

# Prenatal exposure to dental amalgam

## Evidence from the Seychelles Child Development Study main cohort

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The use of amalgams in dental restorations was introduced more than 160 years ago. Favorable physical properties, superior durability and economical cost made amalgam the preferred restorative material for billions of teeth. Results from recent studies indicate amalgam continues to be used frequently today. Investigators in a dental practice-based research network (DPBRN) encompassing 229 dentists in Alabama, Florida, Georgia, Minnesota, Mississippi, Oregon, Denmark, Norway and Sweden surveyed the network members and reported that 38 percent of all recently placed restorations consisted of amalgam, accounting for 45 percent of premolar restorations and 47 percent of molar restorations.<sup>1</sup> Dentists participating in the Northwest Practice-based REsearch Collaborative in Evidence-based DENTistry (PRECEDENT) DPBRN (which involves dentists in Idaho, Montana, Oregon, Utah and Washington) reported using dental amalgam for 28.1 percent of restorations placed in children and adolescents and for 22.7 percent of restorations placed in adults during the preceding 12 months.<sup>2</sup> Placement of dental amalgam restorations remains common practice in all age groups, including children and women of childbearing age.

### ABSTRACT

**Background.** Dental amalgams contain approximately 50 percent metallic mercury and emit mercury vapor during the life of the restoration. Controversy surrounds whether fetal exposure to mercury vapor resulting from maternal dental amalgam restorations has neurodevelopmental consequences.

**Methods.** The authors determined maternal amalgam restoration status during gestation (prenatal exposure to mercury vapor [ $Hg^0$ ]) retrospectively in 587 mother-child pairs enrolled in the Seychelles Child Development Study, a prospective longitudinal cohort study of the effects of prenatal and recent postnatal methylmercury (MeHg) exposure on neurodevelopment. They examined covariate-adjusted associations between prenatal maternal amalgam restoration status and the results of six age-appropriate neurodevelopmental tests administered at age 66 months. The authors fit the models without and with adjustment for prenatal and recent postnatal MeHg exposure metrics.

**Results.** The mean number of maternal amalgam restorations present during gestation was 5.1 surfaces (range, 1-22) in the 42.4 percent of mothers who had amalgam restorations. The authors found no significant adverse associations between the number of amalgam surfaces present during gestation and any of the six outcomes, with or without adjustment for prenatal and postnatal MeHg exposure. Results of analyses with the secondary metric, prenatal amalgam occlusal point scores, showed an adverse association in boys only on a letter- and word-identification subtest of a frequently used test of scholastic achievement, whereas girls scored better on several other tests with increasing exposure.

**Conclusions.** This study's results provide no support for the hypothesis that prenatal  $Hg^0$  exposure arising from maternal dental amalgam restorations results in neurobehavioral consequences in the child. These findings require confirmation from a prospective study of coexposure to MeHg and  $Hg^0$ .

**Key Words.** Mercury; amalgam; pregnancy; neurodevelopment. *JADA* 2011;142(11):1283-1294.

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Dental amalgam is composed of approximately 50 percent metallic mercury, an inorganic form of mercury. Amalgam restorations present in the oral cavity continuously expose a person to mercury vapor ( $\text{Hg}^0$ ) released from the surface across the lifetime of the restoration.<sup>3</sup> Chronic exposure to elevated levels of  $\text{Hg}^0$  results in neurotoxicity consisting of various sensory, motor, cognitive and personality disturbances, but the lowest level of exposure at which such associations occur is not known.<sup>3</sup> In numerous reviews, investigators have suggested low-level  $\text{Hg}^0$  exposure resulting from dental amalgam restorations in adults is unlikely to result in adverse health effects.<sup>4-8</sup> However, data regarding children are limited. Results from two randomized clinical trials in older children in which investigators compared postnatal exposure to composite restorations with exposure to  $\text{Hg}^0$  associated with dental amalgam showed no statistically significant differences in children with amalgam restorations in results from neurobehavioral assessments or nerve conduction velocities,<sup>9</sup> or in adverse neuropsychological and renal functions.<sup>10</sup>

