HETA 2000-0363-2834
Pappas Chiropractic Center
Piscataway, New Jersey

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PREFACE

The Hazard Evaluations and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (NIOSH) conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health (OSHA) Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

HETAB also provides, upon request, technical and consultative assistance to Federal, State, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Kristin K. Gwin of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field assistance was provided by Ronald M. Hall. Analytical support was provided by Data Chem Laboratories, Inc. Desktop publishing was performed by Robin Smith. Review and preparation for printing were performed by Penny Arthur.

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Highlights of the NIOSH Health Hazard Evaluation

Evaluation of Mercury Exposure at the Pappas Chiropractic Center

In September 2000, NIOSH investigators made a health hazard evaluation at the Pappas Chiropractic Center at the request of the owner. He had been diagnosed with mercury poisoning and was concerned that his office may have been the source of exposure. We evaluated the office for possible sources of mercury exposure.

What NIOSH Did

- We made a visual inspection of the building's interior and exterior.
- We took full-shift area air samples throughout the office to assess exposure to airborne mercury vapor.
- We took direct-reading measurements throughout the office to assess exposure to elemental mercury vapor.
- We collected a sample of drinking water and a bulk sample of stained wood chips from the exterior of the building and checked them for mercury.

What NIOSH Found

- We did not see any visible sources of mercury during the walk-through inspection of the building.
- None of the full-shift area air samples revealed detectable mercury concentrations.
- The direct-reading measurements revealed extremely low elemental mercury vapor concentrations (only slightly greater than the limit of detection of the instrument) that were well below the 0.1 mg/m^3 OSHA ceiling limit.
- The drinking water sample and bulk sample of stained wood chips did not contain any detectable concentrations of mercury.
- We saw evidence of water damage in the unfinished portion of the basement.

What Can Be Done at Pappas Chiropractic Center

- Be aware of all federal and New Jersey state advisories for fish and shellfish consumption and stay within the recommended allowance of dietary intake to control methylmercury intake.
- Future episodes of flooding should be dealt with immediately, and water-damaged materials should be dried (within 24-48 hours) and properly cleaned, or replaced (see full report for further details).

What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513/841-4252 and ask for HETA Report # 2000-0363-2834

Health Hazard Evaluation Report 2000-0363-2834
Pappas Chiropractic Center
Piscataway, New Jersey
March 2001

Kristin K. Gwin, M.S.

SUMMARY

On July 14, 2000, the National Institute for Occupational Safety and Health (NIOSH) received a request from the owner of Pappas Chiropractic Center to conduct a health hazard evaluation (HHE) to evaluate possible exposure to mercury (Hg) at his chiropractic office in Piscataway, New Jersey. The requester had been diagnosed with Hg poisoning approximately six months before the request was received by NIOSH. The request was prompted by concerns that the chiropractic office may be the source of Hg exposure, even though there were no known sources of Hg in the office. In response to the request, NIOSH investigators conducted a site visit at Pappas Chiropractic Center on September 11-12, 2000.

The environmental evaluation included a walk-through inspection of the building interior and exterior and full-shift area air samples to assess exposure to airborne Hg vapor and determine which, if any, offices contained a source of Hg. Direct-reading measurements for elemental Hg vapor were also collected throughout the office and outside. A sample of drinking water and a sample of stained wood chips from the exterior of the building were collected and submitted for analysis of Hg content.

No visible sources of Hg were observed during the walk-through inspection of the interior and exterior of the building. There was evidence of water incursion in the unfurnished portion of the basement. The full-shift area air samples revealed no detectable concentrations of Hg vapor. The direct-reading measurements revealed airborne Hg concentrations ranging from no detectable concentration to 0.007 milligrams per cubic meter (mg/m^3) throughout the first floor and basement of the office, and from no detectable concentrations to 0.008 mg/m^3 outside the office. Approximately three to five consecutive measurements were taken at each location tested. Average Hg concentrations throughout the office ranged from no detectable concentration to 0.005 mg/m^3, whereas average Hg concentrations measured outside ranged from no detectable concentration to 0.004 mg/m^3. All of the individual and averaged instantaneous Hg vapor concentrations collected were well below the 0.1 mg/m^3 ceiling limit stipulated by the Occupational Safety and Health Administration (OSHA) and NIOSH. The drinking water sample and the bulk sample of stained wood chips revealed no detectable concentrations of Hg.

NIOSH investigators concluded that employees in the chiropractic office are not occupationally exposed to mercury. Recommendations for controlling methylmercury intake through dietary intake of fish and shellfish, as well as recommendations for dealing with future episodes of water incursion are presented in the report.

