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Occupational hazards and gender differences: a narrative review

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Summary. Personalized medicine, and particularly gender medicine, is becoming essential in daily medical practice. This narrative review aims to assess sex and gender differences in occupational risks among workers. We point out that female workers are more exposed to biological risks (i.e., 70% of healthcare workers during the COVID-19 pandemic were women), but also seem to be more protected against microorganisms (i.e., for HBV vaccination: OR 1.21, p = 0.0023); with regard to physical risks, women are more susceptible to radiations (the estimated incidence of solid tumors for 0.1 Gy of exposure is 0.013% in females and 0.008% in males), while men are more susceptible to heat (infertility prevalence was 22.7% in exposed workers vs 3.0% in controls); female video terminal workers are more susceptible to both computer vision syndrome (aOR 2.57 and aOR 2.35) and musculoskeletal symptoms (OR 3.6). From a psychological point of view, women are more at risk for work-related stress and burnout, as well as workplace mobbing (65% of affected workers are women) and verbal violence, while physical violence was more common among men. In conclusion, important sex and gender differences are present with regard to occupational risks and hazards, thus showing the necessity to improve medical surveillance and to allow occupational physicians to personalize health surveillance.

Keywords. Gender medicine, occupational health, risk assessment, occupational exposure.

Introduction

In the last two decades, modern medicine has been increasingly oriented towards a personalization of care. Major results were achieved on patients' targeted diagnosis, treatments and innovative approaches.[1] The adoption of genomic medicine and other -omics sciences allowed physicians to stratify patients and improve the quality of care; however, the knowledge and awareness of personalised medicine and genomics still need to be improved.[2]

Gender medicine is the first step in personalised medicine and patient-centred care, with an increasing emphasis placed on the assessment of the different characteristics of sex and gender.[3] The differences between males and females should be analysed not only from a physiological, biological, or hormonal perspective (sex difference, with reference to the characteristics an individual has been born with), but they should also be considered through the influence of social roles, cultural and psychological aspects, behaviours, and identities (gender differences, with reference to the social behaviour that an individual develops during the span of their life).[4]

The concept of gender medicine originates from the idea that differences between men and women in terms of health are linked not only to their biological characterisation or reproductive function, but also to environmental, social, cultural, and relational factors, defined by the term 'gender'. Sex-specific biological differences affect the physiology, pathophysiology, clinical manifestation, natural history, incidence, prevalence, treatment response, and mortality rates; similarly, gender-dependent sociocultural issues also affect the epidemiology and the diseases' course, such as in the case of risky lifestyles or difficult access to healthcare.[5]

Biological, genetic, epigenetic, psycho-social, cultural, and environmental factors interact in defining sex/gender differences and affect the health status in different sexes. The role of sex and gender differences in the physiological and pathological processes is crucial in terms of efficient prevention, identification of clinical signs, prognosis definition, and therapy optimization. This approach allowed to identify sex/gender-specific differences, with additional potential benefits in terms of socio-psychological well-being for each individual, as well as the increase in cost-effectiveness for national healthcare systems.[3] A gender-specific clinical assessment can positively impact the appropriateness of therapies, with favourable outcomes not only for the single patient, since – from a public health perspective – it would also be beneficial for the National health service, as it would result in a lower economic impact of the disease burden.[3,6,7]

The first step in gender medicine policies in Europe dates back to 2002, with the European strategy 2002-2006, which established the necessity to integrate gender into risk assessment, preventive measures, and corrective or compensatory measures, in order to take into account women's characteristics in the occupational setting.[8] The issue was also considered in the Community Strategic Plan 2007- 2012,[9] the EU Strategic Framework on Health and Safety at Work 2014-2020,[10] and the EU Strategic Framework on Health and Safety at Work 2021-2027.[11]

In Italy, gender medicine is regulated by law no. 3, January 11, 2018.[12] On May 6, 2019, with article 3, comma 1, of the aforementioned law, the Plan for the application and spread of gender medicine was adopted, to ensure the homogeneity and appropriateness of the services of the National health service.[13] Article 3 places Italy at the forefront of the European gender medicine scenario, as the first European country with a specific law on this issue.

