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Usefulness of HATCH score in the prediction of new-onset atrial fibrillation for Asians

Kazuyoshi Suenari, MD[a,b], Tze-Fan Chao, MD[b,c,*], Chia-Jen Liu, MD[d,e], Yasuki Kihara, MD[a], Tzeng-Ji Chen, MD[f], Shih-Ann Chen, MD[b,c]

Abstract

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 <2 points>) was reported to be useful for predicting the progression of atrial fibrillation (AF) from paroxysmal to persistent or permanent AF for patients who participated in the Euro Heart Survey. The goal of the current study was to investigate whether the HATCH score was a useful scheme in predicting new-onset AF. Furthermore, we aimed to use the HATCH scoring system to estimate the individual risk in developing AF for patients with different comorbidities. We used the "Taiwan National Health Insurance Research Database." From January 1, 2000, to December 31, 2001, a total of 670,804 patients older than 20 years old and who had no history of cardiac arrhythmias were enrolled. According to the calculation rule of the HATCH score, 599,780 (score 0), 46,661 (score 1), 12,892 (score 2), 7456 (score 3), 2944 (score 4), 802 (score 5), 202 (score 6), and 67 (score 7) patients were studied and followed for the new onset of AF. During a follow-up of 9.0 ± 2.2 years, there were 9174 (1.4%) patients experiencing new-onset AF. The incidence of AF was 1.5 per 1000 patient-years. The incidence increased from 0.8 per 1000 patient-years for patients with a HATCH score of 0 to 57.3 per 1000 patient-years for those with a HATCH score of 7. After an adjustment for the gender and comorbidities, the hazard ratio (95% confidence interval) of each increment of the HATCH score in predicting AF was 2.059 (2.027–2.093; $P < 0.001$). The HATCH score was useful in risk estimation and stratification of new-onset AF.

Abbreviations: AF = atrial fibrillation, ARIC = atherosclerosis risk in communities, COPD = chronic obstructive pulmonary disease, FEV1 = forced expiratory volume in 1 second, NHIRD = National Health Insurance Research Database, TIA = transient ischemic attack.

Keywords: atrial fibrillation, HATCH score, incidence

1. Introduction

Atrial fibrillation (AF) is an important risk factor for the ischemic stroke, and the AF-related stroke has a worse prognosis and a higher recurrence rate compared with the non-AF-related stroke.[1] It has been believed that AF was revealed as a paroxysmal state and then became sustained as a persistent state.[2] Recently, de Vos et al[3] reported the useful predicting factors of progression from paroxysmal to persistent as a HATCH score (hypertension <1 point>, age >75 years <1 point>, transient ischemic attack [TIA] or stroke <2 points>, chronic obstructive pulmonary disease [COPD] <1 point>, and heart failure <2 points>) in AF patients who participated in the Euro Heart Survey. The progressive mechanism is considered due to the electrical and structural remodeling of the atria based on those risk factors. However, the scoring system for predicting the new-onset of AF has not been well established. Since the risk factors of new-onset of AF could be close to the progression of AF from paroxysmal to persistent, we investigated whether the HATCH score was a useful scheme in predicting new-onset of AF using a large cohort in Taiwan. Furthermore, we aimed to use the HATCH scoring system to estimate the individual risk in developing AF for patients with different comorbidities.

2. Methods

The study design and methodology of the present study are similar to our previous studies.[4–12] This retrospective study used the National Health Insurance Research Database (NHIRD) of the Taiwan National Health Research Institutes. The National Health Insurance (NHI) system is a mandatory universal health insurance program that offers comprehensive medical care coverage to all Taiwanese residents. The NHIRD was a cohort dataset which contained all the medical claims data for 1,000,000 beneficiaries, who were randomly sampled from the 23 million enrollees under the NHI program. In this cohort dataset, the

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[a] Department of Cardiovascular Medicine, Hiroshima University Graduate School of Biomedical Sciences, Hiroshima, Japan., [b] Division of Cardiology, Department of Medicine, Taipei Veterans General Hospital, [c] Institute of Clinical Medicine, and Cardiovascular Research Center, National Yang-Ming University, [d] Division of Hematology and Oncology, Department of Medicine, Taipei Veterans General Hospital, [e] Institute of Public Health and School of Medicine, National Yang-Ming University, [f] Department of Family Medicine, Taipei Veterans General Hospital, Taipei, Taiwan.

