

# Is the incidence of acute appendicitis really falling?

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To determine if there has been a genuine fall in the incidence of acute appendicitis, an epidemiological study using HAA and Korner datasets for the years 1975-1994 was carried out to identify those children and young adults undergoing appendicectomy for acute appendicitis. The overall incidence of acute appendicitis fell from 1.84/1000 to 1.17/1000. This fall was statistically significant ( $R^2=0.74$ ,  $P<0.01$ ). The decrease was significant in both males (overall reduction, 34%) and females (overall reduction, 40%). No significant reduction was observed in either males or females between 15 and 19 years of age. The overall reduction remains essentially unexplained, but may have implications for health planning and provision of services.

Acute appendicitis remains one of the most common conditions responsible for admitting a child to hospital (1,2) and also accounts for a substantial proportion of bed occupancy on many paediatric wards (3). Although the aetiology remains unclear, some epidemiological data have suggested a decrease in the incidence of acute appendicitis since the Second World War (4,5). Other than a previous study from Glasgow (6), there is scant data examining in detail the epidemiology of childhood acute appendicitis in the UK. Is acute appendicitis decreasing in incidence and, if so, are any particular cohorts affected? In an attempt to answer these questions we examined the long-term secular trends in the incidence of appendicectomy for acute

appendicitis among those aged under 20 years resident in Leicestershire, over a 20 year period.

## Data and methods

Data were obtained from the Hospital Activity Analysis (HAA) for calendar years 1975-1986 and from the Korner (subsequently contract) minimum datasets for financial years 1987/1988 to 1994/1995 on Leicestershire residents aged under 20 years undergoing an appendicectomy. Analysis was based on non-elective admissions which account for 95% of all cases, since few procedures carried out electively are associated with a diagnosis of acute appendicitis. Data therefore represent discharge but not histological diagnoses.

Of the non-elective appendicectomies, 90% were because of a clinical diagnosis of acute appendicitis or abdominal pain for the over 5 years and 70% for those aged 1-4 years, while for the under 1-year-old, most had a diagnosis of intestinal obstruction or congenital abnormality. The proportions with these diagnoses are consistent over time although the contribution of abdominal pain has risen from 5% to 10%. It is not clear whether this is a genuine increase or simply reflects changes in coding practices resulting in the unavailability of the final discharge diagnosis at the time of coding.

No data were available for the last 3 months of 1986 owing to the early cessation of the HAA before the introduction of the Korner system, while the transition to contract datasets resulted in a high percentage of data for 1990/1991 remaining uncoded (12.5% compared with the annual average of 2.5%). Data for both these incomplete years have been omitted from the final analysis. Fully coded data for all patients treated outside Leicestershire

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have only been available since April 1991. Indications are that these constitute approximately 15% of all surgical admissions and that the pattern of patient flows has not altered greatly during the period of the study. Hence totals/rates for earlier years may be underestimated to this extent.

Data analysis to ascertain trends in the incidence of acute appendicitis was by simple linear regression analysis and statistical significance was taken at  $P < 0.05$ .

### Results

Over the two decades under consideration, there was a significant fall ( $R^2 = 0.74$ ) in the incidence of appendicectomy. The overall incidence fell from 1.84/1000 to 1.17/1000, a decrease of 36% for all age groups under 20 years of age. The decrease was as marked in males (2.04/1000 to 1.35/1000; reduction, 34%) as in females (1.63/1000 to 0.98/1000; reduction, 40%) and was statistically significant in both sexes (males:  $R^2 = 0.72$ ; females:  $R^2 = 0.43$ ).

### Age differences

When these reductions in the incidence of appendicectomy are considered within individual age groups, the decreases remain as marked (Fig. 1). In the 0–4 years age group, the age-specific incidence fell from 0.36/1000 to 0.11/1000 ( $R^2 = 0.20$ ) and was not significant. Significant reductions were seen in the 5–9 years group (1.86/1000 to 0.68/1000,  $R^2 = 0.56$ ) and the 10–14 years cohort, where the incidence fell from 2.92/1000 in 1977 to a low of 1.93/1000 in 1989 ( $R^2 = 0.27$ ). Interestingly, there was no significant trend in appendicectomy rates among the 15–19 years age group ( $R^2 = 0.04$ ) with the incidence fluctuating both up and down during the study period.

