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Guidelines for assessment of Working and Environmental Risks during Pregnancy

General background

These guidelines from Occupational and Environmental Medicine, Gothenburg, is intended to answer the most frequently asked questions about risks to pregnancy from various types of exposure, both in the workplace and during leisure. Much is as yet unresearched and so knowledge of any risks from certain of these exposures is limited.

It is normally estimated that around 15-30% of confirmed pregnancies end in miscarriages. Serious malformations on delivery occur in approximately 2% of babies. Most of the organ development takes place during the first 8 weeks of pregnancy. Therefore, the first 3 months are generally regarded as the period of greatest sensitivity to external factors. However, even after that the foetus and the various organ systems continue to develop.

Common questions during pregnancy concern the risk to the unborn child of damage from exposure to chemical or biological agents, radiation, lifting, stress and night work. The questions are dealt with by doctors and/or occupational hygienists, or, in the case of ergonomic questions, by doctors and ergonomists. The questions are always assessed on an individual basis. It is important that if harmful impact is suspected, the pregnant woman should have her issue assessed without delay, to prevent complications during the pregnancy.

Investigation

The investigation of medical issues always involves discussions with doctors. Where appropriate, occupational hygienists, ergonomists and/or psychologists are also linked into the investigation. If the risk exposure at the workplace is difficult to assess, workplace visits and measurements of levels may be required.

Risk evaluation and preventive measures

The evaluation of risk is performed case-by-case, based on an assessment of the medical and/or occupational hygiene and ergonomic factors, plus literature searches of relevant databases. As an aid in this evaluation, the following documentation may be consulted.

Swedish Work Environment Authority – Regulations

The Authority's Regulation AFS 2007:5 on Pregnant and Breastfeeding Workers states that the employer is under a duty to assess any risk of harmful impact on pregnancy and to decide on appropriate measures once the woman has advised the employer that she is pregnant. This falls within the scope of the employer's activities in Systematic Work Environment Management under Regulations AFS 2001:1, AFS 2003:4 and AFS 2008:15.

If a type of harmful exposure or a risk cannot be remedied, or if a redeployment is not possible, the employer is permitted to certify the fact to the Swedish Social Insurance Agency (*Försäkringskassan*). If the risks to the pregnancy are difficult to assess, help

with assessment may be obtained from the company health service or the nearest occupational and environmental medicine clinic.

The pregnant woman can then apply to the local social insurance office for pregnancy paid leave, appending confirmation of pregnancy and the employer's certificate. The insurance office then assesses the risk to pregnancy and the reasons for the remedy or remedies proposed. If the latter are incomplete or flawed, the insurance office may re-contact the employer for clarification. Where appropriate, the case may be referred to the Work Environment Authority (*Arbetsmiljöverket*), which will investigate the case further, normally via contacts with, and an assessment/certificate from, the nearest occupational and environmental medicine clinic. The Authority then issues its judgement to the local social insurance office, which in turn notifies its decision to the pregnant woman and the employer.

Pregnant employees must not be engaged in work that is performed under water, under increased pressure or in BA (Breathing Apparatus) and full suit rescue (AFS 1993:57, AFS 2000:16, AFS 2005:9, AFS 2005:6, AFS 2007:7, AFS 2010:16), in activities that involve a risk of exposure to rubella (German measles), toxoplasmosis or other microbiological work environment risks (AFS 2005:1), working with Lead (AFS 1992:17, AFS 2005:6, AFS 2005:21, AFS 2008:1) or in underground mining activities associated with particular risks (Rock and Mining Activities, AFS 2003:2, AFS 2010:1). Other regulations that must be taken into account are Noise (AFS 2005:16), Ergonomics for the Prevention of Musculoskeletal Disorders (AFS 1998:1, AFS 2010:9), Work with Display Screen Equipment (AFS 1998:5), Night work (AFS 2005:6) and Occupational Exposure Limit Values and Measures against Air Contaminants (AFS 2005:17, AFS 2010:13). Pregnant women are, during their pregnancy, entitled to be redeployed to work not associated with any risk of ionizing radiation (SSM, *Strålsäkerhets-myndigheten;* Swedish Radiation Safety Authority); FS 2008:51). The rule for pregnant women who are not redeployed is that their work must be planned such that the dose to the foetus does not exceed 1 mSv during the remainder of the pregnancy, once this has been confirmed.

