Prevalence of Atrial Fibrillation in Different Socioeconomic Regions of China and Its Association with Stroke: Results from a National Stroke Screening Survey

Xiaojun Wang [a], Qian Fu [b], Fujian Song [c], Wenzhen Li [a], Xiaoxv Yin [a], Wei Yue [d], Feng Yan [e], Hong Zhang [f], Hao Zhang [g], Zhenjie Teng [h], Longde Wang [i,*], Yanhong Gong [a,*], Zhihong Wang [j,*], Zuxun Lu [a,*]

Author Affiliations:

[a] Department of Social Medicine and Health Management, School of Public Health, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China

[b] School of Medicine and Health Management, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China

[c] Norwich Medical School, Faculty of Medicine and Health Science, University of East Anglia, Norwich, UK

[d] Department of Neurology, Tianjin Huanhu Hospital, Tianjin, China

[e] Department of Neurosurgery, Xuanwu Hospital, Capital Medical University, Beijing, China

[f] Department of science and education, People's Hospital of Deyang City, China

[g] Department of Neurology, Rizhao People's Hospital, Rizhao, China

[h] Department of Neurology, Hebei General Hospital, Shijiazhuang, China

[i] The National Health and Family Commission, Beijing, China

[j] Department of Neurosurgery, Shenzhen Second People's Hospital, Shenzhen University, Shenzhen, China

Author contributions

Wang X and Lu Z conceived and designed the study. Wang L is in charge of this project. Lu Z and Wang Z had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Yue W, Yan F, Zhang Hong, Zhang Hao and Teng Z helped conduct the survey and build the dataset. Wang X analyzed the data and drafted the manuscript. Lu Z, Song F, Gong Y, Fu Q and Yin X revised the manuscript for important intellectual content. Li W and Fu Q contributed to the discussion.

***Corresponding Author:**

Zuxun Lu

Address: No. 13 Hangkong Road, Wuhan 430030, China

E-mail: zuxunlu@yahoo.com

Telephone and fax numbers: +86-027-83693756

Zhihong Wang

Address: No. 3002 Sungang Road, Futian District, Shenzhen 518035, China

E-mail: lyyy_wzh@163.com

Telephone and fax numbers: +86-755-83695465

Yanhong Gong

Address: No. 13 Hangkong Road, Wuhan 430030, China

E-mail: gongyanhong@hust.edu.cn

Telephone and fax numbers: +86-027-83693756

Longde Wang

Address: No. 1 Xizhimen Wainan Road, Beijing 100044, China

E-mail: wanglongde2009@163.com

Telephone and fax numbers: +86-010-84025262

Funding

This study was sponsored by the Ministry of Finance of the People's Republic of China (Issued by Finance and Social Security [2011] Document No. 61, Ministry of Finance) and the Fundamental Research Funds for the Central Universities, Huazhong University of Science and Technology, Wuhan, China. (2016YXMS215). The research was designed, conducted, analyzed and interpreted by the authors entirely independently of the funding sources.

Conflict of Interest Disclosures

None declared.

Keywords: Atrial fibrillation, Epidemiology, Prevalence, Stroke, China

Abstract

Background: Atrial fibrillation (AF) is the most common sustained arrhythmia in clinical practice. This study aimed to estimate the prevalence of AF in different socioeconomic regions of China and identify its association with stroke, through a national survey.

***Methods*:** The study included 726,451 adults aged ≥ 40 years who were participants of the China National Stroke Prevention Project, a nationally representative cross-sectional study. Stepwise logistic regression analyses were conducted to investigate the association between AF and stroke.

Results: The overall standardized prevalence rate of AF was 2.31%. The prevalence of AF was highest in high-income regions (2.54%), followed by middle-income regions (2.33%), and lowest in low-income regions (1.98%). Women had a higher prevalence of AF than men in all regions (low-income regions, 2.30% vs 1.65%; middle-income regions, 2.78% vs 1.89%; and high-income regions, 2.96% vs 2.12%). Compared with urban residents, the prevalence of AF among rural residents was higher in low- (2.03% vs 1.91%) and middle-income regions (2.69% vs 1.90%), but lower in high-income regions (2.44% vs 2.58%). Participants with AF were more likely to have a stroke than those without AF (9.48% vs 2.26%). After adjusting for age, sex, location, overweight or obese, smoking, drinking, physical inactivity, hypertension, diabetes, dyslipidemia, and a family history of stroke, results showed that AF was significantly associated with stroke.

Conclusions: The prevalence of AF has increased in recent years, and it was positively correlated with socioeconomic status, sex (women), location (rural areas), and stroke.

1. Introduction

Atrial fibrillation (AF) is the most common sustained arrhythmia in clinical practice and is associated with serious clinical conditions, such as ischemic heart disease and stroke[1]. According to the 2015 Global Burden of Disease Study, approximately 33.3 million people have AF worldwide, and roughly 195,300 deaths from AF were noted in 2015[2]. With economic growth, population aging, and increased prevalence of risk factors, such as diabetes, hypertension, obesity, and alcohol consumption, the prevalence of AF is increasing worldwide, and has become a major public health burden[3,4]. AF is projected to affect approximately 9 million people aged ≥ 60 years by 2050 in China[5].

