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Abstract

A satellite conference was conducted in conjunction with the 10th International Symposium on Neurobehavioral Methods and Effects in Environmental and Occupational Health in Costa Rica on June 11-13, 2008 following the 20th International Conference on Epidemiology in Occupational Health June 9-11, 2008. The satellite conference included a symposium and a workshop focusing on the methodology of assessing occupational exposure to neurotoxins both in clinical and in research settings. The most sensitive current tools used in exposure assessment were presented with particular emphasis on their applicability to non-English speaking populations.

The symposium covered the theoretical multi-aspect background of assessment in the context of neurotoxic exposure and included presentations from experts in the field of risk assessment, occupational medicine, neurology, and neuropsychology. The workshop followed a more didactic approach providing attendees with the opportunity to learn the implementation of and, where appropriate, practice the various assessment methods. Workshop presenters included an international group of experts in neurophysiology, risk assessment, neuropsychology, Spanish-conducted neuropsychological assessment, environmental health, neurology, and occupational medicine and neuroimaging.

In addition to being provided with tools fundamental to conducting assessments in clinical and research settings, attendees to the workshop were also given a DVD containing all the presentations, relevant public domain neuropsychological tests, and all ATSDR toxicological profiles for 2007.

Section 1

Highlights

The goal of this workshop was to expose attendees to a broad range of topics in the field of neurotoxicology and to train them in effective methods that can be implemented in clinical and research settings for the assessment of occupational exposure to neurotoxicants. Particular emphasis was given to the application and efficacy of these methods in non-English speaking populations. Presenters included experts in neurotoxicology, industrial hygiene, neurology, neuroimaging and neuropsychology. The presentations focused on the latest empirical standardized methods to assess human health effects of neurotoxicants. Participants were also given practical training in the implementation of these methods.

Outcomes/Relevance/Impact

By participating in the workshop, attendees were able to form new collaborative and consulting relationships which will promote multidisciplinary research in occupational neurotoxicology. Additionally, they were each given CD-ROMs containing all presentations, all relevant tests in the public domain and questionnaires, as well as instructions for scoring and interpreting these tests. They were also given a DVD containing all of the 2007 ATSDR toxicological profiles. These materials, in conjunction with the knowledge and practical training received at the workshop, gave researchers and clinicians the basic tools necessary for conducting rigorous empirical research concerning occupational exposure to neurotoxicants. Such research can be used to inform policy, and carries the implication of preventing disease and other adverse health effects that arise from exposure to toxins in the workplace. It is imperative that such research be carried out using the most effective and sensitive measures in neurotoxicology.

Section 2

Background

The P.I. has previously been invited to Costa Rica to discuss neuropsychological methods appropriate for the assessment of village residents in the area. Out of this experience grew the knowledge that a workshop presentation on neuropsychological methods would benefit researchers and clinicians in Costa Rica and other Central and South American countries. This prompted the design of the workshop. The P.I. contacted each of the presenters, all experts in their fields, who have conducted either research on neurotoxicants and/or performed large numbers of epidemiological and/or clinical evaluations of workers exposed to neurotoxicants. The presenters have not only taught these methods in their respective university programs to graduate students and residents, they have also given invited presentations at national and international professional meetings and are authors of many scientific articles and chapters in relevant books. The presenting group of scientists is multinational and multi-ethnic. They all have worked with and presented to international audiences on the health of workers from diverse cultures and continents, e.g. North, Central and South America, Asia, and Europe.

This multidisciplinary group of experts, who frequently collaborate together, were invited by the organizers of the 10th International Symposium on Neurobehavioral Methods and Effects in Environmental and Occupational Health in Costa Rica on June 11-13, 2008 in conjunction and following the 20th International Conference on Epidemiology in Occupational Health June 9-11, 2008. They were asked to present the methods they have developed and/or applied in their work on evaluating neurotoxicant exposures in individuals or groups of workers or patients in a two-day conference open to all conference participants. Presenting scientists included five from the United States (Bowler, Perez-Arce, Rutchik, Bouchard, Zimmerman), one from South Korea (Kim), one from Canada (Mergler), as well as collaborators from US-NIOSH (Park), the University of California at San Francisco (Rutchik) and the U.S.ATSDR/CDC (Pohl).

