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# The Occupational Questionnaire in Retrospective Epidemiologic Studies: Recent Approaches in Community-Based Studies

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In community-based studies, questionnaires are usually the sole source of information on occupational exposures. Three main categories of questions can be distinguished and are presented in this paper, along with examples of appropriate questionnaires. General questions elicit information on job history, tasks, and work environment in nonspecific terms as shown by a general questionnaire used in a large hypothesis-generating study of occupational cancer in Montreal. Occupation-specific questionnaires are designed to obtain more detailed information on exposure by detailing the various tasks, processes, and materials associated with given professions or industrial activities; an example is a questionnaire developed in Montreal for welders. Questionnaires may also include exposure-specific questions in the form of checklists of materials and exposures; an exposure-specific questionnaire, developed for exposure to formaldehyde, wood dust, paints, adhesives, chromium, and nickel in the framework of a French nasal cancer study, is presented. The development of a questionnaire depends on the number and nature of the exposures under study. In order to maximize validity, it is recommended that questionnaires be developed and interpreted with the help of hygienists, be administered preferably by interview, include a detailed job anamnesis (general questions) to be followed by occupation or exposure-specific questions, and use a chemical vocabulary understandable by the subjects. **Gérin, M.; Siemiatycki, J.: The Occupational Questionnaire in Retrospective Epidemiologic Studies: Recent Approaches in Community-Based Studies. Appl. Occup. Environ. Hyg. 6:495–501; 1991.**

## Introduction

Community-based case–control studies constitute a choice methodology for occupational epidemiologic studies. Under such circumstances, the optimal source of information on the subjects' occupational exposure histories is usually that which can be obtained from the subjects via a questionnaire. Questionnaires can be administered face to face, by telephone, or by mail, either to the subjects or to surrogates.

Occupational questionnaires can be quite straightforward when the only information elicited is the subject's occupational history, with dates of employment in the various successive jobs, his/her occupational titles, and the economic activity of the various employers. These job characteristics can be coded according to various classification schemes and used as exposure measures. If a job-exposure matrix (JEM) were available to infer exposures on the basis of job titles, it would be a very useful supplement to the history of occupational and industrial titles. However, there is currently no JEM that has been shown to be sensitive and specific in predicting individuals' exposure histories.

The only remaining approach to obtaining specific exposure information is via a targeted questioning process whereby the subject's answers become the crucial link in the chain leading to an exposure assessment. The nature of the questioning process is a crucial element of epidemiologic methodology. However, despite some recommendations[1] that questionnaire methods be presented and discussed more openly in epidemiologic literature, very little information has been published on methods of constructing questionnaires to elicit occupational exposure histories.

This paper will describe some occupational questionnaires. Three types of questions will be discussed: general, occupation-specific, and exposure-specific. Examples for each have been extracted mostly, but not exclusively, from interviewer-administered questionnaires used or developed by the authors. It must be stressed that the procedures outlined in this paper would generally work best only when it is possible to interview the subjects themselves.

This paper is not intended to focus on questionnaire

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administration, validation, or interpretation. These issues will be alluded to tangentially.

## Categories of Questions

The objective of an occupational questionnaire in a case–control study should be to elicit, from a subject's memory, the exposure-related information that is relevant to the objectives of the study. Community-based case–referent studies are often designed to test some hypotheses concerning a limited number of exposures. In other studies, the objective may be to evaluate etiologic fractions, again, with a limited number of exposures to be assessed. A third type of study may focus on generating hypotheses with a list of exposures that may be extensive and not completely defined ahead of time. Exposures under study may be substances easily recalled, such as wood dust and gasoline, or, on the contrary, chemicals such as formaldehyde and polynuclear aromatic hydrocarbons, the presence of which is usually not known by workers.

These and other factors related to study design and resources have led to the development of questionnaires widely differing in length and structure, from short questionnaires that contain only a few specific direct questions to more lengthy questionnaires that include semistructured questions covering each job systematically. All questions fall broadly, however, into one of three categories: 1) general questions, eliciting information on job, tasks, and environment in nonspecific terms; 2) occupation-specific questions, eliciting more details on the environment in specific jobs or occupations; and 3) exposure-specific questions, eliciting information on specific exposures.