In Italy, gender was first introduced into occupational risk assessment in 2008, with legislative decree 81/2008. In particular, article 28 provides for the assessment of all the risks to the safety and health of workers, including those related to gender differences, age and country of origin.[14]

This review aims to investigate gender differences in occupational exposure and risks assessment. To do this, a narrative review of gender differences was performed for the occupational hazards and risks highlighted by legislative decree 81/2008: biological, physical and chemical hazards, ergonomics and manual handling of loads, video terminal work.[15] A review was also performed for gender differences for psychological risks in workers, as well as workplace violence.

Methods

In order to achieve the aim of this narrative review, a two-step methodology was adopted.

First, a literature search was performed on PubMed, retrieving articles published up until April 2022, focusing on gender differences in the occupational setting. The following query was used, tailoring it on each of the occupational risks included in this review: (gender OR "gender differences") AND (work* OR occupational OR employ*) AND (*keywords for specific risk or hazard*). Records in English and Italian were retrieved and screened for relevant articles; research articles fitting the scope of this review were included.

Afterwards, a grey literature screening was performed, in order to include the most recent statistical differences concerning occupational risks and gender. Furthermore, national and European repositories were screened for guidelines, laws and other relevant information on this topic.

Results

Biological hazard

Biological differences between males and females are observed when comparing the frequency, symptoms, and severity of many diseases, but also in the response to therapies and adverse reactions to drugs or vaccines.[6] The recent scientific literature shows a different response to infections and vaccinations between men and women.[16-19]

Male sex is a risk factor for infections, since women's immune system can produce a stronger innate as well as adaptive immune response to pathogens. Sex represents one of the most important influences on innate and adaptive immune responses, and leads to different outcomes from infectious and autoimmune diseases, malignancies, and vaccines.[20] Sex hormones modulate immune responses through specific receptors, which are expressed by most immune cells, including lymphocytes, macrophages, and dendritic cells (DCs).[21]

Low estradiol levels induce Th1-type responses and cell-mediated immunity, whereas high estradiol concentrations induce Th2-type responses and humoral immunity. Progesterone and testosterone are known to have broad anti-inflammatory effects and suppress innate immune responses.[22-24]

Susceptibility to infections changes based on the phases of an individual's life: after puberty, women are less susceptible to infectious diseases, while in men testosterone has immunosuppressive effects. Furthermore, genetic factors determine the outcome of infections and are involved in the susceptibility and resistance to microbial agents. Interestingly, the ability to recognize specific hormonal or chromosomal patterns to survive has been developed by some microorganisms, leading to the need to integrate sexual dimorphism into the development of treatments for transmittable diseases.[25]

Ruggieri A et al. underline how DNA methylation, expression levels of miRs, and chromatin remodelling can be affected by sex hormones, sex-chromosome-encoded genes and environmental exposure, contributing to the immune cell repertoire in response to a specific insult. The consequences are sex-specific responses to vaccination, different risk for autoimmune disorders and susceptibility to pathogens. By fully understanding these differences, an optimal disease management can be implemented, and therapies can be personalized for males and females.[19]

During the COVID-19 pandemic, further evidence has been collected on the increased risk of infection in males and the immunological advantages in women: females demonstrate stronger innate and humoral immune responses than males, and are consequently less vulnerable to many bacterial, fungal, parasitic, and viral infections.[26] Regarding the distribution of infections according to gender, the majority of occupational COVID-19 infections concern women. According to the data of the Italian National Institute for Insurance against Accidents at Work (INAIL, *Istituto Nazionale per l'Assicurazione contro gli Infortuni sul Lavoro*), in Italy women represent 68.3% of reported cases in workers. Furthermore, 70% of frontline healthcare workers during the COVID-19 pandemic were women. However, infection rates by gender are similar in

the general population, suggesting that men are more likely to contract the virus when exposure rates are the same, or that men are exposed to the virus more frequently in a non-healthcare setting.[27,28]

A possible explanation for the differences between males and females in risk and mortality from COVID-19 infection could be the difference in innate and adaptive immune response between the two sexes (such as the angiotensin-converting enzyme 2 levels, since males demonstrate overall greater RAAS activity compared to females) and men's comorbidities affecting the prognosis.[28,29]

It should be also pointed out that sex differences are not the only factor at play: gender differences are relevant, as Ahmed SB et al. highlight in their review, pointing out how the approach to risk during the COVID-19 pandemic appears to differ by gender; men are less likely to adopt preventive measures, as recommended by governmental advisories (such as hygiene practices, social distancing measures, a prompt and correct use of personal protective equipment, etc.), and to request medical assistance.[28]