Keywords: SIC 8041(Offices and clinics of chiropractors), mercury, chiropractic office, neurological effects

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INTRODUCTION

On July 14, 2000, the National Institute for Occupational Safety and Health (NIOSH) received a request from the owner of Pappas Chiropractic Center to conduct a health hazard evaluation (HHE) to evaluate possible exposure to mercury (Hg) at his chiropractic office in Piscataway, New Jersey. The requester had been diagnosed with Hg poisoning approximately six months before the request was received by NIOSH. The requester had been experiencing neurological symptoms for the last five years, including fatigue and weakness, ataxia, very mild parathesia in his feet, tremor, and insomnia. Blood and hair bio-monitoring also revealed abnormal levels of Hg when compared to the reference levels given by the laboratory conducting the testing.

On September 11-12, 2000, NIOSH investigators conducted a site visit to the Pappas Chiropractic Center. A walk-through inspection was made of the building exterior and interior. Full-shift area air samples were collected to assess possible exposure to airborne Hg vapor and determine if any areas of the office contained an unknown source of Hg. Direct-reading measurements for elemental Hg vapor were also collected at various locations throughout the office and outside. A sample of drinking water and a sample of stained wood chips from the exterior of the building were collected for analysis of Hg content to determine whether other potential sources of Hg exposure existed.

BACKGROUND

The Pappas Chiropractic Center is a two-story wooden structure with approximately 2,500 square feet (ft^2) of indoor floor space. The first story is a basement consisting of a small finished room, which used to serve as a rehabilitation area, and a larger unfinished storage area, which is used to store patient files, equipment, and supplies. The rehabilitation area is no longer used by patients due to a moldy odor from water infiltration into the basement. The second story is the office area consisting of a receptionist's office, a waiting area, a doctor's office, a rest room, two examination rooms, an x-ray room, and a small dark room located off of the x-ray room. The building was converted from a residence to an office building 20 years ago and has been leased by the requester for the past 12 years. It was not known what type of business leased the building prior to the requester's occupancy.

Five workers (four doctors and one office manager) are employed at the Pappas Chiropractic Center. The requester (the owner of the chiropractic center) and the office manager have been there for approximately 12 and nine years, respectively, and spent at least 40 hours per week in the office. The owner currently spends approximately six hours per week at the office, depending on the severity of his symptoms. The remaining three doctors have worked there for approximately one and a half years and spend variable amounts of time in the office, depending on the patient load. Their schedules range from approximately three hours per day, two days per week to 30 hours per week.

The requester was diagnosed with Hg poisoning around February 2000, after blood and hair testing revealed abnormal levels of Hg. Adverse health effects, such as fatigue, ataxia, very mild parathesia in the feet, tremor, insomnia, and weakness were experienced by the requester for five years preceding his diagnosis. Hair analysis (utilizing Inductively coupled plasma-Mass spectrometry [ICP-MS]) conducted on November 20, 1999, revealed a Hg concentration of 13 micrograms per gram (µg/g), as compared with a reference range of <1.1 µg/g listed on the report. Blood was collected for analysis on December 8, 1999. A Hg concentration of 35 micrograms per liter (µg/L) was detected, as compared with a reference range of 13 µg/L or less listed on the report. Blood was collected again on January 10, 2000, for red blood cell element analysis. Analysis revealed a Hg concentration of 0.021 µg/g, as compared with a reference range of <0.01 µg/g listed on the report. A repeat hair analysis was conducted on May 9, 2000. A Hg concentration of 4.5 µg/g was detected, as compared with the reference range of <1.1 µg/g listed on the report. The repeat hair analysis indicated that the requester's Hg exposure had decreased; however, his symptoms persisted. The requester also reported that a Magnetic Resonance Imaging (MRI) test performed did not reveal any abnormalities.

The requester reported that he did not have any hobbies that involved exposure to Hg. However, he did report consuming a diet high in various types of commercial fish over a period of many years. His spouse was also tested and no elevated Hg levels were detected. However, she reportedly does not consume fish. The office manager at the chiropractic clinic was also tested for Hg levels due to her long duration of employment. Hair analysis revealed a slightly elevated Hg concentration of 2.4 µg/g, as compared to the reference range listed on the report (<1.1 µg/g). It was reported that her diet did not consist of a large amount of commercial fish. These findings raised concern that the chiropractic office may be a source of Hg exposure.

