

# Reproductive hazards literature search: Summary

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# Reproductive hazards literature search: Summary

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The aim of this work was to establish a current picture of the main documented factors that may be associated with reproductive health, relevant to UK workers. The approach taken was to assess published reviews of literature on reproductive health and gender for workers in the UK, including chemical hazards and risks, as well as other factors.

A limited number of papers were identified in this literature search. From these, a number of occupational exposures or risks were found to have been well-documented as being an issue to both male and female reproductive outcomes. These include exposure to chemicals, exposure to radiation, heavy workload, heat, awkward/ sedentary postures, irregular work schedules, and psychosocial work stress.

The reviews also acknowledge there are probably a variety of other substances or risks where the impact of exposure on reproductive health is currently unknown, and are therefore not well-documented in the literature. This is due to the changing nature of workplaces and new technologies. The evidence for some of the risks is also not conclusive in the literature e.g. stress, heat and posture, as it is sometimes not possible to directly link occupational exposures to reproductive outcomes without removing other factors such as lifestyle and genetics.

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## KEY MESSAGES

This review looked for information to ensure HSE's knowledge about reproductive health and gender is up to date. The review did not find anything of immediate concern but rather a need to keep exposure to some things as low as possible. The information which has been found could be used to check the HSE webpages are not missing any existing, well documented known risks.

The reviews also acknowledge there are probably a variety of other substances or risks where the impact of exposure on reproductive health is currently unknown, and are therefore not well documented in the literature. This is due to the changing nature of workplaces and new technologies. The evidence for some of the risks is also not conclusive in the literature e.g. stress, heat and posture; as it is sometimes not possible to directly link occupational exposures to reproductive outcomes without removing other factors such as lifestyle and genetics.

The difficulties that have been experienced in identifying reviews of the literature published on reproductive health and gender (hazards and risks) for workers in the UK within the last 5 years, may indicate that this is a problematic area to study due to the breadth of information on the topic and one which is currently attracting limited academic interest.

# EXECUTIVE SUMMARY

## Background

The Health and Safety Executive (HSE) board has approved a Single Equality Scheme in order to comply with its statutory equality duties. The External Diversity Action Plan sets out actions HSE intends to take forward in more detail. It includes an action to develop gender specific web pages. The web pages will include diversity specific messages, and where appropriate, may include information on control measures that can improve health and safety outcomes.

During 2010, the HSE External Diversity team began to put together content for a series of gender specific web pages. These covered a range of issues, including reproductive health and gender.

The aim of this study was to carry out an assessment of published reviews of literature on reproductive health and gender (hazards and risks) for workers in the UK (to include both chemical hazards and risks, and all other factors). The study aimed to identify what recent reviews of the literature currently exist on reproductive health and gender, hazards and risks, for workers in the UK. It also tried to identify any gaps in the literature, and where further research may be required. The study aimed to establish a current picture of the main documented factors that may be associated with reproductive health, relevant to UK workers, to inform the development of gender-specific information on the HSE website. It is not a systematic review of individual studies on reproductive health.

## Method

Due to the volume of research in the topic area of reproductive health it was decided that the search would need appropriate parameters to focus the results. However, the original search terms failed to yield sufficient material so, after discussion and agreement, the literature search was repeated in total three times, with adjustments to the search criteria each time. These iterations were conducted in collaboration with the HSE customer.

The final papers that were selected for inclusion in this review met the following criteria:

- A review of the literature, rather than focusing on individual studies;
- Focus on research evidence from human populations only;
- Research from 2006 onwards;
- Covering UK research.

## Findings

A total of six relevant papers were found, reviewed and a detailed bibliography was also created. Leading to the conclusion there have not been many reviews that have been completed within the last five years on this topic area. The bibliography contains a number of papers that were outside the search parameters but were considered to be of use as they are relevant to the topic area and recent pieces of research.

From the limited number of papers identified in this literature search it is clear that there are a number of occupational exposures or risks that have been well documented as being an issue to both male and female reproductive outcomes. These include exposure to:

- Chemicals
- Pesticides
- Heavy metals
- Solvents
- Radiation
- Heavy workload
- Heat
- Awkward/ sedentary postures
- Irregular work schedules
- Psychosocial work stress

## **Conclusions**

The study found some clearly defined hazards and risks to fill gaps in HSE's knowledge about reproductive health and gender. The information generated from this study could be used to check that the webpages are not missing any existing, well documented known risks.



