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A study of the criteria for diagnosing tonsillitis and the indications for tonsillectomy

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A STUDY OF THE CRITERIA FOR DIAGNOSING TONSILLITIS AND THE INDICATIONS FOR TONSILLECTOMY

submitted by

Ruth Capper

for the degree of

Doctor of Medicine

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ABSTRACT

This thesis traces the early history of tonsillectomy and reviews the rise and subsequent decline in incidence that occurred in the twentieth century. As a result of the rapid raise in performance of tonsillectomy, an attempt was made to define the indications more clearly. Several studies were undertaken try to achieve clear understanding of the indications but, in general, they failed to show that there was much benefit from the operation. These studies share one feature in common: they defined benefit purely in terms of reduction in frequency of sore throats. Despite research that suggests little or no benefit from the operation, tonsillectomy remains the second most commonly performed on children in the United Kingdom. Parents often say that tonsillectomy has made "a new person" of their son or daughter. It appears therefore that parents see a benefit even if the trials do not.

I have hypothesised that there has been inadequate attention paid to the views of parents regarding the impact of recurrent tonsillitis on their child's life. As the main carers, they might be seen as the best source of knowledge regarding tonsillitis in children. This thesis has tried to develop a broader definition of tonsillitis from the perspective of parents as well as medical practitioners.

Given that the operation continues to be performed despite "evidence" that it is of little benefit, this thesis has traced the clinical pathway from "tonsillitis" in the community to the waiting list for tonsillectomy. The thesis suggests that previous trials may be missing some important benefits following tonsillectomy. Simple clinical guidelines for the indications for tonsillectomy have been published and these guidelines suggest that the decision to perform tonsillectomy is reliant only upon the frequency of tonsillitis so that the pathway from recurrent tonsillitis to tonsillectomy is clearly defined. This thesis has shown that general practitioners, paediatricians and otolaryngologists do not agree about the diagnostic features of tonsillitis, the indications for tonsillectomy or the expected benefits following tonsillectomy. It may shed light on the complexity of the disease we call "tonsillitis" and why written guidelines are unhelpful in deciding when to perform tonsillectomy. Until the clinical disease of tonsillitis and the decision-making pathway are more clearly understood, it seems likely that the treatment of tonsillitis will continue to appear haphazard and the simple clinical guidelines will continue to be ignored.

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1 INTRODUCTION

1.1 Introduction

This is a re-submission. Preparing for re-submission has given me the chance to re-evaluate the work. In doing this, I hope that it is seen that I have gained further understanding during this process and not simply reconstructed what should have happened.

This thesis examines the pathway along which a child moves when tonsillectomy is being considered, paying particular attention to the factors that influence each step of the pathway. My interest in this process arose primarily as a result of a then untested observation that, although guidelines (1,2) have been written to assist decision-making in children with recurrent tonsillitis, my senior colleagues did not appear to use them. I was also becoming aware that, as a practising doctor, I did not use them either as I was often under pressure from parents to perform tonsillectomy even when their children did not necessarily meet the criteria laid down in the guidelines. This made me question whether the guidelines were relevant, appropriate or useful and whether parents were aware of problems associated with recurrent tonsillitis of which I was ignorant.

The thesis follows the conventional format of Introduction, Methods, Results and Discussion. In this introductory chapter, I outline the need for further research into tonsillectomy in children and review the medical literature relevant to the subject. I show that there has been a wide variation in the incidence of tonsillectomy throughout its history and that this variation still exists today. Consequently, I try to show in this thesis that research to date may not have defined tonsillitis adequately or shown the indications for, and benefits of, tonsillectomy.

The methods section outlines the methods used in the thesis to test the hypotheses outlined in the introduction. The results chapter outlines the results and the discussion chapter relates these to the background knowledge and highlights how knowledge has been advanced by the thesis.

1.2 Background to Thesis

Tonsillectomy is the second most commonly performed operation on children in England and Wales (3) and the most common in Scotland (4). The indications for tonsillectomy quoted in current textbooks or literature include recurrent tonsillitis, recurrent quinsy and obstructive sleep apnoea (1,5,6). For those children undergoing tonsillectomy for recurrent tonsillitis, the frequency of infection deemed appropriate for surgery is quite specifically described. For example,

(i) 6 episodes of tonsillitis per year for each of two consecutive years (1) or
(ii) 7 episodes of tonsillitis in one year, 5 in two consecutive years, or 3 in three or more consecutive years (2)

have been reported as indications for tonsillectomy. Are these guidelines utilised in clinical practice? I have not formally tested the following assertion but my early clinical experience of watching my seniors practice and later my own practice has led me to believe that such guidelines are not always rigorously observed.

Nevertheless, there is indirect evidence to support the assertion that formal guidelines for tonsillectomy are not strictly followed because the tonsillectomy rate varies widely across the United Kingdom, from 142.79 per 100,000 in the South West to 210.81 per 100,000 in the North West (figures for the financial year 1994 – 1995 (7,8)). This variation in the tonsillectomy rate has been consistently reported for many decades both in this country and in North America (9,10,11,12,13,14). The reasons for the variation are not fully understood but possibilities include that formal guidelines are not followed, they are applied inconsistently in some undefined modified way by different practitioners, the pathology of the disease varies in different parts of the country or there are other influences in the decision to perform tonsillectomy that the guidelines do not take into account.

The laying down of simple guidelines assumes they are easy to follow and everyone involved in their execution will use them in the same way. They also assume that all the data needed to reach a decision are incorporated in the guidelines. Children with recurrent tonsillitis fall under the care of their parents and their general practitioner and, if referred to hospital, may be cared for by a paediatrician or an otolaryngologist. Can one assume that these four groups of carers share the same understanding of tonsillitis and the indications for tonsillectomy? Do the published guidelines adequately describe what takes place when a decision is made to perform tonsillectomy?

In order to examine such questions further, this thesis traces the history of tonsillectomy throughout this century to gain a broader historical perspective of the way indications for tonsillectomy have changed. The thesis outlines the attempts to demonstrate the effectiveness of the operation by several trials and then analyses the most important trials to demonstrate that they have failed to show significant benefit from tonsillectomy. It shows that there is a lack of consensus on the diagnostic features of tonsillitis and poor agreement amongst health care professionals regarding the indications for tonsillectomy. There follows a review of the literature for reasons why this disagreement should exist and a search for other features such as social factors and parental pressure that might influence the tonsillectomy rate in children. As each of the ideas is examined, it becomes evident that there is no clear understanding of the reasons why children progress through to tonsillectomy.

1.3 The History of Tonsillectomy

Operations have been performed on the tonsils for centuries. The earliest report seems to be from the ancient Hindus about 1000 BC (15,16) although I have not found any record of how or why tonsillectomy was performed at this time. Celsus, in 50 A.D. (17), described a method of complete removal of the tonsil using the finger to enucleate the organ from its fossa. The indications proposed for the surgery at the time of its earliest report were not recorded but over the centuries tonsillectomy has been advocated for a large proportion of all known illnesses (18). It seems that it is the operation, rather than its indications, that has survived throughout the history of medicine. Kuhn (19) described how, in the face of conflicting data, an hypothesis may be redefined to maintain the concept. In this situation, the concept is tonsillectomy. Kuhn called this "secondary elaboration".

1.3.1 Tonsillectomy in the early Twentieth Century

Until the twentieth century, tonsillectomy remained an uncommon undertaking and, in 1885, Goodhart (20) said:

"It is comparatively seldom that an operation is necessary.... Children grow out of it and at 14 or 15 years of age the condition ceases to be a disease of any importance".

But, in the early part of this century, tonsillectomy rapidly increased in popularity. In 1926, the Chief Medical Officer of the Board of Education (21) reported that

"enlarged tonsils and adenoids of a degree sufficient to require treatment are found in about 2% of the unselected school children examined".

By 1931, one third of school leavers in London had had their tonsils removed and in 1938 it was reported that, over the preceding seven year period, 75% of boys entering Eton College had undergone tonsillectomy prior to school admission (9). What had resulted in this sudden change in medical practice?

Moore (18) and Daland (22) were amongst the proponents of the "focus of infection" theory. The theory stated that chronic infection in the tonsils could be responsible for a wide range of effects elsewhere in the body. The pathogenesis was believed to start when the tonsils became infected either primarily by influenza or other upper respiratory diseases or by food infected with streptococci (most commonly milk or other dairy products) or secondarily from dental infection, sinusitis, otitis media, mastoiditis or conjunctivitis. Trapped in the tonsil crypts, with low oxygen availability, the streptococci slowly acquired virulence, pathogenicity and selectivity for other organs. From here, streptococci or toxins were released into the bloodstream to cause disease elsewhere. Condiions that were believed to be the result of chronic tonsillitis included psychoses, gastric and duodenal ulceration, pernicious anaemia, urinary calculus, acne, optic neuritis and Menière's disease. Adequate treatment of these conditions required removal of the focus of infection, *i.e.* tonsillectomy, and dramatic improvements in the various conditons were claimed as a result of the operation (22,23).

Tonsilectomy was therefore performed for various reasons - frequent sore throats or tonsillitis, frequent head colds, purulent otitis media, cervical adenitis, frequent fever attacks, recurrent hoarseness, frequent nose bleeds, frequent headaches, chorea, rheumatic fever, growing pains, rheumatic carditis, anorexia, failure to thrive, mental retardaion and enuresis (18,24,25,26,27,28,29,30). Tonsillectomy was considered clinicaly appropriate if any of the above named conditions were present and/or the tonsils were considered to be enlarged or unhealthy in appearance. Finding evidence of unhealhy tonsils was common: Moore (18) stated that "*healthy tonsils are exceptional after the first or second year of life*" and Daland (22) reported that *"the tonsils once infected are a menace and should be removed".* Smith (31) studied 104 routine cases for tonsillectomy and found evidence of tonsil disease in 86% of these. Coues (32) found large tonsils in a large proportion of children and interpreted the finding as evidence for the need to continue large-scale tonsillectomy.

The rapid rise in popularity of tonsillectomy was not limited to the United Kingdom. In the United States, the incidence of tonsillectomy rose just as rapidly (9); in 1888, 3% of children in New York were thought to require surgery because of tonsillar hypertrophy; twenty years later this figure had risen to 30% and 1920 and 1940 the figure rose to 50%. Collins and Sydenstricker (33) showed that the incidence of tonsillectomy rose rapidly in children up to ten or eleven years of age but could vary from 1.3% to 61% between different areas and even between different examiners in the same area (34). They also showed that children from higher social class backgrounds were more likely to have had their tonsils removed. In 1938, Glover reported that 61% of the children aged 10 to 14 years of medical officers of the Army, Navy and public health services had been tonsillectomised (9). Kaiser (27) mentioned the situation in America where employment was withheld from those who still had their tonsils and Dean (23) recommended that all student nurses have their tonsils removed prophylactically. In 1948, Boies reported that over the preceding 24 years, tonsillectomy and adenoidectomy had accounted for one third of all surgical operations in the U.S.A. (35).

The rise in tonsillectomy rate was not the same in every part of the world. In Munich, the medical officer for health reported in 1932 that no more than 0.5% of secondary school children in the city had their tonsils removed and in country districts the incidence was even lower (9).

These reports show how respectable surgeons of their time conscientiously collected data in support of a theory that we do not hold to be true today. Is it possible that rigid guidelines for tonsillectomy will be regarded in the same way in the future?

The sudden rise in the incidence of tonsillectomy was soon followed by criticisms that this practice was unnecessary.

1.3.2 Uncertainty about the frequency of tonsillectomy

The first recorded opponent of tonsillectomy is Dionis (around 1700) who felt that the operation was cruel and the results uncertain (16). He believed that the tonsils have an important function that should not be interfered with. Following the rise in frequency of tonsillectomy at the beginning of the 20th century, authors began to call for moderation in advising it began as early as 1914 (36). Questions were raised about the proper role of tonsillectomy (9,37). Blum (37) wrote in 1915 that:

"tonsillectomy has become more than a therapeutic procedure: it has become a menace. It is performed not only where definite indications are present, but also for the most trifling reasons .... and sometimes for no reason".

Selkirk and Mitchell (38) commented on the *"unsatisfactory basis on which the indications for the operation rest"* and were sceptical about the claims made for the procedure.

Evidence to support such scepticism came from epidemiological studies performed at that time. Glover (9) showed that the incidence of tonsillectomy varied greatly from one region to another but could find no medical reason to explain this. Tonsillectomy was noted to be approximately three times more common in the children of higher social class and the operation was performed more frequently in boys than girls. It was noted that a large or sudden change in tonsillectomy rate within a region, calculated from school medical records, usually denoted a change in medical officer. Children from areas with low tonsillectomy rates did not appear to be less healthy than children from high tonsillectomy areas. Glover reported the effect when several school medical officers decided independently to reduce the incidence of the operation in their districts. They lowered the frequency of tonsillectomy to less than 10% of its previous value but this reduction was not accompanied by a rise in absenteeism from school or by an increase in cases of ear disease or cervical lymphadenopathy (which were considered to be signs of tonsil disease).

Ear disease and cervical lymphadenopathy were considered to be indications for tonsillectomy by the proponents of the "focus of infection" theory (18,22,23). These practitioners also believed that enlargement of the tonsils was a sign that they were unhealthy. As part of the argument against widespread tonsillectomy, authors began to question the assumption that a large tonsil was an unhealthy one. Paton (39) wrote in

1943 that *"there is no evidence that size alone is any criterion of the health or disease of a tonsil"* and Selkirk and Mitchell (38) also believed that the appearance of the tonsils could not be related to their state of health or unhealth. In 1930, Bradley (40) studied 289 healthy boys in a school and found that:

"large tonsils are the rule rather than the exception and it is not easy to find an indication for surgical alteration of this rule on account of size only. Operation continues to be a common practice in spite of considerable clinical evidence demonstrating its uselessness."

Bradley also compared the presence and absence of tonsils and, if present, their size, in boys who were never ill and those who were "habituals" (*i.e.* had been admitted to the school infirmary at least three times during the study) and found no difference between the groups. Strangely, he found an "unhealthy appearance" of the tonsils in six boys who were never ill and postulated that they may be carriers of organisms which caused disease in susceptible boys and in whom *"a surgical spring-clean is indicated for the good of the community."* This would appear to contradict his original thesis.

Reiman and Havens (41), in an extensive and critical review, questioned the "focal infection" theory with respect to the role of tonsils and teeth in systemic disease. They reviewed the literature regarding the indications for tonsillectomy and concluded that there was no evidence upon which to accept the "focus of infection" theory as proven. They reported that streptococci had been reported in the mouths of infants a few hours old and in the tonsils of many patients who had no symptoms referable to these organisms. The size of the tonsils was variable and could not be used to indicate the need for removal. They found no evidence to support the role of tonsillectomy in the treatment of acute rheumatic fever, rheumatoid arthritis, bronchitis, epistaxis or childhood infectious illnesses such as measles and mumps. They also reported that in areas with a low incidence of tonsillectomy there was no corresponding rise in presumed tonsil-associated morbidity. They therefore concluded that there was also no evidence to support the practice of widespread tonsillectomy for diseases other than those locally associated with the tonsils, namely recurrent tonsillitis and peritonsillar abscess. They did find evidence in the reports of reduced frequency of sore throat to support the role of tonsillectomy in these latter conditions. They quoted Pepper who had wondered in 1926 whether *"the surgical accessibility of teeth and tonsils was not partly to blame for the tendency"* to remove them in such great numbers.

Barrington-Ward in 1922 (24) and Collins and Sydenstricker in 1927 (33) postulated that tonsillar enlargement might be physiological rather than pathological. In an attempt to support his view with data, Epstein (42) correlated the observations of paediatricians and ENT surgeons with the histology of the tonsils in 152 children. He was unable to find any connection between the reported severity of symptoms and the degree of disease demonstrated histologically in the tonsil and concluded that:

"the physician admittedly does not know an infected tonsil when he sees one... There is nothing ... to lead one to feel that the appearance of the tonsils should ever influence one's judgement as to the advisability of removing them for the improvement of the child's health. It seems that for children at least it would have a salubrious effect on the physician's attitude if he abandoned the stereotyped 'diseased and hypertrophied tonsils and adenoids' and substituted 'frequent sore throats' or whatever the complaint or indication is in each case."

These views supported the opinion of the Medical Research Council Committee (43) who had commented in 1938 on a tendency *"for the operation to be performed as a routine prophylactic ritual for no particular reason and with no particular result".*

In 1943, Denzer and Felshin (44) reported their experience of a pre-tonsillectomy clinic in which they carefully assessed the reasons why children were referred for tonsillectomy. All the children were followed up for several months before a decision was made about the need for surgery. The indications for surgery were defective hearing or chronically inflamed eardrums, large tonsils obstructing respiration, large and/or diseased tonsils with frequent upper and lower respiratory disease and recurrent glandular enlargement and rheumatic disease. The operation rate fell by half in two years. They also reviewed the charts of many children who had undergone tonsillectomy in the preceding years and reported that often no indication was recorded to explain why the child was undergoing tonsillectomy. They also noted that the child had often not been examined by a physician before referral to hospital and that:

"lay people frequently decided the question as to whether tonsils should be removed - parents, teachers, friends, relatives, school nurses etc."

and that, on the part of the doctors seeing these children:

"examinations before tonsillectomy were made merely to determine the child's fitness for operation and not in any way to determine whether tonsillectomy was indicated or not."

As a result of their investigations, they suggested that the history and observation of the child were more important than the appearance of the tonsils when deciding if surgery was indicated. They believed that observation should be undertaken by a doctor and that it was not appropriate for lay people to decide if tonsillectomy was required. This is interesting because later in the thesis the part played by lay knowledge in the development of medical knowledge will be considered and I will question whether such a dismissive attitude to lay opinion is appropriate.

Dey (45) took advantage of an opportunity to report on the effects of deferring tonsillectomy. A poliomyelitis outbreak suspended all tonsil surgery for eighteen months during which time he studied 1415 children who were on the waiting list for tonsillectomy. Six hundred and eighty one children entered the review and of these 252 were judged no longer to need tonsillectomy. The criteria used to determine the need for tonsillectomy were recurrent tonsillitis (3 or 4 per year over two winters), quinsy, upper respiratory tract infections followed by bronchitis, gross tonsillar enlargement causing obstruction and tuberculous cervical adenitis. In the group where tonsillectomy was no longer required were some whose original presentation had been instigated by a relative or neighbour and some whose symptoms had been short-lived. Dey considered a period of twelve to 24 months, usually including two winters, to be a usual length of time for normal children to have throat problems. He therefore supported the findings of Denzer and Felshin (44) who had shown that observation of a child over several months often resulted in cancellation of the tonsillectomy. He also recommended that the decision to perform or withhold tonsillectomy be made by a physician. Dey also noted that the appearance of the tonsils of the children still warranting tonsillectomy did not differ from that of the tonsils of those no longer in need of surgery, supporting the views of Barrington-Ward (24), Collins and Sydenstricker (33) and Epstein (42).

Throughout the period of rapid change in the incidence of tonsillectomy, no formal consideration was given to patient safety. Gale (46) reported in 1951 that approximately 80 children died per year occur in England and Wales as a result of tonsillectomy. In 1954, it was reported to the Royal Society of Medicine that 42 deaths had occurred in England and Wales due to tonsillectomy in 1952 (47). A further five deaths were attributed to tonsillar and adenoidal hypertrophy but tonsillectomy did not appear on the death certificate. As well as the risk of death, significant morbidity was also associated with tonsillectomy. Several authors pointed out the association between recent tonsillectomy and the development of bulbar poliomyelitis (48,49,50,51). Poskanzer (52) reported an increased susceptibility to multiple sclerosis in patients who had undergone childhood tonsillectomy and Vianna *et al.* (53) reported a link between tonsillectomy and Hodgkin's disease but this link was later disproved (54,55). Issues of patient safety appear to compound the views of those who recommended that tonsillectomy be limited to children in whom a need for the operation can be shown.

As a result of the epidemiological evidence that low tonsillectomy areas did not have higher morbidity than high tonsillectomy areas and the evidence of patient safety, guidelines began to be proposed for the appropriate use of tonsillectomy.

1.4 Early Formal Indications for Tonsillectomy

The factors considered to be important when the early guidelines were suggested included the clinical history, the frequency of attacks of tonsillitis or quinsy and tonsillar hypertrophy causing obstruction to the nose, mouth or ears. Collins and Sydenstricker in 1927 suggested three episodes of acute inflammation of the tonsils in one year (or two with joint pains) (33). In 1943, Paton advised at least two sore throats with febrile episodes per year (39) and Illingworth proposed three or four attacks of tonsillitis with fever (56). Illingworth also suggested that peritonsillar abscess, enlargement of the tonsils causing respiratory obstruction and persistent carrier state for *Corynebacterium diphtheriae* be considered indications for tonsillectomy.

Thomas (57) reviewed the indications for tonsillectomy and concluded that the decision could only be made on clinical grounds and that the history was the important factor. He believed that the appearance of the throat or the size of the tonsils could not be relied upon to indicate whether the tonsils were chronically infected or if they had ceased to be immunologically competent. He suggested more stringent indications for tonsillectomy, namely recurrent inflammation of the tonsils or mechanical obstruction to the nose, mouth or ears. In 1951, Gale (46) suggested that the degree of general disturbance (temperature and duration of illness) is more important than the exact number of episodes of sore throat.

Clein (29) in 1952, suggested a much broader range of conditions for which tonsillectomy should be considered:

"repeated tonsillitis, usually with fever; cervical adenitis following sore throats; otitis media, acute, chronic or recurrent, secondary to infection of the upper respiratory tract; systemic infection and/or poor nutrition resulting from repeated attacks of tonsillitis; nasal obstruction and mouth breathing from obstructive adenoids, (often associated with impaired hearing and facial asymmetry); and abscess of the pharynx, tumors or injuries of the tonsils and fetor oris from debris in the crypts of these structures."

He also warned against operating on allergic children in whom he had found a high incidence of re-growth of the lymphoid tissue (58). He listed contra-indications for tonsil surgery as chronic running nose, frequently recurring colds and chronic sinus infections but, despite these exclusions, his list of indications for surgery is not much different from the situation which allowed one third of children to be tonsillectomised. This demonstrates the conflicting opinions that existed about the proper role of tonsillectomy. Bradley (40) had stated in 1930 that *"perhaps in no other subject is there such a great difference in the personal judgement of the surgeon and in the criteria of operability."*

The suggestions for guidelines were not made on the evidence of scientific trial that showed improvement if the indications were met but were the personal opinion of the author based on clinical experience. However, they were a move away from recommending tonsillectomy for every ailment.

1.5 Clinical Trials

It became apparent that evidence was needed to demonstrate the effect of tonsillectomy on those undergoing the surgery. Many reports have since been published on the subject of tonsillectomy and they will be discussed in the sections that follow. I will first summarise the earliest reports. These were largely retrospective, non-randomised and uncontrolled. These reports were followed by trials with control groups – firstly with normal children as controls and later with children who were considered to need tonsillectomy but from whom the operation was withheld.

1.5.1 The first trials

This group of trials comprises three categories of design:

- Purely descriptive, giving an account of the children's health before and after tonsillectomy
- A comparison of operated children with a normal population
- A comparison of operated children with a non-randomised non-operated group who were felt to need surgery but avoided it for varying reasons.

The history of tonsillectomy trials parallels the development of research methodology for clinical trials. These early trials would be regarded as insufficiently rigorous today because of their design. The studies are summarised in table 1.1.

Table 1.1 is divided into three sections summarising the three types of trial design mentioned above. The first section shows that purely descriptive trials, the second the trials where children undergoing tonsillectomy were compared with normal peers and the third section the comparison between children undergoing tonsillectomy with other children felt to require tonsillectomy but in whom the operation was not performed.

The trials are a mixture of prospective and retrospective and vary in size from 50 children to 13709 children. All but the M.R.C. study (43) show a decrease in the frequency of sore throats after surgery. The effect on the number of upper respiratory tract infections is varied.

Table 1.1 Results of various studies with no surgical controls performed to demonstrate the efficacy of tonsillectomy.

Author	Year of Publication	Pro/retrospective Design	Number of Children	Effect on No. Sore Throats	Effect on No. URTIs
Bass	1934	Retro	150	↓	↔
Godwin	1953	Retro	400	↓	↓
Walker	1953	Retro	100	↓	↓
Johnson & Watkins	1954	Pro	598	↓	↓
Crooks	1957	Retro	50	↓	↓
Ogiro	1988	Retro	207	↓	↓
Kim & Lee	1988	Retro	217	↓	↓
Paton	1943	Retro	909	↓	↑
Bradley	1930	Retro	289	↓	↑
M.R.C.	1938	Retro	13709	↔	↔
Mertz	1954	Pro	1100 families	↓	↔
McCorkle *et al.*	1955	Pro	230	not studied	↔
McCammon	1971	Pro	227	↓	↓
LeRiche & Stiver	1957	Retro	1000	↓	↔
Kaiser	1931	Retro	4400	↓	↔
Kaiser	1940	Retro	4400	↓, esp. if cervical adenitis present	↔

All authors who performed descriptive studies reported a great benefit following the operation (59,60,61,62,63,64,65). These studies all used questionnaires and depended upon the parents responding. Response rates ranged from 14% to 70%. Bass reported on 50 children from his private practice but did not comment on how they were selected. Crooks reported on 50 consecutive children with doctor parents. Both Walker (61) and Johnston and Watkins (62) commented on the difficulty in reconciling the favourable responses of the parents in their studies with the conclusions of comparative studies that were being published at around the same time.

With the exception of the study performed by the M.R.C. (43), all the comparative studies showed that tonsillectomy resulted in a reduction in the number of sore throats. Opinion was divided regarding the effect of tonsillectomy on the frequency of upper respiratory tract infections with McCammon (65) showing a reduction, the M.R.C., Mertz (66), McCorkle *et al.* (67) and LeRiche and Stiver (68) showing no change and Paton (39) and Bradley (40) showing an increase. Paton found that colds, bronchitis, pneumonia and pleurisy were more common after tonsillectomy and accounted for more time lost from school than tonsillitis did in the non-operated group. McCammon reported that boys undergoing tonsillectomy continued to have more sore throats than their peers who had not undergone tonsillectomy but the difference was not significant. Girls undergoing tonsillectomy had the same number of sore throats as their peers after the operation.

It appeared that tonsillectomy did not result in great benefit to the health of children upon whom it was performed. At best, it improved health to the same level as in those children in whom tonsillectomy was not felt necessary. The proponents of tonsillectomy tried to explain the apparent failure of tonsillectomy by finding tonsil remnants in the throats of many who had undergone tonsillectomy (69) or by blaming the symptoms on remaining pharyngeal lymphoid tissue (23). Hyde (70), however, found that, although only 32% of 1000 patients had no evidence of tonsil remnants on re-examination, there was no difference in the incidence of remnants between those who had or had not benefited from the operation.

Finke (71) and Burke (72) gave prophylactic antibiotics to children with recurrent respiratory tract infections instead of recommending surgery. The same beneficial results accredited to tonsillectomy were reported. Both studies reported a significant reduction in the frequency of infections. Burke also claimed a reduction in the number of days lost from school, the number of visits to the general practitioner and the size of the tonsils. She suggested that appropriate use of antibiotic prophylaxis might avoid the need for tonsillectomy in some children.

In the 1930s, Kaiser (27,73,74) reported the comparison of 1100 children who had undergone tonsillectomy with a similar number of children for whom tonsillectomy had been recommended but never performed. The reasons for not performing surgery were reported as "various" but included parental objection. The period of follow up was ten years. He reported a reduction in the number of colds suffered by children who had undergone tonsillectomy but that this benefit was not sustained over the period of follow up. After ten years, the children who had undergone tonsillectomy were having more colds than the non-operated control group. Kaiser showed no benefit in the incidence of bronchitis or pneumonia. Overall, he concluded that there was no significant long-term improvement in the health of the children who had undergone tonsillectomy.

The studies discussed so far compared the health of children who had undergone tonsillectomy either before and after the operation or with a normal population of children. From the results of these studies, it is not possible to be certain that any benefit reported was due to the operation. Kaiser's study was exceptional in comparing two groups of children who were felt to require tonsillectomy but only one group of which underwent the operation. However, he did not attempt to control the two study populations in order that the only difference between them should be whether or not they underwent tonsillectomy. Further research was undertaken in the form of randomised controlled trials (75,76,77,78,79,80,2) and these are discussed in the next section.

1.5.2 Randomised controlled trials

The randomised controlled trial is regarded today as the most rigorous methodological study design and so these trials will be discussed in greater detail than those described so far. In the randomised controlled trials, children who met inclusion criteria for tonsillectomy were randomly allocated to receive tonsillectomy or to be observed. A summary of the trials is shown in table 1.2 where the year of publication, study design, effect on the frequency of sore throats and the duration of this effect are summarised.

Table 1.2 Results of various studies with non-operated controls performed to demonstrate the efficacy of tonsillectomy

Author	Year	Pro/retro-spective	Number of Children	Effect on No. Sore Throats Compared with Controls	Duration of Effect
McKee	1960	Pro	413	2 - 4 year olds ↓	2 years
McKee	1963	Pro	413	5 - 7 year olds ↓	1 year
McKee	1963	Pro	413	> 7 year olds	
Mawson *et al.*	1967	Pro	404	↓	2 years
Mawson *et al.*	1968	Pro	404		
Roydhouse	1970	Pro	552	↓	2 years
Paradise *et al.*	1984	Pro	187	↓	2 years, ?3

McKee (75,76) reported on 413 children aged between 2 and 15 years. The criteria used to demonstrate a beneficial result of surgery included a reduction in the number of episodes of sore throat, colds and bronchitis, the number of days off school or in bed and the need for medical attention. He demonstrated a sustainable improvement in health over a two year follow-up period following tonsillectomy in those children aged between 2 and 4 years only. Children aged 5 to 7 years who underwent tonsillectomy were healthier than their controls for 12 months and no demonstrable difference was seen in older children. He concluded that the improvement in health was not sustained because of development of "natural immunity" against the organisms causing sore throats as children grow older. He suggested that the morbidity associated with the operation might not be justifiable in terms of expected benefit in the older age groups. Instead, he proposed that older children be regularly reassessed for natural resolution of tonsillitis whilst on the waiting list as a means of avoiding unnecessary operations. This finding was utilised in a study by Wood *et al.* (81) who demonstrated that such observation could result in the cancellation of tonsillectomy in some children. They observed 217 children on a routine waiting list for tonsillectomy over a two-year period after which only 116 children (53%) were felt still to require the operation.

A further study undertaken by McKee (77) compared the benefits of tonsillectomy and adenoidectomy together with those of adenoidectomy alone. This showed that the combined operation of tonsillectomy and adenoidectomy lowered the incidence of sore throats whilst adenoidectomy alone had no effect. Adenoidectomy alone was as effective in reducing the frequency of otitis media as tonsillectomy and adenoidectomy together and neither operation had any demonstrable benefit for those children with other forms of common upper respiratory disease. McKee concluded that otitis media and common colds and coughs should not be regarded as indications for tonsillectomy.

There are significant weaknesses in the study design of these trials. McKee does not define his inclusion criteria well. Children with three episodes of "tonsillitis", "acute sore throat" or "upper respiratory tract infection associated with cervical lymphadenopathy" were included in the study. He excluded those in whom he felt it was unethical to withhold the operation (history of quinsy, febrile convulsions with sore throat, frequent tonsillitis – not defined), those who did not need tonsillectomy and those who would be difficult to follow up. By his own admission, the inclusion group represented "*children with symptoms that might be referable to the tonsils and might justify an operation, but without urgency.*" He also stated that it is "*probable that for these children, some surgeons would recommend surgery and others would not.*" The results showed that in the first year the control group had 1.96 sore throats compared with 0.39 in the operated group, falling to 1.03 sore throats in the control group and 0.31 in the operated group in the second year. Over the two-year period, those children who had not undergone tonsillectomy lost 13.4 days from school due to sore throats. This is not much more that would have been lost following the operation had it been performed. The differences were claimed to be statistically significant but the significance level chosen was $p<0.1$ rather than the more usual value of <0.05 in contemporary reports. No correction was applied to the p value despite multiple analyses being performed on the data. The t test was been used with no evidence that the populations were normally distributed. It is therefore likely that with the appropriate corrections the results are not significant.

Mawson *et al.* (78,79) also compared a group of children undergoing tonsillectomy with non-operated controls. Children were allocated to surgery or observation randomly but the method of randomisation was not described. The authors studied 404 children over a two-year period, 202 in each group, and concluded that the operation resulted in a marked reduction in the frequency of tonsillitis, sore throats, cervical adenitis and common colds and was followed by a greater weight gain over the next two years than that seen in the non-operated group. Tonsillectomy had little benefit over natural resolution for treatment of otitis media, catarrh, mouth breathing, snoring and cough.

Mawson does not state the inclusion or exclusion criteria for the study and it appears from reading the paper that some children undergoing tonsillectomy had no sore throats in the preceding year. During the study, 25% of the control group underwent tonsillectomy but they remained in the control group for purposes of follow up. In the follow up results, large numbers of children have “attack rate unknown” recorded against frequency of symptoms and this could significantly bias the results. “Tonsillitis”, “sore throat” and “cervical adenitis” were considered to be the same entity during the follow up period. The number of sore throats recorded in each group before and after surgery is not given and no statistical analysis has been performed.

Roydhouse (80) added a further arm to the study by including a third group of children. These children had never been referred to an ENT clinic and were regarded as "normal". He reported that the operated group was healthier than the non-operated but not as healthy as the normal children. The operated children had fewer respiratory illnesses and missed less schooling (on average, 10 days over the two year follow-up period). In contrast to McKee, however, he found tonsillectomy to be more beneficial in older children (8 to 13 year olds). The reduction in the number of days lost from school, however, is roughly equal to the number lost at the time of the operation so overall there is no real benefit in terms of school attendance.

Roydhouse repeated the methodological approach of McKee and his study therefore shares some of the weaknesses of McKee’s study. The populations are all biased towards the lower social classes because of the health service provision in New Zealand. One quarter of the children from the “no operation” arm underwent tonsillectomy because they were believed to “ethically require surgery”. By the end of the second year, 204 children had undergone tonsillectomy compared with only 122 who had not. In the second year, the operated children had 0.25 sore throats compared with 1.86 in the non-operated and 0.43 in the normal control group. The operated children saved ten days schooling but would have lost this at the time of surgery.

This review has shown that, although the studies by McKee, Mawson and Roydhouse included a non-operated control group, they still had serious methodological faults that rendered them unsatisfactory for the purpose of determining whether tonsillectomy has a beneficial effect on the health of children undergoing it. Shaikh *et al.* (82) commented upon these methodological deficiencies in a critique published in 1976. They reviewed 29 studies on the efficacy of tonsillectomy and scored them on a point scale taking into account study design, the sampling method, the description of the illness, forms of treatment and the type of follow-up. The maximum possible score for study design was 34; the maximum score awarded for any reviewed trial was 18. Studies performed by otolaryngologists all came out in favour of the operation; studies performed by paediatricians or public health doctors were equally divided in their conclusions for or against the operation. There also appeared to be a difference in opinion developing between otolaryngologists and paediatricians.

The differences in studies reported in the paediatric and otolaryngological literature came to be reflected in the standard reference textbooks. For example, in 1975, the following statement appeared in the Nelson Textbook of Paediatrics (83):

".... the presence or absence of tonsils does not affect the frequency, the course or the complications of (acute pharyngitis) or susceptibility to it.... so "frequent sore throats" do not represent a valid indication for (tonsillectomy)...."

It was clear that the clinical role of tonsillectomy was still unproven. A large, well-designed randomised controlled trial was needed to address the question of the efficacy of tonsillectomy. The Pittsburgh study was designed in an attempt to answer this question.

1.5.3 The Pittsburgh study

Paradise *et al.* (2,30,84,85,86) realised the necessity for a further large-scale, comprehensive study of sufficient methodological rigor to establish the value of tonsillectomy for recurrent tonsillitis. The authors recognised the need to differentiate between mild and more severe sore throats when considering the indications for tonsillectomy and defined a significant sore throat episode as one accompanied by at least one of the following:

oral temperature of 38.3°C or above
tonsillar or pharyngeal exudate
enlarged (>2cm) or tender cervical lymph nodes
positive throat swab for group A beta-haemolytic streptococcus.

The indications for surgery were defined as seven attacks of sore throat in one year, five attacks per year for the two previous years or three or more attacks in each of the previous three years. Using these inclusion criteria, Paradise and his colleagues in Pittsburgh set up a prospective study of the effects of tonsillectomy on the incidence and severity of sore throats. Only children whose histories had been documented were entered into the study. Over an eleven-year period, 2043 children were referred to the study; of these, only 187 actually met the eligibility criteria. Some of those who were excluded received urgent surgery because of obstructive symptoms, peritonsillar abscess, presumed chronic tonsillitis, chronic cervical lymphadenopathy and "hot potato voice". Most were excluded because their throat disease did not meet the inclusion criteria. Of the 187 children, the parents of 91 accepted random assignment to surgery or control and 43 underwent tonsillectomy with or without adenoidectomy and 48 acted as controls; 96 declined randomisation and of these 52 chose surgery and 44 declined surgery. Tonsillectomy was performed as soon as possible after the decision was made. The children were followed up for three years with biweekly telephone calls and six weekly examinations. Additional examinations were made during each episode of illness. During the three-year follow up period, approximately one third of the control children opted out and received tonsillectomy. After follow up for three years, it was shown that tonsillectomy with or without adenoidectomy was unequivocally effective in reducing the frequency and severity of throat infections for two years and probably for a third (2). In the third year of follow up, the effect of tonsillectomy on the frequency and severity of sore throats was not so definite because of reduced numbers in the control group. Throughout the follow up period, a substantial proportion of the control group experienced relatively little throat infection. For example, in the group of children who were randomly assigned to surgery or observation, those who had undergone tonsillectomy had on average 1.24 sore throats in the first year of follow up whilst the control group had 3.09 sore throats. The difference between the treated and control groups was even less marked in the second and third years.

Several criticisms can be made of the Pittsburgh study. Over a ten-year period, 2043 children were referred to the trial but less than 10% actually met the inclusion criteria and half of these refused randomisation. It seems surprising to me that such a large number of children with relatively minor throat complaints should have been referred initially but this may be a reflection of the different health care systems between UK and USA. The criteria for urgent treatment potentially cover a large group of children depending on how these states were defined. The criteria were stated to be alveolar hypoventilation, difficulty swallowing, severe discomfort in breathing, presumed chronic tonsillitis, peritonsillar abscess, chronic cervical lymphadenopathy and hot potato voice. "Hot potato voice" suggests that the tonsils are large but "obstructive symptoms" was another exclusion criterion and it is therefore difficult to be sure of the significance of the former. Half of the randomised children and two thirds of the non-randomised children were lost to follow-up. The method of randomisation was not stated. Statistical analysis was performed but the authors do not describe which techniques were used and no correction has been applied to the p value where multiple analyses were performed. When such a correction is applied, some of the results that the authors claim to be significant are found not to be so. In the randomised group, operated children have significantly fewer sore throats in the first two years but in reality this amounts to a difference of one sore throat per year in the second year. This degree of benefit does not seem clinically significant and it could be argued that it does not warrant the risks of tonsillectomy.

The low acceptance rate into the study is a reflection of the tightness of the methodology. Studies that are methodologically tight become very exclusive and their findings are therefore difficult to relate to every day clinical practice. The large exclusion rate from the Pittsburgh study provided a rationale to consider a more open methodology that would include many more children and produce results that could be generalised to the majority of children rather than the minority. I believed this to be particularly important as the results of the methodologically rigorous studies did not reflect the opinions of parents following tonsillectomy in their children. These issues will be discussed in a later section.

Paradise *et al.* collected data on some of the children who were excluded from the first paper and published this separately (87). Over a three-year period, they investigated 95 children who were referred to hospital with histories that seemed to meet the criteria for tonsillectomy but had not been documented accurately. Sixty-five of these children were followed up closely for one year. After that time, only 11 still met the criteria for surgery. The remainder had fewer sore throats during the follow-up period than would have been expected from the initial history. Those sore throats were nearly all graded as mild or moderate. Sore throats were graded as "mild", "moderate" or "severe" according to a scoring system involving local and systemic symptoms and signs including fever, altered behaviour and discomfort, the appearance of the pharynx and the presence of cervical lymph nodes. No factors were identified to separate the 11 whose histories were substantiated from the 54 whose histories were not. Several possible hypotheses were suggested to explain the findings. The histories may have been accurate and the reduction in sore throats genuine. Some parents may consciously or sub-consciously exaggerate the frequency and severity of sore throats in an effort to secure tonsillectomy for their child. Finally, the sore throats reported may not have been due to "infective processes". As a result of the study, Paradise and his colleagues suggested that tonsillectomy should not be performed until the history of sore throats has been documented. The child should be kept under review until at least two episodes of tonsillitis had been observed in the frequency suggested by the history.

All the randomised controlled trials used the number of sore throats as the inclusion criterion and a reduction in the number of sore throats as the outcome measure. All these trials failed to show a significant and sustainable benefit following tonsillectomy. Paradise *et al.* rejected parental histories as evidence of the need for tonsillectomy and their second paper suggests that parental histories are inaccurate. Selkirk and Mitchell had also found that parental history telling to be unreliable (38). Paradise *et al.* suggested that parents may exaggerate the history in order to secure tonsillectomy but did not question why this should be. It appears that other factors other than the number of sore throats can influence parents to seek tonsillectomy for their children and that non-clinical influences are involved in the pathway from tonsillitis to tonsillectomy. Parents often report that tonsillectomy has made a "changed person" of their offspring (88). Why should there be such a discrepancy between the medical literature and the reports of those who experience the intervention?

There are several possible answers to consider.

1. The children entered into the trials above were poorly selected and therefore the trial could not show the expected outcome because of poor study design. (Section 1.5)
2. The children entered into the studies were not suffering from recurrent "tonsillitis" but from the usual childhood upper respiratory tract infections. (Section 1.6)
3. The improvement in health reported by parents cannot be measured in terms of number of sore throat episodes. (Section 1.7)
4. The data collected in the trials have not been appropriate. What patients/parents/doctors think are important may be different to what researchers regard as important. This may be reflected in clinical practice where children not meeting the guidelines for tonsillectomy are nevertheless accepted for the operation. This suggested that a research protocol with a more "open" methodology may be useful in gaining an understanding of what is happening when a child moves from

having tonsillitis to undergoing tonsillectomy. The methods used in this study are discussed in some detail later in the thesis in the Methods chapter.

1.6 Definition of "Tonsillitis"

The trials discussed so far about the efficacy of tonsillectomy have not included a clear definition of tonsillitis. Children aged between 3 and 7 years have on average 8 upper respiratory tract infections per year, some of which will be accompanied by a sore throat (89). It is possible that the trials failed to show an improvement after tonsillectomy because the children entered into them were not suffering from recurrent "tonsillitis" but from recurrent "upper respiratory tract infections". Paradise *et al.* attempted to address this issue but the definition could still be fulfilled after the tonsils had been removed for they included clinical symptoms and signs and evidence of the presence of beta-haemolytic streptococcus. Many other micro-organisms have also been implicated in throat infection. The immunological status of a child may also play a role in its susceptibility to recurrent infection. Therefore, a clear definition of "tonsillitis" might be seen as having clinical, immunological and bacteriological features. I propose to examine each of these in turn.

1.6.1 Clinical definition

Authors have addressed the poor definition of the diagnostic term "tonsillitis" (56,93,94,95,96,97,98,99,100,101,102). Without an accepted definition of this condition, it is not possible to be sure what is being treated when tonsillectomy is performed.

The definition of a sore throat for which tonsillectomy was performed in the Pittsburgh trial is not a diagnosis that is used in every day practice. The presence of a pharyngeal exudate is not indicative of disease in the tonsils. Throat swabs are expensive, slow and unreliable, especially for general practitioners (90,91). Burke *et al.* (92) reported that less than 10% of general practitioners in Southampton health district take throat swabs. The swab may not reach the laboratory until the day after it has been taken by which time many organisms have died. The presence of streptococci in the throat may be due to a carrier status and a positive swab is therefore not indicative of streptococcal infection.

Illingworth in 1949 (56) commented that often a sore throat at the beginning of a cold was not differentiated from tonsillitis. Townsend and Sydenstricker (93) performed an epidemiological study of minor respiratory disease in the families of some members of the United States Armed Forces, Public Health Service and a number of colleges and universities. One interesting finding was that different respiratory illnesses are differentiated from each other not by specific symptoms but by different frequency distributions of the same symptoms. The groups merged into each other in a spectrum of disease. This may also apply when differentiation between "tonsillitis", "pharyngitis" and "upper respiratory tract infection" is attempted. Van Volkenburgh and Frost confirmed this finding (94) but also showed that cases of sore throat without coryza or cough were associated with a higher incidence of systemic symptoms. They suggested that sore throat with systemic symptoms were not related to the common cold but had a separate aetiology.

Howie (95,96), Bain (97) and Little *et al.* (98) showed that in general practice an illness is often given a diagnostic label such as "pharyngitis" or "tonsillitis" or "acute otitis media" to justify treatment with an antibiotic. Howie also showed that many general practitioners are influenced by non-physical components of illness when making a diagnosis (101,102). Stott (99) commented on the difficulty in reaching a consensus for minimum diagnostic criteria for tonsillitis, coryza and non-specific upper respiratory tract infection. He classified them together rather than make a "spurious" attempt to differentiate one from another. Marinoni *et al.* (100) showed that the presence of tonsillar plaques or ulcers were regarded as significant diagnostic features for tonsillitis and resulted in a higher incidence of prescription of antibiotics. Referral to an ENT clinic was made on the basis of younger age of patient, recurrent episodes of illness or resistance to treatment.

This review of the literature suggests that there is lack of agreement about the clinical feature of tonsillitis.

1.6.2 Immunological definition

It is recognised that the frequency of tonsillitis usually decreases with age (2,27,33,45) but it is not known why some children have a succession of episodes of tonsillitis whilst others have none. Several authors have suggested that immunological deficiency or immaturity may be responsible for recurrent infection in those children who have recurrent tonsillitis (103,104,105,106).

Between 7.3% and 25% of children undergoing tonsillitis have a "low" or "a relative deficiency of" serum IgA (103,104,105). Low serum IgA has been proposed as the reason for recurrent infections by some authors (103,104,105) but dismissed as merely a delay in the normal maturation of the immune system by others (106,107). Stoop *et al.* (107) studied immunoglobulin levels in 270 healthy children between 4 and 12 years and in 30 adults. Adult IgG levels were reached at ten years; IgA levels were still far below adult at twelve years and IgM levels remained static between four and thirteen years. Girls had higher IgG and IgM levels than boys. There was a very wide range of values in these normal children. Very low values were not exceptional. The value of individual Ig determinations is therefore questionable (105).

Buckley, Dees and O'Fallon (108) reported on 600 children aged from neonate to 19 years who were reported to be subject to frequent respiratory or skin infections. Respiratory infections included pharyngitis. Forty-four *per cent.* had one or more immunoglobulin levels outside the "normal range" for their age. A comparison was made with 181 normal children. Only 7.7% of the normal children had immunoglobulin levels outside the normal range ($p<0.0001$). The authors reported that the infections were more severe in subjects with multiple immunoglobulin deficiencies. This may suggest that, although not uncommon and therefore probably not directly responsible, low levels of immunoglobulins in children *may* result in a tendency towards recurrent infective illnesses.

