

The natural history of acute upper respiratory tract infections in children

Andrew Mitra¹, David Hannay², Akshat Kapur³ and Gwen Baxter⁴

¹Consultant Paediatrician, Dumfries and Galloway Royal Infirmary, Dumfries, UK

²Honorary Consultant, R&D Support Unit, Dumfries and Galloway Royal Infirmary, Dumfries, UK

³Paediatric Registrar, Dumfries and Galloway Royal Infirmary, Dumfries, UK

⁴Research Coordinator, R&D Support Unit, Dumfries and Galloway Royal Infirmary, Dumfries, UK

Aim: To describe the natural history of acute upper respiratory tract infections (AURIs) in primary-school children, by recording their daily symptoms. **Background:** AURIs in children are one of the most common reasons for people seeking advice from general practitioners (GPs); however, little is known about the natural history of AURIs in terms of the length and severity of symptoms, because the majority of illnesses are contracted at home. **Method:** After an initial pilot study to test the feasibility of parents recording symptoms in a diary based on the Canadian Acute Respiratory Illness and Flu Scale (CARIFS), a random selection of primary schools operating in the region was carried out in order to minimise selection bias. Meetings were arranged at the 20 schools to obtain written consent from parents and to give out diaries with a stamped addressed envelope. The diaries recorded daily symptom severity for one episode of AURI, and the data were analysed using SPSS programmes. **Findings:** Diaries were returned from 223 children, of whom 146 had had an AURI. The average age was eight years, and there were almost equal numbers of boys and girls. The most frequent symptoms were runny nose, cough, feeling unwell and sore throat. There was a biphasic distribution with systemic symptoms in the first three days characterised by fever, poor sleep, irritability, not playing and headache. By day four, symptoms localising the infection to the upper respiratory tract appeared with runny nose, cough, sore throat and poor appetite; these continued into the second and occasionally third week. Most symptoms lasted for 5–11 days, with a median length for all symptoms of seven days. Symptoms defined by parents tended to be scored less for severity than symptoms defined by children.

Key words: acute respiratory infections; children; symptoms

Received 18 July 2010; accepted 11 April 2011; first published online 22 June 2011

Introduction

Acute upper respiratory tract infections (AURIs) commonly occur in children and the resulting cough, runny nose, reduced appetite, decreased fluid intake, pyrexia and disturbed sleep are distressing for both the child and caregivers. AURIs

are also one of the commonest reasons for people seeking advice from their family doctor (Butler *et al.*, 1998), with cough being the most frequently managed problem in primary care, resulting in parental anxiety (Hay *et al.*, 2003). Furthermore, if a child is unwell and unable to attend school, working parents will require time off work.

In all, 20% of children with respiratory infections develop complications (Hay and Wilson, 2002) and up to 24% re-consult (Stett, 1979). Many receive inappropriate treatment with antibiotics

Correspondence to: Prof. David Hannay, MD, PhD, FRCGP, FFPH, DCH, Kirkdale, Carluith, Wigtownshire DG8 7EA, UK. Email: drhannay@gmail.com

© Cambridge University Press 2011

prescribed by doctors (Lindback, 2006), and cold and cough medicines are widely used by parents (Euromonitor, 2006), despite there being no evidence that cough medicines reduce the severity or frequency of coughs (Schroeder and Fahey, 2002).

There is surprisingly little research about the natural history of AURIs in children in terms of the length, variety and severity of symptoms. The majority of these illnesses are contracted at home and only a small number require medical attention. Understanding the natural history would allow recognition of children who are following a standard course and those in whom complications may be occurring. In view of their frequency, sometimes inappropriate treatment, parental anxiety, and possible complications, AURIs merit further evaluation.

The aim of this paper is to determine the natural history of AURIs occurring in children of primary school age from their inception at home by recording symptomatology. This information can help doctors and other health-care professionals to advise parents more confidently and treat children more appropriately. Reassurance can be given if children are following the usual natural history and a careful evaluation made for more serious infections if an atypical pattern occurs.

Methods

This was a prospective diary-based study of primary-school children (in the age group of 4–12 years), in the Dumfries and Galloway region of South West Scotland. An initial pilot study was carried out looking at the feasibility of parents recording a 14-day symptom diary based on the Canadian Acute Respiratory Illness and Flu Scale – CARIFS (Jacobs *et al.*, 2000) – as modified for use in United Kingdom primary care (Robling, 2001). This is a validated scale measuring acute upper respiratory symptoms in children, which are defined in the diary as, ‘A cold or respiratory infection, i.e. nasal stuffiness, runny nose, cough or sore throat’.

Approval was obtained from the Local Medical Research Ethics Committee for the pilot study, based on children discharged from a paediatric clinic, in order to assess the acceptability and feasibility of parents using the symptom diary. There

was a 25% response rate from those circulated, and the 20 parents who responded had no difficulty in completing the CARIFS diaries at home.