METHODS

On September 12, 2000, six area air samples were collected for airborne Hg vapor throughout the chiropractic office. Full-shift area air samples were collected in the receptionist's front office, the doctor's office, the x-ray room, in one of the two examination rooms where a thermometer had reportedly been broken two to three years ago, downstairs in the basement in an old rehabilitation room, and outside. The air samples were collected on solid sorbent tubes containing 200 milligrams (mg) of hopcalite (a mixture of manganese and copper oxides), using battery-powered air sampling pumps calibrated to provide a volumetric flowrate of 0.2 liters per minute (Lpm). The samples were analyzed according to NIOSH method 6009, using cold vapor atomic absorption spectroscopy.[1]

A Jerome Instrument Corporation Gold Film Mercury Vapor Analyzer (Model 411) was used to collect direct-reading measurements of Hg vapor. This instrument contains a thin gold film which selectively absorbs elemental Hg from an air sample. An increase in electrical resistance is produced across the film which is proportional to the mass of Hg in the sample.[2] A 12" hollow metal tube is connected to the input port of the device. The end of the tube was placed within 2" of the surface being analyzed. The instrument was operated in the "sample mode," which collects a 125 milliliter (mL) air sample in a period of 10 seconds (sec). The instrument's limit of detection (LOD) is 1 microgram of mercury per cubic meter of air (µg Hg/m^3). Real-time area air samples were collected in various locations throughout each room on the main floor of the office, as well as throughout the basement. Several samples were also taken outside of the chiropractic office to determine ambient air levels.

A sample of drinking water was also collected for analysis of Hg content. The sample was collected from the incoming water supply at the bathroom faucet and was analyzed according to the Environmental Protection Agency (EPA) method 7470 using a Perkin-Elmer FIMS 100 Flow Injection Mercury Analyzer. Due to sample leakage during shipment, the sample was diluted prior to digestion and analysis. The sample was prepared by transferring it to a 250 mL HDPE bottle. A 5 mL aliquot of concentrated sulfuric acid, 2.5 mL of concentrated nitric acid, 15 mL of 5% potassium permanganate, and 8 mL of 5% potassium persulfate were added to the sample, quality control samples, and standards which were placed in a water bath for two hours. After heating, they were removed from the water bath and cooled prior to digestion. After the digestion, 5 mL of 20% hydroxylamine hydrochloride were added to each sample, quality control samples, and standards to reduce the permanganate before analysis.

A sample of stained wood chips from the exterior of the chiropractic office were also submitted for analysis of Hg content to investigate if the stain applied to the exterior of the building could be a source of Hg exposure. The bulk wood samples were digested and analyzed for Hg according to EPA method 7471B. Following digestion, the sample was analyzed using a Perkin-Elmer FIMS 100, Flow Injection Mercury Analyzer. The sample was weighed and transferred to a 250 mL HDPE bottle and then prepared as follows: a 10 mL aliquot of

American Society for Testing and Materials (ASTM) Type II water and a 5 mL aliquot of aqua regia were added and the sample placed in a water bath. After heating for two minutes the sample was removed from the bath, cooled, and 50 mL of ASTM Type II water and 15 mL of 5% potassium permanganate were added. The sample was returned to the water bath for 30 minutes, then removed from the bath, allowed to cool, and an additional 50 mL of ASTM Type II water were added. Standards and quality control samples were prepared in the same manner. Following the digestion, 5 mL of 20% hydroxylamine hydrochloride were added to each sample, quality control sample, and standard to reduce the permanganate before analysis. EPA method 7471B requires 0.5 gram (g) of sample for digestion; however, only 0.2781 g of sample were received. The entire sample was used for analysis. The sample was filtered prior to analysis to remove floating particles of wood.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increases the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),[3] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[4] and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[5] Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criterion.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 95–596, sec. 5.(a)(1)]. Thus, employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended STEL or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

Mercury

Mercury exists in three forms as metallic, or elemental Hg and as inorganic and organic compounds. Each form has different toxicological properties. There was no known source of Hg in the building, but it was thought that if Hg exposure was occurring in the chiropractor's office that it would be due to metallic, rather than inorganic Hg. Exposure to organic Hg (methylmercury) from dietary intake was also a possibility. Because the reported symptoms more closely matched those of metallic and organic Hg exposure, the properties and health effects resulting from exposure to these forms will be discussed further.

