

The Employability of Pregnant and Breastfeeding Servicewomen

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SUMMARY: The Army Medical Services are responsible for promoting health in the military workplace. A survey of the potential health risks in the workplace to British Army servicewomen who are pregnant, or who breastfeed, was carried out. It was found that there was a total of 30 major workplace hazards to pregnant or breastfeeding servicewomen, and that medical guidance in this area was lacking. A Medline literature search on these hazards, was compiled, and an overview of the nature and extent of the military problem, together with a brief policy recommendation applying to each hazard. Guidelines based on these recommendations were distributed to primary care and obstetric unit medical officers in all three Armed Services. It is intended that the guidelines will assist Service doctors in giving informed advice on the avoidance of military occupational risks to pregnancy and to lactation.

Introduction

Since the disbandment of the Women's Royal Army Corps, women in the Regular Army can now serve in most Arms and Services. At present, only the Royal Armoured Corps and the Infantry remain closed to women.

From an occupational health perspective, one consequence of this development is that women of childbearing age are now being exposed by the Army to a much wider range of potential reproductive hazards than was the case formerly. Should they become pregnant, there is a risk of injury to the fetus from harmful agents in the workplace, and from adverse working conditions.

Medical officers who work in primary care obstetrics have a professional responsibility to be aware of these potential hazards, and to advise their Service patients accordingly. Where necessary, the attending medical officer must place a formal restriction on the employability of a pregnant servicewoman, in order to safeguard both her health and that of her unborn child.

During 1994 there were widespread allegations in the national press that the Ministry of Defence (MOD) had been negligent in its administrative management of pregnant servicewomen. In the clinical branch of the Army Medical Directorate (AMD5) it was realised at around this time that there was an almost complete lack of information available to Service medical officers on what military duties a pregnant servicewoman could and could not carry out with safety. There was a clear potential for civil litigation, and steps were therefore taken to remedy this deficiency in medical policy.

Methods

An initial study of the standard reference works on toxicology identified a number of obvious toxic hazards to pregnancy (eg noise, vibration, extremes of temperature) that would apply to most military workplaces. To ensure that the less common hazards were

not overlooked, AMD5 wrote to the Directors of all Arms and Services within the British Army, asking them to report on what they considered to be the main workplace hazards to the health of their pregnant and breastfeeding personnel. Consultation also took place with military occupational health specialists and with medicolegal advisers.

From the information received, a list was drawn up of 30 major reproductive hazards that exist in the military environment. A literature search from 1971 to the present was conducted on Medline with CD-ROM. Those published papers were retrieved which sought to postulate or to disprove a causal relationship between the identified occupational hazards and an adverse outcome of pregnancy or of lactation.

In order to arrive at a concise recommendation for medical officers, an "on average" summary was made of the likely risk posed by each identified hazard to pregnancy or to breastfeeding. For certain reproductive hazards (eg lead, benzene, ionising radiation) it was found that the number of published research papers run into thousands. In these cases, heavy reliance was placed on existing review articles.

The collected guidelines were submitted to professional scrutiny and to modification where necessary, prior to being disseminated widely.

Results

The research findings are summarised in the form of Tables 1 - 5. Referencing in the tables has been limited to major articles, or to key review papers. Towards the end of 1994, the tables were issued in booklet form to all primary care and obstetric unit medical officers in the British Army. In May 1995 they were distributed also to doctors in the Royal Navy and the Royal Air Force.

On account of their wider policy implications, the guidelines were circulated at an early stage by AMD5 to the manning and recruiting branches of the Army's

