



# Guide to Healthy Pregnancies in the Mining Workplace

A Laurentian University &  
Workplace Safety North Initiative

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# Introduction

Mining workplace employers have a legal responsibility to ensure the health and safety of their employees. As the number of female employees increase in the industry, questions and concerns related to the health and safety of pregnant and breastfeeding employees are becoming more prevalent. An understanding of the potential impact of workplace hazards on the pregnant and breastfeeding employee and her developing fetus and ways to eliminate or reduce the exposure risk are essential.

## What is a reproductive hazard?

A hazard is an agent that has the potential to cause harm to a person. A 'reproductive' hazard is therefore an agent that can adversely affect the reproductive health of women and men and/or that can negatively impact the growth and development of a fetus. Examples of reproductive problems linked to hazardous agents include infertility, miscarriages, premature labor (<37 weeks gestation), low birth weight and congenital abnormalities of the baby. Hazardous agents are present in both non-occupational and occupational settings.

## Objectives of this Guide

This guide was developed with two objectives in mind. The first objective was to provide information about the health effects of workplace hazards in the mining industry on pregnant and breastfeeding employees and on the developing fetus. The second objective was to provide information about safety measures or controls that can be put in place to prevent or minimize exposure to these hazards. In many cases, only minor restructuring of the work environment or work schedule and use of protective equipment are required to ensure the safety of the pregnant employee and her unborn child. Employers and employees need to make decisions in the best interest of the employee, on a case-by-case basis using the information provided as a guideline. These suggestions may not encompass all possible ways of minimizing or preventing exposure.

This guide serves as an information resource for human resource managers, occupational therapists, industrial hygienists, employers, supervisors, and employees but should be used with other resources such as confidential interviews with trained health and safety professionals including nurses and physicians, in order to address all concerns in this area.

This guide has not been designed to address the occupational safety matters related to conception or male reproductive biology.

## How to use this Guide

In this guide, hazards in the mining workplace are listed under three major subheadings: physical agents (noise, vibration, heat, radiation); chemical agents (gases, dusts, mists, vapors, metals) and other factors (ergonomic factors, scheduling and workplace stress). Each hazardous agent is identified in the first column and examples of where the agent

is encountered are listed in the second column. In the third column, the risk to the pregnant and breastfeeding employee and the developing fetus is described. In the fourth column, safety measures and controls are described to prevent or minimize the employee's exposure to the agent. When available, the occupational dose or "STEL" (short-term exposure limit) and "TWA" (time-weighted average limit) for the non-pregnant worker are also included for the hazardous agent.

Specific hazardous agents have been selected that are likely to be encountered in the mining workplace, and therefore this guide is not all-inclusive. For instance, the potential negative impacts of biological agents such as viruses, fungi and mold are not included in this guide because the levels of exposure to these agents and the associated risks are not thought to be greater in the mining environment.

There is scientific uncertainty about what regulatory agencies should do to protect the pregnant employee. There are two reasons for this uncertainty. First, identified workplace hazards are generally studied in the non-pregnant employee population, so regulatory agency-determined levels are also based upon the non-pregnant employee. Secondly, because human studies examining the reproductive effects of hazardous agents in the pregnant employee are limited, much of our knowledge comes from animal studies.

Given the sensitive timeframe of the developing fetus and the uncertainty of harm, most regulatory agencies recommend exposure levels be kept to an absolute minimum. Every effort should be made by both the employer and the employee to minimize risk of exposure.

## Why a pregnant employee is at greater risk to hazards

A pregnant woman's body undergoes physical changes that can make her more susceptible to workplace hazards. Those changes occur in almost every system in the body, including the circulatory, respiratory, endocrine, and musculoskeletal systems.

Higher heart rates are normal, particularly during physical activity and the volume of blood increases 30-40%. These changes can put the pregnant employee at increased risk for dehydration, edema and fatigue, among other things.

Due to the fetus' demands for oxygen, the mother's respiratory depth increases. This means that the total amount of air breathed into and out of the lung per minute is larger during pregnancy. As a result, the amount of inhaled toxicants may be significantly greater during pregnancy compared to the non-pregnant state.

Hormones produced during pregnancy cause ligaments, tendons and other connective tissues to soften. These changes prepare the body for delivery, but also make it more prone to injury; particularly for tasks that stretch joints.

Anatomical changes caused by the expanding uterus compounds these risks, by placing increased strain on the back, further increasing the risk of back injury. Enlargement of the uterus can also decrease blood flow to the legs and impinge the sciatic nerve.

## Breastfeeding

It is accepted that there are important benefits of breastfeeding and every effort should be made to support the breastfeeding employee, but contaminants can get into breast milk through inadvertent exposure. Therefore, breastfeeding employees and their employers need to continue minimizing occupational hazard exposures. In cases of known or suspected exposure to a contaminant, blood plasma levels of the hazardous agent should be measured in the employee, preferably prior to breastfeeding. Monitoring plasma levels of a hazardous agent can provide a window for predicting the levels of the hazardous agent in breast milk. These estimates can be used to determine how long to limit breastfeeding. Breast milk can be pumped and discarded during this period in order to allow continued breastfeeding of the child. In rare cases of excessive contamination, it may be necessary to stop breastfeeding. Always seek advice from a lactation consultant and physician.