Breastfeeding employees must not be employed in working with lead or in underground mining activities.

The Swedish Work Environment Act applies to activities in which employees perform work on behalf of the employer. The regulations thus do not apply to hobby activities, but may be used as guidelines and general advice for a healthy environment without exposure to hazardous factors for those who are pregnant. Today, the self-employed are not entitled to pregnancy paid leave in the case of proven exposure to risk of harmful effect on the pregnancy. On the other hand, they are entitled to pregnancy paid leave for 50 days at the end of the pregnancy in the case of heavy physical stress at work. However, the government has ordered the Work Environment Authority and the Social Insurance Agency to investigate the possibilities also for self-employed to be entitled to pregnancy paid leave because of the risks in the work. The issue is now further considered in the Cabinet Office.

Literature documentation

Chemical environmental factors

a) Organic solvents
Several studies – mainly from Finland - demonstrate an increased risk of miscarriage if the man or woman had been subject to a high degree of exposure to several solvents. As far as individual solvents are concerned, toluene (used in rotogravure printing and shoe-making), tetrachloroethylene and perchloroethylene (in dry cleaning) have been discussed as factors of risk. However, a Swedish study of personnel at dry cleaning firms did not identify any above-normal risk of miscarriage. Epidemiological studies of pregnant women who had been exposed to organic solvents during pregnancy in the 1989-1999 period indicate a moderately increased risk of spontaneous abortions and malformations, especially cleft palates. It is also suspected that exposure to organic solvents may affect the ability to become pregnant.

We advise against work or leisure-time activities involving moderate to high exposure to solvents, especially during the first three months of pregnancy. Low-level or short-duration exposure does not normally constitute any factor of risk. "Low-level" exposure is defined as exposure that is **less than one tenth of the occupational exposure limit value.** Many solvents have a low odour threshold, in some cases set at hundredths of the limit value. As a result, it is not enough to base a judgement on detection by odour to classify work as harmful to the foetus or not. In the case of doubt as to levels of exposure, measurements of the concentrations of the solvent in question may be required.

b) Metals
<u>b1) Inorganic lead</u>
Pregnant employees are not permitted to work with lead (AFS 1992:17, AFS 2005:6, 2005:21, AFS 2008:1). It is therefore important that a worker who becomes pregnant or is breastfeeding, as soon as possible notifies her employer. Exposure to inorganic lead can lead to a reduced sperm count and higher incidence of abnormal sperm at blood lead levels of around 2-2.5 μmol/L. An increased exposure to lead may result in the child being born prematurely and below normal birth weight. A risk of impact on the functions of the brain is also found. The biological limit value for adult male workers and women older than 50 years has been established at 2.0 μmol/L (AFS 2005:6, AFS 2005:21, AFS 2008:1). For women younger than 50 years, a lower biological limit value of 1.2 μmol/L is applied. Pregnant and breastfeeding self-employed women are also covered by the restriction on working with lead.

<u>b2) Mercury (organic and inorganic mercury)</u>
Organic mercury – methyl mercury
Methyl mercury is a known reproduction-toxic substance that in adults can cause neurological damage such as tunnel vision, difficulties with walking and numbness in arms and legs. Damage to the foetal brain from exposure of pregnant women constitutes "critical effect", including disruption of the child's mental and motor development.

