# OCCUPATIONAL RESPIRATORY DISEASES

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# RESPIRATORY QUESTIONNAIRES

*Michael D. Attfield*

## INTRODUCTION

Well-designed questionnaires are an important and powerful tool in the exploration of occupational health problems and associated risk factors. They are easy to apply, inexpensive to administer, and readily interpretable.

Unfortunately, the apparent simplicity of the questionnaire technique is deceptive. There is much more to survey work than drafting a set of questions and applying them haphazardly to groups of individuals. The proper use of a questionnaire is dependent on careful design, subsequent verification of validity and reproducibility, and the close monitoring of its application. The careless use of questionnaires has been and continues to be a major source of erroneous results and conclusions.

## DESIGN CONSIDERATIONS

In the course of ascertaining information by questioning groups of people, it was soon realized that the method of *free questioning*, as used in clinical situations, was inadequate. Van der Lende and Orie have said, "...in these procedures [free history taking], errors of omission can act inadvertently or deliberately, irregularly or consistently. The way the clinician asks the questions, the attitudes, the approaches, and the vocabulary may evoke incomplete, inaccurate, or evasive answers. Furthermore, a different opinion of the meaning of a symptom can be a source of error"(25). They go on to say, "obviously, with so many possibilities of making mistakes, *free* history taking, with 'open' questions is unsuitable for epidemiological purposes..." This was clearly demonstrated by Cochrane and others who used a fairly free form of questioning to inquire about certain symptoms such as cough and phlegm (5). They reported the method appeared to give rise to large differences between interviewers. These results spurred the development of a standardized questionnaire—the British Medical Research Council Questionnaire on Respiratory Symptoms (BMRC) (15)(16).

The first step to take after deciding to use a questionnaire is to list the disease processes which are to be investigated. If these are covered by an established questionnaire, it is probably better to use that version rather than drafting a new questionnaire, provided the existing format has been tested and verified for validity and repeatability. If it is necessary to draw up a new questionnaire, its content must be defined by enumeration of those items about which information is sought. Each item must be described in terms of its manifestations and translated into a list of questions. When deciding whether to include a question, Hill's dictum should be applied: "For every question the investigator wishes to include he should ask himself—'Is this question really necessary?'" This is especially important for questionnaires in occupational epidemiology where time is a factor that can affect response.

Once the investigator has chosen his questions, he must determine their specificity and sensitivity and select their form and wording. Specificity and sensitivity will be discussed later.

There are two forms of questions: open and closed. Open questions, where the respondent is required to answer freely with no constraints, are generally unsuitable for epidemiological purposes. Questions such as: "Have you received any medical treatment in the past year?" result in answers that pose enormous problems in data processing and analysis. They also rely on the respondent's memory; prompts, such as a list of diseases or illnesses, are not given to aid recall.

The closed question offers a fixed choice of responses. The simplest form requires a dichotomous response such as YES/NO. Other types offer a list of choices, one of which must be chosen. This list may show a gradient from

one extreme to the other. Another type offers a list where one or more of the elements can be checked and is especially useful because it provides prompts to aid the respondent's memory (e.g., a list of different chest illnesses). For further discussion on the design of questions and indeed on all aspects of medical questionnaires, see Bennett and Ritchie (3).

The wording of questions is a crucial aspect of questionnaire design. One defect is phrasing that suggests a particular answer. The leading question, such as "You do cough," is the most extreme example of this. Vagueness and ambiguity are faults often found in questionnaires. For example, Suchman et al., found that there was confusion as to what constituted "trouble" in the question, "Do you have trouble with your hearing?" (23). Phrasing that decisively inquires about a particular disease entity can be difficult to achieve. Although medical jargon has distinct meaning for physicians, the layman is frequently confused about what terms mean (Boyle)(4). Bennett and Ritchie argue that words implying frequency (such as "often" and "sometimes") should be replaced by more precise terms (3). In addition, it is best to avoid questions that require long recall such as, "Have you ever had...,"; instead use specific time periods such as, "in the past three years" or "before age eighteen."