Women who are breastfeeding need to stay well hydrated, especially in warm environments, in order to ensure adequate milk supply.

## Disclaimer

The information contained in this material is provided as a guide only. Workplace Safety North (WSN) and Laurentian University (LU) recognize that individual companies must develop health and safety policies and programs that apply to their workplaces and comply with appropriate legislation. This material does not constitute legal advice. While the information provided, including references to legislation and established practice, is current at the time of printing, it may become out-of-date or incomplete with the passage of time.

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PHYSICAL HAZARD	EXAMPLES IN THE MINING INDUSTRY	RISK: FETUS AND/OR MOTHER AND/OR BREASTFEEDING	ACTION TO AVOID THE RISK
<b>Extremes of Heat</b>	Summer mine work, depth, working in any hot and/or humid environment	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Developmental abnormalities including neural tube defects, heart defects and abdominal wall defects <sup>[23, 75, 78]</sup></li> <li>- Spontaneous abortion <sup>[54, 88]</sup></li> <li>- Fetal Distress <sup>[108]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Increased risk of dehydration, causing risk of early labour, heat stress and fainting</li> <li>- Increased risk of heat exhaustion and heat stress particularly associated with obesity and/or decreased fitness</li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- May be hampered by heat-induced dehydration <sup>[90]</sup></li> <li>- Dehydration affects the characteristics of breast milk <sup>[90]</sup></li> </ul>	<p>Avoid maternal core temperature &gt; 38.0°C because fetal temperature is approximately 1°C higher than maternal core temperature. <sup>[7]</sup></p> <p>Regular consumption of water to avoid dehydration; drink 2 cups a day more than before becoming pregnant (extra fluid demands during pregnancy).</p> <p>Review the potential sources of heat exposure to recognize and avert risks.</p> <p>Educate worker on increased risk and symptoms of heat exhaustion, heat stroke and dehydration.</p> <p>Heat stroke should be treated as a medical emergency.</p> <p>Avoid environmental temperatures above 32°C especially in the first trimester.</p> <p>During exposure to high temperature; wear monitoring devices for core temperature (e.g. auditory sensor) and heart rate (&gt;160 beats/min take action).</p> <p>Recommend wearing 'cooling vests' when known to be exposed to high temperatures.</p> <p>Recommend elevating legs during all rest breaks.</p> <p>Job-switching recommended during periods of prolonged exposure to strenuous work performed in high temperature/ high humidity settings.</p> <p>Note: fetal risks are increased with strenuous work combined with high temperatures (reviewed in <sup>[88]</sup>).</p>
<b>Hyperbaric Environment</b>	Miners working in deep tunnels	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Insufficient data</li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Same as non-pregnant workers <sup>[88]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Insufficient data</li> </ul>	Insufficient data

PHYSICAL HAZARD	EXAMPLES IN THE MINING INDUSTRY	RISK: FETUS AND/OR MOTHER AND/OR BREASTFEEDING	ACTION TO AVOID THE RISK
<b>Ionizing Radiation</b>	Radiation in mines; especially in mines where thorium or uranium is found	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Spontaneous abortion particularly in early pregnancy <sup>[77, 102]</sup></li> <li>- Central nervous system development problems throughout pregnancy <sup>[62]</sup></li> <li>- Microcephaly, mental retardation and ocular abnormalities <sup>[33]</sup></li> <li>- Incidence of major malformation <sup>[63]</sup></li> <li>- Post-natal risk of cancer particularly after middle to late pregnancy exposure <sup>[2]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Increased risk of leukemia <sup>[63]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Insufficient data</li> </ul>	<p>Maximum occupational dose for the entire pregnancy is 0.5mSv/year <sup>[3]</sup>. This is based upon the average non-occupational exposure of 3 mSv/year. <sup>[2,3]</sup></p> <p>For breastfeeding mothers avoid radiation above the occupational dose limit of 50 mSv/yr. <sup>[41]</sup></p>
	Radon gas	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- No reports linking radon to birth defects, any reproductive study of miners would entail coincidental exposures which could be difficult to control <sup>[41]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Increased risk of lung cancer due to normal physiological changes associated with respiration which occur during pregnancy</li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Insufficient data</li> </ul>	<p>Follow standard exposure regulations for non-pregnant worker.</p> <p>Refer to section 289 of Regulation 854 (Mines and Mining Plants). <sup>[8]</sup></p>