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# 1. INTRODUCTION

## 1.1 BACKGROUND

The Health and Safety Executive (HSE) board has approved a Single Equality Scheme in order to comply with its statutory equality duties. The External Diversity Action Plan sets out actions HSE intends to take forward in more detail. It includes an action to develop gender specific web pages. The web pages will include diversity specific messages, and where appropriate, may include information on control measures that can improve health and safety outcomes.

During 2010, the HSE External Diversity team began to put together content for a series of gender specific web pages. These covered a range of issues, including reproductive health and gender.

HSE identified that their corporate knowledge on reproductive health and gender was out of date, and were concerned that the initial draft content for the reproductive health web pages may contain some gaps. There was also a suggestion that the draft web page content may be too focused on the chemical aspects of reproductive health, at the expense of other factors that may have an influence on reproductive health (such as stress, musculoskeletal disease, heat/temperature, noise, physical threats and shiftwork).

HSE would like to ensure that the content of the HSE web pages is based on the most recently documented information on reproductive health and gender.

A number of research questions were identified:

1. What reviews of the literature have been published on reproductive health (hazards and risks) and gender, in the UK workforce, within the last 5 years?
2. What is the quality of the reviews?
3. Based on the literature, what factors are associated with reproductive health?
4. What is the strength of evidence for any associations between each factor and reproductive health?
5. Are there any gaps in the research? If so what are they?
6. Is there any evidence of the current state of reproductive health in the UK workforce? If so, what is this?
7. What further research (if any) is required on reproductive health in the UK workforce?

## 1.2 AIMS AND OBJECTIVES

The aim of the study was to carry out an assessment of reviews of the literature on reproductive health and gender (hazards and risks) for workers in the UK (to include both chemical hazards and risks, and all other factors). The study would identify what reviews of the literature currently exist on reproductive health and gender, hazards and risks, for workers in the UK. It would identify any gaps in the literature, and where further research may be required. The review would provide evidence to fill a gap in HSE's knowledge about reproductive health and gender, and enable them to develop web pages that are based on current information in the scientific literature.

## 2. METHODOLOGY

It was originally intended that a shortened type of systematic literature review, referred to as a rapid evidence assessment (REA), would be used to review the reviews (<http://www.civilservice.gov.uk/networks/gsr/resources-and-guidance>). This is an approach frequently adopted by Government, as it uses a systematic method (including setting out inclusion and exclusion search criteria) in order to provide a quick overview of existing research on a (constrained) topic. The following section of the report will describe the iterative process carried out to identify any suitable literature.

### 2.1 STAGES OF LITERATURE SEARCH

HSL researchers worked with members of the HSE team to establish the search parameters during the commissioning of the research. Due to the volume of research in the topic area of reproductive health it was decided that the search would be limited:

- to reviews of the literature, rather than focusing on individual studies;
- to focus on research evidence from human populations only;
- to cover research within the last 5 years (from 2006 onwards);
- to cover UK research;
- to a maximum of 10 review papers for chemical hazards and 30 review papers for any other factors, such as psychosocial factors (e.g. stress, MSDs) and temperature etc.

HSL then worked with experts at HSE's search team to develop an appropriate set of search terms for the literature review. Terms included reproduction, fertility, infertility, miscarriage, occupational, workplace, work, plus a variety of other terms. A full list of the search terms used at each time point can be found in Appendix 1. The search team searched databases including Medline, Embase, Oshrom, Oshupdate and Web of Knowledge.

The initial searches were conducted by the HSE search team and the findings were returned to HSL researchers for review. The findings from the initial search failed to yield many results in line with the parameters mentioned above (only two papers were identified that met the original search criteria). However it had been anticipated that a break point meeting with the HSE customer would be appropriate after the search. The purpose of the meeting was to discuss the scope of the work, and any refinements to be made before the papers were reviewed, as at that point the number, length and technical complexity of any relevant review papers was unknown. In line with discussions between the HSE team and HSL researchers, it was decided that the search process should be repeated with redefined terms. The terms were reviewed with HSL, HSE and the HSE search team, and the search was repeated for a second time. This process was again repeated after the second search results were returned. In total the literature search was completed three times.

