During many activities, posture must be continuously regulated by the neuromuscular system to ensure stability. Information about the postural control system can be gained from ground reaction force center of pressure (CoP) kinematics. Traditional analysis methods use scalar measures of stability, which may give limited information about the dynamical organization of the postural control system, especially when considering CoP nonstationarity. In contrast, recurrence quantification analysis (RQA) makes no assumption about stationarity, and provides information about the structure and local dynamic stability of the postural control system. Regulation of posture does not occur in isolation but rather in concert with other physiological systems that could influence balance, such as autonomic respiration. We hypothesized that increasing system demands through either postural or respiratory challenges would stress the postural control system and elicit corresponding changes in the dynamics of the CoP. Ten subjects performed 2.5-minute quiet stance trials under normal and challenged postural and respiratory conditions. The postural challenge was to maintain a 45-degree axial rotation of the trunk, while the respiratory challenge was manifested by having subjects breathe through a long narrow tube, increasing the dead space by ~1150 ml. Anterior-posterior (AP) and Medio-lateral (ML) CoP time series were derived from ground reaction forces, sampled at 120 Hz. The state space was reconstructed from a 30-second record of each CoP time series by time-delayed embedding, followed by RQA analysis. Computed RQA variables assessed system repeatability (percent determinism [%DET]), complexity (entropy [ENT]), and intermittency (percent laminarity [%LAM]). The postural challenge resulted in changes in RQA variables for the ML CoP direction, such that %DET increased from 30.8 ± 33.1% to 45.4 ± 28.6%, ENT increased from 1.96 ± 1.57 bits to 2.73 ± 1.07 bits, and %LAM increased from 41.4 ± 33.6% to 58.1 ± 24.2% (Mean ± S.D.). The postural challenge produced no changes in the AP CoP. The respiratory challenge alone produced no changes in RQA variables. The postural challenge altered the orientation of the vestibular reference frame with respect to the base of support and, therefore, may have required a more complex integration of sensory and motor signals. Additional constraints may have been imposed on the postural control system by the trunk rotation, which increased the deterministic structure of the ML CoP and increased the tendency of the system to remain in specific postural states (decreased intermittency). This research was funded by NSF grant BCS-0341767 and NIH grant R03AG026281-01A1.