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<b>Noise</b>	Vehicular machinery, power tools, pneumatic tools, compressed air discharge, ventilation fans	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Hearing impairment from exposure to lower frequency sounds or loud bursts <sup>[7, 41, 57]</sup></li> <li>- Low birth weight <sup>[48, 71, 72, 116]</sup></li> <li>- Preterm delivery <sup>[66, 72, 73, 82]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Increased risk of pregnancy-induced hypertension <sup>[82]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Exposure to occupational noise may decrease oxytocin release, a compound necessary for milk letdown <sup>[107]</sup></li> </ul>	<p>During entire pregnancy, avoid continuous (&gt; 8 hours) exposure to noises greater than 85dBA. <sup>[49, 57, 66, 68, 96]</sup></p> <p>If expressing milk (pumping) or breastfeeding in the workplace, do so in a quiet room.</p> <p>Beyond the 5<sup>th</sup> month of pregnancy avoid continuous (≥ 8 hours) exposure to 115 dB or peak exposure of 155 dB. <sup>[7]</sup></p>
<b>Vibration</b>	Vehicle operation, equipment, vibrating floors near heavy equipment operations, vibrating platforms	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Miscarriage <sup>[100]</sup></li> <li>- Preterm delivery <sup>[29, 110]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- May reduce uterine blood flow <sup>[85]</sup></li> <li>- May increase risk of preeclampsia <sup>[47]</sup></li> <li>- May increase compression, stress and strain of the spine <sup>[100]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Insufficient data</li> </ul>	<p>During entire pregnancy, keep whole body vibrations to a minimum. A safe limit to avoid a higher risk cannot be derived from the literature. <sup>[100, 110]</sup></p> <p>Vibration at resonance frequencies of the spine (10-12 Hz) and the uterus (8 Hz) should be avoided (reviewed in <sup>[41]</sup>).</p>





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<b>Aluminum</b>	May be encountered during bauxite mining or aluminum refining or processing, welding	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- In cases of severe aluminum exposure: neurobehavioural abnormalities resulting from central nervous system toxicity <sup>[36]</sup></li> <li>- Low birth weight <sup>[27]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- No known effects</li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- No known effects</li> </ul>	<p>No set standards for pregnant worker; therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker (metal dust): 1 mg/m<sup>3</sup>(Respirable fraction)<sup>[7, 56]</sup></p> <p>Threshold limit values for pregnant worker <sup>[41]</sup>:</p> <ul style="list-style-type: none"> <li>- Pyro powders: 5 mg/m<sup>3</sup></li> <li>- Welding fumes: 5 mg/m<sup>3</sup></li> <li>- Soluble salts: 2 mg/m<sup>3</sup></li> <li>- Alkyls: 2 mg/m<sup>3</sup></li> </ul>
<b>Arsenic</b>	Product of mechanical extraction of ores or minerals, byproduct of smelting lead, copper, and zinc ores	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Spontaneous abortion <sup>[35, 45]</sup></li> <li>- Exencephaly, eye defects, renal agenesis, and skeletal abnormalities <sup>[45]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Class A1 confirmed human carcinogen; same risk as non-pregnant worker <sup>[41]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- No known effects. It is excreted in breast milk in small amounts, i.e. less than environmental sources <sup>[44]</sup></li> </ul>	<p>TWA non-pregnant workers: 0.01 mg/m<sup>3</sup> <sup>[7, 56]</sup></p> <p>STEL non-pregnant workers: 0.05 mg/m<sup>3</sup> <sup>[7, 56]</sup></p>
<b>Beryllium</b>	Control rods in nuclear reactors, sheet metal or wire, welding	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Spontaneous abortion <sup>[64]</sup></li> <li>- Decreased fetal growth <sup>[64]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Class A2 suspected human carcinogen <sup>[59]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Insufficient data</li> </ul>	<p>No set standards for pregnant worker; therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker: 0.002 mg/m<sup>3</sup> <sup>[7, 56]</sup></p> <p>STEL non-pregnant worker: 0.01 mg/m<sup>3</sup> <sup>[7, 56]</sup></p>

CHEMICAL HAZARD	EXAMPLES IN THE MINING INDUSTRY	RISK: FETUS AND/OR MOTHER AND/OR BREASTFEEDING	ACTION TO AVOID THE RISK
<b>Cadmium</b>	<p>Product of mechanical extraction of ores or minerals, product from the smelting of zinc, lead, copper ores</p> <p>Cigarette smoking is a source of cadmium exposure.</p>	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Cadmium concentrates in the placenta and may alter the placental barrier with possible adverse affects to the fetus <sup>[41]</sup></li> <li>- Chromosomal aberrations <sup>[53]</sup></li> <li>- Stillbirth <sup>[21]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Mutagen and a class A2 suspected human carcinogen <sup>[80]</sup></li> <li>- Inhalation results in approximately 50% absorption of respirable particles. About 5% of ingested dose will be absorbed increasing risk of calcium and/or iron deficiency <sup>[41]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Excreted in breast milk <sup>[98]</sup></li> </ul>	<p>TWA non-pregnant worker <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- 0.002 mg/m<sup>3</sup> (Respirable fraction)</li> <li>- 0.01 mg/m<sup>3</sup></li> </ul> <p>The plasma half-life of cadmium is very long; therefore under circumstances of known acute exposure; consult a lactation specialist or other health professional about potential for continuing to breastfeed.</p> <p>Tobacco smoke is an important environmental source of cadmium and has associated risks of pre-term delivery and low birth weight; therefore educate workers on the importance of quitting smoking and avoiding second-hand smoke to reduce cumulative effects.</p>
<b>Carbon Monoxide</b>	<p>Diesel exhaust, iron and steel foundries, welding, forklift operations, improper ventilation</p> <p>Cigarette smoking is a source of carbon monoxide exposure.</p>	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Hypoxia <sup>[41]</sup></li> <li>- Abnormalities including brain damage particularly during the first trimester <sup>[114]</sup></li> <li>- Stillbirth in acute carbon monoxide poisoning <sup>[5]</sup> (reviewed in <sup>[46]</sup>)</li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Increased risk of inhalation and asphyxiant exposure than non-pregnant state, due to normal physiologic changes in pregnancy <sup>[41]</sup></li> <li>- Dizziness and headache (35-400 ppm)</li> <li>- Immediate danger to life and health (IDLH) at &gt;1200 ppm based on the US National Institute for Occupational Safety and Health (NIOSH) rating <sup>[81]</sup></li> <li>- Death (&gt; 1600 ppm) <sup>[46]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- No effect</li> </ul>	<p>Avoid Occupational levels &gt;14ug/m<sup>3</sup> during entire pregnancy <sup>[5]</sup> (reviewed in <sup>[88]</sup>).</p> <p>TWA non-pregnant worker: 25 ppm <sup>[7, 56]</sup></p> <p>STEL non-pregnant worker: 100 ppm <sup>[7, 56]</sup></p> <p>Fetal carboxyhemoglobin levels are approximately 10%–15% higher than maternal levels. <sup>[46]</sup></p> <p>Seek medical advice, particularly if maternal carboxyhemoglobin levels are 15% or higher. <sup>[41]</sup></p> <p>Educational workshop; review by worker of safety regulations to keep carbon monoxide levels at a minimum during shift.</p> <p>Tobacco smoke is an important environmental source of carbon monoxide and has associated risks of pre-term delivery and low birth weight; therefore educate workers on the importance of quitting smoking and avoiding second-hand smoke to reduce cumulative effects.</p>