The tonsils play a role in the immune system by producing immunoglobulins. It has been suggested that removing them could result in immunological deficiencies. Lederer and Grossman in 1949 (109) and Meyer in 1950 (110) drew attention to the possible protective role of the tonsils. They called the protection "autovaccination" and it is due to the production of antibodies. They proposed that removal of tonsils from young children may be detrimental to health and suggested that, where possible, tonsillectomy should not be performed before the age of seven years. Gaspar (111) echoed this view stating that tonsillectomy should not be performed in children under the age of four years as, up to that age, the tonsils play an important role in the immunological "learning process". Ogra (112,113) reported that tonsillectomy may result in a reduction in immunological function and showed a diminished response to poliomyelitis virus type I immunisation in children who had undergone tonsillectomy. The diminished response to polio vaccination has been observed up to six years following surgery. Other evidence for a reduction in immunological competence following tonsillectomy includes the reported increased susceptibility to Hodgkin's disease in adults who have undergone tonsillectomy (53) – disproved by Ruuskanen (54) - and the association between multiple sclerosis and childhood tonsillectomy (52).

Several studies have been reported on immunoglobulin levels in patients with recurrent tonsillitis and the effect of tonsillectomy on the immunoglobulin levels (114,115,116,117,118,119). The results are conflicting (see table 1.3) and the studies all have serious faults.

Table 1.3 Effect of tonsillectomy on serum immunoglobulin levels

Author	Year	IgA	IgM	IgG
Veltri *et al*	1972	pre-op high* post-op no change	pre-op normal post-op no change	pre-op high* post-op lower*
Gogoi *et al*	1979	pre-op normal post-op normal	pre-op normal post-op normal	pre-op normal post-op normal
El-Ashmawy *et al*	1980	pre-op high* post-op high^	pre-op high^ post-op normal	pre-op high* post-op normal
Fiori-Ratti *et al*	1983	pre-op normal post-op lower*	pre-op normal post-op lower*	pre-op normal post-op lower*
Lal et al	1984	pre-op high* post-op lower^	pre-op high* post-op lower^	pre-op high* post-op normal
Sainz *et al*	1991	pre-op not stated post-op lower*	pre-op not stated post-op lower*	pre-op not stated post-op lower*

*statistical significance ^ no statistical significance

Veltri *et al.* (114) gave no normal ranges for immunoglobulins so it is not clear whether their findings are abnormal or important. They do not have a control group for the study but compare with a laboratory range. Gogoi *et al.* (115) performed post-operative testing on only 10 of the original 80 subjects. El-Ashmawy *et al.* (116) and Lal *et al.* (118) claimed that the pre-operative levels of immunoglobulins are significantly raised but all the measurements shown have huge ranges and there is great overlap between the results, which are supposed to be significantly different. They have not calculated any confidence intervals and, without these, the results must be interpreted with some caution. Lal quotes the ranges found by several other authors. These show the same wide range in values between subjects and raises doubt over the value of a single measurement in immunoglobulin evaluation. The results section of the paper by Fiorri-Ratti *et al.* (117) is very difficult to interpret but this study is included because it is the only one to claim that tonsillectomy causes a significant reduction in normal immunoglobulin levels. Sainz *et al.* (119) also showed a reduction in immunoglobulin levels following tonsillectomy but did not say if they were abnormal before. The significance of their report is therefore doubtful. It appears that there is no consistent finding linking recurrent tonsillitis or tonsillectomy to abnormalities of immunoglobulin levels.

Another site of possible immunological damage as a result of recurrent tonsillitis is in the tonsil itself where lymphocyte maturation occurs before these cells are released into the circulation. Prusek *et al.* (120) conducted a comparison of 50 children undergoing tonsillectomy for a variety of reasons with a normal control group. Pre-operatively, blood from children undergoing tonsillectomy showed a higher percentage of B lymphocytes and a lower percentage of T lymphocytes than blood from the control group. One month following surgery, the blood lymphocyte count was essentially unchanged but, after ten months, there was a significant decrease in the B population and a significant rise in the T population. These results suggest a gradual return to normal of the blood lymphocyte population but even after ten months this had not been completely achieved. The authors conclude that changes in the proportion of T and B lymphocytes in peripheral blood can be used when deciding for or against tonsillectomy. Virolainen *et al.* (121) reported their results of a comparison of the immune systems of eight 10 year-old boys just before and one month after tonsillectomy and nine 20 year-old men who had undergone tonsillectomy at the age of ten. There was no difference either immediate or long term in the total leukocyte or lymphocyte count.

Bernstein *et al.* (122) showed a trend for increased production of IgG, IgA, IgM and IgD plasma cells if tonsillitis occurred up to 5 times per year. If attacks were more frequent, there was a marked reduction in maturation of these plasma cells. The findings were consistent in patients with streptococcal tonsillitis, recurrent tonsillitis and infectious mononucleosis. There was no control group. The significance of these variable findings is difficult to judge in the absence of any consistent change in blood lymphocyte levels. The findings may suggest that frequent tonsillitis causes some degree of immunological suppression. Alternately, recurrent tonsillitis may be more common in children with immunosuppression (123). Sainz *et al.* (119) have suggested that recurrent infections themselves may cause immunological suppression that is reversed following tonsillectomy (119,124) although it is not very clear how they reach this conclusion from their paper.

Brodsky *et al.* (125) demonstrated that there were more T and B cells in diseased tonsils (*i.e.* tonsils from children with a history of recurrent tonsillitis or idiopathically hypertrophied tonsils) than in normal tonsils. They found a significant correlation between increasing microbial load and increased numbers of lymphocytes. This work would appear to contradict the findings of Bernstein *et al.* discussed above.

It appears that there is no agreement about the role of immunosuppression on the frequency of, or the effect of, tonsillitis or tonsillectomy on the immune system.

1.6.3 Bacteriological definition

Paradise *et al.* included the presence of beta-haemolytic streptococcus in the list of features that they believed were important when considering tonsillectomy (2). The role of the beta-haemolytic streptococcus has been regarded as important in tonsillitis because of the sequelae of rheumatic fever, chorea and glomerulonephritis. The incidence of these complications has fallen dramatically but, since the late 1980s, there have been increasingly frequent reports of another complication of group A beta-haemolytic streptococcal infection, namely the "streptococcal toxic shock-like syndrome" (TSLS) (126). As the name suggests, it is a toxin-mediated form of infection, like scarlet fever. It usually occurs in previously healthy adults and is usually associated with a soft tissue infection, such as necrotising fasciitis, but 10 to 20% of cases are associated with apparent pharyngeal infection.

In 1979, Bisno (127) wrote that all streptococcal sore throats should be treated with antibiotics to prevent the development of the complications mentioned above. He acknowledged the difficulty in making the diagnosis of streptococcal sore throat. Breese (128) believed that skilled physicians could accurately predict the presence of streptococci during an upper respiratory tract infection with the aid of a nine point score card. Points were awarded according to season, age of the child, symptoms, physical signs and degree of leucocytosis. Other authors have not found any of these features to be helpful in determining the presence of streptococci (92, 129).

Throat cultures are the easiest way to diagnose the presence of streptococci but their presence does not mean they are pathogenic. Many people, particularly children, are carriers of the streptococcus in the throat (40,130,131,132,133). Wannamaker (130) quoted that approximately one third of patients with an acute sore throat harbour group A streptococci and approximately half of these are carriers. School surveys have shown the carriage rate in children to be between 10% and 40%. Del Mar (91) reviewed the literature between 1945 and 1990 trying to justify the use of throat swabs for diagnostic purposes in acute sore throat but concluded that the high carrier rate made them unhelpful.

A more accurate method of determining recent streptococcal infection is to measure the serum anti-streptococcal antibody titres. Haverkorn *et al.* (134,135) performed an epidemiological survey in the Netherlands in which they tried to correlate clinical symptoms with the results of a throat swab and antibody titres. They showed that there was a difference in the severity of the illness in patients in whom, when the organism was isolated, a rise in serum anti-streptococcal antibodies was also demonstrated. Presence of the organism alone was not associated with more severe illness and indeed in one area positive throat swabs were found more frequently in people without throat symptoms than in those with sore throats. They remarked that the throat swab is often inadequate in the community as streptococci do not survive for long periods on cotton swabs.

The streptococcus is not the only organism implicated in tonsillitis. Numerous other organisms have been identified in patients with sore throats (both tonsillitis and pharyngitis), including *Bacteroides* spp., *Fusobacterium* spp., anaerobic Gram-positive cocci, *Eubacterium* spp., α-haemolytic streptococci, *Staphylococcus aureus*, *Haemophilus* spp., *Mycoplasma* spp, chlamydiae and *Branhamella* spp and various respiratory viruses (91,133,136,137). Sprinkle and Veltri (133) believed that there was no relationship between the causative organism and the severity or course of the illness.

They showed that children undergoing tonsillectomy had a much higher incidence of pathological organisms in their throats and that tonsillectomy returned the flora to a more physiological state. Their period of follow up was five years. Glezen *et al.* (138) reported that there was no clinical difference in the pattern of disease caused by the various organisms isolated from the throat.

Several authors have shown that the surface flora of the tonsil differs greatly from that of the core (125,137,139,140) and it is suggested that the core organisms play a greater role in the pathogenesis of acute episodes of tonsillitis. Brodsky *et al.* (125) found an association between total bacterial load and tonsil size. Core samples from control patients with no history of tonsillitis had fewer organisms than those from patients with a history of recurrent tonsillitis. Further evidence for the role of core organisms in the pathogenesis of tonsillitis is given by McKenzie in his interesting, and perhaps slightly tongue in cheek, paper (141). He hypothesises that the yawning instinct is responsible for cleansing the tonsillar crypts as they are squeezed during a yawn and that stifling this reflex in modern society is responsible for the rise in the incidence of tonsillitis. He strengthens his argument by recounting the yoga exercise called "Simhasana" or "the Lion Posture" which consists of elevating the head and protruding the tongue and is reputed to help prevent, or even heal, a sore throat. He also comments that the tonsils of other primates do not become a permanent site of infection. In his conclusions, he suggests that clinicians should add encouragement of yawning to their routine treatment of tonsillitis. Ebenfelt and Lundberg (142) contradicted the hypothesis of core organisms being responsible for tonsillitis by showing that the "core" organisms are actually bacteria found in the tonsil crypts and that invasion of the tonsillar tissues does not occur even during acute infection.

The common use of antibiotics has produced a marked change in the bacteriology of tonsillitis. It is postulated that the normal pharyngeal flora may inactivate antibiotics and allow the growth of pathogenic species of bacteria (143). This process has been termed "indirect pathogenesis". The widespread use of penicillins has resulted in the emergence of beta-lactamase-producing strains of both recognised pathogens and saprophytes.

Timon *et al.* (144) studied the bacteriology of tonsils over a 10 year period and reported a rise in beta-lactamase-producing *H. Influenzae* from 2% to 44%.

It appears that there is no agreement in the literature regarding the diagnosis of tonsillitis on clinical, immunological or bacteriological grounds. After completion of the review of the immunological and bacteriological literature, I became concerned that exploring this approach to understand the steps taken along the pathway from tonsillitis to tonsillectomy would not lead to further clarity. There appeared to be no consensus of opinion and, furthermore, attempts to reach a consensus seemed to be unhelpful. I became more persuaded that the answers to my understanding of the pathway from recurrent tonsillitis to tonsillectomy would be found in exploring the views of parents and doctors who were directly involved in the management of children with recurrent tonsillitis.

The literature review presented above suggests that the diagnosis of tonsillitis has not been clearly formulated and that the terms "tonsillitis", "pharyngitis" and "upper respiratory tract" are poorly defined and perhaps randomly used in clinical practice. The randomised controlled trials about the efficacy of tonsillectomy attempted to define "tonsillitis" in order that children suffering from other illnesses should be excluded. I wondered whether there was any real attempt to distinguish between the terms "tonsillitis", "pharyngitis" and "upper respiratory tract infection" by doctors involved in the care of children with sore throats, namely general practitioners, paediatricians and otolaryngologists and, if so, what factors were used in the differentiation. This led to the formulation of the following hypothesis.

HYPOTHESIS

In day-to-day practice, no distinction is drawn between the diagnostic terms "tonsillitis", "pharyngitis" and "upper respiratory tract infection" by otolaryngologists, paediatricians and general practitioners.

1.7 Is there more to Tonsillitis than just a Sore Throat?

So far, I have suggested that the previous studies about tonsillectomy may not have shown the expected benefit because they did not measure the parameters in which parents see the most improvement following tonsillectomy. This may be because the ill effects of tonsillectomy are not measured simply in terms of the number of sore throats but may be affected by multiple social and familial factors, by the quality of the child's sleep or his/her behaviour, amongst others. It may indicate that parents experience tonsillitis in a way that is not understood or fully appreciated by the medical profession. The sections that follow discuss the social and familial factors that have been reported to influence the incidence of tonsillitis and tonsillectomy. The factors to be discussed are social class, parental smoking, family medical history and atopy. The possible link between recurrent tonsillitis and poor sleep quality is also discussed. I illustrate how lay knowledge has helped in the development of medical knowledge in other fields of medicine and discuss the role of parental pressure in the decision to perform tonsillectomy.

1.7.1 Social class

The current relationship between social class and the tonsillectomy rate is unclear. Variation in the tonsillectomy rate according to social class group has existed since the beginning of this century (9) but Venters and Bloor (145) suggested in 1974 that

"*whilst variations in operations persist on a geographical basis, variations according to social class have almost disappeared*".

Bisset and Russell (4) disagreed. They compared grommet insertion rate, tonsillectomy rate and deprivation scores in Scotland in 1990. They reported that, in contrast with English children, tonsillectomy was more common than grommet insertion. They found a twofold variation in tonsillectomy rate (from 3.6/1000 to 8/1000) across the range of the Scottish Health Boards and a positive but not significant association between deprivation and higher tonsillectomy rates. The highest tonsillectomy rates were found in the Health Boards with the largest cities. The findings reflect the higher incidence of deprivation in inner city areas compared to rural communities. Previously, Venters and Bloor commented upon the fall in popularity of tonsillectomy in higher social class families and suggested that it reflected increased awareness amongst the higher social class parents of the change in medical opinion regarding the benefit of tonsillectomy in unselected children.

Hippisley-Cox *et al.* (146) reported the effect of deprivation on general practitioners' referral rates in Nottinghamshire. They found a significant association between deprivation and high total referral rates and medical referral rates. The association with surgical referral rates was not significant. The authors concluded that the association was most likely to reflect increased morbidity in deprived areas but acknowledged that differences in patients' perceptions, doctors' behaviour or the use and provision of services might also have been responsible.

1.7.2 Parental smoking

Said *et al.* investigated the influence of parental smoking on the incidence of tonsillectomy in children (147). They showed a significantly higher incidence of tonsillectomy and/or adenoidectomy in children from families where one or both parents smoke cigarettes. Hinton *et al.* confirmed this finding (148). Neither study controlled for the effect of social class on the results so the results may be invalid.

Harlap and Davies (149) demonstrated a trend for infants of smoking parents to have more upper respiratory tract infections and Maw *et al.* (150) found an association between parental smoking and glue ear in children. Colley (151) and Cameron *et al.* (152) showed a correlation between parental smoking and phlegm production and respiratory symptoms in children. Lebowitz and Burrows (153) and Shy *et al.* (154) did not find an association between parental smoking and respiratory symptoms in children.

1.7.3 Family medical history

Millac (155) showed a positive correlation between mothers with gynaecological problems and an increased incidence in their children of referral to hospital for tonsillectomy. She hypothesised that the link was neurosis on the part of the mother. It has been shown that women attending gynaecological outpatients have a higher than normal neuroticism score. This may make the mother less able to cope with the stress of minor illness, such as repeated sore throats, in her children. Bains and Sales (156) showed that children whose mothers were regularly prescribed psychotropic drugs had a higher referral to ENT clinics than other children. They also accredited their finding to increased neuroticism in the mothers.

Katznelson and Gross (157) reported on a group of 81 children undergoing tonsillectomy and adenoidectomy and a control group of 88 children not undergoing tonsillectomy. They showed that there was a significantly higher incidence of previous tonsillectomy and adenoidectomy in the parents and siblings of the study group than the control group. They postulated that this could be due to environmental, genetic or attitudinal factors. Domenighetti and Bisig (158) also found a significantly higher tonsillectomy rate in children whose parents had undergone tonsillectomy but a significantly reduced incidence of tonsillectomy in doctors' children. They believed that this latter finding was a result of the physician parents' ability to balance the risks and the benefits of the operation better than the general public. Black (3), writing about the incidence of surgery in children with glue ear, reported that children with an older sibling who had undergone surgery for this condition were more likely to have surgery themselves. This may be further evidence to support family clustering of certain operations.

1.7.4 Family atopy

Several reports showed an association between a higher than normal incidence of upper respiratory tract infection, including tonsillitis, and an atopic tendency (29,58,159). The reports also showed that tonsillectomy in such individuals was not beneficial in terms of reducing the number of infections. The authors suggested that tonsillectomy should not be undertaken until adequate anti-allergy treatment had been given (159,160). Saito *et al.* (161), however, reported marked improvement in asthmatic, but not rhinitic, symptoms in individuals undergoing tonsillectomy. Scadding (123) showed that children with perennial allergic rhinitis were four times more likely to have undergone an ear, nose and throat operation than children with orthopaedic problems.

These sections have shown that there is still uncertainty over the effect of social class upon the incidence of tonsillitis or tonsillectomy. There is some evidence linking parental smoking and family medical history to a higher incidence of tonsillectomy but the studies are flawed. I wanted to investigate the influence of these factors upon the decision to perform tonsillectomy and they therefore formed the basis of another hypothesis.

HYPOTHESIS
The number of sore throats and episodes of tonsillitis experienced by children from a normal population cross-section and children awaiting tonsillectomy is not affected by social or familial factors.

1.7.5 Obstructive sleep apnoea

The section below discusses the evidence linking poor sleep quality in children with tonsillectomy. It seemed reasonable to consider that improvement in sleep quality following tonsillectomy may be one area where parents see benefit. This hypothesis has not to date been the subject of a standard medical trial.

In recent years, the syndrome of obstructive sleep apnoea (OSA) has been increasingly recognised in children with hypertrophic tonsils and adenoids. Rosenfeld and Green (162) reported a rise in OSA as the indication for tonsillectomy in children from 0% in 1978 to 19% in 1986. The symptoms of OSA are varied and non-specific, for example snoring, daytime sleepiness, unusual sleeping positions, aggression, poor school progress and enuresis (162,163,164). If untreated, right ventricular failure may develop and sudden death may occur. It is interesting that many of these symptoms were regarded as indications for tonsillectomy in the early part of this century (16,24,28). Adentonsillectomy results in cessation of airway collapse and apnoeic episodes as shown by overnight sleep studies (6,163,165,166) and restoration of normal sleeping and behavioural patterns.

Awareness of the potential long-term effects of OSA has resulted in an increase in referral of snoring children for tonsillectomy by general practitioners (35,167). The true incidence of OSA in children is unknown. Stradling (163) reported an incidence of hypoxia of 61% in a population of children undergoing routine adenotonsillectomy compared with an incidence of 13% in a control population. Croft *et al.* (166) studied 50 children randomly selected from a routine waiting list for tonsillectomy. All the children were awaiting tonsillectomy on account of recurrent upper respiratory infections and none was suspected of having significant airway obstruction. The investigators found that half of the children snored, one had obstructive sleep apnoea, nine had apnoeic episodes but did not reach the criteria for the diagnosis of OSA and three had disrupted sleep. All abnormal sleep studies reverted to normal within three months following adenotonsillectomy.

Owen (168), however, conducted a study of 200 children aged from birth to ten years who had been randomly selected from a normal population. She performed overnight pulse oximetry on the children in their homes. She found that, although 30% of the children habitually snored (a figure which rose to 50% with an upper respiratory tract infection), none of the children in the sample had a pulse oximetry tracing abnormal enough to make a diagnosis of OSA. She also studied thirty-four children from a waiting list for adenotonsillectomy and again found no tracings abnormal enough to make a diagnosis of OSA. Consequently, it appears that OSA may not be as common in children as some authors have suggested.

Owen (168) found that children who snore are more likely to be reported by their parents as having restless sleep and sleep talking. There was a trend associating snoring with morning irritability, morning sleepiness, mouth breathing, eating slowly and sore throats. All these symptoms were significantly improved following adenotonsillectomy. Snoring is more common with upper respiratory infections so these symptoms may be more common in children with recurrent tonsillitis. The correction of these features may be as significant to the perceived benefit of the operation as the reduction in frequency of sore throats. I decided therefore to examine whether there is any difference in reported sleep quality and behavioural characteristics of children awaiting tonsillectomy and normal children. These questions formed the basis of the following hypotheses.

HYPOTHESIS

There is no difference in sleep quality between children from a normal population cross-section and children awaiting tonsillectomy.

There is no difference in behaviour between children from a normal population cross-section and children awaiting tonsillectomy.

1.8 Role of the Lay Community in the Discovery of Medical Knowledge

I have suggested that medical trials have failed to show the benefits of tonsillectomy reported by parents because they may have a different understanding of tonsillitis and the benefits of tonsillectomy from that of the medical profession. In other specialities, lay opinion has played an important role in understanding and exploring medical conditions. It may be that parents of children with recurrent tonsillitis, rather than being excluded as in earlier studies, should play a greater role in developing knowledge about tonsillitis and the indications for and benefits of tonsillectomy.

The individual contributions of the lay and medical populations in determining medical knowledge have been explored in the sociological literature but less so in the medical literature. Some of the findings are pertinent to this study. In 1935, Fleck published his paper "Genesis and Development of a Scientific Fact" in German. Löwy (169) and Harwood (170) have discussed this work. In it, Fleck proposed that medical knowledge is the outcome of a process of interaction and communication amongst distinct groups. He called these groups "thought collectives". Examples of such thought collectives include otolaryngologists, paediatricians, general practitioners and patients (or their parents). He postulated that there is resistance to accepting the ideas of another thought collective in preference to the ideas of one's own thought collective. Medical facts are established by means of exchange and circulation of ideas between these groups and lay people may play an important role. The suggestion is that scientific knowledge is not "discovered" by technical experts and then disseminated to a wider public but rather that the public participates in uncovering the knowledge in the first place.

These ideas have been studied in relation to diseases other than tonsillitis. Fleck developed his ideas through his work as a microbiologist. He illustrated how a diagnostic blood test was discovered for syphilis as a result of the general public's belief in "syphilitic bad blood". Arskey (171) discussed Fleck's theory in relation to repetitive strain injury, a condition still not universally recognised by the medical profession but whose existence has been recognised in law as a result of the lobbying of patients who have the symptoms covered by its definition.

McLean (172) discussed how a lay group of relatives of people with schizophrenia influenced the understanding of the origin of this illness, swaying opinion away from the theory of family pathology to that of a chemical imbalance in the brain. They also managed to redirect most of the research into schizophrenia towards investigating their theory. McLean suggested that the success of the campaign resulted in an approach to the illness which was as imbalanced as the one to which the lay group originally objected. Therefore it can be seen that lay influences can result in an over-reaction from the health professionals (compare the tonsillectomy rate in the early part of this century).

Since lay opinion has helped in some instances in defining medical knowledge, I wondered whether parents have strong views regarding "tonsillitis". Do they see it as a separate clinical entity from other sore throats and are any particular symptoms associated with tonsillitis? To some extent, this is a re-working of the attempt of Paradise *et al.* to define tonsillitis but, instead of rejecting parental opinion, I am relying upon it. Uncovering a "parental definition" of tonsillitis formed the basis of another hypothesis.

HYPOTHESIS
Tonsillitis, as perceived by parents, does not represent a distinct clinical picture when compared with other sore throats.

1.9 Parental Pressure

Venters and Bloor (145) suggested that parental pressure from the higher social classes might be more effective than that of the lower groups. Bunker and Brown (173) showed that professional groups (doctors, lawyers, ministers and businessmen) and their families in the United States utilised medical services 25% - 30% more than the country as a whole. Further evidence that parental pressure can have a significant influence on the decision to perform tonsillectomy came from Forsythe and Logan (174). They reported a variation in tonsillectomy rate within the area served by the North Lonsdale Hospital in Barrow where there was only one otolaryngologist. They concluded that the difference must be due to influences from outside the hospital and concluded that the variation in tonsillectomy rate was a result of "*the anxiety of the parent interacting with the outlook of the family doctor*".

Bakwin (175), Fry (176) and Paradise (86) stressed the importance of parental pressure in the decision to perform tonsillectomy. Fry reported that he had recommended tonsillectomy for 40 children over a ten-year period and for 7 of these children the reason was "extreme parental pressure". Furman (177) attributed parental pressure to two factors - ignorance and guilt. The high incidence of tonsillectomy since the 1920s resulted in a generation of parents who expected tonsillectomy to be performed for the various reasons mentioned previously and who were unaware of any possible beneficial role for the tonsils. Indeed, they seemed to believe that "*the only function of the tonsils is to be removed surgically*". This is not surprising as a large section of the medical profession at that time appeared to hold the same view. Furman believed that guilt may be the result of self blame each time the child is ill with a respiratory infection accompanied by the belief that failure to secure tonsillectomy was paramount to neglect. Bolande (178) considered that many tonsillectomies were performed solely because of parental pressure and believed that doctors' willingness to comply had resulted in the operation becoming a ritual. Anthropologists define "ritual" as "a category of standardised behaviour in which the relationship between the means and the ends is not intrinsic" (179).

The concept of parental pressure can be reframed as a discrepancy between the parental and medical perspective. There is evidence to suggest that doctors do not make the best "quality of life" judgements. Slevin *et al.* (180) compared quality of life assessments by health professionals and patients. They found very wide discrepancies between the assessments and concluded that doctors cannot measure a patient's quality of life adequately. Such findings suggest that parental assessment may have an important role to play in assessing a child's quality of life and in the decision to undertake tonsillectomy in children. Parental "pressure" may arise when their perspective and assessment has not been an adequate part of the decision making process.

Robinson (181), however, pointed out that parental perspective can also have the opposite effect. He illustrated that mothers who believed that tonsillectomy was unlikely to improve their child's health were less likely to consult their general practitioner for minor ailments than mothers who believed that tonsillectomy would be beneficial.

If parental pressure can have such a profound effect upon the decision to undertake tonsillectomy it is possible that other non-clinical factors, such as tiredness on the part of the doctor and waiting list size, could be influential. This possibility formed the basis of another hypothesis.

HYPOTHESIS
The decision by otolaryngologists to perform tonsillectomy is not influenced by non-clinical factors.

1.10 What Do Otolaryngologists, Paediatricians and General Practitioners Think?

1.10.1 The indications for tonsillectomy

So far, I have shown that the trials investigating the effects of tonsillectomy on children with recurrent tonsillitis do not show the great improvement in health reported by parents. I have postulated that this may be due to poor study design or to collecting the wrong data. I have suggested that parents may have an understanding of recurrent tonsillitis that causes them to seek tonsillectomy for their child after which they see improvement. I have also suggested that clinicians may have a different opinion about what is important in tonsillitis and tonsillectomy than the researchers because the guidelines set down for tonsillectomy appear not to be used rigidly. The section below reviews the literature regarding the indications for tonsillectomy and provides evidence that there is poor agreement amongst doctors about the indications for tonsillectomy and the expected benefits of this operation. I suggest that this may partly explain the wide variation in tonsillectomy rates across the United Kingdom mentioned at the beginning of this chapter.

Tucker (182) in 1982 reported the results of a questionnaire completed by 28 consultant otolaryngologists. The questionnaire addressed the symptoms and signs that might be considered important in a child with recurrent sore throats and also the conditions that might improve following tonsillectomy. Only one of seven symptoms (recurrent sore throats) and one of nine conditions (peritonsillar abscess) were unanimously considered to be important when assessing a child for tonsillectomy. A history of frequent colds, poor appetite or obstruction of breathing or swallowing was not important. None of the signs were agreed upon as important. These included the appearance and size of the tonsils and the presence of cervical lymphadenopathy. Opinion was nearly equally divided as regards the appearance of the tonsils in affecting the decision, despite earlier reports which had shown that the appearance of the tonsils is no indication of their state of health (38,39,40,42,183).

Cable *et al.* (184) conducted a study of physical signs in 105 children of whom 64 had recurrent tonsillitis and 41 did not. They looked at the apparent size of the tonsils, the appearance of the anterior pillars, the presence of debris in the crypts and the presence of cervical lymphadenopathy. They found no difference in the presence or absence of any of these signs between the two groups. Mills and Hibbert (185) found similar results when they compared two similar groups of children. They found a statistically significant difference between the cervical nodes of the two groups with all the tonsillectomy group having palpable lymph nodes in the neck. They concluded, however, that it was not clinically significant and that palpable cervical lymph nodes should not be used to indicate the need for tonsillectomy as such nodes were present in 70% of the control group. Weir (186) studied a group of children undergoing tonsillectomy and found no correlation between the apparent size of the tonsils measured pre-operatively and the weight of the tonsils after removal. Brodsky *et al.* (125) contradicted this finding. They found a correlation between pre-operative assessment of size and weight of the tonsil with tonsil size being directly proportional to the bacterial load.

Does this lack of agreement amongst otolaryngologists explain the wide variation in tonsillectomy rate? Roos *et al.* (11), in Canada, found a relationship between performance of tonsillectomy by doctors and their place of training, age and level of qualification. This correlation was not strong enough to explain fully the wide differences in tonsillectomy rate in their study. In a closely related clinical area, Bisset and Russell (4) studied grommet insertion rates. They showed that individual surgeons can have a noticeable effect upon surgical rates. This conclusion was supported by the observation that several of the consultants with the highest rates of grommet insertion had completed their training in the area with the highest rate of grommet insertion.

These investigations have suggested that there is poor agreement between otolaryngologists about the indications for tonsillectomy and that the practice of individual otolaryngologists is partially responsible for the variation in the incidence of tonsillectomy. Since children are referred to otolaryngologists by general practitioners and paediatricians, do the opinions of general practitioners and paediatricians also vary?

Forsyth and Logan (174) in their study in Barrow and Furness reported substantial variations between general practitioners in referral rates to out-patient departments. Other authors have found similar variations and concluded that the differences in referral rates are due to the practice of the doctors rather than variations in the patients (187,188,189). Bloor *et al.* (12,13) showed that, within a particular region, general practitioners referred in a similar way suggesting that post-graduate education may be partly responsible for the inter-regional variation in referral for tonsillectomy. Differences in tonsillectomy rate were due to differences in medical practice and not due to differences in the incidence of disease. The practices of both general practitioners and otolaryngologists had a demonstrable effect on the tonsillectomy rate.

The Scottish Tonsillectomy Audit (88) reported wide variations in the rate of general practitioner referral for consideration for tonsillectomy across the Scottish Health boards with a range of 8.01 referrals per 10000 population to 16.5 per 10000. The Audit did not examine the decision making processes of the general practitioners although the reasons for the referrals extracted from the referral letters were "for tonsillectomy", "because of sore throats" and "sleep apnoea". There was no relation between the referral rate and the tonsillectomy rate or the percentage of patients accepted for surgery at the initial visit. The grade of doctor seeing the patient in the outpatient clinic did not affect the tonsillectomy rate. The main reason for performing tonsillectomy was quoted as "recurrent tonsillitis" but how "tonsillitis" was defined was not stated. The Audit suggests that there is lack of agreement between otolaryngologists and general practitioners about the indications for tonsillectomy. Donnelly *et al.* (190), however, reported the results of a questionnaire study of the indications for tonsillectomy undertaken amongst otolaryngologists and general practitioners in Dublin. The two groups of doctors agreed strongly about the indications for tonsillectomy.

It would appear that the poor agreement between otolaryngologists regarding the indications for tonsillectomy is also present in general practice and that further differences are present between otolaryngologists and general practitioners. Why should this be? Medical education would appear to have a role. Berg (191) discussed the way in which doctors use the information derived from the history and examination of a patient. He showed that doctors may reinterpret the information to fit in with the course of action already decided upon and that this tendency is more pronounced when time is short. In the working environment, "routines" are employed so that the doctor can “see” almost immediately how a situation should be managed. In different hospitals, different routines exist. This may also be true of general practices and may be partly responsible for the different referral rates for tonsillectomy and the differences in acceptance rates for tonsillectomy between hospitals.

Thus it appears that the variation in tonsillectomy rate is caused by many factors. Differences in the management of children with recurrent tonsillitis exist between doctors working in the same specialty of medicine as well as between specialties. The nature of the differences in referral and acceptance for tonsillectomy has not been shown. I decided to examine the reasons for performing tonsillectomy or referring a child for tonsillectomy given by three groups of doctors working in a relatively small geographical area. This formed the basis of the following hypothesis.

HYPOTHESIS

There are no differences in the reasons for performing tonsillectomy in children by otolaryngologists, paediatricians and general practitioners.

1.10.2 The benefits of tonsillectomy

Tucker (182) showed that otolaryngologists did not uniformly agree that symptoms of obstruction to breathing or swallowing were indicative of a need for tonsillectomy. Recently, Richmond *et al.* (192) have reported that obstructive sleep apnoea secondary to adenotonsillar enlargement has replaced chronic tonsillitis as the most common indication for adenotonsillectomy. As a result of the increase in referrals for obstructive symptoms, warnings have been raised that the tonsillectomy rate may also begin to increase again (193). As an alternative to standard tonsillectomy for obstructive symptoms, Gray (194) suggested unilateral tonsillectomy and claimed an 80% success rate, although 22 children of the 54 sample required further surgery.

Some authors have found that features of obstructive sleep apnoea are common in children awaiting tonsillectomy, even in the absence of a history suggestive of this. It may be that the benefit of tonsillectomy is found in relief of poor sleep quality as much as in reduction of the frequency of sore throats. This may be how parents notice the benefit of tonsillectomy that is not seen if the benefit is measured only in terms of a reduction in the number of sore throats.

It is also possible that general practitioners, paediatricians and otolaryngologists made the same or different associations between the need for (adeno)tonsillectomy and the features associated with poor sleep quality or the obstructive sleep apnoea syndrome. This would be reflected in the benefits that these three groups of doctors expect following tonsillectomy and this formed the basis of another hypothesis.

HYPOTHESIS

There are no differences in the expected benefits of tonsillectomy as perceived by otolaryngologists, paediatricians and general practitioners.

1.11 Summary

This chapter has traced the history of tonsillectomy and documented the rise and then decline in its performance that occurred in the early part of the twentieth century. The increase in the frequency of tonsillectomy led to an attempt to define its indications clearly. Several studies were performed with this aim but they failed to show much benefit following tonsillectomy for these studies defined benefit purely in terms of reduction in frequency of sore throats. Despite this lack of evidence supporting the role of tonsillectomy in children with recurrent tonsillitis, it remains the second most common operation performed on children in the United Kingdom. How can this be justified?

Parents often say that tonsillectomy has made "a different person" of their son or daughter. This observation suggests that parents see a benefit even if formal trials did not. I have suggested that ignoring the views of parents may have resulted in a loss of information that is relevant to the treatment of children with recurrent tonsillitis. Consequently, one role of this thesis is to begin to develop a definition of tonsillitis from the perspective of parents as well as the medical profession.

The tonsillectomy rate continues to vary widely across the United Kingdom with a twofold difference between the highest and lowest tonsillectomy areas. Guidelines for the indications for tonsillectomy have been written. If these were followed, the tonsillectomy rate should be fairly uniform as the morbidity from tonsillitis appears not to vary. The variation in the tonsillectomy incidence suggests that the guidelines are not used and that doctors are using different judgements when deciding that tonsillectomy is required. This thesis studies the factors involved in this decision – the diagnosis of tonsillitis, the indications for tonsillectomy, non-clinical factors that may affect the decision to perform tonsillectomy and the expected benefit of the operation - and investigates whether there is agreement between different groups of doctors about these factors.

1.12 Summary of Hypotheses

1. Tonsillitis, as perceived by parents, does not represent a distinct clinical picture when compared with other sore throats.
2. There is no difference in sleep quality between children from a normal population cross-section and children awaiting tonsillectomy.
3. There is no difference in behaviour between children from a normal population cross-section and children awaiting tonsillectomy.
4. The number of sore throats and episodes of tonsillitis experienced by children from a normal population cross-section and children awaiting tonsillectomy is not affected by social or familial factors.
5. In day-to-day practice, no distinction is drawn between the diagnostic terms "tonsillitis", "pharyngitis" and "upper respiratory tract infection" by otolaryngologists, paediatricians and general practitioners.
6. There are no differences in the reasons for performing tonsillectomy in children by otolaryngologists, paediatricians and general practitioners.
7. There are no differences in the expected benefits of tonsillectomy as perceived by otolaryngologists, paediatricians and general practitioners.
8. The decision by otolaryngologists to perform tonsillectomy is not influenced by factors other than those directly related to the child's health.

2 METHODS

This chapter describes the various methods available for the purpose of the study, explains why the particular method was chosen and outlines the strengths and weaknesses of the method. It describes how the populations were chosen and how the data were collected. It highlights the steps taken to ensure comprehensive data collection and discusses data analysis.

2.1 Study Design

Research uses one of two basic types of design – experiments or surveys. An experiment is a "*study of deliberate intervention*" (195) in which the effect of exposure to, or deprivation of, a defined factor is studied. The researcher decides which subjects will receive or be denied the defined factor. If the researcher compares a population who receive the factor with a population who do not, the experiment is controlled. A survey is "*an investigation where information is systematically collected but in which the experimental method is not used*". There is no active intervention by the researcher. The researcher may compare subjects who happen to be receiving the defined factor with those who are not but will not have chosen who receives the factor and who does not.

This thesis studies the pathway along which children with recurrent tonsillitis move towards tonsillectomy or otherwise, by researching the views of parents, otolaryngologists, paediatricians and general practitioners. It aims to determine whether parents can differentiate tonsillitis from other sore throats. It also aims to shed light on the way that otolaryngologists, paediatricians and general practitioners make the diagnosis of tonsillitis, make the decision for or against tonsillectomy and reveal what they perceive as the benefits of tonsillectomy. It examines the characteristics of tonsillitis and other sore throats in two populations – a normal population of children and a population of children awaiting tonsillectomy. For this reason, a methodology based upon the general principle of survey was regarded as appropriate.

2.1.1 Surveys

There are two general approaches to surveys, descriptive or analytic (195).

Descriptive studies describe the general characteristics of the distribution of a disease, relating it to factors of person, place and time. Indices of "person" include demographic data such as age, sex, race, marital status, occupation and life style factors such as consumption of alcohol and use of medication. Indices of place refer to the geographic distribution of the disease either between countries or between urban and rural areas within a country. With regard to time, descriptive studies may examine seasonal variations in disease onset or compare the frequency of disease at the time of the study in comparison with some time in the past.

The major advantage of descriptive studies is that the data are readily available and the studies are therefore relatively quick and inexpensive to perform. The disadvantage is that they are only useful for formulating hypotheses rather than testing hypotheses.

There are three main types of descriptive study:

1. **Correlation study** – uses data from entire populations to compare disease frequencies between different groups during the same period of time or in the same population at different points in time. An example of a correlation study is the study by Armstrong and Doll (196) showing that colon cancer is more common in women in countries with the highest *per capita* meat consumption.

2. **Case reports and case series** – a description of a single case or series of cases illustrating a possible connection between exposure to a risk factor and development of a disease.

3. **Cross-sectional surveys** – a descriptive study in which individuals from a population are assessed with respect to the presence and absence of both the risk factor and disease under investigation. An example is the Health Interview Survey

(197). This survey is a national cross-section study that periodically collects extensive information by questionnaire from a representative sample of over 100,000 individuals in the United States. Data are collected regarding personal and demographic characteristics, illnesses, health habits and utilisation of health care resources. The frequency of various diseases and injuries is calculated and examined in relation to age, sex, race, socio-economic factors, medication use, cigarette smoking and other risk factors. Since exposure to risk factors and presence of disease are measured at the same time, cross-sectional surveys cannot always distinguish whether exposure preceded the development of disease. Therefore, the studies are useful for formulating hypotheses but not for testing hypotheses. An analytic study is required for testing hypotheses.

Analytic studies compare groups of individuals who differ by the presence or absence of a disease or by the exposure or non-exposure to a risk factor. It is the use of an appropriate comparison group that allows the testing of hypotheses in analytic study designs. There are two main types of analytic study – the case-control study and the cohort study.

1. **Case-control studies** involve the comparison of individuals who are known to have the disease or condition under investigation (cases) with individuals who do not have the disease or condition (controls). Data regarding the past histories and exposure to suspected risk factors of both cases and controls are collected by direct questioning or reference to medical records and a comparison is made. Finding a greater exposure to a risk factor in the case group than in the control group lends support to an aetiological hypothesis but does not necessarily prove it because the sequence of events is not always clear. For example, if men with ischaemic heart disease are found to follow sedentary occupations more frequently than their controls, it is not clear whether lack of exercise predisposes to heart disease or whether those with incipient heart disease choose less physically demanding jobs.

In the design of a case-control trial, the most important area is the selection of the cases and controls. In selecting the cases, ideally all cases should be included in the investigation. However, it is rarely feasible or necessary to do this in order to reach valid conclusions (198). Most studies investigate a sample of cases usually identified by some form of cluster sampling technique (see below). Sources commonly used to select the case group include hospital in-patients or out-patients, disease registers and death certificates.

Selection of controls is necessary to establish the frequency with which the suspected causal agents occur in people without the disease under investigation. Controls should be a representative sample of the population from which the cases were recruited. Similarity between cases and controls can be ensured by matching in terms of age, sex and other variables that may influence the development of the disease with exception of the factors being investigated. The limitation of this method is that the effect of the variables used in the matching cannot always be known in advance and there is a danger that over-rigorous matching may result in failure to identify a significant variable. As an alternative, matching may be performed on a group basis with the control group being selected at random from a sample of the parent population from which the cases were drawn. Examples of groups from which control subjects may be selected include:

- People working or living in the same locality as cases
- Routine registers e.g. birth register, electoral roll, payroll, school roll, practice list
- Hospital patients – either all hospital attenders, or more commonly, those with conditions believed to be unrelated to the factors under investigation
- Relatives and spouses – unsuitable if genetic or home environmental factors are under study
- Random digit dialling using telephone exchanges serving the area in which the cases live.

The advantages of case-control studies are:

- They are well-suited to the evaluation of diseases or conditions with long latent periods
- They can examine multiple aetiological factors for a single disease
- They are optimal for the evaluation of rare diseases
- They are relatively quick and inexpensive compared with cohort studies.

The limitations of case-control studies are:

- They rely on retrospective data. This can lead to bias due to inaccurate recall of events by subjects
- The temporal relationship between exposure and disease may be difficult to establish
- There can be difficulties in selecting and recruiting appropriate controls.

2. **Cohort studies** involve the investigation of groups of people who have no manifestations of the disease under study at the time of their recruitment. The study group is observed over a period of time in order to measure the frequency of occurrence of the disease amongst people exposed to the suspected causal agent compared with its frequency amongst individuals not exposed to the agent. The study group may be chosen because of special personal characteristics or because of special exposures.

    - Groups with special personal characteristics have characteristics in common that are unrelated to the risk of development of the disease but make the group easy to follow up, *e.g.* they all belong to a profession with a constantly updated register. The group is followed until a sufficient proportion has reached a predefined endpoint – usually development of the disease or death. During the follow up period, exposure to suspected harmful agents is recorded. Analysis is performed comparing those who have experienced exposure to harmful agents with those who have not. Those with no exposure therefore act as an internal control group.

- Groups with special exposure are chosen on the basis of exposure to the agent under investigation. They are followed up to assess the frequency with which the disease develops. This study design requires recruitment of an external control group who must be similar to the study group in all respects other than exposure to the agent under investigation.

The advantages of cohort studies are:

- They are particularly useful when exposure is rare
- They can examine multiple effects of a single exposure
- They can demonstrate the temporal relationship between exposure and disease
- They allow direct measurement of incidence of disease in the exposed and non-exposed groups
- Bias in the control group is less of a problem than in case-control studies because the necessary comparison groups (exposed and non-exposed) are built into the study design from the beginning. It is important to remember that the two groups may not have the same susceptibility to the disease.

The limitations of cohort studies are:

- They are inefficient for the evaluation of rare diseases
- They can be extremely expensive and time consuming
- Validity of results can be seriously affected by losses to follow up
- In a long running study, "drift" in methods and diagnostic criteria may mean that results from the later stages are not comparable with those obtained earlier.

2.1.2 Other Study Methods Available

Several qualitative methods could have been applicable to the study and are discussed below:

- Observational methods
- Qualitative interviews
- Focus groups
- Consensus methods

"*Observation, in depth interviews and focus groups can be used to provide a description and understanding of a situation or behaviour. At their most basic, these techniques can be used simply to discover the most comprehensible terms or words to use in a subsequent survey questionnaire.*" (199)

Observation methods involve careful and detailed watching and recording of what people say and do (200). It takes place "in the field", that is, in the natural setting of the behaviour being studied. The researcher may be purely an observer or may participate in the activity whilst observing and recording it. Methods of recording information include writing notes and audio or video recording. The researcher tries to record everything that happens, including his/her feelings and responses to the events, and from data collected tries to develop tentative hypotheses to explain the behaviour observed. The subjective nature of this type of research is a crucial component of the process of analysing qualitative observational data.

Disadvantages of observational methods include:

- The need for the researcher to be accepted into the area where the presence of the observer may result in a change in behaviour (Hawthorne effect)
- Research that relies exclusively on observation by a single researcher is limited to the perceptions and introspection of the investigator

- The researcher may become so involved with the group being studied that the research agenda is lost.

An important advantage of observation is:

- It "*can help to overcome the discrepancy between what people say and what they actually do. It circumvents the biases inherent in the accounts people give of their actions caused by factors such as the wish to present themselves in a good light, differences in recall, selectivity and the influences of the roles they occupy*" (200). An example of this type of research is the work of Bloor and Venters (145).

Interviewing is a well-recognised form of qualitative research and the interviewers need to be trained to carry out the interview successfully. There are three main types of interview – structured (usually with a structured questionnaire), semi-structured (open ended questions) and in-depth (one or two issues covered in great detail, questions based on what the interviewee says) (201). The structured questionnaire provides an overlap with quantitative research methods and involves asking questions in a standardised manner. Most qualitative interviews will be less structured but not unstructured as there would be no guarantee that the data collected would be applicable to the research question. The qualitative interview "*aims to discover the interviewee's own framework of meanings*" without imposing the assumptions of the interviewer (201). A semi-structured interview consists of a series of open-ended questions that define the area being explored. From the base of the initial questions, the interviewer or interviewee may diverge to cover an area in more detail. In-depth interviews are less structured still and may cover only one or two issues. They are often needed to "*get at the private, often contradictory and complex beliefs people hold*"; a survey may pick up only the public beliefs of an individual (199).

Difficulties with qualitative interviews can arise when issues of class, sex and race separate the interviewer and the interviewee. The interviewee may give the answer that he/she thinks the interviewer wants and the interviewer must be careful not to impose his/her own thoughts upon the interviewee. Qualitative interviews require considerable skill on the part of the interviewer to avoid being directive, missing verbal or non-verbal cues or losing control of the interview.

Focus groups are a form of group interview and use the interaction between the interviewees to generate data. The method is "*particularly useful for exploring people's knowledge and experiences and can be used to examine not only what people think but how they think and why they think that way*" (202). Focus groups have been used to examine people's understanding of illness and their experience of disease and they are particularly useful for cross-cultural research and for examining workplace cultures. A successful group discussion will allow the interviewees to discuss the areas that are important to them in their own words, illustrating where *their* priorities lie rather than those of the researcher. Many forms of communication can be recorded, including verbal and non-verbal, jokes, anecdotes, teasing and arguing. Such everyday forms of communication may reveal as much, if not more, about what people know or experience (202) and can identify shared knowledge between members of the group.

The advantages of focus groups include:

- They do not discriminate against people who cannot read or write
- They encourage active participation from those who are reluctant to be interviewed on their own (for example, those who are intimidated by the formality and isolation of a one-to-one interview)
- They can encourage contributions from people who feel they have nothing to say.

The disadvantages of focus groups include:

- They can silence individual voices of dissent
- Confidentiality cannot be assured because of the presence of the other group members.

