

# Low-Dose Mercury Exposure in Early Life: Relevance of Thimerosal to Fetuses, Newborns and Infants

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**Abstract:** This review explores the different aspects of constitutional factors in early life that modulate toxicokinetics and toxicodynamics of low-dose mercury resulting from acute ethylmercury (etHg) exposure in Thimerosal-containing vaccines (TCV).

Major databases were searched for human and experimental studies that addressed issues related to early life exposure to TCV. It can be concluded that: a) mercury load in fetuses, neonates, and infants resulting from TCVs remains in blood of neonates and infants at sufficient concentration and for enough time to penetrate the brain and to exert a neurologic impact and a probable influence on neurodevelopment of susceptible infants; b) etHg metabolism related to neurodevelopmental delays has been demonstrated experimentally and observed in population studies; c) unlike chronic Hg exposure during pregnancy, neurodevelopmental effects caused by acute (repeated/cumulative) early life exposure to TCV-etHg remain unrecognized; and d) the uncertainty surrounding low-dose toxicity of etHg is challenging but recent evidence indicates that avoiding cumulative insults by alkyl-mercury forms (which include Thimerosal) is warranted. It is important to a) maintain trust in vaccines while reinforcing current public health policies to abate mercury exposure in infancy; b) generally support WHO policies that recommend vaccination to prevent and control existing and impending infectious diseases; and c) not confuse the 'need' to use a specific 'product' (TCV) by accepting as 'innocuous' (or without consequences) the presence of a proven 'toxic alkyl-mercury' (etHg) at levels that have not been proven to be toxicologically safe.

**Keywords:** Thimerosal, ethylmercury, methylmercury, hair, blood, stools, vaccines, newborns, neurodevelopment.

## 1. INTRODUCTION

For certain infectious diseases, vaccines have been developed for the control and eradication of infectious diseases in susceptible populations. Before vaccine formulations are licensed, it is necessary to ensure that each is safe, efficacious and well tolerated *per se*. Today, the pertinent studies focus on the formulation's immunogenic components. For preservatives and adjuvants in vaccine formulations, a specific testing protocol for their safety and tolerability is rarely executed for their specific effects [1], particularly for Thimerosal-containing vaccines (TCVs) used in newborns and infants.

In the body, Thimerosal (used as a preservative in some vaccines) degrades into ethylmercury (etHg) chloride. After more than 60 years of use, concerns were raised regarding children's exposure to TCV-derived etHg [2]. Nevertheless, organic mercury fungicides have been banned in industrialized countries since the early 1970s [3]. The accidental consumption of organomercurial fungicides (which included etHg compounds) in fungicide-treated grains caused serious health problems in many parts of the world. These incidents and their adverse effects on humans, domesticated animals, and wild-life moved industrialized countries to ban these

fungicides. As a result of these disastrous events, research emerged demonstrating how fast etHg can penetrate the brain of monkeys and rats [4]. Modeling oral exposure to high doses of Hg, the comparative toxicology of the two most studied forms of organic mercury (etHg and meHg) showed that, at high equimolar doses in gavage-treated rats, etHg was systematically more toxic than meHg (significant differences in weight loss and renal damage); however, in neurologic tests, few differences were reported between etHg and meHg with regard to their dorsal root ganglia or coordination disorders [5].

Despite the lack of specific studies addressing low doses of etHg in TCVs for young children, actions have been taken based on existing toxicological studies of etHg. In the last 15 years, recognizing the plausibility of low-dose etHg toxicity, countries in North America and the EU started to withdraw Thimerosal from vaccines for young children. It was only after reducing or withdrawing Thimerosal from these vaccines that studies appeared addressing children's neurodevelopment [6] and the toxicology of small doses relevant to vaccines [7].

The objective of this review is to present, to pediatricians and public health workers, the large body of evidence of adverse biological (mainly neurological) effects pertaining to small-dose etHg exposures at levels relevant to those in vaccines administered to pregnant mothers (fetuses), neonates, and infants.

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