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Occupation hazards - fertility and pregnancy

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Abstract

Occupational exposures threaten both male and female fertility, pregnancy, and the health of the unborn child, e.g. by causing menstrual irregularities, reducing the number and / or deteriorating quality of maturing eggs and sperm, etc. The health hazards from work are in a special position in relation to other health hazards and threats because they are different in nature from general environmental exposure agents. If there are exposure agents in the work environment, most often we emphasize the amount of exposure, duration of action, and systematic nature of the effect, but environmental exposures are usually sporadic and temporary. But it is wise to remember that environmental exposures and a questionable lifestyle can multiply by the effect of environmental hazards, or vice versa. Occupational exposure agents are divided into chemical, physical, and biological exposures. Exposure may occur at work by inhalation, through the skin or through the gastrointestinal tract. If a potential hazard or harm is identified against fertility or pregnancy, the primary goal is to eliminate it. If the hazard or harm is not eliminated, this person, male or female, needs to be transferred to a position better suited for the preconception period and pregnancy. Every workplace should be a health promoting workplace.

Keywords: occupation hazards, safety, fertility, pregnancy

Tiivistelmä

Työperäiset altisteet uhkaavat sekä miesten että naisten hedelmällisyyttä, raskautta, sikiön ja syntyvän lapsen terveyttä mm. aiheuttamalla kuukautishäiriöitä, vähentämällä kypsyvien munasolujen ja

siittiösolujen määrää ja / tai heikentämällä niiden laatua ym. Työstä johtuvat terveydelliset vaarat ovat erityisessä asemassa suhteessa muihin terveyden vaara- ja uhkatekijöihin, koska nämä ovat luonteeltaan erilaisia kuin yleensä ympäristön altisteiden. Työssä, jos siinä on altisteita, korostuu useimmiten altisteen määrä, vaikutusaika ja vaikutuksen järjestelmällisyys, mutta ympäristön altisteet ovat tavallisesti satunnaisia ja väliaikaisia. Mutta kuten sanottu, ympäristön altisteiden ja kyseenalaisten elintapojen merkitys voi moninkertaistua yhdessä työssä olevien altisteiden vaikutusten kanssa, tai myös tosin päin. Työaltisteet jaetaan kemiallisiin, fyysisiin ja biologisiin altisteihin. Altiste voi joutua yksilöön työssä joko hengityksen, ihon tai ruuansulatuselimistön kautta. Jos tunnustetaan hedelmällisyyttä tai raskautta uhkaava vaara työssä, se pitää ensi sijassa poistaa. Jos sitä ei voida poistaa, työntekijä on siirrettävä työhän, joka ei uhkaa terveyttä, eikä raskautta. Jokaisen työpaikan pitäisi olla terveyttä edistävä työpaikka.

Avainsanat: työperäiset vaarat, turvallisuus, hedelmällisyys, raskaus

Introduction

The most common diagnosis among working-age people aged 25–45 is infertility. About 13–15% of this age group suffer from infertility. Infertility in this age group is significantly more common than, for example, infarcts (1% <), cancer (about 1%) and diabetes (about 2%) in total. (Siepe 2019.) It is estimated that in Finland, for example, up to 40% of 35–45-year-olds suffer from childlessness, which is caused by infertility (Ovumia 2019).

Occupational exposure agents threaten both male and female fertility, pregnancy, the health of the unborn child, e.g. causing menstrual irregularities, reducing the number and / or deteriorating quality of maturing eggs and sperm, etc. Although working-age people spend about 20% of their time at work each year, linking work and infertility or pregnancy problems is not straightforward. First, there can be many causes of infertility, and

a causal relationship is difficult to demonstrate. Suspicion of the effects of occupational exposure is mostly based on individual epidemiological studies that have found a statistical association between exposure and fertility disorders. Secondly, occupational exposures, together with malnutrition and other unhealthy lifestyle habits and / or diseases resulting from the unhealthy lifestyle, can threaten fertility in both men and women, pregnancy, and the health of the unborn child. Thirdly, the exposure agent does not in itself mean illness, but the risk of illness depends on e.g. the mechanism of action of the exposure, its entry or avoidance, the time and level of exposure, the working methods and the individual characteristics and lifestyle of the person.