The prevalence of AF varies considerably across different socioeconomic regions, and was highest in high-income regions in Europe, followed by the USA[6]. China is a country with rapid socioeconomic development and has the largest population in the world. The socioeconomic status of its people is highly diverse across regions. The Prospective Urban Rural Epidemiologic (PURE) study in China has reported that the risk-factor burden of cardiovascular diseases was higher in high- and middle-income regions and lower in low-income regions[7]. However, it is still unknown about whether the prevalence of AF is associated with the income level of different regions in China.

Previous studies on the prevalence of AF in China had small sample sizes in different locations[8–10], or were based on hospital inpatient data[11,12]. Data on large community-based population are limited, particularly at the national level. Given the increased prevalence of AF and diverse socioeconomic circumstances in China, up-to-date information about the epidemiology of AF is essential for decision-makers to focus on the prevention and treatment of AF, thereby reducing the risk of AF-related stroke. In the present study, we estimated the current prevalence of AF in different socioeconomic regions of China and identify its association with stroke through a national survey.

2. Methods

2.1 Ethical Statement

The study was performed according to the declaration of Helsinki and approved by the Ethics Committee of the Xuanwu Hospital Institutional Review Board, Capital Medical University (Beijing, China). All participants received information on the study and provided written informed consent to participate.

2.2 Study Design and Population

Our study was based on the data from the China National Stroke Prevention Project (CSPP) in 31 provinces (except Tibet) in mainland China from October 2014 to November 2015. The CSPP is an ongoing community-based study that was conducted by the National Project Office of Stroke Prevention and Control. Using a 2-stage stratified cluster sampling method, 200 project areas were first selected in proportion to the local population size and the total number of counties. Then, an urban community and a rural village were selected from each project area as primary sampling units according to geographical locations and suggestions from local hospitals. The cluster sampling method was used in every primary sampling unit, and all residents aged ≥ 40 years were surveyed during the primary screening. A total of 726,451 residents (386,975 women and 339,476 men) were included after the primary data cleaning.

2.3 Definitions of AF and Stroke

Participants with AF were identified based on a self-reported history of persistent AF or the results of previous ECG or ECG examination during the survey. The identification of participants with ischemic or hemorrhagic stroke was based on the participants' self-reported history and the judgment of a neurologist or physician using neuroimaging (including CT and MRI) according to the WHO criteria[13].

2.4 Assessment of Socioeconomic Regions and Covariates

Data on demographic information, lifestyle risk factors, medical history, and a family history of stroke were collected through face-to-face interviews by trained staff, using standardized CSPP questionnaires.

Socioeconomic regions were classified as low-, middle-, and high-income level according to the tertiles of per capita disposable income of households in 2014[14]. Low-income regions included Henan, Guangxi, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang. Meanwhile, Hebei, Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Hubei, Hunan, Hainan, and Chongqing were considered as middle-income regions. High-income regions included Beijing, Tianjin, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Liaoning, and Neimenggu.

Smoking was defined as former and current smoking (at least one cigarette per day). Drinking was defined as having drunk alcoholic beverages at least once per week for one year. Physical activity was defined as ≥ 3 times of physical activity for at least 30 minutes per week. Body mass index (BMI) was calculated as body weight (kg) divided by the square of height (m). Overweight (BMI ≥ 25 kg/m^2 and < 30 kg/m^2) and obesity (BMI ≥ 30 kg/m^2) were defined according to the BMI classification by the WHO for adults[15]. Hypertension was defined as systolic blood pressure (SBP) ≥ 140 mmHg, diastolic blood pressure (DBP) ≥ 90 mmHg, self-reported hypertension, or the use of antihypertensive medications. Diabetes mellitus was defined as fasting plasma glucose (FPG) level ≥ 7.0 mmol/L, self-reported diabetes, or the use of oral hypoglycemic agents or insulin injection. Dyslipidemia was defined as having one or more of the following: triglyceride (TG) level ≥ 2.26 mmol/L, total cholesterol (TC) level ≥ 6.22 mmol/L, high-density lipoprotein cholesterol (HDL-C) level < 1.04 mmol/L, low-density lipoprotein cholesterol (LDL-C) level ≥ 4.14 mmol/L, self-reported dyslipidemia, or the use of cholesterol-lowering medications[16]. A family history of stroke was defined as the occurrence of stroke in a participant's parents, brothers, or sisters.

2.5 Statistical Analysis

Continuous variables were presented as mean (Standard deviation, SD), and categorical variables were presented as percentages. A comparison was performed among the three socioeconomic regions with one-way analyses of variance (ANOVA) for continuous variables and with χ^2 tests for categorical variables. The calculation of AF prevalence was standardized according to the 2010 population census of age and sex distribution in China. Stepwise logistic regression models were used to estimate the association between AF and stroke in different socioeconomic regions after adjusting for age, sex, location, overweight or obesity, smoking, drinking, physical inactivity, hypertension, diabetes, dyslipidemia, and a family history of stroke. Statistical analyses were performed by using SAS 9.3 for Windows (SAS Institute Inc., Cary, NC, USA). In the two-tailed tests, a P value < 0.05 was considered statistically significant.