Consensus methods are a means of dealing with conflicting scientific evidence and are the qualitative methods' equivalent of meta-analysis (203). They aim to derive quantitative estimates via qualitative approaches and to determine the extent to which experts or lay persons agree with each other. The best known consensus method available to most researchers is the Delphi process. The Delphi process involves several rounds of data collection and interpretation. Firstly, either the team performing the Delphi or a panel of experts state their individual opinions of the subject. These opinions are formed into a questionnaire that is distributed to experts in the field. The experts rank the statements in the questionnaire. These are summarised and the process repeated, allowing experts to change their opinion in the light of the other participants' responses. Respondents whose opinion remains far from the median need not conform but may be required to justify their position. After the second ranking process the questionnaires are assessed for consensus. If adequate, the process stops; if inadequate the process is repeated. The Delphi technique has been used in development of clinical practice (205,205).

Disadvantages of consensus methods include:

- The consensus opinion does not necessarily represent the correct answer and should be matched to with observed data
- The need for several rounds of data collection can result in diminishing numbers of returned questionnaires
- The method may be weakened by poor questionnaire design, inadequate testing of reliability and validity of methods and by the means of defining and selecting the "experts".

Advantages of consensus methods include:

- Anonymity avoids domination of the consensus group by one person and allows individuals to retract their views when the consensus contradicts them
- A large group of experts can be contacted, usually by self-administered questionnaire with few geographical limitations on the sample.

2.1.3 Choice of Study Design

From the review of the study designs available, it is apparent that a case-control study design is the most appropriate for the thesis. There are several reasons for choosing the case-control design above the others:

1. A survey method is required rather than a strictly qualitative method to test the hypotheses outlined in Chapter 1. The aim of the thesis is to study the steps along the pathway from tonsillitis to tonsillectomy. The hypotheses test *what* parents and doctors think are important factors in taking these steps rather than analyse *why* they think that way.
2. An analytic survey method, rather than a descriptive survey method, is required in order to test hypotheses about factors that may influence the pathway from recurrent tonsillitis to tonsillectomy.
3. Comparison of cases and controls is required to demonstrate if children awaiting tonsillectomy have a higher frequency of tonsillitis than a control population or if movement along the pathway to tonsillectomy is primarily due to other factors.
4. Multiple factors are be to investigated, e.g. the role of socio-economic and family health factors on the decision to perform tonsillectomy.
5. Although tonsillitis does not have a long latent period, the pathway from tonsillitis to tonsillectomy has a moderately long course. Published guidelines for tonsillectomy suggest that the history of recurrent tonsillitis should be at least two years in duration.

2.1.4 Definition of the study populations

This thesis studies the pathway along which a child moves from tonsillitis to tonsillectomy. Parents, general practitioners, paediatricians and otolaryngologists may all have an input into this pathway. The study researches the views of these four groups of people. It is unknown whether parents whose children are awaiting tonsillectomy have a different knowledge of the pathway from tonsillitis to tonsillectomy than parents of children who do not have sore throats. This thesis also compares the views of these two groups of parents. Five study populations are then required for the thesis – a normal population of children, a waiting list population of children, a population of general practitioners, a population of paediatricians and a population of otolaryngologists.

A population is a group of people identified by some characteristic that they have in common. This may be their area of residence, type of residence, age, sex, occupation *etc.* (206). Desirable characteristics in a community that aims to represent the normal population include normal socio-economic group distribution, normal ethnic group distribution, a single database, a static population and motivation towards research.

In a case-control study method, careful selection of the control population is extremely important (207). The control population must be comparable to the source population of the cases. For the study presented in the thesis, the town of Frome is chosen as the site of the control population for several reasons. It is a small town situated fifteen miles south of Bath with a cross-section of modern light industry and an old rural community. Modern housing estates, more traditional market town housing and council estates are found there. In these features, it is similar to the other towns from which the case population is derived. The population of Frome is remarkably static and therefore unlikely to change much during the period of the research project. More importantly, the town has been used for several epidemiological studies in the past, including one by this Department (168,208). There are two general practice sites in the town but these represent one practice and there is one database for patient records. The general practitioners are all known to the Otolaryngology Department at the Royal United Hospital, use the hospital as their sole centre for ENT referrals and are encouraging and co-operative with research projects.

The waiting list sample is taken from the waiting list at the Royal United Hospital in Bath as this is the unit in which the research is performed. The general practitioners are selected from all general practitioners in the Bath District Health Authority area, the paediatricians are selected from the Wessex region and the otolaryngologists from the

South West region. These increasing geographical areas are required in order for adequate numbers to be recruited.

2.1.5 Sample size

An appropriate sample size is calculated using the formula

$$n = 2 \times (\text{alpha} + \text{beta})^2 \times s^2/d^2$$

where n = sample size

alpha = the chance of rejecting a null hypothesis when it is true

beta = the chance of accepting a null hypothesis when it is false

s^2 = the variance of the variable being studied and

d = the size of the effect of interest (209)

Because the number of episodes of tonsillitis per year and the variance is unknown, the results of the small pilot study were used to estimate these values. In the pilot population, the average number of tonsillitis episodes per year was 0.38 with a variance of 3.86. Choosing the size of the effect of interest (d) is difficult as there is little evidence upon which to base this estimation. The guidelines for tonsillectomy suggest 6 episodes per year to be abnormal and to require tonsillectomy. This seems to be the obvious value for d but I have shown that the studies based upon these guidelines did not show benefit from tonsillectomy and decided therefore not to use their data. Because the average number of sore throats from the pilot study was less than 1 per year, I chose an increase in the number of tonsillitis episodes per year by 3 as the value for d. Because of multiple significance testing, a p value of 0.001 is required and the conventional multiplier for this value is 3.29. For a powerful study and to compensate for any error introduced by a small value for d, a beta value of 1% was required and the conventional multiplier for this value is 2.33. Hence, sample size

$$n = 2 \times (3.29 + 2.33)^2 \times 3.86^2/3^2 = 105$$

2.1.6 Recruitment of samples

There are two methods of sampling – probability and non-probability sampling. In the first method, the chance of each member of the total population being selected is the same; in the second, the chance is unknown (210).

Methods of probability sampling are:

- Simple random sampling, in which the required number of subjects is chosen at random from a list of the entire study population
- Systematic sampling, in which, for example, every twentieth person is selected from the entire population. The starting point is chosen at random
- Stratified sampling, in which the population is divided into homogeneous groups, for example according to sex or age, and a random selection is made from each group
- Cluster sampling, in which, if the population is large and widely scattered, several small groups are chosen, for example, several general practice groups may be chosen rather than a single general practitioner from numerous practices.

Methods of non-probability sampling are:

- Volunteers
- Convenience sampling, in which the nearest individuals are chosen
- Quota sampling, in which attempts are made to choose representatives of various elements of the population, for example, age and race
- Purposive sampling, in which the researcher picks the sample on the basis of his/her own judgement
- Dimensional sampling, in which the factors of interest are identified in the population and at least one respondent with every combination of these factors is chosen

- Snowball sampling, in which the researcher identifies a small group of individuals with the features he requires and these are used as informants to identify others and these others still.

In this study, two methods of sampling are used. For the normal population, stratified sampling is performed according to one-year age bands. This method is used to ensure that the population is evenly distributed with regard to age. This is important because the incidence of tonsillitis and other sore throats varies with age in children. A stratified sample allows all ages within the age range to be adequately represented. Children on the waiting list for tonsillectomy who were in the age range 3 to 11 years were all selected. This is an example of convenience sampling. This may introduce error if parents exaggerate their answers in order to justify the child's operation or if these children are not representative of other children awaiting tonsillectomy. Convenience sampling is also used for the otolaryngologists and paediatricians because of ease of obtaining accurate lists of employees and a hope that loyalty to the region increases the response rates. The general practitioners were chosen by a combination of convenience sampling (using the practitioners in the immediate area) and simple random sampling of these general practitioners using a computer-generated random number table.

2.1.6.1 Selection of the normal (control) population

A list of all children from three to eleven years of age on 1st May 1993 (the chosen start date of the study) was extracted from the computerised general practice list at the Frome Medical Practice. This list was sub-divided into eight one year age bands so that children born between 1/5/1982 and 30/4/1983 were on one list, those born between 1/5/1983 and 30/4/1984 on another *etc.* up to 30/4/1990. This provided eight lists. Males and females were mixed in the same list. Each child in the eight sub-groups was given a number ranging from 000 to x where x was the last child in the list. A random number table was used to select 100 children from each list. The numbers on the random number lists were used in different directions (horizontally, vertically, forwards and backwards) to prevent use of the same number pattern in each of the patient lists.

There were 2,918 children in this age range on the practice list at Frome at the time of sampling. Eight hundred represents 27.42% of the available population. The age range was chosen because, at three, most children are able to state that they have a sore throat and, at eleven, they leave primary school and move into a wider environment, for example, attending school in another town which necessitates mixing with children from a much wider area. The peak incidence of sore throats and tonsillitis in children occurs between these ages (211).

Exclusions from the study

No children were excluded. In particular, I decided not to exclude those children who had previously undergone tonsillectomy as the study was designed to look at a "normal" population and some children who have undergone tonsillectomy are a feature of such a population. Similarly, when more than one sibling was selected from the Frome population, no alteration was made to the sample as siblings are a feature of a normal population.

Sampling bias

The general practice patient list at Frome probably does not include all children living in the town as some may be registered with another practice. Families recently moved into the area may not yet have registered with the practice and families moving away may not yet have removed their names from the patient list. Some families will not be registered with any general practice for other reasons.

As previous studies have shown differences in tonsillectomy rate by sex and social class (4,212), an attempt was made to ensure equal sex and social class distribution by taking a large sample.

Another questionnaire study was undertaken in Frome by the ENT department of the Royal United Hospital in 1991-1992 (168). Three hundred and twenty-eight families received a questionnaire about sleep quality in their children. No effort was made to exclude these children from the study population and, by chance, 44 children were included in both studies. This represents 5.5% of the subjects in this study and is judged not to be a large enough number to have a significant effect on either the response rates or the quality of data received from the questionnaires.

Some non-responders are to be expected especially in a questionnaire study of a normal population. It may be that more parents whose children have problems with sore throats might return the questionnaire hence introducing bias into the data. Steps taken to increase the response rate are described later along with steps taken to determine whether non-responders were likely to represent a separate population.

2.1.6.2 Selection of the waiting list (case) group

All children aged between three and eleven years on 1st May 1993 whose names were on the waiting list for tonsillectomy, with or without other ENT procedures such as adenoidectomy or grommet insertion, at the Royal United Hospital, Bath were selected to from the Waiting List population. One hundred and thirty children were selected by this method. The number was increased by incorporating into the group children whose names were added to the waiting list from the out-patient department over a period of six months. Questionnaires were available in the out-patient department of all hospitals covered by the Royal United Hospital and where ENT patients are referred. I relied upon the nursing staff in these clinics to give the questionnaire to parents of children whose names were added to the waiting list for tonsillectomy. A further 44 children were recruited.

Sampling bias

The main source of bias is that this group is that the children may have travelled a different path to reach the waiting list. There are three areas where these children may be different from one another.

- Surgeons of different grade or of different experience may have different reasons for recommending surgery.
- A small percentage of the children on the waiting list for tonsillectomy are there because of obstructive sleep apnoea rather than recurrent sore throats.
- The children making up the waiting list group come from a much broader geographical area than the Frome population. The Royal United Hospital provides care for Bath, Bradford on Avon, Chippenham, Calne, Devizes, Frome, Malmesbury, Melksham, Midsomer Norton, Radstock, Shepton Mallet, Trowbridge, Warminster and Westbury. These children and their parents will have received primary care from general practitioners other than those in the Frome practice. The exposure to different doctors may have resulted in the parents having a different understanding of sore throats and the indications for tonsillectomy.

Not all the children whose names were added to the waiting list during the recruitment phase may have been included in the group.

No attempt was made to match the Waiting List population with the Normal population in terms of sex or social class distribution because both of these factors were part of the investigation. Any difference between the Normal and Waiting List populations in terms of sex or social class distribution would be missed if the populations were matched.

2.1.6.3 Overlap of normal and waiting list populations

Children from Frome who were awaiting tonsillectomy were not excluded from the Normal population and it is possible therefore that some children could have been selected for both study groups. In reality, there were 15 children from Frome in the Waiting List population and none of these were selected to be in the Normal population. Therefore there is no overlap between the populations and consequently no bias because of overlap.

2.1.6.4 Selection of the doctor populations

- **Selection of the general practitioners**

A computer print-out of the names and practice addresses of all 562 General Practitioners in the Bath District Health Authority was obtained. The list is arranged alphabetically and each General Practitioner was given a number from 000 to 561 serially according to his/her position on the list. Random numbers were then used to select 100 names. One hundred was chosen as a representative sample (17.8%) broadly similar to the size of the paediatrician and otolaryngologist groups (see below).

All the general practitioners in the Frome practice were also selected to complete a questionnaire. Because of the previous study performed in Frome by the ENT Department at the Royal United Hospital Bath, it is possible that the general practitioners there have a different view on tonsillitis and sore throats to that of the wider general practice population in the Bath District Health Authority. If this were the case, the general practitioners could have taught this view to the parents and children in Frome who could not then be regarded as a normal population.

➢ **Selection of the paediatricians**

Eight-seven paediatricians of consultant, senior registrar and registrar grades working in the Wessex Regional Health Authority area were selected.

➢ **Selection of the otolaryngologists**

Sixty-four otolaryngologists of consultant, senior registrar and registrar grades working in the South West Regional Health Authority area were selected.

2.2 Data Collection

2.2.1 Choice of questionnaire as research vehicle

Data collection in a survey usually involves one or more of the following methods:

- Structured or semi-structured interviews
- Self-completion or postal questionnaires
- Standardised tests of attainment or performance (210).

The choice depends largely on the population to be studied, the research questions and the resources available for the study. In this study, the populations under examination cover a wide geographical area with the otolaryngologist group stretching from Bath to Plymouth. The normal population is confined to a small geographical area but is large in size. For these reasons, a self-completion questionnaire was chosen as the research vehicle.

One advantage of the self-completion questionnaire is that there is no risk of intra- or inter-observer error. Consequently, with self-completion questionnaires, the answers are not biased by the opinion or attitude of the researcher, other than inherently in the questionnaire design.

The main disadvantage of the self-completion questionnaire is that respondents may misinterpret the questions or give the reply that they think is wanted rather than express their true opinion. The variation is almost always random across subjects. On average, random errors cancel out so, provided the sample sizes are large enough and the size of the error small enough, this type of error does not usually result in significant bias (206). Bias is also introduced by non-responders, who can represent a different subset of the population, and by error when the questionnaire data are entered onto a computer spreadsheet.

2.2.2 Questionnaire design

A questionnaire may be specific or generic depending upon whether it has been designed for use with one disease only or for use across several or all diseases. The advantage of a disease specific questionnaire is that it can detect smaller changes in behaviour related to the disease that it measures. This is particularly important for relatively mild illnesses such as tonsillitis where generic measures may not be sensitive enough to detect small changes in behaviour (213). To date, no specific questionnaire has been designed and tested for use in children with recurrent tonsillitis that will measure quality of life in both a normal and affected population. The Glasgow Benefit Inventory (214) has proved useful in assessing patient benefit after otorhinolaryngological interventions, including tonsillectomy, but does not measure the effect of recurrent tonsillitis on quality of life. Several generic questionnaires have been designed to measure the impact of sickness on quality of life or behaviour in adults (215). Of these, the most appropriate are the Sickness Impact Profile, the Nottingham Health Profile and the McMaster Health Index.

The Sickness Impact Profile was developed as a measure of perceived health status. It can be used to evaluate health care across a wide range of health problems and diseases and across demographic and cultural boundaries. Sickness is measured by its impact on behaviour. The questionnaire was designed to be sensitive to changes in health status associated with minor morbidity. It concentrates on assessing the impact of sickness on daily activities and behaviour and can be used in chronically or acutely ill patients. It has been well tested for validity and reliability. Its limitations are that it must be completed via an interview technique, it can only be used with people who are regarded as ill or who regard themselves as ill and it has not been designed or validated for use in children.

The Nottingham Health Profile was developed in the United Kingdom and is based on lay perceptions of health status. It is not an index of disease, illness or disability but relates to how people feel when they are experiencing illness. It can be used to assess whether people have a health problem but does not diagnose the kind of health problem. It is too short to assess the impact of a condition upon the quality of life. It can be administered as a self-completion questionnaire and has been well tested for validity in adults and partially tested for repeatability. It has not been validated for use in children.

The McMaster Health Index Questionnaire is a measure of physical, social and emotional functioning. It was produced as a vehicle to predict a health professional's clinical assessment of a person's health. It includes positive as well as negative discriminators of health. More studies of reliability and validity are required and it has not been validated for use in children.

To date, no questionnaire has been validated to compare the opinions of different health care professionals about the diagnosis or management of any illness.

As the aim of the thesis is to explore new areas for which there are no suitably validated questionnaires, it has been necessary to design new questionnaires for the study. The questionnaires were designed with the assistance of Dr. Michael Whitfield from the Department of Social Medicine, Bristol University and Dr. Tony Robinson from the Department of Statistics, University of Bath. Input from these sources was sought because of the expertise of social medicine in collecting and interpreting data from the general public and the need for the questionnaires to be designed in such a way that statistical analysis could be performed on the data collected. Copies of the questionnaires are in Appendix 1. The layout of the questionnaire and instructions to respondents were designed according to the suggestions in Chapter 4 of Cohen and Mannion (210).

The questions were designed using a combination of clinical experience, theoretical knowledge about questionnaires and a certain amount of conjecture. Symptoms reported by parents in the outpatient clinic were incorporated along with those from textbooks and the literature. Two questions were repeated from the previous study undertaken in the department (168). Use of other authors' questions has the advantage that the questions will have undergone some prior testing and will presumably have shown themselves to be useful. The disadvantage is that errors in the questions are automatically reproduced (213). In the doctor questionnaire, some wording of questions was altered after the pilot study.

Questions may be open-ended or closed. Open-ended questions allow the respondent to reply in his/her own words and thus give the respondent the opportunity to answer more fully. Thus, data collection is more extensive with open questions than with closed questions but problems can arise in interpreting the responses and in coding them for analysis. Closed questions are answered by choosing from a number of fixed alternative responses. Closed questions make for greater uniformity and easier analysis (195) and because of this were used in both the parental and doctor questionnaires.

There are several ways in which answers to closed questions can be recorded in a questionnaire. These are known as "scales of measurement". A scale may be nominal or ordinal.

- A nominal scale consists of named items such as occupation, marital status and religion. Such items are independent of one other.
- An ordinal scale consists of items that fall into a natural order and which are related to one another. Examples include social class groupings, the Likert scale (216,217) and adjectival scales where the categories may include "never", "rarely", "sometimes" and "often".

Two forms of ordinal scale are recognised, interval and non-interval. In an interval scale, the distance between the items is constant and parametric forms of analysis can be used. Social class groupings are an example of an interval ordinal scale. In a non-interval scale, the distance between the items is not constant and non-parametric analysis must be used. Examples of non-interval ordinal scales include the Likert scale and adjectival scales.

The optimum number of items in a scale is between 5 and 7 (213,215). Below five, there is loss of reliability; above seven, there is loss of ability to discriminate between the points.

An adjectival scale was used in the parental questionnaire to allow description of the symptoms occurring when children have a sore throat or tonsillitis or to describe the child's sleep. Error can arise with adjectival scales if the adjective does not convey the same meaning to every respondent and it has been assumed that any such error will be random because of the large size of the populations.

In the doctor questionnaires, the aim was to uncover a diagnosis of tonsillitis, the indications for tonsillectomy and the expected benefits of tonsillectomy. Respondents were offered a list of possible answers and asked to choose the most appropriate answers in decreasing importance. To overcome any bias in the replies due to the order of the lists, the lists were randomised using a random number table. Three random orders were produced for each list of features. One third of each study population received each version of the randomised lists in the questionnaire. This allowed each list to act as its own control with regard to the frequency of item selection in relation to its position in the list.

2.2.2.1 Problems with questionnaire design

Bias

Questionnaire bias may arise in one of three ways: design, application and response. Design bias arises if questions are ambiguous or are loaded towards a particular response. Errors in application arise if a questionnaire is used for a purpose for which it was not designed and has not been validated. Several types of response bias have been identified in questionnaire studies (213):

- Social desirability – an unconscious attempt by the respondent to "put the best foot forward"
- Faking good – a deliberate attempt to look good
- Deviation – the opposite of social desirability, an unconscious bias, may be an attempt to be accepted for treatment
- Faking bad – a deliberate attempt to look bad
- Yea-saying or acquiescence – a tendency to give positive answers such as yes, true, often
- Central tendency - a tendency to avoid the extremes of a scale
- Positive skew – a tendency to use the top end of a scale
- Halo effect – making judgements on an individual aspect of a person's performance based on an overall impression of the person
- Framing – the answer is influenced by the way in which the question is worded or by the preceding question.

Attempts were made to overcome these sources of bias through the design of the questionnaire and the information given to respondents (213). For example, anonymity reduces any perceived gain to the respondent by faking good or faking bad. Answers with yes/no answers can result in acquiescence and so were avoided. Central tendency is less marked with adjectival scales than with the Likert scale but positive skew may be more common. To overcome positive skew, decoy questions, which were expected to have a negative answer, were included.

Validity

The most reliable results from a questionnaire study are obtained when the questionnaire has been validated for the purpose of that study (213). For this study, no validated questionnaire was available that was suitable for the questions being researched. To estimate the impact upon this study of using a non-validated questionnaire, it is first necessary to consider how validity is attained, why the questionnaire was not validated before use and what attempts were made to compensate for the lack of validation.

Questionnaire validity is the extent to which the questionnaire measures what it purports to measure. It is a complex issue, conventionally portrayed by at least one of several statistics (215).

Validation forms part of the development phase of questionnaire design and data from both clinical and general population samples are required. A combination of several conventional statistics, including content validity, criterion validity, concurrent validity and construct validity is applied before the questionnaire is regarded as "validated".

- Content validity – extent to which the scale covers all relevant aspects of the attribute to be measured. This judgement is usually made by experts who decide whether the scale appears appropriate for the intended purpose.

- Criterion validity – the extent to which the variable can be measured with accuracy. This usually involves correlation of the scale with another measure of the attribute under study, ideally a "gold standard".

- Concurrent validity – the extent to which the measure is positively associated with an established measure of the same construct (convergent) or is negatively associated with measures of different constructs (divergent). This is dependent upon the existent of a gold standard measure. An example is the correlation between the parental definition of tonsillitis with a textbook definition of tonsillitis and a textbook definition of the common cold. It might be expected that a positive or convergent correlation would be found with the former and a negative or divergent correlation with the latter. Both measures are given at the same time. Concurrent validity is a subset of criterion validity.

- Construct validity - the extent to which the measure confirms *a priori* hypotheses. This test of validity is most relevant to more abstract areas of investigation such as psychology and sociology where the variable of interest cannot be directly measured. Hypothetical constructs or theories are proposed to explain behaviours or attitudes and these theories are tested during tests of construct validity. There is no one single study that can satisfy the criteria for establishing construct validity – it is an ongoing process.

Attempts were made to establish content validity by seeking the opinion of the consultant otolaryngological staff at the Royal United Hospital, Bath during development of the questionnaires. The consultant otolaryngologists can be regarded as experts in the field.

Concurrent validity can be partially established by comparing the questionnaire results of the diagnostic features of tonsillitis and other sore throats with those already written in standard textbooks. As the Introduction chapter in the thesis has shown that such written diagnoses are not always accurate, concurrent validity cannot be established with certainty.

Reliability

Reliability is usually a pre-requisite of validity. A scale is judged to be reliable when it consistently produces the same results. There are several methods of testing reliability.

- Multiple form reliability – measures the result of one scale against another. This assumes that there is another questionnaire relating to the same area of research against which a newly designed questionnaire can be tested.

- Internal consistency – measures the extent to which the items that cover the same area give the same answer. There is usually some overlap in the area covered by questions in a questionnaire. Internal consistency is tested by comparison of the answers to questions covering the same area. Comparison should take place between questions in the scale and between different halves of the scale.

- Test-retest reliability –measures consistency over time.

Reliability is also influenced by the length of the questionnaire. If the questionnaire is too long, errors may arise through boredom on the part of the respondent; if it is too short, the proportion of random error is high.

From the above discussion, it is obvious that validation is neither quick nor simple but validation does allow for more accurate interpretation of the data collected. The process of validation of some of the better-known health measurement scales, such as the Sickness Impact Profile and the Nottingham Health Profile, has taken up to ten years. Even after this time, the process in still ongoing (215). During the process of validation, a questionnaire needs to be tested in populations similar to those to which it is later to be applied. In the absence of a previously validated questionnaire, I believe I have produced questionnaires that have undergone the first steps towards validation. The process can subsequently be completed with further use and refinement of the questionnaires.

2.2.2.2 Piloting

The parent questionnaire was piloted amongst hospital staff with children aged between 3 and 11 years and at a general paediatric out-patient clinic. A paediatric clinic was used in preference to an ENT clinic as it was thought that the parents at a paediatric clinic would not have given as much consideration to throat symptoms in the recent past as parents of children attending an ENT clinic. These parents and their children would therefore resemble a normal population more closely. Other researchers have used children from a different out-patient department to act as normal controls (218). Parents taking part in the piloting exercise were asked to record how long it took them to complete the questionnaire so this information could be relayed to the parents taking part in the actual study.

The questionnaire aimed at general practitioners and paediatricians was piloted in a teaching session for trainee general practitioners in the ENT department at the Royal United Hospital.

2.2.3 Ethical approval

Ethical approval was sought from and granted by the Bath District Research Ethics Committee.

2.2.4 Measures to Increase Response Rates

Research has shown that covering letters, endorsement by a respected authority and a stamped addressed envelope all help increase response rates (213,219). Covering letters were sent with all questionnaires together with stamped addressed envelopes. A second letter from the Health Centre signed by one of the partners was included with questionnaires sent to the parents of the Normal population. The letters explained the nature of the study and promised confidentiality to the respondents. A copy of the letters can be found in Appendix 2. The covering letters had the recipient's name written at the top and were all hand-signed. The letters were printed on either University of Bath or Frome Health Centre headed paper. A stamped addressed envelope was enclosed.

Two postings were undertaken two months apart. When all the returns were counted, the response rates were 71% for the general practitioners, 67.8% for the paediatricians, 65.6% for the otolaryngologists and 75% for the parents. These response rates compared favourably with those from other postal questionnaire studies - Walker (61) reported a 77.6% response rate, Tucker (182) 66.7% and the Scottish Tonsillectomy Audit (88) 42%. A third mailing was undertaken for the parent questionnaire and increased the response rate to 82.5%.

2.2.5 Non-responders

Some authors recommend sampling the non-responders and visiting them at home to complete the questionnaire and make sure that they are not a separate population from the remainder of the group (206,213). This was not done in this study and represents a weakness and potential source of error.

For the normal population, the responses of those parents who replied to the third posting of the questionnaire were compared to the responses of those who had answered an earlier posting. The results of this comparison are shown in Appendix 7 and demonstrate that the late respondents are not a separate group from the others. As a result, the non-responders are less likely to represent a separate group to those who responded.

2.3 Data Analysis

2.3.1 Allocation to social class

Families were allotted to a social class according to the father's occupation in keeping with the Classification of Occupations 1980 (220). If the father was out of work, not living at home or the mother's occupation ranked higher, the mother's occupation was used. Where the father stated he was "self-employed" but gave no occupation, the family was placed in social class II, in accordance with the instruction given by the Classification of Occupations handbook. This method may have lead to a higher number of families being included in Social Class II. Where the father was unemployed and the mother gave no occupation, the family was classed as "economically inactive".

Some errors will have arisen as occupations stated did not always fit directly into the classification and a degree of "best guess" had to be applied.

2.3.2 Tests used in analysis

The tests used in analysis of the data were

- Salpiro-Wilk test for normality
- Chi-squared test
- Bonferroni correction
- Confidence intervals
- Student's t-test
- Mann Whitney U test
- Spearman's rank correlation test
- Cluster analysis
- Kruskal-Wallis test
- Simple linear regression
- Multiple linear regression

These tests, with the exception of cluster analysis are all in common usage and are therefore not described in detail here. A full description of each of these tests can be found in Appendix 3. Cluster analysis is described below as it is not a commonly used statistic.

Cluster analysis

Cluster analysis is a method of studying how features are related to one another. In relation to question 4 of the parental questionnaire, clustering allows a demonstration of which features on the list are identified together as important features of a sore throat illness. The statistic uses the individual answer of each parent, places them on a correlation matrix (in this case Spearman's rank correlation statistic), compares them on a "similarity matrix" and gathers the features into groups (or clusters) that are related, *i.e.* which have been answered together. The results are displayed on a "tree diagram" or "dendrogram" on which closely related features are placed in close proximity on the same "branch" and non-related features are on different "branches".

The Spearman's rank correlation statistic forms the correlation matrix using the following formula:

$$\rho_{i,j} = 1 - \frac{6}{m^3 - m} \sum_{K=1}^{m} (r_k - s_k)^2 \qquad \textit{for all } i,j = 1 \ldots n$$

where n is the number of features (*i.e.* 23)

m is the number of individuals (*i.e.* 631)

r_k, s_k are the individuals' answers to the two features (with "never", "sometimes",... given as 0,1,... *etc.*)

The correlation matrix is changed into a similarity matrix using the transformation:

$$x_{i,j} = (1 - x_{i,j}) / 2 \qquad \textit{for all } i,j = 1 \ldots n$$

Several different techniques are available for cluster analysis. Two of these were used and the results agreed with those shown later.

This chapter has outlined the methods used to test the hypotheses generated in Chapter. The results of the analysis will be shown in the following chapters.

3 RESULTS

This chapter presents the results of analysis of the questionnaire data, starting with the parental questionnaire results and following with the doctors' questionnaire results.

Results of Parental Questionnaire

This section gives the results of analysis of the parental questionnaire data. The response rates are presented first for both the Normal and Waiting List populations (section 3.1), followed by the demographic comparison of the study populations (section 3.2), a general description and comparison of sore throat illnesses in the study populations (section 3.4) and finally the results of testing the hypotheses derived in the Introduction chapter sections 3.5 to 3.9).

3.1 Response Rates

3.1.1 Normal population

The parents or guardians of 800 randomly selected children were invited to participate in the study and a questionnaire was posted to them. A reminder was sent to the non-responders after two months. After a further two months, another reminder was sent to those who had still not responded along with a single sheet questionnaire asking parents why they had chosen not to participate in the study. After three mailings of the questionnaire, 631 completed forms had been received (78.9%).

3.1.2 Waiting list population

The parents or guardians of 130 children awaiting tonsillectomy, with or without adenoidectomy and grommet insertion, at the Royal United Hospital, Bath were invited to participate in the study and received a questionnaire. A reminder was sent to the non-responders after two months. After two mailings, 101 questionnaires had been returned completed (77.7%). Two questionnaires were returned unanswered, one because the child had already undergone tonsillectomy and the other for no stated reason.

A further 44 children were included in the study as they were added to the waiting list during the time scale of the study. Analysis of the data from these children was similar to the data from the children who were already on the waiting list when selected. The two groups were combined and the term "waiting list" refers to this combined group hereafter.

3.1.3 Non-responders

Information was available on 32 children whose parents had not completed the questionnaire but who returned the single sheet. This information is summarised in table 3.1.

Table 3.1 Reasons for not returning questionnaire. Information on 32 children.

Reason for not replying	Number giving reason
Family no longer at address	17
Child never has a sore throat / tonsillitis	4
No time	4
Child fostered/adopted	3
Questionnaire too long	4
Parents objected to inclusion in study	1
Single sheet returned unanswered	1

Three parents gave two reasons for not returning the questionnaire.

3.2 Demographic data for the Normal and Waiting List Populations

Demographic data is shown to illustrate that the Normal and Waiting List populations are similar in respect to age, sex and social class distribution and that they are suitable for comparison in a case-control study.

3.2.1 Age and sex distribution

The age and sex distribution of the children in the Normal and Waiting List populations are shown in tables 3.2 and 3.3. Chi-squared testing shows that the populations are similar in respect to both age and sex distribution.

Table 3.2 Age distribution of Normal and Waiting list populations

Age (yrs)	Normal		Waiting list	
	No.	%	No.	%
3	76	12.04	21	14.79
4	75	12.88	19	13.38
5	88	13.95	23	16.20
6	75	11.88	21	14.79
7	80	12.68	18	12.68
8	78	12.36	14	9.86
9	81	12.83	11	7.75
10	78	12.36	15	10.56
Total	631	100.00	142	100.00

Chi-squared = 5.55, p = 0.59, degrees of freedom = 7.

Table 3.3 Sex distribution of Normal and Waiting list populations

Sex	Normal		Waiting list	
	No.	%	No.	%
Male	314	49.76	63	44.37
Female	317	50.24	79	55.63
Total	631	100	142	100

Chi-squared = 1.35, p = 0.25, degrees of freedom = 1.

3.2.2 Social class distribution

The social class distribution of the Normal and Waiting list populations are shown in table 3.4. Chi-squared testing shows that the populations are similar in terms of social class distribution.

Table 3.4 Social Class distribution of the Normal and Waiting List populations

Population	Social Class					
	1	2	3	4	5	Others
Normal Population	59	200	189	55	38	90
Waiting List Population	6	39	54	11	7	10

Chi-squared = 2.66, p = 0.13, degrees of freedom = 4

3.2.3 Summary of demographic data

The Normal and Waiting List populations are similar in terms of age, sex and social class distribution.

3.3 Comparison of the Number of Sore Throats between the Normal and Waiting List populations

The differences in the number of sore throats and episodes of tonsillitis reported by parents in the Normal and Waiting List populations are shown in table 3.5. The Waiting List population has a significantly higher incidence of sore throats and tonsillitis than the Normal population. This is interpreted as due to the higher incidence of tonsillitis in the Waiting List population. If the number of episodes of tonsillitis is subtracted from the total number of sore throats, the Normal population has 1.06 sore throats that are not tonsillitis compared with 0.83 in the Waiting List population. Sore throats last longer in the Waiting List population but both populations experience the first sore throat at a similar age.

Table 3.5 Comparison of number of sore throats, age at first sore throat, duration of sore throat illnesses and number of episodes of tonsillitis as reported by parents.

	Normal group	Waiting list group	U value	p value
Ave. no. sore throats / year	1.39	7.53	78910	**<0.001**
Age at first sore throat (y)	3.01	2.90	12737	0.15
Ave. duration of sore throats (d)	3.50	5.82	34065.5	**<0.001**
Ave. no. tonsillitis / year	0.33	6.70	30970	**<0.001**

Significant results are shown in **bold**.

Figure 3.1 shows the frequency of sore throats according to age for the Normal and Waiting List populations. In all age groups, the Waiting List population has many more sore throats than the Normal population. The frequency of sore throats in the Normal population remains relatively static from three to eleven years of age whereas, for the Waiting List children, the frequency of sore throats is maximal at the age of eight and nine years.

Figure 3.1


Average Number Sore Throats per Year according to Age
Average Number of Sore Throats per Year
10
9
8
7
6
5
4
3
2
1
0
3
4
5
6
7
8
9
10
Age (years)
Normal
Waiting List

3.4 Parental Definition of Tonsillitis

Hypothesis 1 Tonsillitis, as perceived by parents, does not represent a distinct clinical picture when compared with other sore throats.

3.4.1 Symptom and sign association with sore throats and tonsillitis

In order to test hypothesis 1, I studied the clinical features that parents associate with sore throats, comparing those thought to be associated with tonsillitis with those thought to be associated with sore throats that are not tonsillitis. The data were collected using question 4 of the questionnaire that asked:

"When your child has a sore throat, which of the following happen at the same time?

A list of randomly arranged symptoms and signs followed and is shown in the questionnaire in Appendix 1. The list included features such as raised temperature, difficulty swallowing and earache that might be associated with tonsillitis and also blocked nose, mouth breathing and snoring that might be more associated with upper respiratory tract infection. Parents were asked to answer whether each feature in the list happened "never", "sometimes", "often", or "always" with a sore throat or only if they thought the sore throat was due to tonsillitis.

Children who never have a sore throat were excluded. The answers of 56.44% (346) of the Normal population and 96.35% (132) of the Waiting List population were analysed. The raw data are shown in Appendix 4.

Four forms of analysis were performed:

- The orders in which the features were ranked from most common to least common were compared for sore throats thought to be tonsillitis and sore throats thought not to be tonsillitis using Spearman's rank correlation test (section 3.4.1.1)

- The frequency with which each symptom is reported by the Normal and Waiting List populations was compared using the Chi-squared test (section 3.4.1.2)
- The Normal and Waiting List populations were compared to see if each population associates the same features with sore throats thought to be tonsillitis and those thought not to be tonsillitis. Spearman's rank correlation test was used for this analysis (section 3.4.1.3)
- Cluster analysis was performed to show which features are most closely associated with one another and form a "clinical picture" (section 3.4.1.4).

3.4.1.1 Comparison of features that occur "Only if Tonsillitis" with those that occur "Often and Always" with other sore throats

Tables 3.6 and 3.7 show the symptoms that were most frequently answered "only if tonsillitis" and "often and always" by the Normal and Waiting List populations. The tables also show the percentage of each population that made the response for each feature, the percentage difference between the Normal and Waiting List populations and the 95% confidence interval related to the difference.

The features shown in table 3.6 are those most commonly answered "only if tonsillitis" by the Waiting List population. They are shown in decreasing frequency with pain on swallowing being the feature most commonly associated with tonsillitis and headache being the eighth most commonly associated feature with tonsillitis.

The features shown in table 3.7 are those most commonly answered "often and always" by the Waiting List population. They are shown in decreasing frequency with mouth breathing being the feature most commonly associated with sore throats that are not tonsillitis and poor appetite being the eighth most commonly associated feature.

Table 3.6 Symptoms that occur "only if tonsillitis"

	Normal population (%)	Waiting List population (%)	% difference	95% confidence interval
Pain on swallowing	14.8	41.8	27.0	20.0 to 34.1
Raised temperature	12.1	38.8	26.7	20.1 to 33.3
Sleeps poorly	5.5	34.9	29.4	24.0 to 34.6
Poor appetite	7.9	31.3	23.4	17.7 to 29.2
Bad breath	6.8	29.6	22.8	17.2 to 28.2
Sick / vomiting	6.6	25.6	19.0	13.6 to 24.3
Earache	3.6	24.8	21.2	16.6 to 25.8
Headache	4.3	22.8	18.5	13.9 to 23.2

Table 3.7 Symptoms that occur "sometimes and often" with a sore throat

	Normal population (%)	Waiting List population (%)	% difference	95% confidence interval
Mouth breathing	30.1	61.5	31.4	23.0 to 40.0
Snoring	24.8	56.9	32.1	23.9 to 40.2
Noisy breathing	17.3	51.2	33.9	26.5 to 41.3
Raised temperature	23.9	41.8	17.9	9.8 to 25.9
Eats slowly/noisily	15.0	41.5	26.5	9.4 to 33.5
Blocked nose	30.8	41.3	10.5	1.8 to 19.0
Cough	30.0	41.2	11.2	2.7 to 19.8
Poor appetite	28.9	41.0	12.1	3.7 to 20.6

In both tables, simple inspection shows that the Waiting List have reported the features more commonly as supported by the % difference and the 95% confidence intervals.

Tables 3.6 and 3.7 illustrate that the symptoms that parents think occur only if a sore throat is due to tonsillitis are different to those that occur with other sore throats that may not be due to tonsillitis. In order to determine whether the symptoms that occur with tonsillitis are significantly different to those that occur when a sore throat is not tonsillitis, Spearman's rank correlation testing was performed. The test compares the order in which the features are ranked for each of the responses "Only if Tonsillitis" and "Often and Always". The comparison was made for the Normal and Waiting List populations separately and the results are shown in the box.

For the Normal population, $r = 0.46$, $p = 0.03$.
For the Waiting List population, $r = 0.35$, $p = 0.1$.

The Bonferroni corrected p value is 0.0125 so neither of these results reaches significance. Thus, the answers chosen by both the Normal and Waiting List populations as occurring "only if tonsillitis" are different to the answers chosen to represent sore throats that may not be tonsillitis and that occur "often and always".

The features that occur most commonly with a sore throat that parents think is tonsillitis are:

- Pain on swallowing
- Raised temperature
- Poor sleep
- Poor appetite
- Bad breath
- Sickness or vomiting
- Earache
- Headache

The features that occur "often and always" with a sore throat that parents do not specifically think is tonsillitis are:

- Mouth breathing
- Snoring
- Noisy breathing
- Raised temperature
- Eating slowly or noisily
- Blocked nose
- Cough
- Poor appetite

3.4.1.2 Chi-squared testing

Tables 3.6 and 3.7 showed that the Waiting List populations reported symptoms with a sore throat much more frequently than the Normal population. Further analysis of the difference between the frequencies with which the symptoms were reported was performed by comparing the features shown in tables 3.6 and 3.7 by Chi-squared testing. The results are shown in table 3.8. The difference between the Normal and Waiting List populations is significant for all features except "eats slowly/noisily". The Waiting List population appear to have symptoms related to sore throats more frequently than do the Normal population.

Table 3.8 Results of Chi-squared tests between the Normal and Waiting List populations

Symptom	p-value
Pain on swallowing	**<0.0001**
Raised temperature	**<0.0001**
Sleeps poorly	**<0.0001**
Poor appetite	**<0.0001**
Bad breath	**<0.0001**
Sick / vomiting	**<0.0001**
Earache	**<0.0001**
Headache	**<0.0001**
Snoring	**<0.0001**
Mouth breathing	**<0.0001**
Noisy breathing	**0.0002**
Eats slowly / noisily	0.0051
Blocked nose	**<0.0001**
Cough	**0.0008**

Bonferroni corrected p value = 0.002.

Thus, the Waiting List population have additional symptoms other than a painful throat more frequently than the Normal population. This suggests that they have a different pattern of illness.

3.4.1.3 Comparison of Answers given by Normal population with those of the Waiting List population

Section 3.4.1.1 showed that both the Normal and Waiting List populations associated different symptoms with sore throats thought to be tonsillitis and sore throats thought not to be tonsillitis. It is not known whether the Normal and Waiting List populations associate the same symptoms with each of these sore throat illnesses. Spearman's rank correlation test was used to compare the ranking of the answers to question 4 of the questionnaire given by the Normal population with that given by the Waiting List population. The comparison was made for each answer "only if tonsillitis" and "often and always" and the results are shown in the box.

"Only if tonsillitis", $r = 0.90$, $\mathbf{p < 0.0001}$
"Often and always", $r = 0.81$, $\mathbf{p < 0.0001}$

Both results are highly significant showing that both the Normal and Waiting List populations ranked the answers for "only if tonsillitis" and for "often and always" in a similar manner. Thus, both populations recognise the same clinical patterns of tonsillitis and other sore throats.

3.4.1.4 Cluster analysis

Cluster analysis is a visual method of presenting relationships between features – see section 2.3.2 for details, page 85. Cluster analysis divides the list of features from Question 4 into distinct groups that have been answered in the same way and which are associated together. Cluster analysis was performed to confirm or refute the symptom complexes that were shown in section 3.4.1.1.

The results of the clustering method on the parents' answers to Question 4 are shown in figures 3.2 and 3.3.

Figure 3.2, relating to the Waiting List population, illustrates that the features identified above as being associated with tonsillitis (pain on swallowing, raised temperature, poor sleep, poor appetite, bad breath, sickness or vomiting and tummy ache) are closely related to one another. They have been highlighted in red on the branched diagram (dendrogram) and are clustered together on one branch where no other features are to be found. The length of the horizontal lines illustrates how close or distant items are so pain on swallowing and poor appetite are closest together followed by poor sleep. Sickness and tummy ache are connected to the other features in the cluster but are not as closely related.

It is also seen that the symptoms "cough", "mouth breathing", "snoring", "noisy breathing", "blocked nose" and "runny nose" have all been grouped together. These are the symptoms that were identified above as being associated with sore throats that are not tonsillitis.

Cluster analysis therefore provides further evidence that parents are good at recognising and differentiating between different clinical patterns in relation to sore throats.

Figure 3.3, which illustrates the answers given by the Normal population, does not show the clinical patterns of tonsillitis and other sore throats as clearly as figure 3.2. The eight highlighted features that represent tonsillitis are more widely spread throughout the diagram although "pain on swallowing", "poor appetite" and "raised temperature", the top three symptoms of tonsillitis, are clustered together and are quite separate from the others. There is no clustering of the symptoms associated with other sore throats ("cough", "mouth breathing", "snoring", "noisy breathing", "blocked nose" and "runny nose").

The dendrograms show that the data from the Waiting List population produce a recognisable cluster of symptoms that can be identified as "tonsillitis" and "upper respiratory tract infection". The Normal population reflect the same picture although not as strongly. Hence, this method of data analysis confirms the previous findings that the features pain on swallowing, raised temperature, poor sleep, poor appetite, bad breath and sickness or vomiting (which can be recognised as tonsillitis) represent a distinct clinical picture compared with the features mouth breathing, snoring, noisy breathing, blocked nose, runny nose and cough (which can be recognised as upper respiratory tract infection).

3.4.1.5 Summary

Parents recognise different patterns of sore throat illnesses. Sore throats that they call "tonsillitis" are associated with pain on swallowing, raised temperature, poor sleep, poor appetite, bad breath and sickness or vomiting. Sore throats that they do not call "tonsillitis" are associated with mouth breathing, snoring, noisy breathing, raised temperature, eating slowly or noisily, blocked nose, cough and poor appetite. Parents from both the Normal and Waiting List populations make the same associations. As a result of the investigations outlined above, hypothesis 1 is rejected.

