



Agreement in diagnosing occupational asthma by occupational and respiratory physicians who report to surveillance schemes for work-related ill-health

Susan Turner, Roseanne McNamee, Catherine Roberts, et al.

Occup Environ Med 2010 67: 471-478 originally published online November 12, 2009

doi: 10.1136/oem.2008.044560

Updated information and services can be found at:

<http://oem.bmj.com/content/67/7/471.full.html>

These include:

References

This article cites 16 articles, 8 of which can be accessed free at:

<http://oem.bmj.com/content/67/7/471.full.html#ref-list-1>

Email alerting service

Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Notes

To order reprints of this article go to:

<http://oem.bmj.com/cgi/reprintform>

To subscribe to *Occupational and Environmental Medicine* go to:

<http://oem.bmj.com/subscriptions>

Agreement in diagnosing occupational asthma by occupational and respiratory physicians who report to surveillance schemes for work-related ill-health

Susan Turner,¹ Roseanne McNamee,² Catherine Roberts,¹ Lisa Bradshaw,³ Andrew Curran,³ Mandy Francis,³ David Fishwick,³ Raymond Agius¹

¹Occupational and Environmental Health Research Group, University of Manchester, Manchester, UK
²Biostatistics, Health Methodology Research Group, University of Manchester, Manchester, UK
³Health and Safety Laboratory, Buxton, UK

Correspondence to

Dr Susan Turner, Occupational and Environmental Health Research Group, The University of Manchester, 4th Floor, C Block, Ellen Wilkinson Building, Oxford Road, Manchester M13 9PL, UK; susan.m.turner@manchester.ac.uk

Accepted 28 October 2009
 Published Online First
 12 November 2009

ABSTRACT

Objectives To assess diagnostic agreement for occupational asthma, and to identify case and rater characteristics associated with this diagnosis.

Methods Summaries of possible occupational asthma cases were sent to 104 occupational and respiratory physicians. Raters assigned likelihood scores (0–100%) of occupational asthma based on case histories (phase 1), and on histories plus investigative procedures (phase 2). Interclass correlation coefficients were calculated as statistical measures of reliability for occupational asthma scores. Comparisons between mean scores were assessed for statistical significance using tests based on multilevel models. RRs were calculated to summarise effects of raters' demographics, and of supplying investigative procedures information.

Results Occupational asthma scores showed limited agreement within each group of (occupational or respiratory) physicians, but scores were not systematically different. The difference between mean overall scores was 2.1% (52.1% occupational physicians; 50.0% respiratory physicians) in phase 1 (95% CI –2.6 to 6.8, $p=0.37$). In phase 2, mean overall scores were 46.1% (occupational physicians) and 41.5% (respiratory physicians); the difference in mean overall scores was 4.6% (95% CI –3.5 to 12.5, $p=0.27$). Raters with General Medical Council registration ≥ 1986 were more likely to give a positive occupational asthma diagnosis. In phase 2, male raters were more likely to label cases as occupational asthma than female raters (RR 4.5, 95% CI 3.3 to 6.0).

Conclusions The RR of a positive occupational asthma diagnosis was unaffected by clinical speciality. Further work on why physicians consider cases to be occupational asthma will assist better diagnosis and prevention of this disease.

BACKGROUND

Occupational asthma continues to be an important health problem, with an estimated average annual incidence of 616/million in the working population between 1992 and 2001.¹ The UK's Revitalising Health and Safety target aimed to reduce the incidence of work-related ill-health by 20% between 1999/2000 and 2009/2010² and guidelines to improve prevention, identification and management of occupational asthma were produced in 2005.³ However, a recent study of diagnostic agreement involving 12 physicians (including nine consultant respiratory physicians with clinical and

What this paper adds

- ▶ Occupational asthma continues to be an important health issue which legislators have targeted to reduce the incidence of work-related ill-health.
- ▶ Recent studies have shown wide variation in the probabilities of occupational asthma assigned to cases.
- ▶ In this study, likelihood scores assigned to cases of possible occupational asthma by occupational physicians and respiratory physicians were not systematically different.
- ▶ Using case history information alone, occupational physicians showed better agreement in occupational asthma diagnosis than respiratory physicians; the reverse was true when investigative procedures information was added.
- ▶ Further improvement in the diagnostic practice of specialist physicians is needed to improve the diagnosis and management of occupational asthma.

research interest in occupational lung disease) found wide variation in the probabilities of occupational asthma (SDs ranging from 12% to 25%) and in all cases except one, the range of probabilities crossed 50%.⁴ Another reliability study investigated the diagnosis and management of occupational asthma among 100 non-specialist respiratory physicians in the UK by asking about participants' diagnostic approaches to a single case scenario, and concluded there was a lack of standardisation and a shortfall of evidence based practice.⁵

Occupational physicians also diagnose occupational asthma, but their approach might differ from that of specialist respiratory physicians because of differences in training, facilities or occupational physicians' approach to assessing patients (eg, regarding work attribution). Timely and accurate diagnosis by occupational physicians is important as they have the opportunity to improve the prognosis for an occupational asthma sufferer by removing an individual from exposure to the allergen as soon as possible after a diagnosis is made. Furthermore, in the UK, information on incidence rates¹ and trends in incidence⁶ is often based on surveillance reports by occupational and respiratory physicians, so it is important to assess the reliability and agreement of these groups of

Original article

medical specialists who participate in surveillance, namely The Health and Occupation Reporting (THOR) network.

