The relationship between poor pulmonary function and irregular pulse in the elderly: findings from a nationwide cross-sectional survey in Korea

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Abstract

Background: Pulse palpation is a useful screening method for early detection of cardiac arrhythmia, which may result from reduced pulmonary function. The aim of this study is to investigate the association between reduced pulmonary function and pulse palpation finding in the elderly.

Methods: Secondary analysis was performed using the Korea National Health and Nutrition Examination Survey (n=2347 subjects aged ≥65 years). Pulse palpation was initially performed for 15 seconds and confirmed again for 60 seconds.

Results: The prevalence of IP was 61 (2.6%). The mean age of subjects with IP was 73.0 (95% CI 71.7-74.3) years, and 45.8% were male. After adjustment, the lowest FVC or FEV 1 and predicted FVC <80% remained significant risk factors for IP. A restrictive or obstructive pattern also independently predicted IP.

Conclusions: The elderly with reduced pulmonary function had a significant risk of irregular pulse, in whom careful pulse palpation may be required for early detection of arrhythmia.

Background

Cardiac arrhythmias are a group of conditions in which the heart rate is irregular, abnormally fast or slow. Some arrhythmias do not cause any symptoms and may first be discovered only incidentally during a routine examination. When the arrhythmia is chronic, some patients are unaware of its presence. Early detection and treatment of arrhythmias is therefore critical for minimizing associated complications. One of the most common arrhythmias in the elderly is atrial fibrillation (AF). This condition increases the risk of stroke five-fold and the risk of cardiac failure three-fold, leading to an increase in the mortality rate [1–3]. Patients usually recognize the onset of paroxysmal AF due to feeling palpitations with a sensation of a rapid heartbeat [4]. An irregular pulse (IP) can also be a sign of an abnormal heart rhythm, as it is deeply associated with AF and is a physical symptom used for screening.

An IP on physical examination is not a rare finding in primary care settings. Pulse palpation is a useful screening method for early detection of cardiac arrhythmias [5–6] and is routinely included in physical exams by clinical nurse. Opportunistic screening for early AF detection by pulse palpation in subjects 65 years of age or older is recommended by the European Society of Cardiology (ESC) guidelines [7]. This recommendation highlights the importance of appropriate and timely examination of the elderly for early detection and prevention of stroke and heart disease. Systematic population screening is useful for identifying individuals with AF, but the use of electrocardiograms (ECGs) to screen for AF may be expensive and time consuming [8]. The Screening for Atrial Fibrillation in the Elderly (SAFE) study concluded that opportunistic screening, such as pulse palpation and optional ECG, is the most appropriate screening method for those with IP [9]. Firzmaurice et al. also reported that pulse palpation is a cost-effective approach [10].

The heart and lungs are anatomically close and have highly related hemodynamics; arrhythmias (including AF) are usually found in patients suffering from chronic obstructive pulmonary disease (COPD). In cases of COPD with insufficient pulmonary function, arrhythmias are likely to occur due to the pulmonary vascular structure and the hemodynamic features of the heart. Impaired pulmonary function can trigger ectopic beats by deterioration of gas composition and pulmonary hypertension [11], which results in elevated atrial pressure and alter the electrophysiological properties of atrial tissue. These changes can trigger supraventricular tachycardia [12]. Previously, some authors have reported that impaired pulmonary function is associated with AF. A low forced expiratory volume in one second (FEV1) is also related to increased risk of AF [13]. The risk of AF was 1.8 times higher for those with an FEV_1 between 60% and 80%, and reduced lung function has been reported to be an independent predictor of AF [14].

While subjects with reduced lung function are at greater risk for cardiac arrhythmia and may be good candidates for screening, the utility of a particular screening technique in this population is unknown. Therefore, we aim to determine whether pulse palpation is effective for screening arrhythmia in the elderly with reduced pulmonary function by examining the relationship between pulmonary function and irregular pulse (IP) using data from the Korea National Health and Nutrition Examination Survey (KNHANES).

Methods

Study design

A cross-sectional descriptive survey design using a secondary analysis of national data was adopted for this study to identify the relationship between reduced pulmonary function and IP.

