A Novel Approach to Assessment and Classification of Pulmonary Function in Early Onset Scoliosis

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Early Onset Scoliosis (EOS) is defined as the lateral curvature of the spine, greater than 10 degrees, in children less than 10 years and is accompanied by vertebral rotation, creating a complex, heterogenous, 3D deformity of the thoracic rib cage. The restricted thorax prevents adequate lung growth, compromising pulmonary function. Treatment is aimed at maximizing spine growth and promoting lung development. Therefore, assessing pulmonary function as well as incorporating it into any classification of EOS as a measure of thoracic deformity is necessary for evaluating treatment outcome, communication, and prognosis. The current method of spirometry based assessment provides unreliable results in this population due to low compliance. Additionally, the current classification model uses two-dimensional curve indices alone. The goal of this project was to use the characteristics of the thoracic deformity to build a prediction model for pulmonary function to replace spirometry as well as to include new deformity indices in the classification model. Ribcages of EOS patients were reconstructed from de-identified CT slices. The transverse plane at the most deviated vertebrae was isolated and landmark points were plotted to calculate deformity parameters. Regression analysis was used to develop predictive models of pulmonary function from these parameters. An autoencoder neural network was used to learn a low dimensional representation of the transverse section mages. K-means algorithm was used to cluster the low dimensional data. The clusters representing the heterogeneity of the ribcage were validated with statistically significant differences in deformity parameters and correlated pulmonary function, providing a novel organizing structure.

Awards Won:

Second Award of $1,500

American Statistical Association: Third Award of $250