3. Results

3.1 General Characteristics of the Study Participants

The mean age of the 726,451 participants was 57.2 ± 11.4 years, and 46.7% were men. The numbers of participants from low-, middle-, and high-income regions were 183,848 (25.3%), 286,503 (39.4%), and 256,100 (35.2%), respectively. **Table 1** shows the characteristics of the study population in different socioeconomic regions of China. No significant difference was observed in the distribution of men and women across the three socioeconomic regions (*P*=0.49). Participants in high-income regions were more likely to be urban residents, current drinkers, overweight or obese, physical inactivity, and less likely to smoke (*P* < 0.001). Moreover, they had a higher prevalence of hypertension, diabetes, and dyslipidemia and a family history of stroke.

3.2 Prevalence of AF in Different Socioeconomic Regions of China

Table 2 shows the prevalence of AF among all participants and in different regions of China. The standardized overall prevalence of AF among Chinese adults aged ≥ 40 years was 2.31% (95% CI: 2.28–2.33%). The prevalence rate increased with age, from 1.13% among adults aged 40–49 years to 4.57% among adults aged ≥ 70 years, and it was higher among women than men (2.72% vs 1.90%) and higher among rural residents than urban residents (2.42% vs 2.19%).

Among the three socioeconomic regions (Table 2), the standardized prevalence of AF was highest in high-income regions (2.54%), followed by middle-income regions (2.33%) and lowest in low-income regions (1.98%). The prevalence of AF increased with advancing age, that is, in adults aged 40–49 years up to 70 years or older in all regions (1.03%–4.09% in low-income regions, 1.26%–4.50% in middle-income regions, and 1.07%–5.01% in high-income regions, respectively). A higher prevalence was observed in women than in men in all regions (low-income regions, 2.30% vs 1.65%; middle-income regions, 2.78% vs 1.89%; and high-income regions, 2.96% vs 2.12%). Compared with urban residents, the prevalence of AF among rural residents was higher in low- (2.03% vs 1.91%) and middle-income regions (2.69% vs 1.90%), but lower in high-income regions (2.44% vs 2.58%).

3.3 Prevalence of Stroke Among Individuals with or without AF

The crude prevalence of stroke was 2.45% (standardized prevalence: 2.12% and 95% CI:

2.09%–2.15%), and it was 1.79%, 2.90%, and 2.42 in low-, middle-, and high-income regions, respectively. **Table 3** presents the prevalence of stroke among the participants with and without AF. Participants with AF were more likely to have a stroke than those without AF (9.48% vs 2.26%, $P < 0.001$). The prevalence of stroke among patients with AF increased with age, that is, from 4.38% among adults aged 40–49 years to 11.65% among adults aged ≥ 70 years ($P < 0.001$). The stroke prevalence was higher in participants with AF than in participants without AF in all regions (low-income regions, 6.25% vs 1.69%; middle-income regions, 11.04% vs 2.69%; and high-income regions, 9.75% vs 2.20%; all P value < 0.001).

3.4 Logistic Regression Analysis of the Association between AF and Stroke

After adjusting for age, sex, location, overweight or obesity, smoking, drinking, physical inactivity, hypertension, diabetes, hyperlipidemia, and a family history of stroke, results showed that AF was significantly associated with stroke. The estimated odds ratios (ORs) of stroke in patients with AF were 1.72 (95% CI: 1.50–1.98), 1.63 (95% CI: 1.50–1.78), and 1.66 (95% CI: 1.52–1.82) in low-, middle-, and high-income regions, respectively (see **Fig. 1 in Ref** [17]).

4. Discussion

AF is a global burden, and its prevalence varied widely among different race and regions. In our population-based study, the estimated overall prevalence of AF among Chinese adults aged ≥ 40 years in 2014–2015 was 2.31%. Epidemiological data on the prevalence of AF were primarily from studies conducted in high-income countries, and the reported prevalence rate ranged from 0.56% to 5.55% in Japan[18], the USA[19], the UK[20,21], Spain[22], Sweden[23,24], Australia[25], and the Netherlands[26]. A recent meta-analysis of AF prevalence in Asia found that community-based AF prevalence ranged from 0.37% to 3.75%, and it has increased in recent years[27]. To compare our results with those of previous studies, we updated and summarized the representative data of AF prevalence in China (see **Table 1 in Ref** [17]). The prevalence of AF varied from 0.2% to 8.5%. The prevalence in our study was higher than the reported rates in most previous studies[8,28–33], and it was nearly three times higher compared with the prevalence rates obtained 10 years ago (0.77% in 2004 and 0.66% in 2005)[9,10]. However, the prevalence of AF in this study was lower than that in Hong Kong[34], Xinjiang province[35], and the Chinese Longitudinal Healthy Longevity Survey (CLHLS)[36]. The differences might be attributable to economic growth, an aging population, geographic regions, detection tool, sex, and sample size. The estimated prevalence of AF in the current study is likely to be more acute because it was based on data from a nationally representative study covered 30 provinces and included a large number of adult participants in China.