Metallic

Biokinetics

Metallic Hg (also known as elemental Hg) is a shiny, silver-white metal that is a liquid at room temperature. It is the pure form of Hg and is the liquid metal used in thermometers and some electrical switches. Since metallic Hg is volatile at ambient temperatures, the majority of occupational exposure is by inhalation. Inhalation exposure accounts for more than 95% of the absorbed Hg dose, whereas dermal exposure and ingestion contribute only 2.6% and 0.1% to this dose, respectively.[6]

The feces and urine are the primary pathways for the elimination of Hg from the body, though it is unclear which is the dominant pathway.[7,8,9] Elimination through sweat, saliva, nails, hair, and bile also contribute a small portion to the excretion process. The elimination kinetics (measured in half-lives) for the major compartments involved with the uptake, distribution, and elimination of Hg are as follows: lungs - 2 days, blood - 2 to 4 days, brain - 21 days, kidneys - 40 to 60 days, and whole body - 40 to 60 days.[7] Thus, blood Hg concentrations are considered markers of recent or acute Hg exposures; whereas urinary Hg concentrations tend to integrate exposures over several weeks; *i.e.*, are markers of chronic exposure. Some evidence exists suggesting that Hg elimination via urine occurs in two exponential phases. Under steady state conditions, a fast phase with a half-life of 2 days accounts for the elimination of 20 to 30% of the Hg body burden. The majority of the Hg body burden is eliminated through a slow phase with a half-life of 40 to 60 days. Because of this slow phase, urine Hg excretion is slightly dependent on temporal variability in Hg airborne exposure.[10]

Effects

Acute or short-term exposure to high concentrations of elemental Hg causes erosive bronchitis, bronchiolitis, and diffuse interstitial pneumonia. Symptoms include tightness and pain in the chest, cough, and difficulty breathing.[11] Other acute effects include nausea, abdominal pain, vomiting, diarrhea, increases in blood pressure or heart rate, headache, and inflammation of the mouth and gums.[12]

Chronic or long-term exposure to Hg can result in symptoms of weakness, fatigue, loss of appetite, loss of weight, gingivitis, metallic taste, disturbance of gastrointestinal functions, and discoloration of the lens in the eye.[6] The target organs for Hg toxicity are the central nervous system (CNS) and the kidneys. A wide variety of CNS-related symptoms, *e.g.*, cognitive, sensory, personality, and motor disturbances, have been reported in humans exposed to Hg. Early symptoms of CNS effects include increased irritability, loss of memory, loss of self-confidence, weakness, reflex abnormalities, emotional instability with depressive moods, and insomnia. At higher exposure levels, fine tremor and coarse shaking can appear, as well as severe behavioral changes including delirium and hallucination. Tremor progresses in severity with duration of exposure. Although the symptoms in cases of slight poisoning regress and disappear when exposure has ceased, nervous system effects may persist in cases of long-term exposure.[3,9,13]

Evaluation Criteria

OSHA currently enforces a PEL for Hg in air of 0.1 milligrams per cubic meter (mg/m^3), as a ceiling limit that should not be exceeded during a work shift.[5] The NIOSH REL for airborne Hg exposure is 0.05 mg/m^3 as a TWA exposure for up to 10-hours per day, 40-hours per week; NIOSH does not have a urinary Hg recommendation.[3] In 1980, the World Health Organization (WHO) Working Group recommended an 8-hour TWA exposure limit of 0.025 mg/m^3, and a urine Hg limit of 0.05 mg/g-Cr.[11] The WHO TWA exposure limit was set at 0.025 mg/m^3 because the WHO Working Group "felt that a health-based occupational exposure limit of 0.025 mg/m^3 . . . would ensure a reasonable degree of protection not only against tremor but also against Hg-induced nonspecific symptoms."[11] In 1994, the ACGIH lowered the TLV and BEI for Hg to 0.025 mg/m^3 (TWA exposure, 8-hours per day, 40-hours per week) and 0.035 mg/g-Cr, respectively.[4] The reason for lowering the TLV was a finding of pre-clinical signs of CNS and renal dysfunction at worker exposure levels above 0.025 mg/m^3. People without occupational exposure to Hg generally have urinary Hg concentrations of 0.005 mg/g-Cr or less.[6,11]

Methylmercury

Biokinetics

Organic Hg compounds are the most widespread and potentially dangerous. Methylmercury, the Hg found in fish, constitutes a major source of Hg ingested by humans. The average daily intake of methylmercury from fish has been estimated to vary between 1 and 20 μg/day, depending on dietary intake of freshwater and saltwater fish and marine mammals, the type of fish consumed, and the level of aquatic contamination. Aquatic methylmercury is produced microbially from inorganic Hg arising from natural or man-made sources. Factors determining the methylmercury concentration in fish are the Hg content in the water and bottom sediment, the pH and redox potential of water, and the species, age, and size of the fish.

