

Prevalence of Atrial Fibrillation in Middle-Aged People in Korea: The Korean Genome and Epidemiology Study

Kwang-Soo Lee, PhD¹, Sun-Ja Choi, MPH¹, Sung-Hee Park, PhD¹,
Hyung-Lae Kim, MD², Haesook Min, MS² and Hyun-Young Park, MD¹

¹Division of Cardiovascular and Rare Diseases, Center for Biomedical Sciences,

²Division of Epidemiology and Health Index, Center for Genome Sciences, National Institute of Health, Seoul, Korea

ABSTRACT

Background and Objectives: The prevalence of atrial fibrillation (AF), the most common sustained arrhythmia, is expected to rise with the aging population, but very few studies have reported on the prevalence and risk factors of AF in Korea. **Subjects and Methods:** We analyzed 10,012 Korean adults (4,750 men and 5,262 women), 40-69 years old, who were enrolled in the Korean Genome and Epidemiology Study. AF was diagnosed by single electrocardiogram recording in a baseline survey (2001-2003). **Results:** The estimated prevalence of AF was 0.4% {95% confidence interval (CI), 0.28-0.52} in adults 40-69 years old, and increased to 1.0% in individuals 60-69 years old. The prevalence rate for men (0.6%) was higher than for women (0.2%) across all age groups. In multiple logistic regression analysis, AF was significantly associated with old age {odds ratio (OR), 8.15; 95% CI, 3.06-21.71}, male gender (OR, 4.04; 95% CI, 1.90-8.61), diabetes mellitus (OR, 2.15; 95% CI, 1.05-4.44), and congestive heart failure (OR, 14.11; 95% CI, 2.56-77.70). Obesity, however, did not show an association with AF. **Conclusion:** The prevalence of AF in Korean adults aged 40-69 years is approximately 0.4%, lower than that in Western populations. Age, male gender, diabetes, and heart failure are associated with AF. Further research in a larger population is necessary to verify for our results. (*Korean Circ J* 2008;38:601-605)

KEY WORDS: Atrial fibrillation; Prevalence; Korea.

Introduction

Atrial fibrillation (AF) is the most common sustained arrhythmia and is generally characterized by a rapid and irregular heartbeat. During AF, atrial activity is inefficient, and blood may stagnate in the atria, promoting clot formation.¹⁾ Thus, AF increases the risk of stroke four- to five-fold and is responsible for approximately 15% of all strokes.^{2,3)}

Stroke is the second leading cause of death in Korea. The mortality rate due to ischemic and hemorrhagic stroke per 100,000 people is 61.4 person-years, second only to cancer (134.8 person-years).⁴⁾ In a study on stroke risk prediction in subjects aged 55-84 years, the 10-year incidence among Korean men was 9.51%, which is similar to data on men from the United States, but Korean women had a higher incidence rate (8.98%)

than United States (US) women (6.5%).⁵⁾

To date, many studies have reported multiple risk factors for AF.^{6,7)} Aging is an important cardiovascular risk factor and plays a role in the development of AF. The prevalence of AF is about 3.8% in individuals over 60 years of age, but reaches approximately 9% in those over 80 in the United States.⁸⁾ Obesity is an independent risk factor for AF, and is associated with increased left atrium size, which is also a risk factor for AF.^{9,10)} The risk of new-onset AF is 3-4% higher per unit increase in body mass index (BMI).¹¹⁾ In the Framingham Study, the adjusted hazard ratio of incident AF was about 1.5 for people who were obese irrespective of gender.¹²⁾ Thus, the rising incidence of AF could result in part from the current obesity pandemic.

As Western countries and Korea are confronted with aging populations and an increasing prevalence of obesity, the number of patients with AF is expected to rise sharply over the next 50 years. Thus estimating the prevalence of AF in Korea is important because only a few such studies have been conducted. The purpose of this study was to estimate AF prevalence and risk factors in Korea.

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Correspondence: Hyun-Young Park, MD, Division of Cardiovascular and Rare Diseases, Center for Biomedical Sciences, National Institute of Health, 194 Tongil-ro, Eunpyeong-gu, Seoul 122-701, Korea
Tel: 82-2-380-1534, Fax: 82-2-388-0924

E-mail: hypark65@nih.go.kr

Subjects and Methods

Study population

The Korean Genome and Epidemiology Study, a community-based prospective cohort study, started in 2001 with the support of the Korean National Institute of Health; the detailed sampling strategy is described in previous reports.^{13,14} In total, 10,038 subjects, 40-69 years old, were enrolled in an urban (Ansan) and a rural (Anseong) area in Gyeonggi Province, Republic of Korea. After excluding 26 subjects with incomplete data, 10,012 individuals (4,750 men and 5,262 women) were enrolled in this study. The study protocol was approved by the institutional review committee and informed consent was obtained from all subjects.