Questions should be as short and contain as few concepts as possible. For example, question five of the British Medical Council's questionnaire on respiratory symptoms asks, "Do you cough like this on most days for as much as three months in the year?" (16). This contains three major concepts: "cough like this"; "on most days"; and "for as much as three months in the year." Each concept requires three different memory recalls: one to remind him of the previous questions ("like this") and two to past events. He must also make a judgment concerning what constitutes "most days" and "for as much as three months in the year."

Some researchers believe that valid results can be attained if information on the cooperativeness of the respondent is available. For example, uncooperative respondents could be eliminated from analysis where there are grounds to believe their answers are untrustworthy. There are several ways of doing this. One method simply asks the interviewer to assess how cooperative the respondent is. Another method elicits the information by inserting (into the questionnaire) questions for which there is a known correct response.

The final design consideration is question order and layout. A "carry-over" effect from preceding questions may influence answers to later ones. This can arise because the respondent strives to present a consistent picture of his symptoms to himself and the interviewer. Alternatively, earlier questions can remind him about aspects of his illness he may have forgotten. Thus in the BMRC questionnaire, the phlegm questions occur after those on cough. If a respondent associates phlegm with coughing but does not admit to cough, he will probably not admit to phlegm. If the position of the two sets of questions were reversed, perhaps more people would state they had phlegm without cough. (This possibility is stated explicitly on that questionnaire).

In laying out the questionnaire, it is important that instructions to the interviewer on question order and on skipping questions be stated clearly. Errors due to incorrect skipping have been reported by Attfield and Melville; these resulted from unclear instructions on the sheet (2). It may also be desirable to print instructions to the interviewer on answer interpretation, close to the relevant question rather than in a separate instruction book. Thus the wording, "most days," in the BMRC questionnaire could be clarified by the direction, "most days means five or more days per week," set in a note close to the question. In this way the interviewer would be constantly reminded. Finally, most questionnaire information is nowadays processed by computer. This involves the transfer of information to computer storage and this transfer can cause errors. It is imperative that the questionnaire sheet be organized for easy and accurate data coding and transfer. The advise of a computer programmer or systems analyst can be invaluable.

## AN EXAMPLE OF A MEDICAL QUESTIONNAIRE

As an example of an established medical questionnaire, the British Medical Research Council's respiratory questionnaire is described and reviewed here (15). The development of this questionnaire was spurred by the results of several epidemiological studies, notably that of Cochrane and colleagues, which had revealed the inadequacies of free questioning in large studies

(5). The BMRC questionnaire was published in 1960 and revised in 1966 and 1976. As Samet has said, "The questions...reflect the hypothesis about the origins of airway obstruction which prevailed in the 1950's..."(21). The questionnaire has been used widely, translated into other languages, and often modified. In Europe it formed the basis for European Coal and Steel Community's investigations into respiratory disease (see Van der Lende and Orie (25)). A shortened version has been used by the Pneumoconioses Field Research of the British National Coal Board (for format see Attfield and Melville (21)), and clear associations between symptom levels and quantitative measures of dust exposure have been demonstrated (20).

In the United States a committee of the American Thoracic Society adopted the questionnaire in 1968 (1). In 1971, the National Heart and Lung Institute (NHLI) made available a version of the BMRC questionnaire, adapted for use in the United States (6). Recently a committee organized by the American Thoracic Society has released a recommended questionnaire named the ATSDLD-78-A; it is based on experience gained with the BMRC and NHLI questionnaires (9). This version has a similar format to its predecessors but differs from them mainly by inquiring about illnesses in childhood. It is more suitable for occupational epidemiology as it seeks to determine how long respondents have had symptoms and illnesses, thereby allowing the researcher to link symptoms and exposure more precisely.

