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Combining quantitative and qualitative approaches in occupational health for a better understanding of the impact of work-related disorders

by Donna Mergler¹

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Over the past years, the work situation has experienced important transformations, notably, the technological revolution and globalization, the influx of women into the labor market, an increased dependence on chemical substances, and a transfer of production and many hazardous procedures from North to South. These changes have important repercussions on the nature and type of occupational exposures, as well as on the labor force, affecting the relation between work and health. While quantitative studies have dominated occupational health research over the past half century, qualitative methods can serve to ground quantitative data with regard to defining the research questions, providing further information on the impact of work conditions on health and well-being, and reducing errors in exposure and health outcomes. Combining qualitative and quantitative methods in a complementary fashion can lead to a better understanding of the rapidly changing work environment and labor situation and a means for developing appropriate strategies for preventive intervention.

Key terms chemical exposures, families, globalization, well-being, women, work distribution.

The ultimate objective of all our studies in occupational health is to ensure that the work environment does not engender health problems. Through our studies, we attempt to identify work conditions that affect human health and well-being with a view to reducing or preventing work-related disorders. Over the last 30 years, research in occupational health increased almost 10-fold. A medline search using the key word "occupational health" showed that, while there were 1410 articles published in the 5-year period from 1968 to 1972, between 1992 and 1997 this number rose to 12 524. This increased research activity was paralleled by growing awareness of occupational health and safety issues and important changes in workplace conditions. Many countries revised their occupational health and safety legislation and implemented more stringent permissible exposure levels and better mechanisms of control.

However, over the years, there have been important changes in the work situation, including (i) the technological revolution and globalization, (ii) the influx of women into the labor market, (iii) an increased dependence on chemical substances, and (iv) a transfer of production and many hazardous procedures from north to

south. This changing situation has important repercussions on the nature and type of occupational exposures, as well as on the labor force, affecting the relation between work and health and the approaches we use to study them.

The technological revolution and trend towards globalization have brought important changes in work distribution and organization, increasing production levels, while decreasing personnel. Christophe Dejours provides a timely description of some of the changes that have occurred in industrialized countries over the past few years (1). In 1973, he and his research group conducted a study of workers in a major automobile manufacturing company. In 1994, they were asked by this same company to reassess the workers' environment and health. They found that work was being done on a very similar assembly line. Although the plant was better organized, with less disorder, cleaner, and much less noisy, there were far fewer workers. While during their first study there had been 17 000 workers, 20 years later, there were less than 6000 and production had considerably increased. Still wearing band-aids around their fingers to stop the bleeding, the workers described the number of

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tasks that they carried out in less than a minute. The jobs required such a high level of attention and concentration that they could never raise their heads, not even when there was a shout or an abnormal noise. Dejours, a psychiatrist, whose research focuses on work psychopathology, describes the psychological defense mechanisms that are brought into play, both for the workers, who are experiencing these changes, and the executives, who are applying them.

On the second point, women also pose a challenge for occupational health research. The proportion of women in the work force has grown, but, in spite of their numbers, women have been conspicuously absent from many studies in occupational health. Excluded in order to maintain homogeneous groups or because they are too complicated to study due to pregnancies and menstrual cycles or because researchers believe that their work conditions are not dangerous to their health, the work-relatedness of women's health problems remains largely unknown. In a recently published book on occupational health and female workers, entitled *One-Eyed Science* (2), Karen Messing demonstrates that work conditions in jobs occupied primarily by women are different from those occupied primarily by men and, since methods in occupational health research have been developed for studying the work conditions and constraints found in men's occupations, women's occupational health problems may be largely underestimated.

Third, the use of chemical substances has become more and more widespread in workplaces and in agriculture. New chemicals or chemical mixtures are continually introduced into the work environment. Our capacity to measure these substances is limited, particularly when several chemicals are present and often changing, as is the case in many workplaces and for agricultural workers. Moreover, we still know relatively little about the effects of chemical exposure on health and well-being, particularly with respect to long-term low-level exposure, and still less about the effects of multiple exposures and different exposure profiles.

Finally, concerning the transfer of production from north to south, we are confronted by major differences in cultures, in climate, in nonoccupational health problems, in the economic, social, and political dynamics, all of which have an impact on the work environment and health (3—6). We should be careful of extrapolating beyond the training set and be able to contextualize methods, results, and practices from industrialized to less industrialized countries and to those with an agriculturally based economy.