HSE and HSL agreed that each of the six papers that had been identified would be reviewed, and that a full rapid evidence assessment would not be required.

The difficulties experienced in completing the literature search are discussed further in section 4.2 within the results.

### 3. RESULTS

The series of searches identified six papers that partially met the specified criteria (e.g. review papers, covering psychosocial issues, etc), with papers by Figa-Talamanca (2006), and Jenson et al (2006), reviewing the reproductive outcomes for women and men respectively, being most relevant.

#### 3.1 SUMMARY OF PAPERS REVIEWED

The relevant papers have been reviewed and these are summarised in table 1.

**Table 1:** Summary of papers reviewed

Author [reference] (year)	Study type	Summary of research
Barzilai-Pesach <i>et al</i> [1] (2006)	This was a cohort study of 75 working women with a female fertility problem attending fertility clinics between the years 1999 and 2000	Barzali-Pesach <i>et al's</i> study was conducted to examine the possible association between women's occupational stress and outcome of fertility treatments.  The research found that women who perceived their job as more demanding were less likely to conceive. Those working fewer hours were more likely to conceive and successfully complete a pregnancy after fertility treatment.
Figa-Talamanca [2] (2006)	The review covers 100 papers from international literature since 1990.  The literature focuses on exposures and negative reproductive outcomes specifically for women.	The research covers a wealth of international literature on exposures and the effects on reproductive health for females.  Figa-Talamanca surmises there are a number of occupational exposures for women. These include metals, solvents, chemical exposures (in the health sector), radiation, noise, heavy workload and awkward postures, work schedules and psychosocial work stress.  For many of the work risks there is sufficient evidence for steps to be taken to protect pregnant women. These exposures include “anaesthetic gases, anti-neoplastic drugs, heavy metals, solvents, heavy physical work and irregular work schedules”. However there is little conclusive evidence for other exposure such as non-ionizing radiation and psychosocial work stress, although some studies have reported on positive associations between work stress and reproductive health outcomes  The review also concludes that some research has suggested there are other contributory factors (e.g. genetics) that could lead to negative reproductive outcomes (e.g.. preterm birth or low birth weight) and would explain why all exposed pregnant females do not necessarily experience the same outcome.
Jenson <i>et al</i> [3] (2006)	The paper focuses on occupational and environmental exposures and toxicants, and negative reproductive outcomes specifically for men.	The review covers a wealth of international literature on exposures and the effects on reproductive health for males.  The review concludes there is a decreased risk from welding metals, although this could partly be due to the exposure levels in the West decreasing. Lead is widely reported as a risk to male reproductive outcomes however the literature “is not

	Over 120 papers were reviewed from international literature since the 1980's.	<p>entirely consistent”</p> <p>A number of the papers reviewed covered physical exposures to heat and sedentary body posture, and radiation. Jenson et al concluded that there needs to be more research to conclusively report whether the effect of exposure to heat within workplaces is sufficient to have any detrimental effect on reproductive health and what effect a sedentary body posture has. The research on radiation is also not consistent enough to define whether “non-ionizing radiation interferes with male reproductive function unless the amount of energy is sufficient to disrupt testicular temperature regulation”.</p> <p>Research on chemical exposures to pesticides and solvents is conclusive for exposure to some substances (e.g. “Glycol ethers [in particular 2-ethoxyethanol (2-EE) and 2-methoxyethanol (2-ME0), 2-bromopropane, carbon disulphide, DBCP.”) but not for all.</p> <p>Jenson et al also comment on psychological exposures. Although occupational stress and burnout have been linked to negative reproductive outcomes in some research “the effect of psychological stress on semen quality and male reproductive health is currently not determined”.</p> <p>There are a number of well-documented occupational and environmental exposures that should be controlled to reduce negative reproductive outcomes. However there are other risks that do not have conclusive evidence and would require further investigation. Jenson et al also rightly note that caution should be taken when applying findings from an internal review as many of the issues may have been addressed in ‘Western’ countries, whereas workers may still be exposed in other areas of the world.</p>
Little and Wakeford [4] (2008)	The research looks at the effects of exposure to tritium	<p>Little and Wakeford reviewed epidemiological data relating to tritium exposure. Tritium is a radioactive isotope of hydrogen.</p> <p>The paper summarises that in general there is insufficient evidence to estimate the risks from tritium exposure but that future studies that would use a number occupationally exposed cohorts could be useful.</p>
Povey and Stocks [5] (2010)	The research looks at the epidemiology of male reproductive health	<p>In the paper the causes of male reproductive health are discussed. Povey and Stocks discuss how “exposure to a causative factor... has changed over time”, with new chemicals being introduced into the environment and occupational settings whilst other well-documented threats e.g. lead, have been reduced.</p> <p>Povey and Stocks report that some research suggests that manual workers are more likely to suffer from male infertility than non-manual workers but that it is not clear if this is due to occupational exposure or other mitigating factors.</p>
Schetter [6] (2011)	The research reviews papers on Psychological Science on Pregnancy.	The paper summarises that stress during pregnancy is implicated as a risk factor for adverse birth outcomes of both preterm term and low birth weight. However this is not