Setting and sample

The present study was performed using nationally representative data from the 5th KNHANES V (2010–2012), a government-approved statistical survey by the Korean Centers for Disease Control and Prevention [15]. The survey was released and was available for download from the KNHANES website (https://knhanes.cdc.go.kr/) after its approval for use. The survey comprised three components: a nutrition survey for dietary assessment, a health examination survey on common chronic and cardiovascular diseases, and a health interview survey on general health conditions and health-related lifestyle [15].

For this study 4,742 subjects aged ≥ 65 years were included from the KNHANES database and those who did not finish the health examination survey (n = 469) or had no spirometry data (n = 1926) were excluded. A total of 2,347 subjects were included in this study.

Measurements

General characteristics

A self-administered questionnaire was used to evaluate history of cigarette smoking (current smoker, ex-smoker, or non-smoker), consumption of alcohol, and level of physical activity (walking, moderate, or strenuous activity), and the data was collected by interviewers. Those who smoked fewer than 100 cigarettes in their lifetime were considered as non-smokers, while those who smoked more than 100 cigarettes were classified as ex- or current smokers depending on current smoking. The frequency of alcohol consumption was divided into four categories depending on the number of drinks in the previous year (on average 1 or less per month, 2–4 times per month, 2–3 times per week, or 4 or more times per week). Alcohol intake was also classified under four categories (none, 1–4 servings per session, 5–9 servings per session, or ≥ 10 servings per session), depending on the average drinking quantity in a single session.

Physical activity was classified into 3 categories. 'Walking' means walking regularly for 30 minutes or more in indoor or outdoor at least 5 times a week, 'moderate activity' means exercising for 30 minutes or more carrying a light item at least 3 times a week, 'strenuous activity' means activities such as climbing, running, fast biking, and carrying heavy objects for 20 minutes or more than 3 times per week.

Physiological data

Body weight, height, and waist circumference (WC) were measured by well-trained examiners. Body weight was recorded to the nearest 0.1 kg using a calibrated balance-beam scale (Giant-150N; Hana Co. Ltd., Seoul, Korea). A portable stadiometer (850–2060 mm; Seriter, Bismarck, ND, USA) was used to measure height to the nearest 1 mm. Waist Circumference (WC) was measured and recorded to the nearest 0.1 cm in a horizontal plane at the midpoint between the iliac crest and the costal margin at the end of a normal expiration. Body mass index (BMI) was estimated as body weight (kg) divided by height squared (m^2). Blood samples were taken using a venipuncture during the health examination after an at least 8-h overnight fast. Total cholesterol (TC), serum glucose, triglycerides (TG), creatinine, and high-density lipoprotein (HDL) cholesterol were enzymatically assessed. Blood pressure and pulse rate were measured by a nurse at a professional checkup team within the Korean Centers for Disease Control and Prevention. Blood pressure (BP) using mercury sphygmomanometers (Baumanometer; Baum, Copiague, NY) while subjects sat quietly after a five minute rest. The final BP value was calculated by taking the average value of the second and third BP measurements.

Pulse palpation

Pulse palpation measured after the subjects had rested for five minutes in a seated position, their radial pulse was initially taken for 15 seconds. Subjects with an irregular radial pulse, slow pulse (less than 15 beats) or fast pulse (more than 26 beats) the pulse was assessed again for 60 seconds. "IP" was defined as variation in the force or rhythm of impulses in radial artery during 60 seconds.

Spirometry measurement

Spirometry was performed using a dry rolling-seal spirometry device (Vmax series Sensor Medics 2130; Sensor Medics, Anaheim, CA, USA), which was operated by specially trained technicians who complied with the pulmonary function test (PFT) guidelines by the American Thoracic Society and European Respiratory Society [16]. Participants with < 0.7 FEV_1/forced vital capacity (FVC) were considered to have COPD. The study only used spirometry results that contained two or more acceptable curves that met the reproducibility criteria [16].

Data analysis

Statistical analyses were carried out using the Statistical Package for the Social Sciences (SPSS) program, version 18.0. The sample weights were incorporated and the analyses were adjusted for the survey's complex sample design. We weighted the survey samples in all of the analyses to generate the estimations that represented the Korean non-institutionalized civilian population. The general characteristics of the sample were calculated by considering their weighted frequency. Continuous variables are represented by mean values with confidence intervals (CIs) of 95% for after an analysis of variance (ANOVA) and categorical variables are represented by frequencies and percentages. Student's t-tests and the chi-square test were employed to analyze the mean values and the categorical variables, respectively. The differences between the means were evaluated by using a one-way ANOVA. A multivariate binary logistic regression analysis was applied to assess the independent relationship of each set of spirometry data or COPD case diagnosed by a physician on IP after adjusting all the covariates such as age, sex, BMI, WC, alcohol consumption, chronic diseases, smoking status, thyroid disease, medications, and physical activity. The adjusted odds ratio (aOR) and 95% CI of IP by quartiles of FVC and FEV_1 were estimated using the highest quartile as the reference. A two-tailed *p*-value of less than 0.05 was considered statistically significant.