The changing work situation worldwide brings to light some of the limitations of traditional indicators of exposure and health. This situation is reflected in the growing activity in new areas of occupational health research, which focus on early indicators of health

changes, psychosocial factors, ergonomic issues, work organization, stress-related problems, premature aging, women's occupational health, and international issues. Although, in recent years, there has been renewed interest in qualitative research, based on observational, interview, and participatory techniques, developed primarily in the social sciences and ergonomics, occupational health researchers are hesitant to apply it or, when we do, to write about it. Needleman & Needleman (7) aptly point out that, in occupational health, quantitative methods have been emphasized far more than other research strategies, with the result that scientists feel they are on uncertain ground when faced with the challenge of developing qualitative insight.

Combining qualitative and quantitative methodologies may be particularly relevant to understanding the new work situations, their impact on human health and well-being and developing adequate preventive intervention strategies. It is interesting that, at the turn of the century, Alice Hamilton's descriptions of workplace conditions and the effects on workers' health and well-being include vivid accounts of the work environment, with quotes from workers' on their perceptions, symptoms, and how their lives were affected by their work, as well as quantitative analyses of work-related disorders (8). Since Hamilton's time, in occupational health studies, quantitative methodologies have dominated the scientific literature and eclipsed more qualitative approaches. Under the guise of presenting "objective measurements" as opposed to "subjective appraisals", quantitative studies have become a synonym for accuracy, while qualitative studies are considered fraught with bias. Once complex situations or experts' opinions have been reduced to numbers, the numbers take on their own existence as an accurate representation of reality.

Negative or positive feedback?

Most important, the numbers generated by occupational health studies constitute the basis for intervention or non-intervention in workplaces and the recognition of work-related problems, which can be exemplified by a negative feedback model. Once a relation between work conditions and health is demonstrated, it can serve to trigger action on a local, industrywide, countrywide, or even international level, through direct changes in work conditions, the establishment of new normative regulation or the recognition of work-related illness or death. These actions serve to improve work conditions and thereby decrease the rate of work-related health problems.

However, if the "quantitative" measures of exposure or health outcomes are inaccurate or incomplete or do

not represent the changing work situation, then errors are introduced. Indeed, in an article on the principles of exposure measurement in epidemiology, Armstrong and his colleagues (9) point out that standard statistical analysis is usually based on the assumption that the explanatory variables are known with or without little error, and it has long been realized that departures from this assumption will, in most instances, lead to an underestimation of the true regression coefficients and of other measures of association and will thereby weaken these measures of association. This error is probably compounded when new exposure parameters are faced for which we have limited knowledge.

The consequences of these errors are important for research and intervention, giving rise to the positive feedback situation. If we do not adequately establish the relation between work conditions and health problems, then the health problems are attributed to other factors, such as individual problems, gender, or race. It thus follows that these particular work conditions are not dangerous and since they are not dangerous, there is no need to study them and so the risk factors are not demonstrated. If the risk factors are not demonstrated, there are no work-related problems. This vicious circle is also true for intervention, if the health problems are erroneously attributed to factors other than the workplace, intervention is not focused on the workplace but on individual treatment.

Qualitative approaches may help to reduce error, both for the explanatory variables and health outcomes, and be particularly useful for orienting preventive intervention strategies. There is a good review of methodological techniques used in qualitative research within the context of occupational health studies, by Needleman & Needleman (7), who examine sampling strategies, such as the use of key informants and selected focus groups, data collection through interview instruments, observations and critical appraisal of documents, and data analysis in the form of a narrative text. Qualitative methods such as these can serve to contextualize quantitative data providing means of cross-validation and what is termed by social scientists as triangulation, that is, the use of different approaches, be they conceptual, methodological or data collecting, to study the same problem in order to optimize the understanding of underlying mechanisms, work activity and environment, relationships, and solutions (10, 11).

In occupational health studies, qualitative techniques are part of participatory action research methodologies, which seek to integrate workers' knowledge of the workplace to understand and improve the work situation (12—15). The French ergonomic approach provides an interesting model for integrating workers into occupational health studies when defining the workplace problem and proposing appropriate solutions (16, 17). Contrary to the preconceived pattern of testing a researcher's hypothesis

in the workplace, this approach uses the workers' appreciation of their health and work conditions to formulate a research project, which takes into account the work process and focuses on the worker, adapting the work to the worker rather than the worker to work. Based on the global analysis of real-life work situations and the utilization of worker's knowledge, it integrates physical and social components of the environment and an analysis of work.