Figure 3.2

Cluster analysis dendrogram for Waiting List Population

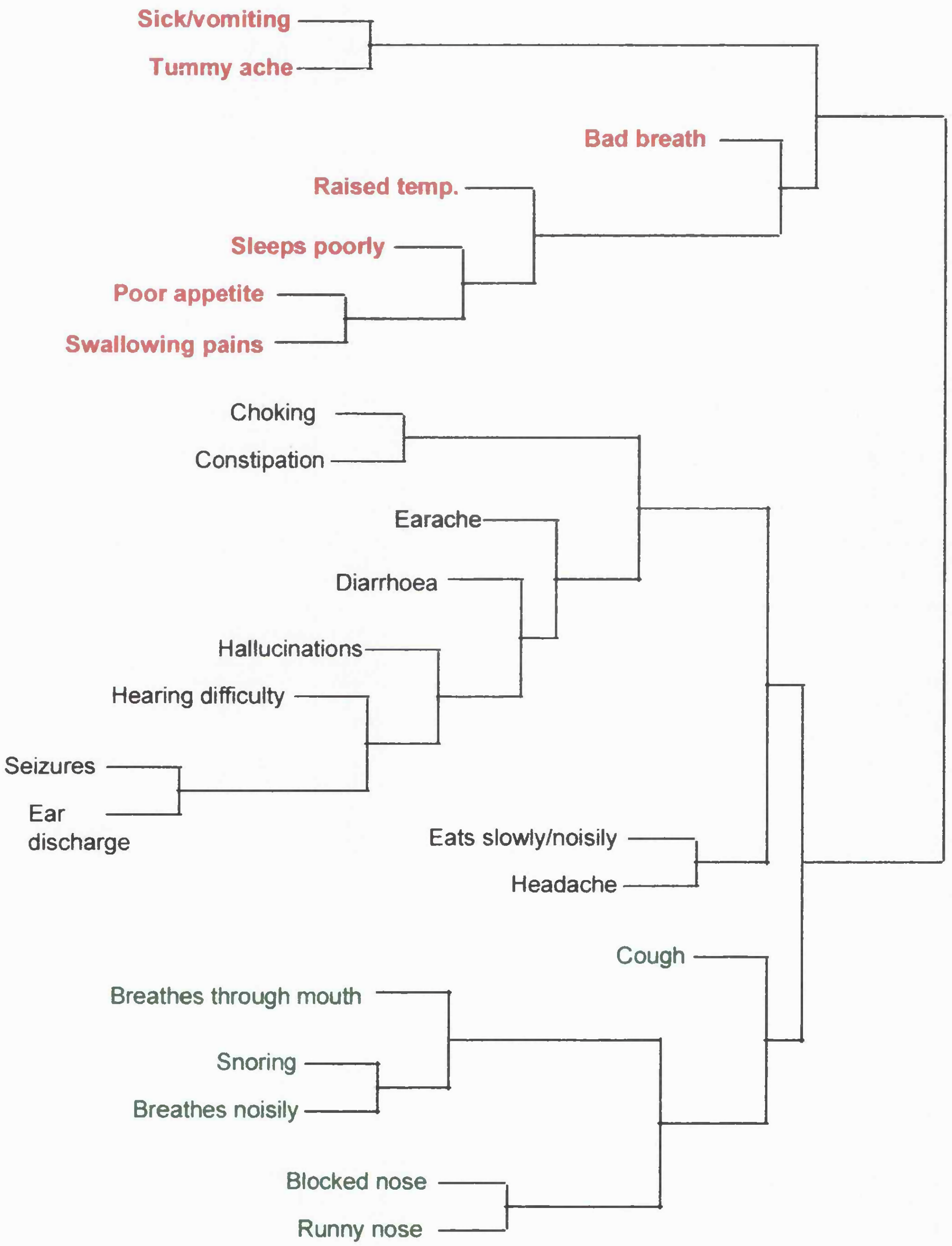
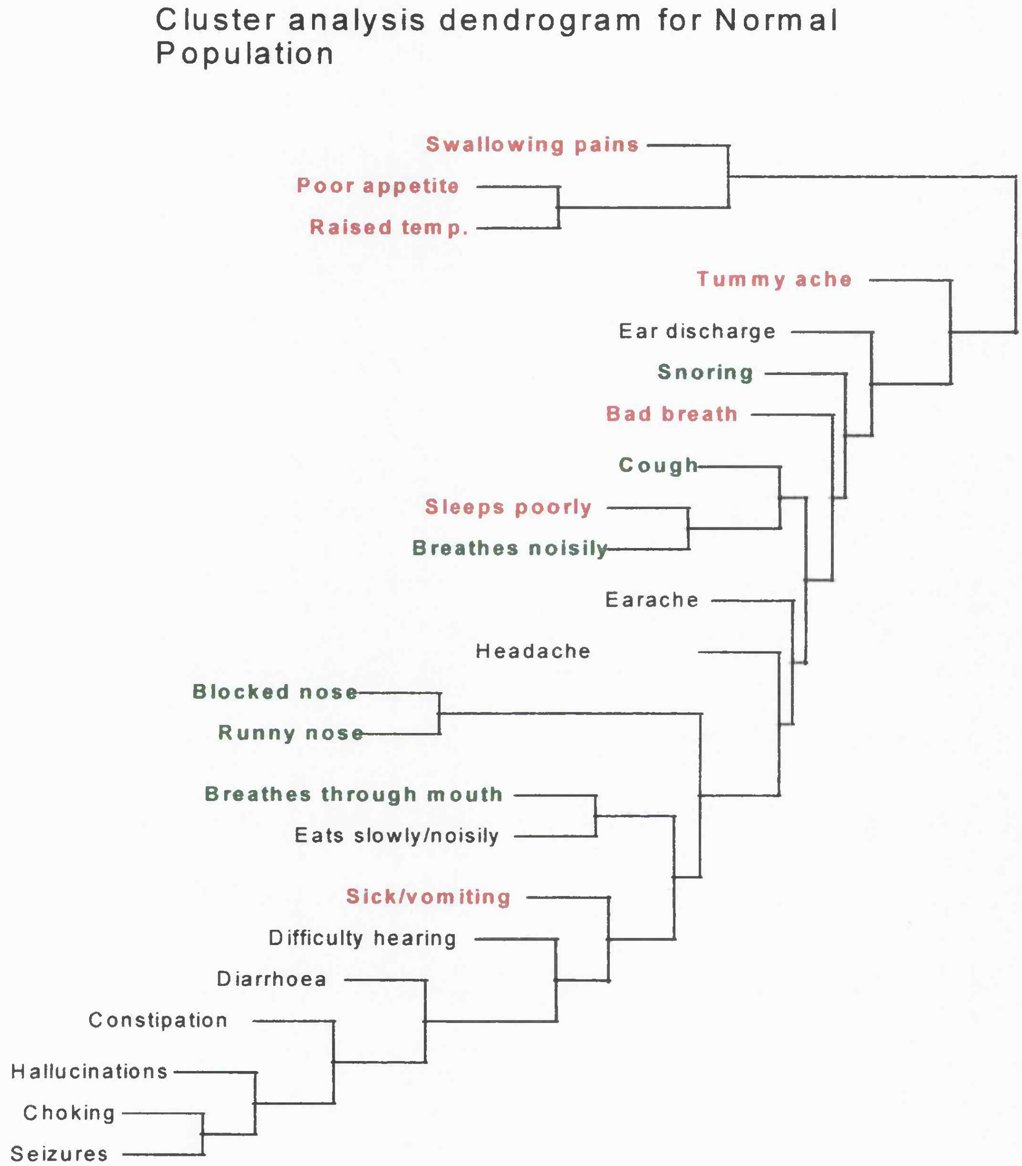


Figure 3.3


Cluster analysis dendrogram for Normal Population
Swallowing pains
Poor appetite
Raised temp.
Tummy ache
Ear discharge
Snoring
Bad breath
Cough
Sleeps poorly
Breathes noisily
Earache
Headache
Blocked nose
Runny nose
Breathes through mouth
Eats slowly/noisily
Sick/vomiting
Difficulty hearing
Diarrhoea
Constipation
Hallucinations
Choking
Seizures

3.4.2 Does the ability to differentiate tonsillitis from other sore throats increase as the frequency of tonsillitis increases?

I have shown that the Waiting List parents identify the following features very clearly with tonsillitis - pain on swallowing, raised temperature, poor sleep, poor appetite, bad breath and sickness or vomiting. The parents of the Normal population children recognise the same features but the clinical picture painted by the Normal population is less clear than that of the Waiting List population. I wondered whether a subgroup of the Normal population who have repeated tonsillitis but who are not awaiting tonsillectomy would resemble the Normal population or the Waiting List population and whether there is evidence that the Waiting List have learned about tonsillitis through the experience of their children having repeated episodes of tonsillitis.

From the Normal population, a subgroup of 65 children was identified. These children had recurrent tonsillitis and their parents claimed that they could tell the difference between tonsillitis and other sore throats. This sub-group was named the "Normal with Tonsillitis" group. In terms of age and sex distribution, the Normal with Tonsillitis group was similar to the Normal study population (tables 3.9 and 3.10).

Table 3.9 Comparison of Age Distribution of the "Normal with Tonsillitis" Group and the Normal population

Age	Normal with Tonsillitis		Normal	
	No.	%	No.	%
3 years	3	4.61	76	12.04
4 years	3	4.61	75	12.88
5 years	9	13.85	88	13.95
6 years	10	15.38	75	11.88
7 years	9	13.85	80	12.68
8 years	8	12.31	78	12.36
9 years	13	20.00	81	12.83
10 years	10	15.38	78	12.36
Total	65	100.00	631	100.00

For age distribution, Chi-squared = 9.513, p = 0.2179.

Table 3.10 Comparison of Sex Distribution of the "Normal with Tonsillitis" Group and the Normal population

Age	Normal with Tonsillitis		Normal	
	No.	%	No.	%
Male	38	58.85	314	49.76
Female	27	41.54	317	50.24
Total	65	100.00	631	100.00

For sex distribution, Chi-squared = 1.942, p = 0.1635.

Table 3.11 shows the number of sore throats and tonsillitis per year, the age at first sore throat and the duration of sore throats for the Normal and Waiting List populations and the Normal with Tonsillitis group. The Normal with Tonsillitis subgroup falls between the Normal and Waiting List populations in terms of the average number of sore throats, average duration of sore throats and the average number of episodes of tonsillitis. This suggests that the Normal with Tonsillitis group have problems with sore throats that are intermediate between the Normal and Waiting List populations.

Table 3.11 Number, age at onset and duration of sore throats in children from the Normal Population, the Normal with Tonsillitis group and the Waiting List Population.

	Normal (n=631)	Normal with Tonsillitis (n=65)	Waiting List (n=139)
Number of sore throats/year	1.39	4.02	7.53
Age at first sore throat (years)	3.01	2.88	2.90
Duration of sore throats (days)	3.50	4.88	5.82
Number of episodes of tonsillitis/year	0.33	2.49	6.70

The average number of sore throats, age at the first sore throat, average duration of sore throats and the average number of episodes of tonsillitis experienced by the Normal and Waiting List populations and the Normal with Tonsillitis group were compared using the Kruskal-Wallis test of analysis of variance. The results are shown in table 3.12 that shows that the three groups are statistically very significantly different from each other in all respects except that the Normal with Tonsillitis group and the Waiting List population have the first sore throat at a similar age and that their sore throats are of similar duration. The finding that the Normal with Tonsillitis group has sore throats of the same duration as the Waiting List children's sore throats suggests that the Normal with Tonsillitis group has sore throats that are similar to those of the Waiting List population.

Table 3.12 Comparison of average number of sore throats, age at the first sore throat, average duration of sore throats and the average number of episodes of tonsillitis in the Normal Population, the "Normal with Tonsillitis" group and the Waiting List Population.

	Normal vs. Normal with Tonsillitis	Normal vs. Waiting List	Normal with Tonsillitis vs. Waiting List
Number of sore throats/year	**$p < 0.0001$**	**$p < 0.0001$**	**$p < 0.0001$**
Age at first sore throat (years)	**$p < 0.0001$**	**$p < 0.0001$**	$p = 0.04$
Duration of sore throats (days)	**$p < 0.0001$**	**$p < 0.0001$**	$p = 0.35$
Number of episodes of tonsillitis/year	**$p < 0.0001$**	**$p < 0.0001$**	**$p < 0.0001$**

Kruskal-Wallis test of analysis of variance. Bonferroni corrected p value = 0.002.

Having identified the Normal with Tonsillitis group and shown that the children in the group have more problems with sore throats than the Normal population as a whole but fewer that the Waiting List population, I compared the answers given by the parents of the Normal with Tonsillitis group to Question 4 of the questionnaire (relating to the features that occur in the presence of a sore throat) with those of the parents of the Normal and Waiting List populations. The features chosen for the "only if tonsillitis" response were compared using the Spearman's rank correlation test and the results are shown in the box:

Normal *vs.* Normal with Tonsillitis	$r = 0.82$, **$p < 0.0001$**
Normal *vs.* Waiting List	$r = 0.90$, **$p < 0.0001$**
Normal with Tonsillitis *vs.* Waiting List	$r = 0.86$, **$p < 0.0001$**

Thus, the Normal and Waiting List populations and the Normal with Tonsillitis group all are therefore strongly agreed about the symptoms that are associated with tonsillitis. As shown earlier, the features are pain on swallowing, raised temperature, poor sleep, poor appetite, bad breath and sickness or vomiting.

Table 3.8 above showed that there is a significant difference in the frequency with which the features listed in Question 4 occur with sore throats between the Normal and Waiting List populations. The Waiting List population report the presence of the features much more commonly in the presence of a sore throat. To demonstrate whether the Normal with Tonsillitis group is similar to the Normal or Waiting List populations, the same comparison was made between the Normal with Tonsillitis group and both the Normal and Waiting List populations. The results are shown in table 3.13. Although a large table, the use of bold figures for the significant results shows the trend easily. In the far right column, the Normal and Waiting List populations are shown to be different in respect to almost every feature. In the second column, the Normal population is shown to be similar to the Normal with Tonsillitis group except in respect to pain on swallowing and raised temperature. The third column shows that the Waiting List population is similar to the Normal with Tonsillitis group in approximately half the features. Thus, the Normal with Tonsillitis group is between the Normal and Waiting List populations with respect to the frequency with which the features listed in Question 4 occur with a sore throat.

Thus, the Normal with Tonsillitis group is shown to have fewer sore throats than the Waiting List population but the sore throats appear to be similar. The parents of the Normal with Tonsillitis group recognise the same features as being associated with tonsillitis as the Waiting List population but the features are not reported as frequently by the Normal with Tonsillitis group as by the Waiting List population. This suggests that the clinical picture of tonsillitis as recognised by parents becomes clearer as the frequency of tonsillitis increases.

Table 3.13 Results of Chi-squared testing between the Normal, "Normal with Tonsillitis" and Waiting List populations.

Symptom	Normal Population vs. Normal with Tonsillitis (p value)	Waiting List vs. Normal with Tonsillitis (p value)	Normal Population vs. Waiting List (p value)
Pain on swallowing	**<0.0001**	**0.0003**	**<0.0001**
Raised temperature	**0.0005**	**0.0001**	**<0.0001**
Sleeps poorly	0.1961	**<0.0001**	**<0.0001**
Poor appetite	0.0318	0.0048	**<0.0001**
Bad breath	0.0055	**0.0016**	**<0.0001**
Sick / vomiting	0.0513	**0.0005**	**<0.0001**
Earache	0.1071	0.0207	**<0.0001**
Headache	0.0064	0.0240	**<0.0001**
Snoring	0.0852	**<0.0001**	**<0.0001**
Mouth breathing	0.3835	**<0.0001**	**<0.0001**
Noisy breathing	0.6312	**<0.0001**	**0.0002**
Eats slowly / noisily	0.1883	0.0039	0.0051
Blocked nose	0.7860	0.0239	**<0.0001**
Cough	0.7225	0.0167	**0.0008**

Bonferroni corrected p value = 0.002

3.5 Impact on Daily Activities

This section looks at the effect of sore throats on the daily activities of the child in terms of social activities, schooling, the need to visit a doctor or receive antibiotic treatment. These features have been regularly used in the past to assess the impact of recurrent sore throats or tonsillitis on a child's life and are regarded as important in deciding whether to perform tonsillectomy (5).

Question 5 of the parental questionnaire asked:

"When your child has a sore throat, does he/she:

- Miss fun things
- Stay away from school
- Stay in bed

- See the general practitioner
- Need an antibiotic

Parents whose child never had a sore throat did not answer Question 5 so the results shown below relate to 56.44% (n=346) of the Normal population and 96.35% (n=132) of the Waiting List population.

Table 3.14 shows the percentage of parents in both the Normal and Waiting List populations using each response to Question 5.

Table 3.14 Results of Question 5 "When your child has a sore throat, does he/she:

Symptom	Never & Rarely (%)		Sometimes, Often and Always (%)		Only if Tonsillitis (%)	
	Normal	Waiting List	Normal	Waiting List	Normal	Waiting List
Miss fun things	52.7	10.2	39.6	47.2	7.7	42.6
Stay away from school	40.8	5.0	48.9	47.9	10.3	47.1
Stay in bed	72.7	27.0	19.9	43.5	7.4	29.6
See GP	44.3	1.7	44.9	55.0	10.8	43.3
Need antibiotic	48.6	1.6	37.3	41.8	14.1	56.6

The "never or rarely" column shows that, in the Normal population, over 40% of parents "never or rarely" keep their child away from school, go to visit the general practitioner or need an antibiotic when the child has a sore throat. This compares with less than 10% of the Waiting List population who act in the same way. The difference in behaviour could be explained either by a difference in severity of the sore throats experienced by the Normal and Waiting List children or by a difference behavioural response to the sore throat by the parents of these children.

Between 40 and 50% of both populations "sometimes, often or always" keep their child away from school, go to visit the general practitioner or need an antibiotic when the child has a sore throat. Over 40% of the Waiting List parents reserve visiting the general practitioner *etc.* for sore throats that they think are tonsillitis ("only if tonsillitis" column).

Approximately 10% of the Normal population parents make this distinction. Thus, staying away from school, visiting the family doctor *etc.* are commonly associated with sore throats whether or not the parents think that the sore throat is due to tonsillitis. Therefore, if these features are present in the history of a child with recurrent sore throats, there is no evidence to suggest that they can help determine whether the child has recurrent tonsillitis or requires tonsillectomy.

The questionnaire did not look at the length of time the child stays away from school with a sore throat. The situation could arise where one child misses one or two days from school with an ordinary sore throat and another misses one or two weeks from school with tonsillitis. These absences from school would elicit the same response on the questionnaire. Table 3.15, however, confirms that the Waiting List children miss many more days from school because of sore throats than children from the Normal population. Therefore, the number of days missed from school may be helpful in determining whether a child has tonsillitis or an ordinary sore throat.

Table 3.15 Number of days lost from school per year for sore throats by the Normal and Waiting List populations.

	Normal Group	Waiting List Group	p value
Days lost from school per year due to sore throats	3.54	17.37	**<0.0001**

3.6 Sleep Quality

Hypothesis 2 There is no difference in sleeping patterns between children from a normal population cross-section and children awaiting tonsillectomy.

Features of disturbed sleep such as snoring and hypoxia have been reported in up to 61% of children undergoing tonsillectomy for recurrent upper respiratory tract infections (163) but snoring has also been reported in 50% of normal children when they have an upper respiratory tract infection (168). In order to investigate whether children awaiting tonsillectomy have more features of disturbed sleep than their normal peers, I compared sleep quality in the Normal and Waiting List populations by studying the characteristics of sleep reported by the parents in the questionnaire. Features used to indicate sleep disturbance included mouth breathing, snoring, restless sleep, sleep walking and choking. All of these features have been recognised as indicative of poor sleep quality. The effect of recurrent tonsillitis on a child's ability to sleep well may form part of the overall picture of "tonsillitis" as perceived by parents.

Question 6 of the parental questionnaire asked:

"Does your child have any of the following features when asleep?"

A list of randomly arranged symptoms and signs followed and is shown in Appendix 1. Each feature could be answered "never", "rarely", "sometimes", "often", "always", "only with a sore throat" or "only if tonsillitis". All parents answered the question. The raw data are shown in Appendix 4.

Two forms of analysis were performed:

- The frequency with which features are reported to happen "sometimes or often" during sleep were compared between the Normal and Waiting List populations using the Chi-squared test (section 3.6.1)

- The order in which the features were ranked from most common to least common by Normal and Waiting List populations were compared to see if each population demonstrates the same features during sleep. Spearman's rank correlation test was used for this analysis (section 3.6.2).

3.6.1 Chi-squared testing

The percentage of parents who reported that the feature occurs "sometimes or often" is shown in table 3.16 for both the Normal and Waiting List populations. "Sometimes or often" was chosen as the lead column in this section because I was interested in the child's quality of sleep on a day-to-day basis rather than particularly during a sore throat episode when sleep quality would be expected to deteriorate (168). The features have been rearranged in decreasing order of frequency. Simple inspection shows that the features are all more common in the Waiting List population (except bed wetting).

Table 3.16 Features that occur "sometimes and often" during sleep in the Normal and Waiting List populations

Symptom	Normal (%)	Waiting List (%)
Mouth open	59.06	73.53
Snoring	47.50	66.18
Restless sleep	33.78	48.48
Sleep walks / talks	32.37	41.67
Irregular breathing	13.78	37.01
Wakes frequently	19.52	31.06
Sweating attacks	19.73	28.68
Unusual position	22.01	26.56
Thrashing / kicking	16.18	25.19
Grinds teeth	23.60	25.00
Nightmares	19.52	24.43
Choking	2.78	16.03
Bed wetting	11.04	6.92

The apparent difference between the Normal and Waiting List populations in frequency of occurrence of the features during sleep was tested using the Chi-squared test. The results are shown in table 3.17. Features that occur significantly more commonly in the Waiting List children are mouth breathing, snoring, restless sleep, irregular breathing, frequent wakening, sweating and choking.

Table 3.17 Results of Chi-squared testing between the Normal and Waiting List populations.

Symptom	Normal vs. Waiting List
Mouth open	**<0.0001**
Snoring	**<0.0001**
Restless sleep	**<0.0001**
Sleeps walks / talks	0.015
Irregular breathing	**<0.0001**
Wakes frequently	**<0.0001**
Sweating attacks	**<0.0001**
Unusual sleeping position	0.202
Thrashes and kicks	0.009
Grinds teeth	0.413
Nightmares	0.09
Choking	**<0.0001**
Bed wetting	0.24

Bonferroni corrected p value = 0.004.

3.6.2 Spearman's rank correlation testing

So far, I have shown that the Waiting List children display features of disturbed sleep more frequently than the Normal children and that mouth breathing, snoring, restless sleep, irregular breathing, frequent wakening, sweating and choking occur significantly more frequently in the Waiting List children. In order to determine whether the Normal and Waiting List children have the same sleep patterns, regardless of the frequency with which the features are reported, the orders in which the parents ranked the features in Question 6 were compared using Spearman's rank correlation test. The result is shown in the box.

r = 0.78, **p = 0.03**

Thus both the Normal and Waiting List populations demonstrate the same features during sleep although mouth breathing, snoring, restless sleep, irregular breathing, frequent wakening, sweating and choking are more common in the Waiting List children. On the basis of these investigations, hypothesis 2 is accepted.

3.6.3 Comparison of sleep patterns in the Normal with Tonsillitis group with the Normal and Waiting List populations

The section above has shown that the Waiting List population have a greater incidence of features suggestive of disturbed sleep than the Normal population. The difference reaches significance for mouth breathing, snoring, restless sleep, irregular breathing, frequent wakening, sweating and choking. If the higher incidence of features of restless sleep in the Waiting List population is due to these children having recurrent episodes of tonsillitis, then children in the Normal with Tonsillitis group should have a sleep pattern that falls between the Normal and Waiting List populations.

Table 3.18 shows a comparison of the answers to Question 6 of the questionnaire given by parents in the Normal with Tonsillitis with those of the Normal and Waiting List populations. The table shows that all the features that were associated with disturbed sleep are less common in the Normal with Tonsillitis group than in either the Normal or Waiting List population. This suggests that there is no relationship between increasing frequency of tonsillitis and increasingly disturbed sleep.

Thus, although the Waiting List population has more disturbed sleep than the Normal population, this does not appear to be the result of increased frequency of tonsillitis but to another unknown cause.

Table 3.18 Comparison of the features that occur "sometimes and often" during sleep in the Normal and Waiting List populations with the Normal with Tonsillitis group

Symptom	Normal (%)	Normal with Tonsillitis (%)	Waiting List (%)
Mouth open	59.06	38.71	73.53
Snoring	47.50	33.85	66.18
Restless sleep	33.78	14.81	48.48
Sleep walks / talks	32.37	10.53	41.67
Irregular breathing	13.78	3.77	37.01
Wakes frequently	19.52	5.77	31.06
Sweating attacks	19.73	27.27	28.68
Unusual position	22.01	8.93	26.56
Thrashing / kicking	16.18	3.57	25.19
Grinds teeth	23.60	8.93	25.00
Nightmares	19.52	4.17	24.43
Choking	2.78	1.59	16.03
Bed wetting	11.04	8.33	6.92

3.7 Behaviour

Hypothesis 3 There is no difference in daytime behaviour and general behaviour between children from a normal population cross-section and children awaiting tonsillectomy.

This section examines whether there is a link between recurrent tonsillitis and altered behaviour. The section above showed that children awaiting tonsillectomy have more disturbed sleep than their normal peers. Section 3.7.1 studies features of daytime behaviour, such as irritability, hyperactive behaviour, poor concentration, morning sleepiness, aggressive behaviour, daytime sleepiness and headache, that are all recognised as daytime sequelae of poor sleep and as part of the obstructive sleep apnoea syndrome. If children awaiting tonsillectomy have disturbed sleep, it is likely that they will exhibit these features of daytime behaviour more strongly than their normal peers.

Section 3.7.2 examines more general aspects of performance – general health, appetite, school progress, behaviour and ability to make friends. These aspects of a child's life may all be affected by recurring episodes of illness. The effect of tonsillitis on a child's ability to learn at school or to acquire social skills may form part of the overall picture of "tonsillitis" as perceived by parents.

3.7.1 Daytime behaviour

Question 7 of the parental questionnaire asked:

"Does your child have any of the following when awake?"

A list of features followed and is shown in Appendix 1. Each feature could be answered "never", "sometimes", "often", "always", "only with a sore throat" or "only if tonsillitis". All parents answered question 7. The raw data are shown in Appendix 4.

The percentage of parents in both the Normal and Waiting List populations responding "often and always" is shown in table 3.19. The complete table is found in Appendix 6.

Table 3.19 shows that the features of daytime behaviour studied are all more common in the Waiting List population. The difference between the Normal and Waiting List populations was examined using the Chi-squared test and the results are shown in table 3.20. Table 3.20 shows that irritability, hyperactive behaviour, poor concentration, morning sleepiness, aggressive behaviour and daytime sleepiness are significantly more common in the Waiting List population than in the Normal population. Only headache is equally common in both populations.

The finding that children from the Waiting List have a greater frequency of irritability, hyperactive behaviour, poor concentration, morning sleepiness, aggressive behaviour and daytime sleepiness adds further evidence to the results of the previous section that showed that children in the Waiting List population have more disturbed sleep than the Normal population. The Waiting List children also have more of the daytime sequelae of disturbed sleep.

Table 3.19 Percentage of parents answering "Often and Always" to features of daytime behaviour

Symptom	Normal Population (%)	Waiting List Population (%)
Irritability	11.60	18.80
Hyperactive behaviour	8.59	17.32
Poor concentration	9.64	16.92
Morning sleepiness	5.44	12.70
Aggressive behaviour	5.15	10.69
Daytime sleepiness	2.54	8.27
Headache	2.21	7.52

Table 3.20 Results of Chi-squared tests between the Normal and Waiting List groups.

Symptom	p-value
Irritability	**0.0006**
Hyperactive behaviour	**0.0049**
Poor concentration	*__0.0011__
Morning sleepiness	**0.0022**
Aggressive behaviour	**0.0029**
Daytime sleepiness	*__0.0001__
Headache	0.0127

Bonferroni corrected p value = 0.007.
* Fisher's exact test used instead of Chi-squared because of small numbers.

3.7.2 General behaviour

Question 8 of the parent questionnaire asked:

"How would you describe your child in the following:"

- General health
- Appetite
- School progress
- Behaviour
- Ability to make friends

The possible answers were "very poor", "poor", "average", "good" and "excellent". All parents answered the question.

Table 3.21 shows the percentage of parents in the Normal and Waiting List populations using each response. The raw data are shown in Appendix 4.

Table 3.21 Answers to Question 8 - How would you describe your child in the following?

Symptom	Very Poor and Poor		Average		Good and Excellent	
	Normal List (%)	Waiting List (%)	Normal List (%)	Waiting List (%)	Normal List (%)	Waiting List (%)
Making friends	3.52	4.96	19.52	24.11	76.96	70.92
School progress	3.46	10.14	24.22	31.16	72.32	58.70
Behaviour	2.65	5.04	37.29	40.29	60.06	54.68
Appetite	8.49	24.11	22.60	21.99	68.91	53.90
General health	0.48	13.57	11.50	37.14	88.02	49.29

Simple inspection of table 3.21 shows that the Waiting List children are less successful than the Normal population children with regard to all the parameters of normal life that have been investigated. Fewer of the Waiting List parents chose the option "Good and

Excellent" to describe their children but more Waiting List parents chose "Very Poor and Poor".

The difference between the Normal and Waiting List populations was compared using the Chi-squared test and the results are shown in table 3.22. This table shows that, apart from the feature "ability to make friends", the populations are significantly different in their general behaviour patterns.

Table 3.22 Results of Chi-squared tests between the Normal and Waiting List populations

Symptom	p-value
Making friends	0.1209
School progress	**0.0023**
Behaviour	**0.0025**
Appetite	**<0.0001**
General health	**<0.0001**

Bonferroni corrected p value = 0.01

On the basis of the investigations outlined in section 3.7, hypothesis 3 is rejected.

3.8 Effect of Social Class on Number of Sore Throats and Tonsillitis

Hypothesis 4(a) The number of sore throats and episodes of tonsillitis experienced by children from a normal population cross-section and children awaiting tonsillectomy is not affected by social class.

The tonsillectomy rate has varied according to social class throughout this century (12,13). It is not known if the frequency of episodes of sore throats and tonsillitis also vary according to social class or whether parents of higher social class families are capable of securing tonsillectomy for their children after only a few episodes of tonsillitis.

In order to investigate whether the number of episodes of sore throat and tonsillitis differ between the social class groups, I studied the effect of social class as determined by parental occupation upon the reported number of episodes of sore throat and tonsillitis. Since social class is influenced by many other factors apart from occupation, other factors were also considered - parental employment, single parent family status, family size and parental smoking.

The results of individual analysis of these factors are shown in Appendix 6. The results of a multivariate analysis are shown in table 3.23. Only three significant results are shown and none of these is significant for both the Normal and Waiting List populations. The clinical significance of the results should therefore be regarded with some caution. It appears, therefore, that the number of sore throats and episodes of tonsillitis experienced by the Normal and Waiting List populations is not affected by social class and hypothesis 4(a) is rejected.

Table 3.23 Effect of Social Class on the Number of Episodes of Sore Throats and Tonsillitis in the Normal and Waiting List Populations - p values

Social Factor	Normal Population		Waiting List Population	
	No. Sore throats	No. Tonsillitis	No. sore throats	No. tonsillitis
Social class	0.21	0.60	0.27	0.84
Father employed	0.96	0.33	0.73	0.76
Father smoker	0.68	0.48	0.88	0.37
Mother employed	0.38	0.59	0.23	0.80
Mother smoker	0.15	**0.04**	0.19	0.13
Single parent	0.18	0.58	**0.04**	0.43
Family size	0.99	0.67	0.20	**0.03**

3.9 Effect of Family Medical History on Sore Throats and Tonsillitis

Hypothesis 4(b) The number of sore throats and episodes of tonsillitis experienced by children from a normal population cross-section and children awaiting tonsillectomy is not affected by the family medical history.

Parental tonsillectomy and other medical conditions in the family have been shown to influence the tonsillectomy rate and the referral rate to otolaryngology clinics in children (155,156,157). The previous reports have studied only one of these factors in isolation but they cannot be regarded as independent of one another. Therefore a multivariate analysis is required.

The effect of parental tonsillectomy, other operations in the parents, family atopy and history of sore throats in the siblings upon the number of episodes of sore throat and tonsillitis is shown individually in Appendix 6. The results of the multivariate analysis are shown in table 3.24.

Table 3.24 shows that for both the Normal and Waiting List populations, there is a significant association between parental tonsillectomy and the number of episodes of tonsillitis reported in a child. There is also a significant association between parental tonsillectomy and the number of sore throats reported in the Waiting List population. Where the parents have undergone other types of surgery, there is a significant association between this history and the number of sore throats and episodes of tonsillitis in the Waiting List population.

Table 3.24 Effect of Family Medical History on the Number of Episodes of Sore Throats and Tonsillitis in the Normal and Waiting List Populations - p values

Family factor	Normal Population		Waiting List Population	
	No. Sore throats	No. Tonsillitis	No. Sore throats	No. Tonsillitis
Parental tonsillectomy	0.19	**0.004**	**0.04**	**0.04**
Other parental surgery	0.97	0.20	**0.03**	**0.03**
Father atopic	0.42	0.32	0.80	0.93
Mother atopic	0.54	0.72	0.31	0.70
Parent atopic	0.54	0.86	0.31	0.78
Child atopic	0.73	0.60	0.97	0.62
Sibling atopic	0.14	0.79	0.05	0.54
Sibling with sore throats	0.74	0.94	**0.03**	0.28
Sibling tonsillectomy	0.86	0.48	0.69	0.73

To illustrate the effect of parental tonsillectomy further, the average number of sore throats and episodes of tonsillitis was compared between children with a parental history of tonsillectomy and those with no history of parental tonsillectomy. The results are shown in table 3.25 for both the Normal and Waiting List populations. In the Waiting List population, those children whose parents have undergone tonsillectomy have *fewer* sore throats and episodes of tonsillitis than children whose parents have not undergone tonsillectomy. The trend is reversed in the Normal population. This finding could be explained as an expression of parental choice with those who felt they benefited from tonsillectomy seeking tonsillectomy early for their children whilst those who felt the operation had not been of benefit to them choosing to allow their children to have more sore throats than their peers rather than undergo tonsillectomy.

Table 3.25 Comparison of the number of sore throats and episodes of tonsillitis in children according to a history of parental tonsillectomy.

	Normal Population		Waiting List Population	
	Parental Tonsillectomy	No Parental Tonsillectomy	Parental Tonsillectomy	No Parental Tonsillectomy
Number of sore throats	1.49	1.27	6.85	8.98
Number of episodes of tonsillitis	0.51	0.22	5.80	7.09

As a further investigation of the impact of parental tonsillectomy on the Normal and Waiting List populations, the number of families in which a parent has undergone tonsillectomy was compared. The result is shown in table 3.26. The Waiting List population has a significantly higher incidence of parental tonsillectomy. This finding also suggests that parents who have undergone tonsillectomy actively seek tonsillectomy for their children.

Table 3.26 Incidence of parental tonsillectomy in the Normal and Waiting List populations.

	No. families with parental tonsillectomy	Whole population
Normal Population	168	631
Waiting List Population	67	142

$\chi^2 = 21.05$, $\mathbf{p < 0.0001}$

The incidence of other types of surgery in parents in the Normal and Waiting List populations was also compared and was found to be similar. The results are shown in Appendix 6.

3.10 Summary of Parental Questionnaire Results

Table 3.27 Summary of parental questionnaire results

Hypothesis	Proved?	Comment
1.Tonsillitis, as perceived by parents, does not represent a distinct clinical picture when compared with other sore throats – section 3.4.	✕	Parents can clearly identify two patterns of sore throat illness by symptom association. The symptoms that occur when parents think the sore throat is due to tonsillitis are pain on swallowing, raised temperature, poor sleep, poor appetite, bad breath and sickness / vomiting. The symptoms that are associated with sore throats that parents do not think is tonsillitis are mouth breathing, snoring, noisy breathing, blocked nose, cough and runny nose.
2. There is no difference in sleeping patterns between children from a normal population cross-section and children awaiting tonsillectomy – section 3.6.	✕	Children awaiting tonsillectomy have more disturbed sleep than children from a normal population.
3. There is no difference in daytime behaviour and general behaviour between children from a normal population cross-section and children awaiting tonsillectomy – section 3.7.	✕	Children awaiting tonsillectomy have poorer behaviour patterns than children from a normal population.
4(a). The number of sore throats and episodes of tonsillitis experienced by children from a normal population cross-section and children awaiting tonsillectomy is not affected by social class – section 3.8.	✓	Social factors have no effect upon the number of sore throats or episodes of tonsillitis in either a normal population or a population of children awaiting tonsillectomy.

Hypothesis	Proved?	Comment
4(b). The number of sore throats and episodes of tonsillitis experienced by children from a normal population cross-section and children awaiting tonsillectomy is not affected by the family medical history – section 3.9.	✕	A history of parental tonsillectomy has a significant effect upon the number of sore throats and episodes of tonsillitis reported in children awaiting tonsillectomy. In the Waiting List population, children whose parents have undergone tonsillectomy have fewer sore throats and episodes of tonsillitis than children whose parents have not undergone tonsillectomy. In the Normal population, the number of episodes of tonsillitis reported is significantly affected by a history of parental tonsillectomy. Children in the Normal population whose parents have undergone tonsillectomy have more sore throats and episodes of tonsillitis than other normal children whose parents have not undergone tonsillectomy. There is a higher incidence of parental tonsillectomy in children awaiting tonsillectomy than in a normal population

In addition:

- The ability to differentiate between tonsillitis and other sore throats may be learnt through experience. There is evidence to support this hypothesis in that the clinical picture of tonsillitis was least clear in the Normal population, clearer in the "Normal with Tonsillitis" group and most clear in the Waiting List population (section 3.4.2).
- Section 3.5 showed that missing school, attending the general practitioner or receiving antibiotics happen with all sore throats and are not particularly associated with tonsillitis.
- There is no evidence to suggest that increasing frequency of tonsillitis is responsible for the difference in sleep quality as there was no trend of increasing sleep disturbance from the Normal population through the "Normal with Tonsillitis" group to the Waiting List population (section 3.6.3).

RESULTS OF THE DOCTORS' QUESTIONNAIRES

This section discusses the results of the doctors' questionnaires. The response rates are shown first, followed by the results of testing each hypothesis in turn.

3.11 Response rates

Sixty-four otolaryngologists, 87 paediatricians and 100 general practitioners were invited to participate in the study and received a questionnaire. After two mailings of the questionnaires, the response rates were

- Otolaryngologists 42, 65.6%
- Paediatricians 57, 67.8%
- General practitioners 71, 71%

3.12 Do Doctors Differentiate between Tonsillitis and Other Sore Throats?

Hypothesis 5 In day-to-day clinical practice, no distinction is drawn between the diagnostic terms "tonsillitis", "pharyngitis" and "upper respiratory tract infection" by otolaryngologists, paediatricians or general practitioners.

In order to test hypothesis 5, I enquired which symptoms or signs are used to make a diagnosis of "tonsillitis", "pharyngitis" and "upper respiratory tract infection" via the questionnaire. Question 2 of the Otolaryngologist questionnaire and Question 1 of the Paediatrician and General Practitioner questionnaire asked:

"From the following list, which features do you use in your every day practice to diagnose the conditions in the box below?"

A list of 23 features followed from which the respondent was asked to choose the three symptoms or signs that most accurately described “tonsillitis”, “pharyngitis” and “upper respiratory tract infection”. The features were answered in descending order of importance. The full question and possible answers are shown in Appendix 1.

Items chosen first were awarded a score of three points, those chosen second were awarded two points and those chosen third one point. This method allowed calculation of a score for each item. The scores were used to rank the items and the rankings were compared using the Spearman’s rank correlation test.

Tables 3.28, 3.29 and 3.30 show the features chosen by at least 30% of the otolaryngologists, paediatricians and general practitioners to diagnose “tonsillitis”, “pharyngitis” and “upper respiratory tract infection” respectively. Very few doctors chose the items that are not included in tables 3.28, 3.29 and 3.30. The tables show the features in decreasing order of importance, the percentage of doctors choosing each item and its score.

The tables show that there is much discrepancy between the doctors about the diagnostic features of “tonsillitis”, “pharyngitis” and “upper respiratory tract infection”. For example, in table 3.28, only 48% of otolaryngologists associated sore throat and tonsillar exudate with a diagnosis of tonsillitis and these were the two most common features believed to be associated with tonsillitis by otolaryngologists. Paediatricians and general practitioners appear to agree more closely with each other with 86% of paediatricians and 87% of general practitioners choosing tonsillar exudate as the most important feature in diagnosing tonsillitis. Even for the paediatricians and general practitioners however there is no clear consensus of opinion regarding the diagnostic features of “tonsillitis”, “pharyngitis” and “upper respiratory tract infection”.

Table 3.28 Diagnostic features of "tonsillitis" chosen by otolaryngologists, paediatricians and general practitioners.

Otolaryngologist			Paediatrician			General Practitioner		
Item	Score	%	Item	Score	%	Item	Score	%
Sore throat	45	48	Tonsillar exudate	114	86	Tonsillar exudate	155	87
Tonsillar exudate	36	48	Sore throat	83	67	Sore throat	94	55
Dysphagia	26	45	Temp > 38.3	49	51	Tender CLN*	50	41
Temp > 38.3	22	36	Tender CLN*	35	42	Temp > 38.3	43	42

*CLN = cervical lymph nodes

Table 3.29 Diagnostic features of "pharyngitis" chosen by otolaryngologists, paediatricians and general practitioners.

Otolaryngologist			Paediatrician			General Practitioner		
Item	Score	%	Item	Score	%	Item	Score	%
Sore throat	71	73	Sore throat	136	88	Sore throat	191	92
Duration < 3 days	26	42	Dysphagia	46	42	Temp > 38.3	46	49
			Temp > 38.3	43	49	Tender CLN*	41	39
Dysphagia	23	33	Tender CLN*	30	33	Dysphagia	37	30

*CLN = cervical lymph nodes

Table 3.30 Diagnostic features of "upper respiratory tract infection" chosen by otolaryngologists, paediatricians and general practitioners.

Otolaryngologist			Paediatrician			General Practitioner		
Item	Score	%	Item	Score	%	Item	Score	%
Nasal discharge	61	85	Nasal discharge	119	79	Nasal discharge	108	61
Nasal blockage	42	58	Cough	49	47	Sore throat	82	54
Cough	27	48	Temp > 38.3	43	49	Cough	74	54
			Nasal blockage	37	30	Nasal blockage	52	38
			Sore throat	35	32	Temp > 38.3	42	35

CLN = cervical lymph nodes

To determine whether the features chosen to describe "tonsillitis", "pharyngitis" and "upper respiratory tract infection" represent similar or different clinical patterns, Spearman's rank correlation test was used. The order in which the features were ranked was compared for each diagnosis. The results of the analysis are shown in table 3.31. Otolaryngologists do not differentiate between "tonsillitis", "pharyngitis" and "upper respiratory tract infection". General practitioners differentiate between all three diagnoses. Paediatricians differentiate "upper respiratory tract infection" from "tonsillitis" and "pharyngitis but do not differentiate between "tonsillitis" and "pharyngitis".

Table 3.31 Results of comparison of the diagnostic features of "tonsillitis", "pharyngitis" and "upper respiratory tract infection"

	Tonsillitis *vs.* pharyngitis		Tonsillitis *vs.* URTI		Pharyngitis *vs.* URTI	
	Correlation coefficient	p value	Correlation coefficient	p value	Correlation coefficient	P value
Otolaryngologist	0.71	**0.0003**	0.88	**<0.0001**	0.74	**0.0001**
Paediatrician	0.75	**<0.0001**	0.29	0.19	0.40	0.07
General practitioner	0.54	0.01	0.45	0.51	0.50	0.02

Bonferroni corrected p value = 0.0056. Significant results are shown in **bold**.

On the basis of the investigations outlined above, hypothesis 5 is accepted for otolaryngologists, rejected for general practitioners and neither accepted or rejected for paediatricians. There appears to be no agreement between otolaryngologists, paediatricians and general practitioners about the diagnostic features of "tonsillitis", "pharyngitis" and "upper respiratory tract infection".

3.13 Features most commonly associated with Tonsillitis by Otolaryngologists, Paediatricians and General Practitioners

As a further inquiry into the diagnostic features of tonsillitis, I compared the features that otolaryngologists, paediatricians and general practitioners associate with a diagnosis of tonsillitis. The comparison aimed to determine whether the three groups of doctor were agreed or disagreed about the clinical features of tonsillitis.

Question 3 of the doctors' questionnaires asked:

"From the following list, choose up to five features which are commonly associated with acute tonsillitis."

A list of 22 features followed from which the respondent chose the five symptoms or signs that were most associated with tonsillitis. The features were answered in descending order of importance. The full question and possible answers are shown in Appendix 1.

Items chosen first were awarded five points, those chosen second were awarded four points and so on. A score was calculated for each item. The raw data are shown in Appendix 5.

Table 3.32 shows the answers given by at least 30% of the otolaryngologists, paediatricians and general practitioners. The table shows the features most commonly associated with tonsillitis in decreasing order of importance, the percentage of doctors choosing each feature and the feature's score. Items not included in table 3.32 were rarely chosen.

Table 3.32 Features most commonly associated with tonsillitis by otolaryngologists, paediatricians and general practitioners

Otolaryngologist			Paediatrician			General Practitioner		
Item	Score	%	Item	Score	%	Item	Score	%
Sore throat	161	81	Sore throat	228	93	Sore throat	241	80
Pyrexia	104	86	Pyrexia	183	92	Tonsillar exudate	227	83
Tonsillar exudate	80	64	Tonsillar exudate	171	84	Pyrexia	159	70
Dysphagia	76	64	Tender CLN	84	54	Tender CLN	117	65
Enlarged CLN	44	48	Enlarged CLN	65	49	Enlarged CLN	100	54
Tender CLN	34	36	Dysphagia	50	37	Dysphagia	70	32
						Halitosis	36	31

CLN = cervical lymph nodes

Spearman's rank correlation testing gave the following results:

Otolaryngologist *vs.* paediatrician	$r = 0.8$,	$p = 0.06$
Otolaryngologist *vs.* general practitioner	$r = 0.71$	$p = 0.1$
Paediatrician *vs.* general practitioner	$r = 0.94$	$\mathbf{p = 0.003}$

Thus paediatricians and general practitioners agree about the diagnostic features of "tonsillitis" but the otolaryngologists use different criteria to make this diagnosis.

3.14 Indications for Tonsillectomy as perceived by Otolaryngologists, Paediatricians and General Practitioners

Hypothesis 6 There are no differences in the reasons for performing tonsillectomy in children by otolaryngologists and the referral of children for tonsillectomy by paediatricians and general practitioners.

In order to test hypothesis 6, I compared the indications for tonsillectomy chosen by otolaryngologists, paediatricians and general practitioners in answer to Question 4 of the doctors' questionnaire.

Question 4 of the questionnaire asked the paediatricians and general practitioners:

"When considering referring a child to hospital for tonsillectomy, which five of the following influence you most?"

The otolaryngologists were asked:

"Of the following features, which five influence you most when deciding whether or not to add a child's name to the waiting list for tonsillectomy?"

A list of 17 answers followed for the paediatricians and general practitioners. A similar list was given to the otolaryngologists excluding “attitude of the local ENT surgeon” and “frequency of home visits required because of tonsillitis”. The full question and possible answers are shown in Appendix 1. Respondents gave their answers in decreasing order of importance and the answers were scored in the same manner as question 3. The raw data are shown in Appendix 5.

Table 3.33 shows the features chosen by at least 30% of the otolaryngologists, paediatricians and general practitioners in descending order of importance. It also shows the score and the percentage of doctors choosing each item. In contrast to questions 3 and 4, the demarcation between common and uncommon answers was not as clear when the raw data were inspected.

Table 3.33 Features used when deciding to perform, or refer for, tonsillectomy

Otolaryngologist			Paediatrician			General Practitioner		
Item	Score	%	Item	Score	%	Item	Score	%
Freq. documented tonsillitis	144	81	Freq. documented tonsillitis	192	81	Freq. documented tonsillitis	284	90
Number of days off school	112	88	Number of days off school	147	76	Number of days off school	190	83
Apnoeic spells	101	71	Apnoeic spells	147	58	Poor general health	88	52
Freq. sore throats reported by parents	87	67	Frequency of URTIs	100	71	Freq. sore throats reported by parents	81	32
			Poor general health	60	39			
Freq. surgery visits	58	45	Tonsil size	54	34	Number of antibiotics	68	34
Number of antibiotics	44	43				Parental pressure	56	38

Spearman's rank correlation testing gave the following results:

Otolaryngologist *vs*. paediatrician	**p = 0.005**
Otolaryngologist *vs*. general practitioner	p = 0.07
Paediatrician *vs*. general practitioner	**p = 0.0008**

The results show that paediatricians use criteria for performing or recommending tonsillectomy that are similar to otolaryngologists and general practitioners. Otolaryngologists and general practitioners use different criteria for recommending tonsillectomy. There is no agreement between the three groups of doctors about the indications for tonsillectomy and hypothesis 7 is rejected.

3.15 Benefits of Tonsillectomy

Hypothesis 7 There are no differences in the expected benefits of tonsillectomy as perceived by otolaryngologists, paediatricians and general practitioners.

In order to test hypothesis 7, I compared the benefits expected to follow tonsillectomy as stated by otolaryngologists, paediatricians and general practitioners using the doctors' questionnaire.

Question 7 of the otolaryngologists' questionnaire and Question 5 of the paediatricians' and general practitioners' questionnaires asked:

"Following tonsillectomy, would you expect any of the following to be improved?"

