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Calls to Florida Poison Control Centers about mercury: Trends over 2003–2013

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ABSTRACT

Objective: The aim of this analysis was to contrast trends in exposure-report calls and informational queries (a measure of public interest) about mercury to the Florida Poison Control Centers over 2003–2013.
Materials and methods: Poison-control specialists coded calls to Florida Poison Control Centers by substance of concern, caller demographics, and whether the call pertained to an exposure event or was an informational query. For the present study, call records regarding mercury were de-identified and provided along with daily total number of calls for statistical analysis. We fit Poisson models using generalized estimating equations to summarize changes across years in counts of daily calls to Florida Poison Control Centers, adjusting for month. In a second stage of analysis, we further adjusted for the total number of calls each day. We also conducted analyses stratified by age of the exposed.
Results: There was an overall decrease over 2003–2013 in the number of total calls about mercury [Ratio per year: 0.89, 95% CI: (0.88, 0.90)], and calls about mercury exposure [Ratio per year: 0.84, 95% CI: (0.83, 0.85)], but the number of informational queries about mercury increased over this time [Ratio per year: 1.15 (95% CI: 1.12, 1.18)]. After adjusting for the number of calls of that type each day (e.g., call volume), the associations remained similar: a ratio of 0.88 (95% CI: 0.87, 0.89) per year for total calls, 0.85 (0.83, 0.86) for exposure-related calls, and 1.17 (1.14, 1.21) for informational queries.
Conclusion: Although, the number of exposure-related calls decreased, informational queries increased over 2003–2013. This might suggest an increased public interest in mercury health risks despite a decrease in reported exposures over this time period.

1. Introduction

Mercury is an environmental toxicant that can occur in several forms (e.g., inorganic, elemental, methylmercury), each with distinct health risks (WHO, 2010). In the United States, the most common, but declining, source of pediatric elemental mercury exposure is broken thermometers (Bose-O'Reilly et al., 2010; Lee et al., 2009), which could impact public visibility of mercury exposures. Methylmercury exposure often comes from seafood (Karimi et al., 2012; Sheehan et al., 2014). Recent surveys in Florida indicate regional variability in mercury exposures, with a quarter of pregnant women in Martin County showing hair mercury ≥ 1 μg/g (Nair et al., 2014) but only 7% of participating women between the ages of 18–49 in Duval County showing hair mercury ≥ 1 pg/g (Traynor et al., 2013). A recent review of calls reporting exposures to the Texas poison control centers found an 89% decrease in exposure-reporting calls from 2000 to 2013 (Forrester, 2016), and national data suggest a decrease of 86% in mercury exposure-report calls between 2000 and 2013 (Litovitz et al., 2001; Mowry et al., 2014).

Patterns of actual exposures and health hazards may differ from the patterns of public concern about mercury. Survey research by Paul Slovick in the 1980s found that mercury was regarded as a “dread risk” and “unknown” risk, per his two-factor psychometric model for risk perceptions (Slovic, 1987); mercury thus fell in the quadrant of perceived risks for which public concern was highest. In addition to Slovick's psychometric paradigm, social scientists have also used appraisal theory and other risk frameworks to investigate perceptions of mercury and other environmental hazards (Bostrom, 2008; Brown, 2014; Keller et al., 2012). Appraisal theory posits that considerations such as certainty and fairness influence emotional evaluations of environmental

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risks (Keller et al., 2012; Watson and Spence, 2007). Other psychological theories like the Risk Information Seeking and Processing Model and Social Amplification of Risk Model suggest that subjective norms and availability of information could also potentially influence mercury risk perceptions (Griffin et al., 1999; Kasperson et al., 1988; Yang et al., 2014). It is plausible that information about the sources, health effects, and severity of consequences of mercury exposure may have improved over time; mercury risk perceptions also may have changed.

There are limited data on how public perceptions of mercury may have evolved over the past several years. Perceptions of mercury exposure and risk may vary by sex, race, and other factors (Lin et al., 2014; Silver et al., 2007). A 2009 study that examined mercury risk perception among a subset of New England residents and in a U.S. nationally representative sample found varying degrees of risk perception, knowledge of mercury sources, and awareness of potential mercury exposures (Turaga et al., 2014). Based on national data from the Food Safety Surveys, awareness of mercury in seafood increased between 2001 and 2006 and the greatest awareness was in parents of children under age 5 (Lando and Zhang, 2011). Mercury-focused community outreach efforts such as fish consumption advisories, the Agency for Toxic Substances and Disease Registry's "Don't Mess with Mercury" campaign, and non-profit organization efforts seek to educate communities about the risks of mercury exposure (Engelberth et al., 2013; Watters and Rayman, 2014). However, in a recent survey of the region near Pensacola, Florida, only 31% of women were aware of the Florida Fish Consumption Advisory (Karouna-Renier et al., 2008).

