



UKLA Metalworking Fluid Product Stewardship Group

TOPIC REVIEW 6: Health Risks from Endotoxin in Metalworking Fluid

Introduction: Inhalation of metalworking fluid (MWF) droplets and mist risks respiratory disease in machinists. Poor water-mix MWF quality promotes microbial growth and microbial toxin buildup. This review explores health risks from exposure to these inflammatory stimulators, focusing on bacterial lipopolysaccharides (LPS) from Gram-negative bacteria and how effective MWF management can reduce these risks.

Research Methods: The review covers studies from 1987 to 2024 on endotoxin and fungal toxin contamination in water-mix MWFs and occupational exposure, including publications from technical and government sources, from Europe and the US.

Main Findings: The review found evidence that both live and dead Gram-negative bacteria contribute to endotoxin concentrations in MWF, which may increase the risk of respiratory inflammation among exposed machinists. Evidence on occupational exposure across different industries points to risks of developing Chronic Obstructive Pulmonary Disease (COPD), Occupational Asthma, Occupational Hypersensitivity Pneumonitis (OHP), and worsening respiratory symptoms, particularly in individuals with pre-existing asthma or a genetic tendency to develop allergies (termed atopy). Experimental and occupational studies indicated that chronic low-level endotoxin exposure speeds up lung decline and COPD development. Patient challenge studies also suggest that acute exposure to endotoxin, combined with hazards like allergens, worsens pre-existing conditions like asthma. The published studies were often based on small sample sizes and the use of different methods for measuring endotoxin. This underscores the need for more evidence on machinists' occupational endotoxin exposure and respiratory health risks. Factors like genetic predisposition, past exposure, and co-exposure to hazards affect individual susceptibility.

Discussion and Analysis: These findings link prolonged endotoxin exposure to respiratory diseases like COPD and OHP, with acute exposures worsening symptoms, especially in those with pre-existing asthma or atopy. This underscores the need for strict MWF quality standards to control endotoxin levels and to counter the environmental conditions that promote microbial growth in MWFs.

Conclusion and Knowledge Gaps: The review found limited evidence that routine endotoxin monitoring is essential for managing machinists' health risks. Endotoxin measurement is affected by complex variables, making these assays impractical for machine workshops. Regular cleaning of MWF supply systems therefore remains important to reduce health risks from these toxins. Research studies have found that although poorly maintained systems often contain high endotoxin levels, airborne concentrations are below those known to trigger inflammation in most people. Further research is necessary to determine the best methods for sampling airborne endotoxin, as well as for its recovery and quantification from filters. Additionally, improved guidance to establish appropriate control levels for managing airborne microbial toxins is required.