The Performance of the HATCH Score for Predicting New-Onset Atrial Fibrillation in An Elderly Hospital-Based Chinese Population

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Research Article

Keywords: atrial fibrillation, HATCH, prediction model, elderly, cohort study, hospital population

Posted Date: October 26th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-994486/v1

Abstract

BACKGROUND: The aging population represents high risk in developing new-onset atrial fibrillation (NOAF). Assessing individual risk of NOAF is pivotal for primary prevention. The role of the HATCH score for predicting NOAF in the elderly hospital-based Chinese population has never been evaluated.

METHODS: In our center, the development of NOAF was followed among patients aged over 65 years. Incidence of NOAF was calculated. Risk factors for NOAF were investigated using uni- and multivariable Cox regression analysis. The performance of the HATCH score for predicting NOAF was evaluated using Kaplan-Meier curve analysis with DeLong test and C-indexes.

RESULTS: A total of 7718 elderly patients were enrolled in the present study, with 421 developed NOAF during 3.18 ± 3.73 years of follow-up with an incidence of 1.71 (95%CI 1.55-1.89) per 100 patient-years. After adjusted with cofounders, only hypertension (hazard ratio [HR] 1.51, 95% confidence interval [CI] 1.23-1.85), COPD (HR 1.86, 95%CI 1.22-2.84) and HF (HR 1.82, 95%CI 1.28-2.59) were independently related to NOAF. The risk of NOAF increased with a higher HATCH score (38% higher risk per 1-point increase). Among those with a HATCH score ≥4, the risk of NOAF was 4.01 (95%CI 3.85-4.16) per 100 patient-years (Log-rank P <0.001). The C-index for the HATCH score was moderate (0.60 [95%CI, 0.57-0.63]), which was better than the single criteria but comparative to other scoring systems.

CONCLUSION: In this elderly hospital-based Chinese population, the HATCH score had a moderate predictive ability for NOAF.

Introduction

Attributing to the aging population and accumulating comorbidities, the incidence of atrial fibrillation (AF) is surging, leading to significantly increased risks of ischemic stroke[1], heart failure (HF) [2], and mortality[3, 4]. Assessing individuals' risk of new-onset AF (NOAF) is critical for fulfilling primary prevention, making screening and early management strategies[5]. The HATCH score (hypertension [1 point], age >75 years [1 point], stroke or transient ischemic attack [2 points], chronic obstructive pulmonary disease [1 point], and heart failure [HF] [2 points>]) was primarily developed for assessing individuals' risk of AF progression from paroxysmal to persistent AF[6]. It has also shown the ability in predicting the risk of relapse after AF ablation procedure[7–13]. Recently, it has been demonstrated that the HATCH score could be used for predicting the development of NOAF among Asians[14, 15], patients with cancer[16], and those receiving thoracic or cardiac surgery[17–22].

However, the performance of the HATCH score in the elderly Chinese population has never been evaluated. Indeed, aging has been identified as a major risk factor for the development of AF[23, 24]. In the latest 2020 European Society of Cardiology (ESC) Guidelines for the management of AF, screening for AF was recommended among the elderly population. Whether the HATCH score be used for assessing the risk of AF among the elderly population has never been reported. In the present study, we aimed at evaluating the performance of the HATCH score in predicting NOAF in a hospital-based Chinese population.

Material And Methods

The elderly population (≥65 years) hospitalized in the XXX Hospital were identified and followed for the development of AF. XXX Hospital is the largest comprehensive medical institution in XX, XX, XX, providing medical services to over 2 million Outpatient visitors and nearly 200 thousand inpatients annually. Each hospitalized patient has a permanent and personal registration number allowing the documentation of all medical records of each hospitalization.

The electronic medical database was applied which included data about patient's general information, diagnosis, medical history, physical examination, laboratory results, imaging data, treatment, and outcomes of discharge, etc. The extracted diagnosis of each hospitalization was based on the International Classification of Disease, Ninth Revision (ICD-9) and Tenth Revision (ICD-10).