### General Questions

A general occupational questionnaire was used in the framework of a large hypothesis-generating, multisite, case–control study of occupational cancer in Montreal. Details of the study design and general methods can be found in a number of reports.[2–4] The target population consisted of males aged 35–70, residing in the Montreal area. Eligible subjects were cancer cases with any of 14 types of cancer incident from 1979 to 1985 as well as a population control series. Altogether, questionnaire information was obtained from 4359 study subjects, of which 82 percent were obtained by interview and the rest by self-administered questionnaire. The primary epidemiologic strategy was to compare each case series with a control group drawn from among the other sites and population controls. Trained interviewers administered the questionnaire to the subjects as soon as they were identified. Self-administered questionnaires were sent to the homes of subjects who could not be contacted in person or who had died.

For each job held for more than six months, subjects were asked to answer 15 broad questions. The complete questionnaire is presented as Appendix A. Questions can be regrouped in five categories:

1. Questions relating to the employer: activities, products, production processes.
2. Occupation of the subject: job title or profession, department.
3. Detailed job description in terms of specific tasks, functions, machines, and materials used.
4. Description of the work environment in terms of the actual work area; the presence of dust, smoke, fumes, gases, oils, solvents, and radiation; the use of protective equipment; and the activities of other workers.
5. Some special questions related to the subject's perception of his/her job in terms of stress, difficult tasks, or adverse health effects.

Most of the questions were open-ended, and the subjects were encouraged to give as much detail as possible in interaction with the interviewer. The task of translating questionnaire information into a list of potential exposures was assigned to a team of chemists and hygienists who worked in close contact with the interviewers.

The chemists coded each subject's potential exposures in each of his/her jobs using a checklist developed during the first years of the study; the checklist covered 275 common exposures which are documented in the chemical and hygiene literature. These exposures include simple chemical products (e.g., carbon monoxide), chemical groups or functions (e.g., nickel products, aromatic amines), mixtures (e.g., gasoline, cement), and general categories of products (e.g., solvent). Semiquantitative indices of exposure are associated with each potential exposure and deal with level, frequency, and reliability of exposure. The chemists relied heavily on scientific and technical literature sources, complemented with the consultation of experts and occasional workplace visits. Each occupational history was reviewed by at least three chemists aiming to reach a consensus.

The five-category questionnaire was effective in generating broad hypotheses, thus meeting the objectives of the study. This type of questionnaire seems to cover most of the general questions that can be asked in any occupational study. Similar types of questions have been reported in many other studies covering industry, occupation, tasks, and environment without necessarily the same order or level of detail.[5–8] Questions in the fifth category, relating to the subject's perception of the negative aspects of his/her job, have elicited, in several instances, information about less frequent or unusual tasks or work episodes which involved potential exposure but had not been reported in the previous sections of the questionnaire.

### Occupation-Specific Questions

Because of the wide variety of occupations encountered in community-based studies, general questions concerning tasks or processes may not be precise enough to elicit the critical details necessary to optimize exposure assessment. It may be necessary to use complementary questions aimed at specific occupational groups; these questions would be administered following the general questions.

Such a strategy was adopted during the course of the Montreal study. The hygienists in charge of coding developed occupation-specific questionnaires for the following

15 occupations: machinists; welders, brazers, and solderers; painters; printers; cooks; farmers; ink makers; cleaners; plumbers; concrete terrazzo finishers; insulation workers; plasterers, drywall installers, and joint finishers; masons and bricklayers; carpenters; and roofers. An average of ten questions per occupation allowed the interviewer to elicit more detailed information concerning tasks, processes, material, equipment, work practices, and specific exposures in the particular environment. As an illustration, Appendix B presents the questionnaire developed for welding, brazing, and soldering occupations. The additional questionnaires were found to substantially improve the ease and reliability of the coding; were well accepted by the subjects who were, as a rule, impressed by the efforts made to better understand their specific trade; allowed a more uniform collection of information; and placed less demands on the interviewers. Given more time and resources, similar questionnaires could have been fruitfully developed to cover most occupations involving exposure.

