A Bayesian multilevel hidden Markov model for intensive longitudinal ecological momentary assessment data of patients with bipolar disorder

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In Bipolar disorder (BD), recognizing and quantifying mood and mood instability may improve care and calls for high-frequency measures coupled with advanced statistical models. We present a multilevel hidden Markov model (HMM) with a Gaussian emission distribution to identify mood states and accommodate heterogeneity between patients using continuous random intercepts. The multilevel HMM was applied to 4-month ecological momentary assessment (EMA) data in twenty patients with BD. EMA data comprised self-reported questionnaires (5 per day) measuring manic and depressive constructs using 12 items. Manic and depressive symptoms were further assessed by weekly administered self-reported questionnaires (i.e., Altman Self-Rating Mania Scale and Quick Inventory for Depressive Symptomatology Self- Report). Alignment between uncovered mood states and weekly questionnaires was assessed with a multilevel linear model. The multilevel HMM uncovered four mood states (euthymic, manic, mixed, and depressive) that aligned with weekly symptom scores. On average, the duration of the states was <24h, and states switched more frequently than weekly data suggested. In almost half of the patients, significant mood instability was observed. Large individual differences were observed in state duration and switching. The results show that data-driven identification of mood dynamics through a multilevel HMM is a promising method for improved diagnosis of clinical subtypes and treatment selection. Quantifying mood instability has the potential to improve the care of patients with bipolar disorder on a very individual scale.