The studied population was restricted to inpatients discharged between 1 Jan 2001 and 1 Jan 2021. Only elderly patients (≥65 years) were eligible for this study. The calculation of the HATCH score was according to the original description[6]. The diagnosis of NOAF was the primary endpoint which was based on the results of electrocardiogram or 24h Holter, with at least 30 s of records showing heart rhythm with no discernible repeating P waves and irregular RR intervals. The diagnosis of diseases at baseline were according to the International Classification of Disease-10th vertion. Data were censored at the date of AF diagnosis or the date of the last follow-up.

This study was conducted in accordance with the Declaration of Helsinki. Since our project was a review of anonymized data from discharged patients, there was no requirement for the study to be approved by the XXX Hospital Ethics Committee.

Statistical analysis

Qualitative variables were described as counts and percentages, and continuous quantitative variables as means ± standard deviation. Comparisons were made using parametric or non-parametric tests as appropriate. The incidence of NOAF during follow-up was described with an incidence rate per 100 person-years. A proportional hazard model was established to identify independent risk factors associated with the development of NOAF. Only risk factors with a P-value <0.1 were included in the multivariable Cox regression analysis. The discriminative capability of risk models was evaluated using receiver operating characteristic (ROC) curves and Harrell's C-indexes (area under the curves, AUC). Comparisons of the accuracy for predicting outcomes were analyzed using the Delong test. The Kaplan-Meier curve analysis was used to compare the difference of AF-free survival between risk groups. In all analyses, a p-value <0.05 was considered statistically significant. All analyses were performed using SPSS (version 25.0).

Results

A total of 7,718 patients entered the study, among which 421 developed NOAF during 3.18 ± 3.73 years of follow-up, with an incidence of 1.71 (95% confidence interval [CI] 1.55-1.89) per 100 patient-years. The baseline characteristics of patients are shown in Table 1. Patients who developed NOAF were older, had higher prevalences of hypertension, coronary artery disease (CAD), chronic obstructive pulmonary disease (COPD), peripheral artery disease, hyperthyroidism, and heart failure (HF) (p <0.05 respectively) (Table 1). The HATCH and CHA_2DS_2-VASc scores were significantly higher in patients with NOAF (p <0.001, respectively) (Table 1).

Table 1
Baseline characteristics

Characteristics	Subjects without AF (n=7297)	Subjects developed AF (n=421)	*P*-value
Demographic variable			
Age, mean ± SD (y)	72.5 ± 5.7	73.6 ± 5.8	<0.001
Age ≥75	2299 (31.5)	156 (37.1)	0.017
Male sex, *No. (%)*	4547 (62.3)	280 (66.5)	0.084
Comorbidities, No. (%)			
Hypertension	2955 (40.5)	238 (56.5)	<0.001
Diabetes mellitus	1459 (20.0)	80 (19.0)	0.620
Coronary artery disease	1312 (18.0)	156 (37.1)	<0.001
Hyperlipidemia	661 (9.1)	46 (10.9)	0.196
COPD	198 (2.7)	23 (5.5)	0.001
Peripheral artery disease	1256 (17.2)	148 (35.2)	<0.001
Ischemic stroke	360 (4.9)	27 (6.4)	0.176
Anemia	164 (2.2)	10 (2.4)	0.864
Renal dysfunction	203 (2.8)	18 (4.3)	0.074
Hyperthyroidism	19 (0.3)	4 (1.0)	0.012
Heart failure	212 (2.9)	38 (9.0)	<0.001
Valvular disease	40 (0.5)	12 (2.9)	<0.001
Scoring systems			
HATCH	0.9 ± 1.0	1.3 ± 1.2	<0.001
CHA_2DS_2-VASc	2.6 ± 1.3	3.1 ± 1.4	<0.001

AF = atrial fibrillation; COPD = chronic obstructive pulmonary disease; IQR = interquartile range; SD = standard deviation; CHA_2DS_2-VASc score = congestive heart failure, hypertension, age ≥75 (doubled), diabetes, stroke (doubled), vascular disease, age 65-74, female.

Risk factors for incident AF

In the univariable regression analysis, multiple risk factors were associated with NOAF including age ≥75 years, hypertension, CAD, COPD, peripheral artery disease and HF (see Table 2). While, after adjustment with cofounders in the multivariable Cox regression model, independent risk factors for NOAF were hypertension (hazard ratio [HR] 1.51, 95%CI 1.23-1.85), COPD (HR 1.86, 95%CI 1.22-2.84) and HF (HR 1.82, 95%CI 1.28-2.59) (Table 2).