Using examples of studies from our research group and others, I would like to illustrate how qualitative data can serve to ground quantitative studies with regard to defining the problem, understanding the exposure parameters, appreciating the impact of exposure and its effects on health and well-being, and orienting effective preventive strategies.

Defining the problem

Qualitative approaches use purposive sampling rather than randomized strategies. They rely on key persons singly or collectively to provide rich descriptions of the situation as they see and experience it. These key informants or focus groups can be useful in helping to define the research problem. In occupational health studies, these persons can be members of occupational health committees, workers from a particular department, managers, shop stewards, or others, depending upon the situation. This technique has proved particularly successful in defining research questions in our studies of neurotoxic exposures. We first applied it in a study in the early 1980s, in which an initial focus group, composed of members of an occupational health and safety committee in an explosives plant, discussed various possible health outcomes with the researchers. The workers indicated that they would focus the study on what was happening to them now, rather than on whether they would eventually develop illnesses, a possibility being proposed as the scientific epidemiologic methodology (18). They felt that exposure to diethyl ether was affecting their present health and social life, although they were still capable of work. Their opinion was strengthened during meetings with the staff from the public health Centre for Local Community Services, who told us that many workers from that particular plant were requesting consultations because of sexual difficulties. The qualitative information gleaned from systematic discussions with the workers and health professionals was translated into a research question on the relation between exposure to diethyl ether and early indicators of nervous system dysfunction. The results of the study, which showed dose-effect relations between exposure and symptom reporting (19) and certain neurobehavioral deficits (20), were used to reduce exposure levels and to initiate new research questions on early indicators of neurotoxicity.

Understanding exposure parameters

A case in point is the way in which occupational health research, and, on a larger scale, public health research use gender, race, and ethnicity as explanatory variables, a practice which is currently being questioned (21–23). In the occupational health setting, gender, race, and ethnicity often reflect different work conditions, which go unnoticed, particularly when the same job title is used, or exposure is grouped into broad-based categories. As explanatory variables for health outcomes, without adequate evidence for the biological feasibility of these differences, gender, race, and ethnicity may mask the relation between work and health outcomes.

For example, in a study of poultry slaughterhouse workers that we did some years ago (24), women reported significantly more symptoms than men, specifically for musculoskeletal disorders and psychological distress. The relative risk for women reporting these problems was approximately 2-fold. We could have stopped there. However, qualitative information about this workplace, obtained through interviews, observations, and questionnaire data, revealed that, for the most part, men and women did not do similar tasks, although they had the same job title. There was, however, a part of the work process in which men and women were doing similar work, and in this subgroup of men and women with similar tasks, no gender differences were observed for these health outcomes. At the conference at which this paper was presented, Susan Burt presented results along similar lines. She reanalyzed data on hand-wrist musculoskeletal disorders from studies of newspaper workers and showed that the odds ratio for the explanatory variable “female gender” decreased substantially when gender groups were better balanced and when factors correlated with gender were taken into account.

Along the same lines, in a recent publication, Messing and her colleagues (25) examined the use of gender as a variable in a major study of sickness absence among French workers in the food processing industry. They showed that, because of differences in work conditions, determinants for sickness absence were not necessarily the same for men and women, when analyzed separately. Furthermore, when analyses were performed with men and women together, including gender as an explanatory variable, many relationships for both genders disappeared. The authors suggest that gender as a variable can be a surrogate for some work conditions.

Referring to the positive feedback model already described, the consequences of not accurately establishing the relations between women’s work conditions and their health relegate the problems to “being a woman”. Indeed some authors claim that women have a propensity for musculoskeletal, hysterical, or fashionable illnesses (26), while others suggest that this “propensity” may reflect different work conditions (2, 27). This dilemma is

exacerbated by the fact that the methods that have been developed for studying the relation between exposure and health in workplaces where the labor force consists mainly of men may be inadequate for studying many of the workplaces in which women are in the majority (2, 28).

It is interesting that many of the studies on women’s work and health have been done by social scientists using qualitative approaches. Interdisciplinary teams, combining these qualitative and quantitative approaches, may provide the means of developing new tools to examine women’s work conditions and their effects on health and well-being.

