Conclusion
The health of female workers: is science still 'one-eyed'?

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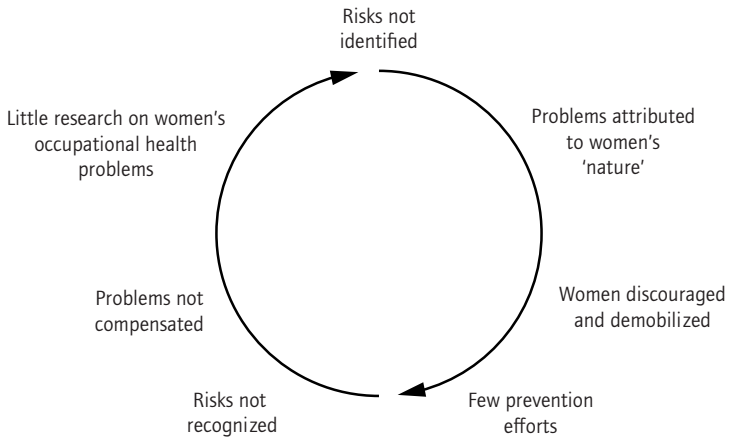
In April 1996, the first international 'Women, Work and Health' conference was held in Barcelona. It was the result of a collaboration between scientists, practitioners and unions, and was an unusual example of fertile interaction among these groups to promote high-quality research on women's occupational health. This paper aims to summarise where the research gaps were in 1996 and show some of the progress that has since been made; fortunately, there has been a lot – too much to cover in a single paper. Due to limitations of both space and competence, I will concentrate on two areas where I have been actively engaged in research: work-related musculoskeletal disorders and the work-family interface. Even within these areas, I have had to leave out many important research results in order to concentrate on a few specific points.

Figure 1 **The vicious circle in women's occupational health, 1996**



By 1996, researchers like Jeanne Stellman, Vilma Hunt and Shelia Zahm had shown that women and the jobs usually done by women were dramatically under-represented in occupational health and safety research. In collaboration with the status of women committees of three Québec trade unions, we were able to show that this lack of knowledge had serious consequences for prevention efforts (Messing 1998). Figure 1 shows the 'vicious circle' affecting women workers as it existed at the time: a lack of knowledge about problems experienced by women led to interpreting women's occupational health

problems as consequences of their biological or psychological 'nature'. One peer-reviewed journal article, for example, referred to health complaints of flight attendants in the following terms: '… some of these girls have become rather anxious'; another suggested that the proportion of women among the victims of workplace air pollution be used as an indicator for determining whether problems were due to 'mass hysteria'. Because of this type of prejudice, women were discouraged from reporting work-related illnesses and found it hard to access workplace health and safety promotion. Their problems remained invisible, cost little to employers and the state, and did not generate the kind of interest that stimulates research, thereby completing the circle. At the beginning of the 21st century, Niedhammer (2000) showed that women were still excluded from occupational health research and that data on women's problems were seldom specifically analysed.

A number of actors were to make that situation evolve over the following fifteen years. The European Trade Union Institute (ETUI), one of the sponsors of the Barcelona conference, produced a number of activities and publications on women's occupational health (see for example Tieves 2011). A group of cancer researchers at the US National Institutes of Health focused on chemical exposures and their consequences and held several conferences on women and occupational cancers, encouraging inclusion of women in occupational cancer research (Hohenadel *et al.* 2015). In 1998, the Swedish government sponsored a programme called 'Women's Health at Work' that stimulated research in both the social and natural sciences. A 1999 'Women, Work and Health' conference in Rio de Janeiro inspired interest in women's jobs in Latin America and research has since developed in several countries (for example, see Ansoleaga *et al.* 2014; Astudillo Cornejo and Ibarra Villanueva 2014). In 2006, the International Ergonomics Association established a Gender and Work Technical Committee, with subcommittees holding regular research and dissemination activities in Europe, North America and Asia. This activity was made visible in three special issues of journals: *Work* (vol. 40, Suppl 1, 2011) presented articles on gender, work schedules and work/family articulation, *Ergonomics* (vol. 55, no. 2, 2012) dealt generally with gender and ergonomic analysis, as did *PISTES* (vol. 18, no. 2, 2016). In 2006, the International Congress of Occupational Health established its Women, Work and Health Scientific Committee, which has also held symposia in various venues.