Occupation-specific questionnaires were utilized in a nasal cancer study with six specialized questionnaires.[6] These covered common occupations involving exposure to wood dust or metal. Each questionnaire contained questions on specific exposures.

Recently, a systematic use of occupation-specific questionnaires has been undertaken in Germany whereby 25 supplementary questionnaires are being applied to jobs and industries with known exposure to lung carcinogens.[9] A matrix of job and industry is used to help interviewers identify the appropriate questionnaires. Similarly, specific questionnaires for 13 groups of occupations have been devised in a study on malignant lymphomas and renal carcinoma in the Varese province of Italy.[10]

### Exposure-Specific Questions

The vast majority of occupational questionnaires include direct questions concerning the exposure(s) under study. Even in hypothesis-generating studies, it may be of interest to include questions regarding some common materials such as solvents, paints, and oils. This strategy was employed in the Montreal occupational cancer study. On a self-administered, preinterview questionnaire, which included a preliminary listing of their jobs, subjects were asked whether they have ever manufactured or used 15 categories of products (leather or fur; wood or wooden objects; glues or adhesives; asbestos; other insulation material; pesticides and fertilizers; pharmaceuticals; food products; inks or dyes; paints, varnishes, or wood stains; plastics or rubber; solvents or degreasers; gasoline, fuels, or heating oils; lubricating oils and greases; other industrial chemicals). These questions serve two important functions. For those workers who do have a good idea of their past exposures, the inquiries allow researchers to tap that valuable information. Even if the subjects do not know their specific exposures, identification of some broad type of exposures (e.g., plastics) can give the hygienist a better understanding of what tasks are being performed. Of equal importance is the role of "priming the pump" which these questions serve. By asking the subject to focus on past occupational exposures, this brief, self-administered questionnaire prepares the subject for the interview that follows a few days later. At that time, the general questionnaire and the occupation-specific questionnaires described in the previous sections are administered.

The use of checklists of materials or specific chemicals is common in many hypothesis-testing studies. These usually follow the general questions where subjects are asked to report their jobs, tasks, and exposures. These checklists can be extensive and cover not only specific *a priori* hypotheses but also other common exposures. Thus, 17 categories of materials, branching out to 42 potential neurotoxic exposures, have been included in a study on Alzheimer's disease.[5] A checklist of 26 substances has been used in a study of hepatocellular carcinoma.[11] Ten categories of materials have been included in a study on leukemia and parental occupation,[12] while 11 substances have been part of the checklist in a study on nasal cancer.[13]

Recognizing the fact that subjects' knowledge about their exposure to most specific chemicals (other than general categories such as paint or wood) was certainly deficient has led researchers to develop more detailed exposure-specific questionnaires. Moving beyond the simple checklist concept, researchers have formulated a set of specific questions dealing with exposure to nine known or suspected lung carcinogens: asbestos, glass wool, mineral oils, chromium, nickel, arsenic, beryllium, vinyl chloride, and chloro- and bis(chloromethyl) ether.[14] For each substance, subjects were asked whether they had worked in particular industrial sectors or professions, doing any of a number of tasks known to involve potential exposure.