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<p><b>Chromium (metal/inorganic) hexavalent form</b></p> <p><b>The trivalent form, in trace amounts, is an essential nutrient for glucose metabolism.</b></p>	Inhalation exposure hazard during stainless steel welding, corrosion inhibitor	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Crosses the placenta <sup>[41]</sup></li> <li>- Fetotoxicity occurs at levels that produce maternal toxicity <sup>[35]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Hexavalent form of chromium (Cr VI) is a class A1 confirmed human carcinogen <sup>[31]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Excreted in breast milk <sup>[22]</sup></li> </ul>	<p>No set standards for pregnant worker; therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- Metal and Cr III compounds: 0.5 mg/m<sup>3</sup></li> <li>- Water-soluble Cr VI compounds: 0.05 mg/m<sup>3</sup></li> <li>- Insoluble Cr VI compounds: 0.01 mg/m<sup>3</sup></li> </ul> <p>The plasma half-life of chromium is very long; therefore under circumstances of known acute or chronic exposure, consult a lactation specialist or other health professional about potential for continuing to breastfeed.</p>
<p><b>Copper</b></p> <p><b>Copper is an essential nutrient, but is toxic at high doses.</b></p>	Used in alloys and in electroplating	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Insufficient data</li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Insufficient data but copper is a A3 animal carcinogen <sup>[41]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Copper is excreted in breast milk as an essential nutrient <sup>[41]</sup></li> </ul>	<p>No set standards for pregnant worker; therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- Fume: 0.2 mg/m<sup>3</sup></li> <li>- Dust and mists: 1 mg/m<sup>3</sup></li> </ul>
<p><b>Fire By-products</b></p>	Mine fire	<p><b>Fetus/Mother/Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Chemical agents in the fire environment are numerous and unpredictable. The toxic effects of fire smoke may adversely affect the fetus and the mother, particularly from carbon monoxide (CO) exposure (see above).</li> </ul>	<p>If a fire occurs, when possible, let other workers deal with the fire and leave the area immediately.</p> <p>If significant smoke inhalation occurs, seek medical advice.</p> <p>Express and discard breast milk after exposure.</p>

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<b>Hydrogen Sulfide</b>	Iron smelters, blast emissions	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- May increase the risk of spontaneous abortion <sup>[50]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Toxic irritant and asphyxiant gas; increased risk of inhalation exposure due to normal physiological respiratory changes during pregnancy <sup>[88]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Insufficient data</li> </ul>	<p>No set standards for pregnant worker; therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker: 1 ppm <sup>[6]</sup></p> <p>STEL non-pregnant worker: 5 ppm <sup>[6]</sup></p> <p>In the case of acute exposure seek medical advice.</p>
<b>Lead (elemental/inorganic)</b>	Used in alloys, and as a chemical compound in pigments, in rubber compounding and in battery plates, fire assay processes	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Lead crosses the placenta <sup>[41]</sup></li> <li>- Stillbirth <sup>[95,112]</sup></li> <li>- Pre-term delivery <sup>[12]</sup></li> <li>- Post-natal effects including neurologic damage <sup>[61]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Class A2 suspected human carcinogen <sup>[41]</sup></li> <li>- Hypertension <sup>[91]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Excreted in breast milk <sup>[98]</sup></li> </ul>	<p>No set standards for pregnant worker; therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- Elemental lead: 0.05 mg/m<sup>3</sup></li> <li>- Tetraethyl lead: 0.10 mg/m<sup>3</sup></li> </ul> <p>STEL non-pregnant worker <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- Tetraethyl lead: 0.30 mg/m<sup>3</sup></li> </ul> <p>The half-life of lead in breast milk is 13 weeks. Lead levels in breast milk can be measured and should not exceed 51 ppb. <sup>[41]</sup> Milk to plasma ratio for lead is 0.2 <sup>[88]</sup>; therefore under circumstances of known acute or chronic exposure; consult a lactation specialist or other health professional about potential for continuing to breastfeed.</p>
<p><b>Manganese (elemental/organic)</b></p> <p><b>Manganese is an essential trace nutrient, but is toxic at high doses.</b></p>	Used in steel production, as chemical compounds, and in welding rods	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Suspected postnatal neurologic developmental problems <sup>[26]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Insufficient data</li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Manganese is excreted in breast milk. Adverse neurodevelopmental effects due to magnesium oxide dust exposure <i>in utero</i> can be exacerbated when exposure is continued through breastfeeding <sup>[65]</sup></li> </ul>	<p>No set standards for pregnant worker; therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- Inorganic forms: 0.2 mg/m<sup>3</sup></li> <li>- Cyclopentadienyl tricarbonyl: 0.1 mg/m<sup>3</sup></li> </ul> <p>The plasma half-life of manganese is relatively long; therefore under circumstances of known acute exposure, consult a lactation specialist or other health professional about potential for continuing to breastfeed.</p>