Baseline examinations

A baseline survey was performed between May, 2001, and February, 2003. Information was collected about medical history and behavioral characteristics by trained interviewers. Blood samples were taken after an overnight fast (8-14 hours), and biochemical assays including plasma glucose were done by a commercial laboratory (Seoul Clinical Laboratories, Seoul, Republic of Korea).

Hypertension was defined as systolic blood pressure (SBP) ≥ 140 mmHg, diastolic blood pressure (DBP) ≥ 90 mmHg, or the use of antihypertensive medications. Criteria for diabetes mellitus were a fasting plasma glucose (FPG) ≥ 126 mg/dL or an oral glucose tolerance test (OGTT) at 2 hours (2hPG) ≥ 200 mg/dL, or use of insulin or other medications to treat hyperglycemia. Obesity was defined as BMI ≥ 25.0 kg/m² according to the guideline of the International Association for the Study of Obesity in the Western Pacific Region of the World Health Organization (WHO).¹⁵ Disease history of ischemic heart disease, congestive heart failure, as well

as smoking and alcohol consumption were obtained by trained interviewers. Current smokers were defined as present smokers or individuals who had attempted to stop smoking during the past year. Current drinkers were classified according to current alcohol intake.

The electrocardiogram (ECG) findings were independently evaluated by two trained medical doctors. AF was defined by disorganized atrial activity without discrete p waves, atrial activation ranging from 350 to 600 beats per minute, and irregular ventricular response.

Statistical analysis

Statistical analyses were performed with Statistical Package for Social Science (SPSS) version 12.0 software (SPSS Inc., Chicago, IL). Normally distributed continuous variables are expressed as the mean \pm SD. Dichotomous variables are presented as numbers and percentages. Logistic regression analysis was conducted to determine the Odds ratio (ORs) and 95% Confidence intervals (CIs) for the independent variables associated with AF development. All tests were two-tailed and a $p < 0.05$ was considered statistically significant.

Results

Table 1 shows the number of participants grouped according to age and general characteristics. The mean age of the participants was 52.3 years (51.8 in men, 52.7 in women), and ranged from 40 to 69 years. The proportion of individuals aged over 60 years was 26.8%.

The overall prevalence of AF was 0.4% (39/10,012) in adults 40-69 years of age and 1.0% (28/2,688) in the 60-69 age group (Table 2). In the 40-69 age group, the prevalence was 0.6% (30/4,750) in men and 0.2% (9/5,262) in women, and in the 60-69 age group, the prevalence was 1.8% (21/1,162) in men and 0.5% (7/

Table 1. Baseline subject characteristics

	Total (n=10,012)	Men (n=4,750)	Women (n=5,262)
Age (years)	52.3 \pm 8.9	51.8 \pm 8.8	52.7 \pm 9.0
Age group (years)			
40-49	4,708 (47.0)	2,353 (49.5)	2,355 (44.8)
50-59	2,616 (26.1)	1,235 (26.0)	1,381 (26.2)
60-69	2,688 (26.8)	1,162 (24.5)	1,526 (29.0)
SBP (mmHg)	121.7 \pm 18.5	122.2 \pm 17.1	121.2 \pm 19.6
DBP (mmHg)	80.3 \pm 11.4	81.9 \pm 10.9	78.9 \pm 11.7
BMI (kg/m ²)	24.6 \pm 3.1	24.2 \pm 2.9	24.9 \pm 3.3
Obesity (BMI ≥ 25 kg/m ²)	4,289 (42.9)	1,862 (39.2)	2,427 (46.1)
Hypertension	3,064 (30.6)	1,491 (31.4)	1,573 (29.9)
Diabetes mellitus	1,075 (10.8)	563 (12.0)	512 (9.8)
Ischemic heart disease	141 (1.4)	82 (1.7)	59 (1.1)
Congestive heart failure	23 (0.2)	10 (0.2)	13 (0.2)
Current smoker	2,745 (27.8)	2,538 (53.7)	207 (4.0)
Current drinker	4,810 (48.5)	3,458 (73.2)	1,352 (26.0)

Data are presented as mean \pm SD or n (%). SBP: systolic blood pressure, DBP: diastolic blood pressure, BMI: body mass index

1,526) in women. The mean age of individuals with AF was 60.9 ± 6.9 years. Compared to women, the overall prevalence of AF in men was threefold higher and considerably greater in all age groups. The prevalence of AF increased significantly with age irrespective of gender.

