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Prevalence of atrial fibrillation and its risk factors in rural China: A cross-sectional study

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ABSTRACT

Objectives: To evaluate the prevalence of atrial fibrillation (AF) in physical laborers in rural China and identify contributing risk factors.
Methods: A cross-sectional study of 11,956 permanent residents of Liaoning Province in rural China ≥ 35 y of age (primarily physical laborers) was conducted between January and August 2013 (response rate 85.3%). All participants completed a questionnaire and underwent a physical exam, echocardiography and electrocardiography. Blood samples were drawn for laboratory analyses, and AF was diagnosed on the basis of history and electrocardiograph findings. Risk factors for AF were evaluated with a stepwise logistic regression analysis.
Results: The prevalence of AF was 1.2% overall, but rose steeply with age (0.1% in those 35–44 y of age, and 4.6% in those ≥ 75 y); there was no significant gender difference at any age. Independent risk factors for AF were age (odds ratio [OR] 1.89; $P < 0.001$), diabetes (OR 2.07; $P = 0.001$), history of myocardial infarction (OR 5.91; $P < 0.001$), low left ventricular ejection fraction (OR 1.85; $P = 0.005$), and low physical activity (OR 1.72; $P = 0.003$), whereas obesity, hypertension, cholesterol and triglyceride levels, current smoking and drinking, left ventricular hypertrophy, and family history of AF were not significant contributors.
Conclusions: Although the prevalence of AF in physical labors in rural China is low, age, diabetes, history of myocardial infarction, low left ventricular ejection fraction, and low physical activity are independent risk factors.

1. Introduction

Atrial fibrillation (AF) is the most common, sustained cardiac arrhythmia in clinical practice, and its prevalence increases with advancing age [1]. The Framingham Heart Study and other investigations have identified advancing age, male sex, hypertension, diabetes mellitus, obesity, heart failure, valve disease, myocardial infarction (MI), and alcohol consumption as major risk factors for AF [2–5]. The prevalence of AF is likely to increase dramatically along with the continually aging population, though improvements in cardiovascular therapies and diagnostic techniques will increase their survival [1,6,7]. AF is an independent risk factor for stroke and is also associated with an increased long-term risk of heart failure, overall mortality, and mortality from cardiovascular disease [8,9]. The prevalence of stroke caused by AF increases from 1.5% for those 50–59 y of age to 23.5% for those 80–89 y [10].

African-Americans and Asians have a lower prevalence of electrocardiogram (ECG)-confirmed AF than Caucasians [11], and racial factors are thought to influence the development of AF. Only a few epidemiologic studies have established the prevalence of AF in China [12–15], though none of these studies were conducted in Liaoning Province, and most of the data were obtained from China's household registration system. As a result, these reports do not reflect the prevalence of AF in the general population of rural China, where most people are physical laborers engaged in heavy manual work. Thus, the purpose of this study was to determine the prevalence of AF in this rural population, and identify contributing risk factors.

2. Patients and methods

2.1. Study population

From January 2013 to August 2013, a representative sample of men and women in rural areas of Liaoning Province was evaluated for the presence of cardiovascular risk factors using a multi-stage, randomly stratified, cluster-sampling scheme. Three counties (Dawa, Zhangwu, and Liaoyang) were selected from the eastern, southern, and northern regions of Liaoning Province, where most of the residents are physical laborers. One township near a city in each county was randomly selected for a total of three townships, and six to eight villages from each township were randomly selected for a total of 26 rural villages. Those who were pregnant, had cancer or mental disorders were excluded from the study.

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All the eligible permanent residents ≥ 35 y of age from each village ($n = 14,016$) were invited to participate, of which 11,956 (85.3%) completed the study. The study was approved by the Ethics Committee of China Medical University in Shenyang, China, and all procedures were performed in accordance with its ethical standards. Written consent was obtained from all participants after they had been informed of the study's objectives, benefits, medical procedures and confidentiality safeguards for personal information. If the participants were illiterate, we obtained written informed consent from their proxies.

2.2. Data collection and measurement

Data were collected during a single clinic visit by cardiologists and trained nurses using a standard questionnaire in a face-to-face interview. All potential investigators received training on the purpose of the study, how to administer the questionnaire, the standard methods of measurement, the importance of standardization, and study procedures. Only those who had a perfect score on a test administered after the training could become investigators. Further instruction and support were provided to the investigators during data collection.

