

127 The Neurocognitive and Emotional Effects of Chronic Polychlorinated Biphenyls (PCB) Exposure

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Learning Overview: After attending this presentation, attendees will have an understanding of the prevalence of PCB exposure to polychlorinated biphenyls in United States schools, be able to identify the appropriate testing battery for patients with known or suspected chronic PCB exposure, and be able to recognize the characteristic pattern of neurocognitive and emotional deficits associated with PCB exposure.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by bringing awareness of the neurocognitive and emotional effects of PCBs.

Background: One of the more powerful indicators of any harmful chemical or toxic exposure is an understanding of the health effects that are caused by that chemical.¹⁻³ An estimated 12,900–25,900 schools in the United States are contaminated with PCBs.⁴ Neurocognitive and emotional effects are among the most well-documented health effects of PCBs. This is a neurocognitive study of a group of 29 adults and 16 children who were chronically exposed to PCBs at school. Many of the occupants became ill. A lawsuit was filed and data collection ensued, including neurocognitive testing.

Methods: Knowledge of the lawsuit was by word of mouth. Participation was open to anyone who spent any time in the buildings. The present study consists of three age groups: young children ages 7–15 ($N=12$); adolescents ages 16–19 ($N=5$); and adults ages 21–58 ($N=29$). Comprehensive neuropsychological testing covered seven cognitive domains: cognitive proficiency, reaction time, multiple aspects of attention, multiple aspects of executive function, auditory verbal learning and memory, visual memory, and fine and gross motor. Baseline premorbid Intelligence Quotient (IQ) was established with the Test of Premorbid Functioning (TOPF), used to predict pre-injury IQ and memory abilities. The TOPF was used for those above 20 year of age. For ages 16–19, the TOPF with parents' demographics only was used. For ages 7 through 15, the General Ability Index from the Wechsler Intelligence Scale for Children® Fifth Edition (WISC®-V) was used to predict a premorbid IQ. Automated Neuropsychological Assessment Metrics (ANAM) was used to establish cognitive proficiency across the cognitive domains as well as different aspects of reaction times. Prefrontal/frontal brain-mediated executive functioning was assessed using: Stoop Color Word Test, Go/No Go Task, Connors Continuous Performance Test (CPT), Trails Making Test (TMT), Wisconsin Card Sorting Task (WCST), Right/Left Orientation, and the Controlled Oral Word Association Test (COWAT). Auditory verbal learning and memory were assessed using the California Verbal Learning Test (CVLT 3) and the Episodic Memory component of the Wechsler Memory Scale®, Fourth Edition (WMS®-IV). Visual memory was tested using Rey Complex Figure Test (Rey CFT), Visual Incidental Learning, delayed recall from the ANAM, as well as the Visual Spatial Memory. Fine and gross motor functioning were measured using the Finger Tapping Test and Grip Test.

Results: Across all groups, multiple areas of impairments were evidenced in overall cognitive proficiency and reaction times, selective attention, sustained attention, divided attention, perceptual reasoning, single trial learning, visual memory and processing, and fine motor ability. In addition to cognitive impairments and decline and inconsistency with baseline predictions, anxiety (Post-Traumatic Stress Disorder [PTSD]), depression, irritability, and emotional distress were common findings.

Conclusions: Even low doses of chronic PCB exposure have measurable and sometimes dramatic neurocognitive and emotional effects that permeate the individual's life. The pattern of results clearly indicates neurocognitive issues significantly below baseline predictions and heightened emotional issues as a direct result of prolonged and chronic exposure to PCBs. These mostly genetic strangers have suffered and continue to suffer from these effects as damage, especially to adults' nervous systems, is rarely repairable.

Reference(s):

1. Baker, D., and M. Nieuwenhuijsen. *Environmental Epidemiology: Study Methods and Application*. (New York: Oxford University Press, 2008), 196-197.
2. Merrill, R.M. *Environmental Epidemiology: Principles and Methods*. (Sudbury, Massachusetts: Jones and Bartlett Publishers, 2008), 162.
3. Savitz, D.A. *Interpreting Epidemiologic Evidence: Strategies for Study Design and Analysis*. (New York, New York: Oxford University Press, 2003), 187-188.
4. R.F. Herrick, J.H. Stewart, and J.G. Allen. Review of PCBs in US Schools: A Brief History, an Estimate of the Number of Impacted Schools, and an Approach for Evaluating Indoor Air Samples. *Environ Sci Pollut Res Int* 23, no. 3 (Feb 2016): 1975-85.

Neurocognitive Testing, Polychlorinated Biphenyls (PCBs), Toxic Exposure