		explicitly linked to occupational stress.
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*\*Full references can be found in the section 5 of the report*

There were also a number of other papers that fell outside of the parameters of this review but may be useful if a full and detailed literature search on reproductive health and workplace hazards were to be carried out in the future. These references were relevant pieces of recent research that may have contained a recent study or review but were from outside the UK or from the early 2000's. A full list of these pieces of research is contained in the Bibliography (section 6 of this report) for future reference.

## **3.2 ANSWERS TO RESEARCH QUESTIONS**

A number of research questions were identified at the outset of this research, the answers to which will now be addressed.

### **3.2.1 What reviews of the literature have been published on reproductive health and gender, in the UK workforce, within the last 5 years?**

Several iterations of searches were completed and found a total of six relevant papers were identified (see Section 4 for details on the six references).

The reviews covered both males and females, although none of the reviews were explicitly just looking at studies on the UK workforce. However, reviews did consider the differences between countries around the world, as for example some of the identified hazards may be better controlled for in western countries.

### **3.2.2 What is the quality of the reviews?**

The reviews included in this search have been published in medical or social science peer reviewed journals including: Occupational and Environmental Medicine, Occupational Medicine, Journal of Radiological Protection, Human Fertility, Annual review of Psychology. Therefore the studies included in the review are considered to be from credible sources.

No quality assessment of the reviews was undertaken as part of the current work. It had originally been intended that the quality review would help to identify the 'best in class'; however due to the small number of papers identified during the searches it was unnecessary.

### **3.2.3 Based on the literature, what factors are associated with reproductive health?**

The reviewed papers identified that exposure to the following factors could have an effect on reproductive health.

For females these risks include exposure to:

- Anaesthetic gases
- Antineoplastic drugs
- Heavy metals
- Solvents
- Radiation

- Heavy workload and awkward postures
- Irregular work schedules
- Psychosocial work stress

For males these risks include exposure to:

- Heat and sedentary body posture
- Welding metals
- Lead
- Pesticides
- Solvents
- Radiation
- Psychosocial work stress

#### **3.2.4 What is the strength of evidence for any associations between each factor and reproductive health?**

There are varying levels of evidence for each of the identified exposures. A number of occupational and environmental exposures are well-documented in the literature. However, the reviews seem to suggest that although hazards (e.g. specific chemicals) can be identified the exposures are often poorly defined, and are often simply by association e.g. dry cleaners and perchloroethylene. For females the well documented exposures include anaesthetic gases, anti-neoplastic drugs, heavy metals, solvents, heavy physical work and irregular work schedules. For males, the reproductive hazard of chemical exposures to pesticides and solvents is well documented for some substances (e.g. glycol ethers) rather than others. There are a number of other agents that are identified as potential reproductive hazards but the literature is not conclusive. In particular there is difficulty in drawing definite links of psychological stress being directly causal in negative reproductive outcomes for both males and females. There is also inconsistency in the literature for the effects of non-ionising radiation on reproduction for both males and females. In addition, for men, there are inconclusive findings in the literature on the risks associated with both heat and sedentary body posture.

#### **3.2.5 Are there any gaps in the research? If so what are they?**

This review has covered a small number of papers which were within the remit of parameters and search terms specified. The searches have also identified a number of individual studies (outside of the scope of this review) which have been published in last 5 years. These have been included in the bibliography for completeness.