The results of our study suggest that the cardiovascular risk factors were highly prevalent in high-income regions of China. We found that the prevalence of AF was positively correlated with socioeconomic status, which was inconsistent with those of previous studies. The PURE study in China showed that the prevalence of cardiovascular events had a reverse trend, although the risk-factor burden was positively correlated with socioeconomic status[7]. The same trend was also observed in the relationship between socioeconomic status and the risk of stroke in the Rotterdam Study[37] or between socioeconomic status and the incidence of AF in the Atherosclerosis Risk in Communities study[38]. The differences might be explained by the following aspects. First, previous studies focused on major cardiovascular events, including stroke, angina, heart attack, and coronary artery disease. Second, the measurements of socioeconomic status were different, and there were regional and racial variations in the epidemiology of AF. Third, this was a cross-sectional study without follow-up information. Thus, we could not predict the long-term effects of socioeconomic status on the incidence or prevalence of AF. Nevertheless, socioeconomic status should be taken into account by policymakers in relation to the prevention and control of AF.

In this study we observed several epidemiological characteristics of AF. The prevalence of AF increased with age, which is in accordance with that in previous studies[8,9,31,35]. However, the overall prevalence of AF was higher in rural residents than in urban residents, which is inconsistent with the study in 2004 in China[9]. Considering economic growth, lifestyle changes, and population aging, the epidemiology of AF may have changed over time. The CLHLS study also reported that rural areas had a higher prevalence of AF[36]. A possible explanation would be that rural residents had more restricted access to health care, and a heavier financial burden, than urban residents [39]. Furthermore, we found that women had a higher prevalence of AF, which is similar to that observed in CLHLS in China[36], although most previous studies showed that men had a higher prevalence of AF than women[9,10,20,24,29,34]. Sex-related differences might be due to changes over time in the distribution of behavioral and environmental risk factors, the differential susceptibility to risk factors, and different physiology and anatomy between men and women[40–42]. There are distinct differences in clinical presentation, outcome, and intensity of investigation and therapy between men and women[43]. These results show that tailored recommendations for the prevention and control of AF in men and women must be considered, and prospective studies are needed to evaluate the sex difference associated with AF.

In this study we found that the participants with AF were more likely to be stroke survivors than participants without AF, which is similar to the results of previous studies[8–10,30,35]. After adjusting for other variables, AF was still significantly associated with stroke. Previous studies have demonstrated that stroke associated with AF is more severe and results in poor prognosis and a greater risk of death[44]. Although oral anticoagulants (OAC) could reduce stroke in people with AF, it was underused in patients with AF in China[45].

Considering the increased prevalence of AF and the poor outcome of stroke associated with AF, reducing the burden of stroke associated with AF might be one of the major health challenges, and significant efforts should be made to improve the use of OAC to reduce the risk of stroke in China.

4.1 Strengths and Limitations

To our knowledge, this is the largest population-based study provided up-to-date information on the prevalence of AF among a nationally representative sample of Chinese adults, and the first study to estimate the AF prevalence in different socioeconomic regions of China.

Our study has some limitations. First, the current study only included participants aged ≥ 40 years, and the results cannot be generalized to those aged <40 years. Second, this was a cross-sectional study, and we could not predict the incidence of AF and the development of future cardiovascular events. Third, the self-reported history of AF or stroke may not be accurate, and leads to over- or underestimation of AF prevalence and its association with the risk of stroke. However, AF or stroke cases were evaluated by a physician through the combination of patients' self-reported diagnoses of the diseases and their medical records. The investigator asked in detail about their medication for the last two weeks, and checked the results of previous examinations or examinations conducted during the survey to make sure the accuracy of the medical history. Stroke patients were additionally asked in detail about the type of stroke, the time of diagnosis, and the course of the disease. In addition, previous studies have found that self-reported AF was reliable[46] and could be used interchangeably or in combination with ECG results to confirm AF[47]. Finally, our data were based on the CSPP study, which was designed for stroke screening in China. We did not have access to full medical information associated with AF. Thus, we did not analyze the risk factors of AF in our study. However, previous studies have shown that most risk factors of AF in China were not different from those in western countries[9,31].

4.2 Conclusions

The prevalence of AF has increased in recent years in China, and it was higher in high-income regions, people with stroke, women, and in rural areas. These findings provide insight for health policymakers to consider specific strategies in the prevention and treatment of AF, thereby reducing the risk of AF-related stroke in different socioeconomic regions.

Acknowledgements

We thank the National Project Office of Stroke Prevention and Control for data support. We also thank all staff members involved in this study for their painstaking efforts in conducting the data collection.

References

[1] World health organization, The top 10 causes of death, World Health Organization. (2017). http://www.who.int/mediacentre/factsheets/fs310/en/ (accessed July 10, 2017).

[2] G.A. Roth, C. Johnson, A. Abajobir, F. Abd-Allah, S.F. Abera, G. Abyu, et al., Global, regional, and national burden of cardiovascular diseases for 10 causes, 1990 to 2015, J. Am. Coll. Cardiol. 70 (2017) 1–25. doi:10.1016/j.jacc.2017.04.052.