### Age differences: males

Over the study period, the age-specific incidence of appendicectomy in the 0–4-year-old age group remained variable from a high of 0.69/1000 in 1982 to a low of 0.17/

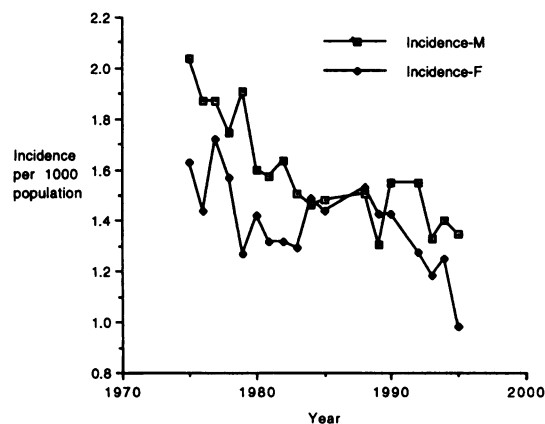


Figure 1. Sex-specific incidence of appendicectomy for acute appendicitis in all groups under 20 years of age.

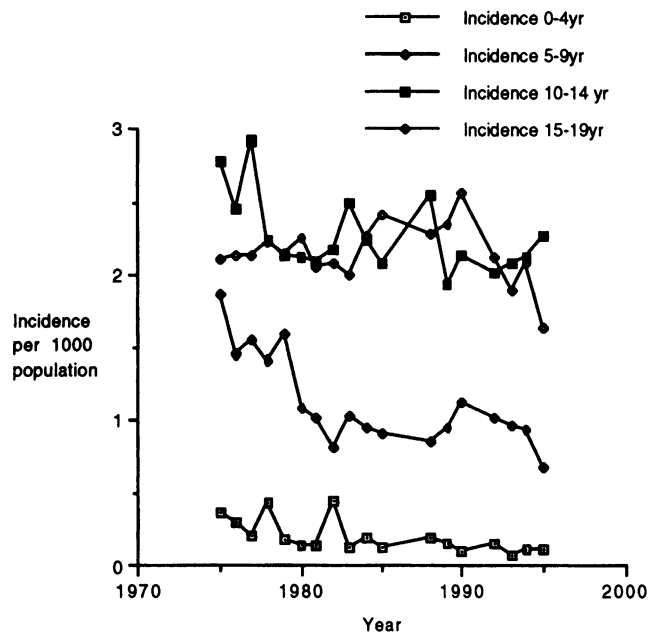


Figure 2. Age-specific incidence of appendicectomy for acute appendicitis in all groups under 20 years of age.

1000 in 1988 (Fig. 2). There was no significant trend over the study period ( $R^2 = 0.07$ ). By contrast, in the 5–9-year-old group the age-specific incidence fell from 2.28/1000 to 0.68/1000 and was highly significant ( $R^2 = 0.49$ ). Similarly, in the 10–14 years group there was a significant ( $R^2 = 0.29$ ) fall in incidence from 3.29/1000 to a low of 1.98/1000 in 1989. Finally, in the 15–19 years group, although there appeared to be decreasing trend, this was not statistically significant ( $R^2 = 0.03$ ).

### Age differences: females

The incidence of appendicectomy in the 0–4-year-old group remained highly variable over the study period, with no obvious upward or downward trend ( $R^2 = 0.00$ ). Interestingly, in the 5–9-years group there was a significant ( $R^2 = 0.39$ ) downward trend from 1.43/1000 to 0.70/1000. By contrast, in the 10–14-year-old group the fall in age-specific incidence from 2.25/1000 to 1.64/1000 was not significant ( $R^2 = 0.05$ ) and similarly in the 15–19 years group the incidence fell from 2.18/1000 to 1.49/1000 and was not significant ( $R^2 = 0.06$ ).

### Discussion

Between 1975 and 1995, annual discharge rates for appendicectomy in Leicestershire fell by approximately 36%. The age-specific incidence is broadly similar to that seen in the USA, and the crude overall incidence of 1.84/1000 falling to 1.17/1000 is not dissimilar either (2). The decrease was as marked in males as in females. Interestingly, further subgroup analysis documented no obvious trend in the 0–4 years age group for either boys or girls. Appendicitis is very rare in this age group (7), this being the age group with the lowest incidence of acute