There have been dissenting voices, however. Concerns have been raised about stimulating occupational health interest specifically in women, women's health problems and women's jobs.

Some objections that have been articulated include:

1. Some feminist scientists have objected to *stereotyping*. Their argument is that treating data on women separately implies that there are important differences between women and men that are relevant to their job performance; such an attitude encourages stereotyping and indirectly encourages discrimination against women workers. It is said that biological and psychological differences between men and women are few and

minor and should not be exaggerated. Both women and men suffer from mental and physical health problems due to their work. According to this argument, we cannot generalise and say that one or the other gender has more problems; women and men need to work together to transform the workplace so that it will be safe for all;

2. Demographers and progressive scientists point out that gender is only one source of *diversity* in the workplace. There are also differences due to age, ethnicity, social class and immigrant status. In fact, every worker's mind and body have a specific interaction with the work task and work environment, depending on the details of workers' anatomy and physiology, their communication styles, family situation, team composition, and other components of the work 'ecosystem'. This argument holds that it would be wrong to single out gender for special treatment to the exclusion of other groupings;
3. Some scientists object to gender analyses on the basis that they are *political* and thus anti-scientific. Their argument: politicising science will not help workers; only objective scientific results will improve the workplace.

These arguments will be discussed below in relation to research on musculoskeletal disorders and work-family articulation.

Stereotyping: why study women separately?

Although it has been known for many years that women and men occupy different niches in the labour market, detailed knowledge of women's and men's exposures is relatively recent. A number of sources supply detail on the different professions and industries where women and men work (http://www.eurofound.europa.eu/surveys/ecs). At the same time, women and men report different frequencies of work-related musculoskeletal disorders and the gender/sex difference also varies by body site (Stock *et al.* 2011; Widanarko *et al.* 2011). Information is also emerging on women's and men's differing career trajectories and the relationship with exposure to health risks (Torgén and Kilbom 2000; Chappert *et al.* 2015). Even after women and men suffer from work-related health problems, and are awarded compensation, their musculoskeletal disorders evolve differently over time (Lederer and Rivard 2014).

Increasingly, studies show gender segregation not only in professions, but also in tasks and exposures within jobs. With regard to musculoskeletal disorders, an Australian group has shown that women do more repetitive work than men with the same job titles in the same companies (Eng *et al.* 2011). Women and men working for the same employers in cleaning and restaurants are exposed to different working postures (Messing *et al.* 2015). Even within the same classification or name of an exposure such as 'repetitive work', 'lifting weights' or 'prolonged standing', men and women are exposed differently: men who lift weights tend to lift heavier weights and the weights women lift tend to be people; women's repetitive work is also more so than that of men (i.e. more movements per minute); women who stand are less able to move around than

men who stand (Vézina and Courville 1990; Messing *et al.* 2015). It is probable that other expressions such as 'sexual harassment' and 'violence at work' also denote different exposures for men and women.

A similar situation exists for variables relating to the work-family interface. Variables like 'night shift', 'possibility of a gradual return to work after parental leave', 'number of children', 'takes care of another person' or 'can take care of personal matters during work time' have a different meaning for women and men, even among those who have responsibility for childcare or eldercare (Messing *et al.* 2009). In addition, in the European context, gender associations with family responsibilities vary widely among countries (Artazcoz *et al.* 2013). Unmeasured exposure variables like precarious employment, short notice of schedule changes or the ability to exchange work schedules can have an important influence on the work-family interface (Scheller 2012).

However, some studies have found relatively few differences between women's and men's exposures. Data on the tasks of male and female house painters in Sweden presented by Heilskov-Hansen *et al.* (2014) suggest that some of the gender differences in the proportion of time allotted to specific tasks could be due to the pronounced age difference between women and men in this profession. Once age was taken into account, no gender differences exceeded 4 per cent of total time. Observations and measurement of postures and movements during the most frequent tasks did not differ by gender. So we cannot presume that tasks and exposures differ by gender in all circumstances.

Sex (biological) differences in response to workplace exposures have so far been little studied, but may be critical in designing both research and prevention. In general, women have been under-studied. Due to sex differences in physiology, the effects of some exposures and their interactions with other exposures may vary for women and men (Côté 2012). Some research has suggested that women in the same physically demanding tasks as men work at a level closer to their physiological limit, with a concomitant increased risk of injury.