Table 1
Workplace Hazards to Pregnancy Servicewomen - Physical Agents

Agent	Human Reproductive Hazard	Scientific Evidence	Recommendation for Medical Officer (MO)
1.1 IONISING RADIATION	With high maternal exposures only : congenital malformations, especially of central nervous system (including microcephaly and mental retardation). With lower maternal exposures: increased incidence of childhood cancers, particularly leukaemias.	Numerous studies (14,15)	Pregnant radiologists and radiographers are at a theoretical risk. However, the nationally-recommended exposure levels for pregnant women are generally one-tenth of the upper limits recommended for non-pregnant workers. This should constitute sufficient protection for the foetus (14). There is not therefore any requirement for an MO to impose additional restrictions.
1.2 NON-IONISING RADIATION SHORT-WAVE EQUIPMENT	Congenital malformations, perinatal deaths	There exists one important study (16) of physiotherapists who had used short-wave therapeutic equipment whilst pregnant, with adverse effects on their pregnancies. There are no known studies on the reproductive hazards of high-frequency radio sets (which operate on short wavelengths) but a sensible precaution would be to avoid them in pregnancy.	MO should restrict pregnant physiotherapists from all duties involving short-wave therapeutic equipment. Pregnant servicewomen complaining of soft tissue or skeletal injuries should not be referred by MO for any treatment involving short-wave therapeutic equipment. MO should restrict pregnant servicewomen from all duties with Clansman HF or VHF sets, or any other high-frequency radio sets.
1.3 NON-IONISING RADIATION -	??Spontaneous abortion. ??Congenital malformations.	In fact the electromagnetic radiation emitted from VDUs is rarely if ever above natural background levels, except at the extremely low frequency end of the range (14). The epidemiological evidence to date does not support the suggestion that there is a causal relationship between adverse pregnancy outcome and VDU use (17-21).	Where advice is sought from a pregnant VDU user, MO should offer reassurance that there is no substantiated risk. If the individual remains unconvinced or anxious the MO should agree to restrict her work with VDUs.
1.4 TRACKED VEHICLE NOISE	??Spontaneous abortion. ??Fetal growth retardation. ??Impaired hearing in offspring.	Some studies have shown that prolonged exposure to industrial noise jeopardises the outcome of pregnancy, particularly when combined with shift work (22,23). However, the majority of studies have not demonstrated such effects (14). The preliminary data relating to the effect of industrial noise exposure of the mother on hearing levels in the offspring are difficult to interpret (24).	As a sensible precaution, MO should restrict pregnant servicewomen from any travel in tracked vehicles . The same exclusion should apply to any travel (unless of only a few minutes' duration) in rotary wing aircraft, ie helicopters .
1.5 GUNFIRE NOISE	??Impaired hearing in offspring	There are no known studies demonstrating a causal relationship between impulse noise and damage to the fetal auditory apparatus. It would be difficult, however, to defend a legal action against MOD alleging childhood deafness as a consequence of exposure to gunfire noise <i>in utero</i> .	As a sensible precaution, MO should restrict pregnant servicewomen from all exposure to gunfire noise. Therefore: ● Pregnant servicewomen should not be armed. ● They should not take part in any range duties, nor any military exercise where they are likely to be exposed at close range to small arms noise, heavy weapons noise, or pyrotechnics noise.
1.6 VIBRATION - WHOLE-BODY	??Preterm labour. ??Low birth weight.	Some studies (25) have shown whole-body vibration to be a hazard in pregnancy. Moreover, the <i>EC Directive on Physical Agents - Vibration</i> , which is likely to be enacted in law in 1996 or 1997, is seeking to impose extremely conservative upper limits for the daily vibration exposure of employees (even where not pregnant).	As a sensible precaution, MO should impose the following restrictions on the employability of pregnant servicewomen. ● No off-road travel in military vehicles. ● No usage of fork lift trucks . ● Only limited travel (no more than a few minutes' duration) in rotary wing aircraft, ie helicopters .
1.7 VIBRATION - HAND-TRANSMITTED	??Preterm labour ??Low birth weight.	Although formal studies are few, the effects on pregnancy of prolonged hand-transmitted vibration are likely to be similar to those for whole-body vibration.	Based on a detailed work history, MO should restrict prolonged usage in pregnancy of: ● Pneumatic or electric power tools (eg drilling machines, power saws, grinders, chipping hammers). ● Vibrating workpieces (eg mobile generators, compressors, pumps).
1.8 HEAVY LIFTING	??Adverse outcome of pregnancy.	Some studies (26) have shown heavy lifting in pregnancy to constitute a hazard to the fetus.	MO should restrict all duties involving heavy lifting (eg movement of stores, erection of tentage, casualty handling). There is likely to be a hazard in many RA and RE trades, also RAMC, RADC, QARANC.

