

How to measure trends in the work environment—a workshop at the international NAM-NIVA Summer School 2007

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The workshop aimed at improving the quality of surveillance data to make analyses such as trends in the work environment possible. It focused on interview-based measurements on a national level at several points in time. Issues and perspectives such as the organizational context of surveillance, social indicators, questionnaire design, and surveillance programs were presented. The impact of a political, administrative, and scientific context on surveillance was considered very important. Data on the work environment are also social indicators and are thus a supplement to economic indicators. It was agreed that a social indicator should be responsive to policy interventions but not subject to manipulation. The wording of interview questions should be unambiguous and precise. Finally, the Danish Work Environment Cohort Study was described. It was concluded that the surveillance community could benefit from agreed principles from the social indicator community; data quality affects data analyses; built-in cohorts make it possible to determine the predictive validity; and surveillance programs with representative data on the work environment and data on occupation make analyses of trends in the work environment possible.

Key terms epidemiology; quality; surveillance; validity.

The aim of the workshop “How to Measure Trends in the Work Environment” held at the NAM-NIVA Summer School in 2007 was to improve the quality of surveillance data in order to make analyses, such as determining trends in the work environment, possible. The workshop focused on interview-based measurements of the work environment on a national level at several points in time.

The three presentations in the workshop dealt with different perspectives of surveillance. In the first presentation, Niels Ploug discussed the social indicator approach (1) in which surveillance of the work environment can be considered a part. In another presentation, by Hermann Burr, quality issues of interview and questionnaire studies were discussed (2, 3). In a third presentation—also by Burr—the Danish Work Environment Cohort Study was described as an example of a surveillance program (4). At the end of that presentation, an analysis was presented of trends in the work environment.

A few references to existing literature were given in all of the presentations. The references were chosen

so that the audience could look further into the various themes covered, giving priority to either the latest or the most illustrative papers within the field.

Contextual issues regarding surveillance

The aim of the introductory presentation was to discuss contextual issues regarding surveillance. In the introduction to the workshop, some general issues were discussed. These were first the political, administrative, and scientific contexts of surveillance, second, direct and indirect measures of the work environment, and, third, indicators of the work environment not based on interviews.

Regarding the context of surveillance, it was stressed that surveillance systems would be more successful if the state and social partners were interested in their data. In addition, the organization of surveillance systems

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is important because it affects the decision process behind the systems, the skill of those who conduct surveillance, and how data are used. In some countries, surveillance data are collected by national statistical bureaus, such as Statistics Canada or Statistics Sweden, and, in other countries, research institutes such as the national institutes of occupational health in Norway and Finland, or independent institutions such as TNO in the Netherlands handle this job. In some countries, for example, occupational health researchers can decide independently what data are relevant, while, in other countries, they are consulted by the organization carrying out the research. Diverse national contexts of surveillance programs—and diverse types of organizing programs—make international coordination of questionnaires difficult or even impossible.

The work environment in a country can be surveyed directly, by measuring occupational exposures (by means of, for example, workplace exposure measurements, observation, or questionnaires), or indirectly, by monitoring morbidity and mortality. There has been a shift in occupational exposure surveillance from prioritizing the surveillance of chemical or thermal exposures and noise and vibration towards prioritizing psychosocial work conditions, work postures, and physical activity. Surveillance has thus become even more multidisciplinary than before. This shift can partly be considered to be a result of automation, computerization, and also globalization, leading to an export of industrial workplaces to newly industrialized countries (5). Many western countries have therefore been labeled service—or even postindustrial—societies (6). Moreover, health data can be regarded as an indicator of the work environment (7). For example, an excess risk of Parkinson's disease among agricultural workers has been found to be related to the work environment within this group (8). Another example is that Finnish and Danish studies have found that occupation explains around 20% of the stroke mortality and morbidity of working populations (9, 10).

The workshop did not discuss other types of data in detail, for example, register data, workplace measurements, or observations. It should be noted that even if measurement data might yield a precise measure of exposures for specific work processes or points in time, it is often difficult to estimate the exposure of individual workers, as exposure often varies over time, not only because workers carry out several tasks, but also because exposure may vary within specific worktasks (11). As already mentioned, health data can be used for surveillance. Such health data can be extracted by linking registers containing information on mortality or morbidity, such as hospitalizations (7, 10), with register data on occupation or industry. As all other types of data, register data should only be used if they are relevant and of sufficient quality.

Social indicators

The aim of this presentation on social indicators was to ensure that the surveillance community can be inspired by experiences from the social indicator community. A social indicator (1) is a measure of social conditions in a country, such as employment, poverty, health, or work conditions. The notion of a social indicator dates back to the 1960s when researchers and decision makers found that social indicators could yield a more comprehensive picture of conditions in a welfare state than economic indicators do. Since the Second World War, decision makers have used economic indicators increasingly as a basis for policy making. As a supplement, surveillance programs were set up in many countries in order to collect social indicator data on issues such as poverty or social inclusion. A famous national example is the Swedish standard of living surveys (12).