In the simple logistic regression analyses of risk factors for the development of AF, being older than 60 years of age (OR, 9.90; 95% CI, 3.82-25.67), male gender (OR, 3.71; 95% CI, 1.76-7.82), hypertension (OR, 2.66; 95% CI, 1.41-4.99), diabetes mellitus (OR, 3.38; 95% CI, 1.67-6.84), ischemic heart disease (OR, 8.20; 95% CI, 2.88-23.39), and congestive heart failure (OR, 25.61; 95% CI, 5.80-113.15) were significantly associated with the risk of AF (Table 3), but obesity (BMI ≥ 25 kg/m²), smoking, and drinking were not. Multiple logistic regression analysis showed that old age (OR, 8.15; 95% CI, 3.06-21.71), male gender (OR, 4.04; 95% CI, 1.90-8.61), diabetes mellitus (OR, 2.15; 95% CI, 1.05-4.44), and congestive heart failure (OR, 14.11; 95% CI, 2.56-77.70) remained independent risk factors for the development of AF.

Discussion

In this study, the crude prevalence of AF was 0.1%, 0.2%, and 1.0% in the age groups 40-49, 50-59, and 60-69 years old, respectively. Among individuals with AF, 71.8% were over the age of 60. These percentages are less than those of a previous study reporting the pre-

valence of AF as being 0.1%, 0.5%, 1.4%, and 2.0% in Koreans aged 40-49, 50-59, 60-69, and over 70 years old, respectively.¹⁶⁾ This discrepancy may have resulted from differences between the study populations—the previous study used ECG data of 14,540 adults from Gyeong-sangnam-do aged 40 years or older obtained from a general health screening test by the National Health Insurance Cooperation that only included ECGs from volunteer subjects, including those with suspected abnormal heart function. Our study analyzed ECG data from all participants; hence, the prevalence of AF may have been artificially augmented in the previous study. Nevertheless, the prevalence of AF in men was consistently threefold higher than that in women in both studies. Another study group analyzed the data from Health Insurance Review and Agency (HIRA), and reported the prevalence of AF was 1.95% and 2.41% in Koreans over the age of 60 or 70 years old.¹⁷⁾ In a hospital-based retrospective study of Koreans who had repeatedly received screening tests for general health, the incidence of new-onset AF was estimated to be 2.9 per 1,000 person-years in those over the age of 65.¹⁸⁾

Our results are similar to the prevalence of AF reported in other Asian countries. In Japan, the overall prevalence of AF was 0.9% in adults aged 30 years or older, and age-specific prevalence rates were 1% in the 60-69 age group and 2.9% in the over 70 age group. These results were derived from three national surveys on cardiovascular diseases during the years 1980-2000.¹⁹⁾ In the Chinese population of Singapore, age-specific prevalence rates were 1.3% in the 60-69 age group and 2.3% in the over 70 age group.²⁰⁾ As in other Asian populations, the prevalence of AF in Koreans was much lower than that reported for the US population, roughly less than half the US rate.⁸⁾²⁰⁾

We also performed analysis of the predisposing risk factors of AF. Although well-known risk factors such

Table 2. Prevalence of atrial fibrillation

Age group (years)	Total N (%)	Men N (%)	Women N (%)
40-49	5 (0.1)	4 (0.2)	1 (0.0)
50-59	6 (0.2)	5 (0.4)	1 (0.1)
60-69	28 (1.0)	21 (1.8)	7 (0.5)
Total	39 (0.4)	30 (0.6)	9 (0.2)