A list of 18 features followed that could be answered "Yes", "No" or "Unsure". The entire question is shown in Appendix 1 with the raw data in Appendix 5.

Table 3.34 shows the features answered "Yes" by at least 30% of otolaryngologists, paediatricians and general practitioners.

Table 3.34 Expected benefits of tonsillectomy

Otolaryngologist		Paediatrician		General Practitioner	
Feature	%	Feature	%	Feature	%
Freq. of sore throats	100.0	Restless sleep	64.4	Freq. of sore throats	80.3
Freq. of URTI	42.5	Freq. of sore throats	62.7	Restless sleep	42.3
Restless sleep	40.0	Daytime sleepiness	54.2	Freq. URTI	32.4
Frequent wakening	30.0	Morning irritability	52.5	Frequent wakening	32.4
Irregular breathing	30.0	Morning sleepiness	52.5	Sweating attacks	31.0
		Frequent wakening	50.6	Morning sleepiness	31.0
		Poor concentration	50.6	Poor concentration	31.0
		Irregular breathing	50.6		
		Unusual sleeping position	49.2		

A comparison was made of the expected benefits of tonsillectomy using the Spearman's rank correlation test. The results are shown in the box and show that the otolaryngologists, paediatricians and general practitioners expect improvement in the same features following tonsillectomy.

Otolaryngologist *vs.* paediatrician	**$p<0.0001$**
Otolaryngologist *vs.* general practitioner	**$p = 0.007$**
Paediatrician *vs.* general practitioner	**$p = 0.0004$**

However, table 3.34 suggests that more of the paediatricians expect benefit in areas such as "restless sleep" and "daytime sleepiness" following tonsillectomy than do the otolaryngologists and general practitioners. To examine whether this is so, the responses were compared using the Chi-squared test and the results are shown in Appendix 5. The features where there was a significant difference between the otolaryngologists, paediatricians and general practitioners in the frequency with which they expected benefit following tonsillectomy were:

- Frequency of sore throats
- Unusual sleeping position
- Irregular breathing
- Morning irritability
- Poor concentration

All otolaryngologists expect an improvement in the frequency of sore throats but only 64.4% of paediatricians and 80.3% of general practitioners expect fewer sore throats after tonsillectomy. This is surprising as "frequency of tonsillitis" was the most commonly stated indication for tonsillectomy by all doctors.

The difference in expectations relating to unusual sleeping position, irregular breathing, morning irritability and poor concentration is explained by the paediatricians having greater expectations of improvement in these areas than either the otolaryngologists or general practitioners.

On the basis of these investigations, it appears that there is no clear consensus between the otolaryngologists, paediatricians and general practitioners about the expected benefits of tonsillectomy and hypothesis 7 is rejected.

3.16 Factors that Influence the Decision to Operate on a Child when the Indications are Equivocal

Hypothesis 8 The decision by otolaryngologists to perform tonsillectomy is not influenced by non-clinical factors.

Question 5 of the Otolaryngologist questionnaire addressed reasons other than the purely clinical indications why a child's name may be added to a waiting list for tonsillectomy. The question can be found in Appendix 1. The number and percentage of otolaryngologists giving each response are shown in table 3.35.

Table 3.35 Non-clinical factors influencing otolaryngologists' decision to perform tonsillectomy

	Always		Sometimes		Never	
Reason	Number	%	Number	%	Number	%
Very busy clinic	1	2.4	19	45.2	22	52.4
Feeling tired	0	0.0	5	11.9	37	88.1
Assertive parents	1	2.4	35	83.3	6	14.3
2nd or 3rd referral of child	13	31.0	27	64.3	2	4.8
Sibling seen at same time needs tonsillectomy	0	0.0	15	35.7	27	64.3
Sibling benefited from tonsillectomy	1	2.4	24	57.1	17	40.5
Waiting list long	0	0.0	5	11.9	37	88.1
Waiting list short	0	0.0	3	7.1	39	92.9
Private patient	0	0.0	4	9.5	38	90.5
Doctor's child	0	0.0	21	50.0	21	50.0

The only reason given by a substantial proportion (31%) of the surgeons for always operating on a child in whom the indications for surgery are "borderline" is re-referral by the general practitioner. A busy clinic, assertive parents, previous or concurrent tonsillectomy in a sibling and a doctor parent can all contribute to the decision at times. Over 80% of otolaryngologists admit that assertive parents can influence the decision to perform tonsillectomy.

On the basis of the results shown above, hypothesis 8 is rejected.

3.17 Use of Suggested Guidelines for Tonsillectomy

Question 6 of the Otolaryngologists' questionnaire asked: "Do you use the suggested guidelines for number of episodes of tonsillitis when deciding to perform tonsillectomy?" The results are shown in table 3.36 that shows that almost 40% of otolaryngologists rarely or never use the guidelines suggested by other authors. The usefulness of such guidelines is doubtful when so many practitioners do not use them.

Table 3.36 Use of published guidelines by otolaryngologists when deciding to perform tonsillectomy

Always	Sometimes	Rarely	Never
4 (9.76%)	19 (46.34%)	7 (17.07%)	9 (21.95%)

3.18 Summary of the Results of the Doctors' Questionnaires

Table 3.37 Summary of results of the doctors' questionnaires

Hypothesis	Proved?	Comment
5. In day-to-day clinical practice, no distinction is drawn between the diagnostic terms "tonsillitis", "pharyngitis" and "upper respiratory tract infection" by otolaryngologists, paediatricians or general practitioners – section 3.12.	✓	General practitioners differentiate between "tonsillitis", "pharyngitis" and "upper respiratory tract infection" by the clinical history. Otolaryngologists do not differentiate between any of these diagnoses. Paediatricians differentiate "upper respiratory tract infection" from "tonsillitis" and "pharyngitis" but do not differentiate between "tonsillitis" and "pharyngitis".
6. There are no differences in the reasons for performing tonsillectomy in children by otolaryngologists and the referral of children for tonsillectomy by paediatricians and general practitioners – section 3.14.	✕	Paediatricians use the same criteria for recommending tonsillectomy as both otolaryngologists and general practitioners. Otolaryngologists and general practitioners are not agreed about the indications for tonsillectomy.
7. There are no differences in the expected benefits of tonsillectomy as perceived by otolaryngologists, paediatricians and general practitioners – section 3.15.	✕	Otolaryngologists, paediatricians and general practitioners are not agreed about the expected benefits of tonsillectomy.
8. The decision to perform tonsillectomy is not influenced by non-clinical factors – section 3.16.	✕	Non-clinical factors such as assertive parents, re-referral by the general practitioner and a busy clinic can influence the decision to perform tonsillectomy.

In addition:

- Paediatricians and general practitioners agree about the diagnostic features of tonsillitis. Otolaryngologists use different diagnostic criteria – section 3.13
- The suggested guidelines for tonsillectomy are poorly used – section 3.17.

4 DISCUSSION

4.1 Introduction

This chapter gives a summary of the literature review, methods and results from the preceding chapters and then discusses how the thesis has provided understandings about the pathway from recurrent tonsillitis to tonsillectomy. It also highlights further research questions that have arisen as a result of undertaking the study and makes suggestions about how these further areas of research could be approached.

4.2 Summary of Previous Literature

This section briefly summarises the literature and demonstrates that there is little evidence to support the role of tonsillectomy in the treatment of children with recurrent sore throats. It then looks at the steps taken from recurrent tonsillitis to tonsillectomy, dealing firstly with the steps taken by parents and secondly with those taken by doctors. It illustrates the areas where the research questions that formed the basis of the hypotheses tested in the thesis arose.

Tonsillectomy is still the second most commonly performed operation in children in the United Kingdom but its incidence varies widely between Health Authorities (3,7,8). The reasons for this are unclear but appear not to be related to differences in morbidity relating to tonsillitis (9).

The history of tonsillectomy showed a great increase in its incidence at the beginning of this century with little evidence that this was accompanied by an improvement in the health of the population (9). The rise in incidence of tonsillectomy was followed by a decline in the frequency of the operation. Several studies were performed in an attempt to demonstrate the benefit of tonsillectomy. These studies failed to support the perceived anecdotal view that children benefited from tonsillectomy. I have postulated that this may be because the studies were poorly designed, that the illness defined as the inclusion criterion was not really "tonsillitis" and that the outcome measurement used was inappropriate, *i.e.* the benefit following tonsillectomy encompasses more than a simple reduction in the number of sore throats.

4.2.1 Parental factors for tonsillectomy

Simplistically, the pathway from recurrent tonsillitis to tonsillectomy requires parents to decide that they think the operation is necessary and to seek the opinion of doctors who then agree. Little is known about how parents decide to request tonsillectomy. Parents report a substantial improvement in their child's health following tonsillectomy (88). The benefit has not been demonstrated by the randomised controlled trials that focussed only on the frequency of sore throats. So, in what other areas may parents seek an improvement following tonsillectomy?

- The sore throats may be different. The literature suggests that upper respiratory tract infections form a spectrum of disease rather than separate clinical entities. Howie wrote that the terms "tonsillitis", "pharyngitis" and "acute otitis media" are often used by general practitioners to justify antibiotic prescription (95,96) rather than as descriptions of separate clinical illnesses. Townsend and Sydentricker (83) wrote that respiratory illnesses share the same symptoms but in different frequencies and intensities. Paradise *et al.* (2) attempted to define the illness for which they thought tonsillectomy was beneficial but excluded all but 187 of 2043 children referred to the study. They showed that parental histories were unreliable when recalling the actual frequency of episodes of tonsillitis but the inclusion criteria were so rigid that the results cannot be generalized to all children. It would appear therefore that there is no clear distinction between tonsillitis and other sore throats. Do parents seeking tonsillectomy for their children have a different understanding of sore throats, recognising "tonsillitis" as a separate entity from other sore throats? This question has never been investigated.

- Sleep quality may be different. The obstructive sleep apnoea syndrome is now thought to be caused by hypertrophic tonsils and adenoids in children. The true incidence of this syndrome is unknown but there is evidence that it is often undiagnosed in children awaiting tonsillectomy. Hypoxia has been found in up to 61% of children undergoing routine adenotonsillectomy (163,166). Improvement in sleep quality may be as important to the outcome after tonsillectomy as a change in sore throats. Previous authors have not reported the incidence of symptoms of poor sleep, such as restless sleep and daytime sleepiness, in children awaiting tonsillectomy. This thesis describes sleep quality in both normal children and children awaiting tonsillectomy.

- There may be a social or familial predisposition to tonsillectomy. The literature refers to many other factors that are said to influence the frequency of tonsillectomy that could have a bearing on the frequency of tonsillitis and the benefit of tonsillectomy. These include:

➢ Social class has long been associated with variations on the tonsillectomy rate with the higher social classes having a higher incidence of tonsillectomy (4,9).

➢ Parental smoking has been associated with a higher incidence of tonsillectomy (147,148).

➢ There is a higher incidence of tonsillectomy in children whose mothers have gynaecological problems (155) or who have required psychotrophic drugs (156).

➢ There is a higher incidence of tonsillectomy in children whose parents have undergone tonsillectomy (157,158).

➢ Atopy is associated with a higher incidence of respiratory tract infections in general (29,58,159).

The previous authors have considered these factors as independent variables but, in the clinical situation, there is overlap between them, for example between social class and parental smoking. This greatly complicates the picture and may be responsible for some of the conflicting reports in the literature. In order to attempt to unravel the situation, it is necessary to study the factors together with the benefit of multivariate analysis.

4.2.2 Doctor factors for tonsillectomy

There is evidence to suggest that doctors do not have a clear-cut decision-making process in relation to tonsillectomy as several factors have been shown to influence it. The steps from recurrent tonsillitis to tonsillectomy may therefore have a random element.

- Parental pressure can lead to tonsillectomy being performed more frequently (86,174,175,176,178) but the role of other external pressures, such as the busy-ness of the clinic and the length of the waiting list, has not been examined. The size of this effect has not been measured.

- Individual general practitioners and otolaryngologists appear to have different thresholds for performing tonsillectomy. Forsythe and Logan (174) found differences in the frequency of tonsillectomy within an area served by only one otolaryngologist and attributed the variation to an interaction between the family doctor and parents. Roos *et al.* (11) and Bloor *et al.* (12,13) showed that otolaryngologists have different levels of "acceptance" for tonsillectomy. This was partly influenced by the training that the surgeon has undergone with "high acceptors" being trained in areas with higher tonsillectomy rates. Tucker *et al.* (182) showed poor agreement amongst otolaryngologists regarding the symptoms and signs that may be important when considering performing tonsillectomy on a child.

- The Scottish Tonsillectomy Audit (88) suggested that there is poor agreement between groups of otolaryngologists and general practitioners regarding the necessity for tonsillectomy. The authors demonstrated no relation between the referral rate and the acceptance rate for tonsillectomy but did not examine the indications used by the general practitioners and otolaryngologists when making their decisions.

In summary, then, there is anecdotal evidence that tonsillectomy has a beneficial effect in children upon whom it is performed for recurrent tonsillitis. Assuming this is a real effect, it has not been shown in the medical literature by the usual methods of randomised controlled trials. This may mean that the studies have failed to show the benefit or that the operation is not beneficial. The studies may have failed to demonstrate benefit because of poor design, incorrect inclusion criteria or inadequate outcome measures. Many other factors such as social class and family medical history have been shown to influence the tonsillectomy rate and this supports the hypothesis that measuring benefit only in terms of reduction in number of sore throats may be insufficient. If parents' views that tonsillectomy is a successful operation are true, then they should be able to describe the condition that they expect to improve following surgery. Such information has never been sought until now.

There appears to be little agreement amongst doctors regarding the diagnosis of "tonsillitis". Otolaryngologists do not agree about the indications for tonsillectomy and, consequently, there is lack of uniformity in recommending tonsillectomy. Part of the reason for the wide variation in tonsillectomy rate across the country may be related to variations in practice of otolaryngologists, paediatricians and general practitioners. This thesis studies the diagnosis of "tonsillitis", the indications for tonsillectomy used by otolaryngologists, paediatricians and general practitioners and the benefits of tonsillectomy expected by these three groups of doctors to delineate variations in the pathway from recurrent tonsillitis to tonsillectomy. Parental pressure is recognised to influence the decision for performing tonsillectomy by doctors but other factors in the doctor's working conditions such as tiredness and waiting list pressures have not been examined.

4.3 Review of Methods

This section explains the rationale behind the choice of methods for the study and discusses their weaknesses and the errors made during the study.

4.3.1 Choice of methods

This thesis studies the pathway along which a child travels towards tonsillectomy. The literature outlined in Chapter 1 defines this pathway as a series of simple steps, namely a child has sore throats in a certain frequency and then meets the criteria for tonsillectomy whereupon s/he undergoes tonsillectomy. This pathway assumes that the child (if old enough), the parents, the general practitioner and a hospital specialist all recognize the same parameters of illness and act upon them in harmony. But is this what really happens? The wide variation in tonsillectomy rate across the country suggests not and the literature shows that there is poor agreement amongst otolaryngologists and between general practitioners and otolaryngologists about the indications for tonsillectomy. Also, there is little evidence from randomised controlled trials to suggest that tonsillectomy has a beneficial effect in children with recurrent tonsillitis. This is contrary to the claims made by parents following the operation (88). Because of the apparent uncertainty about tonsillectomy, I believed there was a need to examine the tonsillitis / tonsillectomy question from a different perspective.

In the medical literature, much greater significance is given to quantitative research with its tight definitions and statistical tests proving or disproving significance than to other forms of research. The ranking of evidence in "Evidence Based Medicine" regards the outcomes of randomised controlled trials as much more important than evidence from more qualitative methodologies (221). Randomised controlled trials form part of the positivist tradition of thinking where only those things that can be measured are regarded as important. Tonsillitis / tonsillectomy has been studied in a positivist manner as described in the literature review in Chapter 1 where only a reduction in the number of sore throats was regarded as a beneficial outcome. This method of study failed to produce the answers that were sought or expected and this suggests that the benefit gained from tonsillectomy cannot be measured in such restricted terms.

Similarly, the steps along the pathway from recurrent tonsillitis to tonsillectomy may not be measurable in a simple positivist manner with so many episodes of tonsillitis justifying tonsillectomy. Such a suggestion reduces the decision to perform tonsillectomy to one factor only – the number of episodes of tonsillitis. Many other factors may influence the pathway, for example, the interaction of the child with the parents, the parents' understanding of tonsillitis and pharyngitis, the interaction of the parents with the general practitioner, the general practitioner with his/her understanding of the role of tonsillectomy, the parent with the otolaryngologist and the otolaryngologist with his/her understanding of the role of tonsillectomy. This thesis studies the factors that relate to the definition of tonsillitis and the indications for tonsillectomy.

As an alternative approach to research methodology, qualitative methods are often regarded as "soft" by the medical profession and are thought to be unable to provide the absolute answer through mathematical testing. They are, however, used widely in the social sciences. There is recognition that the findings of randomised controlled trials are often difficult to apply in day-to-day clinical practice. People are more complex than the subjects of natural science experiments and the interactions between patients and health professionals play an important role in the response to treatment (199). Qualitative research aims to develop concepts that "*help us to understand social phenomena in natural (rather than experimental) settings, giving due emphasis to the meanings, experiences and views of all the participants*" (199). The research starts with an intention to explore a particular area where data are collected. This process generates ideas and hypotheses. Qualitative analysis can therefore help to identify the proper questions that can then be addressed in quantitative studies. "*Until something is classified, it cannot be measured*" (199).

As this thesis studies the perspective of parents, otolaryngologists, paediatricians and general practitioners regarding tonsillitis and tonsillectomy, qualitative methods are needed to help gain an understanding of the views of each group individually but more quantitative methods are needed to test the hypotheses generated from the literature research in Chapter 1. A method that spans the quantitative and qualitative traditions of research was therefore needed for the study. A case-control survey method was chosen for several reasons:

- It allows testing of hypotheses
- It is best suited to a condition with a relatively long latent period. Although each episode of tonsillitis does not have a long latent period, the pathway from recurrent tonsillitis to tonsillectomy does as the guidelines recommend a two-year history of sore throats before undertaking tonsillectomy
- It is best suited where multiple aetiological factors are to be studied simultaneously
- A questionnaire could be used as the method of data collection with focussed forced choice questions that allowed statistical analysis of the answers.

4.3.2 Weaknesses of methods

Inevitably, practical difficulties, oversights and accidents produce methodological imperfections. If the researcher is aware of these imperfections, examines their impact on the results and in the interpretation of the findings, then even imperfect studies can be sound and useful.

The main imperfections of this study are

- Lack of validation of the questionnaire design
- Inconsistency of the answer models for the questions
- Non-responders
- Possible data transcription errors
- Assumptions

and these are all discussed in the section below.

4.3.2.1 Lack of validation of the questionnaire

The main problem is that the research vehicle used in this study has not undergone a process of validation. Validation is desirable because it maximises objectivity, helps with accurate interpretation and gives scientific integrity. However, lack of validation does not mean that there is no merit in the research presented in this thesis. No validated questionnaire was available for use in children at the time of the study and producing such a questionnaire takes many years of work before it can be used in the field. As a result, it was necessary to develop my own questionnaires. In doing this, I made attempts to randomise the questionnaires and to make them as robust as possible. The steps undertaken were discussed in detail in Chapter 2.

4.3.2.2 Inconsistency of answer models

There are areas of the questionnaires that I would alter before using them again. The format of the questions in the parent questionnaire was inconsistent from one question to the next. For example, in questions 4, 5 and 6 the answer options were as shown:

Q4	Never		Sometimes	Often	Always		Only if tonsillitis
Q5	Never	Rarely		Often	Always		Only if tonsillitis
Q6	Never	Rarely	Sometimes	Often	Always	Only if sore throat	Only if tonsillitis

Adding extra answer options as the questions progressed did not help in the analysis of the data and may have made the questionnaire appear daunting to some parents. During analysis, some of the data from the extra answer options were excluded, as few parents had chosen them, so increasing the amount of apparent "missing data" and weakening the results.

4.3.2.3 Non-responders

Non-responders limit the reliability of any postal questionnaire survey. There is a possibility that the non-responders may represent a totally separate subgroup of the whole population. Therefore, omitting their views from the analysis may introduce a significant bias. Ideally, some demographic data should be collected about the non-responders so that comparison can be made between them and the responders. Such data was not collected and this represents an error of omission in the study design. The size of the error cannot be estimated but is related to the number of non-responders.

In this study, the non-responder rates were

Otolaryngologists	39.7%
Paediatricians	20.8%
General practitioners	21%
Normal population parents	21.1%
Waiting list population parents	20.9%

These response rates compare very favourably with other published questionnaire surveys (68,99,107) where non-responder rates of 22.4%, 33.3% and 58% respectively were reported.

In order to secure the highest response rate possible, two reminder letters were sent to all the selected participants along with a copy of the questionnaire. The Waiting List population only received one reminder as their response rate was already equal to the other groups at that point.

Some questionnaires returned by parents and doctors were incomplete. These were included in the analysis as to exclude them would have reduced the numbers in the study quite considerably. Different respondents omitted different parts of the questionnaires. During analysis, those whose data was incomplete were excluded for the particular question that was unanswered but their answers to other questions were included.

The responses of parents who replied to the third mailing of the questionnaire to the Normal population were compared with those of parents who had responded to the earlier mailings. Comparison was made of the number of sore throats per year, the age at first sore throat, the duration of sore throats, the number of episodes of tonsillitis per year, the number of colds per year and social class according to parental occupation. The results are shown in Appendix 7. There was no difference between early and late replies. Although this analysis does not prove that the non-respondents are not a completely separate population from the respondents, it provides some evidence that this may not be so.

4.3.2.4 Data transcription

Data transcription from the questionnaire sheets onto a spreadsheet was all performed by the author with no cross checks by another investigator so error may have been introduced at this stage. No estimation of the error can be made.

4.3.2.5 Assumptions

All research makes some assumptions and these may have significant effects on the reliability of the methods employed. The assumptions made by this research include:

- Respondents have answered the questionnaires truthfully.

There is a risk of untruthful answers in questionnaires that may arise deliberately, instinctively or accidentally. The questions may be biased towards a certain answer or the respondents may answer in such a way as to please the investigator rather than giving their real opinion. This is known as "acquiescence". Long questionnaires may cause responders to lose interest and complete them quickly without adequate concentration, hence leading to inaccuracies. Memory of events in the past may be inaccurate. For example, events are more likely to be remembered and given significance if they occurred around the time of an illness rather than at a time of good health. This is known as "recall bias" and is a recognised source of bias in case-control studies (195,222).

In order to estimate the size of the effect of this assumption, I compared the answers of the Normal population parents with entries in the general practitioner's case notes. I used the estimated number of visits to the general practitioner's surgery and the number of antibiotics prescribed for sore throats as points for comparison. The results, shown in detail in Appendix 7, show that parents have a poor numerical memory of the number of visits to the general practitioner and the number of antibiotics prescribed and greatly overestimate both. This confirms the findings of Paradise *et al.* (2) who showed that children rarely continued to have sore throats in the frequency suggested by the parental history when the children were carefully followed up. However, in my data, there is a trend showing that those who claim to attend the general practitioner "often or always" with a sore throat attend more often than those who attend "never or rarely". Care must be taken when interpreting information from the questionnaires, especially where the answer has a numerical value. However, in order for this work to be applicable to the outpatient setting, where the parental history is the basis of treatment, I have had to accept the assumption that the parental answers represent the true events in their children's lives.

- The "Normal" population is representative of a normal community.

There is no evidence to confirm or refute this assumption. Frome has been used in epidemiological studies before but the authors have not shown that the population is normal in the statistical sense. In this study, Frome was chosen to represent the population served by the Royal United Hospital, Bath, from which the Waiting List population was selected. It is assumed that the results of the parent questionnaire study can be generalized to any area in the Bath District Health Authority. On a larger scale, however, it cannot be assumed that the results of this study can be generalized to an urban or larger U.K. population. Frome is a small market town in a predominantly rural area and cannot therefore be assumed to represent the U.K. as a whole. In particular, it does not approximate to inner city areas or communities with a large ethnic population. Similarly, a study performed in an inner city area may not be applicable to Frome. A parallel study in an inner city area might have been useful.

- The non-responders do not represent a separate population from the responders.

Failure to collect data about the non-responders represents an error of omission in the study and the size of the error cannot be estimated except by the size of the non-responder group. The steps taken to reduce the size of the non-responder population have already been discussed as has the comparison made between those respondents who replied to the third posting of the questionnaire and those who replied to the earlier postings. The results show that there is no difference between the late respondents and the earlier respondents. Although this finding does not prove that the non-responders are not a separate population, it does reduce the risk that it is so.

- In question 4 of the parent questionnaire, that deals with the symptoms that occur at the same time as a sore throat, the answers to "Only if tonsillitis" are assumed to represent the clinical picture of tonsillitis whereas those to "Often and Always" are assumed to represent other sore throats that are not tonsillitis.

This assumption was made before the analysis was performed but the results outlined in Chapter 3, showing that parents recognise two different patterns of sore throat illness, suggest that the assumption is true.

- Previous research performed in Frome has not altered the practice of the general practitioners.

It is important to investigate this assumption as the attitude of the general practitioner may have a significant effect upon the attitude of his/her patients. If the general practitioners in Frome have a different understanding of the diagnosis of tonsillitis and the indications for tonsillectomy than other general practitioners in the Bath District Health Authority, they could have taught the Normal population about their views. This teaching could skew the Normal population away from normality and therefore the results of the parent questionnaire in Frome could not be generalized to a larger population.

The comparison between the Frome and other Bath District Health Authority general practitioners is shown in full in Appendix 7. The comparison showed no difference in terms of age and experience in general practice or otolaryngology. All general practitioners associated the same symptoms with tonsillitis, pharyngitis and upper respiratory tract infection and quoted the same reasons for referral to hospital for tonsillectomy. The only difference was that the Frome general practitioners appeared to have more expectation that the features associated with the obstructive sleep apnoea would improve following tonsillectomy than did the other general practitioners. This may be a consequence of the previous study performed there about snoring and sleep patterns in children (168). However, I do not believe that the difference in the expectations following tonsillectomy have had a significant effect upon the results of this study because the Normal population reported many fewer problems with sleep disturbance than did the Waiting List population. The Normal with Tonsillitis subgroup of the Normal population had even less sleep related symptoms than the Normal population as a whole despite having more tonsillitis. This suggests that the Normal population do not have an increased awareness of any potential link between tonsillitis and disturbed sleep.

4.4 Summary of Significant Results

This section will summarise the results from the thesis that give clearer understanding to the pathway from recurrent tonsillitis to tonsillectomy and will discuss their significance in the light of the previous literature. The results of the parental questionnaires are discussed first (sections 4.4.1 and 4.4.2) followed by the results of the doctors' questionnaires (sections 4.4.3 to 4.4.6).

4.4.1 Parental diagnosis of tonsillitis

This will be discussed under the headings of symptom complexes, sleep patterns and behaviour.

4.4.1.1 Symptom complexes

The symptom complexes that parents use to diagnose tonsillitis and other sore throats are:

- For tonsillitis
  - Pain on swallowing
  - Raised temperature
  - Poor sleep
  - Poor appetite
  - Bad breath
  - Sickness or vomiting

- For other sore throats
  - Mouth breathing
  - Snoring
  - Noisy breathing
  - Raised temperature
  - Eating slowly / noisily

- Blocked nose
- Cough
- Poor appetite

Parents can clearly identify two patterns of sore throats by using symptom complexes. This has not been demonstrated previously. The results in Chapter 3, section 3.4.2, suggested that the knowledge about sore throats might be gained through the experience of the child having repeated episodes of tonsillitis. The parents of the Waiting List children produced much clearer pictures of tonsillitis and other sore throats than the parents of the Normal population. Parents of the "Normal with Tonsillitis" group appeared to have knowledge of the diagnostic features of tonsillitis and other sore throats that was intermediate between the Waiting List and Normal populations.

The finding that parents can differentiate tonsillitis from other sore throats suggests that the first step along the pathway from recurrent tonsillitis to tonsillectomy is clearly defined. Parents appear to consistently describe the illness for which they seek treatment. However, it is unlikely that this tells the whole story.

Paradise *et al.* (2) found that parental histories were unreliable in terms of the frequency with which children were ill with sore throats. Parents overestimated the frequency with which sore throats occur. My findings agree with those of Paradise *et al.* as I have shown that parents were not good at recalling the number of consultations with the general practitioner for sore throats or the frequency with which the child had required antibiotics. Why should there be such an apparent discrepancy between parents' ability to remember the symptoms of a sore throat and their memory of the frequency with which the sore throats occur? An inaccurate memory of the frequency of sore throats and antibiotic consumption may suggest that these features are not the factors relating to tonsillitis that parents find most concerning, even though they are factors that are ranked high on the doctors' lists for indications for tonsillectomy as shown in section 3.15. Parents may learn to exaggerate the frequency of tonsillitis in order to give the doctor the history s/he wants in an attempt to secure tonsillectomy for their child. This would be an example of "faking bad" – exaggerating the symptoms for gain. Alternative, parental concern may result in a perception that the child was ill more frequently than truly was the case. This is an example of "recall bias".

The next two points discuss other areas where parents might hope to see improvement following tonsillectomy.

4.4.1.2 Sleep quality

Section 3.6 of Chapter 3 showed that disturbed sleep is common both in children awaiting tonsillectomy and in children from a normal population cross-section. The following features are significantly more common in the Waiting List population:

- Sleeping with mouth open
- Snoring
- Restless sleep
- Irregular breathing
- Frequent wakening
- Sweating attacks
- Choking

Inclusion of the Normal with Tonsillitis group showed no trend to suggest that sleep quality becomes worse as the frequency of tonsillitis increases. In fact, the Normal with Tonsillitis group has fewer symptoms of disturbed sleep than the Normal population as a whole.

In the medical literature, there is disagreement about sleep quality in children awaiting tonsillectomy compared with normal children. Stradling (163) and Croft (166) showed a greater incidence of disturbed sleep or latent obstructive sleep apnoea in children awaiting tonsillectomy than in normal controls. Owen (168) found no evidence to support the assertion that disturbed sleep is more common in children awaiting tonsillectomy.

This thesis has shown that sleep quality is worse in children awaiting tonsillectomy but that restless sleep in common in all children.

It could be argued that a sleep study would be diagnostically more accurate than parental observation. In its most basic form, the sleep study provides information about the pulse rate and oxygen saturation during sleep. It reduces the measurement of sleep quality to the length of time spent with an oxygen saturation below a certain figure – usually 96% . However, it is recognised that hypapnoeas can occur. These are mini-arousals from sleep that are not associated with desaturation but are associated with a feeling of poor sleep and tiredness the following day. It is not known how much effect undergoing a sleep study has upon the quality of sleep during the test.

Relying on parental observation of sleep quality is not as scientifically rigorous as the sleep study. It does not produce figures and tracings of oxygen saturation. The method does, however, reflect the practice in the out-patient setting. This thesis has shown that parental observation is capable of accurate diagnostic description in children with recurrent tonsillitis and the thesis reports on larger populations than were studied in the previous reports. Parental observation has the strength of greater generalizability to the population of all children aged between three and eleven years but at the expense of loss of reliability.

The thesis has shown that features of disturbed sleep are reported more frequently in children awaiting tonsillectomy. However, there is no evidence of a trend for increasing sleep disturbance as the frequency of tonsillitis increases. The Normal with Tonsillitis subgroup of the Normal population appeared to sleep better than the Normal population as a whole despite having more tonsillitis. There are several possible explanations for the finding:

- There is no relation between tonsillitis and sleep quality. The thesis supports this suggestion and agrees with the findings of Owen (168).

- Children who have recurrent tonsillitis and sleep badly may be referred to hospital for tonsillectomy more quickly than children with recurrent tonsillitis who sleep well.
- Disturbed sleep becomes a feature of recurrent tonsillitis only when the frequency of episodes exceeds a certain level that the Normal with Tonsillitis group did not reach. The Waiting List population had on average 6.7 episodes of tonsillitis per year and the Normal with Tonsillitis group 2.5.
- Disturbed sleep is related to tonsil size. This in turn could be dependent upon the number of episodes of tonsillitis as Brodsky *et al.* (125) showed an association between bacterial load and tonsil size and between the frequency of tonsillitis and bacterial load.

Further investigation is required to evaluate more fully the relationship between recurrent tonsillitis and sleep quality.

4.4.1.3 Behaviour

The parents of the Waiting List children reported poorer behaviour patterns in their children than the parents of the Normal population. Irritability, poor concentration, hyperactive behaviour, morning sleepiness, aggressive behaviour, daytime sleepiness and headache were all more common in the Waiting List children. During an episode of tonsillitis, the features of daytime behaviour change with sleepiness becoming most prominent. Similarly, general behaviour, general health, appetite and school progress are all significantly worse in children awaiting tonsillectomy than in normal children.

This section of the research was an attempt to begin to examine what it means to be healthy. The idea of health has changed considerably over recent decades. The presence or absence of disease has been replaced by a multi-dimensional definition where health is a more positive entity than simply the absence of illness. The World Health Organisation defines health as "a state of complete physical, mental and social well-being and autonomy and not merely the absence of disease or infirmity" (224). With this change in the concept of health comes the need to change how we measure health and the challenge of measuring differences in the health of relatively well individuals. For this purpose, disease specific validated questionnaires are needed that cover not only the physical aspects of the illness but also the psychometric impact of the disease. At the time of the study, no such questionnaire was available and this is still the case. A questionnaire has been designed to measure the impact of otitis media with effusion on all aspects of a child's health (225) and it likely than some parts of this questionnaire could be adapted for use in children with recurrent tonsillitis.

4.4.1.4 Summary

The thesis has shown that parents recognise different symptom complexes for the sore throats that they call tonsillitis and other sore throats that they do not call tonsillitis. The knowledge of these symptom complexes appears to be learnt through the experience of the child having tonsillitis. Parents also appear to recognise that there are other aspects of their child's health that deteriorate when the child has recurrent tonsillitis. Children awaiting tonsillectomy have significantly more disturbed sleep patterns than their normal peers. It is difficult to be certain that this is in fact related to recurrent tonsillitis as there was no pattern of increasing sleep disturbance with increasing frequency of tonsillitis. Children awaiting tonsillectomy also appear to have more behavioural problems than the children from the Normal population. These findings suggest that there is more to tonsillitis than just a sore throat and that factors other than the frequency with which the sore throats occur are important in relation to the child's health. It is likely that factors such as sleep quality and behaviour influence parents when they make the first step along the pathway from recurrent tonsillitis to tonsillectomy.

4.4.2 Social and familial factors

Social class, parental employment, single parent family status, family size and parental smoking have no effect on the frequency of tonsillitis or incidence of tonsillectomy in either population – see section 3.8 of Chapter 3 for full details. This finding confirms the report of Bloor *et al.* (12,13) who stated that variations in the tonsillectomy rate according to social class had disappeared but contradicts the reports of Bisset and Russell (4) who found that such variations persisted. Bisset and Russell performed their study in Scotland and it is likely that differences in the socio-economic climates of Scotland and rural England are responsible for the conflicting results. In the question of the effect of social class upon the tonsillectomy rate, I would accede that the findings of this study cannot be generalized to the United Kingdom as a whole.

Said *et al.*(147) and Hinton *et al.*(148) reported a higher incidence of tonsillitis and tonsillectomy in children whose parents smoked. They did not consider the contributory effect of social class in their studies. When this effect was considered in this thesis, no significant relationship was found between cigarette smoking and tonsillitis or tonsillectomy in children. Therefore, the findings of the previous studies should be rejected on the grounds of inadequate study design.

Section 3.9 of Chapter 3 showed that a history of parental tonsillectomy has a significant effect upon the number of sore throats in children, as reported by parents. In the Waiting List population, children with a parental history of tonsillectomy have *fewer* sore throats and *less frequent* tonsillitis than children whose parents have not undergone tonsillectomy. In the Normal population, children with a parental history of tonsillectomy have *more frequent* tonsillitis than children whose parents have not undergone tonsillectomy. In addition, there were significantly more families in the Waiting List population where parents have undergone tonsillectomy than in the Normal population.

This thesis confirms the reports of Katznelson and Gross (157) and Domenighetti and Bisig (158) who also found a significant correlation between parental tonsillectomy and tonsillectomy in children. The discovery that parents who have undergone tonsillectomy appear to secure the operation for their children when the children have had relatively fewer episodes of tonsillitis is new. It may suggest that adults who have undergone tonsillectomy believe that the operation has a beneficial effect and request tonsillectomy for their children sooner than those adults who have no personal experience of tonsillectomy. The possibility that parents' requests may have an influence on whether or not their child undergoes tonsillectomy raises the issue of the effect of parental pressure on the decision making process for tonsillectomy. It suggests that, at least in some cases, the pathway from recurrent tonsillitis to tonsillectomy is initiated by parental request.

4.4.3 Definition of "tonsillitis", "pharyngitis" and "upper respiratory tract infection" by otolaryngologists, paediatricians and general practitioners

Section 3.12 showed that otolaryngologists and paediatricians do not differentiate between "tonsillitis" and "pharyngitis" in day-to-day practice although 75% of otolaryngologists and over 90% of paediatricians claim that they try to. General practitioners do differentiate between these diagnoses. All three groups of doctor recognise "upper respiratory tract infection" as a separate clinical entity.

In complete contrast to the clear distinction between tonsillitis and other sore throats produced by the parents, the three groups of doctors do not differentiate well between tonsillitis and pharyngitis. Tucker (182) showed poor agreement amongst otolaryngologists regarding the symptoms and signs associated with tonsillitis and this thesis agrees with the finding. It has also shown that the same disagreement exists amongst paediatricians and general practitioners and between otolaryngologists, paediatricians and general practitioners.

Over a quarter of otolaryngologists and almost 10% of paediatricians and general practitioners do not attempt to differentiate between the diagnostic terms "tonsillitis", "pharyngitis" and "upper respiratory tract infection" in day-to-day practice. This may indicate that they do not regard the distinction between the terms "tonsillitis" and "pharyngitis" to be important or that they believe that the terms represent the same illness and require the same treatment.

The poor agreement about the diagnosis of tonsillitis has implications for the decision making process for tonsillectomy. Section 3.14 illustrated that most doctors believe that "frequency of episodes of tonsillitis" is the most significant factor in the decision to perform tonsillectomy. However, if there is no agreement about the diagnosis of tonsillitis, there can be no agreement about when tonsillectomy is indicated. This part of the pathway from recurrent tonsillitis to tonsillectomy will remain unpredictable until or unless agreement can be reached regarding the diagnosis of tonsillitis.

4.4.4 Indications for tonsillectomy

There is poor agreement amongst otolaryngologists, paediatricians and general practitioners regarding the indications for tonsillectomy. All three groups recognise the significance of the frequency of documented tonsillitis and the number of days missed from school.

Tucker *et al.* (182) showed that there was poor agreement amongst otolaryngologists regarding the indications for tonsillectomy. This thesis has confirmed the finding and shown that the disagreement is also found amongst general practitioners and paediatricians. All three groups of doctors agree that "frequency of documented tonsillitis" and "time lost from school" are important indications for tonsillectomy but other factors such as tonsil size and poor general health receive mixed responses. This may indicate that doctors base their decision to perform tonsillectomy upon factors that can be measured easily, *e.g.* number of episodes of tonsillitis and number of days off school, and so reduce the decision to a combination of numbers. This explanation fits well with the positivist view of medical decision-making but is it really what happens?

This thesis has shown that doctors are not agreed about the diagnosis of tonsillitis and the Scottish Tonsillectomy Audit (88) showed no correlation between the referral and acceptance rates for tonsillectomy. Therefore, it appears that some other, possibly subjective, element plays a role in the decision to refer a child for or accept a child for tonsillectomy.

Venters and Bloor (145) showed that general practitioners have varying thresholds for referring children to hospital for tonsillectomy and that otolaryngologists have similar variations in their acceptance of such referrals. The "high acceptors" defined in the paper used several features of the child's history and examination, such as tonsil size, poor sleep quality and poor general health, to decide whether or not to perform tonsillectomy. The "low acceptors" used simply those factors that can be reduced to a numerical value. This suggests that some otolaryngologists work strictly in a positivist paradigm whilst others have a more holistic approach to the patient. Such doctors may believe that tonsillitis is more than a sore throat and recognise more wide-reaching effects on the child's health.

Is there any evidence for this supposition? A positivist thinker could be expected to attempt to differentiate tonsillitis from pharyngitis by the clinical history (only 68% of otolaryngologists always do this) and to adhere strictly to written guidelines for tonsillectomy (only 10% of otolaryngologists always use the guidelines). It appears that other factors influence the decision to perform tonsillectomy.

Table 3.31 showed poor correlation between the otolaryngologists, paediatricians and general practitioners regarding the indications for tonsillectomy. There are two ways to interpret the data from that table. The first interpretation is that only the top two ranked items that the doctors all agree upon are important for the answer. The other items were forced because the questionnaire was designed with more than two spaces for answers and the doctors felt obliged to fill the spaces. Analysis of unimportant answers has resulted in the finding that doctors are poorly agreed about the indications for tonsillectomy. The truth is that the doctors are very closely agreed and only two features are important to the decision to perform tonsillectomy. Evidence from clinical practice suggests that this is not the true interpretation of what happens.

Another interpretation is that the first two features represent what the respondents thought was the "correct" answer and the later responses represent the more private thoughts. Survey methods often identify the public thoughts of the respondent but in depth interviews may be needed to uncover the private and often contradictory views that people hold (223). In the context of this study, the "correct" answer is the one that fits into the traditional positivist thinking of the medical profession – the frequency of sore throats. Randomised controlled trials that used frequency of sore throats as the outcome measure may have legitimised this feature as the most important when considering tonsillectomy even though the studies did not prove benefit. The private thoughts are those that reflect personality, are gained through experience of treating children and are affected by the working conditions in which the doctor finds him/herself. These factors have not received much research attention and such research involves qualitative methods that are not so highly regarded. Therefore, the private thoughts remain unspoken and their influence on the decision to perform tonsillectomy remains poorly investigated. The implementation of the private thoughts may influence whether any doctor is a "high acceptor" or a "low acceptor". This interpretation of the data is subjective and represents an area where further research is required to determine what are the important factors in the decision to perform tonsillectomy.

4.4.5 Expected benefits of tonsillectomy

Section 3.15 showed that there is poor agreement amongst otolaryngologists, paediatricians and general practitioners regarding the benefits expected following tonsillectomy. All three groups of doctors quoted decrease in the frequency of sore throats as the main benefit expected but the view was not universal amongst all doctors. Only 64.4% of paediatricians and 80.3% of general practitioners expected fewer sore throats after tonsillectomy whereas 100% of the otolaryngologists held this belief. Paediatricians had more expectation of improvement in restless sleep, daytime sleepiness, frequent wakening, morning sleepiness, irregular breathing, morning irritability and poor concentration. Otolaryngologists had little expectation of benefit in these factors and general practitioners fell in between.

The benefits expected after tonsillectomy have not been previously investigated. There is some evidence in the literature to suggest that improvement in sleep quality or relief of the obstructive sleep apnoea syndrome may be part of the benefit following tonsillectomy because of the reports of a high incidence of disturbed sleep in children awaiting tonsillectomy (163,166). This thesis has shown that there is poor agreement amongst otolaryngologists, paediatricians and general practitioners about the benefits of tonsillectomy. The reasons for the differences in expectations following tonsillectomy are unclear. Children with recurrent tonsillitis are not routinely referred to paediatricians in this country whereas those with symptoms related to OSA may be more likely to be referred to a paediatrician. The different expectations of benefit following tonsillectomy may be a reflection of the patient populations treated by otolaryngologists, paediatricians and general practitioners. Further research is needed.

4.4.6 Non-clinical factors influencing decision to perform tonsillectomy

Section 3.16 showed that many factors influence the decision to perform tonsillectomy. These include second or third referral of same child by general practitioner, assertive parents, sibling reported as having benefited from tonsillectomy, and a doctor's child. Factors relating to parental assertiveness have the most influence upon the decision-making process.

Parental pressure has been shown to have an influence on the decision-making process for tonsillectomy in children (86,174). In this study, 83.3% of otolaryngologists admit that assertive parents may influence their decision even if they do not think that tonsillectomy is clinically indicated. The "high acceptors" discussed above may be those doctors who are most susceptible to parental pressure but other influences also contribute to variations in the decision making process.

Several other factors have been identified in this study that may influence the decision to perform tonsillectomy, namely a very busy clinic, feeling tired or having a long waiting list. Re-referral of the child by the general practitioner, the child's sibling either requires or benefited from tonsillectomy or the child has a doctor parent may also influence the decision and these may be further expressions of parental pressure. None of the factors is covered by the guidelines for tonsillectomy. The guidelines, therefore, appear to be much too simplistic to give adequate advice or direction to the doctor trying to decide if a child requires tonsillectomy.

4.5 Future Work

Many questions remain unanswered about the pathway from recurrent tonsillitis to tonsillectomy and the benefit of tonsillectomy. This thesis has shown that parents whose children are awaiting tonsillectomy have a clear clinical picture of the sore throat illness that they call tonsillitis. They also report that their children sleep less well than normal children and that they have poorer patterns of behaviour. Further research is needed to evaluate all of these factors and to determine which are the most significant when parents seek tonsillectomy for their children. Methods involving psychometric analytic comparison of normal children with children awaiting tonsillectomy are needed to determine how children awaiting tonsillectomy differ from their normal peers, if at all. Such research is being undertaken at the University of Nottingham. A similar comparison is needed in children before and after tonsillectomy to determine what changes the operation has brought about.

Further research is required to determine the relationship between recurrent tonsillitis and sleep. This thesis shows that children awaiting tonsillectomy sleep less well than their peers but that children having less frequent tonsillitis have less sleep disturbance than the normal children. Does this finding indicate that there is no association between recurrent tonsilitis and sleep quality or is there a type of "rate-limited" response where tonsillitis has to occur above a certain frequency before the effects are noticed? In this study, the Normal with Tonsillitis group only comprised 65 children so a much larger population study is required to investigate the question of tonsillitis and sleep.

The thesis has confirmed the influence of parental tonsillectomy on the likelihood that a child will also undergo the operation. A study of parents' opinions about the surgery may help unravel whether the operation is performed for benefit or ritual. In-depth interviews and focus groups would help to discover what benefit parents who have undergone tonsillectomy expect to see in their child following the operation.

More understanding is needed of the process by which a decision is made to perform tonsillectomy and why some doctors are "high acceptors" and others are "low acceptors". Observational techniques, in-depth interviews to discuss what has been observed, focus groups and consensus methods would all contribute to the area.

Further steps should be taken in the development and validation of the questionnaires.

4.6 Conclusion

This thesis has studied the pathway along which children with recurrent tonsillitis move towards tonsillectomy, studying the views of parents, otolaryngologists, paediatricians and general practitioners. A simple model of this pathway describes a child with recurrent tonsilltis meeting the criteria for tonsillectomy and undergoing the operation. Such a model suggests that parents and doctors have a clear and unanimous idea about the diagnosis of tonsillitis, the indications for tonsillectomy and the benefits of this surgery.

However, the data in this thesis show clearly that this is not the case. The individual steps are not certain and the individuals making the decision at each point are influenced by many factors that have not be determined or investigated.

For the first time, it has been shown that parents have a clear view of the symptoms that are associated with a sore throat that they call "tonsillitis" and the symptoms associated with other sore throats. These sore throats are different from one another. They also recognise that children awaiting tonsillectomy have poorer sleep quality and poorer behaviour patterns that children from a normal population. The initial step from recurrent tonsillitis in the community to seeking medical advice or intervention appears to be well established, if not well investigated.

Conversely, doctors appear not to have a clear opinion regarding the diagnosis of tonsillitis, the indications for tonsillectomy or the benefits to be gained by the operation. Tonsillitis and pharyngitis are poorly differentiated from one another and many doctors do not even attempt this differentiation. Upper respiratory tract infections are recognised as a different entity.