Table 1 - continued

Workplace Hazards to Pregnancy Servicewomen - Physical Agents

Agent	Human Reproductive Hazard	Scientific Evidence	Recommendation for Medical Officer (MO)
1.9 LONG/ IRREGULAR HOURS OF WORK	??Preterm labour. ??Low birth weight.	Some studies (17,27) have suggested that long/irregular hours of work are a hazard in pregnancy. However, there are also conflicting studies of no effect with this parameter (14).	MO should consider restricting work where there is a likelihood of a pregnant servicewoman having to undertake particularly long and irregular hours of work.
1.10 NIGHT WORK	??Adverse outcome of pregnancy.	Animal studies have shown that the fetus is adversely affected by inversion of the normal light/dark cycle of the mother (28). There are no known human studies demonstrating a causal relationship between night work and damage to the fetus.	As a sensible precaution, MO should restrict all night duties where the pregnant servicewoman complains of excessive fatigue resulting from night work.
1.11 PHYSICAL EXERCISE	??Adverse outcome of pregnancy, if excessive.	In fact, maternal exercise is well-tolerated by the fetus at least up to 70% of maximal exercise. The exercise should be in regular short bursts rather than arduous one-off efforts . A maximum maternal heart rate of 140 beats/min is recommended (29). Exercise should be avoided only if there are any adverse obstetric history or risk factors, or a previous history of inactivity (29).	MO should not restrict normal PT or adventurous training in a pregnant servicewoman, unless there are clear contraindications to physical exercise. These contraindications include: acute infectious disease, multiple pregnancy, incompetent cervix, intrauterine growth retardation, hypertension, uterine bleeding, ruptured membranes. Pregnant service women should not be permitted to undertake the Army's Basic Fitness Test or Combat Fitness Test.
1.12 TRAUMA	?Spontaneous abortion.	In fact the fetus is well-protected within the pelvis, and later in pregnancy by the layers of the abdominal wall and uterus, together with the amniotic fluid. However, largely for medicolegal reasons, most sporting bodies bar pregnant women from participating beyond the second trimester (29).	MO should restrict all sports in all pregnant servicewomen after the first trimester. Military parachuting must not be undertaken at any stage of pregnancy. MO should advise pregnant servicewomen who work in equine divisions (eg RAVC and RMP personnel) to avoid all contact with horses on account of possible trauma. If this is impossible, the MO should consider imposing a formal restriction.
1.13 EXTREMES OF HEAT	?Neural tube defects	Animal studies and retrospective data in women have shown maternal hyperthermia to be a risk factor. The prolonged fever (>39°C for 3 days) cited in these reports, however, does not equate with the mild temperature changes experienced during most occupational activities (29).	MO should advise pregnant servicewomen to exercise during the cool part of the day, and to ensure adequate hydration at all times. Pregnant servicewomen must not undertake NBC training , other than in NBC Dress Category Zero or NBC Dress Category 1.
1.14 EXTREMES OF COLD	?Adverse outcome of pregnancy	Some studies have shown cold to be a hazard in pregnancy. However, there are also conflicting studies of no effect with this parameter (14).	MO should advise pregnant servicewomen of the theoretical risk. They should not undertake any adventurous training which might entail prolonged exposure to extreme cold. During exceptionally cold weather (eg in Germany, Norway) pregnant servicewomen should be excused guard duty.
1.15 ELECTRICAL CONTACT	?Adverse outcome of pregnancy	There is anecdotal evidence in the obstetrical literature of low voltage (110-220 volts) electric shock to a pregnant woman having the potential for harm to the fetus, including fetal death (30).	MO must assess the risk realistically. In most military employments, and with most electrical equipments, there is likely to be no danger at all to the pregnant servicewoman. Where there is a known danger of electrical hazard from old or unreliable military equipment (as eg from some armoured fighting vehicle power packs) the MO should restrict pregnant servicewomen from all contact with such equipment.

