

# Thiomersal and Mercury Derivatives: a Review of Epidemiological, Pharmacological and Analytical Studies

Irsida Mehmeti\*, Malvina Hoxha

Catholic University “Our Lady of Good Counsel”, Tirana, Albania

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## Abstract

The simultaneous exposure to different sources of mercury should be taken into consideration, due to potential additive effects. This review summarizes recent data on the effects of thiomersal and related mercury species from the chemical, pharmacological, toxicological and epidemiological point of view. The final objective is to observe if any connection between chemical properties of thiomersal and mercury derivatives in neurodevelopmental disorders can be stated from the literature. Studies on thiomersal and its degradation products toxicity, as well as additive effects from other sources of mercury were searched in PubMed, Scopus, and SciFinder Scholar. The publications considered relevant to the topic were selected, reported and commented. Studies reporting thiomersal in other

forms and dosages from those found in vaccines (0.005% - 0.01%p/v in liquid dosage forms), were not taken in consideration. In our study were included only publications in English language published after 2013. The toxicological mechanisms of thiomersal in neurodevelopmental disorders are various, such as the GSH depletion, induction of oxidative stress, increase in reactive oxygen species and reactive nitrogen species. Despite the similar toxicities of EtHg and MeHg in vitro, these results cannot be inferred to in vivo due to different pathways of the two molecules. Although there are a lot of preclinical studies which assess the mechanism and effects of thiomersal in animals, there are many differences between human biological patterns and animal anatomy. As far as the other studies are

**Address for correspondence:** Irsida Mehmeti\*, Rr.Dritan Hoxha, Tirane, Albania, 1000. Email: [i.mehmeti@unizkm.al](mailto:i.mehmeti@unizkm.al)

concerned, six epidemiological studies reported no association between vaccines and neurodevelopmental outcomes. However, the limitations of in vitro, in vivo, clinical studies and epidemiological studies make their conclusions inadequate to generalize the results about the relationship between thiomersal and neurodevelopmental disorders. Moreover, although the cytotoxicity of mercury significantly depends on its chemical form, most of the scientific studies are focused on the determination of the total amount of mercury in cells, mostly because of the lack of efficient speciation analytical methods and adequate samples.

**Keywords:** thiomersal, toxicity, epidemiological studies, mercury speciation analysis