The health hazards from work is in a special position in relation to other health hazards and threats. In industrialized countries it is regulated by law, but differently in different countries. The EU has defined e.g. the Directive Protecting Pregnant Workers and New Mothers (Council Directive 92/85 / EEC), which have been applied in various ways by EU countries. For example, according to Finnish legislation, the employer is obliged to ensure that the work does not pose a risk to reproductive health. Occupational physicians and occupational health nurses are specially trained to identify work-related hazards and to guide and advise both the employer and the employee in these situations.

Linking work to pregnancy and female and male fertility is a matter of occupational health, but also a matter of maternity care. Although there is a strong occupational health perspective in this article, the review is on a general educational level. At a level that does not require knowledge of the intricacies of occupational health. It is left to occupational physicians and occupational health nurses, and other experts as well as to the special literature on occupational health. This article emphasizes the understanding

that every nurse and midwife should have, when dealing with clients with infertility or pregnant families and when to refer them to an expert.

This article is based on a scoping review with different kind of deliberately selected sources. Due to the defining of the article, a careful analysis of individual exposures and threats to individual occupations will be considered only as examples.

Occupational, environmental and lifestyle hazards

It can be said that almost all the articles in this book are more or less related to this article, because the importance of the environment and lifestyle for occupational health cannot be ignored. It is not easy to separate environmental and occupational hazards as 'Health for all by the year 2000' strategy states:

“There are many problems that require changes connected with environmental protection as well as with occupational health services and occupational safety. Examples of these are the many deficiencies in working conditions, the scarcity of co-operation in environmental protection and occupational safety and the emission of traffic that threaten the quality of air”. (WHO 1981.)

For example, an article by Botha (2021, in this book) clearly shows how environmental toxins are part of occupational hazards. Occupational hazards are different in nature from general environmental exposure agents because work, if there are exposure agents, most often emphasizes the amount of exposure, duration of action, and systematic nature of the effect, but environmental exposures are usually sporadic and temporary. But the importance of environmental exposures and a questionable lifestyle can multiply by the effect of environmental hazards, or vice versa.

An individual's genes, lifestyle, and behaviours are part of his or her work and other living environment. This individual is also a member of society as well as an actor in the global community. However, it can be said that while everything affects everything, work and the work environment may be the cause of illness, infertility and / or pregnancy problems or illness of the unborn child.

Occupational exposures and fertility, pregnancy, and the unborn child

In recent decades, there has been a growing understanding of the importance of occupational exposures to fertility and pregnancy, but even more so, for example, the harmful effects of pesticides and herbicides on gametes often become apparent by chance. When we are talking about occupational exposures and fertility, it is good to remember, in simple terms, the sex segregation is also observed between the occupation and fertility (Begall & Mills 2012). In female dominated jobs females are more fertile (get earlier pregnant and have more children) than females in male dominated jobs.

Occupational exposure agents are divided into chemical, physical, and biological exposures. Exposure may occur at work by inhalation, through the skin or through the gastrointestinal tract.

The aim of the EU directive (92/85 / EEC) is to promote the safety and health of pregnant workers and workers, who have recently given birth or are breastfeeding. The directive prohibits pregnant women from working under pressure or diving, working in an environment involving exposure to *Toxoplasma gondii* and Rubella virus, lead and its derivatives, and underground mining.