In a French study on nasal cancer,[15] 616 subjects (207 cases, 409 controls) were interviewed, either at the hospital or at home, using a specific questionnaire developed by the authors of this paper. This questionnaire was administered immediately after a general questionnaire similar to the one used in Montreal. Its aim was to maximize information about potential exposure to wood dust, formaldehyde, paints, adhesives, leather, chromium, and nickel, which are the main etiologic agents considered. (See Appendix C for an outline of the questionnaire.) Subjects were asked whether they had worked with any of the materials, products, or substances enumerated or whether they had been close to other persons who had used them. Eleven groups of materials followed, each opening up into a listing of specific substances, including trade names and open-ended questions. Formaldehyde is an example of a substance that can be found in a large number of occupations without the specific knowledge of workers. Situations involving potential exposure to this product can best be assessed by inquiring about the presence or use of specific source materials. Thus, a variety of questions were included dealing with the use of: wood products (pressed wood, plywood); formol; formalin; paraformaldehyde; trioxane; certain types of wood varnishes or varnishes for electrical appliances; certain types of wood or paper adhesives; biocides or fumigants; specific types of

resins, plastics, or foams; combustion products of wood and coal; and the manufacture of a series of industrial chemicals. Sections of the questionnaire dealing with some of these materials were used to inquire about other substances of interest such as wood dust (various types of wood), glues or adhesives in general, paints and varnishes, and chromium in certain paints. Other sections were developed specifically for exposure to chromium and nickel. For each positive answer, subjects were asked the calendar periods of exposure, the frequency (numbers of days per week, month, year), and daily duration (number of minutes or hours per day) of use. Since exposure assessment was performed according to a method taking into account the "dose" of exposure,[2] this feature of the questionnaire was found to be extremely informative.

## Discussion

In this paper, occupational questionnaires used in community-based case–control studies have been presented for convenience by classifying questions into three categories: general, occupation-specific, and exposure-specific. The development of a questionnaire for a specific study involves selecting a suitable arrangement among these three categories of questions.

In hypothesis-generating studies, the objective is to have the most detailed description of work practices that can best be translated into a wide array of potential exposures. In Montreal, the use of an extensive, open-ended general questionnaire, preceded by a short prequestionnaire including a checklist of common materials and complemented by occupation-specific questionnaires, was found to yield extensive information for interpretation by our team of chemists and hygienists. The average length of interview, including both occupational information and information on confounders (age, socioeconomic status, diet, etc.), was one hour and ten minutes, with one hour being devoted to the occupational part.

In most hypothesis-testing studies, exposure-specific questions or questionnaires have been used. Questions may be direct: "Have you used or been exposed to substance X" (under study) or indirect: "Have you used or been exposed to substances A, B, C ...." (which will be interpreted as meaning potential exposure to substance X under study). The latter indirect questions should be favored whenever the exposure under study cannot be assessed directly by subjects, which is the case for the majority of substances except the common materials. It involves, however, an *a priori* assessment of the various sources of the compound.

In the French nasal cancer study,[15] the use of two questionnaires, one being an extensive, task-oriented, general questionnaire and the other one an exposure-specific questionnaire, allowed the hygienists in charge of exposure assessment to use two complementary sources of information. This two-part questionnaire was well accepted by interviewers and subjects. The average interview length was approximately one hour, including nonoccupational questions. In only one case was the interview judged too long by a subject and stopped. The presence of a complete general questionnaire has the additional advantage of allowing other hypotheses to be tested in the future.

Another strategy, less common in hypothesis-testing studies, has been the use of occupation-specific questionnaires that are aimed at the main occupations where at least one of the exposures under study may be found. This strategy has the advantage of shortening interview time by focusing additional questions only on a selected subgroup of subjects. It does require, however, a thorough *a priori* assessment of job–exposure associations and could lead to the necessity of developing a multiplicity of questionnaires if the substances under study are numerous and varied in their pattern of use. Furthermore, the use of several such questionnaires, which is viable in interviews, would become cumbersome in studies relying on self-administered questionnaires.

In either exposure- or occupation-specific oriented questions, a major problem exists which concerns validity of subjects' answers to questions concerning their past or even present exposures. Few data exist on the validity of self-reported exposures in community studies. Correlation coefficients have been reported between exposure scores based on the number of self-reported exposures from a checklist of 42 materials and such scores derived by industrial hygienists.[8] No data were reported, however, on the validity of individual exposures.