CHEMICAL HAZARD	EXAMPLES IN THE MINING INDUSTRY	RISK: FETUS AND/OR MOTHER AND/OR BREASTFEEDING	ACTION TO AVOID THE RISK
<b>Mercury</b>	Gold extraction in mines, natural substance in ores that are concentrated during the refining process	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Mercury crosses the placenta; profound teratogen <sup>[41]</sup></li> <li>- Brain damage, mental retardation, cerebral palsy, limb deformity, blindness, and seizures <sup>[10,11,69]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Same as non-pregnant state</li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Elemental mercury is excreted in breast milk <sup>[98]</sup></li> </ul>	<p>No set standards for pregnant worker; therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- Alkyl compounds (as Hg): 0.01mg/m<sup>3</sup></li> <li>- All forms except alkyl (as Hg): 0.025 mg/m<sup>3</sup></li> </ul> <p>STEL non-pregnant worker <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- Alkyl compounds (as Hg): 0.03 mg/m<sup>3</sup></li> </ul> <p>The plasma half-life of mercury is very long; therefore under circumstances of known acute exposure, consult a lactation specialist or other health professional about potential for continuing to breastfeed. The milk to plasma ratio for mercury is 0.9. <sup>[89]</sup></p>
<b>Mono-ammonium Phosphate and Sodium Alkyl Sulfate</b>	Fire extinguisher	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- No known effects</li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- High dust concentrations of airborne material may cause irritation of the nose and upper respiratory tract with symptoms such as sore throat and coughing <sup>[1]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- No known effects</li> </ul>	<p>Avoid usage.</p> <p>If a fire occurs, when possible, let other workers deal with the fire and the pregnant worker should leave the area immediately.</p>
<b>Nickel</b>	Used in alloys such as stainless steel and nickel carbonyl produced during nickel refining	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Spontaneous abortion and birth defects <sup>[25]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Nickel compounds are mutagenic and carcinogenic <sup>[103]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Present in breast milk <sup>[41]</sup></li> </ul>	<p>No set standards for pregnant worker; therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- Elemental/metal: 1 mg/m<sup>3</sup></li> <li>- Insoluble compounds: 0.2 mg/m<sup>3</sup></li> <li>- Soluble compounds: 0.1 mg/m<sup>3</sup></li> <li>- Nickel subsulfide: 0.1 mg/m<sup>3</sup></li> <li>- Nickel carbonyl: 0.05 ppm</li> </ul> <p>The plasma half-life of nickel is relatively short (1-2 days); therefore under circumstances of known acute exposure, consult a lactation specialist or other health professional about potential for continuing to breastfeed and pump and discard breast milk for several days after exposure.</p>

CHEMICAL HAZARD	EXAMPLES IN THE MINING INDUSTRY	RISK: FETUS AND/OR MOTHER AND/OR BREASTFEEDING	ACTION TO AVOID THE RISK
<b>Nitrates, Nitrites, and Organic Nitro Compounds</b>	Explosives, blasting rock	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Spontaneous abortion <sup>[16]</sup> (reviewed in <sup>[41]</sup>)</li> <li>- Methemoglobinemia and postnatal encephalopathy <sup>[14,97]</sup> (reviewed in <sup>[41]</sup>)</li> <li>- Early postnatal death <sup>[104]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Dinitrotoluene is a class A2 suspected human carcinogen; same risk as non-pregnant worker <sup>[41]</sup></li> <li>- Increased risk of methemoglobinemia due to normal physiologic changes in blood volume, erythrocyte mass and oxygen consumption associated with pregnancy (reviewed in <sup>[41]</sup>)</li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- May be excreted in breast milk <sup>[20,19]</sup></li> </ul>	<p>No set standards for pregnant worker. Therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- Dinitrotoluene: 0.2 mg/m<sup>3</sup></li> <li>- Nitrobenzene: 1 ppm</li> <li>- Nitroglycerin: 0.05 ppm</li> <li>- Trinitrotoluene: 0.1 mg.m<sup>3</sup> or 0.01 ppm</li> </ul> <p>STEL non-pregnant worker <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- Trinitrotoluene: 0.02 ppm or 0.2 mg/m<sup>3</sup></li> </ul> <p>Express and discard breast milk after exposure.</p>
<b>Nitrogen Oxides (NOx): Nitrogen Dioxide (NO<sub>2</sub>) and Nitric Oxide (NO)</b>	Diesel exhaust, welding, blasting gases	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Reduction in fetal growth including birth weight, length, and head circumference; particularly during first two trimesters <sup>[30, 60, 67]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Increased blood pressure <sup>[109]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- No known effects</li> </ul>	<p>No known safe levels. Air pollution studies indicate an increased risk above regular exposure to &gt; 40ug/m<sup>3</sup>. <sup>[15, 60]</sup> Therefore, keep exposures 'As Low As Reasonably Achievable'.</p> <p>TWA non-pregnant workers <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- Nitric Oxide: 25 ppm or 45 mg/m<sup>3</sup></li> <li>- Nitrogen Dioxide: 3 ppm</li> </ul> <p>STEL non-pregnant workers <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- Nitrogen Dioxide: 5 ppm</li> </ul> <p>Regular personal exposure monitoring throughout pregnancy.</p> <p>Educational workshop; review with worker safety regulations to keep NOx levels at a minimum during shift.</p>