Another important gender difference has been highlighted during the COVID-19 pandemic in the usage of Personal Protective Equipment (PPE): the female status has been highlighted as a risk factor for adverse dermatological reaction to PPEs [OR = 3.63, CI (1.13-11.69), p = 0.031],[30] and particularly among female nurses ($p < 0.001$).[31]

According to the Italian National Institute of Health (ISS, *Istituto Superiore di Sanità*), women are more immunoreactive and, similarly to the differences in immune responses to viral and bacterial infections, they develop more intense responses to vaccines, with double antibody titers than men.[6] Because of the higher intensity of their response to vaccinations, women have more frequent and more severe adverse reactions to vaccines.[18,32,33] Vaccination response is especially important in workers exposed to biological hazards for vaccine-preventable diseases, and even more so in healthcare workers, since they are exposed to infectious diseases during their profession, but are also a possible source of infection for the patients.

The identification of gender-specific molecular markers acting in vaccination responses could contribute to the execution of healthcare workers' surveillance programs, for the personalization of prevention, and surveillance programs implemented through occupational doctors. The Italian Center for Gender-Specific Medicine (a branch of the ISS) is active in the research of the mechanisms underlying gender differences and in the evaluation of the different markers, such as miRs, vitamine D, hormones, and DNA methylation on human samples responders and non-responders to vaccinations, of both sexes.[6]

In their study, Flanagan KL et al. highlight that males and females differ in vaccine-induced immune responses, adverse events, and protection. Males are more likely to receive vaccines, but females typically develop higher antibody responses and report more adverse effects. Many studies, performed both *in vitro*, in animals and in humans, highlighted numerous immunological, genetic, hormonal and environmental factors that differ between males and females and contribute to a difference in vaccine responses and outcomes.[16]

Many studies show that the humoral immune response to measles-mumps-rubella (MMR) vaccination and post-vaccination morbidities are different in males and females. The relative risk of adverse reactions following vaccination is more than two-fold in males, despite the antibody titer being similar in both sexes.[17,18]

Klein SL et al. also highlight that, in adult females, there is a higher antibody response to vaccines than in males. After either childhood or adult vaccination against influenza, yellow fever, MMR, hepatitis A and B, herpes simplex 2, rabies, smallpox and dengue viruses, protective antibody responses can be twice as high in females compared to males of all ages. The mechanisms implicated in mediating sex-based differences in immune responses (innate and adaptive) are affected by sex hormones, genetic and epigenetic regulation and the microbiome.[18,32,33] As an example, HBV antibodies titers in females were found to be 1.21 ($p = 0.0023$) times higher in female medical school students than in males.[34]

Physical hazard

In exposed individuals, hazardous physical factors can cause adverse health effects, or the onset of a disease. The physical factors mentioned by title VIII of legislative decree 81/2008 – the Italian occupational health and safety law – include noise, ultrasonic waves, infrasound waves, mechanical vibration, electromagnetic fields, optical radiation, artificial radiation, microclimates and high-pressure atmospheres.[15]

Noise is defined as a sound that causes unwanted, annoying, and unpleasant acoustic sensations, which could lead to a gradual depletion of the hearing cells, thus becoming a factor that causes or worsen hearing loss; furthermore, noise can increase the heart rate, trigger stress responses, cause digestive disorders, and distract the operator, with a consequent increase in work-related injuries.[35,36] Despite men being more exposed to noise during work,[37,38] greater effects have been highlighted in women[39-41]; this might be due to differences in noise sensitivity, hormones or use of hormonal contraceptives, pathophysiologic factors in response to noise, and differences in the pathogenesis of cardiovascular diseases.[39-41] Furthermore, exposure to noises during pregnancy can affect hearing and stress levels in women, and also result in hearing problems in the newborn.[42]