Chemical exposure agents

Some chemical exposure agents can damage sperm formation in the testicles in exposed men, which can result in infertility. In women, on the other hand, a possible link between exposure agents to organic solvents and miscarriages has been observed. A toxic substance may cause the death of a developing embryo or unborn child, cause a structural abnormality, i.e. be teratogenic, interfere with fetal growth or cause functional changes in the offspring, including in breastfed children. Table 1 describes some chemical exposure agents from heavy metals lead and mercury, organic solvents, anaesthetic gases, cytostats, pesticides, and tobacco smoke from environment. Table 1 also describes as examples the possible effects of these substances as well as examples of occupations where one may be exposed to these substances.

Table 1. Chemical exposure agents

Exposure agent	possible effects, for example	exposed jobs, for example
Lead	menstrual disorders affects the development of healthy sperm, leads to lower sperm count	painters plastics and rubber industry graphic arts industry manufacture of art ceramics
Mercury	fertility decrease (F&M) fetal growth retardation, damage to the fetal nervous system	pesticide industry repair and maintenance work chlorine industry
Organic solvents	menstrual disorders increase fertility decrease lower sperm count number of abnormal sperm increase risk of miscarriages increases risk of deformities increases low birth weight	painting and varnishing work gluing work silk screen floor waxing work printing work
Anaesthetic gases	fertility decrease risk of abortions increases risk of deformities increases low birth weight	maternity ward work operating theatre work dental clinic work veterinary work
Chemotherapy (changes may be genotoxic)	menstrual disorders increase fertility decrease (F&M) risk of deformities increases	tasks to dilute chemotherapy cleaning rooms where chemotherapy are made injection of cytostats
Pesticides	fertility decrease oestrogen-like effects, linked to poor semen quality risk of abortions increases risk of deformities increases low birth weight	farming work gardening work
tobacco smoke from environment	risk of miscarriages increases risk for premature births increases low birth weight	

Physical exposures

According to EU Directive 92/85 / EEC, the physical factors to be assessed during pregnancy are radiation, shock, vibration or movement, heavy lifting (risk for the back), noise, ionizing and non-ionizing radiation, extreme cold or heat, movement; and postural issues, mental and physical fatigue, and other physical exertion. Table 2 describes occupational exposures and their possible effects as example.

Table 2. Physical exposure agents

Exposure agent		possible effects, for example
Ionizing radiation (male & female)	electromagnetic X-ray and gamma radiation	in living cells, ionization can damage the cell's genome, the DNA molecule. abnormal sperm and lower sperm count, central nervous system damage to the unborn child risk of intellectual disability, microcephaly risk of fetal short stature
	alpha and beta particle radiation	
Non-ionizing radiation (radiofrequency electromagnetic radiation, microwave radiation)		sperm quality deteriorates male fertility decreases
Physical exertion		hormonal imbalances decreased uterine blood flow may harm the unborn child risk of miscarriage increases risk of preterm birth increases low birth weight
Noise		causes stress -> vasoconstriction of placental circulation increased risk of preterm birth retardation of fetal growth (effect on child's hearing > 85dB)
Heat exposure (male)		elevation of scrotal temperature to normal core body temperature results in complete failure of spermatogenesis, quality of semen decreases morphologically abnormal sperm, decreased sperm motility and count
Night work		risk of miscarriage increases, risk of preterm birth increases
Stress		prolonged and intense stress levels impair fertility
Violence or treat of violence		prolonged and intense stress levels impair fertility, risk of miscarriage/abortion, injury of unborn child

Biological exposure agents

Any pathogen, bacteria, viruses, or parasites in the mother's body can pass through the placenta to the fetus. The severity of the infection depends on the pathogen, the mother's immunity, and the stage of pregnancy. Maternal antibodies protect the fetus and unborn child from many infections.

Biological agents or diseases, which may damage fertility, cause harm for pregnancy or unborn child, are for example *Toxoplasma gondii*, *Listeria monocytogenes*, Hepatitis-B, HIV, Chicken pox, Rubella, Measles and Erythrovirus (Table 3). Delbaere (2021, in this book) in 'Infectious diseases' describes many of these biological exposures and how to protect oneself. On the other hand, in Mivšek's (2021, in this book) article she describes sexually transmitted infections, which might also be transmitted in work environments e.g. through dirty needles. In Table 3 are presented some possible effects, which biological exposure agents might have.