KEY: ? = Evidence for reproductive hazard is inconclusive.

?? = Evidence for reproductive hazard is scanty, or non-existent

guidelines and re-issued them in a modified form, for the use of employing officers in all Arms and Services of the British Army. This ensured that employers and their medical advisers would in the future be of one of mind regarding the necessary restrictions to be placed on the employability of any servicewomen who happened to be pregnant.

Discussion

The literature search strategy adopted for this study, and the overview and recommendations which followed from it, are open to some criticism on methodological grounds.

The exclusive concentration on published evidence of reproductive hazards makes it likely that some of the conclusions reached will have been contaminated by publication bias. As is now well recognised (1, 2, 3), small positive studies are more likely to be published than negative ones, potentially distorting the findings of any overview which does not at the same time endeavour to include unpublished evidence.

A further source of potential bias arises from the fact that because of limited time and resources the only database searched was Medline, and furthermore the search was restricted to relevant studies that were published in English only. It is possible that some important studies were missed that appeared in databases other than Medline, and in languages other than English. For this particular research task, however, it was felt that the latter risk was small since from an early stage of the search process it was clear that the vast majority of

studies relating to reproductive health and safety had indeed been published in English (having originated either in Britain/North America or in Scandinavia).

A further criticism of the search methodology follows from the fact that the sensitivity of Medline can be poor, and in some electronic searches has been shown to be as low as 51% against a hand-searched "gold standard" (4). Even with the most diligent searching of Medline, therefore, studies will be missed which are in fact indexed on the database, but are not located by the searcher. The reason for this in most cases will be that the authors did not clearly describe the aims and methods of their research, or else that the coding procedures of the US National Library of Medicine (which "owns" Medline) were not properly applied (5). In the case of the present study the impact of this potential limitation was minimised through considerable reliance on the searching skills and advice of a trained medical librarian.

Lastly, the "on average" reviewing strategy adopted for the study has the fault of lacking in scientific rigor. In such "traditional" reviews of the literature, too much depends on the individual perspective and private judgement of the reviewer, and hence true objectivity can be lost (6). An on-the-average review, therefore, would not occupy a high place in the "hierarchy of validity" originally proposed by Oxman and Guyatt (7). Notwithstanding this, the on-the-average summary is accepted by Light and Pillemer (8) and other respected academic authorities as being a legitimate research tool for obtaining answers to policy questions where there is a need for swift and decisive action.

Table 2
Workplace Hazards to Pregnancy Servicewomen - Biological Agents

Agent	Human Reproductive Hazard	Scientific Evidence	Recommendation for Medical Officer (MO)
2.1 CYTOMEGALOVIRUS (CMV)	CMV infection in pregnancy is associated with fetal hepatosplenomegaly, microcephaly, microphthalmia, mental retardation	Numerous studies (24)	MO should advise hospital personnel who are pregnant to avoid contact with known CMV shedders
2.2 TOXOPLASMA GONDII	<i>Toxoplasma gondii</i> is an intracellular coccidian protozoan of cats, and the cause of toxoplasmosis . This is a common infection which is frequently asymptomatic or else presents as an infectious disease resembling infectious mononucleosis A primary infection during early pregnancy, however, may lead to fetal infection with death of the fetus or choreoretinitis, brain damage with intracerebral calcification, hydrocephaly, microcephaly, fever, jaundice, rash, hepatosplenomegaly and convulsions evident at birth or shortly thereafter. Maternal infection later in pregnancy results in mild or subclinical fetal disease with delayed manifestations, especially recurrent or chronic chorioretinitis.	Numerous studies (31)	MOs should be aware of the risk to: ● Pregnant RAVC personnel who work in veterinary hospitals which operate on cats. ● Pregnant RAVC or RMP personnel who work in equine divisions (where barn cats are an essential part of the establishment). They should advise such personnel accordingly, and if necessary impose a formal restriction on any contact with cats.