Doctors are poorly agreed about the indications for and expected benefits of tonsillectomy. Use of the recommended guidelines is limited and this may indicate that they are inadequate for the purpose of deciding which children require tonsillectomy. Rather than stick to rigid guidelines for tonsillectomy, otolaryngologists are swayed in their judgement by things such as parental pressure, busy clinic and length of waiting list.

This thesis has shown the need for further study into the reasons for performing tonsillectomy in children, using more qualitative methods of research. Throughout the twentieth century, the indications for tonsillectomy changed but were never well defined. Even when guidelines were written, the decision was often influenced by non-clinical factors. Randomised controlled trials failed to demonstrate the beneficial effect of tonsillectomy that parents report. As society's view of health widens in keeping with the World Health Organisation's definition moving away from the "absence of disease" to the presence of physical, mental and social well-being so more qualitative approaches will be needed to research the wider impact of tonsillitis and other medical conditions upon health.

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APPENDIX 1 - QUESTIONNAIRES

Parental questionnaire, version 1

If you have a telephone and you would not mind if I rang you about any of your answers that I could not understand, please put in your number. ____________________

Please complete the following questionnaire about and his family.

1. (a) Date of birth __/__/____ (b) Hospital of birth: ____________

(c) Weight at birth (if known) ____________

(d) Did you breast-feed the baby? Yes / No (Please delete.)

(e) If yes, for how long? _____________

2. Illnesses or operations:

(a) Has your child ever had any operations, including tonsillectomy? Yes / No (Please delete.)

(b) Please tell me about all operations and say at what age they were done.

(c) Has your child ever been in hospital for any other reason? Yes/No (Please delete.)

(d) Please tell me about every occasion your child has been sent to hospital.

(e) Is your child on any medicine from your G.P. at the moment? Yes/No (delete.)

(f) If yes, please tell me which medicines your child is receiving.

(g) Has your child been on a course of medicine from your G.P. which lasted for more than six weeks in the past? Yes / No (Please delete.)

(h) If yes, please tell me which medicines your child has received in the past.

3. If your child is not yet at school:

(a) Does your child regularly go somewhere away from home like a nursery or play-school where there are other children? Yes / No (Please delete)

(b) How many children are usually there? ___________ children.

(c) How often is your child there? ___________ days per week.

(d) Does your child attend more than one of these places each week? Yes / No

4. About sore throats:

(a) How many sore throats per year does your child usually have? ________

If your child never has a sore throat, please turn to question 5 (g).

(b) At what age did your child first have a sore throat? ________

(c) How long is your child usually ill when s/he has a sore throat? _____days.

(d) When your child complains of a sore throat, can you tell if this is due to tonsillitis or if it is an ordinary sore throat? Yes / No / Don't know

(e) If yes, how do you tell the difference?

(f) How many of your child's sore throats per year do you think are due to tonsillitis? When your child complains of a sore throat, which of the following happen at the same time? Please tick the appropriate box and answer all questions. You may tick two answers per question if, for example, your child sometimes has bad breath but only if it is tonsillitis.

	Never	Sometimes	Often	Always	Only if it is Tonsillitis
A. Poor appetite					
B. Choking episodes					
C. Bad breath					
D. Earache					
E. Cough					
F. Snoring					
G. Feeling sick / vomiting					
H. Sleeps poorly					
I. Hallucinations					
J. Blocked nose					
K. Fits or seizures					
L. Runny nose					
M. Constipation					
N. Breathing through his/her mouth					
O. Difficulty hearing					
P. Slow / noisy eating					
Q. Noisy breathing					
R. Ear discharge					
S. Tummy ache					
T. Headache					
U. Raised temperature					
V. Diarrhoea					
W. Difficulty or pain on swallowing					

5. When your child complains of a sore throat:

Please tick the appropriate box and answer all questions. You may tick two answers per question.

	Never	Rarely	Some-times	Often	Always	Only if it is Tonsillitis
(a) Does he/she miss fun things like cubs or brownies						
(b) Does he/she stay away from school or play-school						
(c) Does he/she have to stay in bed						
(d) Does he/she have to see the GP						
(e) Does he/she have to get an antibiotic						

(f) Approximately how many days schooling does your child miss each year because of sore throats? _____ days.

*(g) Approximately how many days schooling does your child miss each year for other reasons? _____ days.

(h) Approximately how many colds does your child have each year? _____ colds.

6. Does your child have any of the following features when asleep:

Please tick the appropriate box and answer all questions. You may tick two answers if you wish.

	Never	Rarely	Some-times	Often	Only with a sore throat	Only with Tonsillitis
Irregular breathing						
Restless sleep						
Nightmares/night terrors						
Bed wetting						
Snoring						
Sleeping with mouth open						
Wakening frequently						
Choking						
Thrashing and kicking						
Unusual sleeping position						
Sleep walking/talking						
Grinding teeth						
Sweating attacks						

7. **Does your child have any of the following when awake:**
Please tick the appropriate box and answer all questions.

	Never	Some-times	Often	Always	Only with a sore throat	Only with Tonsillitis
(a) Sleepiness in morning						
(b) Irritability in morning						
(c) Headache in morning						
(d) Poor concentration						
(e) Hyperactive behaviour						
(f) Sleepiness during day						
(g) Aggressive behaviour						

1. **How would you describe your child in the following:**
Please tick the appropriate box and answer all questions.

	Very poor	Poor	Average	Good	Excellent
(a) General health					
(b) Appetite					
(c) School progress					
(d) Behaviour					
(e) Ability to make friends					

Background Family Information

We would like to know if tonsillitis is more common in children whose parents also had tonsillitis. We would also like to know if anything else is important in getting tonsillitis. We therefore need to know some rather personal details about your family. Please let us remind you that this questionnaire is completely confidential.

9. Parents at Home

Father

(a) Name ________________
(b) What is your date of birth? __/__/____
(c) What work do you do? ______________
(d) Are you working now? ______________
(e) Have you had your tonsils removed? Yes / No / Don't know (Please delete)
(f) Have you had any other operations, for example appendicectomy? (Please state)

(g) Are you the natural father? Yes / No
(h) Do you smoke? Yes / No
(i) If no, have you ever smoked? Yes / No
(j) If yes, when did you give up? ________________
(k) What height are you? ________________

Mother

(k) Name ________________
(l) What is your date of birth? __/__/____
(m) What work do you do? ______________
(n) Are you working now? ______________
(o) Have you had your tonsils removed? Yes / No / Don't know (Please delete)
(p) Have you had any other operations, for example hysterectomy? (Please state)

(q) Are you the natural mother? Yes / No
(r) What height are you? ________________
(s) Do you smoke? Yes / No
(t) If no, have you ever smoked? Yes / No
(u) If yes, when did you give up? ________________
(v) Were you smoking when you found out you were pregnant? Yes / No
(w) Did you stop then? Yes /No

(x) Does anyone else living in the home smoke? Yes / No
(y) Are you a single parent family? Yes / No

With regard to the **natural** parents only: (Please leave blank if you do not know this information about the natural parents.)

Do you, or did you as a child, have any of the following: (Please tick the appropriate box)

	Father		Mother	
	Yes	No	Yes	No
(a) asthma				
(b) hay fever				
(c) eczema				
(d) recurrent sore throats / tonsillitis				
(e) allergies - please state				

10. Brothers and sisters

(a) How many children are in your family? _______ children.

Please list all your children, starting with the oldest, and stating the sex and age of each child. Because we are considering the possibility of heredity, we need to know if any of these children have different parents to the child in the study.

Name	Sex	Age	Different Parents (Yes/No)
1.			
2.			
3.			
4.			
5.			
6.			

Please write the name of any of your children who has had any of these problems:

(b) Allergies ____________________
(c) Asthma ____________________
(d) Hay fever ____________________
(e) Eczema ____________________
(f) Chest infections ____________________
(g) Sore throats ____________________
(h) Used to have sore throats but no longer does____________________
(i) Has had tonsils removed ____________________

Thank-you for taking the time to complete this questionnaire. This will help us to improve the treatment of childhood tonsillitis. If you want to make any comments, please feel free to write them on the back of this sheet of paper.

Parental questionnaire, version 2

If you have a telephone and you would not mind if I rang you about any of your answers that I could not understand, please put in your number. ____________________

Please complete the following questionnaire about   and his/her family.

1. (a) Date of birth __/__/____ (b) Hospital of birth: ____________

(c) Weight at birth (if known) ____________

(d) Did you breast feed the baby? Yes / No
(e) If yes, for how long? ____________

2. Illnesses or operations:

(a) Has your child ever had any operations, including tonsillectomy? Yes / No (Please delete.)

(b) Please tell me about all operations and say at what age they were done.

(c) Has your child ever been in hospital for any other reason? Yes / No (Please delete.)

(d) Please tell me about every occasion your child has been sent to hospital.

(e) Is your child on any medicine from your G.P. at the moment? Yes / No (Please delete.)

(f) If yes, please tell me which medicines your child is receiving.

(g) Has your child been on a course of medicine from your G.P. which lasted more than six weeks in the past? Yes ? No (Please delete.)

(h) If yes, please tell me which medicines your child has received in the past.

3. If your child is not yet at school:

(a) Does your child regularly go somewhere away from home like a nursery or play-school where there are other children? Yes / No (Please delete)

(b) How many children are usually there? _________ children

(c) How often is your child there? _________ days each week.

(d) Does your child attend more than one of these places each week? Yes / No

4. About sore throats:

(a) How many sore throats per year does your child usually have? ________

If your child never has a sore throat, please turn to question 5 (g).

(b) At what age did your child first have a sore throat? ________

(c) How long is your child usually ill when s/he has a sore throat? ________ days.

(d) When your child complains of a sore throat, can you tell if this is due to tonsillitis or if it is an ordinary sore throat? Yes / No / Don't know (Please delete)

(e) If yes, how can you tell?

(f) How many of your child's sore throats per year do you think are due to tonsillitis?

When your child complains of a sore throat, which of the following happen at the same time? Please tick the appropriate box and answer every question. You may tick two boxes in answer to a question if, for example, your child sometimes has earache with a sore throat but only if it is tonsillitis.

	Never	Some-times	Often	Always	Only if it is Tonsillitis
A. Cough					
B. Earache					
C. Diarrhoea					
D. Raised temperature					
E. Difficulty or pain on swallowing					
F. Poor appetite					
G. Tummy ache					
H. Bad breath					
I. Sleeps poorly					
J. Choking episodes					
K. Headache					
L. Blocked nose					
M. Feeling sick / vomiting					
N. Snoring					
O. Runny nose					
P. Fits or seizures					
Q. Hallucinations					
R. Noisy breathing					
S. Ear discharge					
T. Noisy / slow eating					
U. Breathing through his/her mouth					
V. Difficulty hearing					
W. Constipation					

5. What happens when your child complains of a sore throat ?
Please tick the appropriate box and answer all questions. Again, you may tick two boxes if two answers are appropriate.

	Never	Rarely	Some-times	Often	Always	Only if it is Tonsillitis
(a) Does he/she miss fun things, e.g. cubs or brownies						
(b) Does he/she stay away from school or play-school						
(c) Does he/she have to stay in bed						
(d) Does he/she have to see the GP						
(e) Does he/she have to get an antibiotic						

(f) Approximately how many days schooling does your child miss each year because of sore throats? _____ days.

*(g) Approximately how many days schooling does your child miss each year for other reasons? _____ days.

(h) Approximately how many colds does your child have each year? _____ colds.

6. Does your child have any of the following features when asleep:
Please tick the appropriate box and answer all questions. You may place two ticks per question if you wish.

	Never	Rarely	Some-times	Often	Only with a sore throat	Only if it is Tonsillitis
(a) Wakening frequently						
(b) Bed wetting						
(c) Nightmares/night terrors						
(d) Snoring						
(e) Choking						
(f) Grinding teeth						
(g) Sleep walking/talking						
(h) Irregular breathing						
(i) Sleeps with mouth open						
(j) Restless sleep						
(k) Thrashing and kicking						
(l) Unusual sleeping position						
(m) Sweating attacks						

7. Does your child have any of the following when awake:
Please tick the appropriate box and answer all questions. You may place two ticks per question if you wish.

	Never	Some-times	Often	Always	Only with a sore throat	Only if it is Tonsillitis
(a) Headache in morning						
(b) Sleepiness during day						
(c) Sleepiness in morning						
(d) Irritability in morning						
(e) Poor concentration						
(f) Hyperactive behaviour						
(g) Aggressive behaviour						

8. How would you describe your child in the following:
Please tick the appropriate box and answer all questions.

	Very poor	Poor	Average	Good	Excellent
(a) General health					
(b) Appetite					
(c) School progress					
(d) Behaviour					
(e) Ability to make friends					

Background Family Information

We would like to know if tonsillitis is more common in children whose parents also had tonsillitis. We would also like to know if anything else is important in getting tonsillitis. We therefore need to know some rather personal details about your family. Please let us remind you that this questionnaire is completely confidential.

9. Parents at Home

Father

(a) Name ______________________
(b) What is your date of birth? __/__/____
(c) What work do you do? _______________
(d) Are you working now? _______________
(e) Have you had your tonsils removed? Yes / No / Don't know (Please delete)
(f) Have you had any other operations, for example appendicectomy? (Please state)

(g) Do you smoke? Yes / No
(h) If no, have you ever smoked? Yes / No
(i) If yes, when did you give up? _________________
(j) Are you the natural father? Yes / No
(k) What height are you? _________________

Mother

(k) Name ____________________________
(l) What is your date of birth? __/__/____
(m) What work do you do? _______________
(n) Are you working now? _______________
(o) Have you had your tonsils removed? Yes / No / Don't know (Please delete)
(p) Have you had any other operations, for example hysterectomy? (Please state)

(q) Are you the natural mother? Yes / No
(r) What height are you? _______________
(s) Do you smoke? Yes / No
(t) If no, have you ever smoked? Yes / No
(u) If yes, when did you give up? ___________________
(v) Were you smoking when you found out you were pregnant? Yes / No
(w) Did you stop then? Yes / No

(x) Does anyone else living in the house smoke? Yes / No
(y) Are you a single parent family? Yes/No

With regard to the **natural** parents only: (Please leave blank if you do not know this information about the natural parents.)

Do you, or did you as a child, have any of the following: (Please tick the appropriate box)

	Father		Mother	
	Yes	No	Yes	No
(a) asthma				
(b) hay fever				
(c) eczema				
(d) recurrent sore throats / tonsillitis				
(e) allergies - please state				

10. Brothers and sisters

(a) How many children are in your family? _______ children.

Please list all your children, starting with the oldest, and stating the sex and age of each child. Because we are considering the possibility of heredity, we need to know if any of these children have different parents to the child in the study.

Name	Sex	Age	Different Parents (Yes/No)
1.			
2.			
3.			
4.			
5.			
6.			

Please write the name of any of your children who has had any of these problems

(b) Allergies ________________________________
(c) Asthma ________________________________
(d) Hay fever ________________________________
(e) Eczema ________________________________
(f) Chest infections ________________________________
(g) Sore throats this year ____________________________
(h) Used to have sore throats but no longer does____________________
(i) Has had tonsils removed ____________________________

Thank-you for taking the time to complete this questionnaire. This will help to improve the treatment of childhood tonsillitis. If you want to make any comments, please feel free to write them on the back of this sheet of paper.

Parental questionnaire, version 3

If you have a telephone and you would not mind if I rang you about any of your answers that I could not understand, please put in your number. ________________

Please complete the following questionnaire with respect to and his family.

1. (a) Date of birth __/__/____ (b) Hospital of birth:___________

(c) Weight at birth (if known) ____________

(d) Did you breast-feed the baby? Yes / No
(e) If yes, for how long? ____________

2. Illnesses or operations

(a) Has your child ever had any operations, including tonsillectomy? Yes / No (Please delete.)

(b) Please tell me about all operations and say at what age they were done.

(c) Has your child ever been in hospital for any other reason? Yes / No (Please delete.)

(d) Please tell me about every occasion your child has been sent to hospital.

(e) Is your child on any medicine from your G.P. at the moment? Yes / No (Please delete.)

(f) If yes, please tell me which medicines your child is receiving.

(g) Has your child been on a course of medicine from your G.P. which lasted for more than six weeks in the past? Yes / No (Please delete.)

(h) If yes, please tell me which medicines your child has received in the past.

3. If your child is not yet at school:

(a) Does your child regularly go somewhere away from home like a nursery or play-school where there are other children? Yes / No (Please delete)

(b) How many children are usually there?

(c) How often is your child there? ___________ days each week.

(d) Does your child attend more than one of these places each week? Yes / No

4. About sore throats:

(a) How many sore throats per year does your child usually have? ________

If your child never has a sore throat, please turn to question 5 (g).

(b) At what age did your child first have a sore throat? ________

(c) How long is your child usually ill when s/he has a sore throat? _____days.

(d) When your child complains of a sore throat, can you tell if this is due to tonsillitis or if it is an ordinary sore throat? Yes / No / Don't know (Please delete)

(e) If yes, how do you tell the difference?

(f) How many of your child's sore throats per year do you think are due to tonsillitis? _______

When your child complains of a sore throat, which of the following happen at the same time? Please tick the appropriate box and answer all questions. You may tick two boxes if, for example, your child sleeps poorly sometimes but only if it is tonsillitis.

	Never	Some-times	Often	Always	Only if it is Tonsillitis
A. Choking episodes					
B. Sleeps poorly					
C. Snoring					
D. Raised temperature					
E. Diarrhoea					
F. Noisy / slow eating					
G. Noisy breathing					
H. Tummy ache					
I. Difficulty or pain on swallowing					
J. Hallucinations					
K. Constipation					
L. Fits or seizures					
M. Earache					
N. Breathing through his/her mouth					
O. Runny nose					
P. Bad breath					
Q. Blocked nose					
R. Feeling sick / vomiting					
S. Cough					
T. Difficulty hearing					
U. Ear discharge					
V. Poor appetite					
W. Headache					

5. When your child complains of a sore throat:
Please tick the appropriate box and answer all questions. You may place two ticks if you wish.

	Never	Rarely	Sometimes	Often	Always	Only if it is Tonsillitis
(a) Does he/she miss fun things like cubs or brownies						
(b) Does he/she stay away from school or play-school						
(c) Does he/she have to stay in bed						
(d) Does he/she have to see the GP						
(e) Does he/she get an antibiotic						

(f) Approximately how many days schooling does your child miss each year because of sore throats? _____ days.

*(g) Approximately how many days schooling does your child miss each year for other reasons? _____ days.
(h) Approximately how many colds does your child have each year? _____ colds.

6. Does your child have any of the following features when asleep:
Please tick the appropriate box and answer all questions. You may place two ticks if you wish.

	Never	Rarely	Sometimes	Often	Only with a sore throat	Only if it is Tonsillitis
(a) Snoring						
(b) Sleep walking/talking						
(c) Nightmares/night terrors						
(d) Restless sleep						
(e) Irregular breathing						
(f) Choking						
(g) Sleeping with mouth open						
(h) Bed wetting						
(i) Wakening frequently						
(j) Thrashing and kicking						
(k) Sweating attacks						
(l) Unusual sleeping position						
(m) Grinding teeth						

7. Does your child have any of the following when awake:
Please tick the appropriate box and answer all questions. You may place two ticks if you wish.

	Never	Some-times	Often	Always	Only with a sore throat	Only if it is Tonsillitis
(a) Sleepiness during day						
(b) Headache in morning						
(c) Irritability in morning						
(d) Hyperactive behaviour						
(e) Aggressive behaviour						
(f) Sleepiness in morning						
(g) Poor concentration						

8. How would you describe your child in the following:
Please tick the appropriate box and answer all questions.

	Very poor	Poor	Average	Good	Excellent
General health					
Appetite					
School progress					
Behaviour					
Ability to make friends					

Background Family Information

We would like to know if tonsillitis is more common in children whose parents also had tonsillitis. We would also like to know if anything else is important in getting tonsillitis. We therefore need to know some rather personal details about your family. Please let us remind you that this questionnaire is completely confidential.

9. Parents at Home

Father

(a) Name ______________
(b) What is your date of birth? __/__/____
(c) What work do you do? ______________
(d) Are you working now? Yes / No
(e) Have you had your tonsils removed? Yes / No / Don't know (Please delete)
(f) Have you had any other operations, for example appendicectomy? (Please state)

(g) Are you the natural father? Yes / No
(h) Do you smoke? Yes / No
(i) If no, have you ever smoked? Yes / No
(j) If yes, when did you give up? ___________
(k) What height are you? ___________

Mother

(k) Name __________________
(l) What is your date of birth? __/__/____
(m) What work do you do? __________________
(n) Are you working now? Yes / No
(o) Have you had your tonsils removed? Yes / No / Don't know (Please delete)
(p) Have you had any other operations, for example hysterectomy? (Please state)

(q) Are you the natural mother? Yes / No
(r) What height are you? ______________
(s) Do you smoke? Yes / No
(t) If no. have you ever smoked? Yes / No
(u) If yes, when did you give up? ______________
(v) Where you smoking when you found out you were pregnant? Yes / No
(w) Did you stop then? Yes / No

(x) Does anyone else living in the home smoke? Yes / No
(y) Are you a single parent family? Yes / No

With regard to the **natural** parents only: (Please leave blank if you do not know this information about the natural parents.)

Do you, or did you as a child, have any of the following:
Please tick the appropriate box and answer all the questions.

	Father		Mother	
	Yes	No	Yes	No
(a) asthma				
(b) hay fever				
(c) eczema				
(d) recurrent sore throats / tonsillitis				
(e) allergies - please state				

10. Brothers and sisters

(a) How many children are in your family? _______ children.

Please list all your children, starting with the oldest, and stating the sex and age of each child. Because we are considering the possibility of heredity, we need to know if any of these children have different parents to the child in the study.

Name	Sex	Age	Different Parents (Yes/No)
1.			
2.			
3.			
4.			
5.			
6.			

Please write the name of any of your children who has had any of these problems.

(b) Allergies ________________________________
(c) Asthma ________________________________
(d) Hay fever ________________________________
(e) Eczema ________________________________
(f) Chest infections ________________________________
(g) Sore throats ________________________________
(h) Used to have sore throats but no longer does____________________
(i) Has had tonsils removed ____________________________

Thank-you for taking the time to complete this questionnaire. This will help to improve the treatment of childhood tonsillitis. If you want to make any comments, please feel free to write them on the back of this sheet of paper.

Otolaryngologist questionnaire, version 1

DEFINING TONSILLITIS:

1. Do you try to distinguish between recurrent tonsillitis and recurrent pharyngitis by the history? Please ring the appropriate answer.

Always Sometimes Rarely Never

If your answer to question 1 is Rarely or Never, please proceed to question 3.

2. From the following list, which features do you use in your every day practice to diagnose the conditions in the box below? Please insert the appropriate letter.
1 = most important diagnostic feature; 3 = 3rd most important

A. neck pain
B. halitosis
C. nasal discharge
D. muffled voice
E. hearing loss
F. cough
G. abdominal pain
H. enlarged (>2cm) cervical lymph nodes
I. snoring
J. anorexia
K. tender cervical lymph nodes
L. mouth breathing
M. dysphagia
N. oral temperature > 38.3°C
O. positive culture for group A beta-haemolytic streptococcus
P. nasal blockage
Q. sore throat
R. tonsillar exudate
S. time off school or in bed
T. duration of illness > 3 days
U. otalgia
V. duration of illness < 3 days
W. other please state in the space

Tonsillitis	1.________	2.________	3.__________
Pharyngitis	1.________	2.________	3.__________
Upper respiratory tract infection	1.________	2.________	3.__________

3. From the following list, choose up to 5 features which are commonly associated with acute tonsillitis. Please place the most commonly associated feature first and insert the appropriate letter.

A. tonsillar exudate
B. pyrexia
C. duration of illness > 3days
D. neck pain (excluding throat pain)
E. anorexia
F. otalgia
G. nasal discharge
H. nasal blockage
I. sore throat
J. dysphagia
K. abdominal pain
L. enlarged cervical lymph nodes
M. snoring
N. choking when eating
O. muffled voice
P. mouth breathing
Q. noisy eating
R. tender cervical lymph nodes
S. cough
T. hearing loss
U. halitosis
V. other - please state

Associated features:
1. _________
2. _________
3. _________
4. _________
5. _________

Indications for surgery as perceived by ENT specialists:

4. Of the following features, which 5 influence you most when deciding whether or not to add a child's name to the waiting list for tonsillectomy?

Please list in order of decreasing importance.

A. poor school progress
B. aggressive/unpredictable behaviour
C. snoring
D. frequency of sore throats reported by parents
E. poor appetite
F. frequency of visits to the general practitioner because of sore throats
G. frequency of documented tonsillitis
H. tonsil size
I. number of antibiotics prescribed for sore throats
J. poor general health
K. number of days lost from school
L. frequency of upper respiratory tract infections
M. parental pressure for referral
N. reported apnoeic spells
O. other - please state

Features:
1. _______
2. _______
3. _______
4. _______
5. _______

5. This is a difficult question to answer with complete honesty. Recent research has suggested that the following situations represent some non-medical influences in listing children for surgery. Are you more likely to put a child whom you consider to be a border-line case for tonsillectomy on the waiting list for surgery in any of the following situations?

	Always	Sometimes	Never
(a) very busy clinic			
(b) assertive parents			
(c) 2nd or 3rd referral of the same child by GP			
(d) sibling seen at same time needs tonsillectomy			
(e) sibling reported as having benefited from tonsillectomy			
(f) you are feeling tired			
(g) your waiting list is long			
(h) your waiting list is short			
(i) private patients			
(j) doctors' children			

Are there any other factors that may influence you? If so, please state below.

6. The following guidelines have been suggested as indicative of the need for tonsillectomy:

(a) 7 attacks of "tonsillitis" in one year, 5 attacks in each of the two preceding years or 3 attacks in each of the last three years (Paradise, Pittsburgh study)

(b) 6 attacks of "tonsillitis" per year for the last two years (J. Hibbert in Scott-Brown)

Do you use these guidelines in when deciding whether or not to operate on a child referred to you with recurrent tonsillitis? Please ring the appropriate answer.

Always Sometimes Rarely Never

7. Following tonsillectomy, which, if any, of the following symptoms would you expect to be improved? Please tick the appropriate boxes.

	Yes	No	Unsure
(a) sleep walking			
(b) sleep talking			
(c) nightmares/night terrors			
(d) grinding teeth			
(e) bed wetting			
(f) frequency of sore throats			
(g) sweating attacks			
(h) restless sleep			
(i) unusual sleeping position			
(j) frequent wakening			
(k) breath holding			
(l) frequency of upper respiratory tract infections			
(m) irregular breathing			
(n) morning irritability			
(o) morning sleepiness			
(p) daytime sleepiness			
(q) poor concentration			
(r) hyperactive/aggressive behaviour			

Thank-you again for taking the time to complete this questionnaire. Please return it in the envelope supplied.

Otolaryngologist questionnaire, version 2

DEFINING TONSILLITIS:

1. Do you try to distinguish between recurrent tonsillitis and recurrent pharyngitis by the history? Please ring the appropriate answer.

Always	Sometimes	Rarely	Never

If your answer to question 1 is Rarely or Never, please proceed to question 3.

2. From the following list, which features do you use in your every day practice to diagnose the conditions in the box below? Please insert the appropriate letter.
1 = most important diagnostic feature; 3 = 3rd most important

A. time off school or in bed
B. neck pain
C. tender cervical lymph nodes
D. duration of illness < 3 days
E. abdominal pain
F. snoring
G. nasal discharge
H. sore throat
I. duration of illness > 3 days
J. anorexia
K. oral temperature > 38.3°C
L. dysphagia
M. hearing loss
N. halitosis
O. positive culture for group A beta-haemolytic streptococcus
P. otalgia
Q. mouth breathing
R. tonsillar exudate
S. nasal blockage
T. muffled voice
U. cough
V. enlarged (>2cm) cervical lymph nodes
W. other - please state in the space

Tonsillitis	1.______	2.________	3.___________
Pharyngitis	1.______	2.________	3.___________
Upper respiratory tract infection	1.______	2.________	3.___________

3. From the following list, choose up to 5 features which are commonly associated with acute tonsillitis. Please place the most commonly associated feature first and insert the appropriate letter.

A. muffled voice
B. pyrexia
C. mouth breathing
D. snoring
E. cough
F. tonsillar exudate
G. noisy eating
H. halitosis
I. nasal discharge
J. dysphagia
K. enlarged cervical lymph nodes
L. duration of illness > 3days
M. tender cervical lymph nodes
N. neck pain (excluding throat pain)
O. choking when eating
P. nasal blockage
Q. anorexia
R. otalgia
S. hearing loss
T. abdominal pain
U. sore throat
V. other - please state

Associated features:
1. _________
2. _________
3. _________
4. _________
5. _________

Indications for surgery as perceived by ENT specialists:

4. Of the following features, which 5 influence you most when deciding whether or not to add a child's name to the waiting list for tonsillectomy?

Please list in order of decreasing importance.

A. frequency of sore throats reported by parents
B. reported apnoeic spells
C. poor appetite
D. number of antibiotics prescribed for sore throats
E. frequency of upper respiratory tract infections
F. parental pressure for referral
G. number of days lost from school
H. frequency of documented tonsillitis
I. poor general health
J. frequency of visits to the general practitioner because of sore throats
K. aggressive/unpredictable behaviour
L. poor school progress
M. snoring
N. tonsil size
O. other - please state

Features:
1. ________
2. ________
3. ________
4. ________
5. ________

5. This is a difficult question to answer with complete honesty. Recent research has suggested that the following situations represent some non-medical influences in listing children for surgery. Are you more likely to put a child whom you consider to be a border-line case for tonsillectomy on the waiting list for surgery in any of the following situations?

	Always	Sometimes	Never
(a) very busy clinic			
(b) assertive parents			
(c) 2nd or 3rd referral of the same child by GP			
(d) sibling seen at same time needs tonsillectomy			
(e) sibling reported as having benefited from tonsillectomy			
(f) you are feeling tired			
(g) your waiting list is long			
(h) your waiting list is short			
(i) private patients			
(j) doctors' children			

Are there any other factors that may influence you? If so, please state below.

6. The following guidelines have been suggested as indicative of the need for tonsillectomy:

(a) 7 attacks of "tonsillitis" in one year, 5 attacks in each of the two preceding years or 3 attacks in each of the last three years (Paradise, Pittsburgh study)

(b) 6 attacks of "tonsillitis" per year for the last two years (J. Hibbert in Scott-Brown)

Do you use these guidelines in when deciding whether or not to operate on a child referred to you with recurrent tonsillitis? Please ring the appropriate answer.

Always Sometimes Rarely Never

7. Following tonsillectomy, which, if any, of the following symptoms would you expect to be improved? Please tick the appropriate boxes.

Symptoms	Yes	No	Unsure
a. sweating attacks			
b. bed wetting			
c. unusual sleeping position			
d. sleep talking			
e. morning irritability			
f. hyperactive/aggressive behaviour			
g. irregular breathing			
h. poor concentration			
i. daytime sleepiness			
j. sleep walking			
k. breath holding			
l. grinding teeth			
m. morning sleepiness			
n. frequency of recurrent sore throats			
o. frequent wakening			
p. nightmares/night terrors			
q. restless sleep			
r. frequency of upper respiratory tract infections			

Thank-you again for taking the time to complete this questionnaire. Please return it using the envelope supplied.

Otolaryngologist questionnaire, version 3

DEFINING TONSILLITIS:

1. Do you try to distinguish between recurrent tonsillitis and recurrent pharyngitis by the history? Please ring the appropriate answer.

Always	Sometimes	Rarely	Never

If your answer to question 1 is Rarely or Never, please proceed to question 3.

2. From the following list, which features do you use in your every day practice to diagnose the conditions in the box below? Please insert the appropriate letter.
1 = most important diagnostic feature; 3 = 3rd most important

A. positive culture for group A beta-haemolytic streptococcus
B. otalgia
C. oral temperature > 38.3°C
D. dysphagia
E. anorexia
F. cough
G. tonsillar exudate
H. nasal discharge
I. snoring
J. mouth breathing
K. tender cervical lymph nodes
L. neck pain
M. hearing loss
N. sore throat
O. duration of illness < 3 days
P. halitosis
Q. abdominal pain
R. nasal blockage
S. time off school or in bed
T. muffled voice
U. duration of illness > 3 days
V. enlarged (>2cm) cervical lymph nodes
W. other - please state in the space

Tonsillitis	1.______	2.______	3.__________
Pharyngitis	1.______	2.______	3.__________
Upper respiratory tract infection	1.______	2.______	3.__________

3. From the following list, choose up to 5 features which are commonly associated with acute tonsillitis. Please place the most commonly associated feature first and insert the appropriate letter.

A. snoring
B. choking when eating
C. tonsillar exudate
D. noisy eating
E. nasal discharge
F. otalgia
G. dysphagia
H. duration of illness > 3days
I. nasal blockage
J. enlarged cervical lymph nodes
K. pyrexia
L. neck pain (excluding throat pain)
M. cough
N. abdominal pain
O. anorexia
P. muffled voice
Q. sore throat
R. hearing loss
S. tender cervical lymph nodes
T. mouth breathing
U. halitosis

Associated features:
1. _________
2. _________
3. _________
4. _________
5. _________

Indications for surgery as perceived by ENT specialists:

4. Of the following features, which 5 influence you most when deciding whether or not to add a child's name to the waiting list for tonsillectomy?

Please list in order of decreasing importance.

A. number of antibiotics prescribed for sore throats
B. frequency of documented tonsillitis
C. frequency of upper respiratory tract infections
D. aggressive/unpredictable behaviour
E. parental pressure for referral
F. reported apnoeic spells
G. poor general health
H. snoring
I. frequency of sore throats reported by parents
J. tonsil size
K. poor appetite
L. poor school progress
M. frequency of visits to the general practitioner because of sore throats
N. number of days lost from school
O. other - please state

Features:
1. ________
2. ________
3. ________
4. ________
5. ________

5. This is a difficult question to answer with complete honesty. Recent research has suggested that the following situations represent some non-medical influences in listing children for surgery. Are you more likely to put a child whom you consider to be a border-line case for tonsillectomy on the waiting list for surgery in any of the following situations?

	Always	Sometimes	Never
(a) very busy clinic			
(b) assertive parents			
(c) 2nd or 3rd referral of the same child by GP			
(d) sibling seen at same time needs tonsillectomy			
(e) sibling reported as having benefited from tonsillectomy			
(f) you are feeling tired			
(g) your waiting list is long			
(h) your waiting list is short			
(i) private patients			
(j) doctors' children			

Are there any other factors that may influence you? If so, please state below.

6. The following guidelines have been suggested as indicative of the need for tonsillectomy:

(a) 7 attacks of "tonsillitis" in one year, 5 attacks in each of the two preceding years or 3 attacks in each of the last three years (Paradise, Pittsburgh study)

(b) 6 attacks of "tonsillitis" per year for the last two years (J. Hibbert in Scott-Brown)

Do you use these guidelines in when deciding whether or not to operate on a child referred to you with recurrent tonsillitis? Please ring the appropriate answer.

Always Sometimes Rarely Never

7. Following tonsillectomy, which, if any, of the following symptoms would you expect to be improved? Please tick the appropriate boxes.

Symptoms	Yes	No	Unsure
a. nightmares/night terrors			
b. grinding teeth			
c. sleep walking			
d. daytime sleepiness			
e. irregular breathing			
f. restless sleep			
g. poor concentration			
h. frequent wakening			
i. sweating attacks			
j. unusual sleeping position			
k. hyperactive/aggressive behaviour			
l. sleep talking			
m. bed wetting			
n. frequency of sore throats			
o. breath holding			
p. morning irritability			
q. morning sleepiness			
r. frequency of upper respiratory tract infections			

Thank-you again for taking the time to complete this questionnaire. Please return it in the envelope supplied.

General practitioner and paediatrician questionnaire, version 1

QUESTIONNAIRE

1. From the following list, which features do you use in your every day practice to diagnose the conditions in the box below? Please insert the appropriate letter.
1 = most important diagnostic feature; 3 = 3rd most important

A. neck pain
B. halitosis
C. nasal discharge
D. muffled voice
E. hearing loss
F. cough
G. abdominal pain
H. enlarged (>2cm) cervical lymph nodes
I. snoring
J. anorexia
K. tender cervical lymph nodes
L. mouth breathing
M. dysphagia
N. oral temperature > $38.3^{o}C$
O. positive culture for group A beta-haemolytic streptococcus
P. nasal blockage
Q. sore throat
R. tonsillar exudate
S. time off school or in bed
T. duration of illness > 3 days
U. otalgia
V. duration of illness < 3 days
W. other - please state in the space

Tonsillitis	1.________	2.________	3.___________
Pharyngitis	1.________	2.________	3.___________
Upper respiratory tract infection	1.________	2.________	3.___________

2. Do you usually differentiate between these diagnostic terms (tonsillitis, pharyngitis and upper respiratory tract infection) when writing your notes? Yes / No

If no, why not?

3. From the following list, choose up to 5 features which are commonly associated with acute tonsillitis. Please place the most commonly associated feature first and insert the appropriate letter.

A. tonsillar exudate
B. pyrexia
C. duration of illness > 3days
D. neck pain (excluding throat pain)
E. anorexia
F. otalgia
G. nasal discharge
H. nasal blockage
I. sore throat
J. dysphagia
K. abdominal pain
L. enlarged cervical lymph nodes
M. snoring
N. choking when eating
O. muffled voice
P. mouth breathing
Q. noisy eating
R. tender cervical lymph nodes
S. cough
T. hearing loss
U. halitosis

Associated features:

1. ________
2. ________
3. ________
4. ________
5. ________

4. When considering referring a child to hospital for tonsillectomy, which 5 of the following features influence you most in your decision?

Please list the most important feature first and insert the appropriate letter.

A. poor school progress
B. aggressive/unpredictable behaviour
C. snoring
D. frequency of sore throats reported by parents
E. poor appetite
F. frequency of visits to the surgery because of sore throats
G. frequency of home visits required because of sore throats
H. frequency of documented tonsillitis
I. tonsil size
J. attitude of local ENT surgeon, i.e. likelihood that tonsillectomy will be performed
K. number of antibiotics prescribed for sore throats
L. poor general health
M. number of days lost from school
N. frequency of upper respiratory tract infections
O. parental pressure for referral
P. reported apnoeic spells
Q. other - please state

Features:
1. _______
2. _______
3. _______
4. _______
5. _______

5. Following tonsillectomy, would you expect any of the following to be improved?

	Yes	No	Unsure
(a) sleep walking			
(b) sleep talking			
(c) nightmares/night terrors			
(d) grinding teeth			
(e) bed wetting			
(f) frequency of sore throats			
(g) sweating attacks			
(h) restless sleep			
(i) unusual sleeping position			
(j) frequent wakening			
(k) breath holding			
(l) frequency of upper respiratory tract infections			
(m) irregular breathing			
(n) morning irritability			
(o) morning sleepiness			
(p) daytime sleepiness			
(q) poor concentration			
(r) hyperactive/aggressive behaviour			

Personal details: (general practitioners only)

Age: under 30 Please tick opposite the appropriate age group.
31-40
41-50
51-60
over 60

Sex: male / female

Number of years since qualification:______

Number of years in general practice:______

Have you had any post-graduate training in ENT? Yes / No

If yes, how long? _______

In what form (please ring the appropriate answer)

(i) SHO (ii) Registrar (iii) clinical assistant

(iv) out-patient sessions (v) other (please state)

General practitioner and paediatrician questionnaire, version 2

QUESTIONNAIRE

1. From the following list, which features do you use in your every day practice to diagnose the conditions in the box below? Please insert the appropriate letter.
1 = most important diagnostic feature; 3 = 3rd most important

A. time off school or in bed
B. neck pain
C. tender cervical lymph nodes
D. duration of illness < 3 days
E. abdominal pain
F. snoring
G. nasal discharge
H. sore throat
I. duration of illness > 3 days
J. anorexia
K. oral temperature > 38.3^{o}C
L. dysphagia
M. hearing loss
N. halitosis
O. positive culture for group A beta-haemolytic streptococcus
P. otalgia
Q. mouth breathing
R. tonsillar exudate
S. nasal blockage
T. muffled voice
U. cough
V. enlarged (>2cm) cervical lymph nodes
W. other - please state in the space

Tonsillitis	1._______	2._______	3.___________
Pharyngitis	1._______	2._______	3.___________
Upper respiratory tract infection	1._______	2._______	3.___________

2. Do you usually differentiate between these diagnostic terms (tonsillitis, pharyngitis and upper respiratory tract infection) when writing your notes? Yes / No
If no, why not?

3. From the following list, choose up to 5 features which are commonly associated with acute tonsillitis. Please place the most commonly associated feature first and insert the appropriate letter.

A. muffled voice
B. pyrexia
C. mouth breathing
D. snoring
E. cough
F. tonsillar exudate
G. noisy eating
H. halitosis
I. nasal discharge
J. dysphagia
K. enlarged cervical lymph nodes
L. duration of illness > 3days
M. tender cervical lymph nodes
N. neck pain (excluding throat pain)
O. choking when eating
P. nasal blockage
Q. anorexia
R. otalgia
S. hearing loss
T. abdominal pain
U. sore throat

Associated features:
1. ________
2. ________
3. ________
4. ________
5. ________

4. When considering referring a child to hospital for tonsillectomy, which 5 of the following features influence you most in your decision?

Please list the most important feature first and insert the appropriate letter.

A. frequency of sore throats reported by parents

B. reported apnoeic spells

C. poor appetite

D. number of antibiotics prescribed for sore throats

E. frequency of upper respiratory tract infections

F. parental pressure for referral

G. attitude of local ENT surgeon, i.e. likelihood that tonsillectomy will be performed

H. number of days lost from school

I. frequency of documented tonsillitis

J. poor general health

K. frequency of visits to the surgery because of sore throats

L. aggressive/unpredictable behaviour

M. frequency of home visits required because of sore throats

N. poor school progress

O. snoring

P. tonsil size

Q. other - please state

Features:

1. ___________
2. ___________
3. ___________
4. ___________
5. ___________

5. Following tonsillectomy, would you expect any of the following to be improved?

	Yes	No	Unsure
(a) sleep walking			
(b) sleep talking			
(c) nightmares/night terrors			
(d) grinding teeth			
(e) bed wetting			
(f) frequency of sore throats			
(g) sweating attacks			
(h) restless sleep			
(i) unusual sleeping position			
(j) frequent wakening			
(k) breath holding			
(l) frequency of upper respiratory tract infections			
(m) irregular breathing			
(n) morning irritability			
(o) morning sleepiness			
(p) daytime sleepiness			
(q) poor concentration			
(r) hyperactive/aggressive behaviour			

Personal details: (general practitioners only)

Age: under 30 Please tick opposite the appropriate age group.
31-40
41-50
51-60
over 60

Sex: male / female

Number of years since qualification: ______

Number of years in general practice: ______

Have you had any post-graduate training in ENT? Yes / No

If yes, how long? _______

In what form (please ring the appropriate answer)

(i) SHO (ii) Registrar (iii) clinical assistant

(iv) out-patient sessions (v) other (please state)

General practitioner and paediatrician questionnaire, version 3

QUESTIONNAIRE

1. From the following list, which features do you use in your every day practice to diagnose the conditions in the box below? Please insert the appropriate letter.
1 = most important diagnostic feature; 3 = 3rd most important

A. positive culture for group A beta-haemolytic streptococcus
B. otalgia
C. oral temperature > 38.3°C
D. dysphagia
E. anorexia
F. cough
G. tonsillar exudate
H. nasal discharge
I. snoring
J. mouth breathing
K. tender cervical lymph nodes
L. neck pain
M. hearing loss
N. sore throat
O. duration of illness < 3 days
P. halitosis
Q. abdominal pain
R. nasal blockage
S. time off school or in bed
T. muffled voice
U. duration of illness > 3 days
V. enlarged (>2cm) cervical lymph nodes
W. other - please state in the space

Tonsillitis	1.______	2.______	3.__________
Pharyngitis	1.______	2.______	3.__________
Upper respiratory tract infection	1.______	2.______	3.__________

2. Do you usually differentiate between these diagnostic terms (tonsillitis, pharyngitis and upper respiratory tract infection) when writing your notes? Yes / No

If no, why not?

3. From the following list, choose up to 5 features which are commonly associated with acute tonsillitis. Please place the most commonly associated feature first and insert the appropriate letter.

A. snoring
B. choking when eating
C. tonsillar exudate
D. noisy eating
E. nasal discharge
F. otalgia
G. dysphagia
H. duration of illness > 3days
I. nasal blockage
J. enlarged cervical lymph nodes
K. pyrexia
L. neck pain (excluding throat pain)
M. cough
N. abdominal pain
O. anorexia
P. muffled voice
Q. sore throat
R. hearing loss
S. tender cervical lymph nodes
T. mouth breathing
U. halitosis

Associated features:
1. _________
2. _________
3. _________
4. _________
5. _________

4. When considering referring a child to hospital for tonsillectomy, which 5 of the following features influence you most in your decision?

Please list the most important feature first and insert the appropriate letter.

A. frequency of home visits required because of sore throats

B. attitude of local ENT surgeon, i.e. likelihood that tonsillectomy will be performed

C. number of antibiotics prescribed for sore throats

D. frequency of documented tonsillitis

E. frequency of upper respiratory tract infections

F. aggressive/unpredictable behaviour

G. parental pressure for referral

H. reported apnoeic spells

I. poor general health

J. snoring

K. frequency of sore throats reported by parents

L. tonsil size

M. poor appetite

N. poor school progress

O. frequency of visits to the surgery because of sore throats

P. number of days lost from school

Q. other - please state

Features:

1. _______
2. _______
3. _______
4. _______
5. _______

5. Following tonsillectomy, would you expect any of the following to be improved?

	Yes	No	Unsure
(a) sleep walking			
(b) sleep talking			
(c) nightmares/night terrors			
(d) grinding teeth			
(e) bed wetting			
(f) frequency of sore throats			
(g) sweating attacks			
(h) restless sleep			
(i) unusual sleeping position			
(j) frequent wakening			
(k) breath holding			
(l) frequency of upper respiratory tract infections			
(m) irregular breathing			
(n) morning irritability			
(o) morning sleepiness			
(p) daytime sleepiness			
(q) poor concentration			
(r) hyperactive/aggressive behaviour			

Personal details: (general practitioners only)

Age: under 30 Please tick opposite the appropriate age group.
31-40
41-50
51-60
over 60

Sex: male / female

Number of years since qualification: ______

Number of years in general practice: ______

Have you had any post-graduate training in ENT? Yes / No

If yes, how long?_______

In what form (please ring the appropriate answer)

(i) SHO (ii)Registrar (iii) clinical assistant

(iv) out-patient sessions (v) other (please state)

APPENDIX 2 - COVERING LETTERS

Letter to parents requesting their participation in the study.

Headed letter paper

9th July, 1993.

Dear ,

I am undertaking research into the nature of tonsillitis in children in the Frome area. Part of this work involves obtaining information from parents of children in the town about the frequency and severity of this problem. This information will help us to understand better what parents mean when they say that their child suffers from tonsillitis.

I have randomly selected children from the patient lists of the general practitioners in Frome and your child is one of those chosen. Your general practitioner is fully aware of this project. I would be very grateful if you would help. All I require is that you complete the questionnaire which accompanies this letter. Your decision to take part is entirely voluntary and, if you decide not to return the questionnaire, this will not in any way affect any future treatment you may require at the hospital. Absolute confidentiality is assured.

Thank-you for taking the time to read this. I hope you will agree to participate.

Yours sincerely,

Ruth Capper,
Research Registrar

Reminder letter to parents

Headed letter paper

17th January 1994.