CHEMICAL HAZARD	EXAMPLES IN THE MINING INDUSTRY	RISK: FETUS AND/OR MOTHER AND/OR BREASTFEEDING	ACTION TO AVOID THE RISK
<b>Particulate Matter (PM)</b>	<p>Diesel exhaust from machinery, rock dust</p> <p>Cigarette smoke is a source of Particulate Matter.</p>	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Preterm delivery <sup>[43]</sup></li> <li>- Low birth weight; <sup>[30, 115]</sup> based on epidemiological studies of air pollution; PM<sub>2.5</sub> and PM<sub>10</sub> have an association with low birth weight and preterm birth. For every 10 mg/m<sup>3</sup> increase in PM<sub>2.5</sub>; an increase in preterm birth by 6-15% is estimated <sup>[115]</sup></li> <li>- Increased asthma and allergy susceptibility <sup>[76]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Pregnancy induced hypertension and preeclampsia <sup>[109]</sup></li> </ul> <p><b>Breastfeeding:</b> No known effects</p>	<p>No known safe limits of particulate matter (personal communication with Dr. M. Brauer 2011; also see <sup>[18]</sup>).</p> <p>Keep exposures 'As Low As Reasonably Achievable'.</p> <p>TWA non-pregnant worker respirable combustible dust:</p> <ul style="list-style-type: none"> <li>- 1.5 mg/m<sup>3</sup> (effective January 2012, TWA for total carbon will be set at 0.4 mg/m<sup>3</sup>) <sup>[8]</sup></li> </ul> <p>Regular personal exposure monitoring throughout pregnancy.</p> <p>Educational workshop; review by worker of safety regulations to keep particulate matter levels at a minimum during shift.</p> <p>Tobacco smoke alone enhances the risk of pre-term delivery and low birth weight; educate workers on the importance of quitting smoking and avoiding second-hand smoke to reduce cumulative effects.</p>
<b>Polycyclic Aromatic Hydrocarbons</b>	<p>Generated from incomplete combustion of organic material and fossil fuels, vehicle exhaust</p> <p>Cigarette smoke is a source of Polycyclic Aromatic Hydrocarbons.</p>	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Miscarriage <sup>[32]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Increased risk of inhalation exposure to this A1 confirmed human carcinogen due to normal physiologic changes in respiration during pregnancy <sup>[41]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- No known effects</li> </ul>	<p>No set standards for pregnant worker; therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker: Keep exposure by all routes as low as possible <sup>[7, 56]</sup></p> <p>Educational workshop; review by worker of safety regulations to keep particulate matter (because polycyclic aromatic hydrocarbons typically bind to fine particulate matter) levels at a minimum during shift.</p> <p>Tobacco smoke is an important environmental source of polycyclic aromatic hydrocarbons and has associated risks of pre-term delivery and low birth weight; therefore educate workers on the importance of quitting smoking and avoiding second-hand smoke to reduce cumulative effects.</p>
<b>Selenium</b> <b>Selenium is an essential nutrient but potentially toxic at high doses.</b>	<p>Product of mechanical extraction of ores or minerals</p>	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Limited data</li> <li>- One report of occupational exposure describes an increased risk of miscarriage <sup>[92]</sup></li> </ul> <p><b>Mother:</b> Insufficient data</p> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Is excreted in breast milk as an essential nutrient <sup>[41]</sup></li> </ul>	<p>No set standards for pregnant worker; therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- Selenium and compounds: 0.2 mg/m<sup>3</sup></li> <li>- Selenium hexafluoride: 0.025 ppm or 0.1 mg/m<sup>3</sup></li> </ul>