As for occupational radiation exposure, a 2006 report by the National Academy of Sciences on the Biological Effects of Ionizing Radiation (BEIR VII) highlighted that women may have a significantly higher risk of radiation-

induced cancer than the men exposed to the same dose of radiation.[43] Numerous studies, many of them on healthcare workers exposed to medical radiation, show an occupational risk with increased rates of thyroid, rectal, lung, melanoma cancers and leukemia in both sexes, but higher in females.[44-46] However, men also have an increased relative risk of colon, pancreatic, prostate, and testicular cancer.[47,48] Overall, the estimated incidence of solid cancers in males for an assumed exposure of 0.1 Gy is 800/100,000 (0.008%) vs 1300/100,000 (0.013%) in females.[43] These differences are so significant that gender-specific precautions and training are often needed to enable workers to perform their job safely. For example, astronaut protection standards are based on predicting the risks over an individual's lifetime, and gender differences limit the amount of time women can spend in space.[49] The exact mechanisms underlying sex differences in radiation-induced cancer remain unclear, and may include hormonal regulation, as well as a genetic risk and X-linked factors that have not been identified.[50]

With regard to microclimatic risks, and in particular heat exposure, an impact has been highlighted on male fertility: in men who are repeatedly exposed to high temperatures, the testicular thermoregulation system may fail, leading over time to substantial changes in sperm characteristics (such as motility and morphology).[51,52] As an example, the prevalence of infertility among bakers was 22.7%, while in controls it was only 3.0%.[52] On the other hand, women typically have a significantly higher body fat content than men, and they are at a thermoregulatory disadvantage during non-compensable heat stress.[53] In addition to differences in body fat, women also have a lower aerobic fitness and tolerate lower core temperature at exhaustion than men.[54] Particular attention should be paid during pregnancy, since it naturally elevates the body's temperature, placing women at risk for heat exhaustion, and potentially harming the unborn child.[55]

Chemical hazard

In recent years, due to the rising number of women workers throughout the world, the difference between male and female workers in terms of occupational health approach has become apparent. The effect of work-related exposures and risk factors is inherently different in male and female workers, and as such it should be characterized and studied. In 2010, Kim et al.[56] pointed out that most of the clinical trials – and medical research in general – had been conducted using mostly men as subjects, meaning that the clinical effect of those drugs or treatments, and their safety, was clear for men, but not always appropriately studied in women. This discrepancy should be reduced, if not altogether eliminated, in order to safely test the effect of drugs in a heterogeneous population of men and women. Similarly, occupational hazards have different effects on male and female workers, and biological and chemical or physical occupational exposures should be studied in both genders, with attention to the different effects they may have.

Furthermore, chemical occupational exposure may be dangerous for workers, depending on the absorbed amount of chemicals, and a limit has been set for hazardous chemical compounds (threshold limit value, TLV) beyond which the worker could be unsafe. Multiple studies have been conducted on different compounds, and TLVs are frequently updated.[57] The problem is that TLVs have been calculated on men, and the studies that calculated the TLVs for both men and women in the same occupational setting are scarce, despite biological differences playing a key role in how the chemical compounds are metabolized and absorbed, therefore leading to the assumption that TLVs may be different for males and females, due to different body sizes and composition (i.e., muscle mass, adipose tissue, bone mass), genetic-molecular-biochemical differences, and hormonal differences.[58] As mentioned above, among the enzymes involved in the metabolism of chemical agents, the CYP450 family plays a critical role, and a sex difference has been observed in how these enzymes metabolize the compounds.[59] The discrepancies in male and female CYP450 expression and activity are caused not only by genetic differences (cytochromes are coded by somatic chromosomes, therefore this difference cannot be assumed to be only due to genetic coding), but are also due to environmental factors and hormonal influences.[60,61]

However, further studies are needed, both in drug clinical trials and in toxicology studies, to determine the extent of gender differences in the risks and hazardous factors of occupational health.

Ergonomics and manual handling of loads

Ergonomic and biomechanical risks include repetitive tasks, awkward postures, sitting or standing for a long time and working at high speed. Physical and strength differences between men and women can sometimes lead to being assigned to very different work tasks; this is a key factor when analysing gender differences in occupational exposures, accidents, and diseases. In general, men are exposed to longer working hours, more physically demanding jobs, louder noises and higher-status occupational roles.[62]

Musculoskeletal disorders are among the most common work-related health problems for both women and men. Several studies have also reported male/female differences in the prevalence of symptoms of work-related musculoskeletal disorders, some resulting from differences in workplace exposure.[63] These can affect workers in all sectors, but an additional risk factor for many women is the use of tools and equipment that are

not always designed for the female working population.[64] Throughout the world, work equipment, tools, and PPE have traditionally been designed for male body size; workers who do not conform to the standard male body size may find difficulties in using PPEs. Uncomfortable work equipment and tools can lead to poor posture at work, increasing the risk of musculoskeletal disorders in both women and men.[65,66]