Table 3. Biological exposure agents

Exposure agent	possible effects, for example
Toxoplasma gondii	increased risk of injury to the unborn child increased risk of miscarriage increased risk of intrauterine death
Listeria monocytogenes	increased risk of miscarriage increased risk of death of newborn
Hepatitis-B	the newborn becomes infected
HIV	the newborn becomes infected
Chicken pox	increased risk of miscarriage risk of deformities increases
Rubella	risk of deformities increases Rubella-syndrome: heart defects, central nervous system developmental disorders
Measles	increased risk of miscarriages increased risk of intrauterine death
Erythrovirus	increased risk of intrauterine death

These effects are focusing mostly on the time during pregnancy. It remains unclear, how much before the conception special hazards should be avoided, but in principle all occupational hazards are hazards for health as long they exist.

Secondary infertility or problems in fertility due to work

We can speak of work-related secondary infertility or disorders in infertility. For example, the treatment of work-related cancer may lead to infertility problems. Strong cancer treatments can deplete a woman's entire egg supply, leading to sex hormone deficiency and infertility. Treatments can also reduce testicular sperm production or stop it altogether. Male fertility may be partially or completely restored after treatments. Permanent or long-term disruption of sperm production occurs when cancer treatment affects testicular stem cells.

Reproductive toxicity of substances and CLP -regulations

The European Commission verifies CLP (the classification, labelling and packaging of substances and mixtures) -regulations yearly. All packages, which maintain hazardous or harmful substances to reproductive health must bear a label, and it is good for everybody to know the pictograms to avoid these hazardous products.

Toxicants and mixtures, which may cause genetic defects or damage fertility or the unborn child, are identified by their CLP classification as category 1 A or 1 B. If the substance or mixture is suspected of causing genetic defects or impairing fertility or harm to the unborn child, it is classified in Category 2 according to the CLP. In addition, they are labelled with the following hazard statement and signal word according to the category (Table 4), and the warning symbol (Picture 1).

Table 4. Mandatory statements in products, which may cause effects to fertility or unborn children

Hazard statement	Signal word	Hazard category
May cause genetic defects	DANGER	1A and 1B
Suspected of causing genetic defects	Warning	2
May damage fertility or the unborn child	DANGER	1A and 1B
Suspected of damaging fertility or the unborn child	Warning	2

Picture 1 is in Finnish, but in every country the pictogram is similar, and the statement and signal word is in the same place in each individual country and language.



Picture 1. An example of a hazard pictogram.

Health promotion in the workplace and occupational environment

If a potential hazard or harm is identified for fertility or pregnancy, the primary goal is to eliminate it. If the hazard or harm is not eliminated, this person, male or female, needs to be transferred to a position better suited for the preconception period and pregnancy. The hallmarks of a health promoting workplace are:

1. The work culture of the workplace supports safe work
2. The work environment enables and supports healthy choices
3. The culture and professional identity of the work community encourages and accepts healthy choices
4. Individual attitudes, knowledge, and skills promote healthy choices and habits

To conclude

Cynically, it can be stated that while man invented agriculture, its' by-products were the invention of work, and work-related injuries and diseases. It is only in the last 50–70 years that we have paid serious attention to the dangers of work to reproductive health, and pregnancy. Research is being done all over the world, and the understanding is evolving continuously. However, people in different parts of the world are in a very unequal position. On the other hand, one can from time to time read about how many countries, or the various factories in many countries, do not heed to health regulations, not to mention the protection of individuals' reproductive health or pregnancy. On the other hand, researchers in universities are currently more or less confused about microplastics and nanoparticles, and their importance to fertility and pregnancy.

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