During the excretion of methylmercury it is biotransformed to inorganic Hg by demethylation in the body. In one study, after short-term exposure to methylmercury, 50% of the total Hg in the kidney was inorganic; in the bile the inorganic percent ranged from 30% to 85%, the liver contained 20%, and the brain contained less than 5%.[14] This indicates that biotransformation is unlikely to occur in the brain. In nonhuman primates it has been shown that after cessation of exposure or following chronic exposure, the Hg concentration in the brain is a much larger percentage. The demethylation of methylmercury and subsequent binding, or trapping, in the brain may account for this.[15] The major routes of excretion for methylmercury are bile and feces. Much of the methylmercury excreted in the bile is reabsorbed in the gut, producing enterohepatic circulation of methylmercury. About 90% is excreted in feces after acute or chronic exposure and does not change with time The excretion half-life is approximately 70 days. The half-life in specific organs, most notably the brain, may be much longer.[16] Human adults attain a steady-state body burden where intake equals excretion after an exposure period of about one year. Once steady-state body burden is attained, the body burden should be directly proportional to the average daily intake.

Blood and hair can serve as indicator media in studies of individuals and populations exposed to methylmercury. Mercury concentration in red blood cells is perhaps the more reliable index of methylmercury body burden and brain concentration, although hair analysis may prove useful in the reconstruction of exposure of adults.[17] However, possible problems with hair analysis must be considered. Many factors, such as hair treatment and external contamination, can affect hair mineral concentrations. In addition, analytical variability among commercial laboratories conducting nutritional hair mineral analyses makes interpretation of such data problematic.[18] Another contributing factor is that dose-response data linking hair mineral concentrations to target organ effects are largely unavailable. Methylmercury is the only chemical with an established threshold for target organ effects that is based on hair element concentrations.[19,20] Mercury in the form of inorganic Hg invariably exists in the hair, although the amount is very small, compared with methylmercury.[21] Methylmercury is deposited in the hair during formation of the pile. The deposition of the methylmercury in the pile is proportional to the Hg concentration in blood at the time of pile formation. The methylmercury concentration in the hair can be used as an indicator of body burden, provided that an allowance is made for the growth rate of the hair pile (about 1 centimeter [cm] a month, dependent on age).[17]

Evidence indicates that the concentration of Hg in human and animal blood follows a constant ratio to the concentration of methylmercury in the brain and is directly proportional to the daily intake of methylmercury in individuals who are chronically exposed and have achieved a state of metabolic balance. However, knowledge of a single blood Hg level does not provide an accurate representation of Hg body burden because past blood Hg concentrations are not known. When intake of Hg is sporadic, significant concentrations of Hg in blood can easily be missed if consumption of Hg has ceased several weeks prior to obtaining a blood sample for analysis.[22]

Urinary excretion of methylmercury is very small and methylmercury concentration in urine is easily masked by the presence of inorganic Hg. Thus, Hg concentration in urine is not a good indicator of methylmercury body burden or concentration in the brain.[17]

Effects

The hazards involved in long-term intake of food containing methylmercury and in occupational exposure to methylmercury are due to the efficient absorption (90% in humans) and the long retention-time (half-time 70 days) with accumulation in the brain. Methylmercury is a systemic poison and depending on the dose and length of exposure, it can have an effect at various sites. The nervous system is the main target, and a latent period of weeks or months may ensue before the appearance of signs and symptoms of poisoning.[22] Clinical manifestations of neurotoxic effects are parathesia, a numbness and tingling sensation around the mouth, lips, and extremities; ataxia, a clumsy stumbling gait, difficulty in swallowing and articulating words; neuraesthenia, a generalized sensation of weakness, fatigue and inability to concentrate; vision (constriction of the visual field) and hearing loss; and spacticity and tremor.[17]

Toxicological data obtained from episodes of accidental Hg poisonings in Minamata and Niigeta, Japan, in the 1950s and in Iraq in 1972, helped develop the dose-response relationships between health risks and intake of methylmercury. In adults, the health effect that occurs at the lowest level of exposure is paresthesia. The average long-term daily intake associated with health effects in the most susceptible individual was calculated by combining the relationships of body burden versus intake and effect versus body burden. The intake was estimated to be about 300 μg/day for an adult.