Up to now, however, the BMRC version has been the most widely used questionnaire. The BMRC questionnaire asks questions on cough, phlegm, wheezing, breathlessness, chest illness, and other factors. It has comprehensive sections on smoking habits and on occupational history. Instructions on question order are clear and clarificatory notes are printed in the text. Layout and transfer to computer storage are uncomplicated. The validity and reproducibility have been tested and its utility verified by countless studies in which it has been used.

## QUESTIONNAIRE VERIFICATION

Verification of a questionnaire involves two concepts: validity and reproducibility. These have been introduced and discussed in the section on Epidemiology and Study Design in this chapter. As mentioned there, reproducibility measures the random variation seen on different occasions; a valid questionnaire is one in which results agree with the best possible measurements that can be made to determine the presence or absence of disease (or exposure).

## VALIDITY

Validity can be divided into two concepts: sensitivity and specificity. Sensitivity is a measure of the proportion of truly diseased persons found to be positive for disease by the questionnaire or test procedure. The numerator of this index is the number of all true positives; the denominator is the sum of the true positives and false negatives (Table I-63). Table I-64 gives some data on men aged 40-64 in Vlaardigen, Holland, who were examined by the BMRC questionnaire and given a bottle in which to collect sputum over 24 hours. The 43% figure does not show high sensitivity, but the authors give valid reasons as to why that figure should be considered satisfactory.

**Table I-63**
CALCULATION OF SENSITIVITY

| | Disease Present | Disease Absent |
|---|---|---|
| Positive replies | a | c |
| Negative replies | b | d |

$$\text{Sensitivity} = \frac{a}{a + b} \times 100$$

Source: Historical Definition.

**Table I-64**
EXAMPLE OF SENSITIVITY CALCULATION

| | Sputum Present | Sputum Absent |
|---|---|---|
| Yes to BMRC question 10 | 104 | 22 |
| No to BMRC question 10 | 138 | 203 |

$$\text{Sensitivity} = \frac{104}{104 + 138} \times 100 = 43\%$$

Source: (25)

The main problem with determining sensitivity is that the value of the index is dependent on the degree of similarity between the two measures being compared. In Table I-65, the two methods are not directly comparable: question 10 of the BMRC questionnaire is concerned with phlegm on most days for as much as three months in the year; the sputum samples were collected on one day only. Men who said "yes" validly to question 10 may not have been able to produce sputum on the one day they were given the bottle. Thus, although the question answer and the sputum collection apparently disagree, and cause the sensitivity index to be reduced, such disagreement is perfectly allowable. Unfortunately, when using questionnaires, it is seldom possible to devise an independent test which is reliable and which is *absolutely* comparable to the question. The result of this is to make sensitivity figures only approximate guides to true sensitivity.

That an index other than sensitivity is needed can be demonstrated in an example. Suppose, in a study of respiratory symptoms, we wish to include a question with great sensitivity to identification of bronchitis. One question which would certainly identify such people would be "Have you ever coughed?" While this has excellent sensitivity, it would also identify many of the nonbronchitics. In other words, it is not specific to bronchitis. In order to measure this effect we need another index. This index, *specificity*, is defined as the quotient of the number of truly nondiseased found to be negative by the questionnaire or test and the sum of true negatives and false positives (Table I-65). While sensitivity measures the ability of a questionnaire or test to discover a large proportion of the diseased persons subjected to examination, specificity measures the ability of the questionnaire or test to identify those truly nondiseased. Usually, the more sensitive a questionnaire is made, the lower its specificity tends to become. Table I-66 gives an example conceiving specificity, taken again from the Dutch study of Van der Lende and Orie (25).

Most studies in occupational epidemiology involve the effects of inhaling dusts or vapors and so include a respiratory symptoms questionnaire. It is in this field, therefore, where the investigation of sensitivity and specificity has been studied most. Even so, as Samet has noted, there are few appropriate standards with which to assess the validity of questions on cough, phlegm, and dyspnea (21). In his review of the history of the respiratory symptoms questionnaire, Samet discusses the various attempts to validate questions. He notes that validation of the BMRC questionnaire has been limited to assessment of questions on phlegm, dyspnea, and chest illness, and comments that only the phlegm questions have been adequately validated. For these questions the sensitivity and specificity are good. For the rest, the findings are mixed but generally favorable, although assessment is dogged by the unavailability of a realistic standard.