Diversity: to treat gender properly is important, but gender is not the only important variable

Unfortunately, many exposure variables whose impact differs by gender are insufficiently described in questionnaires and ergonomic scoring systems. If the parameters of relevant exposures are unknown or cannot be fully specified, more accurate information will be obtained if analyses are stratified (separated) by gender, even where there is no obvious male-female difference in exposure-effect relationships (Messing *et al.* 2009).

Does stratification exaggerate male-female differences and increase stereotyping? The fact of forcing diverse people into only two categories does involve a risk of false dichotomy. Few if any gender or sex differences are

absolute: some men are shorter than most women; many women never have responsibility for childcare; an increasing number of 'non-traditional' professions are welcoming women; the boundaries of sex and gender categories are fluid and some people cannot be readily classed as male or female. Probably, though, there are more advantages than disadvantages to taking gender and sex into account. It has been shown, for example, that women are less likely than men to be able to access compensation for their employment-related injuries (Cox and Lippel 2008). As long as a pronounced imbalance in power, knowledge base and visibility persist between male and female workers, it is most important to make sure that women's problems are studied, and that women's jobs are safe. And as long as the dangers in men's work are considered normal and 'part of the job', it is important to emphasise that gender can also be associated with health risks for men.

Treatment of variables related to sex differences in size, strength, metabolism and pain sensitivity can also pose a problem. Some researchers use a more or less arbitrary factor to 'normalise' their data when including both sexes in their samples. Others have found ways to render some parameters comparable: Chung and Wang (2012) compared women's and men's walking strategies and physiological effects on the basis of 'preferred walking speed' for each individual, rather than 'absolute walking speed', which is dependent on sex-related body dimensions and may differ greatly by sex.

However, gender/sex is not the only sociodemographic descriptor associated with exposure-outcome relationships in occupational health. Many other groups suffer discrimination and under-recognition of their occupational health problems. Low socioeconomic status is associated with some injury-prone working conditions (Falkstedt *et al.* 2014; Goh *et al.* 2015). Immigrant groups are treated differently both in the workplace and by compensation systems (Kosny *et al.* 2015). Age is related both to different likelihoods of exposure and to different effects (Volkoff *et al.* 2010). Stratifying simultaneously for gender (two strata), ethnicity (strata differ by country), immigrant status (at least two strata, more if recent immigration is considered separately), socioeconomic status (at least three strata) and age (several strata) would require enormous populations - impossible with the sample sizes available to researchers.

Many scholars, including feminists, have long reflected on how to consider the combined impacts of different types of inequality (Kergoat 2012). Nancy Krieger (1999), an epidemiologist who has extensively studied health inequalities that are due to racial discrimination, suggests that workers' bodies integrate the effects of multiple social determinants of health. Thus, researchers are advised to measure social constructs like organisational justice, job control or discrimination, in order to capture the health effects of power imbalances in the workplace.

However, sex, age, ethnicity and even social class have physiological and health correlates in addition to their social dimensions. In order to avoid the problem of multiple strata while recognising the challenge posed by diversity; Swedish

researchers have proposed cluster analysis (Härenstam 2009). One way to use cluster analysis is to use mathematical techniques to group data on individuals so that those with similar working conditions are found in the same cluster. Then, clusters can be examined in regard to socioeconomic and health-related variables so as to detect patterns (Leijon *et al.* 2006). In particular, it can be seen that women or men (or people with young children, or low-paid workers, or people with health problems, etc.) are found more often in certain clusters of working conditions. The results of such studies have been used in Sweden to identify clusters of working conditions that should be changed. Unsurprisingly, women and other less-powerful groups are more often found in such clusters. Thus, cluster analysis is a way to make power relationships visible and reduce social inequalities in occupational health (Messing *et al.* 2016).

Political? The scientific advantages of studying gender/sex

Although the efforts to include women in occupational health and safety research have necessarily involved policymakers as well as scientists, science itself has profited from research into sex and gender differences. This is the case because women's biological specificity needs to be included in prevention efforts and also because looking at women's needs sometimes opens the door to ideas for research or scientific strategies that are important for studying both men and women.