[3] S.S. Chugh, R. Havmoeller, K. Narayanan, D. Singh, M. Rienstra, E.J. Benjamin, et al., Worldwide epidemiology of atrial fibrillation: a Global Burden of Disease 2010 Study, Circulation. 129 (2014) 837–847. doi:10.1161/CIRCULATIONAHA.113.005119.

[4] X. Du, J. Dong, C. Ma, Is Atrial fibrillation a preventable disease?, J Am Coll Cardiol. 69 (2017) 1968–1982. doi:10.1016/j.jacc.2017.02.020.

[5] H.F. Tse, Y.J. Wang, M. Ahmed Ai-Abdullah, A.B. Pizarro-Borromeo, C.E. Chiang, R. Krittayaphong, et al., Stroke prevention in atrial fibrillation--an Asian stroke perspective, Hear. Rhythm. 10 (2013) 1082–1088. doi:10.1016/j.hrthm.2013.03.017.

[6] F. Rahman, G.F. Kwan, E.J. Benjamin, Global epidemiology of atrial fibrillation, Nat Rev Cardiol. 11 (2014) 639–654. doi:10.1038/nrcardio.2014.118.

[7] R. Yan, W. Li, L. Yin, Y. Wang, J. Bo, P.U.-C. Investigators, cardiovascular diseases and risk-factor burden in urban and rural communities in high-, middle-, and low-income regions of China: A Large Community-Based Epidemiological Study, J Am Hear. Assoc. 6 (2017). doi:10.1161/JAHA.116.004445.

[8] Y. Guo, Y. Tian, H. Wang, Q. Si, Y. Wang, G.Y.H. Lip, Prevalence, incidence, and lifetime risk of atrial fibrillation in China: new insights into the global burden of atrial fibrillation, Chest. 147 (2015) 109–119. doi:10.1378/chest.14-0321.

[9] Y. Li, Y.F. Wu, K.P. Chen, X. Li, X. Zhang, G.Q. Xie, et al., Prevalence of atrial fibrillation in China and its risk factors, Biomed Env. Sci. 26 (2013) 709–716. doi:10.3967/0895-3988.2013.09.001.

[10] Z. Zhou, D. Hu, An epidemiological study on the prevalence of atrial fibrillation in the Chinese population of Mainland China, J. Epidemiol. 18 (2008) 209–216. doi:10.2188/jea.JE2008021.

[11] Y. Liu, H. Liu, L. Dong, J. Chen, J. Guo, Prevalence of atrial fibrillation in hospitalized patients over 40 years old: ten-year data from the People's Hospital of Peking University, Acta Cardiol. 65 (2010) 221–224. doi:10.2143/AC.65.2.2047057.

[12] Q.I. Wen-Hang, Society of Cardiology, Chinese Medical Association, Retrospective investigation of hospitalised patients with atrial fibrillation in mainland China, Int J Cardiol. 105 (2005) 283–287. doi:10.1016/j.ijcard.2004.12.042.

[13] Stroke--1989. Recommendations on stroke prevention, diagnosis, and therapy. Report of the WHO Task Force on stroke and other cerebrovascular disorders, Stroke. 20 (1989) 1407–1431. doi:10.1161/01.STR.20.10.1407.

[14] National Bureau of Statistics of China., China Statistical Yearbook 2016, China Statistics Press, Beijing, 2016. http://www.stats.gov.cn/tjsj/ndsj/2016/indexch.htm.

[15] Lee, S.J. Stolfo, Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee., World Health Organ. Tech. Rep. Ser. 854 (1995) 1–452. doi:854.

[16] Joint Committee for Developing Chinese guidelines on Prevention and Treatment of Dyslipidemia in Adults, Chinese guidelines on prevention and treatment of dyslipidemia in adults, Zhonghua Xin Xue Guan Bing Za Zhi. 35 (2007) 390–419. http://www.ncbi.nlm.nih.gov/pubmed/17711682.

[17] X. Wang, Q. Fu, W. Li, L. Wang, X. Yin, W. Yue, et al., Data on prevalence of atrial fibrillation and its association with stroke in low-, middle-, and high-income regions of China, Data Br. Submitted (2018).

[18] H. Inoue, A. Fujiki, H. Origasa, S. Ogawa, K. Okumura, I. Kubota, et al., Prevalence of atrial fibrillation in the general population of Japan: an analysis based on periodic health examination, Int J Cardiol. 137 (2009) 102–107. doi:10.1016/j.ijcard.2008.06.029.

[19] A.S. Go, E.M. Hylek, K.A. Phillips, Y. Chang, L.E. Henault, J. V Selby, et al., Prevalence of diagnosed atrial fibrillation in adults: national implications for rhythm management and stroke prevention: the AnTicoagulation and Risk Factors in Atrial Fibrillation (ATRIA) Study, Jama. 285 (2001) 2370–2375.

[20] M. Sudlow, R. Thomson, B. Thwaites, H. Rodgers, R.A. Kenny, Prevalence of atrial fibrillation and eligibility for anticoagulants in the community, Lancet. 352 (1998) 1167–1171. doi:10.1016/s0140-6736(98)01401-9.