Methyl mercury becomes concentrated in the food chain. The main source of exposure is normally via the diet. Particularly high levels of mercury have been reported in pike, pike-perch, burbot, perch and eel, as well as in fish caught in contaminated lakes. Certain fish of prey such as halibut, larger species of tuna, swordfish and shark may also contain levels of mercury up to 1 mg/kg. According to the recommendations of the Swedish National Food Administration (*Livsmedelsverket*), pregnant and breastfeeding women, as well as women planning a pregnancy, should not eat pike, perch, pikeperch, burbot, Atlantic halibut, as well as shark, swordfish, thornback ray and tuna more than at the most 2-3 times/year. However, all farmed fish is safe to eat for pregnant women. More information is available on the Swedish National Food Administration's Website (www.slv.se).

Discrete brain damage may occur in roughly 5% of children when the level of mercury in the mother's hair is around 10-20 mg/kg. Intake of methyl mercury over a long period in doses of 0.2 mg per week may give rise to a concentration of mercury of around 6 mg/kg. In studies of levels of methyl mercury in the hair of pregnant women in Sweden, the highest levels were 5-10 times lower than the levels that are considered to be capable of affecting the nervous system in the foetus. For mercury a reference dose of 0.1 µg/kg body weight for daily intake corresponds to a mercury concentration in hair of 1 µg/g and a methyl mercury concentration in blood of 4 µg/L.

Inorganic mercury
The risks associated with inorganic mercury are lower. Certain studies have found reduced ability to become pregnant and an increased risk of miscarriage among dental nurses in whom sharply higher levels of urine mercury were established. Since the 1980s, the average exposure to mercury in dental care in Sweden has normally been calculated as at, or up to, a few micrograms per m^3. This normally produces blood mercury levels clearly below the reference value of 25 - 30 nmol/L (5-6 µg/L), which constitutes the biological guideline value for occupational and environmental investigations of individuals exposed to mercury. It is not thought that any risk of impact on the foetus exists if the work is performed in accordance with the regulations stated in AFS 1989:7, Amalgam and Mercury in Dental Care. Women are advised to avoid dental treatment involving amalgam fillings during pregnancy.

b3) Cadmium
Occupational exposure to cadmium may affect the blood circulation in the placenta, inhibit foetal growth and increase the chance of premature birth. Cadmium may also affect vascular circulation in the testicles, which can impair the fertility of the man. The normal value for cadmium in blood differs clearly between non-smokers and smokers. AFS 2005:6, Medical Surveillance in Working Life, states biological limit values for cadmium in blood.

b4) Other metals
Other potentially reproduction-toxic metals are arsenic, chromium and nickel. The normal values for individuals not exposed to these metals in their work are between 1 and 4 µg/L for arsenic in blood, approximately 0.1 µg/L for chromium in plasma/serum and between 0.1 and 1.1 µg/L for nickel in plasma/serum.

c) Gases

c1) Anaesthetic gases

Increased risk of spontaneous abortions among anaesthetic and intensive care nurses who are exposed to anaesthetic gases was reported in several studies during the 1960s and 1970s. Later studies, however, have not confirmed these results and so it is suspected that the earlier findings may have been attributable to methodological shortcomings in the studies. Exposure to anaesthetic gases in surgical wards also declined in the 1980s and 1990s. Against this background, the justification for advising anaesthetic nurses against continuing to work during their pregnancy has considerably declined. However, since available studies do not entirely exclude suspicions of a risk of miscarriage, great importance should be attached to the desire of the woman herself for redeployment. More recent anaesthetic gases such as enflurane and isoflurane, as well as halothane, lead to reproduction-toxic effects in animal experiments and should therefore be assessed in the same way, despite the fact that they are not studied as much on man. Anaesthetic gases are subject to the regulations AFS 2001:7, Anaesthetic Gases, and AFS 2005:17, AFS 2010:13 Occupational Exposure Limit Values and Measures against Air Contaminants.