This study aimed to:

- ▶ assess diagnostic agreement for occupational asthma between physicians within a clinical discipline (ie, occupational or respiratory medicine)
- ▶ compare diagnostic agreement for occupational asthma between disciplines (ie, occupational physicians and respiratory physicians)
- ▶ identify case characteristics associated with making an occupational asthma diagnosis
- ▶ investigate whether investigative procedures improve agreement between physicians
- ▶ investigate the effects of reporters' characteristics on diagnosing occupational asthma.

METHODS

THOR is a UK-based surveillance network comprising a number of schemes for occupational ill-health reporting including the Occupational Physicians Reporting Activity (OPRA) scheme, and the Surveillance of Work-Related and Occupational Respiratory Disease (SWORD) scheme.^{7 8} In 2007 there were approximately 425 reporters in the former and 495 in the latter. The wide membership and active involvement⁹ of these reporters in surveillance provided an extensive resource of physicians who might take part in a study of diagnostic agreement for occupational asthma.

Potential participants in this study were physicians who had reported a case of occupational respiratory ill-health to OPRA or SWORD from 2002 to 2004. A small number of these physicians were 'experts' (ie, consultant respiratory physicians with a clinical and research interest in occupational lung disease) who had been involved in a previous study of diagnostic agreement.⁴ These were excluded. The remaining reporters were selected at random to identify 50 occupational physicians and 50 respiratory physicians for inclusion. In contrast to eligibility studies based on the opinion of experts, this study aimed to describe reliability among a large group of UK-wide occupational physicians who had achieved the qualification of Associateship, Membership or Fellowship of the Faculty of Occupational Medicine of the Royal College of Physicians of London, and clinical specialists in respiratory medicine.

The 19 cases used here had been assessed previously (for content) in the study of 'expert' respiratory physicians' diagnostic agreement.⁴ These cases had been selected for that study at random from a large series of patients who had been referred to six secondary care respiratory centres. The series could include any patient with suspected occupational asthma who had been referred from a variety of sources, and study physicians had been allowed to investigate each patient according to their own judgement. Cases therefore provided typical examples of data available within specialist respiratory centres in the UK. For some cases exposure had ceased (either on a voluntary basis by the patient, or as a result of occupational health advice), which resulted in a lack of prospective peak flow monitoring data. In addition, at the time that these cases were collated, not all of the centres had access to repeat reactivity testing. However, in the opinion of the physicians involved in the original ('expert') study "the patients included in the study were a true reflection of day-to-day clinical practice".⁴

Two researchers visited each respiratory centre and transcribed clinical information, examination findings and investigations from hospital case notes to a proforma. This information was converted into an anonymous summary document for each case,

and any investigations that could not be computerised (eg, serial peak expiratory flow measures) were photocopied and added to the case summary.

The case histories included patient details on age, gender, industry type, job/tasks, exposures, occupational/medical/family/social history, treatment and work-related symptoms. Ten of the cases ('long' cases) had additional information from investigative procedures such as pulmonary function results (FEV₁ and FVC), bronchial responsiveness/challenge, immunological testing (skin prick testing or IgE levels), peak flow measurements, OASYS-2 plots and chest radiography; the others ('short' cases) had histories only. None of the 19 cases contained specific allergen challenge investigative procedures/results.

In phase 1 of the study, each potential participant was sent four case histories that had been randomly assigned to them for assessment. The four case histories comprised two short cases, plus two case histories that had been extracted from long cases. Based on the case histories, raters were asked to assign a likelihood score (0–100%) of occupational asthma, and to reply 'yes/no' as to whether sufficient information had been provided for them to make such an assessment. Non-responders were sent one follow-up reminder/invitation to participate and, if there was no reply, were then replaced from the reporting pool until 50 occupational physicians and 50 respiratory physicians had been recruited.

In phase 2 of the study, participants were sent all available information on their two long cases, namely case histories plus investigative procedures/results. Raters were again asked to assign a likelihood score (0–100%) of occupational asthma, and to reply 'yes/no' as to whether the information was sufficient.

Interclass correlation coefficients were calculated as statistical measures of reliability for occupational asthma scores; these may be interpreted in a similar way to κ coefficients (a coefficient of zero indicates agreement no better than chance, while one indicates perfect agreement between raters). In the first instance, all of the scores were used for analysis regardless of whether raters judged the information sufficient; reliability was then re-measured after excluding ratings where the rater said there was insufficient information.

As an index of the ease/difficulty of reaching a conclusion about occupational asthma for each case, the absolute value, that is ignoring sign, of $2 \times (\text{mean occupational asthma score} - 50)$ was calculated for each case. This index (index rating) is scaled so that a value of 0 would mean all raters give scores of 50 (ie, were undecided either way), while a score of 100 would be obtained if they all give scores of 0 or they all give scores of 100. The overall direction of opinion for each case was based on whether the mean was greater than 50 or not; if greater, the direction is towards a diagnosis of occupational asthma and, if less, the direction is against a diagnosis of occupational asthma.

Comparisons between mean scores for occupational physicians and respiratory physicians were assessed for statistical significance using tests based on multilevel models which take account of correlation between ratings of the same case. Multilevel binomial regression (with log link) was used to assess the effects of raters' demographics on occupational asthma diagnosis including their gender, date of full registration on the General Medical Council (GMC) register, and history of reporting an occupational asthma case to THOR, which are summarised by relative risks (RRs). Multilevel models were also used to assess the effect of supplying (or not) information from investigative procedures (ie, a comparison of phases 1 and 2 of this study). RRs were also calculated for raters' responses regarding sufficiency of information provided in phases 1 and 2 of the study.