Results

General characteristics

The general characteristics of all subjects are shown in Table 1. Among the 2,347 subjects, 61 (2.6%) had an IP. Figure 1 shows the prevalence of IP stratified by age. The highest frequency of IP (3.9%) was seen in those older than 80 years of age, while the prevalence of IP tended to increase with age (p=.090). Smoking was not significantly different between the two groups. However, subjects with an IP had significantly more frequent alcohol consumption than those with a regular pulse (RP) (16.9% vs. 8.3%, respectively; p=.022). The degrees of physical activity were similar.

Physiological data comparisons

The subjects in both groups had similar physiologic characteristics in Table 2; however, the WC of those with an IP (87.6) tended to be larger than those with a RP (84.9) (p=.065). There were no differences in systolic BP, diastolic BP, or pulse pressure between the two groups. However, a marginally lower heart rate was found in subjects with an IP (66.0 vs. 69.2) (p=.085). None of the laboratory findings were significantly different.

Pulmonary function test and irregular pulse

The predicted FVC (FVCp) was significantly lower (85.9% vs. 90.6%) (*p*=.005), and the prevalence of patients with FVCp <80% was higher (42.7% vs. 19.3%) (*p*<.001) in the IP group (Table 3). However, there were no differences in the mean FEV_1/FVC values or the prevalence of FEV_1/FVC <0.7 between the two groups. FEV_1 was reduced (2.03 vs. 2.14) (*p*=.040), and predicted FEV_1 was lower (88.7% vs. 93.3%) (*p*=.027) in the IP group. Based on the interpretation of the PFT guidelines [17], more subjects in the IP group showed restrictive (22.4% vs. 12.4%) and obstructive patterns (37.5% vs. 29.9%) (*p*=.037).

The effects of reduced pulmonary function on IP

The subjects in the lowest FVC or FEV_1 quartile were more likely to have an IP compared with those in the highest FVC or FEV_1 quartile after adjustment for covariates of age, sex, BMI, WC, chronic diseases, thyroid disease, medications, smoking status, alcohol consumption, and physical activity (FVC: aOR=6.55, 95% CI: 1.53–28.00, *p*=.011; FEV_1: aOR=5.52, 95% CI: 1.49–20.39, *p*=.011, respectively) (Table 4). FVCp <80% was associated with IP (aOR=2.61, 95% CI: 1.33–5.11, *p*=.005). Based on the PFT interpretation, subjects with a restrictive or obstructive pattern had a significantly higher risk of IP than those with normal spirometry results (aOR=2.14, 95% CI: 1.04–4.41, *p*=.040).

Discussion

Our study found a significant correlation between reduced pulmonary function and IP in subjects aged ≥ 65 using nationally representative data in Korea, this finding highlights the importance of careful assessment for IP, especially in subjects with reduced pulmonary function. Pulse palpation and then optional ECG for those with an IP could help identify the associated arrhythmia, especially AF, which is the most beneficial diagnosis for the early prevention of stroke in asymptomatic and undiagnosed elderly subjects.

COPD is usually diagnosed using PFT; FEV_1/FVC < 70% confirms the presence of persistent airflow limitation and thus of COPD [18]. The worldwide prevalence of COPD is estimated to be 3–11% [19]. However, the prevalence of self-reported COPD in the present study was just 1–2%. Therefore, the prevalence as assessed by PFT was higher than that determined from the patient responses on the questionnaires. This suggests that many subjects in this study had undiagnosed COPD. Yoo et al. showed a similar trend, reporting that, despite the high prevalence of COPD in Korea, the disease is actually underdiagnosed, and most COPD patients are under-treated [20].

