Abstract
Differences in health status at older ages are a result of genetic predispositions and social and biological responses to the accumulation of deleterious exposures across the lifespan. These exposures vary across individuals leading to heterogeneity in health status as people age. Chronological age (CA) is a classic indicator that represents overall risk of morbidity and death as older age is highly correlated with risk of chronic disease, morbidity, disability, and mortality. However, CA is only a crude proxy for underlying individuals’ physiological deterioration. An alternative to CA is biological age (BA), an indicator of age-related biological change measured by biomarkers of major physiological systems. Several methods have been proposed to estimate BA, all rely on linear regression approaches, and all constrain the slope of the linear relation to be 1. In this paper we propose an alternative indicator of BA that improves upon existing ones. First, we represent the relation between BA and CA through a flexible structural equation model (SEM), relax the assumption of a linear relation between CA and BA, empirical test for parameter constraints and, finally, employ the rate of change of BA relative to CA as an indicator of latent rate of aging or senescence. We implement the method using the US National Health and Nutrition Examination Survey 1988-1994 and compare our results with those from three commonly used methods (principal components, multiple regression, and Klemera-Doubal’s method). We also use BA estimates as predictors of mortality in the NHANES 2015 mortality follow-up and assess the effects of differences between CA and BA on mortality risks. Results show that our SEM-based estimates of BA differ significantly from those generated by principal components and multiple regression, and are comparable to but have slightly better predictive power than Klemera-Doubal’s. Key advantages of the proposed method are that it is feasible to test the accuracy of ex ante parameter constraints and admits a richer interpretation as indicator of latent individual’s physiological deterioration.