

THE EFFECTS OF INDUSTRIAL OTOTOXIC AGENTS AND NOISE ON HEARING

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ABSTRACT

Recent epidemiological and laboratory experimental studies have established that some commonly used organic solvents and heavy metals can be ototoxic. Workers exposed to these substances may also be exposed to high levels of industrial noise.

The possibility of short or long term combined exposure to noise and chemicals poses new questions for hazard risk assessment. This research project reviews aspects of the scientific literature on potential industrial and environmental ototoxic agents and, where possible, on the combined effects of multiple exposures. Multiple exposures may be exposures to mixtures of chemicals, sequential exposures to chemicals or exposures to chemicals and noise sequentially or simultaneously.

Organic solvents implicated are unsaturated aliphatic or aromatic compounds including toluene, styrene, xylene, trichloroethylene and carbon disulphide and the heavy metals include lead, mercury and tin.

Animal and human studies of the effects of these substances on hearing are reviewed. Particular attention is devoted to combined effects. Some data on other possible ototoxic chemicals are reviewed.

The study finds that there are similarities in the effects of various solvents on the cochlea and that there are neurotoxic effects of variable severity. Interactions between noise and chemicals are described.

There is some information on the effects of those agents at the cellular and biochemical level especially for mercury and tin. Generally, however knowledge of the biochemical and pharmacokinetic basis for ototoxicity was found to be quite limited.

Studies of chemicals and noise together in both humans and animals confirm the need for watchfulness in occupational health and safety regulation and rigour in enforcing existing exposure standards for both noise and chemicals especially where there is the possibility of multiple exposures.

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Abbreviations

ABLB	Alternate Binaural Loudness Balance (Test)
ACGIH	American Conference of Governmental Industrial Hygienists
ART	Stapedial Reflex Threshold(s)
BAER	Brainstem Auditory Evoked Response
BERA	Brainstem Evoked Response Audiometry
CAP	Compound Action Potential
CAR	Conditioned Avoidance Response
ceil	ceiling: that concentration of a chemical which should not be exceeded even instantaneously.
CERA	Cortical Evoked Response Audiometry
d	day(s)
d/w	days per week
dB	decibel
dBA	The A-weighted SPL of a sound
dBHL	Sound Pressure Level in dB re audiometric or reference zero
dB L _{eq}	That continuous steady state sound pressure (in dBSPL) which has the same total acoustic energy as the reference sound over a set period of time.
dBSPL	Sound Pressure Level in dB re 20microPascals
DNA	Deoxyribonucleic acid
DPOAE	Distortion Product Otoacoustic Emissions
h	hour(s)
h/d	hours per day
Hg	Mercury
IHC	Inner Hair Cell
IPL	Interpeak Latency
kg	kilogram(s)
kHz	kilohertz

mg	milligram(s)
MRI	Magnetic Resonance Imaging
NIOSH	National Institute for Occupational Safety and Health (United States)
OBN	Octave Band Noise
OHC	Outer Hair Cell
OSHA	Occupational Safety and Health Administration (United States)
Pb	Lead
PB-max	Maximum Speech Discrimination
ppm	Parts per million
PTA	Pure Tone Audiometry
SD	Standard Deviation
SEM	Scanning Electron Microscop(e)(y)
SGC	Spiral Ganglion Cell
SISI	Short Increment Sensitivity Index
SPL	Sound Pressure Level
SRT	Speech Reception Threshold
STEL	Short term exposure limit adopted by ACGIH - the maximum concentration to which workers may be exposed for a period of up to 15 minutes continuously, provided that no more than four excursions per day are permitted, with at least 60 minutes between exposure periods and provided that the daily TLV/TWA is not exceeded.
TEM	Transmission electron microscop(e)(y)
TLV	Threshold Limit Value. The TWA adopted by ACGIH
TMT	Trimethyltin
TWA	Time-weighted average for normal 8 hour working day and 40 hour working week.
w	week(s)