Data were analysed using the software packages SPSS (v 15.0) and STATA.

Multicentre Research Ethics Committee approval has been given for THOR, and for the diagnostic agreement study.

RESULTS

Between 2002 and 2004 there were 280 physicians who reported a case of work-related respiratory ill-health to either OPRA or SWORD, who were therefore eligible to be potential raters for this study. Most of these (192, 69%) were SWORD reporters, that is respiratory physicians, while 88 (31%) were occupational physicians reporting to OPRA. The reporters were mainly males (231/280; 83%) and had a mean year of GMC registration of 1980 (SD 8.4).

The target number of participants (100 overall; 50 occupational physicians and 50 respiratory physicians) was achieved between January and July 2006. In total, approaches were made to 65 occupational physicians to join the study; 51 (79%) agreed to participate, 13 (20%) did not respond, and one refused because of time/work pressures. For respiratory physicians, of the 103 approached, 53 (52%) agreed to participate, there was no response from 44 (43%) and the remaining six gave the following replies: one had retired, one was on sabbatical, one refused because of time/work pressures, two said they did not wish to participate, and one person replied that they did not see enough occupational asthma cases within clinical practice to enable participation. In total therefore, 104 raters (51 occupational physicians, 53 respiratory physicians) were recruited to phase 1. THOR reporting histories for study participants showed that 41/51 (80%) occupational physicians and 38/53 (71%) respiratory physicians had reported at least one case of occupational asthma prior to the study commencing. Demographic data for study participants

showed that 81/104 (78%) were males, and that 26% of responders had a GMC registration year before 1974, 24% registered from 1975 to 1978, 24% registered from 1979 to 1985, and 25% registered from 1986 onwards. Participation rates for phase 2 of the study were high, with 87 (84%) of the 104 phase 1 raters returning results for their two 'histories plus investigations' cases, producing 174 additional returns.

It is important to note that nearly all the raters assigned a score, irrespective of the opinions they gave about sufficiency of information provided within the cases (83% saying there was insufficient information in phase 1, 44% in phase 2 and 70% overall). Of the 416 (104×4) returns in phase 1 of the study, all but nine (2%) of the raters assigned an occupational asthma score, while in phase 2 there were only two (1%) returns where raters did not assign an occupational asthma score. Therefore, in total there were 590 returns (579 excluding those with no score) from phases 1 and 2 of the study.

The number of ratings per case in phase 1 varied between 17 and 28, with approximately equal numbers from occupational physicians and respiratory physicians; in phase 2 between 13 and 21 additional ratings per case were obtained for the 10 long cases. There was a wide range of occupational asthma scores in both phases of the study (table 1); for many cases the mean scores were quite close to 50 suggesting that reporters found some cases difficult to classify. Of the 579 returns where an occupational asthma score was assigned, there were 89 (15%) where the rater scored the likelihood of occupational asthma as 50%; approximately equal numbers of 50% scores originated from occupational physicians (43; 48%) and respiratory physicians (46; 52%). Most of these occupational asthma likelihood scores of 50% were assigned in phase 1 of the study (73/89; 82%), when slightly fewer originated from occupational

Table 1 Raters' decisiveness in assessing whether a case is/is not occupational asthma using 'best' information*

Case number (age and gender)	Number of raters	Mean (range) of likelihood of OA (%)	Know sensitiser cited in history, yes/no (agent)	Latency in years of symptoms after exposure	Investigations data available, yes/no	Airway hyper-reactivity present (fourfold difference in any measure)	OASYS-2 result ≥2.5, yes/no/not done	Index rating	Proportion (%) of returns where raters said that sufficient data were provided, and also did not assign an OA score of 50%
4 (58 M)	24†	24 (5–60)	No	2	No	—	—	51.2	8
16 (32 M)	19	26 (0–95)	Yes (isocyanate)	1	Yes	No (not done)	Yes	48.2	53
12 (59 F)	18	26 (1–90)	Yes (glutaraldehyde)	0	Yes	Yes (not done)	No	47.4	67
15 (61 M)	19	27 (0–75)	Yes (chrome)	?	Yes	Yes (not done)	No	45.8	68
5 (60 F)	20†	35 (5–90)	No	10	No	—	—	29.6	5
3 (43 M)	15	36 (3–90)	Yes (chrome)	1	Yes	Not done	No	27.4	60
6 (59 M)	13	41 (0–95)	Yes (isocyanate)	1	Yes	Yes (yes)	Not done	17.6	85
18 (57 F)	18	42 (5–80)	No	4	Yes	No (not done)	No	15.6	61
1 (37 M)	21	47 (10–100)	Yes (flour)	2	Yes	Not done	No	6.6	57
7 (54 M)	24†	47 (10–90)	Yes (flour)	5	No	—	—	6.2	8
10 (43 M)	28	48 (0–90)	No	22	No	—	—	5.0	14
17 (44 M)	16†	52 (5–100)	No	22	Yes	No (not done)	Yes	4.2	47
11 (44 M)	21	55 (0–100)	No	2	No	—	—	10.6	24
8 (34 F)	25	58 (20–90)	No	1	No	—	—	16.4	16
2 (43 M)	20	60 (5–90)	Yes (colophony)	5	No	—	—	19.0	20
9 (61 F)	20†	65 (10–98)	Yes (glutaraldehyde)	7	No	—	—	29.8	19
19 (64 M)	17†	66 (10–94)	Yes (isocyanate)	?	Yes	Not done	Yes	32.8	61
13 (59 F)	22	71 (20–90)	Yes (glutaraldehyde)	5	No	—	—	41.4	27
14 (45 M)	16	77 (10–95)	No	0	Yes	Yes (not done)	Yes	54.2	94

*'Best' information: for cases where there were no investigations/results, data used consisted of information returned in phase 1; for cases where there were investigations/results, data used consisted of information returned in phase 2.