[*] Correspondence: Tze-Fan Chao, Division of Cardiology, Department of Medicine, Taipei Veterans General Hospital, Shih-Pai Road, Taipei, Taiwan (e-mail: eyckeyck@gmail.com); Chia-Jen Liu, Division of Hematology and Oncology, Department of Medicine, Taipei Veterans General Hospital, Taipei, Taiwan (e-mail: chiajenliu@gmail.com).

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patients' original identification numbers have been encrypted to protect their privacy, but the encrypting procedure was consistent, so that a linkage of the claims belonging to the same patient was feasible within the NHI database and can be followed continuously. The large database provided a good opportunity to study the usefulness of the HATCH score in predicting new-onset AF.

The HATCH score was calculated for each patient based on a point system (2 points for either a history of TIA/stroke or heart failure, respectively; 1 point for hypertension, age >75 years, or COPD, respectively). Information about important comorbid conditions of each individual was retrieved from the medical claims based on the International Classification of Diseases-Ninth Revision-Clinical Modification (ICD-9-CM) codes. We defined patients with a certain disease only when it was a discharge diagnosis or confirmed more than twice in an outpatient department. The diagnostic accuracies of important comorbidities in Taiwan NHIRD, such as hypertension, diabetes mellitus, heart failure, myocardial infarction, hyperlipidemia, and chronic obstructive pulmonary disease, have been validated before.[13,14]

2.1. Study cohort and clinical endpoint

From January 1, 2000, to December 31, 2011, a total of 670,804 patients older than 20 years and who had no history of cardiac arrhythmias were identified from the Taiwan NHIRD. The HATCH score was calculated for every patient. Finally, 599,780 (score 0), 46,661 (score 1), 12,892 (score 2), 7456 (score 3), 2944 (score 4), 802 (score 5), 202 (score 6), and 67 (score 7) patients were studied and followed for the occurrences of AF. A flowchart of the study enrollment is shown in Fig. 1.

The clinical endpoint was the occurrence of new-onset AF (ICD-9-CM code 427.31) during the follow-up period. To ensure the accuracy of diagnosis, we defined patients as having AF only when it was a discharge diagnosis or confirmed more than twice in the outpatient department.[15] The diagnostic accuracy of AF using definition in NHIRD has been validated previously.[16,17]

2.2. Statistical analysis

Data were presented as the mean ± SD for continuous variables and proportions for categorical variables. An unpaired 2-tailed Student's *t* test was used for the analysis of continuous variables, and the differences between nominal variables were compared by the chi-square test. The incidence rate of new-onset of AF was calculated by dividing the number of events by person-time at risk with the 95% confidence interval (CI) estimated by exact binomial probabilities. The risk of incidence of AF was assessed using the Cox regression analysis. Statistical significance was set at $P<0.05$, and all statistical analyses were carried out by using SPSS 17.0 (SPSS, Chicago, IL).The present study was approved by the Institutional Review Board (IRB) at Taipei Veterans General Hospital, Taipei, Taiwan.

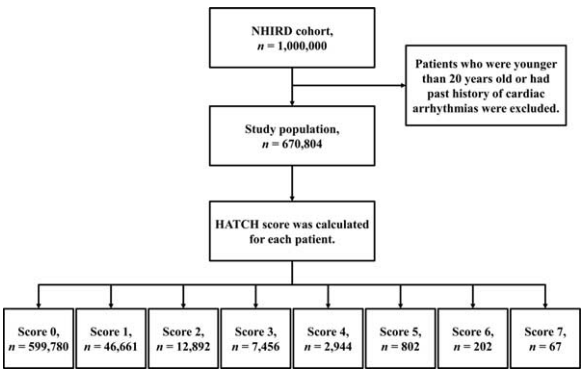


Figure 1. The flowchart of the enrollment of the study patients.

Table 1

Baseline characteristics of the patients (n = 670,804).