CHEMICAL HAZARD	EXAMPLES IN THE MINING INDUSTRY	RISK: FETUS AND/OR MOTHER AND/OR BREASTFEEDING	ACTION TO AVOID THE RISK
<b>Tellurium</b>	Product of mechanical extraction of ores or minerals	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Tellurium does not appear to cross the placenta in humans and adverse human reproductive effects have not been reported <sup>[55]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Insufficient data</li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Insufficient data</li> </ul>	<p>No set standards for pregnant worker; therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- Tellurium and compounds, as Te, excluding hydrogen telluride: 0.1 mg/m<sup>3</sup></li> <li>- Tellurium hexafluoride: 0.01 ppm or 0.1 mg/m<sup>3</sup></li> </ul>
<b>Thallium</b>	Product of mechanical extraction of ores or minerals, smelting of lead and zinc ores	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Increased risk of congenital abnormalities <sup>[34]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Same as non-pregnant state</li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Thallium is excreted in breast milk <sup>[79]</sup></li> </ul>	<p>No set standards for pregnant worker; therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non pregnant worker: 0.1 mg/m<sup>3</sup> <sup>[7, 56]</sup></p> <p>The plasma half-life of thallium is unknown; therefore under circumstances of known acute exposure, consult a lactation specialist or other health professional about potential for continuing to breastfeed and pump and discard breast milk for several days after exposure.</p>
<b>Uranium</b>	Mining product	<ul style="list-style-type: none"> <li>- For a discussion regarding the reproductive health effects of ionizing radiation associated with Uranium; see "ionizing radiation" above.</li> </ul> <p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- No human studies</li> <li>- Mice developed dose-dependent teratogenicity given uranyl acetate by subcutaneous injection <sup>[17]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Designated A1 confirmed human carcinogen due to lung cancer in miners attributed to radon exposure <sup>[41]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Uranium is excreted in breast milk <sup>[41]</sup></li> </ul>	<p>No set standards for pregnant worker; therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker: 0.2mg/m<sup>3</sup> <sup>[7, 56]</sup></p> <p>STEL non-pregnant worker: 0.6 mg/m<sup>3</sup> <sup>[7, 56]</sup></p>

CHEMICAL HAZARD	EXAMPLES IN THE MINING INDUSTRY	RISK: FETUS AND/OR MOTHER AND/OR BREASTFEEDING	ACTION TO AVOID THE RISK
<b>Vanadium Pentoxide</b>	Used as an alloy, present in crude oil, and used in some diesel exhaust catalysts	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Can cause embryotoxicity and teratogenicity particularly skeletal abnormalities and cleft palate in rodents <sup>[35, 42, 113]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Same as non-pregnant worker</li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Studies in rats suggest vanadium exposure through lactation would induce neurotoxicity in developing central nervous system <sup>[101]</sup></li> </ul>	<p>No set standards for pregnant worker; therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker: 0.05 mg/m<sup>3</sup> <sup>[7, 56]</sup></p> <p>The plasma half-life of vanadium pentoxide is unknown; therefore under circumstances of known acute exposure, consult a lactation specialist or other health professional about potential for continuing to breastfeed and pump and discard breast milk for several days after exposure.</p>
<p><b>Zinc Chloride</b></p> <p><b>Zinc Oxide</b></p> <p><b>Zinc is an essential nutrient, but can be toxic at high doses.</b></p>	Used as an alloy, as a metal coating and soldering flux, and released when welding galvanized surfaces	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Spontaneous abortions at high oral doses of zinc <sup>[35]</sup></li> <li>- Skeletal abnormalities <sup>[24]</sup></li> <li>- Pre-term delivery at high oral doses of zinc <sup>[35]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Same as non-pregnant worker</li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Zinc is an essential nutrient excreted in breast milk <sup>[41]</sup></li> </ul>	<p>No set standards for pregnant worker therefore, keep exposures 'As Low As Reasonably Achievable.'</p> <p>TWA non-pregnant worker <sup>[7, 56]</sup>:</p> <ul style="list-style-type: none"> <li>- Zinc Chloride fume: 1 mg/m<sup>3</sup></li> <li>- Zinc Oxide: 2 mg/m<sup>3</sup> (Respirable fraction)</li> </ul> <p>STEL non-pregnant worker <sup>[7, 56]</sup> :</p> <ul style="list-style-type: none"> <li>- Zinc Chloride fume: 2 mg/m<sup>3</sup></li> <li>- Zinc Oxide: 10 mg/m<sup>3</sup> (Respirable fraction)</li> </ul>