In a completely different area, Moir & Bucholz (14), describing the Construction Occupational Health Project of the Work Environment Department at the University of Massachusetts — Lowell, suggested that a participatory research methodology, which combines qualitative and quantitative approaches, is not just appropriate, but is perhaps the only effective method for ergonomic studies in this industry due to the social and economic dynamics of this industry and to the extreme variability of ergonomic exposures. This statement may be true not only for ergonomic exposures, but for many complex exposures.

Health effects

Qualitative approaches may also be useful for appreciating the impact of poor work conditions on health and well-being. Explicitly or implicitly, many studies use a model of health deterioration in relation to occupational hazards on a continuum, in which biological changes and early symptoms constitute the first stages of a continuum towards preclinical signs and symptoms and clinically defined illnesses. The rapidity with which one moves from well-being to illness depends upon exposure parameters, individual factors, and genetic susceptibility.

Illness and death are examined using dichotomous variables: one is ill or not ill, one is dead or not dead, and the definition and diagnosis of illness and cause of death are of utmost importance for accurate classification. Studies that focus on early indicators of adverse workplace effects, for the most part, use measures on a continuous scale of physiological, biochemical, or psychological dysfunction, which is examined with respect to exposure parameters.

Although there is agreement that illness and death are unwanted outcomes, there is much controversy as to the meaning of early indicators of change in biological functioning. With the development of more and more sensitive tools, changes in biological parameters can be assessed in the absence of manifest illness. Early indicators may reflect a new steady-state situation, with little

impact on health or well-being. They may also be predictive of an increased risk for future illness. Indeed, many scientists consider that the only interest in early indicators is in terms of their predictive value for specific illnesses or death. Early indicators may also be predictive of premature aging. Finally, early indicators of physiological and psychological changes may also reflect diminishing well-being, a concept which is much harder to define, particularly with numbers. It is this latter aspect that I would like to examine more in detail with respect to how qualitative analysis may be useful in understanding the impact of health deterioration in the absence of clinically diagnosed illness.

At the cost of being labeled a "heretic", I would like to illustrate diminishing well-being with a poem, written by a woman who worked as an electrician (29):

It's a good thing I'm not macho

by Susan Eisenberg

If the injury had begun more
high pitched —

an open artery
a four story fall —

I would not have hesitated
to see a doctor sooner.

But the action enfolded gently
the pain in my hands
just a little

at first
an easy distraction to ignore;
and the crippling, too, came on
slow paced —

no dramatic moment
spotlighted center stage —
so I merely

made adjustments. When the right wrist
no longer moved as I commanded
I transferred screwdriver and pliers
into my left. When the left
began to refuse as well and
not only wrists, but fingers, too
mocked my commands
I used both hands together

and set my alarm clock earlier
to allow extra time
for lacing boots
and opening the lid on the juice jar

And when, mid-act, my hands dropped character
revealing themselves

swollen and flaccid as warm pudding,
barely recognizable as hands

I pretended not to notice. Critics
will not say this actor faltered.

Maybe if injury were not weakness
and weakness

lower than woman

I would have seen a doctor sooner. . .

I waited
Until pain

screamed fear;

I waited until a moment
before 'too late.'

Every few months, still, pain
gives me short kick

reminding me
the show need not

always go on.

This simple poem describes the loss of well-being; there are no numbers. But it provides a qualitative eloquent description of what persons with musculoskeletal problems endure. Since not everyone can express themselves so poetically, interview techniques can be used to elicit information on the impact of work-related disorders. Catherine Teiger, a French ergonomist using focus groups, individual interviews, and observational techniques, described the many elements involved in piece work, with a high mental and physical work load (30). In these studies, electromyographic techniques served to measure muscle activity at the back of the neck, relating it to the time of day and particular work activities. Through interview techniques and questionnaires, she developed a model for describing the social effects of chronic fatigue. As the level of chronic fatigue increased, the workers' circle of interests decreased. The first elements that dropped were general interests, such as reading books and newspapers, then community activities (attending union or parents' meetings), followed by diminished social life (friends and recreational activities). Finally the family is ignored until there is nothing but work left, and, when one can no longer continue to work, there remains one's self. This diminishing well-being does not show up on occupational health statistics, but clearly affects the exposed persons' well-being.