We considered Florida Poison Control Centers' historical record of calls about mercury as a novel and objective indicator for how the Florida public's concerns about mercury exposures may have evolved over 2003–2013. Contrasting the informational queries against exposure-report calls provides greater context for understanding how perceptions may have evolved over time vis-à-vis reported exposures. The objective of this study was to summarize the temporal trends of calls about mercury to Florida Poison Control Centers over 2003–2013, overall and grouped into calls about exposure (an indicator of exposures that elicited concern sufficient for a call) or informational queries (an indicator of general public interest and concern about mercury).

2. Methods

2.1. Data source

Calls to the 1-800-222-1222 Poison Help® line in Florida are routinely entered into a standardized database (ToxSentry®, trademarked by the Grady Memorial Hospital Corporation and the University of Florida Health Sciences Center - Jacksonville) by the three poison centers that comprise the Florida Poison Information Center Network. These data are available for public data analysis once personal identifiers have been removed. The data from these calls prior to de-identification include identifiers such as date, specific substance, medical outcome, substance of concern, age, and sex. Data were collected both for calls about specific exposure events and on calls that are "informational" only.

Staff at the Florida Poison Information Center – Miami located the records of calls from 2003 to 2013 coded in ToxSentry® as involving mercury (i.e., searched for the entire category of "mercury" - AAPCC product code #0158000 - in the National Poison Data System), removed most individual identifiers (for this analysis, dates were retained), and provided summary information about each day's calls, in particular: the age of the persons reportedly exposed, and the chemical motivating the calls [inconsistently coded text strings including "MERCURY", "THERMOMETERS", "MERCURY THERMOMETERS (GENERAL FORMULATION)", "THERMOMETER, B-D BASAL FROM BECTON DICKENSON < UNITED STATES > ", "THERMOMETER, BABY RECTAL FROM SUPERX DRUGS < UNITED STATES > ", "THERMOMETER, ORAL FEVER FROM KROGER", "MERCURY, ELEMENTAL", "THERMOMETERS (MERCURY) (GENERAL FORMULATION)", "MERCURY, ORGANIC", "THERMOMETERS: MERCURY", "MERCURY, OTHER" etc.]. We defined thermometer-related calls as calls whose description of the exposure included the character string "THERM" and then recoded "MERCURY (ELEMENTAL) (EXCLUDING THERMOMETER)" as not-thermometer related. This analysis was deemed "not human subjects research" by the Emory University IRB.

2.2. Statistical methods

We evaluated the total number of calls about mercury each day, and also stratified calls based on whether they were informational queries or reports of possible exposure. For the purposes of describing the overall temporal trends in calls about mercury, there is a substantive rationale for simplifying all kinds of mercury exposure as "mercury": mercury in the environment can gain or lose a methyl group (Celo et al., 2006; Choi and Bartha, 1994; Li and Cai, 2013) and mercury can also change methylation state in the gut and body (Parajuli et al., 2016; Rothenberg et al., 2016; Sherman et al., 2013). Furthermore, on a practical level, there may be inconsistencies in how calls about specific mercury species were recorded by poison control center specialists, so collapsing into a single category of mercury should reduce misclassification of the number of calls. Nonetheless, we recognize that differences between mercury-containing molecules are tremendously important for the biological effects of mercury, and that different sources of exposure are expected to lead to varying doses of different kinds of mercury. Aggregation of all kinds of mercury exposure also allows for clearer alignment of public *perceptions* of mercury risks with mercury exposures over time, as risk perception studies about mercury typically refer to "mercury" rather than to mercury species.

Two dates were extreme outliers, with those days' calls predominantly reflecting unusual mass exposure events, and so for our main analysis those two days were re-coded to only include calls unrelated to the mass exposure events (leaving zero mercury exposure-related calls on 1/28/2003 and two mercury exposure-related calls on 11/20/2006). We also present results from sensitivity analyses without recoding these outliers. The data analysts for this project had restricted access to the detail of all calls over a decade, so we did not subtract other "group poisoning" events from our adjustment variable of the total number of calls about any compound per day.

Time-series of count data can be modeled as Poisson; if autocorrelation is present, it may be accounted for using generalized estimating equations (GEE) (Dominici et al., 2002; Schwartz et al., 1996; Zeger, 1988). We estimated Poisson GEE models with an independent autocorrelation structure (Liang and Zeger, 1986; Zeger, 1988) to summarize population-averaged trends in the total number of mercury-related calls, mercury exposure-reporting calls, and informational queries; and conducted sensitivity analyses for alternative assumptions about the correlation structure. We also conducted stratified analyses for exposure-related calls by patient age and by whether the call was coded as thermometer-related.

In secondary analyses, we conducted an analysis stratified by age of the person exposed to mercury in the call, to examine how the time trends of mercury exposure-related calls may differ by age. We excluded calls about persons for whom age was not reported, restricting our stratified analysis to 2313 of the 2944 exposure-related calls. For these secondary, descriptive analyses, we grouped participants into age categories that were small enough to be informative, but large enough to allow stable estimation.

3. Results

The time-series of calls about mercury to Florida Poison Control Centers, overall and stratified by nature of the call, are shown in Fig. 1.