Poster: 0141

HELD's Hand-Transmitted Vibration Program - From R&D to Practice

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Significance and Objectives: Powered hand tools such as chipping hammers, grinders, chainsaws, rock drills, road breakers, and riveters are widely used in several industries such as foundries, automobile manufacturing, forestry, construction, mining, and bridge construction. Hand-arm vibration syndrome (HAVS) is one of the major diseases among more than one million U.S. workers exposed to hand-transmitted vibration (HTV). The most well-known component of HAVS is termed as vibration-induced white finger (VWF). Although HAVS has been studied for more than 80 years, the mechanisms of the syndrome are not sufficiently understood. It is still inconvenient, expensive, and technically difficult to accurately measure tool vibration and to assess related exposure factors such as applied forces and postures. The diagnosis of the disease still mainly depends on subjective questionnaires. Many aspects of current risk assessment methods have not been validated. Further studies on HTV exposure and health effects are required. In responding to these needs, a research and development program has been gradually established in the Health Effects Laboratory Division (HELD) of NIOSH. This presentation provides a brief outline of the program's status and its major achievements.

Methods: The HTV Program is currently aimed at: (1) conducting comprehensive studies of the biodynamics of the fingers-hand-arm system using advanced vibration testing and measurement methods, and finite element modeling; (2) developing practical and efficient methodologies to measure hand-applied forces and to assess hand-arm postures when using powered hand tools; (3) understanding the cellular, physiological, and pathological effects of vibration exposure using animal models; (4) using human subjects to determine the acute effects of vibration exposure on physiological measures such as the vibrotactile perception threshold shift, the thermal perception threshold shift, and blood circulation changes in the fingers and hand; (5) establishing new frequency weightings and dose-response relationships for risk assessments of the major components of hand-arm vibration syndrome; (6) developing more effective vibration measurement methods, devices, and expert systems so that reliable and accurate measurements can be carried out by non-experts in the field; and (7) investigating the effectiveness of vibration isolation devices such as anti-vibration gloves and sleeves through tests using

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an instrumented vibrating handle that simulates specific tools and vibration characteristics.

Results: Systematic studies have created several new concepts and methodologies for studying HTV exposure and health effects, generated new knowledge of the biodynamics of the system, proposed new frequency weighting for exposure quantification, developed new anti-vibration glove test methods and medical test devices, enhanced understanding of the disorders and diagnostic methods, proposed alternative tool tests, and improved vibration and force measurement methods. This program has led to many conference presentations and the publication of more than 40 peer-reviewed journal papers.

R2P Outcomes: Our instrumented handle developed from this program has been marketed as a commercial product. We have helped develop another commercial product: a novel 3-D HTV test system. Our automation nail press test has been patented. The knowledge generated from this program has directly influenced the revisions and/or developments of several international standards. The knowledge has also been used to provide consulting service and health hazard evaluation (HHE) for workplaces.

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