The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces through safety and health research

Effects of Welding Fume Exposure on Human Placental Cells

NIOSH DATASET RD-1012-2019-0 OCTOBER 2019

As more women join the skilled-trade workforce, the effects of workplace exposures on pregnancy need to be explored. This study aimed to identify the effects of mild-steel (MS) and stainless-steel (SS) welding fume exposures on first-trimester placental trophoblast cells, using the HTR-8/SVneo cell line. MS is primarily composed of Iron (Fe) and Manganese (Mn), while SS also contains chromium (Cr) and nickel (Ni). We found that all three welding fumes had significant effects on cellular viability, and also caused increases in free radical production, while negatively affecting their invasive capabilities. MS was the only sample to cause an increase in production of the pro-inflammatory cytokines IL-6 and IL-8. Our results show that welding fume exposure is in fact cytotoxic to trophoblasts, and understanding how these occupational exposures could impact maternal and fetal health is necessary. Identifying how the varying combinations of heavy metals and other materials present in MS and SS welding fumes, along with fume particle size adversely affects the maternal fetal interface and gestational outcomes should be considered an emerging issue, and appropriate measures should be taken to reduce exposures in the workplace.

Download Data

- Olgun 1 [XLS – 627 B]
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- Data Dictionary [PDF – 228 KB]
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Methods Collection

1. Welding fume characterization and composition
    - Welding fume was collected by Lincoln Electric
    - X-Ray Fluorescence used for element detection
    - OSHA method ID-215 for Cr(VI) determination
2. Welding fume particle sizing
    - Nanosight NS300 nanoparticle tracking analysis software
3. Endotoxin analysis

- Limulus Amebocyte Lysate (LAL) assay

4. Cell Culture
   - HTR-8/SVneo cell line using RPMI 1640 medium supplemented with fetal bovine serum and penicillin/streptomycin
5. Scanning Electron Microscopy
   - Diluted particles imaged using a Hitachi S4800 field-emission scanning electron microscope at 5 kV
6. Transmission Electron Microscopy
   - Fixed cells were placed on 200 mesh copper grids and stained. Images obtained using a JEOL 1400 transmission electron microscope.
7. Cellular Viability
   - Measured using the water soluble tetrazolium (WST-1) assay
8. Electron spin resonance
   - Detection of the hydroxyl radical was measured using a Bruker EMX spectrometer and the 5'5-dimethylpyrroline N-oxide (DMPO) spin trap
9. Intracellular ROS
   - Cells were incubated with the cell permeable fluoroprobe 2',7'-dichlorohydrofluorescin diacetate (DCFH-DA) and monitored over the course of 6 hours.
10. Cytokine production
    - Production of the cytokines IL-1β, TNFα, IL-6, and IL-8 was determined using a V-plex, pro-inflammatory MULTI-SPOT assay system, and quantified with a MESO Quickplex SQ120 instrument.
11. Invasion Assay
    - A CytoSelect™ 24-well kit was used. Cells were stained and imaged using an Olympus IX 70 inverted microscope. Optical density was measured at 560 nm

Acknowledgements

This work was supported by NIOSH. CAN 79210443. This was a pilot study.

This work has been submitted to the *American Journal of Reproductive Immunology* for consideration for publication, as of October 8, 2019.

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This work was also made possible by contributions from Dr. Charles Graham (Queen's University, Ontario, Canada), the West Virginia University Genomics Core, and the West Virginia University National Research Center for Coal and Energy

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Page last reviewed: October 11, 2019