Video terminal workers

Prolonged usage of Video Display Terminals (VDT) has been associated with eye and/or vision problems that result from prolonged screen time, defined as Computer Vision Syndrome (CVS). An increased risk for CVS has been highlighted for female VDT workers, both in female physicians and surgeons (aOR 2.57; 95% CI: 1.36-4.88), as well as in nurses (aOR 2.35; 95% CI: 1.03-5.37).[67]

Furthermore, VDT workers are also exposed to an increased risk of musculoskeletal disorders: this risk has been reported to be higher in female workers (OR 3.6; 95% CI: 1-12).[68,69] Moreover, in 2009 Lapointe et al. highlighted that musculoskeletal symptoms reported by male VDT workers that are attributable to postural risk factors and their interaction with job strain are located in the lower back region, while in women musculoskeletal symptoms are located in the shoulders, neck, lower back, and upper limb regions.[70]

Psychosocial risks

There are gender differences between the mental health of male and female workers, such as the risk of work-related stress. With regard to the latter – defined as the perception of imbalance that the employee feels when work demands exceed the ability of the worker to cope with such demands – male and female workers are exposed to this risk in different ways, in relation to both biological and socio-economic differences.[71] In 2010, Weinberger et al. pointed out that, generally, work-related stress is due to several factors, such as type of work, hierarchical position, horizontal and vertical discrimination, sexual harassment, and the personal situation outside work.[72] As reflected in the recent scientific literature, women are more exposed than men.[73-75] Furthermore, as the most recent data from the Health and Safety Executive (HSE) shows, compared to workers in general, British women have statistically significant higher rates of work-related stress, depression or anxiety than men.[73] Sorrentino et al. highlighted that women are more likely to be exposed, due to job segregation and their increased domestic responsibilities.[58] In addition to being more widespread among the female gender, this phenomenon is very common in organizational realities that, due to their professional nature, require a significant psychological and physical involvement on the part of the worker; this is the case for all helping professions, but especially for healthcare workers during the COVID-19 pandemic, when female nurses were more exposed to psychosocial risks, with high levels of stress, depression and burnout.[76]

In Italy, there is a legal obligation to assess work-related stress under art. 28 of legislative decree 81/08, but there is no explicit reference to gender differences in this area.

An important gender difference has been observed in Italy, not only for work-related stress, but also for other psychological distress conditions related to work, such as mobbing. Mobbing is defined as: "the presence of violent behaviours, including physical and emotional abuse, by co-workers, subordinates or superiors to force someone out of the workplace through rumour, innuendo, intimidation, humiliation, discrediting and isolation".[77] A study conducted in Italy between 2001 and 2009 highlighted that 65% of victims of mobbing are women, thus remarking an important gender difference when it comes to workplace mobbing.[75] Furthermore, this study also highlighted different reasons behind mobbing for men and women: while men are mostly harassed for the "content of their work", women are mostly harassed for "personal aspects related to emotional and relational factors".[75]

It is through studies such as the present review that awareness should be raised of these increasingly widespread problems.

Workplace violence

The International Labour Organization defines Workplace Violence (WPV) as "any action, incident or behaviour that departs from reasonable conduct in which a person is assaulted, threatened, harmed, injured in the course of, or as a direct result of, his or her work".[78] According to the Italian National Institute of Statistics (ISTAT) report, 1,404,000 women experienced physical harassment or sexual abuse in the workplace during their working life, which is 8.9% of all female workers; 1,173,000 (7.5%) experienced sexual abuse at work.[79]