The diaries listed 16 symptoms that were scored each day for severity, ranging from 0 to 3 – with 0 being no problem, 1 a minor problem, 2 a moderate problem and 3 a major problem. Parents were asked to complete the CARIFS score each day for one episode of AURI in their child and return the diary in a stamped addressed envelope at the end of the episode. As some AURIs lasted for more than 14 days in the pilot study, the length of the diary was increased to a maximum of 21 days for the main study. The daily scores together with the length of the symptoms in days were entered onto Excel spreadsheets, which were then transferred to SPSS for further analysis. The CARIFS score included observable signs and symptoms, which may be ‘other defined’ – that is, by caregivers/parents – or ‘self defined’, that is, by children themselves.

In the development of CARIFS (Jacobs *et al.*, 2000), 25% of children reached a score of a quarter or less of the threshold in three days. The present study was originally designed as an intervention study, which an independent statistician calculated would require a sample of 200 children in each group to show a significant difference between two groups, giving a total of 400 children in all. With a response rate of 25% in the pilot study, the main sample would need to be 1600. In the present study, 20 primary schools with a total roll of 1808 were selected by the independent statistician as a random cluster sample. Of these, 570 parents (32%) consented to take part.

Approval was obtained from the Local Medical Research Ethics Committee for the main study, and the education authorities also gave permission to approach a random selection of primary-school head teachers to ask their support for the study. Before the start of the study, an independent statistician reviewed the methodology and randomised schools within the region to minimise selection bias (Sheikh *et al.*, 2002). All schools contacted agreed to take part, except one, for which a randomised replacement was made.

Meetings were arranged at the 20 randomly selected primary schools in order to obtain written consent, and to give out the diaries with a stamped addressed envelope. Children over eight years of age were asked for their written consent

in addition to their parent/guardian's consent. Reminder letters were sent to the parents via the schools. Families were also provided with the phone number of an independent contact in case they wished further impartial advice about the research. The study took place between September 2007 and March 2008, before the swine flu epidemic.

Results

The parents of 570 children consented and agreed to complete a diary. Of these, 223 diaries were returned, with a response rate of 39% of those who had consented. In all, 146 of the children had an AURI and 77 diaries reported no AURI during the study period. The age and sex distribution was similar in the children who had episodes of AURI and those who did not, with an overall average age of about eight years. Slightly more

diaries were returned for boys than girls, although girls had marginally more infections (Table 1).

The most frequent symptoms overall were runny nose, cough, feeling unwell and sore throat. The majority of children also had sleep disturbance, irritability, poor appetite, fever and headache. Those in the age group of four to six years ($n = 39$) were most likely to have a runny nose, sore throat and feel unwell. This youngest age group were also most likely to need extra care and cry excessively. Those in the age group of seven to nine years ($n = 57$) were the most likely to be irritable. The 10- to 12-year-olds ($n = 50$) were the most likely to cough, not sleep or play well, have a poor appetite, fever and headaches, lose interest in things, have muscle aches and pains, and be unable to get out of bed (Figure 1).

There was a biphasic distribution of symptoms, with the commoner symptoms in the first three days being different from those reported later in the illness. The initial symptoms were characterised by

Table 1 Characteristics of study population

	Number of boys (%)	Mean age of boys (years)	Number of girls (%)	Mean age of girls (years)
Total number of children	124 (55.6)	7.4	99 (44.4)	7.7
Children with AURIs	71 (48.6)	8.4	75 (51.4)	7.9

AURIs = acute upper respiratory tract infections.

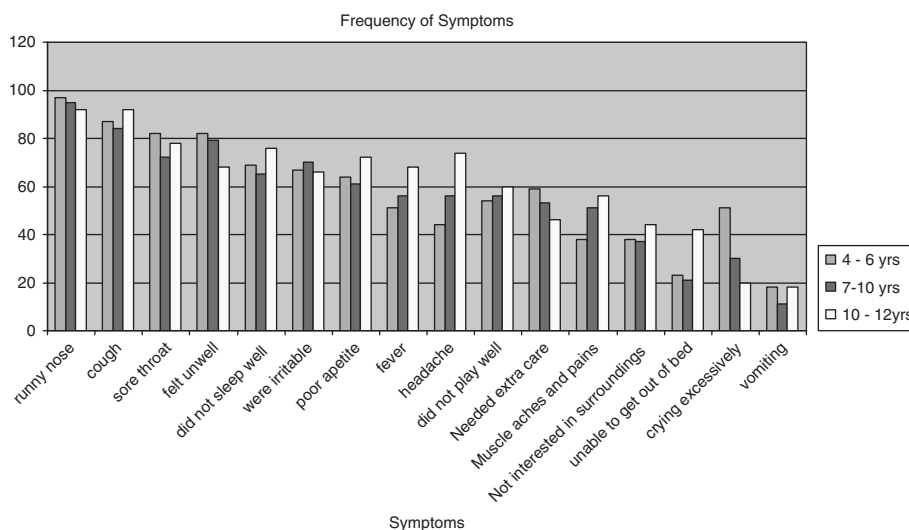


Figure 1 Frequency of symptoms by age group

fever, poor sleep, irritability, not playing and headache. This changed, and by day four, runny nose, cough, sore throat and poor appetite predominated. These latter symptoms continued in the second week and until the infection resolved (Table 2).