Variables	Study population, n = 670,804
Age, y	42.4 ± 16.0
Age ≥ 75 y old, n (%)	29,891 (4.5%)
Gender (male), n (%)	341,157 (50.9%)
Underlying diseases, n (%)	
Hypertension	36,781 (5.5%)
Previous stroke/transient ischemic attack	12,456 (1.9%)
Chronic obstructive pulmonary disease	14,918 (2.2%)
Congestive heart failure	2889 (0.4%)
Diabetes mellitus	21,739 (3.2%)
Coronary artery disease	13,601 (2.0%)
End-stage renal disease	2356 (0.4%)
Malignancy	5858 (0.9%)
HATCH score, n (%)	
Score = 0	599,780 (89.4%)
Score = 1	46,661 (7.0%)
Score = 2	12,892 (1.9%)
Score = 3	7456 (1.1%)
Score = 4	2944 (0.4%)
Score = 5	802 (0.1%)
Score = 6	202 (< 0.1%)
Score = 7	67 (< 0.1%)

3. Results

The age, percentage of each risk factor, and HATCH score of the study patients are shown in Table 1. The mean ages were 42.4 ± 16.0 years, and most of the patients (89.4%) have a HATCH score 0.

During a follow-up of 9.0 ± 2.2 years, there were 9174 (1.4%) patients experiencing new-onset AF. The overall incidence of AF was 1.5 per 1000 patient-years. The incidence rate increased from 0.8 per 1000 patient-years for patients with a HATCH score of 0 to 57.3 per 1000 patient-years for those with a HATCH score of 7 (Table 2 and Fig. 2).

Table 2

Incidence of new-onset AF in patients with different HATCH scores.

HATCH score	Number of patients (n = 670,804)	Number of new onset AF (n = 9,174)	Person-years	Incidence*
0	599,780	4418	5,482,841	0.8
1	46,661	2772	381,590	7.3
2	12,892	971	98,518	9.9
3	7456	565	53,860	10.5
4	2944	313	17,382	18.0
5	802	90	4393	20.5
6	202	32	992	32.3
7	67	13	227	57.3

AF = atrial fibrillation.
* AF cases per 1000 person-years of follow up.

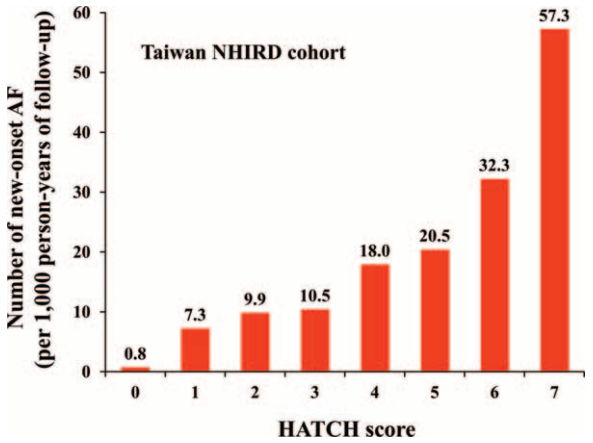
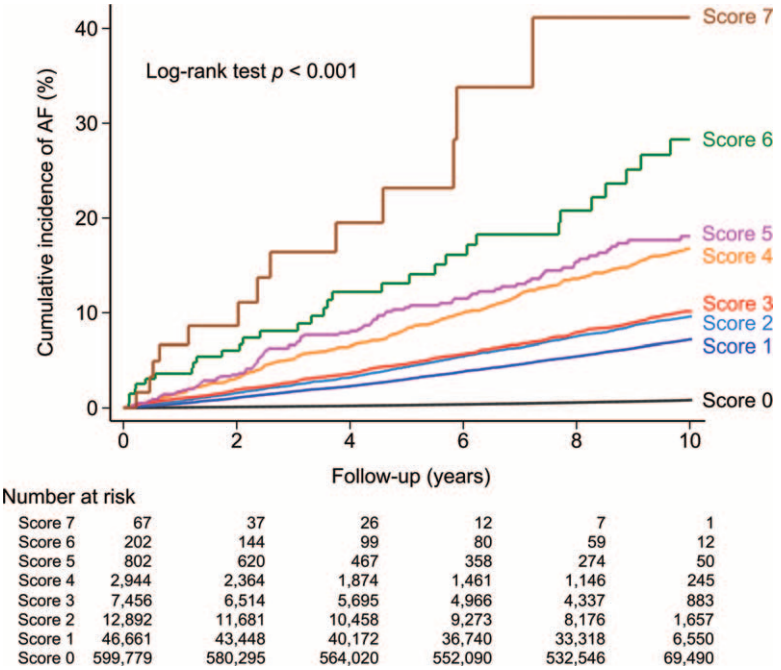


Figure 2. Incidence of new-onset AF in patients with different HATCH scores. AF = atrial fibrillation.

