

The Effects of Hazardous Materials Gloves on the Performance of Fine Manual Skills.

H. Carnahan¹, J. Larmer¹, V. LeBlanc², R. Macdonald³, M. Praamsma¹, B.A., Darroch¹, & A. Dubrowski⁴

¹Dept. of Kinesiology, University of Waterloo; ²Dept. of Medicine, University of Toronto; ³Air Ambulance Base Hospital Program, Sunnybrook and Women's College Health Sciences Centre; ⁴Dept. of Surgery, University of Toronto

Fire fighters and paramedics often perform manual tasks that require very fine fingertip movements while wearing latex hazardous materials (HAZMAT) gloves, however little is known about how sensory and motor function is affected by these garments. Recent terrorist attacks, increased military involvement, and the spread of communicable diseases, such as Severe Acute Respiratory Syndrome (SARS) mandates health care workers to perform many medical procedures while wearing heavy HAZMAT gloves. For example, emergency medicine services (EMS) personnel routinely respond to incidents with potential exposure to hazardous chemical or biological agents. These include EMS responses to petrochemical industry sites, clandestine drug laboratories, pharmaceutical manufacturing sites, and other locations where chemical or biological agents are being stored or used. EMS agencies must be able to provide medical assistance in these situations without endangering the health and well-being of their personnel. However, the effects of HAZMAT gloves on sensory acuity, manipulative force generation, and motor performance with and without the use of medical instruments are unclear.

In a series of experiments we show that the use of these heavy latex gloves impairs both fine sensory and motor function. More specifically, in Experiment 1 participants performed two timed manual dexterity tasks (with and without tools). In Experiment 2 they were asked to lift objects instrumented with a force/torque sensor. The coefficient of friction between the digits and the object were estimated during these lifts. Fingertip sensitivity was also assessed. In Experiment 3, fingertip placement when lifting objects of various masses was quantified. All test were performed with bare hands and when wearing HAZMAT gloves. It was found that the participants' ability to manipulate small objects decreased when gloves were worn. However, there were no performance decrements when the task was performed using a tool. Elevated grasping forces were present when the gloves were worn. The estimates of the coefficient of friction were lower for the gloved digits, and fingertip sensitivity to touch was decreased when wearing the glove. Lastly, glove wear was associated with misalignment of the digits on the surface of the object. To summarize, the negative effects of glove use on motor performance were related to three factors: decreased sensitivity to light touch, increased slipperiness between the digits and the object, and a misalignment of the digits. The results of this study can be used to guide protocols for working while wearing HAZMAT gloves, or can be used when designing tools, or HAZMAT garments.