However, the original expectations of creating such surveillance systems were not met, for several reasons. First, it turned out that it was impossible to implement the original idea of creating a system of uniform social accounts for the entire world. It fell victim to the heterogeneity of the social reality in different countries. Second, it was not easy to combine various measures of social indicators into one single scale or measure. For example, usually it does not make sense to put such questions together, such as “not voting” and “not having running water”. Third, researchers were facing data-collection problems. For example, there was no consensus as to what the observation unit should be (eg, persons or households). Fourth, there were measurement problems, both regarding misclassification and time trends. Fifth, researchers also faced the omnibus problem. An omnibus is a group of people who take part in several interviews over a short period of time—in order to reduce data-collection costs. The problem is that people interviewed often change their minds regarding the issues they are asked about when compared with the population they are drawn from.

During the 1990s, researchers within the field agreed upon some principles of indicator construction (1). The first principle was that a good indicator should identify the essence of the problem to be measured and that there existed a clear and accepted normative interpretation. Second, the indicator—or rather the question measuring the indicator—should be robust and statistically validated. Third, the indicator should be responsive to policy interventions but not subject to manipulation. For example, during the 1980s, Britain changed its definition of unemployment several times a year, making comparisons over time impossible. Fourth, indicators should be comparable across countries. Fifth, measurement should not impose too heavy a burden with respect to finance and manpower. Sixth, the portfolio of indicators should

also be considered. Indicators should be balanced across different dimensions and be transparent and accessible. One should be aware of gender mainstreaming. Seventh, the measurement unit, such as individual persons, the household, or the family unit, should be determined. Finally, the organization collecting such data should build up a statistical capacity, not only for making analyses of sufficient quality, but also for determining the whole data-collection system that is necessary.

Quality

The aim of this presentation was to demonstrate that data quality affects data analyses. The specific topics were questionnaire design, face validity, and predictive validity.

Proper questionnaire design should—among other things—take data collection methods and the wording of questions into account. When data collection methods are determined, the choice of a telephone interview versus postal questionnaires is not straightforward. Whereas telephone interviews usually yield higher participation rates, few missing answers, and a complex questionnaire structure when they are compared with postal questionnaires, postal questionnaire surveys are often much cheaper, allow respondents to give socially unacceptable answers (13), and entail questions with more response categories than is possible in telephone interviews. For example, answers to telephone interviews with Likert-scale response categories tend to be biased towards answers in the most extreme categories than answers to questionnaires are (13).

Another issue relevant for surveillance studies is the wording of questions in that preferably the questions should be unambiguous, that is, the questions should deal with one dimension at a time. For example, one can look at the measurement of general health. In an in-person interview (a face-to-face interview) with the aim of determining whether people have health problems, the question was “Does your work affect your health?” with the response categories “Yes” or “No” (14). The respondents could then indicate the type of their health problem. What respondents indicate is a mixture of having a health problem and a perception of a possible relation between work and health. Thus judging the observed trend reflected by the responses to that question is not possible. In addition, precision matters. For example, a validation study found that answers to the question, “Is it so noisy that you need to shout to make yourself heard?”, correlated better with measurement data than with answers to the question “Is it noisy at your workplace?” (2, 3). In other words, if one specifies the type

of noise in the question, the question is more valid, and the answers are thus easier to interpret.

One way of looking at the validity of the questions used in surveys would be to look at their face validity. An example of face validity, that is, to see if prevalence patterns are expected, is to analyze whether the aforementioned question (“Does your work affect your health, or not?”) actually measures ill health. In this case, 43% of all of those self-employed reported health problems, whereas only 34% of the employees reported health problems (14). Usually, employees would experience more health problems than self-employed people. If this expectation is well founded, the face validity of the question—as a measure of ill health—is low.

Another means of determining validity is to look at predictive validity, that is, if a certain measure predicts expected outcomes. Using data from the Danish Work Environment Cohort Study, one study found that employment in occupations with a high prevalence of violence or threats of violence was related to an elevated incidence of hospitalization with depression and affective disorders (15). In addition, it was found that being subjected to nasty teasing predicted self-reported poor mental health 5 years later (16). Therefore, when a study is able to find expected associations, it indicates that the variables have a high predictive validity.

An example of an existing surveillance system

The aim of this presentation was to illustrate the design of a specific surveillance program, The Danish Work Environment Cohort Study, with built-in cross-sections and cohorts that allowed analyses of, for example, trends in the work environment. This study had the following two purposes: surveillance and etiology. In that context, surveillance was the monitoring of the prevalence of occupational risk factors and the prevalence and incidence of health symptoms—etiology was, in this case, the estimation of changes in outcomes such as health and labormarket status as possible consequences of occupational risk factors.