Figure 3 shows that the cumulative incidence curves of AF for patients with different HATCH scores. It demonstrated that patients with higher HATCH scores were associated with a higher rate of new-onset AF during the follow-up period. After an adjustment for the gender and comorbidities other than the components of the HATCH scoring system (diabetes mellitus, coronary artery disease, end-stage renal disease, and malignancy) in the multivariate regression analysis, the hazard ratio (95% confidence interval) of each increment of the HATCH score in predicting AF was 2.059 (2.027–2.093; P <0.001). The relative risk of the development of AF in each group of patients with different HATCH scores compared to those with a HATCH score of 0 represented by hazard ratios is shown in Table 3 and Fig. 4. The c-index on the basis of area under the receiver operating characteristic curve for the HATCH score in predicting new-onset AF was 0.716 (95% confidence interval = 0.710–0.723, P value < 0.001).



Number at risk

Score 7	67	37	26	12	7	1
Score 6	202	144	99	80	59	12
Score 5	802	620	467	358	274	50
Score 4	2,944	2,364	1,874	1,461	1,146	245
Score 3	7,456	6,514	5,695	4,966	4,337	883
Score 2	12,892	11,681	10,458	9,273	8,176	1,657
Score 1	46,661	43,448	40,172	36,740	33,318	6,550
Score 0	599,779	580,295	564,020	552,090	532,546	69,490

Figure 3. The cumulative incidence curves with a log-rank test demonstrated that patients with higher HATCH scores were associated with a higher rate of new-onset AF during the follow-up period. AF = atrial fibrillation.

Table 3

Hazard ratio of new onset AF in patients with different HATCH scores in comparison to the patients with a HATCH score of zero.

HATCH score	Number of patients (n = 670,804)	Number of new onset AF (n = 9174)	Hazard ratio*	95% CI	*P*
0	599,780	4418	1	–	–
1	46,661	2772	8.338	7.933–8.763	<0.001
2	12,892	971	10.900	10.138–11.719	<0.001
3	7456	565	11.166	10.191–12.235	<0.001
4	2944	313	19.126	16.980–21.542	<0.001
5	802	90	20.645	16.696–25.529	<0.001
6	202	32	32.797	23.104–46.556	<0.001
7	67	13	55.426	32.067–95.801	<0.001

AF = atrial fibrillation.

* The HATCH score was adjusted for the gender and co-morbidities other than the components of the HATCH scoring system (diabetes mellitus, coronary artery disease, end-stage renal disease, and malignancy) in the multivariate regression analysis.

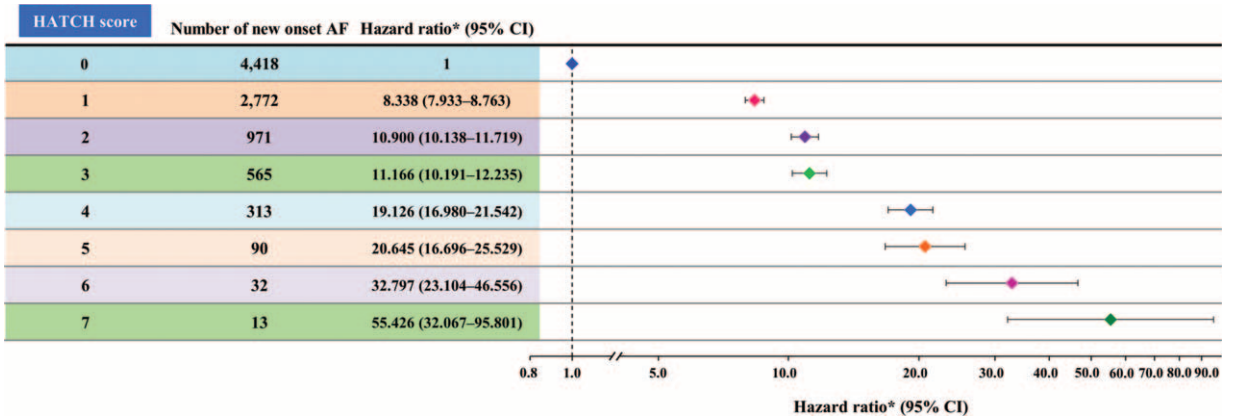


Figure 4. Risk of new-onset AF in patients with different HATCH scores. AF = atrial fibrillation.

