



Memorandum

Date: January 27, 2004

From: Susan B. Board, Program Official *S.B. Board*
Office of Extramural Programs, NIOSH, E-74

Subject: Final Report Submitted for Entry into NTIS for Grant 5R03OH007380-02.

To: William D. Bennett
Data Systems Team, Information Resources Branch, EID, NIOSH, P03/C18

The attached final report has been received from the principal investigator on the subject NIOSH grant. If this document is forwarded to the National Technical Information Service, please let us know when a document number is known so that we can inform anyone who inquires about this final report.

Any publications that are included with this report are highlighted on the list below.

Attachment
cc: Sherri Diana, EID, P03/C13

List of Publications

20046375

Kirrane E (2002). Organic Solvent Exposure and Neuropsychological Function among Fishers in North Carolina. Department of Epidemiology. Chapel Hill, University of North Carolina: 158.

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1126953*

Kirrane, E., Loomis, D., Attix, D., Moe, C., Savitz, D. Organic solvent exposure and self-reported neuropsychological symptoms among commercial fishers in North Carolina. Proceedings of the 8th International Symposium on Neurobehavioral Methods and Effects in Occupational and Environmental Health, Brescia, Italy, June 2002.

neurotoxicology 24(4-5)

NOT FOUND

Kirrane, E., Loomis, D., Attix, D., Moe C. and D. Savitz. Exposure to organic solvents and self-reported neurological symptoms among commercial fishers (submitted).

20032214

Kirrane, E., Loomis, D., Egeghy, P., and L Nylander-French. Personal exposure to fuel emissions among commercial fishers: 2-Stroke, 4-Stroke and Diesel Engines (submitted).

Title: Organic Solvent Mixtures & Neuropsychological Outcomes
Investigator: Ellen Kirrane
Affiliation: University Of North Carolina
City & State: Chapel Hill, NC
Telephone: (919) 929-5931
Award Number: 1R03OH007380-01
Start & End Date: 4/1/2001-3/31/2003
Total Project Cost: 72084
Program Area:
Key Words: fishing, solvents

Final Report Abstract:

Commercial fishers work with a variety of organic solvents that are toxic to the central nervous system including fuel and styrene. The goal of my research was to characterize fishers' occupational exposure to these solvents and determine the effect of exposure on neuropsychological function. The study population consisted of 238 fishers and other workers from North Carolina who were recruited to participate in an ongoing longitudinal cohort study. Participants were followed for approximately 2.5 years.

Three studies were conducted. First, a self-monitoring approach was used to obtain repeat measurements of personal exposure to benzene in fuel emissions among a subgroup of fishers (n=50). Predicted exposure levels were determined for categories of engine type using mixed-effect linear regression models. Second, weekly or biweekly telephone interviews (n=13,028) containing self-reported descriptions of maintenance work, as well as self-reports of symptoms were analyzed to estimate crude and adjusted rate ratios using Poisson regression methods. Finally the effect of cumulative and recent maintenance work on neuropsychological test performance was estimated using Generalized Estimating Equations (GEEs). The data for these analyses included 723 neuropsychological examinations among 219 fishers.

Personal exposure to fishers on boats equipped with 2-stroke, 4-stroke engines and diesel engines were estimated to be 50.1, 32.6 and 27.9 $\mu\text{g}/\text{m}^3$, respectively. Fishers reported higher rates of symptoms indicative of cognitive effects in weeks they did maintenance work involving solvents compared to weeks they did not. However, no strong or consistent relationship between self-reported exposure to solvents during maintenance work involving solvents during maintenance work and objective neuropsychological performance was observed.

Exposure to neurotoxic organic solvents was documented in this population. The conflicting results regarding the effect of maintenance work on neuropsychological symptoms versus neuropsychological test outcomes may be explained by a variety of factors. Neuropsychological testing may not be adequately sensitive to measure the subtle effects of solvents. Alternatively, the exposure levels may not have been high enough to affect the central nervous system. If this is the case, the associations between maintenance work and self-reported symptoms may have been biased. However, it is

also possible that exposure misclassification resulted in attenuation of the associations between maintenance work and neuropsychological test performance.

