Letter to the Editor

COMMENTS ON WATERCRAFT-RELATED DROWNINGS

In the September/October, 2003 issue of *Public Health Reports*, Marilyn L. Browne and collegues[1] described environmental and personal risk factors associated with 216 watercraft-related drownings occurring between 1988 and 1994 among New York state residents. Carbon monoxide (CO) exposure was not one of the risk factors identified as meaningful for future reduction in such drownings.

As part of an ongoing investigation of boat-related CO poisonings in the United States, we have identified 503 severe CO poisonings occurring primarily between 1990 and present.[2] Of these poisonings, 101 resulted in death, and 46 of these deaths were CO-related drownings. One of these drownings occurred in New York in 1996. This woman voluntarily entered the water to swim and drowned after 10 minutes in the water. Because the Medical Examiner analyzed the blood specimen for carboxyhemoglobin (COHb), which was found to be 62%, CO exposure from the boat's operating propulsion engine was listed as contributory to her drowning.

During an extensive review of U.S. National Park Service records of boat-related drownings that occurred between 1994 and 2002 at Lake Powell (U.S. National Park Service Glen Canyon National Recreation Area), we determined that 11 of the 26 (42%) boat-related drownings were related to CO exposure. These drowning victims had measured COHb concentrations ranging from 26% to 59%. Nine of these victims voluntarily entered the water, one collapsed while on a platform (fell overboard), and one death was unwitnessed; thus, no information was available about his entry into the water. These drownings occurred because boat design features intended for occupancy (e.g., swim platforms, extended rear decks) and exhaust terminus configuration place people close to propulsion engine and/or on-board gasoline-powered electrical generator exhaust. Studies conducted since 2000 have shown that these engines, most of which have no emission controls, produce CO-rich clouds with concentrations greater than 60,000 parts of CO per million parts of air (690 times the short-term exposure limit recommended by the World Health Organization) measured outside the cabin area of the boat. These studies, as well other related technical and educational materials, can be found at: http://safetynet.smis.doi.gov/COhouseboats.htm.

The information from our studies leads us to ask the following questions:

- Were COHb concentrations measured for any of the 99 motorboat-related drownings noted in the reported study?
- What were the circumstances involved with the 50 deaths in which the victim fell overboard and the 24 deaths in which the victim voluntarily entered the water?
- Are there any stored blood specimens still in existence for any of the cases cited by the authors that could be analyzed for CO testing? If so, positive results could shed light on whether poisonings had been missed as a contributing cause to the drowning.

We found it interesting that the authors based their recommendation about alcohol use on the fact that 18/73 victims for which alcohol results were available had blood alcohol concentrations greater than 100 mg/dl. Thus, the authors conclude that alcohol is a risk factor based on 18 of 216 (8%) drownings in which the victim was known to be above the limit legally recognized as "drunk." One wonders how this would compare with CO exposure as a risk factor if all 99 motorboat-related drownings (or even if just the 73 tox screens) had included a COHb analysis? If we extrapolate the Lake Powell findings (where alcohol and COHb analyses are routinely conducted on autopsy due to their history of recognition of this problem), CO could have been related to as many as 42 of the 99 New York drownings. For this reason, we recommend that COHb analyses be performed in every boat-related death whether it is a drowning, an apparent natural death on the boat itself, or accidental trauma.

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AUTHOR RESPONSE

I thank McCammon et al. for their interest in our paper and for calling attention to carbon monoxide exposure as a risk factor for watercraft-related drownings. While I find this to be an important concern, I would like to point out that carbon monoxide poisoning associated with recreational watercraft activities has appeared in the literature only relatively recently. When our study began in 1995 we were not aware of carbon monoxide exposure as a risk factor for drowning. In addition, the drownings in our study occurred in 1988-1994. At that time medical examiners, coroners, police investigators, and pathologists may not have been looking for carbon monoxide exposure as a contributing cause of drowning. Nevertheless, as part of our study, all autopsy reports and toxicology reports were examined for contributing causes of death and all unique causes were assigned separate codes. Carbon monoxide exposure was not reported as a contributing cause of death for subjects in our study.

I will address the questions posed by McCammon et al. from last to first.

- Ours was a retrospective study; we did not collect blood specimens and doubt that any stored specimens are still in existence.
- The circumstances surrounding the deaths in which victims fell overboard or voluntarily entered the water were varied. Focusing on the drownings associated with motorboats (*N*=99), 30 victims fell overboard, 13 entered the water voluntarily, and for one the circumstances under which the victim entered the water could not be determined. In some cases the engine was stated to have been turned off, the boat was disabled, or the victim was described to have been swimming a distance from the boat. Other details such as the victim calling for help and struggling would indicate that carbon monoxide poisoning severe enough to cause loss of consciousness had not occurred. Less severe carbon monoxide poisoning cannot be ascertained from our data. In only two instances was a scenario described that might be linked to carbon monoxide exposure. In those two cases the motor was idling and the victim was or may have been at the rear of the boat. The circumstances of the 44 drownings mentioned have been summarized in a table that will be provided upon request (e-mail: mlb10@health.state .ny.us).
- We re-examined files for 18 drownings for which a situation inconsistent with carbon monoxide poisoning could not be inferred from the data in our computer files alone. Toxicology reports were available for all 18, three of which included carboxyhemoglobin (COHb) concentrations. The levels reported were all less than 3% saturation.

Although the objectives and timing of our study limit conclusions related to carbon monoxide exposure, the information available to us suggests that carbon monoxide poisoning was not a common contributing factor in the motorboat-related drownings in our study. However, risk patterns can change over time[1] and we support McCammon et al.'s efforts to raise awareness about a serious risk associated with exposure to motorboat exhaust. To reiterate a point that we make in a separate publication,[2] the use of uniform investigation report forms by medical examiners and coroners would greatly assist injury prevention surveillance and research. A system for developing and modifying uniform investigation report forms and practices, including specimen collection, could also expedite changes in investigation practices in response to newly identified or suspected risk factors such as carbon monoxide exposure in boat-related deaths.

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