OTHER FACTORS	EXAMPLES IN THE MINING INDUSTRY	RISK: FETUS AND/OR MOTHER AND/OR BREASTFEEDING	ACTION TO AVOID THE RISK
<b>Ergonomic Exposure</b>	Lifting, pushing, pulling, bending, heavy work	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Spontaneous abortion <sup>[105, 106]</sup> (reviewed in <sup>[110]</sup>)</li> <li>- Low birth weight <sup>[13]</sup> (reviewed in <sup>[110]</sup>)</li> <li>- Pre-term delivery (reviewed in <sup>[66, 73, 110]</sup>)</li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Back pain <sup>[37]</sup></li> <li>- Increased risk of injury due to normal physiologic changes associated with pregnancy <sup>[86, 87]</sup></li> <li>- Women with a history of repeated spontaneous abortion may be more sensitive to the risk associated with increased physical exertion <sup>[41]</sup></li> <li>- Increased fatigue <sup>[41]</sup></li> <li>- Increased risk of slipping <sup>[70]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- No adverse effects reported</li> </ul>	<p>After 24 weeks, avoid demanding postures: maximum of 3 hours/day. <sup>[68]</sup></p> <p>As pregnancy progresses review work demands as tasks may become increasingly difficult due to changes in the pregnant worker's body shape.</p> <p>If risk is identified, consider whether the task can be avoided or performed by someone else.</p> <p>Use mechanical aids.</p> <p>Ensure proper lifting, pushing, pulling and bending techniques are practiced.</p> <p>Lifting:</p> <ul style="list-style-type: none"> <li>- Avoid lifting heavy weights <math>\geq 15</math> times/day <sup>[71, 72]</sup></li> <li>- Avoid continuous lifting of objects weighing <math>\geq 10</math> kg <sup>[105, 106]</sup></li> </ul> <p>Pregnant workers with chronic hypertension may have to limit activity much earlier in pregnancy. <sup>[41]</sup></p>
<b>Ergonomic Exposure</b>	Prolonged standing	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Stillbirth <sup>[39, 72]</sup></li> <li>- Congenital defects <sup>[83]</sup></li> <li>- Pre-term delivery <sup>[9, 66]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Dizziness and fainting <sup>[41]</sup></li> <li>- Hypertension <sup>[94]</sup></li> <li>- Edema in legs and feet <sup>[41]</sup></li> <li>- Varicosity development <sup>[93]</sup></li> <li>- Placental abruption <sup>[38]</sup></li> <li>- Normal physiologic changes associated with pregnancy may cause low back pain and strain <sup>[86]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- No adverse effects have been reported</li> </ul>	<p>After 24 weeks, avoid standing longer than 6 hours/shift. <sup>[68]</sup></p> <p>Avoid prolonged standing for more than 30 minutes at any time after 32 weeks gestation. <sup>[41]</sup></p> <p>Regular consumption of water to avoid dehydration; drink 2 cups a day more than before becoming pregnant (extra fluid demands during pregnancy). <sup>[41]</sup></p> <p>Vascular support hose may decrease leg fatigue. <sup>[41]</sup></p> <p>Ideally keep a stool or chair handy to change position periodically.</p>

OTHER FACTORS	EXAMPLES IN THE MINING INDUSTRY	RISK: FETUS AND/OR MOTHER AND/OR BREASTFEEDING	ACTION TO AVOID THE RISK
<b>Ergonomic Exposure</b>	Prolonged sitting	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- No known adverse affects <sup>[41]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Lower extremity edema <sup>[58]</sup></li> <li>- Increased risk of blood clot development <sup>[41]</sup></li> <li>- Muscle strain, particularly in lower back <sup>[40]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- No adverse effects have been reported</li> </ul>	<p>Avoid continuously sitting for &gt; 2 hours without a position change. <sup>[58]</sup></p> <p>Adjust workstations to reduce postural problems/risks.</p> <p>Avoid crossing legs.</p> <p>Regular consumption of water to avoid dehydration; drink 2 cups a day more than before becoming pregnant (extra fluid demands during pregnancy) <sup>[41]</sup>.</p>
<b>Scheduling</b>	Working hours, shift rotation, and shift duration/night shift	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Spontaneous abortion <sup>[71, 72]</sup> (reviewed in <sup>[110]</sup>)</li> <li>- Low birth weight <sup>[68]</sup> (reviewed in <sup>[110]</sup>)</li> <li>- Pre-term delivery <sup>[66]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Increased risk of sleep disturbance than non-pregnant state <sup>[99]</sup></li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- Requires support from workplace to prevent disruption (eg. provide appropriate place to express milk) <sup>[74]</sup></li> </ul>	<p>Avoid working <math>\geq</math> 46 hours/week. <sup>[71, 72]</sup></p> <p>Avoid working <math>\geq</math> 10 hours per shift. <sup>[41]</sup></p> <p>Avoid working between midnight and 6 a.m. <sup>[4, 28]</sup></p> <p>Consider increasing number and/or length of breaks.</p> <p>Ensure appropriate place for worker to express milk.</p> <p>Educational workshop on rights of the breastfeeding mother.</p> <p>Specific medical conditions may require a restriction on shift schedules (e.g. gestational diabetes, pregnancy-induced hypertension etc). <sup>[41]</sup></p>
<b>Occupational and Non-Occupational Stress</b>	Death of a spouse, divorce, job loss, loss of work, high job demands and minimal job control, workplace conflicts	<p><b>Fetus:</b></p> <ul style="list-style-type: none"> <li>- Spontaneous abortion <sup>[84]</sup></li> <li>- Low birth weight <sup>[51, 111]</sup></li> <li>- Preterm delivery <sup>[51, 52]</sup></li> </ul> <p><b>Mother:</b></p> <ul style="list-style-type: none"> <li>- Same as non-pregnant worker</li> </ul> <p><b>Breastfeeding:</b></p> <ul style="list-style-type: none"> <li>- May decrease oxytocin release, a compound necessary for milk letdown <sup>[107]</sup></li> </ul>	<p>Encourage workers to attend educational workshops on stress management.</p> <p>Review job tasks and adjust as required.</p> <p>Estimate stress levels and identify relative contribution of occupational stress.</p>

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