#### **3.2.6 Is there any evidence of the current state of reproductive health in the UK workforce? If so, what it this?**

No explicit mention was made in the published papers regarding the state of reproductive health in the UK in any of the papers. However comment was made that it would be hoped that some of the identified exposures would be well controlled for in Western countries whereas workers may still be exposed in other areas of the world.

### **3.2.7 What further research (if any) is required on reproductive health in the UK workforce?**

We believe it may be worth considering the individual studies listed in the Bibliography which, although outside the remit of this piece of research (due to the search parameters), may offer additional evidence for areas for consideration. Data on current levels of exposure to some of the hazards identified would help to prioritise improvements in controls.

### **3.3 LIMITATIONS OF SEARCHES**

We experienced issues with the literature searches. The closely defined parameters of the research failed to identify papers that fitted the criteria. The literature search ended up being an iterative task that was undertaken three times in total with six relevant papers being covered in the review.

The first round of literature searches found only two results that fitted the search parameters agreed for the project, although a large number of papers were identified during the search. The returned lists of literature were not reviews, UK based, or, within the last 5 years. A large number of results were in fact reviews of relevant literature but from the 1980's, and therefore not the up to date review articles required for this search. There were also a number of reviews from the early 2000s, which fell just outside of the defined timescales. However two papers were identified as fitting the criteria in this round of searches.

Due to the difficulties with the original search results the HSL team decided to revisit the search terminology. The search terms were reviewed in an attempt to obtain more relevant results. This process was completed in conjunction with discussions with both the HSE customer and the HSE search team.

This search process was then repeated with updated search terms and relaxing some of the parameters. However, again the combination of terms used in the search were bringing up unsuitable references. For example, some of the returned papers appeared to be regarding reproductive health and the workplace but were in fact linking issues with reproductive health as being detrimental to individuals career (e.g. Impact of endometriosis on quality of life and work productivity). Other returns were either not reviews, UK based, or within the last 5 years; with some results seeming to have identified some of the search terms but not in fact relevant to the topic area, (e.g. The epidemiology of renal cell carcinoma, cello scrotum, 1974-2009: history of a medical hoax, Which factors predict the time spent answering queries to a drug information centre?).

After the second round of searches were completed and the lack of relevant papers was identified, we carried out an ad-hoc search on the Pub-med database to try and establish what the issues were with the searches. The results from these and the search terms were passed onto the HSE search team for consideration and the terms were again reviewed for a third and final search of the databases.

The final round of searches identified the majority (four out of six) of relevant papers that have been included in this literature review. However, again the results were limited, leading us to the conclusion that there may not be many reviews that have been completed within the last five years. That is not to say there are no other relevant individual studies that have been completed within the timeframe on human populations and cover UK research, but these were outside the remit of this piece of work.

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## 6. APPENDIX

### 6.1 SEARCH TERMS

The following are the search terms used at each of the three time points.

#### 6.1.1 Search 1

((Reproductive same health) or (Reproductive same medicine) or Infertility or Miscarriage\* or Stillbirth\* or (Foetal same death\*) or (Neonatal same death\*) or (Pregnancy same outcome)) AND Title=(review) AND Topic=((osh or (occupational and (Health or safety or hygiene) ) or (health and safety))) AND Year Published=(2006-2011)

OR

Reproductive same health) or (Reproductive same medicine) or Infertility or Miscarriage\* or Stillbirth\* or (Foetal same death\*) or (Neonatal same death\*) or (Pregnancy same outcome)) AND Topic=((systematic same Review) or literature or (meta adj analysis) or metaanalysis) AND Topic=((osh or (occupational and (Health or safety or hygiene) ) or (health and safety))) AND Year Published=(2006-2011)

OR

(Reproductive near3 health) or (Reproductive near3 medicine) or Infertility or Miscarriage\* or Stillbirth\* or (Foetal near3 death\*) or (Neonatal near3 death\*) or (Pregnancy near3 outcome)

AND

((systematic near3 Review) or literature or (meta near3 analysis) or metaanalysis) OR review in ti,de 2006 to 2009

OR

Reproductive .-3. health) or (Reproductive .-3. medicine) or Infertility or Miscarriage\* or Stillbirth\* or (Foetal .-3. death\*) or (Neonatal .-3. death\*) or (Pregnancy.-3.outcome)