†One additional rater did not assign any occupational asthma rating (%) to the case. OA, occupational asthma.

Original article

physicians than from respiratory physicians (32 (44%) and 41 (56%), respectively). In phase 2, for the 16 occupational asthma likelihood scores of 50%, most (11; 69%) originated from occupational physicians, while five (31%) were returned by respiratory physicians. Analysing these occupational asthma likelihood scores of 50% by the cases to which they referred showed that case 19 had the highest number (11) of 50% scores overall, closely followed by cases 17 and 18 (each having nine occupational asthma scores of 50%).

CASE CHARACTERISTICS AND EASE OF CLASSIFICATION

Characteristics of the cases are shown in table 1, together with summary statistics for the ratings based on the most complete information for each case (ie, phase 1 ratings for short cases and phase 2 ratings for long cases). Based on whether or not the mean occupational asthma score across all raters was greater than 50 or not, in eight cases the opinion was towards a positive diagnosis. The index rating ranged from 4 to 54; if we take a value of 40 or more as meaning 'easy', then, using all available information, only six of the 19 cases were easy to classify. The percentage of returns per case was calculated where raters said that sufficient information was provided, and where occupational asthma scores other than 50% were assigned to the case. This produced a wide range of values (5–94%) and, interestingly, did not correlate very well with the index rating.

Case characteristics included latency between exposure and symptom onset, and citation of a specific sensitising agent. Latency data were available for 17/19 cases, and produced a mean overall latency (including cases where there was no known sensitiser cited in the history) per case of 5.3 years. Where individual sensitisers were cited, mean latencies per case were as follows: flour (3.5 years), isocyanate (1 year), colophony (5 years), chrome (1 year) and glutaraldehyde (4 years).

Index ratings for phase 1 and phase 2 returns separately were analysed by individual case characteristics, and are shown in table 2.

There was no obvious pattern between index rating and latency, but an impression (albeit on small numbers of cases) that exposure to certain agents (eg, glutaraldehyde) produced higher ratings than others (eg, flour). When case investigation information was analysed, there was an indication that a positive OASYS-2 result or the presence of airways hyper-reactivity was associated with higher index ratings, but these findings were not statistically significant (using Mann–Whitney testing).

The scores from occupational physicians and respiratory physicians were not systematically different. Mean overall occupational asthma scores from phase 1 of the study were 52.1% for occupational physicians and 50.0% for respiratory physicians, and the difference (occupational physicians' mean–respiratory physicians' mean) was 2.1% (95% CI –2.6 to 6.8, $p=0.37$). Using the phase 2 information for each case, mean overall occupational asthma scores for occupational physicians and respiratory physicians were 46.1% and 41.5%, respectively, and the difference (occupational physicians' mean–respiratory physicians' mean) was 4.6% (95% CI –3.5 to 12.5, $p=0.27$).

ANALYSIS OF RETURNS BY SUFFICIENCY OF INFORMATION

We anticipated that a 'natural' (perhaps defensive) response by physicians rating the cases in this study would be that insufficient information had been provided to them, especially because they were provided with a 'yes/no' option to answer this point. In addition, the proportion of cases deemed by raters to include sufficient information was expected to be higher when case histories plus investigative procedures/results were provided (in phase 2) rather than when case histories alone were presented (in phase 1). In reality, in phase 2 of the study the number of