Publications:

Kirrane E (2002). Organic Solvent Exposure and Neuropsychological Function among Fishers in North Carolina. Department of Epidemiology. Chapel Hill, University of North Carolina: 158.

Kirrane, E., Loomis, D., Attix, D., Moe, C., Savitz, D. Organic solvent exposure and self-reported neuropsychological symptoms among commercial fishers in North Carolina. Proceedings of the 8th International Symposium on Neurobehavioral Methods and Effects in Occupational and Environmental Health, Brescia, Italy, June 2002.

Kirrane, E., Loomis, D., Attix, D., Moe C. and D. Savitz. Exposure to organic solvents and self-reported neurological symptoms among commercial fishers (submitted).

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Final Performance Report – R03 OH07380

Department of Epidemiology
University of North Carolina at Chapel Hill
School of Public Health
Chapel Hill, NC 27599-7035

**Organic Solvent Exposure and Neuropsychological Function among Fishers in
North Carolina (December, 2002)**

Principal Investigator:

Dr. Ellen Kirrane

Co-investigators:

Dr. Dana Loomis, Advisor
Dr. Deborah K. Attix
Dr. Christine Moe
Dr. Leena Nylander-French
Dr. David A. Savitz

Abstract

Organic Solvent Exposure and Neuropsychological Function among Fishers in North Carolina

Commercial fishers work with a variety of organic solvents that are toxic to the central nervous system including fuel and styrene. The goal of my research was to characterize fishers' occupational exposure to these solvents and determine the effect of exposure on neuropsychological function. The study population consisted of 238 fishers and other workers from North Carolina who were recruited to participate in an ongoing longitudinal cohort study. Participants were followed for approximately 2.5 years.

Three studies were conducted. First, a self-monitoring approach was used to obtain repeat measurements of personal exposure to benzene in fuel emissions among a subgroup of fishers (n=50). Predicted exposure levels were determined for categories of engine type using mixed-effect linear regression models. Second, weekly or biweekly telephone interviews (n=13,028) containing self-reported descriptions of maintenance work, as well as self-reports of symptoms were analyzed to estimate crude and adjusted rate ratios using Poisson regression methods. Finally the effect of cumulative and recent maintenance work on neuropsychological test performance was estimated using Generalized Estimating Equations (GEEs). The data for these analyses included 723 neuropsychological examinations among 219 fishers.

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Exposure to neurotoxic organic solvents was documented in this population. The conflicting results regarding the effect of maintenance work on neuropsychological symptoms versus neuropsychological test outcomes may be explained by a variety of factors. Neuropsychological testing may not be adequately sensitive to measure the subtle effects of solvents. Alternatively, the exposure levels may not have been high enough to affect the central nervous system. If this is the case, the associations between maintenance work and self-reported symptoms may have been biased. However, it is also possible that exposure misclassification resulted in attenuation of the associations between maintenance work and neuropsychological test performance.

Significant Findings

Qualitative Exposure Assessment Results

Commercial fishing is known to be a dangerous occupation but little is known about occupational disease in this population. My research documented occupational exposure to organic solvents among commercial fishers. Commercial fishers do much of their own boat maintenance e.g. the repair boat motors and other mechanical equipment and use glues epoxies or resin (typically styrene-based resin) to repair fiberglass boats. This work involves inhalation of gasoline vapors as well as skin contact, exposure to styrene and other chemicals in fiberglass boat repair including acetone. Fishers less frequently report coating pots or nets with tar and using fungicidal paints (copper oxide). Table I.1 (p.16) of technical report lists the number of reports and person-time spent on solvent-related maintenance activities. Exposures are discussed in more detail in Chapter I pp. 1-5.

Exposure to Benzene in Fuel while Fishing

Significant predictors of benzene exposure during the commercial fishers' workday included re-fueling his/her car, truck or boat and engine type (2-stroke, 4-stroke and diesel). Results are detailed in Chapter III of the technical report pp 48-50. Although emissions have been measured to gauge environmental effects, no previous studies personal exposure to benzene while using a 2-stroke or 4-stroke engine were discovered in my literature review.