Dear Parent,

You are aware that we are undertaking some research into sore throats in children and that we sent you a questionnaire to complete last year. We have had three quarters of these returned to us but, in order for the results to be strong, we would like the response rate to be higher. Our hope is that we will learn more about how best to look after children with sore throats. We have therefore taken the liberty to send you another copy of the questionnaire in the hope that you will return it. If you cannot do so, could we ask you instead to complete the small survey at the end of this letter and return it.

As before, you are under no obligation to return anything but we would be very grateful if you would.

Yours sincerely,

Miss Ruth Capper,
Research Registrar,
Department of ENT Surgery.

Mr. Richard Canter,
Consultant ENT Surgeon,
Department of ENT Surgery.

If you cannot or do not wish to complete the questionnaire, please say why by ticking the appropriate box below.

I did not complete the questionnaire because:

I did not have the time	[ ]
It was too long	[ ]
It was too complicated	[ ]
My child never has a sore throat	[ ]
Other reason (please state)	

Letter to parents of children on the Waiting List for Tonsillectomy

Headed letter paper

1st November 1993.

Dear Parent,

Your child's name is on our waiting list to have his/her tonsils removed. We are currently studying sore throats and tonsillitis in children and would be grateful if you would help. You will find enclosed a questionnaire about your child and your family which we would like you to complete. Some of the questions are of a personal nature but this is important because we want to study the possibility that tonsillitis may be hereditary. The answers to the questions will be confidential and will be shown to no-one else. It should take you 15 minutes to complete it.

You are, of course, under no obligation to complete the questionnaire. If you decide not to, it will not affect your child's treatment in any way. We hope, however, that you will decide to help. If you do, please return the questionnaire in the stamped addressed envelope supplied.

Yours sincerely,

Miss Ruth Capper,
Research Registrar,
Department of ENT Surgery.

Mr. Richard Canter,
Consultant ENT Surgeon,
Department of ENT Surgery.

Reminder letter to parents of children on the waiting list for tonsillectomy

Headed letter paper

14th January 1994.

Dear Parent,

In November you received a questionnaire about your child who is on the waiting list to have his/her tonsils removed. We have had a very good response to these questionnaires but, in order to draw firm conclusions from the results, we would like to have more replies. We have therefore sent a further copy of the questionnaire to you in the hope that you will complete it and return it to us. Our hope is that in the future we will be able to treat children with recurrent tonsillitis better as a result of this research but we cannot do this without the help of parents whose children have problems with sore throats.

You are, of course, under no obligation to complete the questionnaire. If you decide not to, it will not affect your child's treatment in any way. We hope, however, that you will decide to help. If you do, please return the questionnaire in the stamped addressed envelope supplied.

Yours sincerely,

Miss Ruth Capper,
Research Registrar,
Department of ENT Surgery.

Mr. Richard Canter,
Consultant ENT Surgeon,
Department of ENT Surgery.

Letter to parents of children seen in the Out-patient Department who have been added to the waiting list for tonsillectomy

Headed letter paper

Dear Parent,

Your child's name has been placed on our waiting list to have his/her tonsils removed. We are currently studying sore throats and tonsillitis in children and would be grateful if you would help. You will find enclosed a questionnaire about your child and your family which we would like you to complete. Some of the questions are of a personal nature but this is important because we want to study the possibility that tonsillitis may be hereditary. The answers to the questions will be confidential and will be shown to no-one else. It should take you 15 minutes to complete it.

You are, of course, under no obligation to complete the questionnaire. If you decide not to, it will not affect your child's treatment in any way. We hope, however, that you will decide to help. If you do, please return the questionnaire to a member of staff in the out-patient clinic.

Yours sincerely,

Miss Ruth Capper,
Research Registrar,
Department of ENT Surgery.

Mr. Richard Canter,
Consultant ENT Surgeon,
Department of ENT Surgery.

Letter to otolaryngologists

Headed letter paper

12th September 1994.

Dear

We are conducting a study about tonsillitis in children and, as part of this, are interested in your views about sore throats and tonsillitis and what you think are the indications for surgery and the benefits of tonsillectomy. Similar questionnaires have been sent to general practitioners and paediatricians with a response rate of 79% but we need the opinions of otolaryngologists to complete our data and to allow us to compare the thinking of the three main groups of doctor involved in the care of children with sore throats. This type of research is becoming particularly important in the new purchaser / provider environment.

You will find enclosed a questionnaire which addresses these issues. The questionnaire has been drawn up with the assistance of the Department of Epidemiology and Public Health Medicine at Bristol University and the Department of Statistics at the University of Bath. We should be very grateful if you would complete it and return it to us using the stamped addressed envelope supplied. Your answers are, of course, confidential. Two envelopes are supplied for return. One has been left blank and you should place your completed questionnaire in it. The other has the Department's address and a number on the outside. Please place the sealed blank envelope in the second envelope and return it to us. The number will allow us to identify which questionnaires have been returned. When we have received a sufficiently large percentage, the outer envelopes will be discarded and only then will the inner envelopes be opened. In this way, we will be unable to connect any reply with an individual. Please return the questionnaire by 14th October 1994.

Thank you very much for your help.

Yours sincerely,

Miss Ruth Capper FRCSI
Research Registrar
Department of Post-graduate Medicine
University of Bath

Mr. Richard Canter FRCS
Honorary Senior Lecturer
Department of Post-graduate Medicine
University of Bath

Reminder letter to otolaryngologists

Headed letter paper

17th November 1994.

Dear

About two months ago we sent you a questionnaire about tonsillitis in children and your attitude to its diagnosis and treatment. Unfortunately we have no record of a reply and have therefore taken the liberty of sending you another copy. It should only take a few minutes to complete. It is crucial that we have a good response rate in order to draw sound conclusions from the work. We have already had a 79% return rate from our general practice and paediatrician colleagues.

This is an important study bearing in mind the new purchaser/provider environment in which we all now work. Please, please, please return the questionnaire to us in the envelopes supplied. Your answer is entirely confidential.

Yours sincerely,

Ruth Capper, FRCSI
Research Registrar
Department of Post-graduate Medicine
University of Bath

Richard Canter, FRCS
Honorary Senior Lecturer
Department of Post-graduate Medicine
University of Bath

Letter to general practitioners and paediatricians

Headed letter paper

31st July 1993.

Dear ,

We are currently undertaking some research into tonsillitis in childhood. Part of the project aims to define what general practitioners, paediatricians, otolaryngologists and parents understand by the term "tonsillitis" and to show what improvements each group expects to see following surgery.

We would be grateful if you would fill in the enclosed questionnaire which addresses these points and return it to the above department. The questionnaire has been drawn up with the assistance of Dr. Michael Whitfield from the Department of Epidemiology and Public Health Medicine at Bristol University and Dr. Tony Robinson from the Department of Statistics at Bath University.

Confidentiality is, of course, assured. Two envelopes are supplied for return. One is left blank and you should place your completed questionnaire in it. The other has the address of the Department and a number on it. This number will allow us to identify which questionnaires have been returned. When a sufficiently high proportion has been received, the outer envelopes will be discarded and only then will the inner envelopes be opened. By this method, it will be impossible to identify the respondent.

Please return the questionnaire by 21st August 1993.

Thank-you very much for taking the time to do this.

Yours sincerely,

Ruth Capper, FRCSI,
Research Registrar,
Department of Post-graduate Medicine,
University of Bath.

Richard Canter, FRCS,
Honorary Senior Lecturer,
Department of Post-graduate Medicine,
University of Bath.

Letter to Frome general practitioners

Headed letter paper

16th January 1995.

Dear

We have been conducting a study about tonsillitis in children using a sample of 800 of your patients aged between 3 and 11 years and approximately 150 children currently on the waiting list for tonsillectomy at the Royal United Hospital.

Alongside this, we have also run a study of doctors' attitudes to tonsillitis and tonsillectomy. This latter project has involved sending questionnaires to 100 randomly selected general practitioners from the Bath District Health Authority area and all paediatricians and otolaryngologists of consultant, senior registrar and registrar grade in Wessex.

We have had a very good response rate all round and have built up a good database of information. We will be comparing the "normal" population from Frome with the "abnormal" population on the waiting list. The waiting list population has been drawn from the Bath District Health Authority area and we are assuming that Frome is representative of that whole area. One way in which we can demonstrate this is to compare the tonsillectomy rate in children from Frome with the area's tonsillectomy rate. Another way is to demonstrate that the attitudes of the general practitioners in Frome to tonsillitis and tonsillectomy are the same as those of the wider population of general practitioners. On order to do this, we need you all to complete the same questionnaire as we sent to the other 100 general practitioners. It will only take a few minutes to fill in and the responses will be very important to us in "firming up" our data.

Thank you very much for your help.

Yours sincerely,

Miss Ruth Capper, FRCSI, Research Registrar, Royal United Hospital.	Mr. Richard Canter, FRCS, Consultant ENT Surgeon, Royal United Hospital.

APPENDIX 3 - STATISTICAL TESTS

Salpiro-Wilk test

The Salpiro-Wilk test is a complex analysis of variance that can be used to test a variable for departures from normality of its data. There must be a random sample of between 3 and 5000 data. The null hypothesis of the test is that the sample is taken from a normal distribution, thus a significance level of < 0.05 rejects this supposition of normality. Parametric methods may not be used with variables for which W is significant. The test is reliable for small to medium sized samples.

Chi-squared test

The chi-squared test is a test of statistical significance that can be applied to non-parametric data. It is used to determine whether an apparent difference in proportion (of some event or characteristic) between patient groups could reasonably have occurred by chance. In this study, it will be used to compare questionnaire answers between the two populations of parents or the three doctor groups.

The data are arranged into contingency tables (see tables A3.1 and A3.2). The test is not appropriate if the numbers are small as it becomes unreliable and should not be used if any expected values are less than five. One method of overcoming this problem is to combine cells to give a smaller table with larger values. The responses "never" and "sometimes" will be combined as will "often" and "always" to facilitate this.

Table A3.1 2 x 3 contingency table

Question 4A "When your child has a sore throat, does s/he have a poor appetite?"

	2 x 5 table					2 x 3 table		
	Never	Some-times	Often	Always	Only if tonsillitis	(N) + (S)	(O) + (A)	Only if T
Normal population	60	141	55	37	25	201	92	25
Waiting list	6	30	23	32	42	36	55	42

Table A3.2 2 x 4 contingency table

Question 7(a) "Is your child sleepy in the morning?" (paraphrased)

	2 x 6 table						2 x 4 table			
	Never	Some-times	Often	Always	Only if sore throat	Only if tonsillitis	N + S	O + A	ST	T
Normal Population	322	207	23	9	18	9	529	32	18	9
Waiting List	43	41	10	6	4	22	84	16	4	22

Bonferroni correction

When multiple tests are performed on the same data, a risk arises that a positive result may be found due to chance rather than as a true result. Where the level of significance is set at 5%, even if there is no true difference between the groups, there will still be a 5% chance of getting a false positive test result. If n tests are performed on the same set of data, the risk of a false positive result increases to $1 - (0.95)^n$. In order to avoid this false result, the Bonferroni correction sets a new level of significance approximately calculated by $p = 0.05/n$.

Confidence Intervals

Confidence intervals estimate how much random error can be expected in a result derived from a random sample rather than the complete population. Traditionally two standard deviations either side of the mean are used. This range is the 95% confidence interval and is interpreted by saying that there is 95% confidence that the result (which may be a mean, correlation coefficient, *etc.*) of the total population falls within this range. In this study, confidence intervals will be used to demonstrate whether differences between samples (*e.g.* the Normal and Waiting List groups) can be accepted with confidence as true differences.

Student's t-test

The Student's t-test determines whether an apparent difference between the means of two independent normally distributed populations could have occurred by chance. It can be used with small sample sizes but can only be used when the populations under study have approximately normal distributions and approximately equal standard deviations. There are three forms of the test - the one-sample t-test, the paired t-test and the unpaired t-test. The one-sample test compares the mean of a sample with the whole population from which it was drawn. The paired t-test compares two paired measurements from the same sample (e.g. before and after treatment measurement) and the hypothesis is that the difference in the means is equal to a stated figure, usually zero. The unpaired t-test compares one measurement from each of two separate groups (e.g. the number of sore throats in children from single or two parent families). The unpaired t-test assumes that the population variances are equal. If this assumption cannot be made, the Welch modification of the t-test is used. This modification has been used in the analysis presented later.

Mann-Whitney test

The Mann-Whitney test is used to compare two samples are not normally distributed with equal variances. It can be applied to samples of different sizes.

The test depends on the ranks of the observations in each sample and determines whether they are likely to be samples from a single larger population or from independent populations.

This test will be used for some comparisons of the Normal and Waiting List populations.

Spearman's Rank Correlation test

Spearman's rank correlation test calculates whether two groups of the same size are uncorrelated. Both groups are ranked according to a scoring system and the statistic compares the orders in which the lists are arranged. The actual score awarded to each item in the list is not used, simply its position in the list.

A result of -1 confirms that the two groups are entirely negatively related whilst a result of 1 indicates that the groups are identical. A result of 0 means that the two groups are entirely unrelated.

If $n <= 30$, a p value for the correlation coefficient can be derived from standard tables. If $n > 30$, Fisher's transformation must be used to calculate the z value that can then be converted to a p value by consulting standard tables.

In this study, Spearman's rank correlation test will be used to determine correlation between lists of symptoms, *e.g.* features chosen by doctors or parents as associated with tonsillitis. In the doctor questionnaire, several features may be chosen in response to a single question. In the situation where three answers are allowed, each response will be given a score, *i.e.* the feature chosen first will receive three points, the second two points and the third one point. The total score will be used in the ranking before the correlation calculation is performed. In the parent questionnaire, ranking will simply be performed according to the frequency with which parents respond to any symptom.

Kruskal-Wallis test

The Kruskal-Wallis test is a non-parametric test of analysis of variance. The test does not assume that the populations under examination are normally distributed nor that their variances are equal. It allows more than two populations to be compared.

The test depends on the ranks of the observations in each population under examination and determines whether these populations are likely to be samples from a single larger population or from independent populations.

The test will be used to compare the number of sore throats and episodes of tonsillitis in children from different sized families.

Simple Linear Regression

Simple linear regression describes the relationship between two variables in terms of the dependence of one upon the other. It allows the prediction of one variable when the value of the other is known. The test fits a straight line to the data whereby the distance between the data points and the fitted line is minimised. This line is known as the regression line. The standard method is called "least squares" regression and it minimises the squares of the vertical distances between the data and the regression line. The y-co-ordinate of the point on the regression line corresponding to a data point is known as the fitted value and the difference between the observed and fitted value is called the "residual". In order for the regression to be valid, the residuals must be normally distributed.

Where the residuals are not normally distributed, the data may be transformed to achieve this. The most common transformation is to the natural logarithm and this has been performed in places in this thesis. Where the number of sore throats is under examination, the transformation "$\log_e$ (1+ number of sore throats)" has been used. This is to avoid the situation where "$\log_e 0$", which is non-existent, would be attempted in the transformation for those children who have no sore throats. The non-existent value for the logarithm would result in these children being excluded from the analysis and thus introduce a significant error.

The statistical package Arcus calculates the correlation coefficient of the regression line and gives the p value.

Simple linear regression will be used to compare the effect of one variable upon another *e.g.* the effect of birth weight on the number of sore throats.

Multiple Linear Regression

Multiple linear regression permits the study of the effect of simultaneous changes in more than one variable upon one dependant variable. The significance of each independent variable is calculated. The variance ratio shows whether the overall regression is significant and the r square value (r = correlation coefficient) shows how much of the variance is accounted for by the regression, *i.e.* whether or not the model is a good predictor of the dependant variable.

Multiple linear regression will be used to determine the influence of several social factors (social class, single parent status, family size, parental employment status and parental smoking) on the number of sore throats and tonsillitis before proceeding to analyse these factors individually.

APPENDIX 4 - RAW DATA FROM PARENTAL QUESTIONNAIRES

Table A4.1 Answers to Question 4, parts A to W.

	Normal Population				Waiting List Population			
Symptom	Never + Some-times	Often + Always	Only if Tonsillitis	NA	Never + Some-times	Often + Always	Only if Tonsillitis	NA
Poor appetite	201	92	25	313	36	55	42	5
Choking episodes	578	4	7	342	93	16	8	21
Bad breath	217	69	21	324	41	51	39	7
Earache	238	57	11	325	65	28	31	14
Cough	217	95	5	314	63	54	13	8
Snoring	223	76	7	325	34	74	21	9
Sick/vomiting	255	28	20	328	67	28	33	10
Sleeps poorly	234	57	16	342	48	38	46	7
Hallucinations	283	6	10	342	103	2	16	17
Blocked nose	210	95	3	323	60	52	13	13
Fits or seizures	289	1	2	339	115	1	2	20
Runny nose	222	86	4	319	79	38	8	13
Constipation	289	5	0	337	109	5	3	20
Mouth breathing	203	92	11	325	30	80	19	9
Hearing problems	255	41	2	333	89	25	9	15
Eats	244	45	11	331	57	51	14	16
slowly/noisily	236	52	13	330	43	65	18	12
Breathes noisily	212	14	3	402	99	11	8	20
Ear discharge	262	31	8	330	69	35	25	9
Tummy ache	227	64	13	327	61	36	29	12
Headache								
Raised	206	77	39	309	25	56	52	5
temperature	274	13	3	341	100	8	10	5
Diarrhoea	183	88	47	313	21	46	56	5
Swallowing pains								

Table A4.2 Answers to Question 5

	Normal Population				Waiting List Population			
Symptom	Never + Some-times	Often + Always	Only if Tonsillitis	NA	Never + Some-times	Often + Always	Only if Tonsillitis	NA
Miss fun things	157	118	23	333	16	56	51	15
Stay away from school	135	162	34	300	7	66	52	3
Stay in bed	237	65	24	305	34	56	38	10
Has to see GP	147	149	36	299	2	76	56	4
Needs antibiotic	159	122	46	304	2	61	73	2

Table A4.3 Answers to Question 6: Normal Population

Symptom	Never + Rarely	Sometimes + Often	Only if Sore Throat	Only if Tonsillitis	NA
Irregular breathing	326	54	8	4	57
Restless sleep	355	200	24	13	39
Nightmares	463	115	5	6	42
Bed wetting	522	65	1	1	42
Snoring	294	285	17	4	31
Mouth open	225	352	14	5	34
Wakes frequently	439	114	23	8	47
Choking	554	16	4	1	56
Thrashes/kicks	482	94	2	3	50
Unusual position	445	127	3	2	54
Sleep walks/talks	393	191	2	4	41
Grinds teeth	449	139	0	1	41
Sweating attacks	446	116	12	14	43

Table A4.4 Answers to Question 6: Waiting List Population

Symptom	Never + Rarely	Sometimes + Often	Only if Sore Throat	Only if Tonsillitis	NA
Irregular breathing	58	47	9	13	15
Restless sleep	28	64	12	28	10
Nightmares	85	32	3	11	11
Bed wetting	118	9	2	1	12
Snoring	17	90	10	19	6
Mouth open	10	100	8	18	6
Wakes frequently	49	41	11	31	10
Choking	95	21	5	10	11
Thrashes/kicks	90	33	1	7	1
Unusual position	87	34	2	5	14
Sleep walks/talks	68	55	3	6	10
Grinds teeth	92	35	0	13	0
Sweating attacks	58	39	8	31	6

Table A4.5 Results of Question 7: Normal Population

Symptom	Never + Sometimes	Often + Always	Only if Sore Throat	Only if Tonsillitis	NA
Morning sleepiness	529	32	18	9	43
Morning irritability	508	69	11	7	30
Morning headache	552	13	17	6	43
Poor concentration	515	57	11	8	40
Hyperactive behaviour	543	51	0	0	37
Daytime sleepiness	528	15	30	18	40
Aggressive behaviour	582	32	6	1	37

Table 4.6 Results of Question 7: Waiting List Population

Symptom	Never + Sometimes	Often + Always	Only if Sore Throat	Only if Tonsillitis	NA
Morning sleepiness	84	16	4	22	16
Morning irritability	86	25	4	18	9
Morning headache	95	10	8	20	9
Poor concentration	83	22	7	18	12
Hyperactive behaviour	100	22	1	4	15
Daytime sleepiness	67	11	14	41	9
Aggressive behaviour	105	14	4	8	11

Table A4.7 Answers to Question 8

	Normal Population				Waiting List Population			
Symptom	V. poor + poor	Average	Good + Excellent	NA	V. poor + poor	Average	Good + Excellent	NA
General health	3	72	551	5	19	52	69	2
Appetite	53	141	430	7	34	34	76	1
School progress	21	147	439	24	14	14	81	4
Behaviour	7	239	385	7	7	7	76	3
Makes friends	22	122	481	6	7	7	100	2

APPENDIX 5 - RAW DATA FROM DOCTORS' QUESTIONNAIRES

Raw data from question 1 of the GP and paediatrician questionnaire and question 2 of the ENT questionnaire.

Table A5.1 Tonsillitis

Feature	Paediatrician			General Practitioner			Otolaryngologist		
	No.	%	Score	No.	%	Score	No.	%	Score
Neck pain	1	1.75	2	0	0	0	0	0	0
Halitosis	1	1.75	1	7	9.86	7	0	0	0
Nasal discharge	0	0	0	0	0	0	0	0	0
Muffled voice	0	0	0	1	1.41	1	0	0	0
Hearing loss	0	0	0	0	0	0	0	0	0
Cough	2	3.81	4	0	0	0	0	0	0
Abdominal pain	0	0	0	1	1.41	1	0	0	0
Enlarged CLN	5	8.77	9	15	21.13	24	3	9.09	6
Snoring	2	3.81	4	0	0	0	0	0	0
Anorexia	0	0	0	0	0	0	1	3.03	3
Tender CLN	24	42.10	35	29	40.85	50	4	12.12	10
Mouth breathing	0	0	0	0	0	0	0	0	0
Dysphagia	4	7.02	7	8	11.27	14	15	45.45	26
Temp > 38.3°C	29	50.88	49	30	42.25	43	12	36.36	22
Positive culture	10	17.54	16	5	7.04	7	1	3.03	3
Nasal blockage	0	0	0	0	0	0	0	0	0
Sore throat	38	66.67	83	39	54.93	94	16	48.48	45
Tonsillar exudate	49	85.96	114	62	87.32	155	16	48.48	36
Time off school or in bed	0	0	0	4	5.63	7	11	33.33	16
Duration > 3 days	1	1.75	1	6	8.45	10	9	27.27	14
Otalgia	0	0	0	1	1.10	2	0	0	0
Duration < 3 days	0	0	0	0	0	0	0	0	0

Table A5.2 Pharyngitis

Feature	Paediatrician			General Practitioner			ENT		
	No.	%	Score	No.	%	Score	No.	%	Score
Neck pain	5	8.77	7	4	5.63	6	2	6.06	4
Halitosis	2	3.51	2	2	2.81	4	0	0	0
Nasal discharge	0	0	0	1	1.41	1	0	0	0
Muffled voice	3	5.26	4	8	11.27	17	1	3.03	1
Hearing loss	0	0	0	0	0	0	0	0	0
Cough	7	12.28	16	5	7.04	7	1	3.03	1
Abdominal pain	0	0	0	0	0	0	0	0	0
Enlarged CLN	3	5.26	4	5	7.04	10	1	3.03	1
Snoring	0	0	0	0	0	0	0	0	0
Anorexia	3	5.26	3	0	0	0	1	3.03	1
Tender CLN	19	33.33	30	28	39.44	41	8	24.24	12
Mouth breathing	0	0	0	0	0	0	0	0	0
Dysphagia	24	42.10	46	21	29.58	37	11	33.33	23
Temp > 38.3°C	28	49.12	43	35	49.30	46	3	9.09	4
Positive culture	3	5.26	3	0	0	0	1	3.03	3
Nasal blockage	0	0	0	1	1.41	2	1	3.03	1
Sore throat	50	87.72	136	65	91.55	191	24	72.72	71
Tonsillar exudate	3	5.26	5	0	0	0	0	0	0
Time off school or in bed	0	0	0	2	2.81	1	1	3.03	3
Duration > 3 days	1	1.75	1	8	11.27	1	1	3.03	2
Otalgia	2	3.51	2	1	1.41	0	0	0	0
Duration < 3 days	1	1.75	1	14	19.72	14	14	42.42	26

Table A5.3 URTI

Feature	Paediatrician			General Practitioner			ENT		
	No.	%	Score	No.	%	Score	No.	%	Score
Neck pain	0	0	0	0	0	0	0	0	0
Halitosis	0	0	0	0	0	0	0	0	0
Nasal discharge	45	78.95	119	43	60.56	108	28	84.85	61
Muffled voice	2	3.51	2	3	4.23	4	0	0	0
Hearing loss	0	0	0	1	1.41	1	0	0	0
Cough	27	47.37	49	38	53.52	74	16	48.48	27
Abdominal pain	0	0	0	0	0	0	0	0	0
Enlarged CLN	3	5.26	4	3	4.23	6	1	3.03	1
Snoring	0	0	0	0	0	0	0	0	0
Anorexia	1	1.75	1	0	0	0	1	3.03	1
Tender CLN	7	12.28	12	11	15.49	15	3	9.09	5
Mouth breathing	0	0	0	3	4.23	5	2	6.06	2
Dysphagia	1	1.75	1	2	2.81	4	0	0	0
Temp > 38.3^{o}C	28	49.12	43	25	35.21	42	3	9.09	6
Positive culture	0	0	0	0	0	0	0	0	0
Nasal blockage	17	29.82	37	27	38.03	52	19	57.58	42
Sore throat	18	31.58	35	38	53.52	82	9	27.27	21
Tonsillar exudate	4	7.02	8	1	1.41	3	0	0	0
Time off school or in bed	0	0	0	0	0	0	0	0	0
Duration > 3 days	1	1.75	2	7	9.86	11	1	3.03	1
Otalgia	12	21.05	22	5	7.04	9	0	0	0
Duration < 3 days	3	5.26	3	2	2.81	3	2	6.06	5

Table A5.4 Raw data from Question 3 of Doctor questionnaire showing score, number of doctors responding to feature and percentage of doctors responding to feature.

	Paediatricians			General Practitioners			Otolaryngologists		
Feature	Score	No.	%	Score	No.	%	Score	No.	%
Tonsillar exudate	171	48	84.21	227	59	83.10	80	27	64.29
Pyrexia	183	52	91.23	159	50	70.42	104	36	85.71
Duration > 3 days	16	10	17.54	19	7	9.86	25	10	23.81
Neck pain	7	3	5.26	10	4	5.63	4	1	2.38
Anorexia	21	13	22.81	12	8	11.27	13	6	14.29
Otalgia	3	3	5.26	12	7	9.86	14	8	19.05
Nasal discharge	3	2	3.51	0	0	0	0	0	0
Nasal blockage	0	0	0	0	0	0	0	0	0
Sore throat	228	53	92.98	241	57	80.28	161	34	80.95
Dysphagia	50	21	36.84	70	23	32.39	76	27	64.29
Abdominal pain	2	2	3.51	14	10	14.08	1	1	2.38
Enlarged CLN	65	28	49.12	100	38	53.52	44	20	47.62
Snoring	0	0	0	7	2	2.82	0	0	0
Choking	20	9	15.79	12	8	11.27	0	0	0
Muffled voice	1	1	1.75	16	7	9.86	0	0	0
Mouth breathing	3	1	1.75	10	5	7.04	0	0	0
Noisy eating	0	0	0	2	1	1.41	0	0	0
Tender CLN	84	31	54.39	117	46	64.79	34	15	35.71
Cough	11	7	12.28	0	0	0	0	0	0
Hearing loss	0	0	0	0	0	0	0	0	0
Halitosis	11	8	14.04	36	22	30.99	14	6	14.29

Table A5.5 Features regarded as important in referring a child for or deciding to perform tonsillectomy.

	Paediatricians			General practitioners			Otolaryngologists		
Feature	Score	No.	%	Score	No.	%	Score	No.	%
Poor school progress	14	6	10.53	32	11	15.49	6	2	4.76
Aggressive	3	1	1.75	3	3	4.23	1	1	2.38
Snoring	38	17	29.82	34	15	21.13	7	3	7.14
Freq. sore throats reported by parents	31	12	21.05	81	23	32.39	87	28	66.67
Poor appetite	19	9	15.79	14	5	7.04	9	4	9.52
Freq. surgery visits	9	3	5.26	62	20	28.17	58	19	45.24
Freq. home visits	0	0	0	7	3	4.23	-	-	-
Freq. documented tonsillitis	192	48	84.21	284	64	90.14	144	34	80.95
Tonsil size	54	20	35.09	48	20	28.17	4	3	7.14
Attitude of local ENT surgeon	15	8	14.04	11	7	9.86	-	-	-
No. antibiotics	37	15	26.32	68	24	33.80	44	18	42.86
Poor general health	60	23	40.35	88	37	52.11	15	9	21.43
No. days off school	147	45	78.95	190	59	83.10	112	37	88.10
Freq. URTI's	100	42	73.68	35	17	23.94	4	2	1.76
Parental pressure	15	11	19.30	56	27	38.03	7	5	11.90
Apnoeic spells	147	34	59.65	56	17	23.94	101	30	71.43

Table A5.6 Raw data for question 5 of GP and Paediatrician questionnaire and question 7 of ENT questionnaire.

	Paediatrician			General Practitioner			Otolaryngologist		
Feature	Yes	No	Unsure	Yes	No	Unsure	Yes	No	Unsure
Sleep walking	2	51	6	6	53	12	3	28	9
Sleep talking	1	52	6	5	54	12	0	29	11
Nightmares/terrors	5	46	8	9	52	10	1	28	11
Grinding teeth	1	50	8	1	56	14	0	33	7
Bed wetting	6	48	5	4	58	9	4	26	10
Freq. of sore throats	37	17	5	57	13	0	40	0	0
Sweating attacks	8	36	15	22	33	16	4	25	11
Restless sleep	38	15	6	30	31	10	16	9	13
Unusual sleeping position	29	23	7	13	39	19	5	24	11
Frequent wakening	30	22	7	23	32	16	12	13	13
Breath holding	9	45	5	4	52	15	10	17	12
Freq. of URTI	13	41	5	23	44	4	17	17	5
Irregular breathing	30	25	4	20	39	12	12	12	14
Morning irritability	31	24	4	21	36	14	6	21	10
Morning sleepiness	31	22	6	22	37	12	9	17	11
Daytime sleepiness	32	21	6	21	38	12	11	14	12
Poor concentration	30	24	5	22	38	11	6	22	11
Hyperactive/aggress-ive behaviour	10	41	8	9	44	18	1	23	14

Table A5.7 Results of chi-squared testing of expected benefits of tonsillectomy by otolaryngologists, paediatricians and general practitioners

Feature	Chi-squared value	p value
Sleep walking	4.03	0.1335
Sleep talking	4.93	0.0852
Nightmares/terrors	3.18	0.2036
Grinding teeth	8.85	0.6522
Bed wetting	5.01	0.8800
Freq. of sore throats	22.47	**<0.0001**
Sweating attacks	0.03	0.9900
Restless sleep	9.70	0.0078
Unusual sleeping position	18.45	**<0.0001**
Frequent wakening	8.08	0.0176
Breath holding	10.69	0.0048
Freq. of URTI	6.29	0.0430
Irregular breathing	14.44	**0.0007**
Morning irritability	16.54	**0.0003**
Morning sleepiness	10.87	0.0044
Daytime sleepiness	10.45	0.0054
Poor concentration	15.71	**0.0004**
Hyperactive/aggressive behaviour	9.42	0.0090

APPENDIX 6 –RESULTS OF ANALYSIS OF PARENTAL QUESTIONNAIRE

Table A6.1 Question 4 - Percentage of parents responding "Only if it is Tonsillitis"

	Only if Tonsillitis			
Symptom	Normal (%)	Waiting List (%)	% Difference	95% CI
Pain on swallowing	14.78	41.79	27.01	20.0 to 34.1
Raised temperature	12.11	38.81	26.70	20.1 to 33.3
Sleeps poorly	5.54	34.85	29.31	24.0 to 34.6
Poor appetite	7.86	31.34	23.48	17.7 to 29.2
Bad breath	6.84	29.55	22.71	17.2 to 28.2
Sick / vomiting	6.60	25.58	18.98	13.6 to 24.3
Earache	3.59	24.80	21.21	16.6 to 25.8
Headache	4.28	22.83	18.55	13.9 to 23.2
Tummy ache	2.66	19.23	16.57	12.5 to 20.6
Snoring	2.29	16.15	13.86	10.0 to 17.7
Mouth breathing	3.59	14.62	11.03	8.6 to 16.0
Noisy breathing	4.32	14.17	9.85	5.5 to 14.2
Hallucinations	3.46	13.11	9.65	5.6 to 13.7
Eats slowly/noisily	3.67	11.38	7.71	3.7 to 11.7
Blocked nose	0.97	10.32	9.35	6.5 to 12.2
Cough	1.58	9.92	8.34	5.2 to 11.5
Diarrhoea	1.03	8.40	7.37	4.6 to 10.1
Hearing problems	0.67	7.26	6.59	4.1 to 9.0
Choking episodes	2.42	6.78	4.36	1.1 to 7.6
Ear discharge	1.31	6.72	5.41	2.7 to 8.1
Runny nose	1.28	6.35	5.07	2.4 to 7.7
Constipation	0.00	2.52	2.52	1.3 to 3.7
Fits or seizures	0.68	1.68	1.00	-0.7 to 2.7

Table A6.2 Question 4 - Percentage of parents answering "Often and Always"

	Often and Always			
Symptom	Normal (%)	Waiting List(%)	% difference	95% CI
Pain on swallowing	27.67	34.33	6.66	-1.6 to 15.0
Raised temperature	23.91	41.79	17.88	9.8 to 25.9
Sleeps poorly	19.72	28.79	9.07	1.6 to 16.6
Poor appetite	28.93	41.04	12.11	3.7 to 20.6
Bad breath	22.48	38.64	16.16	8.2 to 24.1
Sick / vomiting	9.24	21.71	12.47	6.7 to 18.3
Earache	18.63	22.40	3.77	-3.5 to 11.0
Headache	21.05	28.35	7.30	-0.3 to 14.9
Tummy ache	10.30	26.92	16.62	10.5 to 22.7
Snoring	24.84	56.92	32.08	23.9 to 40.2
Mouth breathing	30.07	61.54	31.47	23.0 to 40.0
Noisy breathing	17.28	51.18	33.90	26.5 to 41.3
Hallucinations	2.08	1.64	-0.47	-3.0 to 2.1
Eats slowly/noisily	15.00	41.46	26.46	19.4 to 33.5
Blocked nose	30.84	41.27	10.43	1.8 to 19.0
Cough	29.97	41.22	11.25	2.7 to 19.8
Diarrhoea	4.48	6.72	2.24	-1.7 to 6.2
Hearing problems	13.76	20.16	6.40	-0.1 to 12.9
Choking episodes	1.38	13.56	12.18	8.9 to 15.5
Ear discharge	6.11	9.24	3.13	-1.4 to 7.7
Runny nose	27.56	30.16	2.60	-5.6 to 10.8
Constipation	1.70	4.20	2.50	-0.2 to 5.2
Fits or seizures	0.34	0.84	0.05	-0.7 to 1.7

Table A6.3 Question 4 - Comparison of Order of Symptoms according to Parents' answers to "Only if Tonsillitis" and "Often and Always"

ORDER: Only if Tonsillitis		ORDER: Often and Always	
Normal	Waiting List	Normal	Waiting List
Pain on swallowing	Pain on swallowing	Blocked nose	Mouth breathing
Raised temperature	Raised temperature	Cough	Snoring
Poor appetite	Sleeps poorly	Mouth breathing	Noisy breathing
Bad breath	Poor appetite	Poor appetite	Raised temperature
Sick / vomiting	Bad breath	Pain on swallowing	Poor appetite
Sleeps poorly	Sick / vomiting	Runny nose	Cough
Noisy breathing	Earache	Raised temperature	Blocked nose
Headache	Headache	Snoring	Slow / noisy eating
Eats slowly/noisily	Tummy ache	Bad breath	Bad breath
Mouth breathing	Snoring	Headache	Pain on swallowing
Earache	Mouth breathing	Sleeps poorly	Runny nose
Hallucinations	Noisy breathing	Earache	Sleeps poorly
Tummy ache	Hallucinations	Noisy breathing	Headache
Choking episodes	Eats slowly/noisily	Eats slowly/noisily	Tummy ache
Snoring	Blocked nose	Hearing difficulty	Earache
Cough	Cough	Tummy ache	Sick / vomiting
Ear discharge	Diarrhoea	Sick / vomiting	Hearing difficulty
Runny nose	Hearing difficulty	Ear discharge	Choking
Diarrhoea	Choking episodes	Diarrhoea	Ear discharge
Blocked nose	Ear discharge	Hallucinations	Diarrhoea
Fits or seizures	Runny nose	Constipation	Constipation
Hearing difficulty	Constipation	Choking episodes	Hallucinations
Constipation	Fits or seizures	Fits or seizures	Fits or seizures

Table A6.4 Question 4 - Results of Chi-squared tests between the Normal and Waiting List groups

Symptom	Chi-squared	p-value
Pain on swallowing	38.72	**<0.0001**
Raised temperature	44.06	**<0.0001**
Sleeps poorly	65.53	**<0.0001**
Poor appetite	45.32	**<0.0001**
Bad breath	41.57	**<0.0001**
Sick / vomiting	34.34	**<0.0001**
Earache	45.28	**<0.0001**
Headache	35.53	**<0.0001**
Tummy ache	31.95	**<0.0001**
Snoring	29.32	**<0.0001**
Mouth breathing	19.45	**<0.0001**
Noisy breathing	17.43	**0.0002**
Hallucinations	15.06	**0.0005**
Eats slowly/noisily	10.57	**0.0051**
Blocked nose	18.92	**<0.0001**
Cough	14.19	**0.0008**
Diarrhoea	16.56	**0.0003**
Hearing difficulty	14.80	**0.0006**
Choking episodes	7.56	0.0200
Ear discharge	8.75	0.0126
Runny nose	6.69	0.0350
Constipation	-	-
Fits or seizures	5.68	0.0580

Table A6.5 Question 4 - Responses made by the Normal with Tonsillitis Group

Symptom	Never and Sometimes	Often and Always	Only if Tonsillitis
Pain on swallowing	14.52	35.48	50.00
Raised temperature	28.12	31.25	40.62
Sleeps poorly	50.85	25.42	23.73
Poor appetite	35.48	27.42	37.10
Bad breath	45.00	28.33	26.67
Sick / vomiting	67.24	10.34	22.41
Earache	63.93	19.67	16.39
Headache	49.18	32.79	18.03
Tummy ache	72.41	17.24	10.34
Snoring	55.93	33.90	10.17
Mouth breathing	47.46	35.59	16.95
Breathes noisily	59.65	21.05	19.30
Hallucinations	84.91	1.89	13.21
Eats slowly / noisily	65.00	20.00	15.00
Blocked nose	60.34	34.48	5.17
Cough	66.13	27.42	6.45
Diarrhoea	85.45	9.09	5.45
Hearing difficulty	82.14	14.29	3.57
Choking episodes	75.86	3.45	20.69
Ear discharge	90.70	4.65	4.65
Runny nose	67.80	25.42	6.78
Constipation	98.21	1.79	0.00
Fits or seizures	96.49	0.00	3.51

Table A6.6 Question 4 - Comparison of orderings according to "Only if Tonsillitis"

Normal Population	Normal with Tonsillitis	Waiting List
Pain on swallowing	Pain on swallowing	Pain on swallowing
Raised temperature	Raised temperature	Raised temperature
Poor appetite	Poor appetite	Sleeps poorly
Bad breath	Bad breath	Poor appetite
Sick / vomiting	Sleeps poorly	Bad breath
Sleeps poorly	Sick / vomiting	Sick / vomiting
Noisy breathing	Choking episodes	Earache
Headache	Noisy breathing	Headache
Eats slowly/noisily	Headache	Tummy ache
Mouth breathing	Mouth breathing	Snoring
Earache	Earache	Mouth breathing
Hallucinations	Eats slowly / noisily	Noisy breathing
Tummy ache	Hallucinations	Hallucinations
Choking episodes	Tummy ache	Eats slowly/noisily
Snoring	Snoring	Blocked nose
Cough	Runny nose	Cough
Ear discharge	Cough	Diarrhoea
Runny nose	Diarrhoea	Hearing difficulty
Diarrhoea	Blocked nose	Choking episodes
Blocked nose	Ear discharge	Ear discharge
Fits or seizures	Hearing difficulty	Runny nose
Hearing difficulty	Fits or seizures	Constipation
Constipation	Constipation	Fits or seizures

Table A6.7 Question 4 - Results of Chi-squared tests between the populations

Symptom	Normal Population vs. Normal with Tonsillitis (p value)	Waiting List vs. Normal with Tonsillitis (p value)	Normal Population vs. Waiting List (p value)
Pain on swallowing	**<0.0001**	**0.0003**	**<0.0001**
Raised temperature	**0.0005**	**0.0001**	**<0.0001**
Sleeps poorly	0.1961	**<0.0001**	**<0.0001**
Poor appetite	0.0318	0.0048	**<0.0001**
Bad breath	0.0055	**0.0016**	**<0.0001**
Sick / vomiting	0.0513	**0.0005**	**<0.0001**
Earache	0.1071	0.0207	**<0.0001**
Headache	0.0064	0.0240	**<0.0001**
Tummy ache	0.0696	0.0050	**<0.0001**
Snoring	0.0852	**<0.0001**	**<0.0001**
Mouth breathing	0.3835	**<0.0001**	**<0.0001**
Noisy breathing	0.6312	**<0.0001**	**0.0002**
Hallucinations	0.5216	0.2638	**0.0005**
Eats slowly/noisily	0.1883	0.0039	0.0051
Blocked nose	0.7860	0.0239	**<0.0001**
Cough	0.7225	0.0167	**0.0008**
Diarrhoea	0.5686	0.1551	**0.0003**
Hearing difficulty	0.7681	0.1226	**0.0006**
Choking episodes	0.7500	0.0044	0.0200
Ear discharge	0.6067	0.0623	0.0126
Runny nose	0.9850	0.2348	0.0350
Constipation	-	0.2397	-
Fits or seizures	0.2419	0.6384	0.0580

Table A6.8 Question 5 - Results of Chi-squared tests between the Normal and Waiting List groups

Symptom	Chi-squared	p value
Miss fun things	90.49	**<0.0001**
Stay away from school	83.56	**<0.0001**
Stay in bed	85.88	**<0.0001**
Has to see GP	103.74	**<0.0001**
Needs an antibiotic	122.43	**<0.0001**

Table A6.9 Question 6 - Results of Chi-squared testing between the Normal and Waiting List populations

Symptom	Chi-squared	p value
Irregular breathing	62.04	<**0.0001**
Restless sleep	50.34	**<0.0001**
Nightmares	35.21	**<0.0001**
Bed wetting	6.72	0.0813
Snoring	53.27	**<0.0001**
Mouth open	94.38	**<0.0001**
Wakes frequently	130.54	**<0.0001**
Choking	88.58	**<0.0001**
Thrashes and kicks	25.75	**<0.0001**
Unusual sleeping position	17.09	**0.0007**
Sleeps walks / talks	24.06	**<0.0001**
Grinds teeth	51.77	**<0.0001**
Sweating attacks	101.57	**<0.0001**

Table A6.10 Question 7 - Results of Chi-squared tests between the Normal and Waiting List groups.