Table 2 Analysis of index ratings by case characteristics

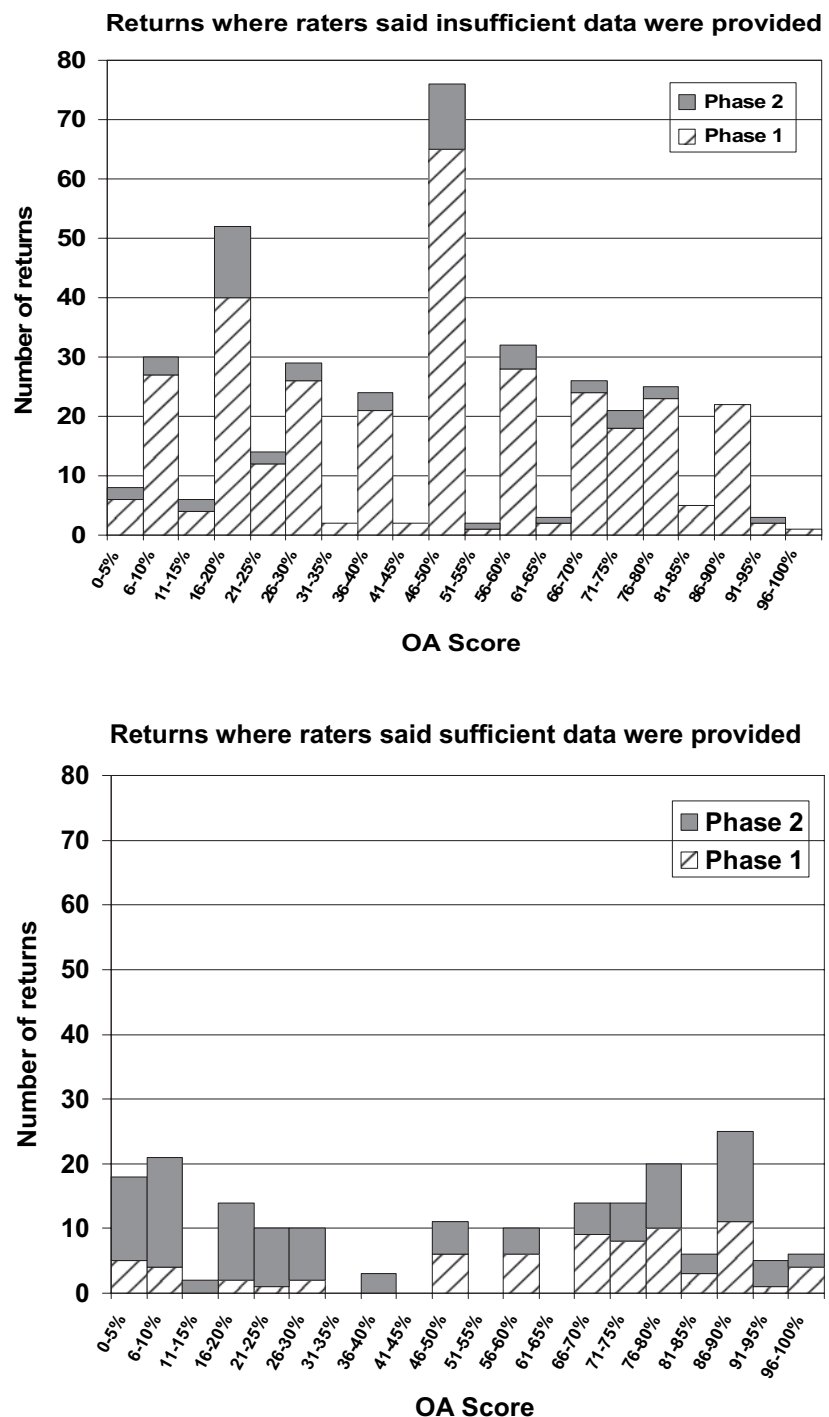
Case characteristic	Number of cases (%)	Index rating			Mann–Whitney testing
		Median	Mean	SD	
Information from case histories (phase 1)					
Latency					
≤2 years	9 (47)	16.4	19.7	14.5	≤2 years vs >2 years, p=0.74
>2 years	8 (42)	16.8	18.3	14.3	
Unknown	2 (11)	24.9	24.9	13.3	
Total	19 (100)	16.4	19.7	13.7	
Sensitiser					
None cited	8 (42)	15.5	18.5	15.9	No agent vs all cited agents, p=0.60
Flour	2 (11)	6.9	6.9	0.9	
Isocyanate	3 (16)	15.5	14.6	8.4	
Colophony	1 (5)	19.0	19.0	—	
Chrome	2 (11)	22.4	22.4	16.9	
Glutaraldehyde	3 (16)	32.6	34.6	6.0	
All cited agents	11 (58)	19.0	20.5	12.6	
Total	19 (100)	16.4	19.7	13.7	
Information from investigations (phase 2)					
OASYS-2 result ≥2.5					
No	5 (26)	27.5	28.6	18.0	No vs yes, p=0.56
Yes	4 (21)	40.5	34.8	22.4	
Not done	10 (53)	18.3	22.7	15.2	
Total	19 (100)	27.5	26.8	17.2	
Airway hyper-reactivity present					
No	3 (16)	15.6	22.6	22.8	No vs yes, p=0.40
Yes	4 (21)	46.6	41.3	16.2	
Not done	12 (63)	23.2	22.0	14.8	
Total	19 (100)	27.5	26.8	17.2	

cases where raters said there was sufficient information was 117/208 (56%), the number with insufficient information was 53/208 (25%), and there were 38 blank/missing responses. In comparison, in phase 1 physicians said that they had been provided with sufficient information in 72 of the 416 case ratings (17%), 340 (82%) replied that there was insufficient information, and there were four blank responses. However, as noted earlier, most raters assigned a score, irrespective of their replies about sufficiency of information. The scores when raters said there was insufficient information tended to be closer to 50 than when raters judged it sufficient, but there were many closer to 0 or 100 (figure 1), also suggesting that raters were prepared to judge despite, in their view, insufficiency.

Subsequently, where raters said that sufficient information was provided, occupational asthma (OA) scores of 50% (50% equating to an 'undecided' score) were removed to produce results referred to as 'OA decisions'. Overall, of the 590 returns, 178 (30%) were OA decisions. The effects of excluding the remaining 412 returns have been shown on a case by case basis in table 1; of note are cases 4, 5 and 7, where the proportions of returns were low (<10%) when data were restricted in this manner.

Unsurprisingly, provision of investigations/results information resulted in a higher proportion of returns that were OA decisions: 112/174 (64%) returns from phase 2 compared to 66/416 (16%) from phase 1 (RR 4.0, 95% CI 3.1 to 5.3). Analysis by

Figure 1 Distribution of occupational asthma (OA) scores (%) by sufficiency of data.