In principle, errors could be due to: 1) subjects not recalling that a given exposure had occurred in the past; 2) subjects not knowing to what they were exposed; and 3) cases exaggerating and referents underestimating their exposure. This last point has been discussed[16] and means proposed to evaluate the importance of recall bias. It was also recommended to include various extraneous matters in the interview in addition to the specific exposure(s) under study.

Various procedures can be adopted to optimize validity: 1) conduct face-to-face interviews with trained interviewers rather than self-administered questionnaires, thus allowing more probing of the subject's answers and an evaluation of the subject's reliability; 2) precede questions on specific exposures with a full, general occupational history questionnaire, thus allowing verification of the validity of self-reported exposures; 3) develop specific questionnaires favoring indirect questions when exposure is to chemicals other than common materials; and 4) have professionals (e.g., industrial hygienists) take a leading role in the development and interpretation of questionnaires. It is hoped too that, with the current implementation of hazard communication and right-to-know legislation for the workplace, more precise and valid answers will be obtained from questionnaires in future studies.

## Conclusions and Recommendations

Recent years have seen a refinement of the occupational

questionnaires used in community-based studies. A variety of specialized questionnaires have been developed and used in conjunction with the traditional job anamnesis. Our experience with such questionnaires used in the framework of interview-based studies indicates that these questionnaires facilitate the subsequent exposure assessment step considerably without placing unmanageable pressure on subjects or interviewers. It can only be recommended that more specific questionnaires be developed and shared between researchers, helping build a more complete database covering more exposures and occupations. It is further recommended that each questionnaire include a detailed job anamnesis in the form of a precise description of tasks and environment, thus helping in the interpretation of the specific questionnaires and leaving the possibility open for testing other exposures.

The availability of community-based job–exposure matrices, such as the one recently developed by the U.S. National Institute for Occupational Safety and Health,[17] and of industrial hygiene data banks should help in devising better questionnaires in the future by helping to focus on the relevant occupations, industries, tasks, or circumstances associated with a given exposure. In addition, it may be reasonable to think that, with the advent of portable computers, an interviewer may soon be able to administer the relevant questions directly to a subject through interaction with a database or an expert system.

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*Editors note:* Appendices A, B, and C appear on the following two pages.

## APPENDIX A

### General Occupational Questionnaire Used in a Montreal Community-Based Cancer Study

Name, Surname, I.D. Number
Job Number

W 1. You worked at _____
from 19____ to 19____ as a _____
Was this full-time or part-time?
Was there shift work? If yes, what hours?

W 2. Main activity of company or organization?

W 2. a) Probe for other relevant activities or products

W 2. b) If industrial, probe for production process used

W 3. Now I would like to ask some questions about your job and about the type of environment where you worked. How would you describe the place where you usually worked?
(factory or plant; laboratory; vehicle; construction site; warehouse; outdoors; office; restaurant or hotel; other)

W 4. In what department of the company or organization did you work?

W 5. I would like you to describe in detail your specific tasks. Try to describe what you did and how you did it. We are particularly interested in any materials that you manipulated or machines that you used.
(Operation and maintenance of machines, vehicles; loading, unloading containers; cleaning; substances or chemicals used—probe for functions and names)

W 6. Did you ever have to replace someone else?
If yes, how often and what were your tasks?

W 7. What other work was being done around you by other workers?

W 8. Can you describe the (room, office, workshop) where you worked?

W 9. Was there dust or smoke or fumes or gases in the environment where you worked?
If yes, probe for description, source, names.

W 10. Did you work with oils or solvents or acids or detergents?
If yes, probe for functions, names.

W 11. Did your job involve exposure to radiation? (X-rays, microwaves . . .)
If yes, probe for function.

W 12. Did you have to wear any protective equipment while at work?
If yes, what and why?

W 13. Did this job have a bad effect on your physical health?
If yes, why?

W 14. Was there anything you did not like to do?

W 15. How stressful was the job? Did this job make you feel tense or anxious most of the time?
If yes, why?