% = number of AF (n)/number of participants

Table 3. Analysis of risk factors of atrial fibrillation

Risk factor	AF (n=39)	Control (n=9,973)	Unadjusted OR			Adjusted OR*		
			OR	(95% CI)	p	OR	(95% CI)	p
Age group (years)								
40-49	5 (12.8)	4,703 (47.2)	1					
50-59	6 (15.4)	2,610 (26.2)	2.16	(0.66-7.09)	0.203	1.89	(0.57-6.25)	0.300
60-69	28 (71.8)	2,660 (26.7)	9.90	(3.82-25.67)	<0.001	8.15	(3.06-21.71)	<0.001
Gender (male)	30 (76.9)	4,720 (47.3)	3.71	(1.76-7.82)	0.001	4.04	(1.90-8.61)	<0.001
Hypertension	21 (53.8)	3,043 (30.5)	2.66	(1.41-4.99)	0.002	1.56	(0.81-3.01)	0.188
Diabetes mellitus	11 (28.9)	1,064 (10.8)	3.38	(1.67-6.84)	0.001	2.15	(1.05-4.44)	0.037
Obesity (BMI ≥25 kg/m ²)	18 (46.2)	4,271 (42.8)	1.14	(0.61-2.15)	0.677			
Ischemic heart disease	4 (10.3)	137 (1.4)	8.20	(2.88-23.39)	<0.001	2.10	(0.55-7.98)	0.278
Congestive heart failure	2 (5.1)	21 (0.2)	25.61	(5.80-113.15)	<0.001	14.11	(2.56-77.70)	0.002
Current smoker	13 (33.3)	2,732 (27.8)	1.30	(0.67-2.54)	0.439			
Current drinker	19 (50.0)	4,791 (48.5)	1.06	(0.56-2.01)	0.851			

Data are presented as n (%). *Multiple logistic regression analysis was adjusted for age group, gender, hypertension, diabetes mellitus, ischemic heart disease, and congestive heart failure as covariables. BMI: body mass index (kg/m²), OR: odds ratio, CI: confidence interval

as hypertension and ischemic heart disease showed significant associations with AF in the simple logistic regression analyses, only old age, male gender, diabetes mellitus, and congestive heart failure remained as statistically independent risk factors for AF after multiple logistic regression analysis. In the Framingham Heart Study, after multivariable adjustment, hypertension was significantly associated with a 1.5- and 1.4-fold risk, heart failure a 4.5- and 5.9-fold risk for AF in men and women, respectively, and myocardial infarction was associated with a 1.4-fold risk for AF in men only.⁶⁾ In addition, the lifetime risk for development of AF increased by 7-10% in adults aged 40 years or older with antecedent congestive heart failure or myocardial infarction.²¹⁾ The lack of association between ischemic heart disease and AF in our study may have been due to an underestimation of ischemic heart disease obtained by a questionnaire and the relatively small proportion of elderly people who were vulnerable to cardiovascular diseases.

Several studies have reported that people who are obese have increased susceptibility to AF. Wang et al.¹²⁾ observed that obese individuals had a 50-60% increased risk of AF in both genders. Dublin et al.¹¹⁾ reported that the AF risk was 3% higher on average and 7% higher in sustained AF (duration ≥ 6 months) per unit increase in BMI. In a US population, the prevalence of obesity, defined as BMI ≥ 30 kg/m², was 32.2% in adults aged 20 years or older and 31.0% in those aged 60 years or older.²²⁾ In Korean adults, the prevalence of obesity, defined as BMI ≥ 25 kg/m² according to the guideline of the International Association for the Study of Obesity in the Western Pacific Region of the WHO,¹⁵⁾ was 31.5% and 36.1% for the same age groups, respectively.²³⁾ However, despite the similarity in the prevalence of obesity, our data did not show any association between obesity and the risk of AF. This population difference in obesity-related AF risk may result from differences in the prevalence of other cardiovascular risk factors, including hypertension, diabetes, and ischemic heart disease.

Recently, Watanabe et al.²⁴⁾ showed that metabolic syndrome and all the associated components except elevated triglycerides significantly increased the risk of new-onset AF in a Japanese population. However, in our study population, metabolic syndrome, as well as the associated components, was not significantly associated with the risk of AF (data not shown). The association between metabolic syndrome, obesity, and the development of AF is unclear, suggesting that further studies are needed to confirm our results in a larger population or other ethnic group.

Several limitations in our study should be noted. Since the study population was relatively small and only individuals aged 40-69 years were enrolled, the number

of patients with AF could have been underestimated. In particular, cardiovascular diseases as the underlying causes of AF might be underreported due to the inaccuracy of self-reporting. Nevertheless, we performed this study using a prospective community-based cohort study, which should have minimized the sampling bias effect. As a result, the prevalence data of AF could be considered representative of the Korean population.

In conclusion, the prevalence of AF was 0.4% in Korean individuals 40-69 years of age. The prevalence of AF may increase with the aging population as well as the obesity epidemic. Thus, AF may become a public health problem of major concern. Changing the awareness and management of AF is needed to help reduce future cardiovascular disease events, and our results help further the understanding of AF in Korea.

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