Original article

physicians' speciality showed no difference between raters: 83/292 (28%) of occupational physicians' returns and 95/298 (32%) of respiratory physicians' returns being OA decisions (RR 0.95, 95% CI 0.78 to 1.16). Additionally, physicians who had previously reported an occupational asthma case to THOR were equally likely to return OA decisions as those who had not: 135/452 (30%) previous reporters and 43/138 (31%) never reporters (RR 0.97, 95% CI 0.78 to 1.21). Of note, male raters were more likely to return OA decisions than females: males 156/478 (33%), females 22/112 (20%) (RR 0.65, 95% CI 0.44 to 0.95). This gender difference was investigated further by producing RRs for OA decisions associated with phases 1 and 2, and using male raters' responses to phase 1 as the baseline, the RRs were:

- ▶ female raters' responses (phase 1) RR 1.1 (95% CI 0.6 to 1.9)
- ▶ male raters' responses (phase 2) RR 4.5 (95% CI 3.3 to 6.0)
- ▶ female raters' responses (phase 2) RR 1.9 (95% CI 1.0 to 3.8).

This shows a gender difference in the effect of providing investigations/results information, that is in phase 2 of the study males were much more likely to label a case as occupational asthma than females.

Interclass correlations and 95% CIs were also calculated for occupational asthma scores for separate physician groups (occupational physicians; respiratory physicians), for all physicians (occupational physicians and respiratory physicians) and for physicians who had previously returned an occupational asthma case to THOR (table 3). The effects of restricting information to OA decisions for each results group are also shown, but the small number of ratings within some of these OA decisions groups should be noted (especially for phase 1 results).

ANALYSIS OF RETURNS WITH SUFFICIENT INFORMATION (OA DECISIONS) BY REPORTER CHARACTERISTICS

The 178 OA decisions were analysed as a dichotomous occupational asthma score (no=0–49%; yes=51–100%) and used to investigate the characteristics of doctors who returned a positive (yes) occupational asthma diagnosis:

- ▶ physician group (occupational physician/respiratory physician)
- ▶ reporter gender (male/female)
- ▶ ever reported an occupational asthma case to THOR (ever/never)
- ▶ GMC registration year.

Reporters' GMC registration year was sub-divided into four (approximately equal) groups: up to 1974 (n=49), 1975–8 (n=41), 1979–85 (n=43) and ≥ 1986 (n=45). Analysis of a positive (yes) occupational asthma diagnosis by this characteristic was similar for all groups except for those with GMC registration ≥ 1986 , and therefore further analysis was summarised as either GMC registration up to (and including) 1985 or 1986 onwards.

The results from phase 1 showed that doctors with GMC registration from 1986 onwards were 25% more likely to give a positive occupational asthma diagnosis than those with GMC registration up to the end of 1985 (table 4). In phase 2 we found that female doctors were half as likely to give a positive occupational asthma diagnosis, but that physicians who had previously reported an occupational asthma case to THOR were 40% more likely to give a positive occupational asthma diagnosis. Later GMC registration for the reporter (ie, from 1986 onwards) again increased the likelihood of a positive occupational asthma diagnosis in phase 2 of this study (RR 1.87), this finding being statistically significant ($p=0.003$).

DISCUSSION

This study sought to establish the diagnostic agreement for occupational asthma diagnoses within and between physicians in two clinical specialties, namely occupational and respiratory medicine. The intention was to use cases which were typical examples of possible occupational asthma, rather than 'gold standard' cases. Indeed, the 'gold standard' (specific bronchial challenge testing) should only be considered in a limited number of circumstances: to identify previously unknown causative agents, to distinguish the causative agent from others if this otherwise proves difficult in complex environments, where there are persisting doubts about the diagnosis and definite advice is

Table 3 Summary of interclass correlations (ICCs) and 95% CI for ratings

Results group	Occupational physicians		Respiratory physicians		All physicians		Physicians who had previously reported an OA case to THOR	
	ICC (95% CI)	Number	ICC (95% CI)	Number	ICC (95% CI)	Number	ICC (95% CI)	Number
Phase 1: history information only								
Short cases only (A)	0.34 (0.07 to 0.62)	100	0.24 (0.00 to 0.48)	104	0.24 (0.03 to 0.45)	204	0.20 (0.00 to 0.40)	156
Short cases only excluding insufficient data and 50% ratings (B)	0.21 (0.00 to 1.00)	14	0.77 (0.47 to 1.06)	18	0.50 (0.12 to 0.88)	32	0.34 (0.00 to 0.83)	23
Long cases only	0.15 (0.00 to 0.35)	98	0.05 (0.00 to 0.18)	105	0.12 (0.00 to 0.25)	203	0.09 (0.00 to 0.22)	155
Long cases only excluding insufficient data and 50% ratings	0.78 (0.49 to 1.08)	17	0.00 (0.00 to 0.60)	17	0.54 (0.17 to 0.92)	34	0.52 (0.09 to 0.96)	23
All cases	0.24 (0.08 to 0.41)	198	0.14 (0.01 to 0.27)	209	0.17 (0.06 to 0.29)	407	0.14 (0.03 to 0.26)	311
All cases excluding insufficient data and 50% ratings	0.56 (0.20 to 0.92)	31	0.39 (0.00 to 0.79)	35	0.50 (0.24 to 0.76)	66	0.43 (0.11 to 0.75)	46
Phase 2: history and investigations information								
Long cases only (C)	0.20 (0.00 to 0.43)	88	0.28 (0.02 to 0.54)	84	0.26 (0.05 to 0.48)	172	0.23 (0.02 to 0.44)	134
Long cases only excluding insufficient data and 50% ratings (D)	0.17 (0.00 to 0.45)	52	0.35 (0.04 to 0.65)	60	0.27 (0.03 to 0.51)	112	0.24 (0.00 to 0.49)	89
'Best' information (from phases 1 and 2)								
All cases (ie, A+C)	0.27 (0.10 to 0.44)	188	0.27 (0.09 to 0.44)	188	0.25 (0.11 to 0.40)	376	0.23 (0.08 to 0.37)	290
All cases excluding insufficient data and 50% ratings (ie, B+D)	0.18 (0.00 to 0.44)	66	0.44 (0.18 to 0.70)	78	0.33 (0.12 to 0.55)	144	0.31 (0.09 to 0.54)	112

OA, occupational asthma.