Table 2
Uni- and multivariable Cox regression analysis of risk factors for new-onset atrial fibrillation

Risk factors	Univariable analysis			Multivariable analysis		
	HR	**95% CI**	***p*-value**	**HR**	**95% CI**	***p*-value**
Age ≥75	1.32	1.08-1.61	0.006	1.20	0.98-1.46	0.077
Male sex, No. (%)	1.14	0.93-1.39`	0.208			
Hypertension	1.83	1.51-2.22	<0.001	**1.50**	**1.23-1.84**	**<0.001**
Diabetes mellitus	0.94	0.73-1.20	0.597			
CAD	2.23	1.83-2.72	<0.001	1.65	0.94-2.88	0.080
Hyperlipidemia	1.21	0.89-1.65	0.220			
COPD	2.07	1.36-3.16	<0.001	**1.86**	**1.22-2.84**	**0.004**
PAD	2.17	1.78-2.65	<0.001	1.07	0.61-1.88	0.816
Ischemic stroke	1.32	0.90-1.96	0.159			
Anemia	0.99	0.53-1.85	0.965			
Renal dysfunction	1.60	1.00-2.56	0.052	1.30	0.80-2.54	0.287
Hyperthyroidism	1.90	0.71-5.10	0.202			
Heart failure	2.79	2.00-3.89	<0.001	**1.78**	**1.25-2.53**	**0.001**

CAD = coronary artery disease; CI = confidence interval; COPD = chronic obstructive pulmonary disease; HR = hazard ratio; PAD = peripheral artery disease.

Performance of the HATCH score in predicting new-onset atrial fibrillation

The incidence of NOAF increased significantly with higher HATCH score (Table 3) with a 38% higher risk per 1-point increase. Among those with a HATCH score ≥4, the risk of NOAF was 4.01 (95%CI 3.85-4.16) per 100 patient-years. As is depicted in the K-M curves (Figure 1), patients with HATCH score ≥3 showed significantly lower non-AF survival rates compared to those with a HATCH score between 0-2 (Log-rank P <0.001). The HATCH score showed a C-index of 0.60 (95% CI 0.57-0.63), which was better than the single criteria of age (C-index 0.56), COPD (0.51]), hypertension (0.58) and HF (0.53). We have also compared the HATCH score with other scores showing capability for predicting incident AF. The results are showing in Table 4 and Figure 2.

Table 3
Risk of new-onset atrial fibrillation according to the HATCH score

HATCH score	No. of patients	Number of NOAF	Incidence and 95%CI
0	3024	98	1.01 (0.99-1.03)
1	3038	195	2.02 (1.99-2.05)
2	1088	65	1.87 (1.83-1.92)
3	365	37	3.33 (3.22-3.44)
≥4	203	26	4.01 (3.85-4.16)

CI=confidence interval; NOAF=new-onset atrial fibrillation.

Table 4
Comparison of the HATCH score and other scoring systems for incident atrial fibrillation

Scoring systems or risk factors	C-index	95% Confidence Interval	P-value*
HATCH	0.60	0.57-0.62	–
C2HEST	0.62	0.60-0.65	<0.001
HAVOC	0.65	0.62-0.68	<0.001
CHA2DS2-VASC	0.59	0.57-0.62	0.549
COPD	0.56	0.54-0.59	<0.001
Hypertension	0.58	0.56-0.60	0.067
Age	0.56	0.54-0.59	0.008
Heart failure	0.53	0.52-0.44	<0.001

* compared with the HATCH score; COPD: chronic obstructive pulmonary disease

Performance of the HATCH score in subgroups of patients

At baseline, there were 387 patients with previous ischemic stroke with a mean age of 74.4 ± 6.0 years. During follow-up, among those with ischemic stroke history, 27 individuals developed NOAF, with an incidence of 2.24 (95%CI 2.16-2.33) per 100 patient-years. The HATCH score had a C-index of 0.687 (95%CI 0.585-0.790) for predicting NOAF, which was numerically or significantly higher than those single criteria, such as age (0.595, 95%CI 0.486-0.703, Delong test P =0.010), hypertension (0.593, 95%CI 0.528-0.658, Delong test P =0.048), and HF (0.567, 95%CI 0.499-0.636, Delong test P =0.008). The HATCH score in other subgroups of patients is demonstrated in Table 5.

