

Title: Electrolyte and Inflammatory Marker Differences in Meniere's Disease: A Multi-Institutional Comparative Analysis

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Background: Meniere's Disease (MD) is an idiopathic inner ear disorder that is characterized by repeated episodes of vertigo, hearing loss, and a sense of fullness or tinnitus in the affected ear. Though MD etiology is associated with autoimmunity, genetic disorders, viral infection, and migraines, its specific pathophysiology is broadly speculative. Research suggests that MD is most accurately characterized by endolymphatic hydrops, which impairs inner hair cell function and causes subsequent vestibular dysfunction. Current treatment options are thus directed at managing fluid dynamics and reducing inflammation within the inner ear. MD is often treated pharmacologically with corticosteroids, antibiotics, or diuretics. The use of diuretics in MD are associated with a widespread reduction in vertigo episodes, suggesting that fluid accumulation in the ear plays a strong role in the pathophysiology of MD. While there are studies to support this mechanism, the underlying pathophysiology behind MD remains poorly understood. Additionally, there is little to no population-based research on how characteristics of MD may differ from the general population. Thus, the aim of our research is to evaluate differences in systemic electrolytes between MD patients and controls within a population-level study.

Methods: A retrospective meta-analysis was conducted using TriNetX, a national healthcare database. The study analyzed a total of 47,285 patients with Meniere's Disease (F:65.2%, M:34.8%) and 8,792,754 patients who represented the general population (F:55.5%, M:44.5%) from 2015 – 2025 between ages 30 and 60. Patients with chronic kidney disease (CKD), acute kidney injury (AKI) were excluded to minimize renal confounding. Patients undergoing loop or thiazide diuretic treatment were also later excluded to minimize confounding. Biometric data from the age- and sex-matched cohorts was then compared against one another using independent t-tests through TriNetX. Effect sizes were calculated for significant p-values.

Results: Even after the exclusion of potential confounders, Meniere's Disease (MD) was associated with several electrolyte differences. Potassium levels were significantly lower in MD patients ($d = 0.24$), with mild alterations noted in calcium and magnesium and modest elevations in calcidiol. Sodium levels were comparable between groups overall, though differences reached statistical significance, especially among females. Consequently, the Na/K ratio was slightly elevated in both male and female MD cohorts relative to controls. Leukocyte and neutrophil counts were higher in MD patients ($d \approx 0.3$), whereas ESR and CRP were lower. Rheumatoid factor was slightly higher in female patients ($d \approx 0.1$). Mild lipid profile differences were observed, including small variations in cholesterol and triglyceride levels, though effect sizes were minimal.

Conclusions: These preliminary findings suggest subtle but consistent systemic differences in electrolyte balance and inflammatory biomarkers among patients with Meniere's Disease. The observed reduction in potassium and increased Na/K ratio may support hypotheses linking altered ionic homeostasis to Meniere's Disease pathophysiology. Further analyses are warranted to clarify the mechanistic significance of these findings. By identifying differences in the serum electrolyte composition of MD, healthcare providers may adjust pharmacologic treatment and prevention strategies to optimize patient outcomes.