Table 4 Relative risks (RRs) for occupational asthma diagnosis: phase 1 and phase 2 results

OA diagnosis (yes vs no)	Phase 1 (n=66)		Phase 2 (n=112)	
	RR	95% CI	RR	95% CI
Doctor group (OP vs RP)	1.04	0.80 to 1.33	1.06	0.75 to 1.49
Reporter gender (F vs M)	0.95	0.69 to 1.31	0.50	0.13 to 1.89
Ever reported an OA case to THOR (ever vs never)	1.04	0.79 to 1.37	1.40	0.86 to 2.30
GMC registration year (1986 onwards vs ≤1985)	1.25	0.97 to 1.61	1.87	1.23–2.83

GMC, General Medical Council; OA, occupational asthma; OP, occupational physician; RP, respiratory physician; THOR, The Health and Occupation Reporting network.

needed on future employment at a particular workplace, or for research into the underlying mechanisms of occupational asthma (where written informed consent by the subject is required).¹⁰ The cases used in this study reflect what specialist respiratory physicians are capable of extracting within the current system of provision of specialist work-related respiratory health services in the UK. Indeed, seeking 'gold standard' data would invalidate the process of rating used in this study, as this would mean that cases would have been reviewed in more than one centre before a diagnosis of work-related lung disease had been assigned.

The two study phases also gave an indication of decision making that might be made after an initial appointment (when history based information was available) and at a later stage in the consultation process (using additional information from clinical investigations). In reality, some clinicians may only have the opportunity to obtain history based information before having to make recommendations about a potential occupational asthma diagnosis, for example if advising on onward referral or about an individual's fitness for work (albeit perhaps on a temporary basis until further information is available).

Analysis of all returns when assessing diagnostic agreement for occupational asthma produced a wide range of occupational asthma scores from physicians within a clinical discipline (ie, occupational or respiratory medicine). This is perhaps unsurprising in view of the variations in diagnostic agreement that were reported by Fishwick *et al*⁴ (who used the same case reports as in this study), but where 75% of study participants/raters were consultant respiratory physicians with a clinical and research interest in work-related lung disease. A related question is whether (and how much) the outcome of this study and the Fishwick study⁴ is affected by the use of case histories, rather than the physicians seeing patients on a face-to-face basis, the case histories being selected at random from a series of patients with suspected occupational asthma at six secondary care respiratory centres (as defined by the Group of Occupational Respiratory Disease Specialists (GORDS)) in the UK.¹¹ The cases had been transcribed by two researchers from hospital case notes on to a standard study proforma (which also allowed insertion of investigations which could not be summarised), and then anonymised to produce a case history. However, the use of case summaries (vignettes) has been subjected to scrutiny as a methodology for measuring the quality of clinical practice in previous studies of this type,^{12 13} and they are also used extensively in medical education.^{14 15}

This study found that, when presented with 'case history' information alone, occupational physicians showed better agreement in occupational asthma diagnosis than respiratory physicians. This might result from occupational physicians' day-to-day practice, as they may be required to attribute the work-relatedness of disease and assign a (possible) diagnosis when presented solely with information from a case history and a workplace assessment. In contrast, respiratory physicians see secondary (or even tertiary) referrals, and may be more accus-

tomed to greater use, and perhaps reliance on, 'history plus investigation' information. In addition, after investigation information was made available to study participants, respiratory physicians showed better agreement in occupational asthma diagnosis than occupational physicians. As patterns of reporting to THOR may differ within and between clinical specialities, perhaps caused by variations in physicians' case loads/mixes and day-to-day practice, such differences also need to be addressed in the context of the reliability or validity of occupational asthma diagnosis.

This study also aimed to investigate the effects of case study characteristics on diagnosing occupational asthma. The specific characteristics investigated such as latency between exposure to an agent and development of symptoms and citation of a sensitising agent could not show clear relationships because of the low power associated with these characteristics within this study. However, an OASYS-2 result of greater than 2.5 or the presence of airway hyper-reactivity (ie, results of investigative procedures) produced higher index ratings, and may therefore be indicators of positive predictive clinical investigations in occupational asthma diagnosis. More steps may need to be taken to further improve the diagnostic practice of specialist physicians, especially with respect to the systematic collection and interpretation of work-related lung function data, as part of a strategy to improve the diagnosis and management of occupational asthma.¹¹

Furthermore, the results should be interpreted with caution, especially when taking into account the effects of exclusion of cases, that is when raters said there was insufficient information or assigned an 'undecided' occupational asthma score (of 50%). An effect of excluding ratings that were not OA decisions has been shown (using interclass correlations as an example) and varied substantially between the 19 cases used in this study, some cases being better represented (having more OA decisions per case) than others.