Table 5
Performance of the HATCH score in subgroups of patients

Subgroups	C-index	95% Confidence Interval	P-value
Male	0.584	0.550-0.618	<0.001
Female	0.632	0.586-0.678	<0.001
≥75 years	0.576	0.527-0.625	0.001
Diabetes mellitus	0.541	0.447-0.606	0.213
Renal dysfunction	0.514	0.369-0.659	0.846
Structural heart disease	0.490	0.330-0.650	0.898

Discussion

In this elderly hospital-based population, we found that NOAF was prevalent during follow-up. Independent risk factors for NOAF included hypertension and HF. The HATCH score showed moderate predictive accuracy for NOAF. Among subgroups of patients, such as those ≥75 years, with diabetes, renal dysfunction and structural heart disease, the performance of the HATCH score for predicting NOAF ranged from poor to moderate.

Multiple international guidelines and large-scale screening studies regarding AF have recommended or use age as the single criteria for making screening strategies[5, 25, 26]. However, with the surging number of the aging population, massive screening among the elderly is limited with cost-effectiveness. Considering that the elderly population generally represents a high-risk group for developing NOAF, stratifying this group of patients into diverse risk categories may help to identify those at real high risk or exclude those at low risk from unnecessary screening. In the present study, among the elderly population, the risk of NOAF was 1.71 per 100 patient-years which was higher than those from the community-based Yunnan Medical Insurance database, which was 0.28-0.77 per 100 patient-years in subjects aged ≥61 years[24]. In another Japanese cohort of male subjects, among the elderly population, the incidence was 2.58 (if body mass index <25 kg/m^2) and 5.53 (if body mass index ≥25 kg/m^2) per 100 patient-years[27], which was higher than the present study, probably due to the all-male gender in the Japanese cohort.

Risk factors for NOAF have been largely reported previously[28–35], which include aging, hypertension, HF, renal dysfunction, CAD, structural heart disease, obesity, etc. However, in the present study, we found that among elderly subjects, only hypertension and HF were independently related to the development of AF. The other underlying risk factors did not show significance after adjustment. This result could be attributed to the limited sample size and event rate in represent subgroups of patients. For example, age≥75 years (HR 1.21, P=0.059) and CAD (HR 1.71, P=0.060) are not too far away from showing statistical significance. On the other hand, this result demonstrated that well-controlled blood pressure and HF may be necessary for reducing cardiovascular events, including the development of AF.

Previously, the HATCH score has been developed for predicting AF progression from paroxysmal to persistent subtypes[6]. Lately, this score has also been validated to predict AF in diverse populations[14, 16, 17, 19–22]. The reason for the generalization application of this score is that the pathophysiology processes of AF development and AF progression share multiple common risk factors, such as HF and hypertension, etc. In the present study, the performance of the HATCH score was moderate. Compared with other risk scoring systems showing capability of predicting incident AF, the HATCH score was inferior to the C2HEST and the HAVOC scores, but superior to the CHA2DS2-VASc score. In subgroups of patients, the C-indexes ranged from 0.490 to 0.632. The relatively lower predictive accuracy may be due to unrelated compositions in the scoring system. For example, stroke and transient ischemic attack was not significantly related to AF development in some studies[24, 35, 36], but was enlisted as one of the major risk factors in the HATCH score with 2 points of weight[6]. The development of stroke/transient ischemic attack may reveal those underdiagnosed AF, but not a driven factor for the development of AF.

Strength and limitation

This is the first study assessing the performance of the HATCH score in an elderly hospital-based Chinese population in predicting NOAF. However, limitations exist in the present study. First, we did not have instrumental and biomarker-based variables which have been shown to have the ability for predicting AF. Thus, we could not test whether the addition of these markers could improve the performance of the HATCH score. Second, the relatively limited outcome events may be a major reason for the poor to moderate performance of the HATCH score, which merits further investigations in larger cohorts. Third, not all patients received systematic screening during hospitalization, which may lead to underdiagnosis of AF.

Conclusions

In an elderly hospital-based Chinese population, the HATCH score had a moderate predictive ability for NOAF which was better than the single criteria of hypertension, age and HF. Whether the HATCH score could be used for risk stratification of NOAF merits further studies.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Commette of XXX Hospital. All participant were consented.