[21] D.A. Lane, F. Skjoth, G.Y.H. Lip, T.B. Larsen, D. Kotecha, Temporal trends in incidence, prevalence, and mortality of atrial fibrillation in primary care, J Am Hear. Assoc. 6 (2017). doi:10.1161/JAHA.116.005155.

[22] J.J. Gomez-Doblas, J. Muniz, J.J. Martin, G. Rodriguez-Roca, J.M. Lobos, P. Awamleh, et al., Prevalence of atrial fibrillation in Spain. OFRECE study results, Rev Esp Cardiol (Engl Ed). 67 (2014) 259–269. doi:10.1016/j.rec.2013.07.014.

[23] J. Norberg, S. Backstrom, J.H. Jansson, L. Johansson, Estimating the prevalence of atrial fibrillation in a general population using validated electronic health data, Clin Epidemiol. 5 (2013) 475–481. doi:10.2147/CLEP.S53420.

[24] L. Friberg, L. Bergfeldt, Atrial fibrillation prevalence revisited, J Intern Med. 274 (2013) 461–468. doi:10.1111/joim.12114.

[25] J. Ball, D.R. Thompson, C.F. Ski, M.J. Carrington, T. Gerber, S. Stewart, Estimating the current and future prevalence of atrial fibrillation in the Australian adult population, Med J Aust. 202 (2015) 32–35. https://www.ncbi.nlm.nih.gov/pubmed/25588442.

[26] J. Heeringa, D.A. van der Kuip, A. Hofman, J.A. Kors, G. van Herpen, B.H. Stricker, et al., Prevalence, incidence and lifetime risk of atrial fibrillation: the Rotterdam study, Eur Hear. J. 27 (2006) 949–953. doi:10.1093/eurheartj/ehi825.

[27] Y. Bai, Y.L. Wang, A. Shantsila, G.Y.H. Lip, The global burden of atrial fibrillation and stroke: A systematic review of the clinical epidemiology of atrial fibrillation in Asia, Chest. (2017). doi:10.1016/j.chest.2017.03.048.

[28] Q. Li, H. Wu, W. Yue, Q. Dai, H. Liang, H. Bian, et al., Prevalence of stroke and vascular risk factors in China: a Nationwide Community-based Study, Sci Rep. 7 (2017) 6402. doi:10.1038/s41598-017-06691-1.

[29] X. Han, Y. Yang, Y. Chen, L. Gao, X. Yin, H. Li, et al., Association between insomnia and atrial fibrillation in a Chinese population: A cross-sectional study, Clin Cardiol. (2017). doi:10.1002/clc.22731.

[30] W.H. Lu, H.Y. Mu, Z.Q. Liu, Y.C. Yang, P.Y. He, H.Y. Yan, et al., The prevalence and distributing feature of atrial fibrillation in Xinjiang Uygur Autonomous Region Kazaks adult population., Zhonghua Nei Ke Za Zhi. 51 (2012) 674–676.

[31] G.Z. Sun, L. Guo, X.Z. Wang, H.J. Song, Z. Li, J. Wang, et al., Prevalence of atrial fibrillation and its risk factors in rural China: a cross-sectional study, Int J Cardiol. 182 (2015) 13–17. doi:10.1016/j.ijcard.2014.12.063.

[32] L.H. Li, C.S. Sheng, B.C. Hu, Q.F. Huang, W.F. Zeng, G.L. Li, et al., The prevalence, incidence, management and risks of atrial fibrillation in an elderly Chinese population:

a prospective study, BMC Cardiovasc Disord. 15 (2015) 31. doi:10.1186/s12872-015-0023-3.

[33] K. Yu, A. Xing, D. Wang, S. Qi, G. Wang, R. Chen, et al., Prevalence and relative risk factors of atrial fibrillation in male coal miners in North China, Int J Cardiol. 174 (2014) 223–224. doi:10.1016/j.ijcard.2014.04.002.

[34] N.Y. Chan, C.C. Choy, Screening for atrial fibrillation in 13 122 Hong Kong citizens with smartphone electrocardiogram, Heart. 103 (2017) 24–31. doi:10.1136/heartjnl-2016-309993.

[35] H. Miao, Y. Hong, K. Kabinur, T. Zou, A. Palida, X. Zhou, Epidemiological survey of atrial fibrillation among Uygur and Han elderly people in Xinjiang Uygur autonomous region, Zhonghua Liu Xing Bing Xue Za Zhi. 36 (2015) 1065–1068. https://www.ncbi.nlm.nih.gov/pubmed/26837345.

[36] C.L. Chei, P. Raman, C.K. Ching, Z.X. Yin, X.M. Shi, Y. Zeng, et al., Prevalence and risk factors of atrial fibrillation in Chinese Elderly: Results from the Chinese Longitudinal Healthy Longevity Survey, Chin Med J. 128 (2015) 2426–2432. doi:10.4103/0366-6999.164918.

[37] C.T. van Rossum, H. van de Mheen, M.M. Breteler, D.E. Grobbee, J.P. Mackenbach, Socioeconomic differences in stroke among Dutch elderly women: the Rotterdam Study, Stroke. 30 (1999) 357–362.