Significance

Much of the progress in occupational/environmental neurotoxicology has been established in the western world. With the shifting of industrial production to developing (non-English speaking) countries, it is imperative that the knowledge in this field is imparted to the scientists and policy makers of those countries, in order to ensure the health and safety of their workers. Often times, many of the evaluations and research application methods employed in these countries are less sensitive than those utilized in more industrialized nations, thus it is important to introduce and educate on the latest multidisciplinary methods for the clinical evaluation of individual workers, as well as epidemiological evaluations of groups of workers, exposed to neurotoxicants. The latest methods used in industrial hygiene (Zimmerman) and occupational risk assessment (Park) were illustrated in practical, hands-on and didactic presentations. Dr. Mergler discussed neurotoxicant exposure in the context of the ecosystem approach to human health. One of the presenters from the field of occupational medicine (Kim) discussed recent advances in neuroimaging and a neurologist expert in neurotoxic exposures

illustrated the current neurological methods in use in the U.S. In neuropsychology, the methods of clinical evaluation of neurotoxicant-exposed workers and children were discussed (Perez-Arce). Early health effects and their specific portraits, which can be identified from screening for specific neurotoxicants (metals, pesticides, organic solvents, and toxic gases) were also addressed by the chair (Bowler). The Spanish speaking US-trained neuropsychologist (Perez-Arce) discussed culturally-relevant factors and presented some of the neuropsychological tests she recommends for use in clinical and research settings. It was expected that researchers and clinicians from other countries which have more recently enhanced their industrialized technologies would particularly benefit from the knowledge and experience of the presenters. It was also expected that some of these applied methodologies will result in the design of future research investigations and in subsequent scientific publications.

Specific Aims

The purpose of this project was to conduct a 1-day satellite workshop and a 2nd-day symposium on Multidisciplinary Methods of Clinical & Epidemiologic Research Evaluations at the 10th International Symposium on Neurobehavioral Methods and Effects in Environmental and Occupational Health in Costa Rica on June 11-13, 2008 in conjunction and following the 20th International Conference on Epidemiology in Occupational Health June 9-11, 2008 with the overall conference theme: Multiple Exposures, Multiple Effects. The objectives of the satellite conference were to provide an introduction to and training in multidisciplinary methods of industrial neurotoxicology, to develop and apply methods for early detection of adverse health effects, to add to knowledge on the prevention of neurological disease in workers exposed to industrial neurotoxicants, and to promote collaboration in scientific research and global harmonization in occupational health issues.

The specific aims of this two-day conference were:

1. to present some of the latest empirical methods and research findings of human health effects of neurotoxicants drawn from different disciplines including industrial hygiene, occupational medicine, neurology, neurotoxicology, neuroimaging, and neuropsychology, with emphasis on cultural sensitivity and with specific relevance to non-English speaking countries.
2. to present a practical, hands-on workshop demonstrating the methodologies used in the disciplines cited above and train interested participants in applying these methods clinically and in their research studies.

Procedures

Day 1

Workshops were developed to demonstrate and train in the particular methods used in clinical and research neurotoxicology. The goal of the workshop was to improve clinical practice and research in the prevention of neurotoxic injury and disease around the world, specifically in Central and South American countries. Health professionals and clinicians were able to learn practical tools that can be adapted to their own local

conditions and can be rapidly applied. The conference and workshop also provided a forum for building networks among research scientists and health professionals in neurotoxicology, industrial hygiene, risk assessment, occupational medicine, neurology, and neuropsychology.