Our research group has worked extensively on the early effects of exposure to neurotoxic substances, and, like many other researchers, we have documented dose-effect relations with neuropsychological and neurophysiological end points, as well as psychological symptoms, using symptom questionnaires and psychological scales (31, 32). Like other researchers we have reported these findings without questioning their impact, other than in terms of their similarity on a smaller scale to the symptomatology of toxic encephalopathy.

Recently, we undertook an exploratory study to examine whether psychological symptoms had an impact on family life. A total of 55 couples participated. They responded to known, validated questionnaires on mental health and their family life. In addition, they were interviewed by a psychologist and were filmed discussing a point of marital discord and a workplace problem (33). Workplace exposure to neurotoxic substances was rated by an industrial hygienist (34). None of the women were

exposed, while there was a gradient of exposure for the men.

For the men, the Profile of Mood States was significantly associated with exposure. An analysis of the video tapes using an observational grid showed that it was inadequate for describing exposed couples' relationships, which were characterized by the trained observers as asymmetric, with the exposed men manifesting little reaction, while their spouses dominated the discussion. This was reflected in the marital questionnaires, which revealed that, compared with the wives of men with low or medium exposure to neurotoxic substances, the wives of the high exposure husbands seemed to develop strong negative reactions to their husbands. The results of this exploratory study suggest that the effects of neurotoxic exposure do have an impact on family life. However, better tools need to be developed to document this relation. Indeed, a review of the literature showed that very few psychological studies have been performed on communication within working class families.

Orienting preventive strategies

My colleague, Karen Messing, used a modified version of the French ergonomic approach, combining quantitative and qualitative measures, in a study of elementary school teachers and found absences for stress-related health problems were increasing (35). Although the causal relation between being an elementary school teacher and psychological stress has been documented (36), it is not immediately obvious that caring for children for 25 hours a week, with 2 months vacation every year is a stressful job. The objective of the study was to identify the risk factors in this workplace, with a view to identifying the relevant areas for intervention.

The study included physical measures, an analysis of work activity, interviews, and observations to identify the stressful elements of teaching. A 3-stage protocol was adopted which included (i) a preliminary data collection phase, involving individual and collective interviews, (ii) preliminary observations to generate hypotheses and establish a grid for observations of work activity, and (iii) systematic data collection to verify the hypotheses. Contrasting quantitative measurements with qualitative information provided important insight into the stressful components of the teachers' tasks:

- The researchers observed that the teachers spent 100% of the time standing, although it was possible to sit down. A questioning of the teachers revealed that they remained standing because they needed to do a "show" in order to keep the children constantly involved and thus could not sit down.

- The researchers observed that teachers made rapid changes in eye position (3 to 4 seconds in duration), and explanations were short (8 seconds in grade 1 to 14 seconds in grade 6). When questioned about this, the teachers revealed that each action had many thoughts behind it, and many activities are being done simultaneously.
- While measurements showed that the temperature, humidity, and noise were all below the recommended standards as determined for physical damage, teachers associated these parameters with students' loss of concentration, which requires the teachers to improve their "show" and be more vigilant.

The results of the study gave rise to practical recommendations, based on the teachers' real situation, which were discussed by the teachers' union. Many of these recommendations are being incorporated into their current negotiations.

Involving workers, management, and joint occupational health and safety committees in the research process helps to orient effective prevention intervention strategies. Each group in the workplace has their own representation of the workplace, as do occupational health scientists. Mutual understanding of these different visions can help to overcome resistance to change and bring about concrete improvements in work conditions. Using qualitative interview techniques with focus groups of workers and management in 3 reinforced plastics plants, a sociologist from our research group described their different organizational cultures. In parallel, a quantitative, repeated measure of exposure and neurobehavioral outcomes was applied over a 2-year period to determine whether improvement had occurred over this period (37). Combining the results allowed us to identify the behaviors and policies that resulted in workplace changes and improved health.

There are limits and advantages to both qualitative and quantitative methods, and the limits of one are often the advantages of the other. Faced with the rapidly changing work environment, using these approaches in a complementary fashion may help us to define research questions better, reduce errors in exposure and health outcomes, trigger intervention at appropriate times (ie, where possible) prior to the development of illness, and provide relevant information for improving adverse work conditions and practices.

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