Data on demographic characteristics, medical history of AF, MI, hypertension, diabetes mellitus, lifestyle risk factors, and familial history of AF were obtained from a standardized questionnaire during the interview with the participating investigator. There was a central steering committee with a subcommittee for quality control to ensure that all data were collected according to well-known standards.

According to the American Heart Association, blood pressure (BP) should be measured three times at two-minute intervals after at least 5 min of rest using a standardized automatic electronic sphygmomanometer (HEM-907; Omron, Kyoto, Japan). Two doctors calibrated the Omron device every month using a standard mercury sphygmomanometer according to the British Hypertension Society protocol [16]. The participants were advised to avoid caffeinated beverages and exercise for ≥ 30 min before the measurement. During the measurement, the participants were seated with their arms supported at the level of their hearts. The mean of three measurements was calculated and used in all analyses.

Weight and height were measured to the nearest 0.1 kg and 0.1 cm, respectively, with the participants in lightweight clothing and without shoes. The body mass index (BMI) was calculated as weight in kilograms divided by the square of the height in meters.

Fasting blood samples were collected in the morning after at least 8 h of fasting for all participants. Blood samples were obtained from an antecubital vein using BD Vacutainer tubes containing EDTA (Becton, Dickinson and Co., Franklin Lakes, NJ, USA). Serum was subsequently isolated from whole blood, and all serum samples were frozen at −20 °C for testing at a central, certified laboratory. Fasting plasma glucose, total cholesterol (TC), triglycerides (TG) and other routine blood biochemical indices were analyzed enzymatically on an auto-analyzer (Olympus AU640 Auto-Analyzer; Olympus Corp., Kobe, Japan).

Twelve-lead ECGs (resting, 10 s) were performed on all participants by well-trained cardiologists using a MAC 5500 (GE Healthcare; Little Chalfont, Buckinghamshire, UK) and analyzed automatically by the MUSE Cardiology Information System, version 7.0.0 (GE Healthcare). ECG-based AF diagnoses were confirmed by at least two independent cardiologists.

Echocardiograms were obtained using a commercially available Doppler echocardiograph (Vivid; GE Healthcare) with a 3.0-MHz transducer. The transthoracic echocardiogram included M-mode, two-dimensional, spectral and color Doppler with subjects in the supine position. Echocardiogram analyses and readings were performed by three doctors specialized in echocardiography, and two other specialists were called in if questions or uncertainty arose. Measurements were performed according to the recommendations of the American Society of Echocardiography. M-mode images were used to measure and calculate the left ventricular ejection fraction (LVEF) [17].

2.3. Definitions

AF was diagnosed based on previous history (diagnosed by a physician) and/or ECG findings (absence of consistent P waves, presence of rapid, irregular f waves with a frequency of 350–600 beats/min, and an irregular ventricular response). Left ventricular systolic dysfunction was defined as LVEF < 0.5 based on M-mode echocardiography. Hypertension was defined as a systolic BP ≥ 140 mm Hg and/or diastolic BP ≥ 90 mm Hg and/or the use of antihypertensive medications according to the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC-7) Guidelines [18]. World Health Organization criteria were followed for defining obesity (BMI ≥ 30 kg/m^2) [19] and diabetes mellitus (fasting blood glucose ≥ 7.0 mmol/L or 126 mg/dL, and/or being on treatment for diabetes) [20]. Our standards for dyslipidemia came from the Third Report of the National Cholesterol Education Program Adult Treatment Panel III [21]. High TC was defined as ≥ 6.21 mmol/L (240 mg/dL), and high TG was defined as ≥ 2.26 mmol/L (200 mg/dL). ECG-left ventricular hypertrophy (LVH) was defined as equal voltage × QRS duration product: (RaVL + SV3) × QRS duration > 2440 mm * ms for men and (RaVL + SV3 + 8 mm) × QRS duration > 2440 mm * ms for women according to the Cornell Criteria [22].

