

# **Quantitative Methods for Evaluation of Tremor and Neuromotor Function:**

## **Application in Workers Exposed to Neurotoxic Metals and Patients With Essential Tremor**

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av

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- I.** Wastensson G, Lamoureux D, Sällsten G, Beuter A, Barregård L. Quantitative tremor assessment in workers with current low exposure to mercury vapor. *Neurotoxicology and Teratology* 2006;28:681–93.
- II.** Wastensson G, Lamoureux D, Sällsten G, Beuter A, Barregård L. Quantitative assessment of neuromotor function in workers with current low exposure to mercury vapor. *Neurotoxicology* 2008;29:596–604.
- III.** Wastensson G, Sällsten G, Bast-Pettersen R, Barregård L. Quantitative assessment of neuromotor function in welders formerly exposed to manganese. *Submitted*.
- IV.** Wastensson G, Holmberg B, Johnels B, Barregård L. Quantitative methods for evaluating the efficacy of deep brain stimulation in patients with essential tremor. *Manuscript*.



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# **Quantitative Methods for Evaluation of Tremor and Neuromotor Function:**

## **Application in Workers Exposed to Neurotoxic Metals and Patients With Essential Tremor**

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### **ABSTRACT**

The overall purpose of this thesis was to investigate the usefulness of certain quantitative methods for detecting or quantifying changes in tremor or other neuromotor functions. Tremor and impairment in neuromotor function may be the early signs of adverse effects due to low-level exposure to neurotoxic metals such as mercury and manganese, and are also common features of neurological diseases. One of the most common movement disorders is essential tremor (ET), which is characterized by postural and kinetic tremor usually affecting the arms. Sensitive quantitative tests of tremor, motor speed, manual dexterity, diadochokinesis, eye–hand coordination, and postural stability were administered to a group of chloralkali workers with current mercury exposure, as well as former ship welders with previous manganese exposure. No effects of low-level mercury exposure on tremor amplitude and the ability to perform rapid pointing movements or rapid alternating forearm movements were shown. However, some findings provided support for a decrease in tremor frequency in the non-dominant hand resulting from mercury exposure. Former welders performed less well than referents in a test of manual dexterity and motor speed, and poorer performance was associated with cumulative manganese exposure, which indicates an irreversible adverse effect of long-term exposure to manganese. However, the performance in most of the other neurobehavioral tests was similar between groups. The use of certain quantitative methods in evaluating the efficacy of thalamic deep brain stimulation (DBS) was examined in a group of ET patients, and these methods were compared with traditional clinical tools for tremor assessment. The agreement between clinical rating of postural tremor and tremor intensity as measured by an accelerometer was relatively high ( $r_s=0.74$ ). Moreover, the quantitative system's sensitivity and specificity were estimated at 100% and 100%, respectively. The agreement between clinical rating of kinetic tremor and the main outcome variable from a quantitative test was low ( $r_s=0.34$ ), as was the sensitivity for this test (47%), even if the specificity was high (100%). In general, agreement between clinical tremor rating and quantitative measurements of tremor was low at low tremor amplitudes. In conclusion, no effect of low-level mercury exposure was shown, either on tremor amplitude, or on other certain neuromotor functions. Former welders had poorer performance on a test of motor speed and manual dexterity and this finding is probably caused by previous manganese exposure, even long after cessation of exposure. Quantitative methods may be useful tools for detecting subtle changes in tremor or other neuromotor functions at low-level exposure to neurotoxins; qualitative methods may be too insensitive as tools in this situation. Quantitative methods for measurement of tremor could complement clinical assessment in evaluating the efficacy of DBS in clinical practice.

**Key words: Tremor, neuromotor function, neurobehavioral methods, mercury vapor, manganese previous exposure, welding, essential tremor, deep brain stimulation**

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