appendicitis of all groups up to and including the over 75 year olds (2). Whatever the causes of the overall reduction in acute appendicitis, they do not appear to be affecting this age group. Indeed, only approximately 40% of appendectomy in the 0–4 years age group was for a diagnosis of abdominal pain, the rest being for intestinal obstruction or for congenital abnormality. Alternatively, because of the relative rarity of acute appendicitis in this age group, it may be that our observations are subject to random variation. Perhaps the most dramatic reductions were those seen in the 5–14 years age groups in both boys and girls. Characteristically, the peak incidence of acute appendicitis occurs in the second decade of life and is more common in boys. Whatever, the aetiological factors, both groups appear to be similarly affected. By contrast, there was very little reduction in the incidence of acute appendicitis in the 15–19 years age group. The 15–19 years group for females account for the highest incidence of negative primary appendectomy and this data may be interpreted as providing evidence to suggest no improvement in our diagnostic accuracy of acute appendicitis. We are unable to specifically address this problem as the data do not take into account the final histological diagnosis. The reasons for this anomaly therefore remains speculative.

The falling incidence of acute appendicitis will have an impact on wider issues. Bed occupancy for acute appendicitis represents a substantial cost to the National Health Service (3). The future provision of bed and staffing requirements may have to be adjusted in future projections of healthcare requirements. The training aspects may prove to be more dramatic (8). Acute appendicitis and appendectomy has traditionally heralded the 'introduction to gastrointestinal surgery' for a trainee surgeon. For future trainees, not only will there be less opportunity for performing such surgery but with the greater push towards consultant care and the introduction of laparoscopic appendectomy in some centres, this can only compound the drought faced by junior trainee surgeons (8).

In contrast to the pattern observed in developed countries, the incidence of appendectomy in developing countries, where historically the incidence of acute appendicitis has been low (9,10), appears to be increasing. This increase has been attributed to dietary changes (10) as well as a variety of other factors, but again no conclusive causal association has been demonstrated. Falling discharge rates for appendectomy have been noted in the UK (11), the USA (2) and Europe (12). The reasons for these observations remain unclear and most

hypotheses are speculative. Suggestions include improvement in nutrition and diet as well as improvement in socioeconomic status (5). Interestingly, Barker *et al.* (11,13) were unable to demonstrate any correlation between fibre, meat and sugar consumption and the incidence of acute appendicitis, but did speculate that changes in population immunity to respiratory and enteric infection resulting from improved hygiene and sanitation may be a possible explanatory factor. As yet, no causal association has been demonstrated. The results of this study clearly demonstrate that there has been a genuine and sustained reduction in discharge rates for appendectomy over the last two decades. The reasons for this decline remain speculative.

## References

- 1 Ashley DJB. Observations on the epidemiology of appendicitis. *Gut* 1967; 8: 533–8.
- 2 Addiss DG, Shaffer N, Fowler BS, Tauxe RV. The epidemiology of appendicitis and appendectomy in the United States. *Am J Epidemiol* 1990; 132: 910–25.
- 3 Henderson J, Goldacre MJ, Fairweather JM, Marcovitch H. Conditions accounting for substantial time spent in hospital in children aged 1–14 years. *Arch Dis Child* 1992; 67: 83–6.
- 4 Castleton KB, Puestow CB, Sauer D. Is appendicitis decreasing in frequency? *Arch Surg* 1959; 78: 794–801.
- 5 Palumbo LT. Appendicitis—is it on the wane. *Am J Surg* 1959; 98: 702–4.
- 6 Matheson LM, Henderson JB, Hole D, Dunnigan MG. Changes in the incidence of acute appendicitis in Glasgow Asian and white children between 1971 and 1985. *J Epidemiol Community Health* 1988; 42: 290–93.
- 7 Williams N, Kapila L. Acute appendicitis in the under five year old. *J R Coll Surg Edinb* 1994; 39: 168–70.
- 8 Balfour TW. Where has all the appendicitis gone? *Lancet* 1994; 344: 700.
- 9 Freud E, Pilpel D, Mares AJ. Acute appendicitis in childhood in the Negev region: some epidemiological observations over an 11-year period (1973–1983). *J Pediatr Gastroenterol Nutr* 1988; 7: 680–84.
- 10 Burkitt DP. The aetiology of appendicitis. *Br J Surg* 1971; 58: 695–9.
- 11 Barker DJP. Acute appendicitis and dietary fibre: an alternative hypothesis. *BMJ* 1985; 290: 1125–7.
- 12 Noer T. Decreasing incidence of acute appendicitis. *Acta Chir Scand* 1975; 141: 431–2.
- 13 Barker DJP, Morris J, Nelson M. Vegetable consumption and acute appendicitis in 59 areas in England and Wales. *BMJ* 1986; 292: 927–30.

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