4. Discussion

The present study is the first large-scale nationwide population-based investigation analyzing the risk of new-onset of AF stratified by the HATCH score. We demonstrated that the overall incidence rate of AF was 1.5 per 1000 patient-years in Taiwan, and the HATCH score could be used to estimate the individual risk of new-onset AF for patients with different comorbidities.

4.1. HATCH score and risk of incident AF

It is well known that an abnormally rapid firing from the pulmonary veins can trigger and initiate AF.[18,19] Moreover, an arrhythmogenic atrial substrate could be related to AF maintenance rotor with the generation of wave splitting and stabilized re-entry.[20] The AF substrate can result from the electrical and structural remodeling due to an aging effect and several systemic diseases such as hypertension and heart failure.[21,22] Therefore, AF might easily occur and become perpetuated without self-termination to SR among patients having a high HATCH score.

COPD, a pulmonary rather than cardiovascular disorder, represents a unique component of the HATCH scheme. AF and COPD frequently coexist and complicate treatment of both conditions. Previous researches reported that COPD had been present in more than one-tenth of the patients with AF and were associated with increased mortality and incidence of major adverse events.[23–25] Recent studies have demonstrated that reduced forced expiratory volume in 1 second (FEV1) and obstructive respiratory disease were associated with an increased risk of incident AF.[26,27] Li et al[26] analyzed the data of 15,004 middle-aged subjects enrolled in the Atherosclerosis Risk in Communities (ARIC) cohort study; the rate of incident AF was inversely associated with FEV1. There were several possible mechanisms which may explain for the relationship between COPD and AF. Impaired lung function could trigger ectopic beats by deterioration of gas composition and pulmonary hypertension,[28] resulting in elevated atrial pressure and altering the electrophysiological properties of atrial tissues, which in turn trigger AF.[29] Besides, hypercapnia, which was not uncommon in COPD patients, could alter atrial electrophysiology and increase the vulnerability to AF.[30]

4.2. Clinical applications

Although the reported incidence and prevalence of AF is lower in Asians than Caucasians,[31,32] Asia has a higher overall disease burden because of its proportionally larger aged population.[33] For example, on the basis of reported age-adjusted prevalence rates and projected population figures in China, there will be an estimated 5.2 million men and 3.1 million women with AF older than 60 years by year 2050.[33] Therefore, how to estimate the risk of incidental AF among Asians is an important issue. There were several scoring schemes which have been proposed to predict the risk of new-onset AF.[34,35] However, the data from which these clinical risk stratification schemes derive were acquired in cohorts, which mainly consisted of Caucasian patients, such as ARIC and Framingham Heart Studies. In the present study, we showed that an easily calculated clinical scheme, the HATCH score, can be used to estimate the individual risk of incidental AF for patients with different comorbidities. As contrasted with the HATCH score, both of $CHADS_2$ and CHA_2DS_2-VASc scores include a diabetes mellitus (DM).[7] Several studies show that type 2 DM could play an important role of AF induction and maintenance[22,36] and lead to cerebrovascular complications due to even brief episodes of AF.[37] Moreover, patients with chronic heart failure (CHF) are also reported to have a potential of having subclinical AF.[38] Therefore, DM and CHF patients with cryptogenic stroke and transient ischemic attack who showed high risk of new onset of AF based on the HATCH score should be strongly considered to implant a continuous monitoring device for detecting subclinical AF. The c-index on the basis of area under the receiver operating characteristic curve of HATCH score in predicting new-onset AF (0.716) was similar to, but slightly higher than that of, the $CHADS_2$ score (c-index = 0.713) reported in the previous publication.[5] Furthermore, when patients having a high HATCH score without previously documented AF exhibit acute stroke, we may have to survey for "subclinical" AF more aggressively to reduce the risk of recurrent ischemic events through the use of oral anticoagulants.

4.3. Study limitations

There were several limitations of the present study. First, the diagnosis of AF was based on the diagnostic codes registered by the physicians responsible for the treatments of patients, and was not further checked externally. However, the accuracy of diagnosis of AF in Taiwan's NHIRD has been previously well validated.[16,39] Second, the present study only enrolled Taiwanese patients, and whether the results can be extrapolated to other populations remains uncertain. A further prospective study is necessary to confirm the results of our study.

5. Conclusions

The HATCH score which consisted of an age >75 and several clinical risk factors was useful for the risk estimation and stratification of the development of AF.

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