Evaluation Criteria

The OSHA PEL for airborne alkyl (organo) Hg compounds is 0.01 mg/m^3 as an 8-hour TWA exposure limit, and 0.04 mg/m^3 as a ceiling limit.[5] NIOSH recommends that exposure to alkyl Hg compounds in air be limited to 0.01 mg/m^3, determined as a TWA exposure for up to a 10-hour workday.[3] NIOSH also recommends a STEL of 0.03 mg/m^3, which can not be exceeded for longer than 15 minutes at any time during the workday. The REL also includes a skin designation. The concentration considered to be immediately dangerous to life and health (IDLH) is 2 mg/m^3.[3] The ACGIH recommends an 8-hour TWA TLV of 0.01 mg/m^3 for alkyl Hg compounds based on critical effects to the CNS. A STEL/ceiling limit of 0.03 mg/m^3 is also recommended by ACGIH and the TLV includes a skin notation.[4] There is no BEI for organic Hg compounds.

RESULTS

No visible sources of Hg were observed during the walk-through inspection of the interior and exterior of the building. There was evidence of water incursion in the unfurnished portion of the basement. It was reported that this portion of the basement experienced flooding due to a defective sump pump in one corner of the basement. The owner of the building had been made aware of the problem, but nothing had been done to remedy the pump at the time of the site visit. During one episode of flooding, water came into contact with a can of the fixer solution used to develop x-rays that was being stored in the basement. A water line was visible on the concrete floor where the fixer solution and water had dried. The carpet in the rehabilitation room had reportedly become wet during one flooding incident. The carpet was dry at the time of the site visit, but a moldy odor was noticeable in this area.

None of the six area air samples collected throughout the chiropractic office for airborne Hg vapor yielded detectable Hg. The minimum detectable concentration (MDC) for Hg at the chiropractic center was 0.15 µg/m^3.

The direct-reading measurements revealed airborne Hg vapor concentrations ranging from no detectable concentration to 0.007 mg/m^3 throughout the first floor and basement of the office, and from no detectable concentrations to 0.008 mg/m^3 outside the office. Approximately three to five consecutive measurements were taken at each location tested. Average Hg concentrations throughout the office ranged from no detectable concentration to 0.005 mg/m^3, whereas average Hg concentrations measured outside ranged from no detectable concentration to 0.004 mg/m^3. All of the individual and averaged instantaneous Hg vapor concentrations collected were well below the 0.1 mg/m^3 ceiling value stipulated by the OSHA regulation and NIOSH recommendation.

The Hg concentration in the drinking water sample collected from the incoming water supply at the bathroom faucet was less than the Reporting Limit for Hg established by the EPA, Office of Drinking Water, Technical Support Division. The LOD and limit of quantitation (LOQ) reported by the laboratory were 0.5 µg/L and 2.0 µg/L, respectively. The bulk sample of stained wood chips also revealed no detectable Hg content. The laboratory reported a LOD of 0.06 µg/g and an LOQ of 0.2 µg/g.

DISCUSSION & CONCLUSIONS

The results from the environmental assessment indicate that the office personnel are not being exposed to airborne Hg vapors. The only detectable levels of Hg were measured using the Jerome Gold Film Mercury Vapor Analyzer. Most measurements were only slightly greater than the LOD, and often repeat measurements at each location showed highly variable responses. This coupled with the fact that no detectable concentrations of Hg were found on the full-shift area air samples, in which the LOD of this method was lower than that of the Jerome, indicate that the direct-reading measurements should only be considered in a qualitative manner. Regardless, all Hg vapor concentrations measured using the Jerome Hg Vapor Analyzer were extremely low and were well below the 0.1 mg/m^3 ceiling value stipulated by OSHA and NIOSH. In addition, the airborne Hg vapor concentrations measured outside were similar to the concentrations found in the office, indicating a source of Hg was not present in the chiropractic office.

One suspected source of possible residual Hg contamination in the office was from a thermometer that had broken in one of the examination rooms two to three years prior to the NIOSH site visit. According to the requester, the Hg was properly disposed of and the area thoroughly cleaned by an environmental professional. Our results revealed no evidence of residual Hg from this source. Instantaneous Hg concentrations measured ranged from no detectable concentration to 0.005 mg/m^3 around the area where the thermometer was broken, indicating that there is no residual contamination resulting in exposure to Hg vapor. Another possible source of exposure that we examined was the stain used on the exterior wood of the building. Mercury-based biocides such as phenylmercuric acetate, 3-propylmercuric acetate, didodecenyl succinate, and phenylmercuric oleate, were registered as biocides in interior and exterior paints, and in antifouling paints. The use of Hg in antifouling paints was banned in 1972, and as of July 1990, most registrations for Hg biocides used in interior and exterior paints and coatings were voluntary canceled by the registrants.[23] EPA announced the voluntarily cancellation of the remaining Hg biocide registrations in 1991.[23] No Hg is allowed in the manufacture of paints in the United States. However, paints purchased prior to these years and stored for future use could contain Hg. The bulk samples of stained wood chips from the exterior of the building confirmed that Hg was not a constituent of the stain.