AND

(systematic .-3. Review) or literature or (meta .-3. analysis) or metaanalysis

OR

(Reproductive (3A) health) OR (Reproductive (3A) Medicine)

or Infertility OR Miscarriage# OR Stillbirth# or (Foetal (3A) Death#) OR (Neonatal (3A) Death#) OR (Pregnancy

AND (Review OR Literature OR (Meta (3A) Analysis) OR Metaanlaysis)

AND 2006-2011/PY

(Reproductive (3N) Health) OR (Reproductive (3N) Medicine) or Infertility OR Miscarriage?? OR Stillbirth?? Or (Foetal (3N) Death??) OR (Neonatal (3N) Death??) OR (Pregnancy (3N) Outcome)

AND

((Occupational (3N) (Health OR Safety OR Hygiene OR Disease?? OR Exposure OR Accident??) ) OR (Health and Safety)) or exploded meshterms Occupational Disease or Occupational Exposure or Occupational Health or Accidents Occupational or Occupational Exposure or Occupational Diseases

AND document type = review

### **6.1.2 Search 2**

This was slightly simplified in the less complex databases. Any of the following in title or keywords:

Reproduction

Reproductive near3 (health or hazard\* or risk\*)

Pregnan\* or miscarriage\* or stillbirth\* or (premature near2 birth\*)

(Birth or congenital ) near3 (defect\* or abnormalit\*)

impaired near2 neural near2 develop\*

(foetal or fetal) near2 develop\*

fertility

(Sperm near2 count)

Menstruation or (menstrual near2 cycle) or Menopaus\*

Impotence or (erectile near2 dysfunction)

Sexual near2 dysfunction (may need physiological)

Impair\* near2 sexual near2 function\*

(Offspring or infant\* or baby or babies or birth) near5 ( weight or develop\*)

(Reproductive or sex) near3 (system or organ\*) Genitalia

Uterus or ovary or fallopian tubes or vagina or vulva

Penis or prostrate or testis or scrotum

PLUS

Year limit >2007

PLUS

Occupational terms if not using a specific Health & Safety database.

For Medline and Embase this was the occupational health/diseases/accident/exposure mesh terms.

For web of knowledge this was occupation\* or work\* or job or jobs or employ\* or industr\*

PLUS

Restriction to UK, North America, Western Europe

PLUS

Medline and Embase limited to humans.

### **6.1.3 Search 3**

Reproductive health terms (slimmed down from the last 2 searches):

(Reproduct\* near/3 health) or (Reproduct\* near/3 hazard\*) or (Reproduct\* near/3 risk\*) or (Reproduct\* near/3 toxic\*)

or

fertility or Infertility or Miscarriage\* or Stillbirth\* or pregnan\* or (premature near/3 birth\*)

or

Reproduction

or

(Foetal or Neonatal or birth\* or congenital) near/5 (develop\* or death\* or abnormal\* or fatal\*)

or

(offspring or infant\* or baby or babies or birth\*) near/5 (weight or development\* or death\* or fatal\*)

and

Stress or psycho\*

And occupational terms

Medline mesh terms including occupational, workplace, work

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Rwdrlkuj gf "d{ "yj g"J gcnj "cpf "Uchgv{ "Gzgewkxg""29B5

# Reproductive hazards literature search: Summary

The aim of this work was to establish a current picture of the main documented factors that may be associated with reproductive health, relevant to UK workers. The approach taken was to assess published reviews of literature on reproductive health and gender for workers in the UK, including chemical hazards and risks, as well as other factors.

A limited number of papers were identified in this literature search. From these, a number of occupational exposures or risks were found to have been well-documented as being an issue to both male and female reproductive outcomes. These include exposure to chemicals, exposure to radiation, heavy workload, heat, awkward/ sedentary postures, irregular work schedules, and psychosocial work stress.

The reviews also acknowledge there are probably a variety of other substances or risks where the impact of exposure on reproductive health is currently unknown, and are therefore not well-documented in the literature. This is due to the changing nature of workplaces and new technologies. The evidence for some of the risks is also not conclusive in the literature e.g. stress, heat and posture, as it is sometimes not possible to directly link occupational exposures to reproductive outcomes without removing other factors such as lifestyle and genetics.

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