Consent for publication

Not applicable

Availability of data and materials

The datasets generated and/or analyzed during the current study are available on request.

Competing interests

The authors declare that they have no competing interests.

Funding

This study was not funded.

Authors' contributions

HY Wu designed the study and wrote the manuscript. RZ Dai collected and analyzed the data. M Wang analyzed the data. CB Chen reviesed the manuscript.

Acknowledgements

Not applicable.

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Figures

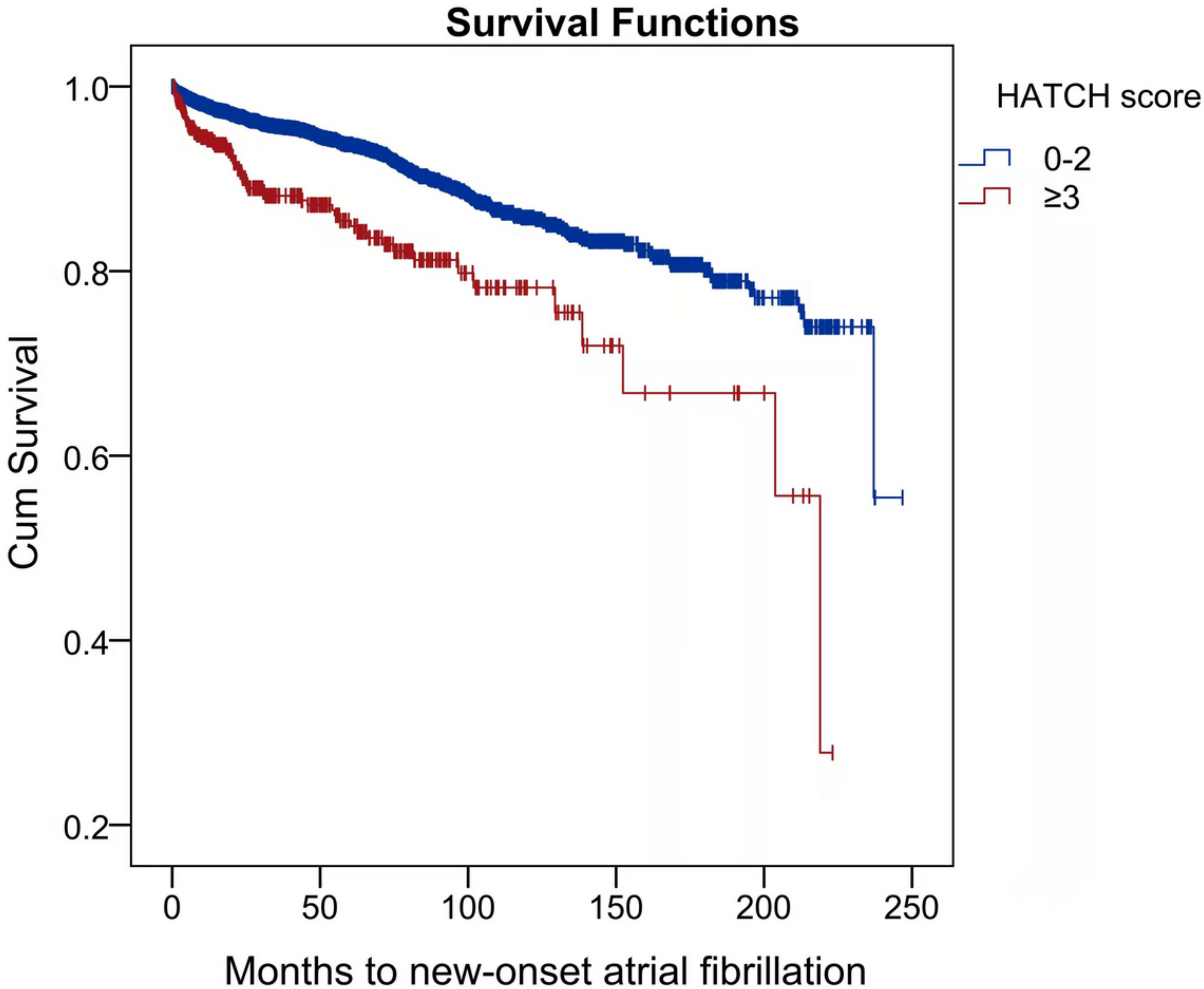

Figure 1

Survival rates of different HATCH score groups

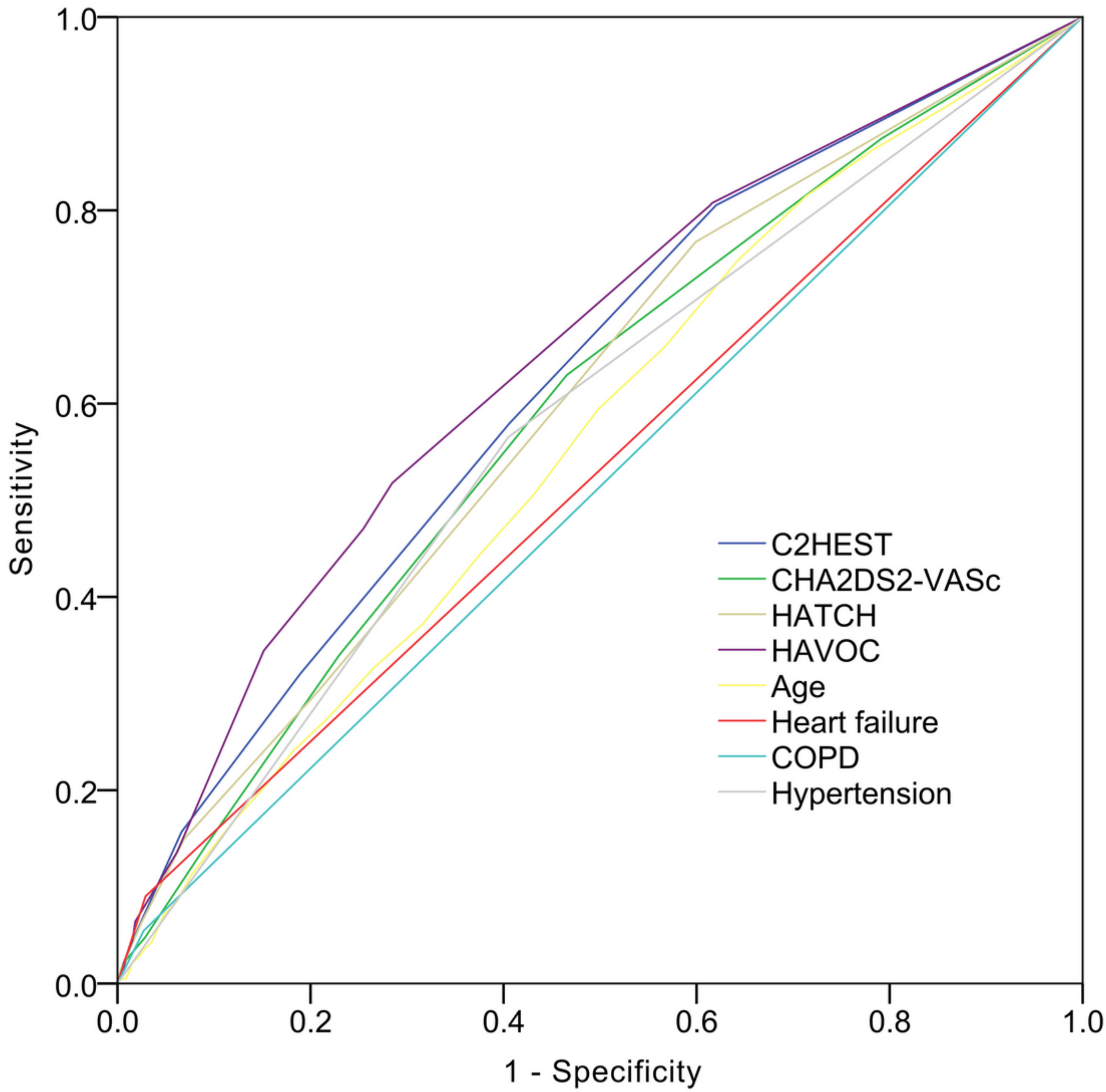

Figure 2

Comparison of C-indexes