Symptom	Chi-squared	p-value
Sleepy in morning	75.34	**<0.0001**
Irritability	59.13	**<0.0001**
Headache	77.83	**<0.0001**
Poor concentration	63.54	**<0.0001**
Hyperactive behaviour	33.16	**<0.0001**
Sleepy during day	138.12	**<0.0001**
Aggressive behaviour	43.10	**<0.0001**

Table A6.11 Question 8 - Results of Chi-squared tests between the Normal and Waiting List populations

Symptom	Chi-squared	p-value
General health	145.48	**<0.0001**
Appetite	39.42	**<0.0001**
School progress	16.57	**0.0023**
Behaviour	16.40	**0.0025**
Making friends	7.299	0.1209

Table A6.12 Effect of Social Class on Number of Sore Throats in Normal Population

Social Class	1	2	3	4	5
No. in Class	59	200	189	55	38
Ave. No. Sore Throats	1.03	1.23	1.71	1.42	1.08
Ave. No. Tonsillitis	0.45	0.41	1.17	0.50	0.76

Table A6.13 Effect of Social Class on Number of Sore Throats in Waiting List Population

Social Class	1	2	3	4	5
No. in Class	7	42	59	16	8
Ave. No. Sore Throats	6.33	8.35	6.03	11.60	9.79
Ave. No. Tonsillitis	5.50	6.77	5.21	8.80	8.25

Figure A6.1

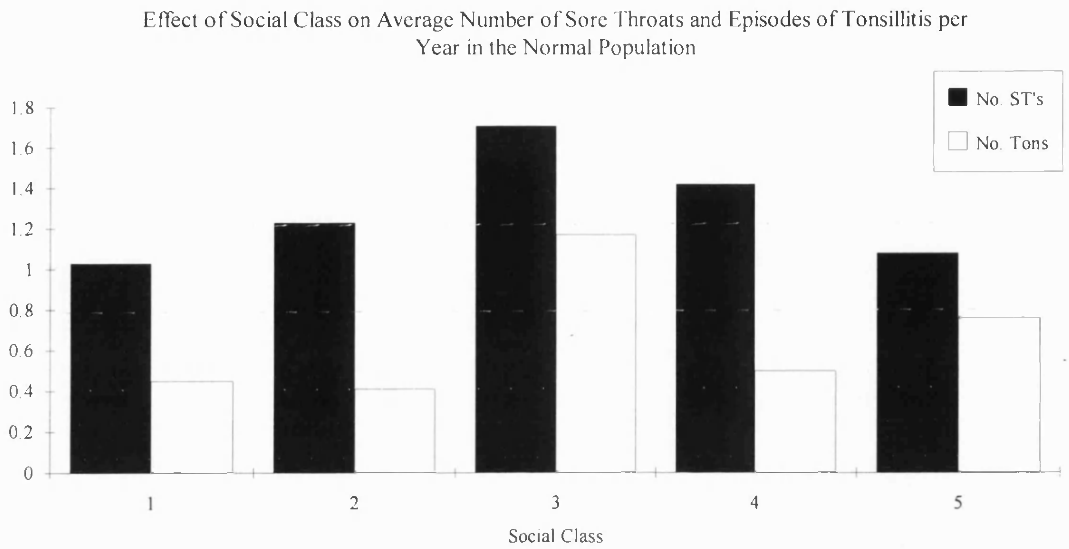


Figure A6.2

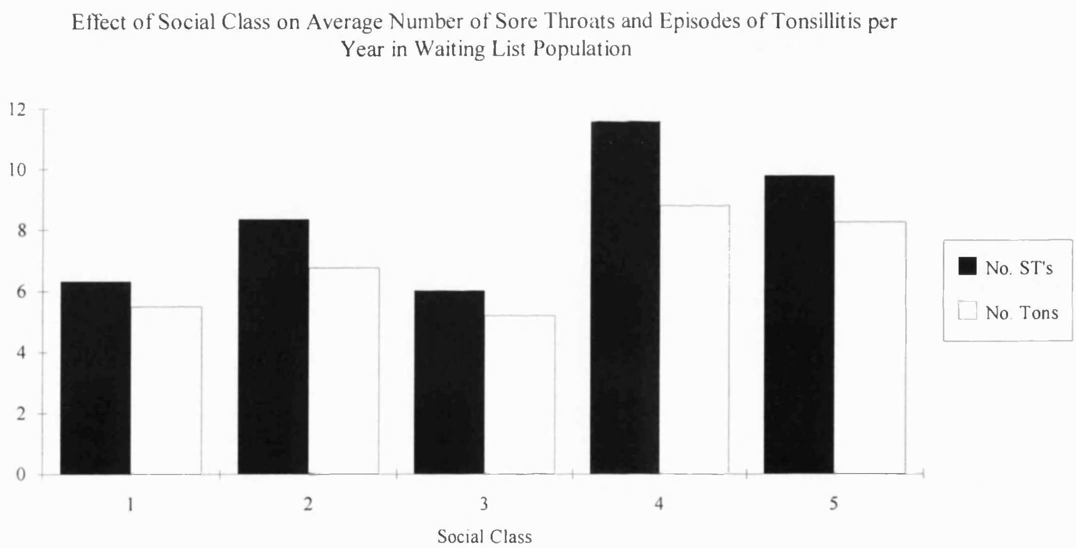


Table A6.14 Comparison of the Normal with Tonsillitis group with the Whole Population in terms of Social Class distribution

	Social Class	1	2	3	4	5
Normal with	No.	4	16	30	4	4
Tonsillitis	%	6.15	24.62	46.15	6.15	6.15
Whole	No.	62	210	198	68	35
Population	%	9.76	33.07	31.18	10.71	5.51

$\chi^2 = 7.47$, $p = 0.1129$

Table A6.15 Effect of Single Parent Family Status on Number of Sore Throats and Tonsillitis

	Frome				Waiting List			
	Single Parent (n = 80)	Not single parent	t value	p value	Single Parent (n = 7)	Not single parent	t value	p value
No. sore throats	1.77	1.35	1.45	<0.2	7.5	7.75	-0.03	>0.9
No. tonsillitis	1.35	0.69	3.68	**<0.001**	5.78	6.41	-1.24	<0.5

$\chi^2 = 5.897$, **$p = 0.0152$**

Figure A6.3 Effect of Family Size on Number of Sore Throats

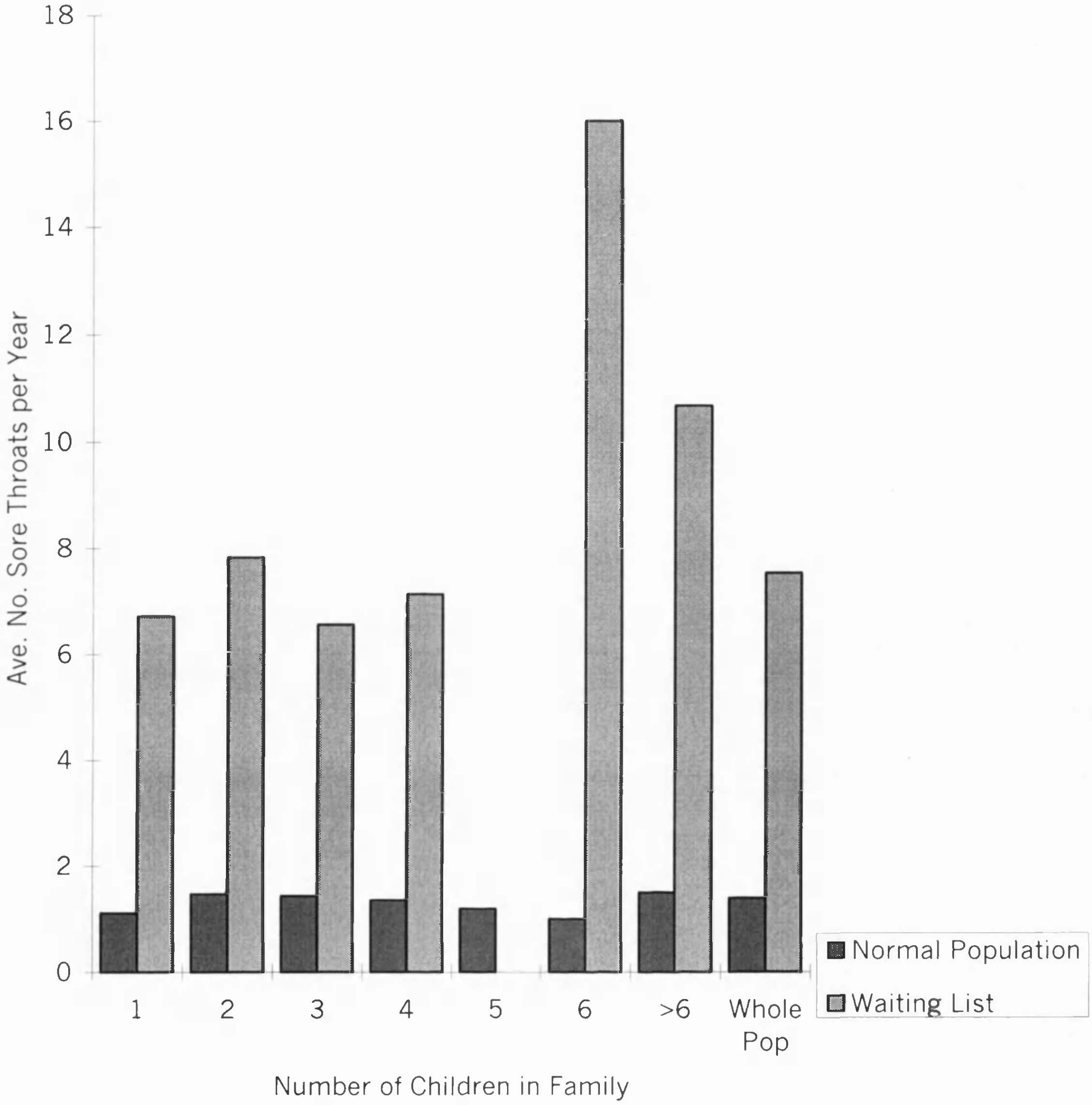


Table A6.16 Comparison of number of sore throats and tonsillitis in the Normal and Waiting List populations according to family size - p values

	Normal	Waiting List
Sore throats	0.91	0.15
Tonsillitis	0.37	0.12

Kruskal-Wallis test of analysis of variance

Table A6.17 Effect of Family size on Ability to differentiate Tonsillitis from Other Sore Throats

	Number of Children in Family			
	1	2	3	>=4
Normal Pop.	44	309	170	96
Normal Aware	3	35	15	12
Waiting List	11	55	30	14

$\chi^2 = 3.28$, $p = 0.7724$

Table A6.18 Number of sore throats in pre-school children - effect of day-care

	Normal (Frome)		Waiting List	
Day-care	Yes (%) (n=107)	No (%) (n=9)	Yes (%) (n=18)	No (%) (n=2)
No. sore throats	0.92	1.11	4.19	10.5
No. tonsillitis	0.14	0	3.19	7.5

Table A6.19 Effect of Parental Tonsillectomy on Reported Number of Sore Throats and Tonsillitis in Normal Population.

	Mother	Not mother	U value	p value	Father	Not father	U value	p value
No. sore throats	1.69	1.30	34414	0.44	1.19	1.43	22316	0.9
No. tonsillitis	0.73	0.21	8331	**0.007**	0.23	0.35	4326	0.99
Total	148				111			

	Either or both	Neither	U value	p value	Whole pop
No. sore throats	1.59	1.32	45483	0.83	1.39
No. tonsillitis	0.66	0.21	43096	0.37	0.33
Total	168				631

Table A6.20 Effect of Parental Tonsillectomy on Reported Number of Sore Throats and Tonsillitis in Waiting List Population

	Mother	Not mother	U value	p value	Father	Not father	U value	p value
No. sore throats	6.72	7.99	1684	0.13	6.36	8.04	1449	0.06
No. tonsillitis	5.75	7.27	1437	0.74	4.24	7.75	1110	0.11
Can differentiate	80.0%				72.1%			
Total	45				43			

	Either or both	Neither	U value	p value	Whole pop
No. sore throats	6.59	8.37	3128.5	0.05	7.53
No. tonsillitis	4.81	8.37	3106	0.04	6.69
Can differentiate	77.7%				84.5%
Total	67				142

Table A6.21 Incidence of parental tonsillectomy in each population.

	No. families with parental tonsillectomy / total
Normal Population	168 / 631
Waiting List Population	67 / 142

$p < 0.0001$

Table A6.22 Effect of Previous Surgery in Fathers (excluding tonsillectomy) on the Number of Sore Throats and Episodes of Tonsillitis

Normal Population	No previous op (n=370)	Previous op (n=184)	U value	p value
Ave. no. sore throats	1.31	1.41	33342.5	0.3
Ave. no. tonsillitis	0.73	0.40	5686	0.25

Waiting List Population	No previous op (n=86)	Previous op (n=42)	U value	p value
Ave. no. sore throats	6.75	8.45	1965.5	0.14
Ave. no. tonsillitis	5.88	5.96	1344	0.96

Table A6.23 Effect of Previous Surgery in Mothers (excluding tonsillectomy) on the Number of Sore Throats and Episodes of Tonsillitis

Normal Population	No previous op (n=364)	Previous op (n=250)	U value	p value
Ave. no. sore throats	1.49	1.30	39368.5	0.11
Ave. no. tonsillitis	0.83	0.71	6993	0.06

Waiting List Population	No previous op (n=70)	Previous op (n=64)	U value	p value
Ave. no. sore throats	6.61	8.49	2729	**0.02**
Ave. no. tonsillitis	5.22	7.38	2240	**0.005**

Table A6.24 Chi-squared p values for comparison of incidence of previous paternal and maternal surgery.

Fathers	1.00
Mothers	0.134

Table A6.25 Effect of parental smoking on the number of sore throats and tonsillitis episodes in the Normal population.

	Father n = 172	Not father n=362	U value	p value	Mother n = 164	Not mother n=452	U value	p value
No. sore throats	1.43	1.32	29687	0.72	1.68	1.30	38173	0.07
No. tonsillitis	0.73	0.63	5613	0.71	1.11	0.61	7994	0.29

	Either/ both n = 251	Neither n=368	U value	p value	Whole Pop n = 631
No. sore throats	1.52	1.32	40065	0.25	1.39
No. tonsillitis	0.98	0.63	7820	0.21	0.33

Table A6.26 Effect of parental smoking on the number of sore throats and tonsillitis episodes in the Waiting List population.

	Father n=41	Not father n=76	U value	p value	Mother n = 33	Not mother n=92	U value	p value
No. sore throats	7.09	8.04	1814	0.95	7.80	7.51	1986	0.27
No. tonsillitis	6.04	6.48	1256	0.23	6.98	5.93	1640	0.17

	Either/ both n = 60	Neither n=66	U value	p value	Whole Pop n = 142
No. sore throats	7.16	8.0	2282	0.74	7.53
No. tonsillitis	6.05	6.32	1699.5	0.82	6.69

Table A6.27 Incidence of parental smoking in each population.

	No. families with parental smoker / total
Normal Population	251 / 631
Waiting List Population	60 / 142

p = 0.697

Table A6.28 Effect of parental atopy on the number of sore throats and episodes of tonsillitis in the Normal Population

	Asthma	No asthma	U value	p value	Hay fever	No hay fever	U value	p value
No. ST's	1.32	1.41	26016	0.92	1.38	1.39	37834	0.81
No. tonsillitis	0.45	0.31	5843	0.39	0.25	0.36	6110	**0.02**
Total mother	48				99			
father	75				61			
both	7				15			

	Eczema	No eczema	U value	p value	Any	None	U value	p value
No. ST's	1.35	1.4	28814	0.87	1.33	1.44	44492	0.37
No. tonsillitis	0.28	0.34	5864	0.6	1.48	1.57	7380	**0.02**
Total mother	177				324			
father	36				172			
both	7				29			

Significant results are highlighted.

Table A6.29 Effect of parental atopy on the number of sore throats and episodes of tonsillitis in the Waiting List Population

	Asthma	No asthma	U value	p value	Hay fever	No hay fever	U value	p value
No. ST's	6.91	7.68	1404	0.72	8.08	7.22	2401	0.7
No. tonsillitis	4.63	6.30	871	0.2	5.96	7.1	1919	0.45
Total mother	12				29			
father	14				17			
both	1				5			

	Eczema	No eczema	U value	p value	Any	None	U value	p value
No. ST's	7.46	7.55	1933	0.83	8.24	7.40	2287	0.59
No. tonsillitis	5.51	7.09	1362	0.36	6.12	6.58	2013	0.43
Total mother	21				62			
father	13				44			
both	2				8			

Table A6.30 Effect of sibling atopy on the number of sore throats and episodes of tonsillitis in the Normal Population

	No. sore throats	U value	p value	No. tonsillitis	U value	p value	Total
Allergies	1.52			0.42			100
Asthma No asthma	1.52 1.38	21894	0.34	0.63 0.30	4749	0.03	64
Hay fever No hay fever	1.66 1.36	23634	0.05	0.39 0.32	4849	0.59	68
Eczema No eczema	1.53 1.36	33176	0.34	0.38 0.32	6141	0.66	118
Chest infections No chest infections	1.64 1.34	33293	0.007	0.36 0.32	6639	0.23	106
Sore throats No sore throats	2.17 1.12	52858	**<0.0001**	0.60 0.19	9306	0.003	163
Sore throats in past No sore throats in past	1.54 1.38	13874	0.43	0.41 0.32	3073	0.98	40
Tonsils removed Tonsils not removed	1.3 1.39	7246	0.82	0.56 0.32	1625	0.97	25
Whole population	1.39			0.33			631

Bonferroni corrected p value = 0.007

Table A6.31 Effect of sibling atopy on the number of sore throats and episodes of tonsillitis in the Waiting List Population

	No. sore throats	U value	p value	No. tonsillitis	U value	p value	Total
Allergies	8.68			6.18			11
Asthma No asthma	6.79 7.68	1685	0.96	4.95 7.04	1249	0.94	24
Hay fever No hay fever	9.10 7.41	1487	0.14	6.35 6.72	1140	0.29	10
Eczema No eczema	8.71 7.29	2512	0.005	6.17 6.80	1687	0.32	24
Chest infections No chest infections	9.19 7.32	1802	0.19	7.03 6.65	1391	0.19	16
Sore throats No sore throats	7.49 7.54	1943	0.86	5.75 7.03	1648	0.35	38
Sore throats in past No sore throats in past	6.25 7.67	901	0.24	4.67 6.91	638.5	0.1	14
Tonsils removed Tonsils not removed	7.50 7.53	745.5	0.94	4.95 6.85	440.5	0.26	12
Whole population	7.53			6.70			142

Bonferroni corrected p value = 0.007

Comparison of the incidence of atopy in the Normal and Waiting List populations was performed using the Chi-squared test with the following results:

Asthma	$p = 0.73$
Hay fever	$p = 0.15$
Eczema	$p = 0.12$

Table A6.32 Effect of atopy on the number of sore throats and episodes of tonsillitis in the Normal Population

	Asthma	No asthma	U value	p value	Hay fever	No hay fever	U value	p value
No. sore throats	1.35	1.4	17231	0.75	1.51	1.38	15245	0.28
No. tonsillitis	1.15	0.74	3610	0.04	0.8	0.78	3680	0.05
Total	71	560			52	579		

	Eczema	No eczema	U value	p value	All together	None	U value	p value
No. sore throats	1.39	1.39	22917	0.29	1.36	1.40	36720	0.44
No. tonsillitis	0.42	0.85	3873	0.37	0.65	0.84	6960	0.54
Total	90	541			169	462		

Bonferroni corrected p value = 0.0125

Table A6.33 Effect of atopy on the number of sore throats and episodes of tonsillitis in the Waiting List Population

	Asthma	No asthma	U value	p value	Hay fever	No hay fever	U value	p value
No. sore throats	7.47	7.72	963.5	0.64	6.78	7.76	823	0.71
No. tonsillitis	6.58	6.28	730.5	0.34	4.19	6.49	572.5	0.7
Total	18	109			9	118		

	Eczema	No eczema	U value	p value	All together	None	U value	p value
No. sore throats	8.37	7.55	1175	0.17	7.3	7.84	1771	0.33
No. tonsillitis	6.42	6.29	744.5	0.05	5.58	6.61	1236	0.09
Total	21	104			45	87		

Bonferroni corrected p value = 0.0125

Table A6.34 Effect of birth weight upon the number of sore throats per year and the age at which the first sore throat occurred in the Normal population.

Birth weight (kg)	No. children	No. sore throats/year	No. tonsillitis/ year	Age at first sore throat
<2.0	16	0.59	0.06	2.67
2.0-2.49	20	1.98	0.25	2.68
2.5-2.99	100	1.56	0.32	2.66
3.0-3.49	235	1.47	0.45	3.33
3.5-3.99	158	1.35	0.29	2.55
4.0-4.49	60	1.06	0.14	3.39
4.5-5.02	14	2.00	0.21	3.64
Don't know	28	0.81	0.18	3.23
Whole population	631	1.39	0.33	3.00

Table A6.35 Effect of birth weight upon the number of sore throats per year and the age at which the first sore throat occurred in the Waiting List population.

Birth weight (kg)	No. children	No. sore throats/year	No. tonsillitis / year	Age at first sore throat
<2.0	3	10.50	4.83	4.50
2.0-2.49	11	8.67	2.26	2.83
2.5-2.99	19	8.11	6.50	2.83
3.0-3.49	48	7.39	5.81	2.88
3.5-3.99	34	7.02	4.65	3.22
4.0-4.49	23	7.31	4.95	2.79
4.5-5.02	0	-	-	-
Don't know	4	3.5	1.5	0.25
Whole population	142	7.53	6.70	2.90

Figure A6.2

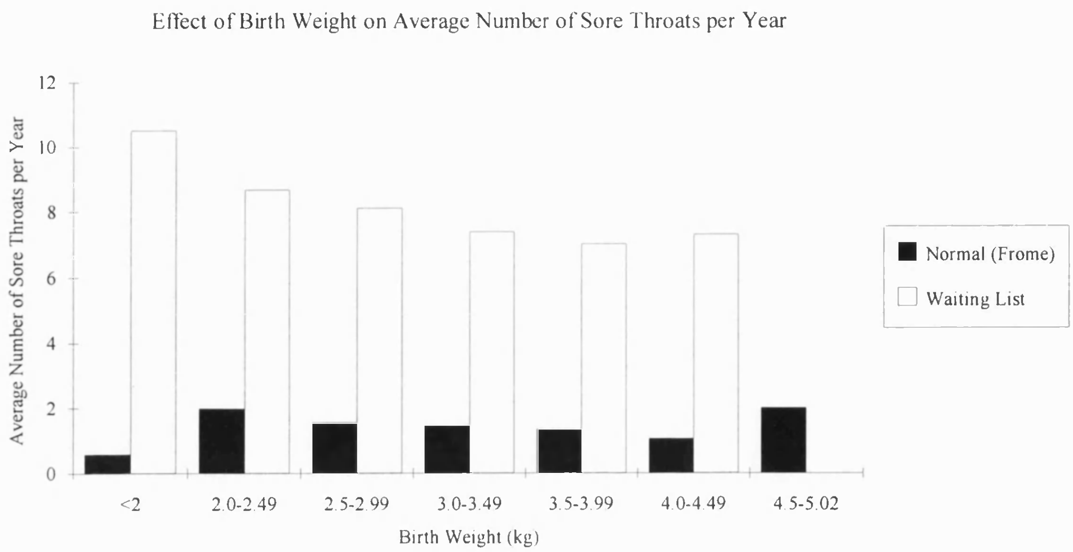


Figure A6.3

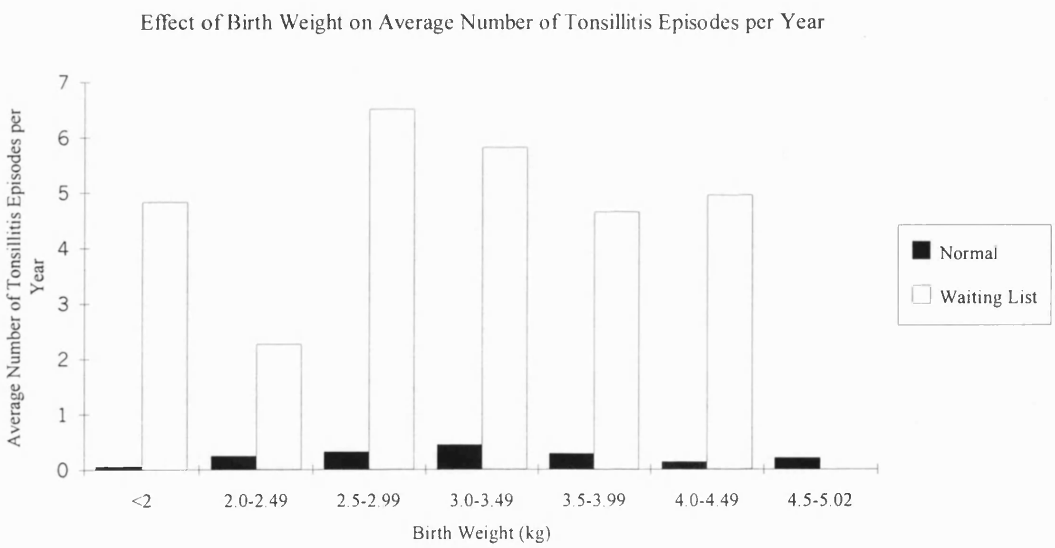
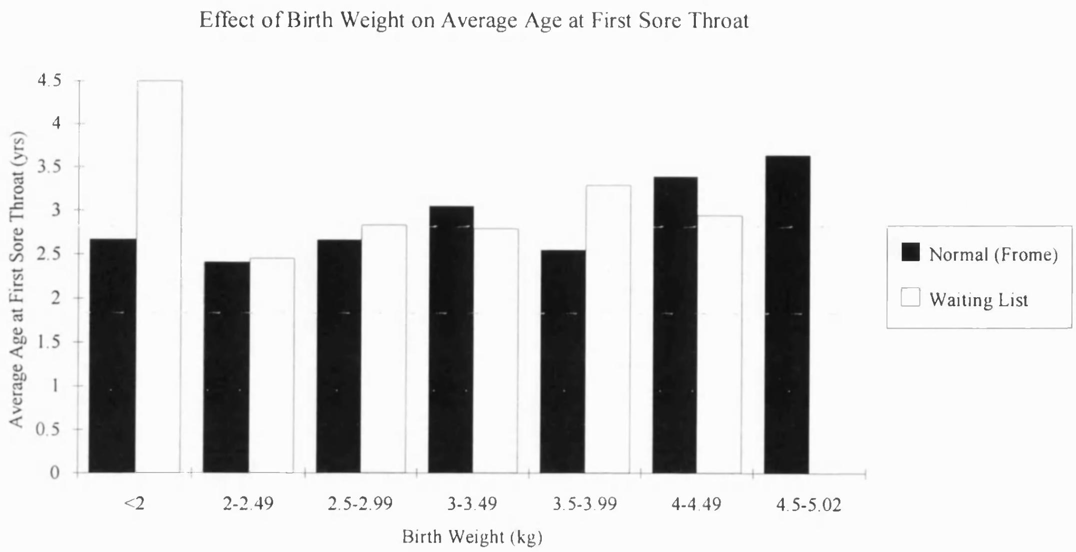


Figure A6.4



The regression equations are shown below.

Normal Population

$\text{Log}_e(1+ \text{ no. sore throats}) = 0.0431 \times \text{Birth weight} + 0.62$ $\quad p = 0.62$

$\text{Log}_e(1+ \text{ no. tonsillitis}) = 0.0503 \times \text{Birth weight} + 0.79$ $\quad p = 0.46$

Age at first sore throat = 0.14 x Birth weight + 2.52 $\quad p = 0.42$

Waiting List Population

No. sore throats = -1.38 x Birth weight + 12.43 $\quad p = 0.08$

No. tonsillitis = -1.06 x Birth weight + 9.98 $\quad p = 0.14$

Age at first sore throat = 0.00773 x Birth weight + 2.84 $\quad p = 0.98$

Table A6.36 Effect of breast feeding on average number of sore throats and age of first sore throat in the Normal population.

Duration of breast feeding (months)	No. children	No. sore throats/year	No. tonsillitis/ year	Age at first sore throat
Never	221	1.33	0.35	2.98
<2	82	1.65	0.32	2.80
2-2.9	32	1.39	0.45	2.64
3-4.9	51	1.54	0.61	3.20
5-6.9	73	1.12	0.20	3.26
7-9.9	80	1.65	0.38	3.33
10-12	63	1.35	0.25	2.91
>12	29	1.13	0.10	2.41
Whole population	631	1.39	0.33	3.00

Table A6.37 Effect of breast feeding on average number of sore throats and age of first sore throat in the Waiting List population.

Duration of breast feeding (months)	No. children	No. sore throats/year	No. tonsillitis / year	Age at first sore throat
Never	57	7.83	5.59	2.85
<2	23	7.02	5.28	2.57
2-2.9	9	7.17	4.88	3.19
3-4.9	15	7.64	5.04	4.17
5-6.9	12	10.40	8.36	3.42
7-9.9	15	8.10	4.38	2.77
10-12	5	5.60	7.75	2.20
>12	6	6.80	4.00	1.90
Whole population	142	7.53	6.70	2.90

Figure A6.5

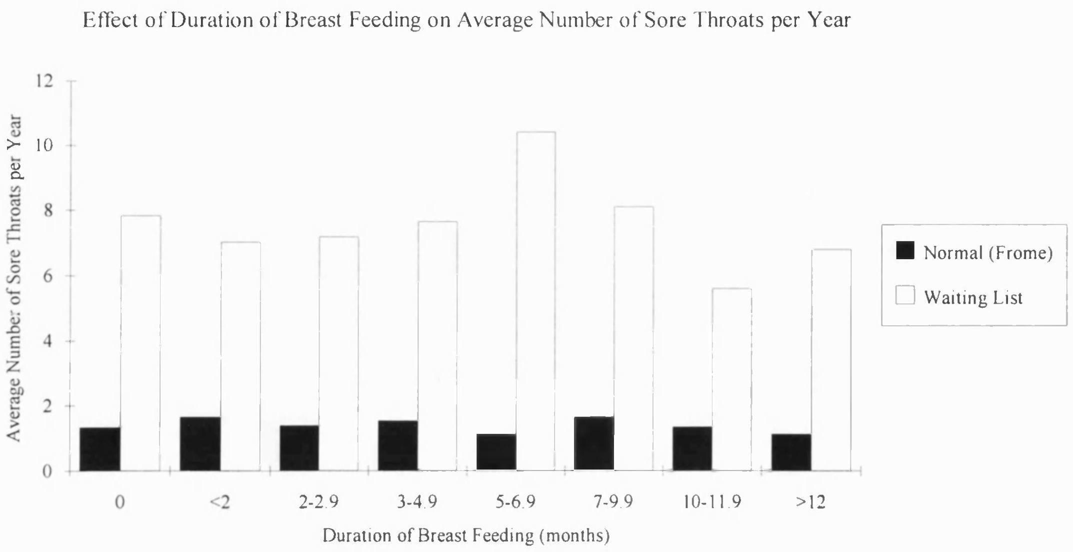


Figure A6.6

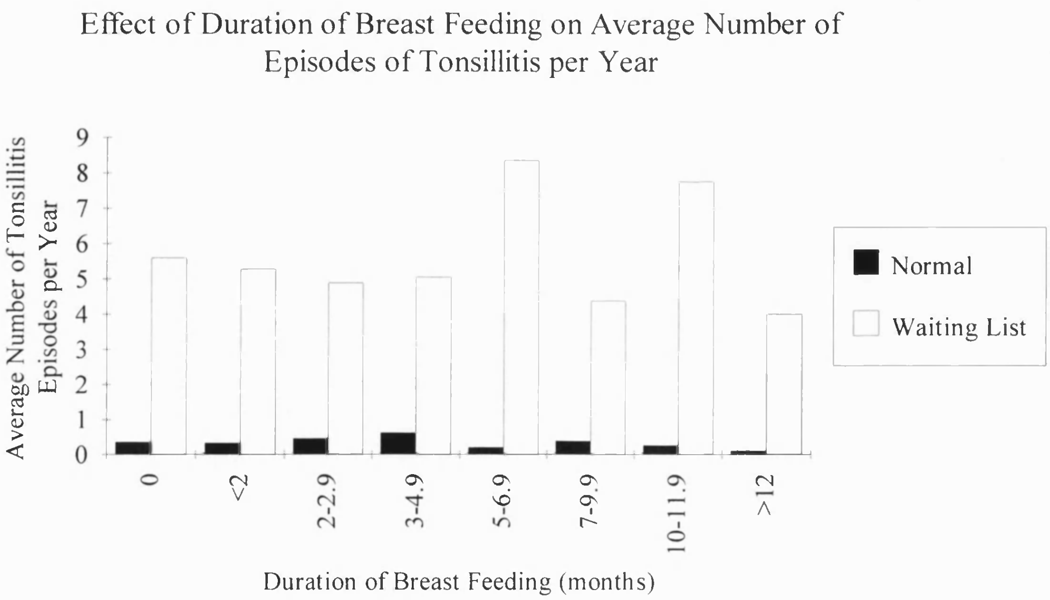
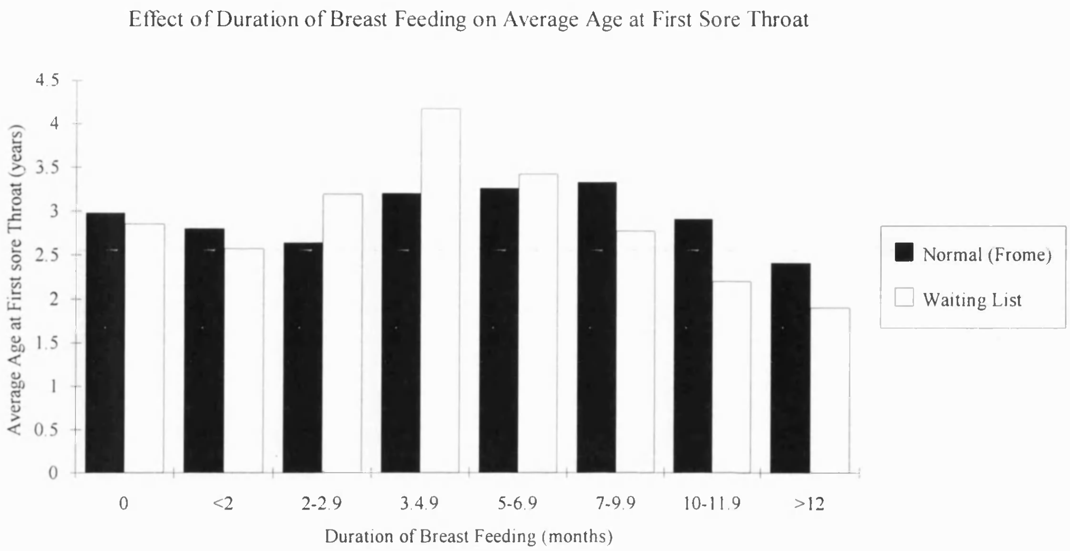


Figure A6.7



The regression equations are shown below.

Normal Population

No. sore throats = -0.00494 x Log_e duration of breast feeding + 1.41 p = 0.95

Log_e(1 + no. tonsillitis) = 0.0012 x Log_e duration of breast feeding + 0.96 p = 0.97

Age at first sore throat = -0.00684 x Log_e duration of breast feeding + 3.01 p = 0.72

Waiting List Population

Log_e(1 + no. sore throats) = -0.00854 x duration of breast feeding + 1.95 p = 0.52

Log_e(1 + no. tonsillitis) = -0.059 x Log_e duration of breast feeding + 1.88 p = 0.64

Log_e age at first sore throat = -0.0582 x duration of breast feeding + 0.81 p = 0.72

APPENDIX 7 – STEPS TAKEN TO OVERCOME STUDY DESIGN BIAS

The study has three important areas where bias may be introduced because of the design, namely,

- The responses made by parents in the questionnaire are accurate and honest about their children's sore throats
- The non-responders do not represent a separate population from the responders
- The Frome general practitioners are not different from the other general practitioners in the Bath District Health Authority area in terms of their understanding of sore throats and tonsillitis.

In order to assess the size of bias introduced into the results of the study because of these three areas, the following steps were undertaken:

- Data given by the parents of the Normal population were checked against entries in the general practice case notes
- Answers given by parents who responded to the third mailing of the questionnaire were compared with the answers given by parents who had responded to an earlier posting of the questionnaire.
- The general practitioners in Frome all received a questionnaire and their answers were compared with the general practitioners sample population representing all of the Bath District Health Authority area.

A7.1 Comparison of the Parental Questionnaires with the General Practice Case Notes

The number of visits to the general practitioner because of sore throats and tonsillitis was chosen as the area to validate the information given by parents in the questionnaire by comparison with information already held in the general practice case notes. Data were collected from the general practice case notes for the two years prior to the study.

For the purpose of the comparison of the questionnaire data with the case notes, the Normal population was divided into four groups according to their response to question 5(d) of the questionnaire:
"When your child has a sore throat, does he/she have to see the GP?"

- Those who never have a sore throat
- Those who "rarely or never" see the general practitioner because of a sore throat
- Those who "always, often or sometimes" see the general practitioner because of a sore throat
- Those who see the general practitioner "only if it is tonsillitis".

The average number of sore throats and episodes of tonsillitis reported by the parents was calculated from the questionnaire data and compared with the average number of visits to the surgery because of sore throats and episodes of tonsillitis recorded in the general practice notes of these children. The results are shown in tables A7.1 and A7.2.

Table A7.1 Comparison of the average number of sore throats per year according to general practice notes and questionnaire data.

Child sees general practitioner with a sore throat:	Average number of visits to general practice surgery recorded in case notes	Average number sore throats reported in questionnaire
Never has sore throat	0.20	-
Rarely or never	0.26	2.25
Always, often or sometimes	0.53	2.88
Only if tonsillitis	0.34	4.03

Table A7.2 Comparison of the number of episodes of tonsillitis per year according to general practice notes and questionnaire data.

Child sees general practitioner with tonsillitis:	Average number of visits to general practice surgery recorded in case notes	Average number of episodes of tonsillitis reported in questionnaire
Never has sore throat	0.39	-
Rarely or never	0.28	0.08
Always, often or sometimes	0.88	1.25
Only if tonsillitis	1.83	2.53

Table A7.1 shows that there is a discrepancy between the number of sore throats reported in the questionnaire, the parents' perception of frequency of surgery visits and the number of visits to the general practitioners for this reason. For example, children in the "always, often and sometimes" group visit the general practitioner 0.53 times per year according to the case notes but have 2.88 sore throats according to the questionnaire data. There is a trend, however, for the "always, often and sometimes" group to visit the general practitioner more often with a sore throat than the children in the "rarely and never" group. The same trend can be seen in table A7.2 with regard to surgery visits for tonsillitis. Children whose parents report that they visit the general practitioner "only if tonsillitis" have more episodes of tonsillitis recorded in their case notes than the other children. Children who never have a sore throats according to the questionnaire data visit the general practitioner less frequently than the others for sore throats but have more tonsillitis than the "rarely and never" group. The reason for this anomaly is uncertain but the figures are small.

A7.2 Comparison of Responses to Third Posting of Questionnaire with those to Earlier Postings of the Questionnaire

For the Normal population, the responses of those who replied to the third mailing of the questionnaire were compared with the responses of those who replied to earlier postings. The comparison was performed to demonstrate if the late responders represented a separate population from the earlier responders. The findings of this comparison were extrapolated to the non-responders to estimate whether they were likely to represent a separate population.

Comparison was made for

- Number of sore throats per year
- Age at first sore throat
- Duration of sore throats
- Number of episodes of tonsillitis per year
- Number of colds per year
- Social class

The results are shown in tables A7.4 and A7.5. The tables show that there is no difference between the responses of the earlier repliers and those who replied to the third mailing of the questionnaire in respect to any of the areas tested.

Table A7.4 Comparison of the Responses to Third Posting of Questionnaire with those to Earlier Postings of Questionnaire

	Third Posting	Earlier Postings	p value
Number of sore throats per year	1.41	1.11	0.75
Age at first sore throat (years)	2.99	3.20	0.56
Duration of sore throats (days)	3.52	3.17	0.55
Number of episodes of tonsillitis/year	0.82	0.33	0.42
Number of colds per year	3	2.45	0.21

Mann Whitney U test performed

Table A7.5 Comparison of Social Class Distribution between Responders to Third Posting of Questionnaire and Responders to Earlier Postings of Questionnaire

	SC1	SC2	SC3	SC4	SC5
Third Responders	2	16	14	2	5
Earlier Responders	58	191	164	54	27

$\chi 2 = 5.95$, $p = 0.2$

A7.3 Comparison of the Frome General Practitioners with the Sample Population of General Practitioners from the Bath District Health Authority Area

The study assumes that the population in Frome is representative of the larger population served by the Bath District Health Authority and thus is suitable as the source of the control population in the case-control study design. The practice of the general practitioners in Frome could have a significant influence on the attitudes of the parents in Frome. General practitioners may, directly or indirectly, teach parents about sore throats, tonsillitis and tonsillectomy. Hence, it is important to compare the general practitioners in Frome with the larger group selected from the Bath District Health Authority. If there are marked differences in practice, then the assumption that the Frome population is a "normal" subgroup of the larger population becomes invalid.

Of the thirteen general practitioners in the Frome Medical Practice, ten completed and returned the questionnaire (76.9%).

Tables A7.6, A7.7 and A7.8 show the number of general practitioners choosing each feature in the question for the diagnostic features of tonsillitis, pharyngitis and upper respiratory tract infection. The numbers are too small to apply a chi-squared test but simple inspection strongly suggests that the distribution of answers to the listed features is similar for the Frome general practitioners and the larger general practitioner sample population.

Table A7.6 Raw data for number of Frome General Practitioners and Sample General Practitioner Group answering each Feature for Tonsillitis

	Frome General Practitioners			All General Practitioners		
Feature	T1	T2	T3	T1	T2	T3
Neck pain	0	0	0	0	0	0
Halitosis	0	0	0	0	0	7
Nasal discharge	0	0	0	0	0	0
Muffled voice	0	0	0	0	0	1
Hearing loss	0	0	0	0	0	0
Cough	0	0	0	0	0	0
Abdominal pain	0	0	0	0	0	1
Enlarged CLN	0	1	0	2	5	8
Snoring	0	0	0	0	0	0
Anorexia	0	0	0	0	0	0
Tender CLN	0	1	6	3	15	11
Mouth breathing	0	0	0	0	0	0
Dysphagia	0	0	0	2	2	4
Temp > 38.3^{o}C	0	1	2	0	13	17
Positive culture	0	0	0	1	0	4
Nasal blockage	0	0	0	0	0	0
Sore throat	3	3	1	23	9	7
Tonsillar exudate	7	3	0	37	19	6
Time off school or in bed	0	0	1	1	1	2
Duration > 3 days	0	1	0	0	4	2
Otalgia	0	0	0	0	1	0
Duration < 3 days	0	0	0	0	0	0
Other	0	0	0	2	2	1

Table A7.7 Raw data for number of Frome General Practitioners and Sample General Practitioner Group answering each Feature for Pharyngitis

	Frome General Practitioners			All General Practitioners		
Feature	P1	P2	P3	P1	P2	P3
Neck pain	0	0	1	1	0	3
Halitosis	0	0	0	1	0	1
Nasal discharge	0	0	0	0	0	1
Muffled voice	0	0	0	2	5	1
Hearing loss	0	0	0	0	0	0
Cough	0	0	1	0	2	3
Abdominal pain	0	0	0	0	0	0
Enlarged CLN	0	0	1	1	3	1
Snoring	0	0	0	0	0	0
Anorexia	0	0	1	0	0	0
Tender CLN	0	3	2	0	13	15
Mouth breathing	0	0	0	0	0	0
Dysphagia	1	0	0	2	12	7
Temp > 38.3°C	0	0	1	0	11	24
Positive culture	0	0	0	0	0	0
Nasal blockage	0	0	0	0	1	0
Sore throat	9	0	0	61	4	0
Tonsillar exudate	0	0	0	0	0	0
Time off school or in bed	0	0	0	0	1	1
Duration > 3 days	0	0	1	0	4	4
Otalgia	0	0	0	0	0	1
Duration < 3 days	0	3	0	0	10	4
Other	0	4	1	3	5	5

Table A7.8 Raw data for number of Frome General Practitioners and Sample General Practitioner Group answering each Feature for Upper Respiratory Tract Infection

	Frome General Practitioners			All General Practitioners		
Feature	U1	U2	U3	U1	U2	U3
Neck pain	0	0	0	0	0	0
Halitosis	0	0	0	0	0	0
Nasal discharge	6	0	1	29	7	7
Muffled voice	0	0	0	0	1	2
Hearing loss	0	0	1	0	0	1
Cough	1	3	1	12	12	14
Abdominal pain	0	0	0	0	0	0
Enlarged CLN	0	0	0	1	1	1
Snoring	0	0	0	0	0	0
Anorexia	0	0	0	0	0	0
Tender CLN	2	0	0	0	4	7
Mouth breathing	0	1	0	0	2	1
Dysphagia	0	0	0	0	2	0
Temp > 38.3°C	0	1	2	5	7	13
Positive culture	0	0	0	0	0	0
Nasal blockage	0	0	3	7	11	9
Sore throat	1	1	0	13	18	7
Tonsillar exudate	0	0	0	1	0	0
Time off school or in bed	0	0	0	0	0	0
Duration > 3 days	0	1	0	1	2	4
Otalgia	0	0	0	1	2	2
Duration < 3 days	0	2	1	0	1	1
Other	0	1	1	1	1	2

Table A7.9 shows the number of general practitioners choosing each answer option for the features associated with acute tonsillitis. Again, numbers are too small to apply a Chi-squared test but inspection suggests that the Frome general practitioners and other general practitioners are similar.

Table A7.9 Raw Data for Number of Frome General Practitioners and All General Practitioners answering the Features in Question 3

	Frome General Practitioners					All General Practitioners				
Feature	1	2	3	4	5	1	2	3	4	5
Tonsillar exudate	1	2	2	1	0	24	16	8	8	3
Pyrexia	1	5	3	1	0	5	17	14	10	4
Duration > 3 days	0	0	1	0	0	1	1	2	1	2
Neck pain	0	0	0	0	0	0	0	2	2	0
Anorexia	0	0	0	1	0	0	0	1	2	5
Otalgia	0	0	0	1	0	0	0	1	3	3
Nasal discharge	0	0	0	0	0	0	0	0	0	0
Nasal blockage	0	0	0	0	0	0	0	0	0	0
Sore throat	5	1	3	0	0	36	7	6	7	1
Dysphagia	0	1	0	0	2	2	8	5	5	3
Abdominal pain	0	0	0	0	1	0	1	0	1	8
Enlarged CLN	0	0	0	4	1	1	7	14	9	7
Snoring	0	0	0	0	0	1	0	0	1	0
Choking	0	0	0	0	0	0	0	0	4	4
Muffled voice	0	0	0	0	0	0	2	1	1	3
Mouth breathing	0	0	0	0	0	0	1	1	0	3
Noisy eating	0	1	0	0	0	0	0	0	1	0
Tender CLN	0	0	1	2	2	0	11	12	14	9
Cough	0	0	0	0	0	0	0	0	0	0
Hearing loss	0	0	0	0	0	0	0	0	0	0
Halitosis	0	0	0	0	4	1	0	4	2	15
Other	0	0	0	0	0	0	0	0	0	1

Table A7.10 shows the indications for referral to hospital for tonsillectomy as answered by the Frome general practitioners and the General Practice population. Inspection suggests that the populations are similar in their mode of answering.

Table A7.10 Raw Data for Number of Frome General Practitioners and All General Practitioners answering the Features in Question 4

	Frome General Practitioners					All General Practitioners				
Feature	1	2	3	4	5	1	2	3	4	5
Poor school progress	0	0	0	1	1	2	2	3	1	3
Aggressive	0	0	0	0	0	0	0	0	0	3
Snoring	0	0	0	1	0	0	3	2	6	4
Freq. sore throats reported by parents	2	1	0	1	1	4	6	4	6	3
Poor appetite	0	0	0	0	0	0	1	3	0	1
Freq. surgery visits	0	1	2	0	1	4	4	6	2	4
Freq. home visits	0	0	1	0	0	0	0	1	2	0
Freq. documented tonsillitis	6	3	0	0	0	43	12	4	4	1
Tonsil size	0	1	1	0	1	0	3	6	7	4
Attitude of local ENT surgeon	0	0	0	1	0	0	0	1	2	4
No. antibiotics	0	0	2	0	1	4	5	4	5	6
Poor general health	0	1	1	1	1	1	3	9	11	10
No. days off school	0	2	2	3	0	6	22	16	9	6
Freq. URTI's	0	0	0	0	0	0	1	3	6	7
Parental pressure	1	1	0	0	3	1	3	6	4	13
Apnoeic spells	1	0	1	1	1	5	3	2	6	1
Other	0	0	0	1	0	1	0	0	0	0

Table A7.11 shows the answers to question 4 about the expected benefits of tonsillectomy. Again the numbers are too small to apply statistical testing. The highlighted features are those in which there appears to be a difference in the way the groups have responded. These features are all related to the symptoms associated with the obstructive sleep apnoea syndrome and there appears to be a greater incidence of expectation of improvement in these features in the Frome general practitioners. This potential source of bias has not had a significant effect upon the responses of the parents via the questionnaire because the Waiting List population reported much more disturbed sleep than the Normal population and the Normal with Tonsillitis subgroup of the Normal population had less disturbed sleep than the Normal population as a whole despite having more tonsillitis.

Table A7.11 Features expected to improve following tonsillectomy

	All General Practitioners			Frome General Practitioners		
Feature	Yes	No	Unsure	Yes	No	Unsure
Sleep walking	6	53	12	3	5	2
Sleep talking	5	54	12	0	7	3
Nightmares/night terrors	9	52	10	2	7	1
Grinding teeth	1	56	14	0	8	2
Bed wetting	4	58	9	0	8	2
Frequency of sore throats	57	13	1	7	2	1
Sweating attacks	22	33	16	5	4	1
Restless sleep	**30**	**31**	**10**	**7**	**2**	**1**
Unusual sleeping position	**13**	**39**	**19**	**3**	**4**	**3**
Frequent wakening	**23**	**32**	**16**	**6**	**3**	**1**
Breath holding	4	52	15	0	7	3
Frequency of URTI's	23	44	4	2	7	1
Irregular breathing	20	39	12	2	7	1
Morning irritability	**21**	**36**	**14**	**4**	**4**	**2**
Morning sleepiness	**22**	**37**	**12**	**5**	**4**	**1**
Daytime sleepiness	**21**	**38**	**12**	**6**	**3**	**1**
Poor concentration	**22**	**38**	**11**	**6**	**3**	**1**
Hyperactive/aggressive behaviour	9	44	18	2	6	2

Demographic Details

Further areas of comparison were the age and sex distribution, the number of years in general practice and previous ENT experience of the general practitioners in the Frome group and the larger sample from the Bath District Health Authority. The data in table A7.11 showed that the Frome general practitioners seem to be more aware of the features associated with the obstructive sleep apnoea syndrome. This syndrome has come to light in recent years and it is possible that awareness of it may be greater amongst younger general practitioners.

The results of the analysis are shown in table A7.12. It can be seen that the two groups of general practitioners are identical in all respects except that 15.49% of the General Practitioner sample have had experience of ENT outside of general practice and none of the Frome group have had this type of training.

Table A7.12 Comparison of age and sex characteristics and years of experience between all the general practitioners and the Frome general practitioners.

		All General Practitioners		Frome General Practitioners	
Age	<=30	0	0.00%	1	10%
	31-40	27	38.03%	4	40%
	41-50	25	35.21%	3	30%
	51-60	18	25.35%	1	10%
	>60	1	1.41%	1	10%
Sex	M	49	69.01%	7	70%
	F	21	29.58%	3	30%
No. years qualified		20		19	
No. years in general practice		14		14	
Previous ENT experience		11	15.49%	0	0%