c2) Ethylene oxide

Ethylene oxide is a reactive substance that is used, for example, as a sterilizing gas for disposable articles in healthcare. The bactericidal effect of the ethylene oxide derives from its toxic effects on living cells. Ethylene oxide has an exposure limit value in Sweden of 2 mg/m^3. A study from Finland on healthcare personnel using ethylene oxide to sterilize instruments indicated a rise in the incidence of spontaneous abortions. In a recently published study from South Africa there was a significantly increased risk of spontaneous abortions and pregnancy loss for pregnant workers highly exposed to ethylene oxide compared to low exposed workers. Experiments on rats and mice showed reduced fertility.

c3) Carbon monoxide

It is well known that the foetus is more sensitive to carbon monoxide than the mother. Foetal damage has not been demonstrated at exposure to levels below the exposure limit value, but knowledge of any effects at lower exposure is insufficient, and it is therefore not possible to exclude entirely the possibility of damage.

d) Combustion gases and fumes

d1) Cigarette smoke and environmental tobacco smoke

Pregnant women who smoke more than 10 cigarettes/day may be affected by a reduced ability to conceive and by an increased risk of foetal death, or other disruption of the child's development. Inhibition of foetal growth is dose-dependent. Mothers who smoke during pregnancy are twice as likely to give birth to low birth weight infants (< 2500 g).

d2) Emissions from motor vehicles

Emissions from motorized vehicles contain polyaromatic hydrocarbons (PAH) and carbon monoxide. Consequently, high levels of exposure to motor vehicle emissions should be avoided. The relative moderate exposure to motor vehicle emissions encountered in urban environments is not known to be capable of causing any impact on pregnancy.

d3) BA (breathing apparatus) and full suit rescue
Women employees, who are pregnant and have notified their employer of their pregnancy, are not allowed to be involved in BA or full suit rescue (AFS 2005:6, AFS 2007:7).

e) Other chemicals
The list of exposure limit values (AFS 2005:17, AFS 2010:13, Category E) includes an additional number of chemical substances that have been classified as reproduction-disruptive. Examples include benso(a)pyrene, dibutylphtalate, dimethylformamide, ethylene thiourea, formamide, cadmium difluoride, carbon disulfide, carbon monoxide, nickel carbonyl, tetraethyl lead and tetramethyl lead. Further reproduction-disruptive substances are listed on the Website of the Swedish Chemicals Agency (*Kemikalieinspektionen*) (www.kemi.se).

e1) PAH (polycyclic aromatic hydrocarbons)
Work that involves exposure to polycyclic aromatic hydrocarbons is defined in the Swedish Work Environment Authority's (*Arbetarskyddsstyrelsen*) regulation AFS 2007:5 on Pregnant and Breastfeeding Workers, as any exposure situation in which the employer is required to assess the risk of effect on the pregnancy. PAHs occur, for example, in soot, tar, pitch and smoke. Some of the substances that are classified as PAHs, for example benzo[a]pyrene, are carcinogenic. However, specific knowledge of risk to pregnancy from such exposures is lacking.

e2) Pharmaceutical industry
Work in the pharmaceutical industry may cause effects on pregnancy.

e3) Hairdressing
A Swedish study of female hairdressers indicated an extended time-to-pregnancy and a somewhat higher risk of miscarriage. Another study by the same research team indicates a somewhat higher risk of growth inhibition and malformations in the children of women hairdressers, compared to the control group. However, it was not possible to link the effects to any specific exposure at the workplace. In a study from Finland of about 10 600 hairdressers an increased risk of low birth weight, preterm delivery and perinatal death was observed compared to the control group (teachers). A partly different pattern, however, was seen in a study from Spain. In this study hairdressers showed a non-significant increased risk of spontaneous abortions, but no increase in the risk for preterm delivery or low birth weight. Regulations aimed at preventing exposure are laid down in AFS 1985:18, Hairdressing.