**Table I-65**
CALCULATION OF SPECIFICITY

| | Disease Present | Disease Absent |
|---|---|---|
| Positive replies | a | c |
| Negative replies | b | d |

$$\text{Specificity} = \frac{d}{c + d} \times 100$$

Source: Historical Definition.

**Table I-66**
EXAMPLE OF SPECIFICITY CALCULATION

| | Sputum Present | Sputum Absent |
|---|---|---|
| Yes to BMRC question 10 | 104 | 22 |
| No to BMRC question 10 | 138 | 203 |

$$\text{Specificity} = \frac{203}{22 + 203} \times 100 = 90\%$$

Source: (25)



## REPRODUCIBILITY

Apart from validity, a questionnaire must be reliable; i.e., the random variation in the answering of questions must not be great. Reliability is measured by a statistic which is variously named consistency, reproducibility, or repeat-

ability and which is calculated as shown in Table I-67.

In practice, assessment of the consistency of questions is not as straightforward as it appears. Since the response in the same individual on two occasions is required, this repetition has its problems. If the period between the two interviews is too short, factors such as memory may influence the assessment. For example, the respondent may remember his replies, and although after recollection he may come to believe some of his earlier replies were incorrect, he may reply the same way the next time in order to be consistent. On the other hand, recollection between interviews for some individuals may lead them to change their mind. If the period between surveys is too long, real changes in their health will result in alteration in their replies. Seasonal factors can also play a part in this.

For questions on respiratory symptoms, reliability has been assessed in a number of studies. Most investigations report consistencies varying between 70% and 90%. Samet has extracted some reliability figures on phlegm production from several studies and these are shown in Table I-68. For his own study (last in the Table), he believes the poor reproducibility arose from excess reporting in the second interview.

Compared to questions on phlegm production, those on smoking are very reliable. Table I-69 shows some statistics on the reliability from four studies and as exemplified by Samet. The consistency statistics range from 95% to 99%.

**Table I-67**

CALCULATION OF CONSISTENCY

| | Second Response | |
|---|---|---|
| | **Positive** | **Negative** |
| *Positive* | a | b |
| First response | | |
| *Negative* | c | d |

$$\text{Consistency} = (a + b)(a + b + c + d) \times 100$$

Source: Historical Definition

## BIAS

There are two kinds of variation: that which occurs randomly and thus should act both positively and negatively with equal probability, and that which acts consistently in the same direction. The latter is called bias and is a frequent source of problems in epidemiological studies. Bias can arise from differences between interviewers, from method of administration, from changes in the format of the questionnaire, and possibly, from seasonal effects.

## INTERVIEWER DIFFERENCES

Since most studies endeavor to maintain consistency in their methodology, (i.e., not mixing postal with administered questionnaires, and not making drastic changes to the format during a study), the most common source of error is that associated with interviewer differences. Two methods of assessing observer differences have been used in the past. The first, which involves repeat interviews on the same person, is not practical for epidemiological surveys and suffers from the same memory and temporal change problems as does the assessment of consistency. The more widely used technique requires random allocation of respondent groups to different observers. Where necessary in analysis, account must be taken of age, smoking, and other relevant factors.

Observer differences have been reported by a number of workers. Most of those studies were undertaken before the introduction of the BMRC. One of the early ones, if not the earliest, was by Cochrane and colleagues who found a twofold difference in prevalence between four interviewers (23%-46%) for cough, and a threefold difference for sputum production (13%-42%) (5). In later studies, such as that by Lebowitz and Burrows among others, no or few differences were reported (14). However, in an investigation which looked at differences between two observers over the long term, Attfield and Melville found consistent evidence of bias amounting, for one question, to as much 10% on average over eight comparability trials (2). This occurred despite continued monitoring and correction.

