# Balance Performance in Individuals with Meniere's Disease

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**Summary:** This study investigated differences in balance performance between individuals with Meniere's disease (MD) and healthy controls in static and dynamic balance conditions. The purpose of this study was to identify quantitative measures of balance control that may help clinicians diagnose Meniere's disease.

There was no clearly observable differences between individuals with Meniere's disease and controls across two measures of balance performance. However, two different responses were observed within balance disturbance coefficient scores of the Meniere's groups leading to subgroup analysis which highlighted differences between stable and unstable Meniere's participants.

**Introduction:** MD is a vestibular disorder characterised by episodic vertigo, unilateral hearing loss and increased motion sensitivity. Individuals with MD find it difficult to navigate environments with floor motion such as bridges or skyscrapers. We know that individuals with Meniere's find it difficult to balance in these environment thanks to studies that have used semi-structured interviews[1] to identify problems that arise in everyday life because of MD. However little research has investigated whether having MD results in an observable deficit in balance performance. In line with the aim of this study, balance disturbance coefficients (BDC)[2] were developed to utilise frequency analysis providing a quantitative measure of balance that could be used by clinicians with the study finding BDC sensitive to balance tasks of increasing difficulty.

This study aims to examine the differences in BDC and linear measures of centre of pressure (COP) with the hope of better understanding how MD affects the vestibular system and whether we can identify MD using measures of COP. We hypothesis that individuals with MD will exhibit higher balance disturbance coefficient (BDC) scores indicating poorer balance performance and larger linear measures of COP motion.

**Methods:** 11 individuals with MD and 11 age and sex matched healthy controls volunteered to participate in the study and gave written informed consent (REC Number: 22/EE/0127). All participants were 18-60 years old to prevent the confounding of age-related vestibular decline. Participants stood on a moving platform and completed two static balance tasks and two balance tasks with sinusoidal frequency ramping from 0.5Hz to 4Hz of the platform with a maximum displacement of 1.8mm. One of each task was done with closed eyes. Participants stood on an AMTI force plate (1000Hz) mounted to the platform. Kinetic data was filtered (10Hz low-pass, 4th order Butterworth) and down sampled to 100Hz. Fast Fourier transform analysis was conducted to identify BDC score[2] for each group during each condition with linear measures of COP also calculated.

**Results and Discussion**: Two subgroups of MD participants were identified using BDC scores and confirmed using a k-means clustering method. BDC scoring identified four individuals (unstable) with MD with a significant deficit in their balance performance when compared to the rest of the Meniere's group (stable). The BDC increased in all groups as the task became harder. BDC scores of the unstable MD group was significantly higher than control and stable MD groups showing they are moving their COP both faster and greater distances, associated with instability [2]. The stable MD group showed significantly lower linear measures of COP such as amplitude when compared to the control group and unstable MD group suggesting they purposefully restricted their COP, likely a result of lower balance confidence [3].
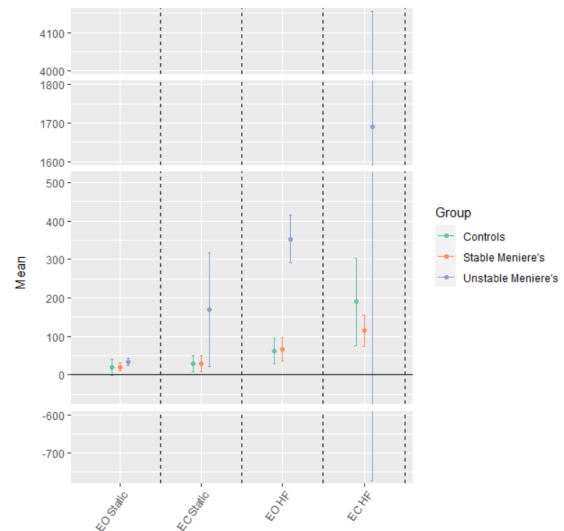


**Figure 1**: Mean BDC score and SD in Control, Stable and Unstable Meniere's group during a combination of eyes open (EO), eyes closed (EC), static and high frequency (HF) conditions.

**Conclusions:** Individuals with MD showed varying deficits in balance performance when compared to healthy controls. Using both analysis techniques, individuals with Meniere's can be differentiated from healthy controls using COP.

**References:**

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