ABSTRACT

The Illusion of Safety: Disparity in PM10 and PM2.5 Toxicity among Material Warehouse Workers

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Background : Occupational Health and Safety (OHS) monitoring in material warehouses traditionally prioritizes coarse dust (PM10), neglecting the more hazardous fine particles (PM2.5). The assumption that PM10 compliance guarantees a safe environment creates an "illusion of safety", masking PM2.5 toxicity threats caused by resuspension inside enclosed spaces.

Objective : To evaluate the toxicological disparity between PM10 and PM2.5 exposure, demonstrating how PM10-based environmental monitoring may fail to protect workers from latent hazards.

Research Methods/ Implementation Methods : This cross-sectional analytical observational study with an Environmental Health Risk Assessment (EHRA) approach was conducted on nineteen workers in Limba U Satu. Measurements of particulate concentrations, exposure duration, and worker characteristics were analyzed to quantify the intake rate and threat level (Risk Quotient/RQ).

Results : Average PM10 concentration was extremely safe (7.0 µg/m3). Conversely, PM2.5 breached the toxic threshold, averaging 111.49 µg/m3. Risk characterization clearly demonstrated the illusion of safety: all workers were safe from PM10 (maximum RQ = 0.07), but 57.89% of the population operated inside the toxic PM2.5 zone (maximum RQ = 2.08). The absence of clinical symptoms among at-risk workers is potentially compatible with the ‘healthy worker effect’. This condition was exacerbated by the absence of mask usage and dry sweeping methods triggering massive mechanical resuspension.

Conclusion/Lesson Learned : Using PM10 parameters as OHS audit benchmarks is highly misleading. Fine PM2.5 particulates act as progressive latent hazard agents. Technical interventions like wet cleaning, exhaust fans, and mandatory N95 respirators are now urgently needed.

Keyword : Occupational Exposure; Particulate Matter; Material Warehouse; Healthy Worker Effect; Environmental Health Risk Assessment