f) Pesticides
Epidemiological studies have shown that people in agriculture, nurseries and horticulture have experienced higher incidence of miscarriages and malformations. However, the findings are not clear. Several pesticides (chloro-organic compounds, organic phosphorus compounds, carbamates, dithiocarbamates) have shown toxic and reproduction-disruptive properties in various systems of testing, and so special safety regulations have been established for these agents. As a result, a generally high level of caution should be maintained with regard to exposure to various pesticides among

pregnant women (AFS 1998:6, AFS 2000:29). Several pesticides (e.g. dibromochloropropane and ethylene dibromide) may also give rise to effects on male fertility, e.g. extended time-to-pregnancy. I a newly published meta-analysis of 15 studies, the development of childhood leukemia was positively related to the residential exposure to pesticides, insecticides and herbicides during pregnancy.

g) Cytostatics
Work in the production of cytostatics in healthcare requires special protective measures to limit the exposure of personnel (AFS 2005:5, AFS 2009:6). Unprotected work with cytostatics involves a degree of exposure that leads to increased incidence of disruptions of the DNA in peripheral blood cells. As a result, unprotected work with cytostatics is particular inappropriate for pregnant women. If work with cytostatics has to be performed by pregnant women, adequate protective equipment (fume hood, protective clothing etc.) must function optimally and must be used consistently.

h) Food
Women who had eaten food seriously contaminated with polychlorinated biphenyls (PCBs) during their pregnancy have given birth to children with short-term inhibition of growth, and dark pigmentation of the skin. Disruptions in the neuro-psychological development of children have been discussed, but the results from different studies are not consistent. Because of the content of dioxin and dioxin-like PCBs, The Swedish National Food Administration (*Livsmedelsverket*) has issued recommendations that pregnant women, children and women of childbearing age should not eat Baltic herring (including fermented Baltic herring), wild salmon and salmon trout from the Baltic, Lake Vänern and Lake Vättern, and wild char from Lake Vättern more than at the most 2-3 times/year.

The administration also issued recommendations to avoid eating fish that may contain increased levels of methyl mercury (see “Mercury” section above).

Physical environmental factors

a) Ionizing radiation
Ionizing radiation has a clearly reproduction-toxic effect. In men, the testicle is the critical organ. A reduced sperm count normally occurs at a dose corresponding to 15 rads (0.15 Gy). Considerably higher doses are needed to affect reproduction in women. The Swedish Radiation Safety Authority [*Strålsäkerhetsmyndigheten* (SSM)] has issued special regulations on work involving ionizing radiation (SSM FS 2008:51). Where a pregnancy is confirmed, the equivalent dose to the foetus must not exceed 1 mSv for the remainder of the pregnancy. Pregnant women who in their work are exposed to ionizing radiation are entitled to be redeployed. No certain correlations between observed reproduction-toxic effects in Sweden and radioactive fallout from nuclear accidents – for example at Chernobyl in 1986 – have been confirmed.

b) Radon in drinking water
The average level of radon in drinking water in Sweden is estimated at around 38 Bq/L (SOU 2001:7). At 1000 Bq/L of radon in drinking water, an adult will receive an annual dose of around 0.5 mSv of radiation per year, a 10-year old child a dose of 1.5 mSv/year

and a baby a dose of all of 7 mSv per year. The biggest risk from radon in the drinking water arises from respiration of radon that evaporates into the air indoors, and not from drinking the radon-containing water. When a person drinks water containing radon, the major share of the radon is absorbed via the gastro-intestinal tract, which is thought to receive the biggest dose of radiation. The Swedish Radiation Safety Authority (SSM) estimates that a radon level of 1,000 Bq/L may produce a radon level in the air of 200 Bq/m^3, but usually the amount yielded is considerably lower. A current US study indicates that a level of 100 Bq/L in water increases the level in the air by 10 Bq/m^3. However, the calculations of doses and the estimations of risks are, according to SSM, based on an insufficient number of experimental studies, which makes their findings uncertain. No epidemiological studies of sufficient quality are currently published.