Although  $\text{Hg}^0$  crosses the placenta, scientific data allowing adequate assessment of whether maternal dental amalgam restorations pose health risks to the developing human fetus are limited.<sup>8,11</sup> Results from several animal studies suggested that adverse neurodevelopmental outcomes in offspring can be a consequence of prenatal exposure to  $\text{Hg}^0$  when exposure is at levels higher than those associated with dental restorations.<sup>12-15</sup> Moreover, investigators in a 2010 study in rats found neurotoxic risk may be elevated in offspring coexposed during gestation to  $\text{Hg}^0$  and methylmercury (MeHg), an organic form of mercury.<sup>16</sup> Comparable human studies are lacking, as noted in 2008 by an independent scientific committee of the European Commission, which stated, "With respect to populations at risk, there is a lack of information about effects in pregnant women."<sup>16</sup> More recently, in 2009 the U.S. Food and Drug Administration (FDA) reviewed the issue of dental amalgams and neurodevelopment and issued a final rule on amalgam, in which the FDA stated, similarly to the European Commission committee, that "very limited to no clinical information is available regarding long-term health outcomes in pregnant women and their developing fetuses, and children under the age of six [years]."<sup>17</sup>

To address prenatal exposure to  $\text{Hg}^0$  associated with amalgam restorations, we retrospectively reconstructed the maternal amalgam restoration status during gestation for mothers of children

enrolled in the main cohort of the Seychelles Child Development Study (SCDS). This study, in which several of the authors participated (T.W.C, P.W.D., G.J.M., C.F.S.), is a study of the association of a maternal diet high in fish (MeHg exposure) on neurodevelopmental outcomes in the offspring. This cohort of children was of interest because they were exposed to elevated levels of MeHg both prenatally and postnatally through a diet high in fish, and they already had undergone extensive neurodevelopmental testing by the time our retrospective analysis began. We first examined the association between the children's prenatal  $\text{Hg}^0$  exposure (with maternal amalgam restoration status serving as a biological marker) and results from their 66-month test battery. We then examined the association with adjustment for prenatal and recent postnatal MeHg exposures to determine whether coexposure to the inorganic ( $\text{Hg}^0$ ) and organic (MeHg) forms of mercury influenced the analyses.

## METHODS

**Participants.** The institutional review boards of the University of Rochester, N.Y., and the Ministry of Health, Republic of Seychelles, reviewed and approved this study. All study participants provided informed consent or assent. The SCDS main cohort is a well-described group of 779 mother-infant pairs residing in the Republic of Seychelles. The infants were enrolled at age 6 months in 1989 and 1990 in a prospective, double-masked, longitudinal study designed to test the hypothesis that prenatal MeHg exposure resulting from a maternal diet high in fish is related to a child's neurodevelopmental outcomes. At enrollment, the mothers consumed an average of 12 fish meals per week.<sup>18</sup> The investigators evaluated the children at multiple ages through age 19 years by using batteries of neuropsychological tests to determine their cognitive and neurological development.<sup>19-23</sup> Of the original 779 mother-child pairs enrolled in the SCDS main cohort, investigators evaluated 711 children at 66 months of age, and these were eligible to participate in this dental study. We were able to ascertain retrospectively

**ABBREVIATION KEY.** **CBCL:** Child Behavior Checklist. **DPBRN:** Dental practice-based research network. **FDA:** Food and Drug Administration. **GCI:** General Cognitive Index.  **$\text{Hg}^0$ :** Mercury vapor. **HOME:** Home Observation for Measurement of the Environment. **LEL:** Lower exposure limit. **MeHg:** Methylmercury. **PLS:** Preschool Language Scale. **SCDS:** Seychelles Child Development Study. **SES:** Socioeconomic status. **THg:** Total mercury. **UEL:** Upper exposure limit. **W-J:** Woodcock-Johnson.

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