Gender differences in WPV have been thoroughly investigated among healthcare workers. An Italian study recently highlighted that aggression, both verbal and physical, is remarkably common for healthcare workers: 88.2% reported verbal aggression, 60% psychological aggression, and 30% physical aggression. Interestingly, verbal abuse was mostly reported by women (92.6% vs 81.5%, $p = 0.016$); conversely, physical aggression was mostly reported by men (38.3% vs 27.9%, $p = 0.020$). Overall, "female gender was associated with a 2.6 times higher risk for the presence of aggression" ($p = 0.034$).[80] These findings are consistent with those of a recent Swedish study investigating nurses' exposure to violence: Schlup et al. highlighted that males have a lower risk (OR 0.49; 95% CI: 0.34-0.70; $p < 0.05$) of exposure to verbal

sexual violence and physical sexual violence (OR 0.66; 95% : 0.41-1.05; p = 0.08).[81] Jia et al. also found that, in China, male and female healthcare workers suffer from a higher prevalence of physical violence (OR =3 .31, 95% CI: 1.12-9.79) and psychological violence (OR=1.71, 95% CI 1.24-2.36), respectively.[82]

The consequences of WPV also seem to predominantly affect women: a recent article by Wizner et al. investigating Post-Traumatic Stress Disorder (PTSD) caused by WPV found that WPV PTSD is higher in female workers (male gender was a protective factor, OR 0.82, 95% CI: 0.71, 0.95).[83] Furthermore, Cannavò et al. also highlighted that the emotional consequences of WPV affect more women (69%) than men (46%), and that men feel more irritation, disappointment, confusion and humiliation when subjected to WPV, while women feel more helplessness and sadness, while anger is felt by both genders.[84]

A clear example of extreme violence in the workplace is represented by homicide: workplace homicide accounts for 31% of occupational fatalities among women, while it only represents 9% of occupational fatalities in men. On the contrary, accidental falls mostly affect men, accounting for 13% of occupational fatalities, while only 9% of occupational fatalities are due to accidental falls among women. The same is true for harmful substances/environments, which account for 10% of occupational fatalities in men and 4% in women, although the differences in fall and chemical fatalities might be due to different exposure rates, since they are far more common in typically male-dominated work fields (i.e., construction workers for accidental falls, farmworkers for chemical exposures, etc.).[78]

Discussion

This review highlights many gender and sex differences concerning occupational exposures, hazards, risks, as well as social differences, in the approach to the work environment that lead to different rates and characteristics of work-related stress and workplace violence. The aim of this review was to summarize the many existing differences according to gender and sex, in order to provide occupational physicians, as well as policymakers, with an overview of the main literature on this topic.

Our results highlight the importance to perform risk assessment in workers, as well as medical surveillance, which should be tailored on the person, with particular focus on the essential gender and sex differences. This necessity has been shown in previous literature, highlighting the need for public and private companies to consider gender and sex differences in order to guarantee the safety and health of their workers.[85] Although Italy has developed a plan for the application and spread of gender medicine,[13] many steps still need to be taken when practicing occupational medicine. Occupational doctors should carefully evaluate sex and gender differences and apply them in clinical practice and medical surveillance; employers should also carefully evaluate gender differences when performing risk assessments.

Moreover, a few key steps should be taken in the upcoming years to better approach this issue during clinical practice. For example: occupational physicians should undergo training on gender differences, and then transmit this knowledge to workers; healthcare services should be personalized for the workers based on gender differences; policymakers should ensure appropriate safety and health policies are put in place.[86]

This review has some strengths and some limitations. On one hand, the narrative review structure provides an overview on the recent relevant literature on various occupational risks, on the other it does not provide a systematic review of all existing literature. Furthermore, this review was performed on the main occupational risks, but is not comprehensive of all health differences in workers.

Conclusions

This review highlights sex and gender differences in occupational risks and hazards. It is important to integrate gender medicine in occupational medicine, evaluating these differences during every step of the occupational doctor's practice, as an essential part of the decision-making process. As personalized medicine becomes more relevant, it is mandatory to use our current knowledge about sex and gender differences to ensure better health and safety for all workers.

Key messages

- Gender medicine is a key aspect of personalised medicine and patient-centred care, and is becoming essential in daily medical practice; in occupational health, sex and gender differences are essential for the risk assessment and prevention among workers.
- Italy is on the forefront of gender medicine legislation, being the first European country with a specific law on this issue, with law no. 3, January 11, 2018, and with legislative decree 81/08.
- Sex and gender differences in the occupational setting are present with regard to biological, physical and chemical hazards, ergonomic and manual handling of loads, video terminal workers, psychosocial risks and workplace violence.
- Occupational doctors should carefully evaluate sex and gender differences and apply them in clinical practice and medical surveillance; employers should consider sex and gender differences when performing risk evaluations.

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