

Deep neural network estimated electrocardiographic-age as a mortality predictor

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Background:The electrocardiogram (ECG) is the most commonly used exam for the screening and evaluation of cardiovascular diseases. Here we propose that the age predicted by artificial intelligence (AI) from the raw ECG tracing (ECG-age) can be a measure of cardiovascular health and provide prognostic information.**Methods:**A deep convolutional neural network was trained to predict a patient's age from the 12-lead ECG using data from patients that underwent an ECG from 2010 to 2017 - the CODE study cohort (n=1,558,415 patients). **Results:** On the 15% hold-out CODE test split, patients with ECG-age more than 8 years greater than chronological age had a higher mortality rate (hazard ratio (HR) 1.79, $p < 0.001$) in a mean follow-up of 3.67 years, whereas those with ECG-age more than 8 years less than chronological age had a lower mortality rate (HR 0.78, $p < 0.001$). Similar results were obtained in the external cohorts ELSA-Brasil (n=14,236) and SaMi-Trop (n=1,631). The ability to predict mortality from the ECG predicted age remains even when we adjust the model for cardiovascular risk factors. Moreover, even for apparent normal ECGs, having a predicted ECG-age 8 or more years greater than chronological age remained a statistically significant predictor of risk (HR 1.53, $p < 0.001$ in CODE 15% test split). **Conclusion:** These results show that AI-enabled analysis of the ECG can add prognostic information to the interpretation of the 12-lead ECGs.