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Table 3
Workplace Hazards to Pregnancy Servicewomen - Chemical Agents

Agent	Human Reproductive Hazard	Scientific Evidence	Recommendation for Medical Officer (MO)
3.1 LEAD	Reduced fertility, spontaneous abortion, prematurity, stillbirth, neonatal death, congenital malformations, abnormal central nervous systems development, behavioural abnormalities	Numerous studies (32,33)	MO should restrict pregnant servicewomen from all duties within indoor firing ranges.
3.2 BENZENE	Vaginal bleeding, haemorrhagic complications of pregnancy, spontaneous abortion.	Numerous studies (34) It should be noted that petrol by law may contain up to 5% benzene. Diesel fuel , on the other hand may contain a variable amount of benzene. Currently, the levels are not regulated by law.	MO should restrict pregnant servicewomen from any direct contact with benzene or with benzene vapour, even when wearing protective equipment. Pregnant women should not be permitted to refuel military vehicles at any time. This applies also to military drivers, who must not refuel their own vehicle if pregnant.
3.3 CARBON MONOXIDE	Neurological damage to fetus, fetal growth retardation.	Carbon monoxide readily crosses the placenta and is likely to cause reduced fetal haemoglobin concentration. The potential for this hazard has been demonstrated in numerous studies (34). It should be noted that vehicle exhausts contain carbon monoxide as well as oxides of nitrogen (which are also believed to have an adverse effect on pregnancy).	MO should restrict pregnant servicewomen from all duties in vehicle parks, other than brief visits.
3.4 ANAESTHETIC GASES	Spontaneous abortion (one-and-a-half to threefold increase). ?Fetal growth retardation, congenital malformation, low birth weight, stillbirth.	Numerous retrospective studies (35)	MO should restrict RAMC, RADC, QARANC and RAVC servicewomen who are pregnant from any exposure to anaesthetic gases. This applies to surgeons, anaesthetists, operating theatre nurses, operating theatre technicians, etc.
3.5 ANTIMITOTIC (CYOTOXIC) DRUGS	Pregnant doctors and nurses administering antimetabolic agents (even when doing so with extreme care) have shown a significant increase in fetal loss and/or congenital malformations.	Numerous studies (17,36)	MO should restrict pregnant RAMC and QARANC servicewomen (including doctors, nurses, pharmacists and pharmacy technicians) from handling antimetabolic drugs in any form .
3.6 ANTIMALARIAL CHEMOPRO-PHYLAXIS - MEFLOQUINE	?Congenital malformations	Mefloquine is teratogenic when administered to rats and mice in early gestation. Its prophylactic use during human pregnancy should therefore be avoided as a matter of good clinical practice (37). Pregnancy should also be avoided for 3 months after completing a course of mefloquine, on account of its long half-life (37).	MO should not prescribe mefloquine to any servicewoman travelling to a malarious area, unless there is no risk at all of pregnancy (eg following hysterectomy, bilateral oophorectomy or tubal ligation).
3.7 PESTICIDES	?Spontaneous abortion. ??Congenital malformations	Various studies (38)	Although the majority of Service-approved pesticides are likely to pose no threat at all in pregnancy, MO should nevertheless restrict pregnant servicewomen from all duties involving the use of pesticides.
3.8 CS GAS	??Adverse outcome of pregnancy	No known studies	As a sensible precaution, MO should restrict pregnant servicewomen from any exposure to CS gas, eg during NBC training. See also the restriction at Table 1.13.

KEY: ? = Evidence for reproductive hazard is inconclusive.

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Outcome

Initial user response to the guidelines has been favourable. The guidelines are felt to have filled a serious policy gap in the delivery of responsible medical care to those servicewomen who exercise their statutory right to become pregnant. As at 1 April 1994, 7% of all UK Regular Forces were female (9). In the case of the Army, 187 female personnel out of a total female strength of 7,052 took maternity leave during 1993/94. This equates to a general fertility rate within the British Army of approximately 26.5 live births per annum per 1,000 servicewomen of childbearing age. The rate is likely to increase over time, as pregnancy amongst servicewomen becomes increasingly acceptable, and maternity rights more extensive.

