An Age Index Derived From Heart Rate Metrics Is Associated With Cardiovascular Risk Biomarkers

Davide Valeriani , Hulya Emir-Farinas , Tony Faranesh
Google, 1600 Amphitheatre Pkwy, Mountain View, CA 94043
dvaleriani@google.com, hfarinas@google.com, tfaranesh@google.com

Introduction

Conventional cardiovascular (CV) risk scores depend on clinical and laboratory measurements, and therefore have limited accessibility in the general population. Consumer wearables provide heart rate measures which individually correlate with CV risk, but it is not known how well they align collectively with conventional clinical biomarkers.

Objective

To demonstrate the alignment of a composite index based on heart rate metrics available from consumer wearables with clinical biomarkers and risk scores.

Methods

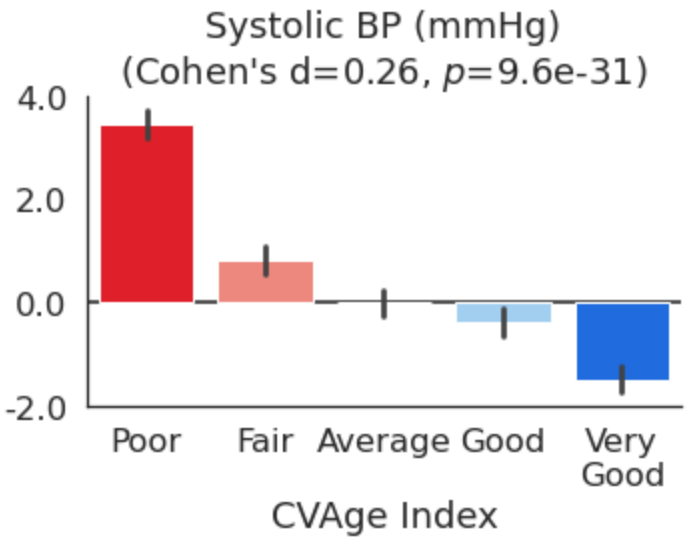
As chronological age is a strong predictor of cardiovascular health, we trained a linear regression model on the UK Biobank (UKB) dataset to predict chronological age from sex, body mass index, resting heart rate (RHR), and mean HR, maximum HR, HR recovery and estimated VO2max during a cycle ergometry test. Data from 53,670 individuals aged 40-70 years were used: 30,247 for training and 23,423 for testing. A cardiovascular age (CVAge) index was obtained as the difference between chronological and predicted age of the individual: a positive/negative CVAge index indicates the CV health is better/worse than the age would suggest. Heart rate predictors and CVAge index were z-scored using age and sex data on the training set.

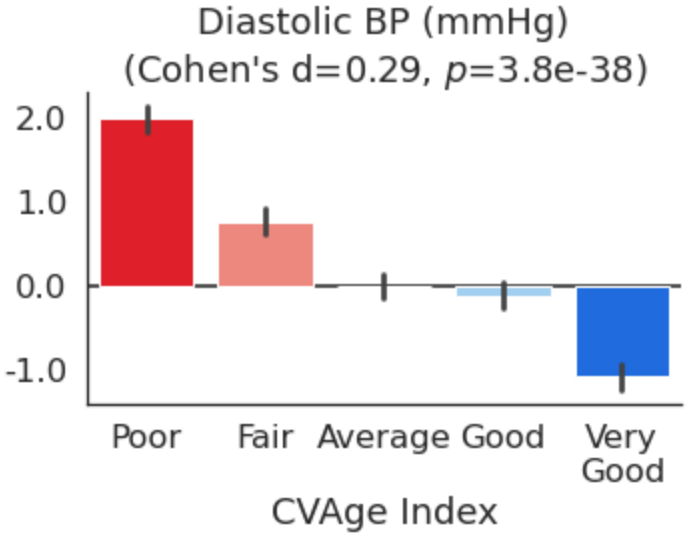
Results

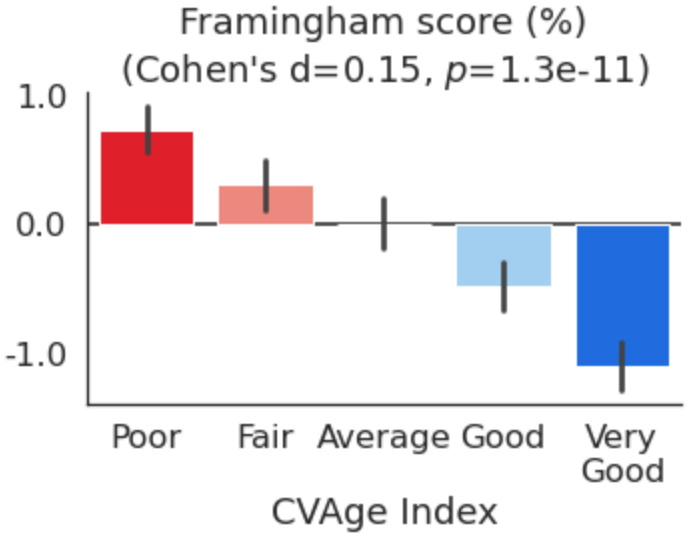
Individuals in the bottom quintile (“Poor CVAge index”) of the test set had higher systolic blood pressure (+5.0 mmHg), diastolic blood pressure (+3.0 mmHg), Framingham 10-year risk score (+1.8%) and ASCVD risk score (+0.8%), than those in the top quintile (“Very Good CVAge index”) – Figure 1.

Conclusion

Continuous monitoring of heart rate metrics may help users track their heart health even in the absence of clinical and laboratory measurements.


Systolic BP (mmHg)
(Cohen's d=0.26, p=9.6e-31)
4.0
2.0
0.0
-2.0
Poor
Fair
Average
Good
Very Good
CVAge Index


Diastolic BP (mmHg)
(Cohen's d=0.29, p=3.8e-38)
2.0
1.0
0.0
-1.0
Poor
Fair
Average
Good
Very Good
CVAge Index


Framingham score (%)
(Cohen's d=0.15, p=1.3e-11)
1.0
0.0
-1.0
Poor
Fair
Average
Good
Very Good
CVAge Index

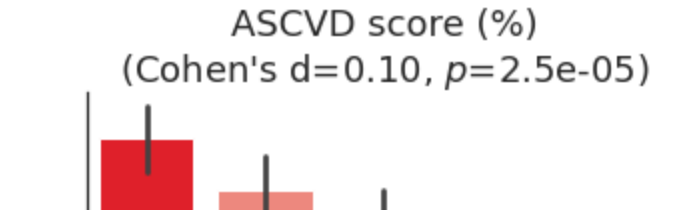

ASCVD score (%)
(Cohen's d=0.10, p=2.5e-05)

Figure 1. Average CVAge index in each quintile, referenced to the average CVAge index across the test set. Effect size shows the difference between “Poor” and “Very Good” CVAge index groups.