived quintile (SIMD quintile 1) had the largest share, followed by quintile 2, then 3 and so on – this was true for every year observed.

SIMD quintile was not a significant indicator for adenoidectomy rate in the Quasi-Poisson model ($P = 0.148$). SIMD quintile was removed from the model and the Chi-Square test was repeated. With SIMD quintile removed from the model, all variables; year, sex and age group were significant ($P < 0.001$). Converse to tonsillectomy, adenoidectomy rates were significantly higher in males than in females, under the age of 16 ($P < 0.001$). The estimated adenoidectomy rate in males was 1.231 times higher than females. Children aged 0-5 were 1.767 times as likely to receive adenoidectomy as 6-10 year olds. Adenoidectomy rate does not appear to be affected by deprivation and there is an absence of any trend relating to deprivation over the period.

Year, sex, age group and SIMD quintile were significant variables in the Quasi-Poisson regression model for grommet insertion rate. Grommet insertion rate was significantly higher in males than females ($P < 0.001$). Grommet insertion rate in boys was 1.233 times that of girls of the same age and SIMD quintile. The 0-5 age group is most likely to have grommet insertion. As seen in **Figure 3**, the least deprived quintile (5) had the lowest grommet insertion rate, at almost all points in the period. Each of SIMD quintiles 1, 2, 3 and 4 had significantly higher rates than SIMD quintile 5 ($P < 0.001$). The most deprived areas were 10.4% more likely to require grommet insertion surgery than the least deprived areas.

The rate of tonsillectomy was higher than the rate of tonsillitis at the beginning of our study period however with the rate of tonsillectomy falling, a steady increase in tonsillitis rates was observed as seen in **Figure 4**. In more recent years a noticeable gap between the rates has emerged with a considerably larger number of admissions for tonsillitis than tonsillectomy. The related Pearson correlation coefficient $r = -0.06$, showed no statistically significant relationship between the rates over the full period ($P = 0.800$). However, analysing data from 2000/01 onwards – following the implementation of SIGN guidelines - the Pearson $r = 0.78$ shows significant positive correlation ($P < 0.001$). The model estimates that children from the most deprived areas were 72.2% more likely to be admitted to hospital with tonsillitis than those from the least deprived areas.

There were 569 episodes of hospital admission for quinsy over the 20-year period 1997-2007 with an average annual rate of 2.85 per 100,000. There was no significant correlation between the rates of quinsy and tonsillectomy over the period ($r = -0.13$, $P = 0.56$). A moderate negative correlation between quinsy and tonsillectomy rate was observed after the introduction of SIGN guidelines however this did not quite reach statistical significance ($r = -0.46$, $P\text{-value} = 0.063$). Children from the most deprived SIMD decile were 59% more likely to be admitted to hospital with quinsy than those in the least deprived. There were 121 episodes of deep neck space infection in Scotland over the study period; average annual rate 0.62 per 100,000. The average rate of DNSI for the 3 years prior to SIGN guidelines was 2.6 episodes per year whereas after 1999/2000 the average rate was 6.28 episodes per year. When post-SIGN data was analysed a moderate negatively correlation between DNSI and tonsillectomy was observed but remained non-significant ($r = 0.45$, $P\text{-value} = 0.071$).

Discussion

Rates of tonsillitis and tonsillectomy are higher in children in deprived areas. After the introduction of SIGN guidelines, the proportion of children from deprived areas receiving tonsillectomy remained static indicating that the recommendations have affected all SIMD groups equally. However the higher rates of tonsillitis and therefore indication for tonsillectomy in children from more deprived areas highlights underlying health inequalities. Deprived children are more likely to suffer with infections of the middle ear and respiratory tract.⁹ The reasons for this are complex but may include poor nutrition including lower rates of breast-feeding¹⁰ and vitamin D deficiency¹¹, poor living conditions especially damp and mould¹², exposure to environmental pollutants and parental smoking.^{13,14} Data regarding the relative levels of antibiotic prescribing by primary care in deprived and affluent areas is mixed. A UK study specifically analysed the use of antibiotics in children with tonsillitis and found lower rates of antibiotic prescription in deprived areas¹⁵ however deprived areas appear to receive more antibiotic prescriptions generally.¹⁶

Our data is in concordance with other studies which show the rate of tonsillectomy in children under 4 has been increasing, particularly over the last 10 years.¹⁷ As a consequence of the implementation of SIGN guidelines, the indication for tonsillectomy has shifted away from recurrent tonsillitis. There is increased awareness and subsequent diagnosis of obstructive sleep apnoea (OSA) amongst general practitioners and otolaryngologists. This has been found to be especially true in children from deprived areas.^{18,19} Obesity is an independent risk factor for OSA and associated with socio-economic deprivation.²⁰ Therefore rising levels of childhood obesity may partly be driving the high tonsillectomy rate in the most deprived.

Significant correlation was observed in the rates of tonsillitis and tonsillectomy following the introduction of SIGN guidelines in 1999. Given the observational nature of this study we cannot prove causation however it would be reasonable to expect rates of recurrent tonsillitis to be inversely proportional to the rate of tonsillectomy and this relationship has been demonstrated in previous studies.⁶ The quinsy rate appeared to climb from the implementation of SIGN guidelines to a peak in 2005/06 and then trended downwards. It is possible that the increased rate of tonsillectomy for obstructive sleep apnoea limited the rising incidence of quinsy. Children in the most deprived group are significantly more likely to be admitted to hospital with quinsy, the reasons for which are similar to the reasons for higher rates of tonsillitis. The same effect has not been observed in DNSI likely due to the very small rate observed.

Among the strengths of this study is the availability of high quality, long-term data with national coverage both from ISD - a branch of NHS Scotland - and SIMD, which is collected and updated by the Scottish Government. The SIMD is effective at evaluating the relative deprivation of areas however it is worth highlighting that not all deprived people live in a deprived area. Also it is noted that private hospital data is not included in this study which may have increased the surgery rate observed in the most affluent areas.

Conclusion

In conclusion, children from deprived backgrounds are more likely to receive tonsillectomy and this remains unchanged after the introduction of SIGN guidelines. The decline in tonsillectomies being performed is significantly associated with acute hospital admissions for tonsillitis.

Children from deprived backgrounds are at increased risk of upper respiratory tract infection including tonsillitis due to several preventable factors including obesity, parental smoking, poor nutrition and vitamin D deficiency. These should be the focus of further study with the potential to inform policies to address health inequality.

Disclosure statement

None of the stated authors have a conflict of interest, financial or otherwise, to disclose in relation to this work.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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