In comparison to the case study characteristics, investigation of the effects of reporters' characteristics on diagnosing occupational asthma (ie, clinical speciality, gender, date of registration as a medical practitioner and previous THOR reporting history) showed that GMC registration year influenced occupational asthma diagnosis in phase 1 of the study. Assuming GMC registration year estimates a physician's overall clinical experience, then shorter post registration study participants were more likely to label cases as occupational asthma on grounds of history (pre-test probability). The assumption that less experienced doctors are not as capable of determining pre-test probability has been analysed for another specific diagnosis, namely pulmonary embolism.¹⁶ As in our study, the pulmonary embolism diagnosis analysis used case scenarios constructed from medical records, and found that junior doctors were more likely to agree on the pre-test probability of pulmonary embolism diagnosis than senior colleagues, suggesting that as physicians gain experience they recognise that diagnosis can be difficult to assess on clinical grounds. Of note, however, is that

Original article

the pulmonary embolism study¹⁶ compared junior doctors (house officers and registrars) and consultant groups, whereas our study comprised clinical specialists in occupational or respiratory medicine.

Female gender, previous occupational asthma case reporting and GMC registration affected the post-test labelling of cases as occupational asthma (ie, provision of investigations/results to raters in phase 2). Other studies have also shown higher rates of (and presumably reliance upon) laboratory test referral in association with female gender of the physician,^{17–19} but there is less agreement about use of tests in relation to doctors' overall clinical experience.^{18–20} However, in our study, these observations may be the result of the random allocation of cases to raters (ie, case characteristics) rather than reporter characteristics.

Although the RR of a positive occupational asthma diagnosis was not affected by clinical speciality (occupational physician or respiratory physician), either at the pre- or post-test stage (phases 1 or 2) of this study, further work on what triggers physicians to consider a case to be occupational asthma (or not) is necessary to assist better diagnosis and prevention of this disease for employees.

Funding THOR is partially funded by the Health and Safety Executive and has also received funding from the Department of Health, and from charitable sources (eg, the British Cotton Growers' Association). This article expresses the views of the authors, and not necessarily of the funders.

Competing interests None.

Ethics approval This study was conducted with the approval of the Multicentre Research Ethics Committee (MREC).

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

1. McDonald JC, Chen Y, Zekveld C, *et al*. Incidence by occupation and industry of acute work related respiratory diseases in the UK, 1992–2001. *Occup Environ Med* 2005;**62**:836–42.
2. **Revitalising Health and Safety Strategy Statement**, 2000. <http://www.hse.gov.uk/revitalising/strategy.pdf>.
3. Nicholson PJ, Cullinan P, Newman Taylor AJ, *et al*. Evidence based guidance for the prevention, identification, and management of occupational asthma. *Occup Environ Med* 2005;**62**:290–9.
4. Fishwick D, Bradshaw L, Henson M, *et al*. Occupational asthma: an assessment of diagnostic agreement between physicians. *Occup Environ Med* 2007;**64**:185–90.
5. Barber CM, Naylor S, Bradshaw LM, *et al*. Approaches to the diagnosis and management of occupational asthma amongst UK respiratory physicians. *Respir Med* 2007;**101**:1903–8.
6. McNamee R, Carder M, Chen Y, *et al*. Measurement of trends in incidence of work-related skin and respiratory diseases, UK 1996–2005. *Occup Environ Med* Published Online First: 16 April 2008. doi: 10.1136/oem.2007.036731.
7. Cherry NM, Meyer JD, Holt DH, *et al*. Surveillance of work-related diseases by occupational physicians 1996–1999. *Occup Med (Lond)* 2000;**50**:496–503.
8. Meredith SK, Taylor VM, McDonald JC. Occupational respiratory disease in the United Kingdom 1989: a report to the British Thoracic Society and the Society of Occupational Medicine by the SWORD project group. *Br J Ind Med* 1991;**48**:292–8.
9. **University of Manchester Occupational and Environmental Health Research Group**. THOR - The Health and Occupation Reporting network, <http://www.medicine.manchester.ac.uk/coeh/thor> (accessed 20 Oct 2008).
10. **Health and Safety Executive**. *Medical aspects of occupational asthma Guidance note MS25*. 2nd edn. Norwich: HMSO, 1998.
11. Fishwick D, Barber CM, Bradshaw LM, *et al*. Standards of care for occupational asthma. *Thorax* 2008;**63**:240–50.
12. Peabody JW, Luck J, Glassman P, *et al*. Measuring the quality of physician practice by using clinical vignettes: a prospective validation study. *Ann Intern Med* 2004;**141**:771–80.
13. O'Neill E, McNamee R, Agius R, *et al*. The validity and reliability of diagnoses of work-related mental ill-health. *Occup Environ Med* 2008;**65**:726–31.
14. Chappel JN. Educational approaches to prescribing practices and substance abuse. *J Psychoactive Drugs* 1991;**23**:359–63.
15. Baskett SJ. Teaching psychiatry in a new medical school: a multimedia approach. *South Med J* 1978;**71**:1507–10.
16. Iles S, Hodges AM, Darley JR, *et al*. Clinical experience and pre-test probability scores in the diagnosis of pulmonary embolism. *Q J Med* 2003;**96**:211–15.
17. Vinker S, Kvint I, Erez R, *et al*. Effect of the characteristics of family physicians on their utilization of laboratory tests. *Br J Gen Pract* 2007;**57**:377–82.
18. Franks P, Williams GC, Zwanziger J, *et al*. Why do physicians vary so widely in their referral rates? *J Gen Intern Med* 2000;**15**:163–8.
19. Hartley RM, Charlton JR, Harris CM, *et al*. Pattern of physicians' use of medical resources in ambulatory settings. *Am J Public Health* 1987;**77**:565–7.
20. Salloum S, Franssen E. Laboratory investigations in general practice. *Can Fam Physician* 1993;**39**:1055–61.