Another possible source of the requester's Hg exposure could be due to ingestion of methylmercury-contaminated fish and shellfish.

Although the requester's blood and hair samples were never speciated to determine the exact type of Hg exposure, methylmercury was a consideration due to the large consumption of fish reported by the requester. Additional information concerning methylmercury exposure from consumption of mercury-contaminated fish and shellfish is included in Appendix I.

RECOMMENDATIONS

Any future episodes of water incursion (referring to the basement) should be dealt with by the owner of the building immediately. Water should be removed immediately from porous, water-damaged furnishings, carpets, and construction materials. Heat fans should be used within 24 hours to dry carpets and other applicable surfaces. Steam or other water-based cleaning methods which add moisture to the environment must be used with extreme care. Any soft materials that become wet with sewage-contaminated water should be promptly discarded.

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APPENDIX I

To reduce methylmercury exposure from consumption of mercury-contaminated fish and shellfish, consumption advisories are issued by states recommending that individuals restrict their consumption of specific fish and shellfish species from certain water bodies where Hg concentrations in fish and shellfish tissues exceed the level of concern for human health. Although this level of concern is set by individual state agencies, several states use the Federal Drug Administration (FDA) action level of 1 part-per-million (ppm) to issue advisories recommending no consumption or restricting consumption of contaminated fish and shellfish from certain water body types (e.g., lakes and/or rivers). This value was designed to protect consumers from the health risks associated with consumption of fish and shellfish that are shipped in interstate commerce and purchased in commercial markets. However, the FDA action level was not intended to be used as a criterion for the protection of high-end fish consumers who routinely and repeatedly consume large quantities of fish from local bodies of water.

EPA's Office of Water issued guidance to states on sampling and analysis procedures to use in assessing the health risks from consuming locally caught fish and shellfish, to address this concern. EPA's proposed risk assessment method was designed to assist states in developing fish consumption advisories for recreational and subsistence fishers, including the sensitive sub-populations of pregnant women, nursing mother, and children in these high-end consumption populations.[1] A screening value of 0.6 ppm Hg (wet weight) in fillets for the general population was advised to states by the EPA's Office of Water as a criterion to evaluate their fishable waters.[1] Currently 1,782 advisories restricting the consumption of mercury-contaminated fish and shellfish are in effect in 41 states and one U.S. Territory (American Samoa).[2] Mercury is the chemical pollutant responsible in part for over 77% of the fish advisories issued in the United States.[3] In addition, 19 states (Alabama, Connecticut, District of Columbia, Florida, Indiana, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Ohio, Rhode Island, Texas, and Vermont) currently have state-wide Hg advisories, which recommend that residents of these states restrict consumption of locally caught freshwater fish.[3]

In 1994 the state of New Jersey issued Commercial Health Advice to consumers of supermarket purchased fish. The health advice was issued for the general population, women of childbearing age, and children under seven years of age regarding both shark and swordfish species. This advisory currently remains in effect. The Department of Environmental Protection and the Department of Health also issued consumption advisories due to elevated levels of Hg found in largemouth bass and chain pickerel in certain freshwater lakes in New Jersey. Refer to the appendix to see the specific restrictions for freshwater bodies located in the state.

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APPENDIX II

A Guide to Mercury Health Advisories for Eating Fish from New Jersey Freshwaters

Recent research on largemouth bass and chain pickerel in certain freshwater lakes in New Jersey has prompted the Department of Environmental Protection and the Department of Health to issue consumption advisories due to elevated levels of mercury found in these species. Mercury, a toxic metal, accumulates in fish tissue through the food chain. Since larger fish feed on smaller fish, mercury collects in their fish tissue as well, so that larger fish at the top of the food chain -- such as largemouth bass and chain pickerel -- are more likely to have elevated levels of mercury.

It is very unlikely that the level of mercury found in these fish would cause immediate health effects. However, repeated consumption of contaminated fish poses potential health effects. Of particular concern is the potential effect on the nervous system of developing fetuses.

Although data show elevated levels of mercury in certain fish, it does not affect the quality of the waters used for drinking and bathing.

The chart below provides general and specific information on the statewide and the Pinelands area advisories. The Pinelands area covers much of the seven counties in the southeastern portion of the state: Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester and Ocean counties. Some, but not all of the water bodies covered under these general advisories have been tested. More testing is underway.