Biological specificity

In the area of work-related musculoskeletal disorders, there is a lot of interest in why women report more pain than men. Researchers have only recently noticed that almost all articles published on the mechanisms that process pain have only involved male mice. They were therefore very unhappy when they realised that male and female mice differ enormously in their reactions to pain. Completely different spinal cells are involved, and researchers are now beginning to more fully characterise pain-processing in females and males (Sorge *et al.* 2015). Other researchers have found that the muscles of women and men may be activated differently and may fatigue at different rates and in different ways, explaining to some extent why women appear to have more endurance but also report more pain (Nie *et al.* 2014).

Lifting strategies may reflect biological as well as gender differences between women and men. Researchers in biomechanics at the Robert Sauvé Institute for Research in Occupational Health and Safety in Québec (IRSST) studied lifting by experienced and novice workers in order to prevent musculoskeletal disorders (MSDs). They quickly became aware that their research on male workers could not be applied to women. They found that even experienced women used different lifting techniques when given the same weights as men

(Plamondon *et al.* 2014). These findings have implications for worksite design and training. For example, Céline Chatigny and colleagues, working with unions in Québec, found that lifting techniques taught to workers in non-traditional jobs were inappropriate for most women, given differences in size and body proportions (Couture *et al.* 2005).

In the 1990s, the engineer Angela Tate of Memorial University, Canada, alerted scientists interested in gender and occupational health to bias in biomechanical studies, attributable to the use of male cadavers in developing the biomechanical models. However, her communications did not arouse much interest and there has still been no biomechanics research on the effects of breast size, for example, on lifting techniques associated with back pain.

Why thinking about women is important for learning about men too?

It is still common for researchers studying work-family conflict to adjust for sex and gender, for example by including sex/gender as a 'co-variate' in multivariate analyses (Higgins *et al.* 2014), rather than by studying the many possible interactions among gender, working conditions and health effects (Leineweber *et al.* 2012). This also happens in research on musculoskeletal disorders. In some circumstances, adjusting for gender can have the effect of adjusting for important unmeasured exposure variables (Messing *et al.* 2009). For example, the fact that women who stand at work are less likely to move around has been a source of confusion in the literature concerned with the effects of general working posture on mortality. Gender is therefore a surrogate for mobility at work and adjusting for gender simultaneously adjusts for mobility. The negative effects of prolonged static standing on musculoskeletal and cardiovascular health are thereby made invisible, leading common but erroneous recommendations that people stand rather than sit at work (Messing *et al.* 2015).

Several studies have related working conditions to dysmenorrhea, which is often experienced as pain in the lower back. It would therefore be desirable for researchers who administer questionnaires on lower-back pain to distinguish between perimenstrual and non-perimenstrual pain; otherwise, they risk confusing their data analysis for all respondents. However, this is usually not done in studies of back pain.

Some new conceptions and scientific approaches have been developed by those interested in women's occupational health. For example, ergonomists interested in gender have developed an approach to ergonomic analysis of the work/life interface that enables them to identify workplace determinants of work-family conflict (See *Work* vol. 40 Suppl. 1). However, many researchers in the area of work-family conflict still adjust for gender without considering its different meanings in this context.

Finally, research in women's occupational health has also served to make visible the important scientific impact of communication between workers and scientists, which serves to develop new ideas for research and to understand its findings (Messing 2014). As Eakin (2010) has pointed out, scientists' 'standpoints' determine not only their choice of what to study, but also what they consider important about the phenomena they are looking at. Working with the communities affected by the research provides important insights into the phenomena under study.

Many researchers who have developed important concepts in women's occupational health have close ties to unions or other community groups. ETUI was among the first organization to promote gender inclusiveness in occupational health research and practice. The initial 1996 Barcelona conference grew out of a collaboration among Spanish medical researchers, a community clinic and the union 'Confederación Sindical de Comisiones Obreras' [Trade Union Confederation of Workers' Commissions] (CCOO). In Chile, the Centro de Estudios de la Mujer [Woman Study Institute], a community group, has collaborated with the government public health institute as well as unions to develop an important research and intervention programme in women's occupational health, leading to new policies providing for the integration of gender considerations in occupational health practice (Astudillo Cornejo and Ibarra Villanueva 2014). At the Université du Québec à Montréal, CINBIOSE researchers have greatly profited from a unique arrangement whereby professors are given specific course credit and financial and human resources for teaching and research carried out in collaboration with unions, women's groups and other community organisations (Messing 2014: Preface). Without this help, it would have taken us a lot longer to learn about the hazards in women's work. We hope that other universities and communities will follow these leads.

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