Didactic presentations by each researcher/clinician included the scientific knowledge base from each of the presenter's disciplines as well as an overview and summary covering the major classes of industrial neurotoxicants. Topics included:

1. Industrial hygiene – Dr. Neil Zimmerman
2. Neurology and Neuroimaging – Dr. Jonathan Rutchik
3. Environmental health – Dr. Maryse Bouchard
4. Risk Assessment – Mr. Robert Park
5. ATSDR's Toxicological Profiles – Dr. Hana Pohl
6. Two presenters in neuropsychology with emphasis on cultural sensitivity:
Dr. Rosemarie Bowler
Dr. Patricia Perez-Arce

The presentations of these major topic areas incorporated discussions on the major classes of neurotoxicants:

- Metals & metallic compounds
- Pesticides and PCBs
- Organic solvents
- Toxic gases

Day 2

On Day 2 we presented a didactic symposium illustrating the methods described from neurotoxicology, industrial hygiene, risk assessment occupational medicine, neurology, and neuropsychology and the development of a multiple exposure toxicological profile. Small break-out workshops (1-2 hours) in each scientific area were held for attendees, who were encouraged to follow up with questions regarding their specific interests and fields. The didactic presentations covered methods of evaluation for neurotoxicants in general, and focused on particular aspects of each class of neurotoxicants, as appropriate. Each presenter gave practical research or case illustrations and made recommendations for performing applied evaluations in specific clinical and research settings. Attendees were given CD-ROMs containing all public-domain tests covered in the presentations, as well as instructions for administration, scoring, and interpretation. Additionally health questionnaires, suitable for inquiry into neurotoxic exposures were included for copy. Spanish versions of both the tests in the public domain and questionnaires were also on the CD-ROM.

Presentation Details

The group of presenters included recognized scholars and health professionals whose research efforts have resulted in ground-breaking contributions to occupational

neurotoxicology. The following are the names of the participating scientists, their affiliation, and their internationally recognized areas of expertise:

1. **Dr. Donna Mergler**, CINBIOSE, Université du Québec à Montréal, Canada – Ecosystem approach to neurotoxicants
2. **Dr. Hana Pohl**, ATSDR, - toxicological risk assessment
3. **Mr. Robert Park**, NIOSH – Risk assessment
4. **Dr. Neil Zimmerman**, Purdue University – Industrial hygiene
5. **Dr. Rosemarie Bowler**, San Francisco State University – Neuropsychology
6. **Dr. Patricia Perez-Arce**, Clinica de la Raza, Oakland, CA – Spanish Language Neuropsychological Assessment
7. **Dr. Maryse Bouchard**, Université du Québec à Montréal, Canada – Environmental Health
8. **Dr. Jonathan Rutchik**, University of California San Francisco, CA Department of Neurology – Neurology and neuroimaging
9. **Dr. Yangho Kim**, Ulsan University, S. Korea – Occupational and environmental medicine

The abstracts for some of their presentations are below:

1. Industrial Hygiene (Occupational Health) Exposure Assessment of Neurotoxic Agents

Dr. Zimmerman's presentation assisted attendees in understanding the Industrial Hygiene (Occupational Health) issues related to the exposure assessment of neurotoxic agents. The objectives of this session were to educate safety and health professionals attending as to the basic fundamentals of the industries and processes that generate a wide variety of neurotoxins, their physicochemical characteristics, exposure guidelines and regulations, and typical industrial exposures, as well as a review of methods to control such exposures. On Day 2, he presented an overview of the practical aspects of personal and area monitoring for a variety of neurotoxins, and included the opportunity for hands-on experience with sampling instrumentation.

2. Neurology and Neuroimaging - Evaluation of a Patient with Neurotoxic Illness

Dr. Rutchik's presentation showed a clinical algorithm for a patient with neurological symptoms that potentially are derived from an occupational or environmental source injury. With demonstration of the neurological examination, didactic and video description of electromyography and movement disorder, the audience was able to enhance their clinical abilities. Furthermore, Dr Rutchik demonstrated two clinically applicable cases; one with occupational manganism and parkinsonism and another occupational lead encephalopathy, neuropathy and ataxia with video and didactic slides. Dr. Bowler also presented the neuropsychological testing results and conclusion for these cases.