c) Non-ionizing radiation
Non-ionizing radiation in the high-frequency range above all gives rise to warming effects. Warming has an adverse effect on the sperm and, an increase of temperature of one degree in the testicle, results in a temporary halving of the number of the sperm cells after a period of latency of approximately 6 weeks. Similar effects of warming have also been discussed in welders, for example. Otherwise, there is no scientific evidence to support the notion that non-ionizing electro-magnetic radiation from, for example, computers or mobile telephones, brings an increased risk of miscarriage or malformation. The Swedish Work Environment Authority and SSM (SSM FS 2008:18) have jointly framed a principle of caution regarding low-frequency electrical and magnetic fields. "If measures may be taken at reasonable cost and with otherwise reasonable consequences, every effort should be made to reduce fields that deviate considerably from what is regarded as normal in the environment in question". It may therefore be appropriate for pregnant workers not to be exposed to fields that are in excess of those recommended as acceptable for the public.

d) Noise
High noise levels may create increased stress and tiredness in the mother and may also adversely affect the blood circulation in the placenta. The foetus is sensitive to external noise from around the 26th week of pregnancy, when the organs of hearing are fully developed. Noise attenuation by the abdominal wall and amniotic fluid is frequency-dependent. Low frequencies of less than 200 Hz may in some cases be amplified in passing through the amniotic fluid. Occupational noise exposure above 85 dB(A) has been linked to an increased risk of growth inhibition in the foetus. High noise levels also represent a risk of impact on the hearing organs of the foetus, for example in the cases of impulse noise such as in shooting. It has also been observed that pregnant women exposed to stress during their pregnancy may have children who later show impaired defence from noise (AFS 2005:16). However, it is not held that there is any risk of damage to development and hearing in the foetus if the average daily exposure to noise is below 80 dB(A).

Ultrasound is attenuated during its passage through the mother's body to such a degree that the likelihood of effect on the foetus must be considered as low-level, as long as the levels of exposure are not very high. Infrasound at levels below those stated in the regulations on noise are not normally thought of as giving rise to any risk of damage to the mother or the foetus.

e) Vibration
It is held that violent shocks and vibrations may increase the chance of haemorrhaging, contractions of the womb and miscarriages, as well as premature birth. This should be taken into account if the pregnant woman is exposed to a high level of whole-body vibration (AFS 2005:15).

f) Cold and heat
Standing and walking work in intense heat may increase the risk of dizziness and fainting (AFS 1997:2). Work in the cold has not as yet been shown to represent any risk during pregnancy or breastfeeding if suitable protective clothing is worn.

Other environmental factors

a) Diving
Pregnant women employees who have notified their employer of their pregnancy must not be employed in diving activities (AFS 1993:57, AFS 2000:16, AFS 2005:6, 2005:9, AFS 2010:16).

b) Physical stress
Considerable physical stress may have adverse impact on the pregnancy, possibly causing contractions of the womb (AFS 1998:1, AFS 2010:9). In a systematic guideline from Royal College of Physicians in London (2009), 24 studies addressed the association between preterm delivery and heavy physical work. Of these, 11 showed a positive association, while the remaining 13 were negative. Among the studies with a positive relationship the risk estimates were generally ≤ 2. The association between low birth weight and heavy physical work showed a positive relationship in 6/10 studies while the remaining four were negative. Overall, the positive studies indicated a moderate effect (relative risk ≤ 2.4). The compilation showed no association between preterm delivery and lifting in 9/14 studies and a modestly increased risk in the other studies. Elite sportswomen may be affected by disruption of the menstrual cycle and, in some cases, by the absence of menstruation. Physically strenuous work that includes walking and standing for the major part of the working day is regarded as representing a risk of premature birth during the last months of pregnancy. This applies in particular to women with a congenital weakness in the cervix. Work that involves particular health risks to pregnant women because of considerable physical stress includes, for example, work at height in mast and pole work, as well as work from ladders and on scaffolding (AFS 2000:6, AFS 2005:11). Prolonged standing or sitting work may result in an increased risk of swelling, varicose veins and thrombosis in the legs. In the later stages of pregnancy, it may also become difficult to perform awkward working movements and work in confined spaces. In the compilation by Royal College of Physicians, a positive association between preterm delivery, spontaneous miscarriage and perinatal mortality on the one hand and prolonged standing on the other, was observed. The risk increase was moderate (< 1.5) in 14/21 studies with a pooled risk estimate of 1.28 in a meta-analysis of high quality studies.