The study used a split-panel design (4). In 2005 and 1990, panels consisting of simple random samples were drawn from the central population register and consisted of people aged 18–59 years (figure 1, bars 1 and 8). Six additional panels were drawn in order to adjust for the ageing of the 1990-panel and immigration since 1990 (figure 1, bars 2–6). Three age panels were based on random samples drawn in 1995, 2000, and 2005, consisting of people who were 18–22 years of age. Three immigration panels were based on samples drawn in 1995, 2000, and 2005 consisting of people who did not live in Denmark exactly 5 years previously. The

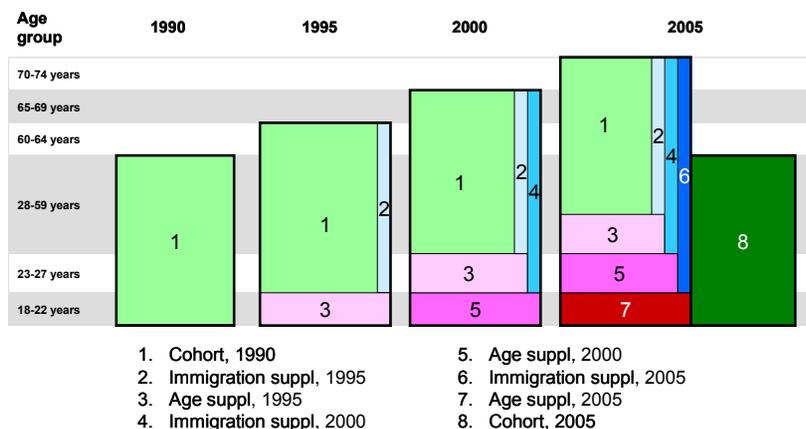


Figure 1. The split sample design of the Danish Work Environment Cohort Study.

people in all of the panels were contacted again in later rounds, irrespective of participation in previous rounds. The combined 2005 participating population consisted of 12 413 people, the participation rate being 63%. In former rounds, the participation rates ranged from 90% to 75%. Currently, the study contains cross-sections (four representative samples from 1990 to 2005) and cohorts (three 5-year cohorts, two 10-year cohorts, and one 15-year cohort).

In some of the analyses, data on weekly social transfer payments [Danish Register on the Estimation of Transitions in and out of the Labor Market (DREAM)] or data on hospitalization from the national in-patient register have been linked on an individual level to all respondents in the Danish Work Environment Cohort Study.

The cohort contains about 1100 variables covering occupational exposures (psychosocial, chemical, physical, and thermal exposures, work postures, and heavy work), health (dyspnea, skin symptoms, musculoskeletal complaints, self-rated health, vitality, mental health), and other variables, including job, industry, smoking habits, body mass index, occupational accidents, and labor market status.

The study is being carried out by the National Centre for the Working Environment (NRCWE), formerly called the Danish National Institute of Occupational Health). The setting in a research organization has ensured the statistical and epidemiologic capacity for making prospective studies possible. Detailed surveillance data have been used for setting up priorities and making evaluations by the social partners. This approach can be considered to be a result of the fact that NRCWE is part of the Danish occupational health system. The funding of the Danish Work Environment Cohort Study has changed from ad hoc in the first three rounds, to part of the Institute's regular work environment surveillance program, set up in 2004.

The data collection method was mainly telephone interviews from 1990 to 2000, and, in 2005, mainly

postal questionnaires were used. In 2005, people were randomly selected to fill out questionnaires, as well as undergo telephone interviews, making possible analyses of data-collection effects. Data on a few demographic variables have been extracted from the central population register.

The Danish Work Environment Cohort Study has made possible follow-up studies of the relationship between the work environment at baseline and subsequent changes in health—such as self-rated general health (17), fatigue (18), severe depressive symptoms (19), circulatory disease (20), and smoking habits (21), as well as labor market status (22–25). In addition, data have been used to generate exposure matrices (14, 26, 27). Surveillance data on prevalences in occupations, industries, and age groups and according to gender have been disseminated in reports, pamphlets, and on the Internet (28).

At the end of the presentation of the Danish Work Environment Cohort Study at the workshop, an example of a trend analysis based on the cohort was presented (29). The aim was to describe work-environment trends from 1990 to 2000 among employees in Denmark and to establish whether possible trends were attributable to changes in the labor force. Three cross-sections of 6067–5404 employees, aged 18–59 years, each being representative of the total Danish employee labor force in 1990, 1995 and 2000, were analyzed. Stepwise logistic regression analyses were carried out in which each work-environment exposure was the independent variable. In the analyses, only calendar year was included in the first step. In the second step, occupation was entered to determine whether the estimates for calendar year changed. Some occupations, such as clerks, cleaners, textile workers, and military personnel, had a decreasing prevalence, while other occupations, such as academics, computer professionals, and managers, had an increasing prevalence. Intensive computer use, long work hours, and noise exposure increased. Job insecurity, part-time work, kneeling work posture, low job control,

and skin contact with cleaning agents decreased. Labor-force changes (ie, changes in the number of employees in occupations) fully explained the declines in low job control, as well as skin contact to cleaning agents, and half of the increase in long workhours, but not the other work-environment trends. What is needed for doing such analyses of other datasets is that these datasets contain representative cross-sections from two or more years and—apart from data on the work environment—data on occupation or industry.

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