The source of interviewer variation does not rest completely with the interviewer. Fairbairn and colleagues examined in detail the reasons for observer disagreement (7). They estimated 62% of the variation arose with the interviewer, 21% with the respondent, and the remainder was the fault of the question format. They reported that most of the observer errors arose from failure to keep to the briefing. Reasons given were:

1) wrong treatment of vague answers;
2) unwarranted probing or insufficient probing;

**Table I-68**

RELIABILITY OF RESPONSE TO PHLEGM QUESTIONS

| Author/Date (Ref.) | Population | Questionnaire: Question | Reliability (%) |
|---|---|---|---|
| Fletcher, 1959 (10)<br>Fairbairn, 1959 (7) | Postal employees, England | MRC: grade of phlegm | 77 |
| Morgan, 1964 (18) | Coal miners, England | PFR: AM phlegm | 77* |
| | | PFR: persistent phlegm | 89 |
| Holland, 1966 (13) | Coal miners, Wales | PFR: AM phlegm | 80 |
| | | PFR: persistent phlegm | 81 |
| | | MRC: phlegm, 3 months | 82 |
| Van der Lende, 1972 (24) | Population sample, Netherlands | MRC: phlegm, 3 months | 91+ |
| Samet, 1978 (22) | Shipyard workers, USA | MRC: phlegm, 3 months | 63 |
| | | Clinician: phlegm, 3 months | 62 |

*Calculated from Table 2 (Samet article (21)).
+Consistent response on four occasions during two years.
Source: Adapted from (21)

3) rewording of questions;
4) phrasing probing questions so as to bias reply;
5) forcing answers.

Attfield and Melville also analyzed the reasons for interviewer differences and came to the same conclusions as Fairbairn and co-workers (2). They blamed lack of clear instruction on the questionnaire for some of the errors and noted it had resulted in incorrect skipping of questions early on in their study. Since probing had resulted in errors, it was disallowed later in the study.

## COMPARISON BETWEEN QUESTIONNAIRES

Literal comparison between results from different studies is unwise, but when very different questionnaires have been used, validity of the comparison is even more tenuous. In general, it can be said that questionnaires that differ greatly in wording or structure will lead to differing estimates of prevalence. Despite this, their individual validity, as measured by comparison with independent criteria, may be equally good. The evidence suggests that where wording and other changes are minor, differences in response are not great. For instance, Lebowitz and Burrows compared the BMRC format with that of the NHLI and found nearly identical prevalences for similarly worded questions (14). In contrast, inconsistent prevalences were obtained on chest illness, for which the questions were worded differently.

## SEASONAL EFFECTS

The most recent evidence on seasonal effects suggests they are not as great as once thought. Seasonal effects were reported several times twenty to thirty years ago in Britain. It is now believed that air pollution, rather than cold weather, was responsible for these effects since household coal-fired heating was then used extensively.

## INTERVIEWER TRAINING

Interviewer training must not be skimped in the undertaking of a study. The BMRC questionnaire instructions suggest that before embarking on a study, all interviewers should first study the questionnaire and instructions and discuss any points of difficulty (16). They should then listen to recordings that have been made "...of interviews based on the questionnaire." They go on to say that "interviewers should then apply the questionnaire to 10 or more subjects (such as hospital patients) who have at least some chest symptoms (since no difficulty arises with subjects

**Table I-69**
RELIABILITY OF SMOKING HISTORY

| Author/Date (Ref.) | Population | Questionnaire: Question | Reliability (%) |
|---|---|---|---|
| Fletcher, 1959 (10)<br>Fairbairn (7) | Postal employees, England | MRC: smoking status | 98 |
| Morgan, 1964 (18) | Coal miners, England | PFR: smoking status | 95 |
| Holland, 1966 (13) | Coal miners, Wales | PFR: smoking status<br>MRC: smoking status | 99<br>99 |
| Samet, 1978 (22) | Shipyard workers, USA | MRC: calculated lifetime cigarette consumption | 0.81* |

*Correlation coefficient.
Source: Adapted from (21)

who answer all questions with a confident "no"). These interviews should either be witnessed by an experienced colleague or tape-recorded so that any mistakes or doubtful points can be corrected or clarified at leisure afterwards." We suggest experienced interviews act as fake respondents so that new interviewers can practice. The former will know the problems and pitfalls and can introduce them in his replies so that the new interviewer's proficiency can be evaluated.

