Occupational noise exposure during pregnancy and its effect on the foetus

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Noise

• Unwanted or undesirable sound subjectively disrupting or physiologically/psychologically stressful
• Negative health effects:
  • noise-induced hearing loss (NIHL)
  • noise-induced stimulation of sympathetic nervous system and endocrine system
Industrial Noise

• Higher risk to noise:
  • more excessive
  • potential ototoxicants

• Industrial hearing loss in adults usually result in general reduction of hearing between 3000-6000 Hz

Aim

To analyse the current literature on occupational noise exposure during pregnancy, the health outcomes for the foetus, and to suggest possible solutions to eliminate or reduce any foreseeable risk.

• Why?
  • Changing workforce
  • Women working throughout pregnancy
  • Vulnerable populations
  • Gap in current knowledge
  • Current exposure standard for noise 85dBA for an 8 hour shift
Foetal Hearing

• Foetal cochlea structurally ready to function by the 18th week of gestation
• In utero, foetus is surrounded by amniotic fluid
  • Modifies how sound travels and heard by the foetus
  • Bone conduction primary source for noise exposure in utero
• Sound transferral and foetal responsiveness dependant on:
  • gestational age
  • sound frequency
  • attenuation of the environment to external sounds

Sound Environment of the uterus

• Gestation progression important factor towards sound attenuation
• Increasing amount of energy filtered from mid and high frequency sounds as the foetus progresses
• Different body positions can affect sound transmission in the uterus
• Women in a lying down position filters sound better than when in a sitting or standing position
Sound Environment of the uterus

- Frequency attenuation in the uterus:
  - Between 500 Hz and 10kHz, energy entering the uterus can be attenuated as high as 40 to 50 dB
  - Above 10 kHz, sound attenuation could drop as low as 3dB in sheep foetuses
  - Low frequency sounds (125 Hz) are potentially enhanced by 3.7dB within the uterus

Animal Studies

- Experimental studies using animals provide insight towards negative affects of noise on the foetus
  - Don’t rely on retrograde information
  - No harmful experimental designs on human foetuses
Animal Studies: acoustic trauma

- Hearing loss and histological damage found in rats exposed to high noise intensity 90dB and 102dB sound pressure level (SPL)
  - More profound long-term changes in hearing within older group compared to younger group
  - Histology found greater damage to hair cells within the cochlear in younger group compared to older group
  - Developing ear not more vulnerable to acoustic trauma compared to developed ear

Animal Studies: stillbirths and birth weight

- Mice exposed to construction noise during either the first, second or third weeks of gestation
  - All three weeks of gestation found to have increased risk of stillbirths
- Rat foetuses exposed to white noise (90dB) during foetal development were at an increased risk of being born with lower body weight
Human Studies

• Variety of human studies researching negative health effects on the foetus
• High proportion of human studies focus on or indicate noise exposure during pregnancy can lead to possible hearing loss, low birth weight or prematurity
• Improvement of technology has lead to an improvement in the quantity and quality of published human studies surrounding noise exposure and the foetus

Human Studies: hearing loss

• High frequency hearing loss has been found in children aged 4-10 years after being exposed in utero to occupational noise conditions between 85-95dB(A)
• A Swedish cohort study found that there was an association between hearing dysfunction in children exposed to constant occupational noise levels above 85dB(A) during pregnancy
• Another study found that intense, sustained noise produce changes in the hearing of the foetus and cochlea for low-frequency sound energy
Human Studies: birth size and prematurity

- Women exposed to high noise levels during pregnancy were at higher risk of small for gestational age babies, prematurity, gestational hypertension and congenital malformations
  - Long-term stress or high noise levels can overload neuroendocrine system to pass cortisol to foetus and reduce foetal growth
  - Discrepancies towards noise levels measured for studies
- One study found mothers working in roles exposed to 75-85dB(A) were at increased risk of small for gestational age or low birth weight
  - Identified for women working full time with less than 20 days sick leave during pregnancy

Human Studies: birth size and prematurity

- Discrepancies towards findings within the literature
- Some literature reviews found no association between noise and pregnancy outcomes such as low birth weight, pre-term birth, congenital abnormalities, or perinatal/neonatal death.
Findings

• Gaps in the literature with some inconsistencies towards results
• Possible negative health outcomes:
  • low birth weight
  • small for gestational age
  • pre-term birth
  • hearing loss
• Sound attenuation highly associated with gestational development and body positioning

Further research

• More research is needed in the following areas:
  ▪ health impacts of high sound levels during pregnancy
  ▪ attenuation of sound levels within the amniotic sac and uterine environment
  ▪ role of body position towards permeation of sound into the uterus