Mining work may also constitute increased physical stress, as well as the possibility of effects on pregnancy from noise, vibration (whole- and part-body vibration), ionizing radiation and stress (AFS 2003:2, AFS 2010:1).

c) Infectious agents
Pregnant women are not permitted to be employed in activities where any risk of infection with German measles (rubella) or toxoplasmosis may be present. This restriction also applies to self-employed women. German measles during pregnancy may cause serious damage to hearing and development in the foetus. Primary infections with toxoplasma gondii, which may be spread via the faeces of cats or via uncooked meat, may give rise to a higher risk of foetal death and foetal damage. The commonest infectious agent during pregnancy is cytomegalovirus (CMV), which can infect the offspring in the womb, via breast milk or via the mother's saliva. This infection can cause serious neurological defects in the foetus/child. Other possible agents are parvovirus B19 (erythema infectiosum), TBC, hepatitis B, hepatitis C, herpes simplex, enteroviruses, listeria, influenza, whooping cough, measles and chicken pox (AFS 2005:1). Questions should in the first instance be directed to the nearest infectious disease clinic and/or to the infectious disease doctor.

d) Stress; shift and night work; psycho-social factors
High levels of stress are thought possibly to affect the hypothalamus in the brain and to cause reduced LH production, with the risk of absence of menstruation. Other possible effects that have been discussed include impact on the ability to conceive and on foetal growth. Night work during pregnancy and breastfeeding is not normally regarded as representing any increased risk. On the other hand, night work that may involve any tangible physical and/or psychological stress should be avoided during pregnancy. This includes, for example, work in emergency services or similar work, where urgent actions are often required. In addition, night work may be inappropriate for women who are subject to an increased risk of complications in their pregnancy. In such cases, redeployment to day work should be considered (AFS 2005:6, Medical Surveillance in Working Life). Some studies indicate a somewhat higher risk of miscarriages and premature birth with irregular working hours, such as with night-time working, while other studies do not indicate any increase in risk. In the survey by Royal College of Physicians, 9/16 studies showed an increased risk of preterm delivery during shift work, while the remaining 7 studies were negative. A high quality meta-analysis based on four papers showed a pooled risk estimate of 1.2. The results for the association between low birth weight and shift work were conflicting. Fixed night shifts during pregnancy may increase the risk of late fetal loss.

No studies showing clear correlations between reproduction disruptions on the one hand and psychological stress in a work place on the other hand have been published (AFS 1980:14; AFS 1993:2; AFS 1993:17). Violence may constitute a direct risk to the foetus, for example, kicks to the stomach. Consequently, in the presence of any risk of violence or menace, redeployment may be considered for the pregnant woman.

Carcinogens

Carcinogens and products that are given off during the following processes are EU-listed:

1. Production of auramine (4,4'- Carbonimidoylbis(N,N-dimethylbenzenamine)
2. Work that involves exposure to carcinogenic polycyclical aromatic hydrocarbons (PAHs) that are found in soot, tar, pitch, smoke and dust;
3. Work that involves exposure to dust, smoke gases or splashes caused during burning-off and electro-refining of copper-nickel matte;
4. Process involving the use of concentrated acid in the production of isopropyl alcohol;
5. Work involving exposure to wood dust from deciduous trees.

This list is EU-wide. The processes referred to in points 1, 3 and 4 are not at present found in Sweden. Substances formed during the processes listed are also regarded as increasing the risk of cancer at low-level exposure. For that reason, it is important to prevent exposure to these substances to all employees, irrespective of gender.

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Questions

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