Most symptoms resolved by day seven, although occasionally cough and runny nose continued for up to 20 days. The median length of all symptoms was seven days with an interquartile range of five to eleven days. Runny nose and cough lasted the longest, followed by feeling unwell and sore throat, and then not sleeping well, irritability and poor appetite. There were no marked differences between the age groups, although symptoms tended to last longer in the seven- to nine-year-olds (Table 3).

Table 2 Six commonest cumulative symptoms

Days 1–3	Days 4–14
Fever	Runny nose
Not sleeping well	Cough
Irritable	Sore throat
Feels unwell	Feels unwell
Not playing well	Poor appetite
Headache	Irritable, not sleeping well, needing extra care

Table 3 Duration of symptoms by age group

Symptoms	Duration of symptoms in days							
	4–6 years (N = 39)		7–9 years (N = 57)		10–12 years (N = 50)		All ages (N = 146)	
	Median	Max	Median	Max	Median	Max	Median	Max
All symptoms	7	17	7	20	7	18	7	20
Runny nose	6	17	6	20	5	18	6	20
Cough	5	17	4	20	6	18	5	20
Feeling unwell	3	9	3	13	3	14	3	14
Sore throat	3	9	3	15	4	15	3	15
Did not sleep well	2	15	1	10	2	14	2	15
Were irritable	3	12	2	16	1	10	2	16
Poor appetite	2	8	1	13	2	17	2	17
Fever	1	7	1	9	1	7	1	9
Headache	0	7	1	11	2	15	1	15
Did not play well	1	7	1	11	1	10	1	11
Needed extra care	2	8	1	11	0	15	1	15
Muscle aches and pains	0	6	1	12	1	10	0	12
Not interested	0	7	0	10	0	9	0	10
Unable to get out of bed	0	3	0	9	0	8	0	9
Crying excessively	1	8	0	9	0	6	0	9
Vomiting	0	3	0	6	0	7	0	7

Primary Health Care Research & Development 2011; **12**: 329–334

The severity scores for each symptom are listed in Table 4. This shows the interquartile range, as well as the maximum score for each symptom. All the mean scores were between one (a minor problem) and two (a moderate problem). However, for 11 symptoms, the maximum score was 3, indicating a major problem for that child and family. In addition, a mean total severity score for each symptom was calculated, which was the average of the sum of the scores for that symptom for each day. This gives an indication of the burden of each symptom in terms of severity and duration. Runny nose and cough were considered most troublesome, followed by sore throat and feeling unwell.

Of the 223 diaries returned, 15 recorded that the child was on regular medication for asthma, of which one was in the group reporting no AURI. There was no clear difference between those with asthma and others with an AURI, either in terms of the age–sex distribution or the duration and severity of symptoms.

Discussion

This study indicates a biphasic distribution of symptoms. It suggests that there is an initial systemic

Table 4 Symptom severity scores

Symptoms	Severity score, inter-quartile range	Mean of total severity scores	Maximum severity score
Runny nose	1–1.8	9.8	3.0
Cough	1–1.7	9.0	3.0
Felt unwell	1–1.6	5.1	2.5
Sore throat	1–1.8	5.9	3.0
Did not sleep well	1–1.5	3.5	1.7
Were irritable	1–1.5	3.3	2.2
Poor appetite	1–1.5	3.7	1.6
Fever	1–2.0	2.6	3.0
Headache	1–1.7	3.1	3.0
Did not play well	1–1.7	2.5	3.0
Needed extra care	1–1.5	2.7	3.0
Muscle aches and pains	1–1.8	2.4	3.0
Not interested	1–1.4	1.4	3.0
Unable to get out of bed	1–1.5	0.9	2.0
Crying excessively	1–1.6	1.4	3.0
Vomiting	1–2.0	0.4	3.0

upset lasting one to three days, characterised by fever, poor sleep, irritability, feeling unwell, not playing well and headache, which are all systemic symptoms. Subsequently, symptoms localising the infection to the upper respiratory tract appear. The characteristic cough and runny nose then predominate, with associated sore throat and poor appetite.