Consumption Advisories for Largemouth Bass and Chain Pickerel from New Jersey Freshwaters

	Species	Advisory**	
New Jersey Statewide		**General Population**	**High-Risk Individual***
For all freshwater bodies (except those listed below)	bass and pickerel	do not eat more than once a week	do not eat more than once a month
Pinelands Area			
For all water bodies (except those listed below)	bass and pickerel	do not eat more than once a month	do not eat
Site-Specific Pinelands			
Lake Lenape	bass	do not eat more than once a month	do not eat
	pickerel	do not eat more than once a week	do not eat more than once a month
Mirror Lake	bass	no restrictions	do not eat more than once a month
	pickerel	no restrictions	do not eat more than once a week
Stafford Forge	bass	do not eat more than once a month	do not eat
	pickerel	do not eat more than once a week	do not eat
Wading River	bass	do not eat more than once a month	do not eat
	pickerel	do not eat more than once a week	do not eat
Site-Specific Statewide			
Assunpink Creek	bass	no restrictions	do not eat more than once a week
	pickerel	do not eat more than once a week	do not eat more than once a month
Atlantic City Reservoir - No Fishing Allowed	bass pickerel	do not eat	do not eat

	Species	Advisory**	
Big Timber Creek	bass	no restrictions	do not eat more than once a week
	pickerel	do not eat more than once a week	do not eat more than once a month
Canistear Reservoir	bass	do not eat more than once a week	do not eat
	pickerel	do not eat more than once a week	do not eat more than once a month
Clinton Reservoir	bass	do not eat more than once a week	do not eat
	pickerel	do not eat more than once a week	do not eat more than once a month
Cranberry Lake	bass	do not eat more than once a week	do not eat more than once a month
	pickerel	no restrictions	do not eat more than once a month
Crosswicks Creek	bass	no restrictions	do not eat more than once a week
	pickerel	do not eat more than once a week	do not eat more than once a month
Crystal Lake	bass	no restrictions	do not eat more than once a week
(Burlington County)	pickerel	do not eat more than once a week	do not eat more than once a month
Delaware River	bass	no restrictions	do not eat more than once a month
(Easton to Trenton)	pickerel	do not eat more than once a week	do not eat more than once a month
Delaware River (Trenton to Camden)	bass	no restrictions	do not eat more than once a week
	pickerel	do not eat more than once a week	do not eat more than once a month
Lake Carasaljo	bass	do not eat more than once a week	do not eat
	pickerel	no restrictions	do not eat more than once a month
Lake Hopatcong	bass	no restrictions	do not eat more than once a month
	pickerel	no restrictions	do not eat more than once a month
Manasquan Reservoir	bass	do not eat more than once a month	do not eat
Manasquan Reservoir	pickerel	do not eat more than once a week	do not eat more than once a month
Merrill Creek Reservoir	bass	do not eat more than once a week	do not eat
	pickerel	do not eat more than once a week	do not eat more than once a month
Monksville Reservoir	bass	do not eat more than once a week	do not eat
	pickerel	do not eat more than once a week	do not eat more than once a month
Rockaway River	bass	do not eat more than once a week	do not eat more than once a month
	pickerel	no restrictions	do not eat more than once a month
Round Valley Reservoir	bass	no restrictions	do not eat more than once a month
	pickerel	do not eat more than once a week	do not eat more than once a month
Shadow Lake	bass	no restrictions	do not eat more than once a week
	pickerel	do not eat more than once a week	do not eat more than once a month
Spruce Run Reservoir	bass	no restrictions	do not eat more than once a month
	pickerel	do not eat more than once a week	do not eat more than once a month
Swartswood Lake	bass	do not eat more than once a week	do not eat more than once a month
	pickerel	no restrictions	do not eat more than once a week

	Species	Advisory**	
Union Lake	**bass**	**do not eat more than once a month**	**do not eat**
	pickerel	**do not eat more than once a month**	**do not eat**
Wanaque Reservoir	**bass**	**do not eat more than once a week**	**do not eat**
	pickerel	**do not eat more than once a week**	**do not eat**
Wilson Lake	**bass**	**do not eat more than once a week**	**do not eat more than once a month**
	pickerel	**do not eat more than once a week**	**do not eat**
Woodstown Memorial Lake	**bass**	**no restrictions**	**do not eat more than once a month**
	pickerel	**do not eat more than once a week**	**do not eat more than once a month**

**** One meal is defined as an eight-ounce serving.**

*** High risk individuals are pregnant women, women planning pregnancy within one year, nursing mothers, and children under five years old.**

For Information on Other
Occupational Safety and Health Concerns

Call NIOSH at:
1–800–35–NIOSH (356–4674)
or visit the NIOSH Web site at:
www.cdc.gov/niosh

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