After the new interviewer has had his first experience in the field, his performance should be compared with experienced observers where possible.

Training must not cease with the introduction of the recruit into regular interviewing. What Bennett and Ritchie term "interviewer drift" can act to cause differences between observers (3). Interviewer drift occurs as the interviewer ceases to maintain his initial standards. As those authors note, "the more times an interviewer uses a given questionnaire, the more remote the training period becomes and the more he will forget his briefing." To avoid interviewer drift, the performance of the interviewers must be monitored periodically. Comparability trials, tape recordings, and special test sessions are all methods of assessing whether incorrect methodology has crept in. Van der Lende and Orie suggest that pairs of interviewers be formed to interview each other (25). They note "it soon becomes a sport to 'trap' each other. The interviewee tries to give answers that are difficult for the interviewer to handle... Of course, the teachers listen carefully, and after such sessions we discuss the difficulties and errors made."

## SELF-ADMINISTERED AND POSTAL QUESTIONNAIRES

Since one of the major biases in the application of questionnaires is that arising from observer differences, it would seem that elimination of interviewers through the use of a self-administered questionnaire would improve the reliability of the information obtained. Unfortunately, the elimination of one type of error through use of the self-administered questionnaire seems to be accompanied by the introduction of another kind of error. This problem, non-response, which is particularly prevalent in postal surveys, results in incomplete answers being obtained or the absence of any information on a large part of the study sample. For example, Fletcher and Tinker found in a mailed questionnaire survey that 25% of the subjects did not complete the entire questionnaire (11). When compared with an interviewer administered group, answers on cough, phlegm, dyspnea, and smoking habits were similar. A number of workers have achieved an excellent response through carefully planned and executed studies and so have shown the problem of nonresponse can be eliminated.

One great advantage of a postal questionnaire survey is economy. Samet has noted, "...large mailed surveys have been successfully performed which would have been otherwise infeasible..."(21) Against this we have the possible disadvantages that completion is not under the

researcher's control; that the wrong person (such as a spouse) might complete the questionnaire for the designated respondent; or that a respondent's reply might be influenced by family members. One further disadvantage is that self-completion forms must be simpler than interviewer-administered forms as there is no knowledgeable person to guide the respondent. On the other hand, greater sensitivity is claimed for the self-completion form by a number of researchers. Mittman and co-workers report on such a case (17). Mork reviews the validity and reproducibility of the self-administered questionnaire and discusses other problems (19).

## CONCLUSION

As Feinstein has stated, "History taking, the most clinically sophisticated procedure of medicine, is an extraordinary investigative technique: in few other forms of biological research does the observed material talk... The acquisition of data by this verbal method is far more complex than by the techniques of physical examination or laboratory tests." The techniques and procedures outlined in this section aid in making the data acquired through questionnaires as reliable and valid as possible.