[38] J.R. Misialek, K.M. Rose, S.A. Everson-Rose, E.Z. Soliman, C.J. Clark, F.L. Lopez, et al., Socioeconomic status and the incidence of atrial fibrillation in whites and blacks: the Atherosclerosis Risk in Communities (ARIC) study, J Am Hear. Assoc. 3 (2014). doi:10.1161/JAHA.114.001159.

[39] Q. Meng, H. Fang, X. Liu, B. Yuan, J. Xu, Consolidating the social health insurance schemes in China: towards an equitable and efficient health system, Lancet. 386

(2015) 1484–1492. doi:10.1016/s0140-6736(15)00342-6.

[40] W.G. Zhu, R. Wan, Y. Din, Z. Xu, X. Yang, K. Hong, Sex differences in the association between regular physical activity and incident atrial fibrillation: a meta-analysis of 13 prospective studies, Clin Cardiol. 39 (2016) 360–367. doi:10.1002/clc.22531.

[41] M.S. Bailey, A.B. Curtis, The effects of hormones on arrhythmias in women, Curr Womens Heal. Rep. 2 (2002) 83–88.

[42] K. Yoshida, M. Obokata, K. Kurosawa, H. Sorimachi, M. Kurabayashi, K. Negishi, Effect of sex differences on the association between stroke risk and left atrial anatomy or mechanics in patients with atrial fibrillation, Circ Cardiovasc Imaging. 9 (2016). doi:10.1161/circimaging.116.004999.

[43] C.R. Kerr, K. Humphries, Gender-related differences in atrial fibrillation, J Am Coll Cardiol. 46 (2005) 1307–1308. doi:10.1016/j.jacc.2005.07.007.

[44] M. Lamassa, A. Di Carlo, G. Pracucci, A.M. Basile, G. Trefoloni, P. Vanni, et al., Characteristics, outcome, and care of stroke associated with atrial fibrillation in Europe: data from a multicenter multinational hospital-based registry (The European Community Stroke Project), Stroke. 32 (2001) 392–398.

[45] X. Yang, Z. Li, X. Zhao, C. Wang, L. Liu, C. Wang, et al., Use of warfarin at discharge among acute ischemic stroke patients with nonvalvular atrial fibrillation in China, Stroke. 47 (2016) 464–470. doi:10.1161/STROKEAHA.115.011833.

[46] B.M. Psaty, T.A. Manolio, L.H. Kuller, R.A. Kronmal, M. Cushman, L.P. Fried, R et al., Incidence of and risk factors for atrial fibrillation in older adults, Circulation. 96 (1997) 2455–2461. doi:10.1161/01.cir.96.7.2455.

[47] E.Z. Soliman, G. Howard, J.F. Meschia, M. Cushman, P. Muntner, P.M. Pullicino, et al., Self-reported atrial fibrillation and risk of stroke in the Reasons for Geographic and

Racial Differences in Stroke (REGARDS) study, Stroke. 42 (2011) 2950–2953. doi:10.1161/STROKEAHA.111.621367.

Table 1 Characteristics of the Study Population in Different Socioeconomic Regions of China

Variables	Overall	Low-Income Regions	Middle-Income Regions	High-Income Regions	*P* value[a]
n	726451(100.0)	183848 (25.3)	286503 (39.4)	256100 (35.2)	
Mean Age (y), mean (SD)	57.2 (11.4)	57.7 (11.7)	56.9 (11.2)	57.2 (11.4)	< 0.001
Age					< 0.001
40-49	224361 (30.9)	56378 (30.7)	89324 (31.2)	78659 (30.7)	
50-59	213178 (29.3)	50029 (27.2)	85424 (29.8)	77725 (30.4)	
60-69	172905 (23.8)	44701 (24.3)	69374 (24.2)	58830 (23.0)	
≥ 70	116007 (16.0)	32740 (17.8)	42381 (14.8)	40866 (16.0)	
Sex					0.486
Men	339476 (46.7)	85918 (46.7)	134105 (46.8)	119453 (46.6)	
Women	386975 (53.3)	97930 (53.3)	152398 (53.2)	136647 (53.4)	
Location					< 0.001
Urban	344635 (47.4)	74177 (40.4)	124159 (43.3)	146299 (57.1)	
Rural	381816 (52.6)	109671 (59.6)	162344 (56.7)	109801 (42.9)	
Smoking	115730 (15.9)	28962 (15.8)	49386 (17.2)	37382 (14.6)	< 0.001
Drinking	24957 (3.4)	5233 (2.8)	8122 (2.8)	11602 (4.5)	< 0.001
Overweight or obesity	228550 (31.5)	55944 (30.4)	80089 (28.0)	92517 (36.1)	< 0.001
Physical inactivity	134147 (18.5)	29155 (15.9)	45854 (16.0)	59138 (23.1)	< 0.001
Hypertension	159844 (22.0)	39186 (21.3)	61665 (21.5)	58993 (23.0)	< 0.001
Diabetes	46411 (6.4)	12340 (6.7)	16220 (5.7)	17851 (7.0)	< 0.001
Dyslipidemia	99500 (13.7)	24788 (13.5)	36232 (12.7)	38480 (15.0)	< 0.001
A family history of stroke	46425 (6.4)	8116 (4.4)	20197 (7.0)	18112 (7.1)	< 0.001

