



Study reveals effective measures for 3D printing risks

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The emergence of metal 3D printing carries health risks associated with particle exposure, but a new study shows targeting critical tasks and preventative actions can protect workers.

Researchers from Linköping University's Occupational and Environmental Medicine Centre in Sweden, and other institutions, measured the dust and particle concentrations and employee urine and dermal metal levels at a metal additive manufacturing (AM), or 3D printing, facility.

They found the total inhalable dust levels in the facility were "well below" Swedish occupational exposure limits, but there were elevated levels of harmful metal nanoparticles detected during specific tasks like sawing printed products from the construction plate and removing excess powder from finished products.

Importantly, they identified higher levels of metals in AM operators' urine compared to a control group of office staff, but the trend was significantly reduced in the second year of the study, after the employer improved its personal protective equipment guidelines and work methods.

"This indicates that the preventive actions taken by the company with work routine restrictions and use of PPE at the most critical work tasks successfully decreased the exposure of the operators," the researchers say.

The new guidelines required PPE like overalls, shoe covers, single-use nitrile gloves and powered air-purifying respirators during open handling of the metal powder, they say.

"During other operations in the AM facility, similar PPE but without the shoe covers and powered air-purifying respirator were required."

The employer also implemented restrictions preventing printed products from being taken out of the factory before being post-processed and de-powered.

The researchers say their results highlight the need for "careful design and regulation of the AM environments", and for monitoring the workplace and workers for relevant exposures and health risk markers.

"However, the AM operators still had a trend for elevated levels compared to the controls indicating that there could be some persistent exposure not prevented by the interventions," they cautioned.

According to the researchers, additive manufacturing, involving "sequential addition of layers of materials followed by specific fusing based on digital models", is a "rapidly expanding" new technology with many advantages for industry, but poses occupational health challenges.

There are a range of metal AM techniques with different properties, but data around the health and safety risks are scarce, they say.

However, it has been established that inhalation of metal particles can alter nasal lavage fluid acute phase proteins and increase cancer risk in the lungs, kidneys and bladder, they say.

The researchers say AM sites need to prioritise design, ventilation and mandatory PPE, as well as machines with closed powder handling systems.

[Biomonitoring of metal exposure during additive manufacturing \(3D-printing\)](#). Stefan Ljunggren, et al, Sweden, *Safety and Health at Work*, online first August 2019, doi: 10.1016/j.shaw.2019.07.006.

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