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VO₂ prediction based on physiologic and mechanical exercise measurements



M A Pacheco Pereira, R Almeida, H Dias

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Article

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Abstract

The Cardiopulmonary Exercise Test (CPET) is a diagnostic test that evaluates the functional capacity of an individual through the integrated response of the cardiovascular, respiratory and metabolic systems. VO₂max is the parameter that assess functional capacity, although it's difficult to achieve given the effort that implies.

In recent years, an increase in computing capabilities combined with available storage of large amounts of information has led to a heightened interest in machine learning (ML).

We aimed in this study to enable CPET with ML models that allow predicting oxygen consumption in healthy individuals.

The study methodology is based on the cleaning and exploratory analysis of a public database with about 992 CPET performed on healthy individuals and athletes.

To predict the each value of VO₂ (~569,000 instances), five ML algorithms were used (Random Forests, kNN, Neural Networks, Linear Regression and SVM) with heart rate, respiratory rate, time from the beginning of the exam and treadmill speed, using a 20-fold cross-validation.

The best result came from the Random Forest model, with a R² of 0.88 and a RMSE of 334.34 ml.min⁻¹.

Furthermore, using the same methodology but different features, we tried to predict the the VO₂max with the 724 adult participants with a maximal test (RER≥1.05) but weaker results were obtained (best model was the Linear Regression, with a R² of 0.50 and a RMSE of 498.06 ml.min⁻¹). Still, this model showed a better correlation with the real VO₂max than the Wasserman equation (R=0.71 vs R=0.59).

It's possible to predict with accuracy breath-by-breath VO₂, based in easy-to-obtain physiological and mechanical measurements.

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Footnotes

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