3. Manganese Neurotoxicity: Detection of Effects using Tremor and Postural Stability Parameters

Dr. Bouchard presented and discuss the use of the CATSYS, in the context of findings obtained for workers overexposed to Mn from welding fumes. The findings show a continuum of changes, related to increasing cumulated exposure to Mn. The postural stability test can be administered using different conditions, eliciting different challenges for the examinee. For example, postural stability was found to be more affected by Mn exposure in the “eyes closed” condition than “eyes open”. Emphasis will be placed on the need for future studies on Mn exposure to incorporate instruments allowing one to dissect and better understand the tremor and postural sway parameters.

4. Neuroimaging using Proton magnetic resonance spectroscopy

Dr. Yangho Kim discussed how an elevated signal in the T1 magnetic resonance imaging (MRI) in the globus pallidus is a biologic marker of manganese (Mn) accumulation in Mn-exposed workers and how the signal shows significant correlation with decreased neurobehavioral function as well as high air/blood Mn concentration. Because signal intensity on T1- weighted MRI does not directly reflect the biochemical or pathological change of the central nervous system caused by Mn the ^1H MRS is a useful, noninvasive method used to study CNS pathologies. The objectives of his session are to educate safety and health professionals attending the World Congress as to the basic knowledge of ^1H MRS. On Day 2, Field Applications, he will present an overview of the practical applications of ^1H MRS in evaluations of a variety of neurotoxic syndromes as well as Mn-induced CNS syndromes.

5. Risk Assessment of Manganese and other Neurotoxicants

Mr. Robert Park presented methods of risk assessment used in neurotoxicant-exposed groups of workers. He will use a recent example of an investigation using this technology with manganese exposed workers.

On Day 2 he described a method that couples reported symptoms with neurobehavioral signs and then assigns standard disability, impairment and quality of life scores as used in DALY and QALY public health analyses of disease burden. The development of a practical procedure to relate measured neurobehavioral changes in a worker population to impairment will be presented.

6. Neuropsychological Screening of Neurotoxicant Exposed Workers -Dr.

Rosemarie Bowler described the development of the use of neurobehavioral testing from the clinical methodologies to evaluate brain injury from neurotoxicants. She described the testing and results of studies she has conducted and published, and findings of occupational workers exposed to organic solvents, gases, pesticides, and heavy metals. On Day 2 she trained attendees in the administration, scoring and interpretation of the recommended screening tests. She primarily utilized, whenever possible, tests from the public domain which can be and have been used in non-English speaking worker populations. Attendees were given a CD-ROM containing all tests that are covered that are in the public domain, in addition to instructions for scoring, administration, and interpretation. The goal of her presentation and the

practical hands-on workshop were hoped enable participants to become competent in administering a brief neuropsychological screening relevant to various neurotoxicants.

Upon conclusion of the workshop, attendees were asked to fill out brief anonymous evaluation forms covering areas like content clarity, preparedness, and relevancy. The response scale consisted of the following: 1 – Absolutely, 2- Somewhat, 3- Uncertain, 4- Probably Not, 5- Absolutely Not.

Question 1: Was the workshop consistent with its objectives and title?

The overall average score was 1.21, indicating that almost all attendees found the workshop to correspond to its objectives and title.

Question 2: Did the workshop expand your knowledge of this topic?

The overall average score was 1.64 (Somewhat)

Question 3: Was the material relevant to your professional activities?

The overall average score was 1.82 (Somewhat)

Question 4: Did the instructor know the subject matter?

The overall average score was 1.1 (Absolutely)

Question 5: Was the instructor well prepared?

The overall average score was 1.15 (Absolutely)

Question 6: Was the instructor attentive to questions?

The overall average score was 1.22 (Absolutely)

Question 7: How would you rate the overall value of the workshop?

(response scale: 1-Excellent, 2- Good, 3- Fair, 4-Poor)

The overall average score was 1.53 (Good)

Conclusions

Attendees were exposed to a broad range of topics in the realm of Occupational and Environmental Neurotoxicology and were trained in methodology and given relevant tests that will enrich their own future research. They were also given the opportunity to network with other attendees to promote international research collaborations. The hope is that these tools will encourage research and subsequent policy making that will promote a safe environment for workers in newly industrialized nations.