The guidelines have proved to be especially timely in the light of the government's decision during 1994 to implement the health and safety provisions of the EC Pregnant Workers Directive (10). The implementation was accomplished through the Management of Health and Safety at Work (Amendment) Regulations (11), which came into effect on 1 December 1994. Under the

regulations employers are required to assess any risks within their undertaking to the health of new and expectant mothers in their employment, and to take all "reasonably practical" steps to control those risks. Military employers would normally rely on their unit medical officers to provide them with detailed, scientific advice on how to carry out all stages of this risk assessment.

For some of the hazards identified, AMD5's guidelines have proved to be more proscriptive than the national guidelines (12) which the Health and Safety Executive issued in December 1994, to complement the new regulations. This can be justified on the grounds that MOD has consistently aspired to a standard of occupational health and safety which is at least as high as the best civilian industrial practice, and where possible higher. Moreover, defensive medicine is now accepted as a normal component of prudent medical practice (13), and it could be argued that where Service pregnancies are concerned it is appropriate that the attending medical staff should engage in it.

It is thought that AMD5's study is the first

Table 4
Workplace Hazards to Pregnancy Servicewomen - Working Conditions

Working Condition	Human Reproductive Hazard	Scientific Evidence	Recommendation for Medical Officer (MO)
4.1 DIVING	?Adverse outcome of pregnancy	Hyperbaric oxygen (ie the standard treatment for decompression illness) is known to damage the fetus (39).	Military diving must not be undertaken at any stage of pregnancy.
4.2 FLYING - AIRCREW	?Low birthweight ??Congenital abnormalities	The partial pressure of oxygen within aircraft cabins is normally low, approximating to an altitude of 1520-2440 m (40), with oxygen concentrations ranging from 15.2% to 17.6% (41). In the case of a pregnant member of the aircrew, this would result in a slightly reduced haemoglobin oxygen saturation, in both mother and fetus. Any extended exposure to a low partial pressure of oxygen is thought to constitute a threat to the fetus (42). In addition, flying duties involve risks to the pregnant servicewoman from prolonged noise exposure, and from whole-body vibration .	MO should restrict pregnant aircrew from all flying duties .
4.3 FLYING - PASSENGERS	?Preterm labour	There is probably no risk to infrequent passengers from the low partial pressure of oxygen within aircraft. Should pregnant passengers elect to fly in advanced pregnancy, however, there is a risk of preterm labour due to the changes in ambient atmospheric pressure (43).	Any pregnant servicewoman who is between her 32nd and 36th week of pregnancy must be examined by a medical officer before she can be considered fit to fly in an RAF or MOD-chartered aircraft. Between the 35th and 36th week of pregnancy it is prudent to restrict air travel to short journeys only (43). After the 36th week of pregnancy air travel in an RAF or MOD-chartered aircraft will only be authorised as an aeromedical patient.

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Table 5
Workplace Hazards to Breastfeeding Servicewomen - Chemical Agents

Agent	Human Reproductive Hazard	Scientific Evidence	Recommendation for Medical Officer (MO)
5.1 LEAD	Lead can enter maternal milk and may cause abnormal central nervous system development in the lactating infant.	Limited studies (33)	MO should restrict servicewomen who are breastfeeding from all duties within indoor firing ranges.
5.2 PESTICIDES	Certain pesticides (eg chlordecone [Kepone]) appear as concentrates in maternal milk. The health risks to the lactating infant are variable.	Limited studies (34)	MO should restrict servicewomen who are breastfeeding from all duties involving the use of pesticides. This applies to:- ● Female Environmental Health Technicians. ● Female unit pest control personnel.

comprehensive appraisal to have been conducted by any Defence organisation of reproductive hazards in the military environment. It is acknowledged that in the course of time new hazards will emerge and existing hazards will assume greater or less prominence. The guidelines will need to be revised periodically.

Pregnancy in the workplace is a highly emotive issue which carries severe economic penalties if the medical attendant or the employer can be shown, through civil litigation, to have been negligent. It is hoped that AMD5's medical guidelines on employability during pregnancy and lactation will help reduce the incidence of such penalties, to the mutual benefit of all parties.

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