**Longitudinal data, trajectories and time series: how to analyze them? An example of sleep data**

**Abstract (295 words)**

**Background:** Repeated measurement data, known as longitudinal data are common in the study of sleep apnea to assess changes in weight, symptoms of insomnia or daytime sleepiness, continuous positive airway pressure (CPAP) parameters such as adherence, leaks, apnea-hypopnea index. These data, collected at multiple points in lifetime, make it possible to examine how differences between individuals and within-person changes in outcome are associated with a longitudinal factor. However, working with longitudinal data presents some challenges, such as the choice of the statistical method to analyze them. An inadequate choice of method can add bias to parameter estimates and outcome predictions.

**Objective:** To provide a guide to the selection and application of statistical techniques for the analysis of longitudinal data.

**Methods:** Eleven main methods used to analyze longitudinal data were described and applied to simulated variables of CPAP adherence and Epworth Sleepiness Scale score. The simulated data correspond to a dataset of 50 patients and 1,000 measurements with continuous, categorical and discrete outcomes.

**Results:** Firstly, the type and source of the data are two important elements in choosing an appropriate statistical method.Secondly, the study question and objectives must be well defined. Finally, the statistical method needs to be verified before it is applied, in particular with regard to its assumptions, limitations, objectives and specific type of data. With increasing application difficulties, there are ANOVA and χ² methods for comparison; LCA, K-means and LTA methods for classification; GMM, mixed model, GBTM, ARIMA and cross-correlation, joint model and Hidden Markov model for modeling, forecasting.

**Conclusion:** Selecting the best statistical method for analyzing longitudinal data requires careful consideration of data type, data source, study objectives and methodological criteria. This study provides a detailed overview of commonly used statistical methods, through a comprehensive step-by-step approach to longitudinal data analysis.