One of the strengths of this study is the setting. Community-based studies in the home setting are challenging to undertake but provide useful information on the natural history and symptomatology of AURIs from onset, rather than when parents seek medical advice. In addition, randomisation by an independent statistician was used to minimise the selection bias. It is difficult to get consent from parents as they do not come to special meetings at school, and only some of those who signed consent forms actually returned the diaries. However, although it was low, the response rate was higher than expected from our pilot study, perhaps due to repeat school visits and follow-up letters. There was no evidence that non-responders had mild illnesses, and the diaries allowed for minor problems of short duration, which was reflected in some of those completed.

Although data were collected over six months, there was a staggered approach to recruitment in schools. Some schools only reported for three months, and this may explain why 35% of responders did not report an AURI in their child.

These 77 diaries made clear that the child had not had an episode of AURI during the study period. But this study was not intended to measure the incidence of AURIs, but rather the symptomatology of a single episode. The large cluster sample originally designed for an intervention study meant that randomisation minimised selection bias, so that the symptoms captured by the 146 episodes of AURI in the study should be valid for children with this common condition.

Signs (eg, cough, runny nose) and symptoms (eg, sore throat, headache, muscle aches and pains) defined by children, all reached a score of 3 (major problem) in some children. In contrast, symptoms defined by parents (eg, not sleeping well, irritability, poor appetite, unable to get out of bed) did not reach maximum severity for any child. This suggests that either children over-emphasise symptoms, or that parents underestimate how poorly a child is feeling, which may be important in younger children.

Overall, this study provides new information about the symptomatology of AURIs from onset at home. This information is useful for parents, general practitioners (GPs), paediatricians and pharmacists who regularly give advice for this common condition. It allows a more evidence-based approach, as little was previously known about the natural history of these infections at home. Children with a persistent fever for more than three days are not following a characteristic

pattern (Van den Bruel *et al.*, 2010). GPs might consider examining for secondary infections (eg, secondary pneumonia, urinary infection, tonsillitis, otitis media) in this group of children rather than simply advising antipyretics. Parents can also be told that for most children the symptoms of an AURI will last for approximately 5–11 days, with a minority continuing for 20 days. As symptoms rarely last more than 14 days, doctors may also wish to review this group of children.

Acknowledgements

We are grateful to Ann Bray and Heather Fitzpatrick of the Research and Development Support Unit in Dumfries and Galloway Royal Infirmary for help with undertaking the study; and to Harper Gilmour of the Department of Statistics at Glasgow University for statistical advice.

Funding: The study was funded by the Research and Development Support Unit of the Dumfries and Galloway Health Board.

Ethical approval: Ethical approval for the pilot and main study was given by the Local Medical Research Ethics Committee.

Competing interests: There were no competing interests.

References

Butler, C.C., Rollnick, S., Kinnersley, P., Jones, A. and Stott, N. 1998: Reducing antibiotics for respiratory tract symptoms in

primary care; consolidating why and considering how. *British Journal of General Practice* 48, 1865–70.

Euromonitor. 2006: Major market profiles. Retrieved December 2006 from www.majormarketprofiles.com/

Hay, A.D., Wilson, A., Fahey, T. and Peters, T.J. 2003: The duration of cough in pre-school children presenting to primary care: a prospective cohort study. *Family Practice* 20/6, 696–705.

Hay, A.D. and Wilson, A.D. 2002: The natural history of acute cough in children aged 0 to 4 years in primary care: a systematic review. *British Journal of General Practice* 52, 401–409.

Jacobs, B., Young, N.L., Dick, P.T., Ipp, M.M., Dutkowski, R., Davies, H.D., Langley, J.M., Greenberg, S., Stephens, D. and Wang, E.E.L. 2000: Canadian Acute Respiratory Illness and Flu Scale (CARIFS): development of valid measure for childhood respiratory infections. *Journal of Clinical Epidemiology* 52, 793–99.

Lindback, M. 2006: Prescribed antibiotics in patients with acute cough and otitis media. *British Journal of General Practice* 66, 164–65.

Robling, M.R. 2001: The validation of CARIFS outcome measure for children with respiratory illness in UK primary care. Presentation at SAPC meeting, Leeds.

Schroeder, K. and Fahey, T. 2002: Over-the-counter medications for acute cough in children and adults in ambulatory settings. *The Cochrane Library*, Issue 4, Oxford.

Sheikh, A., Smeath, L. and Ashcroft, R. 2002: Randomised controlled trials in primary care: scope and application. *British Journal of General Practice* 52, 746–51.

Stett, N.C. 1979: Management and outcome of winter upper respiratory tract infections in children aged 0–9. *British Medical Journal* 1, 29–31.

Van den Bruel, A., Haj-Hassan, T., Thompson, M., Buntinx, F. and Mant, D. 2010: Diagnostic value of clinical features at presentation to identify serious infection in children in developed countries: a systematic review. *Lancet* 375, 834–45.