Physical activity included occupational and leisure-time physical activity; a detailed description of these standards has been presented elsewhere [23]. Occupational physical activity was defined as light (sitting office work, e.g., secretary), moderate (standing and walking, e.g., store clerk), and active (walking, lifting, and heavy manual labor, e.g., industrial and farm work). Self-reported leisure-time physical activity was defined as low (almost completely inactive, e.g., reading, watching TV, or minor physical effort), moderate (>4 h/week of walking, cycling, etc.), or high (vigorous physical activity > 3 h/week, such as running, skiing, or a competitive sport). The combination of occupational and leisure-time physical activity was therefore described as low (light levels of activity in both categories), moderate (moderate or high levels of activity in one of the categories), or high (moderate or high levels of activity in both categories).

2.4. Statistical analysis

All statistical analyses were conducted with SPSS 17.0 statistical software (SPSS, Inc., Chicago, IL, USA). Differences between groups were compared using a two-tailed Student's *t*-test for continuous variables and a χ^2 test for categorical variables. Factor-specific prevalence values were calculated for all factors. Univariate and stepwise multivariate logistic regression analyses were performed to evaluate the association between selected risk factors and AF. Data are presented as odds ratio (OR) and 95% confidence interval (CI), mean ± standard deviation, or frequency and percentages; a $P < 0.05$ was considered as statistically significant.

3. Results

3.1. Characteristics of the study population

Of the 11,956 willing participants, 615 had incomplete data and were excluded; therefore the study population was comprised of 5172 men and 6169 women with a mean age of 53.8 y. The subjects with AF ($n = 139$) were significantly older and had significantly higher systolic and diastolic BPs and ventricular beat rates than those without AF (all *P*s < 0.05) (Table 1). In addition, the subjects with AF had significantly higher prevalences of diabetes, hypertension, history of MI, and lower LVEF, ECG-LVH, and levels of physical activity (all *P*s < 0.05). However, there were no significant differences in TC, TG, BMI, smoking status, gender, or familial history of AF between the two groups.

3.2. AF prevalence in the study population

The prevalence of AF was 1.2% (139/11,341) (95% CI, 1.0–1.4). The prevalence rose steeply with advancing age in men and women; the highest prevalence of 4.6% (4.8% for men and 4.4% for women) was in

Table 1
Characteristics of the study population.

Variable	Without AF ($n = 11,202$)	With AF ($n = 139$)	*P*
Age, y	53.7 ± 10.5	63.3 ± 9.4	<0.001
Male	5108 (45.6)	64 (46.0)	0.917
BMI, kg/m^2	24.8 ± 3.7	24.9 ± 3.7	0.836
SBP, mm Hg	141.7 ± 23.5	147.7 ± 24.0	0.003
DBP, mm Hg	82.0 ± 11.7	86.2 ± 14.5	0.001
PP, mm Hg	59.7 ± 17.4	61.5 ± 19.5	0.286
FBG, mmol/L	5.89 ± 1.62	6.40 ± 2.18	0.007
TC, mmol/L	5.23 ± 1.09	5.33 ± 1.19	0.286
TG, mmol/L	1.64 ± 1.51	1.56 ± 0.90	0.536
Current smoker	3940 (35.2)	41 (29.5)	0.163
Current drinker	2504 (22.4)	21 (15.1)	0.041
Physical activity			<0.001
Low	3279 (29.3)	75 (54.0)	
Moderate	7290 (65.1)	58 (41.7)	
High	633 (5.7)	6 (4.3)	
Diabetes	1137 (10.1)	34 (24.5)	<0.001
Hypertension	5696 (50.8)	99 (71.2)	<0.001
Myocardial infarction	116 (1.0)	15 (10.8)	<0.001
Family history of AF	336 (3.0)	8 (5.8)	0.074
LVEF < 0.5	1242 (11.5)	28 (20.9)	0.001
Heart rate, bpm	71.6 ± 12.2	86.7 ± 22.7	<0.001
ECG-LVH	993 (8.9)	117 (15.8)	0.004

Abbreviations: AF = atrial fibrillation; BMI = body mass index; DBP = diastolic blood pressure; ECG-LVH = left ventricular hypertrophy detected by electrocardiography; FBG = fasting blood glucose; LVEF = left ventricular ejection fraction; PP = pulse pressure; SBP = systolic blood pressure; TC = total cholesterol; TG = triglycerides.
Note: Data are presented as mean ± standard deviation or *n* (%).