## REFERENCES


1. American Thoracic Society: Standards of Epidemiologic surveys in chronic respiratory disease. National Tuberculosis and Respiratory Disease Association 1969.
2. Attfield, M. D. and Melville, A. W. T.: Inter-observer variability in the application of a respiratory symptoms questionnaire. To be published.
3. Bennett, A. E. and Ritchie, K.: Questionnaires in Medicine. London, Oxford University Press, 1975.
4. Boyle, C. M.: Difference between patients' and doctors' interpretation of some common medical terms. Br Med J *2:*286.
5. Cochrane, A. L., Chapman, P. J. and Oldham, P. D.: Observers' errors in taking medical histories. Lancet *1:* 1007, 1951.
6. Department of Health, Education and Welfare: Proceedings, First National Heart and Lung Institute Epidemiology Workshop, 1971.
7. Fairbairn, A. S., Wood, C. H. and Fletcher, C. M.: Variability in answers to a questionnaire on respiratory symptoms. Br J Prev Soc Med *13:*175, 1959.
8. Feinstein, A. R.: Scientific methodology in clinical medicine IV. Acquisition of clinical data. Ann Intern Med *61:*1162-1193, 1964.
9. Ferris, B. G.: Epidemiology standardization project. II. Recommended respiratory disease questionnaires for use with adults and children in epidemiologic results. Am Rev Respir Dis *118*(Part 2, No. 6): 7, 1978.
10. Fletcher, C.M., Elmes, P. C., Fairbairn, A. S., and Wood, C. H.: The significance of respiratory symptoms and the diagnosis of chronic bronchitis in a working population. Br Med J *2:*257, 1959.
11. Fletcher, C.M. and Tinker, C. M.: Chronic bronchitis: A further study of simple diagnostic methods in a working population. Br Med J *1:*1491,1961.
12. Hill, A. B. : Observation and experiment. N Eng J Med *248:*995-1001, 1953.
13. Holland, W. W., Ashford, J. R., Colley, J. R. T., Morgan, D. C. and Pearson, N.J.: A comparison of two respiratory symptoms questionnaires. Br J Prev Soc Med *20:*76, 1966.
14. Lebowitz, M. D. and Burrows, B.: Comparison of questionnaires: The BMRC and NHLI respiratory questionnaires and a new self-completion questionnaire. Am Rev Respir Dis *113:*627, 1976.
15. Medical Research Council: Standardized Questionnaire on respiratory symptoms. Br Med J *2:*1665, 1960.
16. Medical Research Council's Committee on Research into Chronic Bronchitis. Instructions for the use of the questionnaire on respiratory symptoms. London, MRC, 1966.
17. Mittman, C., Barbela, T., McCaw, D., and Pedersen, E.: The respiratory questionnaire: use of a self-administered version. Arch Environ Health *34/3:*151, 1979.
18. Morgan, D. C., Pasqual, R. S. H., and Ashford, J. R.: Seasonal variations in the measurement of ventilatory capacity and in the answers of working coal miners to a respiratory symptoms questionnaire. Br J Prev Soc Med *18:*88, 1964.

19. Mork, T.: Some problems related to the use of mail questionnaires. J Chronic Dis *23:* 399, 1970.
20. Rae, S., Walker, D. D., and Attfield, M. D.: Inhaled Particles III, ed. W. H. Walton, Old Woking, Unwin. *2:*883, 1971.
21. Samet, J. M.: A historical and epidemiologic perspective on respiratory symptoms questionnaires. Am J Epidemiol *108(6):* 435, 1978.
22. Samet, J. M., Speizer, F. E., and Gaensler, E. A.: Questionnaire reliability and validity in asbestos exposed workers. Bull Eur Physiopathol Respir *14:*177, 1978.
23. Suchman, E. A., Phillips, B.S., and Streib, G. F.: An analysis of the validity of health questionnaires. Social Forces *36:*223, 1958.
24. Van der Lende, R., Van der Muelen, G. G., and Wever-Hess, J.: Investigation into observer and seasonal variation of the prevalence of respiratory symptoms at Schiermonni—koog. Int J Epidemiol *1:* 47, 1972.
25. Van der Lende, R. and Orie, N. G. M.: The MRC-ECCS questionnaire on respiratory symptoms (use in epidemiology). Scand J Respir Dis *53:*218, 1972.
26. Wood, M. M. and Elwood, P. C.: Symptoms of iron deficiency anemia: a community study. Br J Prev Soc Med *20:*117, 1966.