## APPENDIX B

### Occupation-Specific Questionnaire for Welders Used in a Montreal Community–Based Cancer Study

1. Type of operation

1.1 What kind of operation did you perform? (often, sometimes)
(gas welding [with torch] or brazing, gas cutting [with torch], electric arc welding, electric arc cutting or gouging, soldering, other)

2. For all types

2.1 What kind of metal did you assemble or cut?
(stainless steel, ordinary steel, construction steel, galvanized metal [with zinc], lead, copper, aluminum, other)

2.2 Were the metal parts already covered with a primer or paint? (yes, no)
If yes, what kind?

2.3 Did you have to clean up the metal parts before or after the assembly? (yes, no)
If yes, did you use solvents?
If yes, what kind? (mineral spirits, carbon tetrachloride, trichloroethylene, perchloroethylene, other)
Did you use a chemical remover? (yes, no)
If yes, what kind? (caustic solution, acid)

2.4 Did you have to polish or grind parts with abrasives before or after? (yes, no)
If yes, what kind of abrasives?

3. For gas welding or brazing or gas cutting

3.1 What kind of fuel gas was used?
(acetylene, propane, hydrogen, natural gas, other)

3.2 Did you use filler metal rods? (yes, no)
If yes, what kind of filler metal was used:
(tin–lead solder, bronze, silver, brass, copper, other)

3.3 Did you use fluxes for gas welding or brazing? (often, sometimes)
If yes, what kind?

4. For electric arc welders or cutters

4.1 What arc welding process did you use? (often, sometimes) (ordinary arc welding, inert gas arc welding)

4.2 If you used an inert gas, what kind was it?
(helium, argon, carbon dioxide)

4.3 What kind of electrodes did you use most often? (code numbers if possible)

4.4 Did you use fluxes? (yes, no)
If yes, what kind?

4.5 Were you exposed to exhaust fumes from engines used to generate electricity? (yes, no)

5. For solderers

5.1 What type of soldering iron did you use?
(electric, other)

5.2 What kind of solder metal was applied?

5.3 Did you use resins or fluxes? (yes, no)
If yes, what kind?

## APPENDIX C

### Exposure-Specific Questionnaire Used in the French Community-Based Nasal Cancer Study

Have you worked with one of the materials, products, or substances listed, or have you been close to other persons who used them? For each item indicate: what company or job or period; what frequency (days per week or month); what duration (hours per day).

1. Wood or wood products resulting in the production of dust (e.g., sawing, planing, polishing).
   If yes, what kind of wood?
   (checklist of 12 varieties of wood, including softwoods, hardwoods, tropical species, various composite wood products, others)
2. Formol, formaldehyde, formalin, paraformaldehyde, trioxane, or products containing these.
   If yes, name and use of product:
3. Paints, varnishes, lacquers.
   If yes, what kind and applied on what materials?
   (wooden floor varnishes [list of trade names], airplane primers, lacquers for transformers and electrical motors)
4. Glues and adhesives.
   If yes, what kind and applied on what materials?
   (checklist of various glues possibly containing or releasing formaldehyde)
5. Leather and products for treating or tanning leather.
   If yes, what kind of leather and what products?
   (checklist of tanning processes: chromium, yellow or green; tannin; formalin)
6. Dyes or pigments.
   If yes, what products on what material?
   (checklist of dyes, pigments or materials related to chromium or formaldehyde)
7. Disinfectants, biocides, fumigants.
   If yes, what usage, what names?
   (checklist of materials on which formaldehyde may be applied)
8. Artificial resins, plastics products or synthetic foams.
   If yes, what kinds, for what usage?
   (checklist of resins, plastics, foams containing or releasing formaldehyde)
9. Metals or alloys resulting in the production of dusts or fumes (foundries, welding, brushing, polishing . . .).
   If yes, what sort of metal, what operation, for the production of what material?
   (checklist of metals and alloys containing chromium and/or nickel)
10. Have you been exposed to combustion fumes or smoke:
    If yes, what were the materials? (wood, cooking, coal)
11. Have you been involved in the manufacturing or the use of the following products?
    (checklist of 15 products related to formaldehyde, nickel, or chromium).