Data are presented as n (%) unless otherwise indicated.
[a]Data were compared using ANOVA/χ^2 tests

Table 2 Prevalence of Atrial Fibrillation in Different Socioeconomic Regions of China

	Overall		Low-Income Regions		Middle-Income Regions		High-Income Regions	
	n (%)	% (95% CI)	n (%)	% (95% CI)	n (%)	% (95% CI)	n (%)	% (95% CI)
Overall	18736 (2.58)	2.31 (2.28-2.33)	4112 (2.24)	1.98 (1.92-2.06)	7300 (2.55)	2.33 (2.27-2.35)	7324 (2.86)	2.54 (2.48-2.56)
Age								
40-49	2582 (1.15)	1.13 (1.09-1.14)	585 (1.04)	1.03 (0.95-1.08)	1146 (1.28)	1.26 (1.19-1.37)	851 (1.08)	1.07 (1.00-1.17)
50-59	4676 (2.19)	2.15 (2.09-2.16)	910 (1.82)	1.80 (1.68-1.92)	1913 (2.24)	2.20 (2.10-2.30)	1853 (2.38)	2.34 (2.23-2.41)
60-69	6175 (3.57)	3.52 (3.43-3.59)	1277 (2.86)	2.81 (2.66-2.95)	2331 (3.36)	3.31 (3.18-3.43)	2567 (4.36)	4.31 (4.15-4.46)
≥70	5303 (4.57)	4.57 (4.45-4.72)	1340 (4.09)	4.09 (3.88-4.31)	1910 (4.51)	4.50 (4.30-4.70)	2053 (5.02)	5.01 (4.80-5.21)
Sex								
Women	11511 (2.97)	2.72 (2.67-2.75)	2503 (2.56)	2.30 (2.21-2.39)	4534 (2.98)	2.78 (2.70-2.88)	4474 (3.27)	2.96 (2.87-3.09)
Men	7225 (2.13)	1.90 (1.85-1.95)	1609 (1.87)	1.65 (1.56-1.79)	2766 (2.06)	1.89 (1.82-1.97)	2850 (2.39)	2.12 (2.04-2.18)
Location								
Urban	8762 (2.54)	2.19 (2.14-2.25)	1669 (2.25)	1.91 (1.81-2.00)	2707 (2.18)	1.90 (1.82-1.98)	4386 (3.00)	2.58 (2.50-2.68)
Rural	9974 (2.61)	2.42 (2.37-2.45)	2443 (2.23)	2.03 (1.95-2.08)	4593 (2.83)	2.69 (2.61-2.78)	2938 (2.68)	2.44 (2.35-2.49)

AF, Atrial Fibrillation

n (%), the numbers of AF patients and crude prevalence.

% (95% CI), standardized prevalence according to National Population Census of China in 2010.

Table 3 Prevalence of stroke among individuals with or without AF

	Overall		Low-Income Regions		Middle-Income Regions		High-Income Regions	
	Non-AF	**AF**	**Non-AF**	**AF**	**Non-AF**	**AF**	**Non-AF**	**AF**
Overall	16016 (2.26)	1777 (9.48)*	3043 (1.69)	257 (6.25)*	7502 (2.69)	806 (11.04)*	5471 (2.20)	714 (9.75)*
Age								
40-49	977 (0.44)	113 (4.38)	189 (0.34)	4 (0.68)	497 (0.56)	54 (4.71)	291 (0.37)	55 (6.46)
50-59	3598 (1.73)	375 (8.02)	621 (1.26)	49 (5.38)	1776 (2.13)	197 (10.30)	1201 (1.58)	129 (6.96)
60-69	6565 (3.94)	671 (10.87)	1225 (2.82)	100 (7.83)	3078 (4.59)	296 (12.70)	2262 (4.02)	275 (10.71)
≥70	4876 (4.40)	618 (11.65)*	1008 (3.21)	104 (7.76)*	2151 (5.31)	259 (13.56)*	1717 (4.42)	255 (12.42)*
Sex								
Women	7706 (2.05)	1021 (8.87)	1513 (1.59)	164 (6.55)	3583 (2.42)	459 (10.12)	2610 (1.97)	398 (8.90)
Men	8310 (2.50)	756 (10.46)*	1530 (1.81)	93 (5.78)*	3919 (2.98)	347 (12.55)*	2816 (2.45)	316 (11.09)*
Location								
Urban	7651 (2.28)	892 (10.18)*	1285 (1.77)	120 (7.19)*	3307 (2.72)	319 (11.78)*	3059 (2.16)	453 (10.33)*
Rural	8365 (2.25)	885 (8.87)	1758 (1.64)	137 (5.61)	4195 (2.66)	487 (10.60)	2412 (2.26)	261 (8.88)

AF, Atrial Fibrillation

Data are presented as n (%).

*Data was compared between AF and Non-AF among all participants and among different socioeconomic regions, all *P* value <0.001.