Maintenance Work and Neuropsychological Symptoms

Rate ratios describing the association between maintenance exposures involving exposure to gasoline and symptoms indicative of cognitive effects were distinguished by being among the highest, increasing if work was done inside, and increasing with direct skin contact. There was no evidence to support an association between exposure to styrene during fiberglass work and symptoms of cognitive effects. Results are described in detail in Chapter IV of the technical report (pp. 69-71)

Maintenance Work and Neuropsychological Test Scores

Observed associations between recent exposure and to solvents during maintenance work and cumulative exposure over the course of were not clinically relevant. See Chapter V in the technical report for a detailed description of methods, results and discussion (pp 85-100).

Usefulness of Findings

A variety of unsafe practices that lend themselves to training and education efforts were identified through this work:

1. Fishers often use gasoline to clean their hands and skin contact with gasoline was strongly associated with symptoms of cognitive effects.
2. Fishers put styrene-based resins (purchased from marine supply stores or friends) from 55 gallon drums into unmarked containers. Therefore, safety and health information may not be transferred to the fishers.
3. Fiberglass boat repair projects range in size and may be performed in unventilated spaces without the use of personal protective equipment.
4. The use of 4-stroke engines can reduce personal exposure to gasoline emissions as well as reduce environmental contamination.

Publications and Presentations

Kirrane E (2002). Organic Solvent Exposure and Neuropsychological Function among Fishers in North Carolina. Department of Epidemiology. Chapel Hill, University of North Carolina: 158.

Kirrane, E., Loomis, D., Attix, D., Moe, C., Savitz, D. Organic solvent exposure and self-reported neuropsychological symptoms among commercial fishers in North Carolina. Proceedings of the 8th International Symposium on Neurobehavioral Methods and Effects in Occupational and Environmental Health, Brescia, Italy, June 2002.

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Kirrane, E., Loomis, D., Egeghy, P., and L Nylander-French. Personal exposure to fuel emissions among commercial fishers: 2-Stroke, 4-Stroke and Diesel Engines (submitted).

The publications listed above address the specific aims enumerated in my grant proposal, submitted in June 2000. The first reference is my doctoral dissertation, which addresses each of the aims and has been submitted to serve as a technical report. I have reference the relevant chapter in my dissertation next to each aim.

Specific Aims

1. *To quantify organic solvent exposure among commercial fishers*
 - a) *Characterize exposure to evaporative emissions from fuel and fuel exhaust using benzene as a marker. (Chapter III).*
 - b) *Characterize intermittent exposure to solvents including gasoline styrene and styrene 7,8 oxide, acetone and other solvents generated during maintenance work. (Chapter II)*
2. *To identify the determinants of solvent exposure in order to identify options for controlling exposure. (Chapter III)*
3. *To determine the association between exposure to solvents and neuropsychological test scores. (Chapter IV,V)*

January 19, 2004

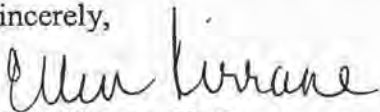
David Staudt
Grants Management Specialist
Centers for Disease Control and Prevention
Procurement and Grants Office
Acquisition and Assistance Field Branch
626 Cochrans Mill Road
PO Box 18070, MS-P05
Pittsburgh, PA 15236

Re: Final Inventions Statement

Dear Mr. Staudt,

There were no inventions conceived under the grant.

Sincerely,


Ellen Kirrane, Ph.D.

January 19, 2004

David Staudt
Grants Management Specialist
Centers for Disease Control and Prevention
Procurement and Grants Office
Acquisition and Assistance Field Branch
626 Cochrans Mill Road
PO Box 18070, MS-P05
Pittsburgh, PA 15236

Dear Mr. Staudt,

I have enclosed the final report for grant R03 OH07380. I apologize for the delay. I included a summary report as well as my doctoral dissertation, which has the form of a technical report. Thank you very much.

Sincerely,

A handwritten signature in cursive script that reads "Ellen Kirrane".

Ellen Kirrane, Ph.D.