Reduced FEV1 and obstructive pulmonary disease are associated with the incidence of AF. The Atherosclerosis Risk in Communities (ARIC) study reported that impaired pulmonary function was correlated with higher AF incidence [21], while the Malmö Preventive Project found that impaired pulmonary function was an independent predictor of AF [22]. Therefore, further evaluation of systematic AF screening is encouraged in at-risk populations [7]. Because the diagnosis of AF requires rhythm documentation using an ECG, we suggest that measuring pulse palpation-guided ECG diagnostic testing may help to detect AF in this at-risk group. Pulse palpation is currently the evidence-based method of choice for screening for arrhythmia among individuals aged ≥ 65 [23]. Kallmuzer et al. reported that pulse palpation at the radial artery is a simple, noninvasive, first-step screening tool to guide ECG diagnostics for cardiac arrhythmias like AF; moreover, its diagnostic accuracy is appropriate compared with continuous ECG [24]. Therefore, pulse palpation is a powerful tool for identifying subjects who require confirmatory ECG to diagnose AF. Undiagnosed AF is common, and opportunistic screening for silent AF is likely to be cost-effective in the elderly [9, 25]. Screening of older populations yielded a prevalence of 2.3% for chronic forms of AF [26]. In the present study, the prevalence of IP was only 2.6%. This finding is consistent with the low or underestimated prevalence of AF in the general population in Korea. In a healthy, asymptomatic rural Korean population, the prevalence of ECG-diagnosed AF was only 2.3% among 60- and 70-year-olds [27]. Because subjects with paroxysmal AF may be classified as having an RP, pulse palpation may only be able to screen those with persistent or permanent AF.

Inpatient measurement of vital signs, such as pulse palpation, is usually performed by nurses. It is important that all nurses in primary or secondary care are aware of the significance of IP to detect new AF or prevent stroke in an early and timely manner. In particular, nurses working in pulmonology or cardiology departments should be well trained and cautioned not to miss IPs in patients with reduced pulmonary function and suspected AF. The present study showed that the lowest quartile of FVC or FEV_1, predicted FVC < 80%, and a restrictive or obstructive pattern based upon spirometry interpretation were significant risk factors of IP. Therefore, clinical nurses should pay particular attention to patients with a more severely decreased FVC or FEV_1 level or those already diagnosed with COPD or restrictive lung disease. In contrast to inpatients, who are carefully monitored by nurses, elderly community dwellers do not commonly have the opportunity for someone to check their pulse on a daily or even weekly basis. To confirm AF, outpatients should undergo further examination, such as ECG, in addition to pulse palpation. Fortunately, some authors have reported that a smartphone can be used to check for an IP at home without visiting a hospital [28–29]. This is particularly promising for elderly subjects because information technology applications will enable them to self-monitor for an IP at home without the aid of medical staff. Elderly people who are not accustomed to new technology, such as smartphones, could be assisted by family members. The appropriate application of such technology will enhance the timely detection of AF, even in elderly community members who are not hospitalized, especially those with reduced pulmonary function.

In this study, there were no statistically significant differences in the risk of IP when patients with restrictive or obstructive spirometry patterns were analyzed separately. However, when the restrictive and obstructive patterns were combined, abnormal spirometry was a significant risk factor for IP compared with a normal spirometry pattern. This finding may indicate the presence of overlap between restrictive and obstructive spirometry patterns on spirometry; 157 (36.5%) of 474 participants with FVCp < 80% were classified as having an obstructive pattern.

Limitations

This study has a few limitations. We used a cross-sectional survey design, so our results may have been influenced by selection bias because we excluded ineligible subjects who lacked complete data. There were no available ECG data to verify specific arrhythmia diagnoses. Elderly subjects are susceptible to a wide range of different cardiac arrhythmias, many of which may be associated with radial pulse irregularities. In addition, there are no data about the period of discontinuation of smoking in ex-smokers or the exact prevalence of cardiomyopathy or thyroid disease, which might influence pulmonary function or the prevalence of arrhythmia, respectively. Lastly, COPD may be misdiagnosed using $FEV_1/FVC < 0.7$ among subjects aged ≥ 65. However, a major strength of this study was that no previous study has described the association between pulmonary function and pulse palpation in the general population. Further studies with confirmatory ECG are needed.

Conclusion

Our findings showed that reduced pulmonary function was correlated with IP in people ≥ 65 years of age. This association suggests that the elderly with reduced pulmonary function are good candidates for early detection of cardiac arrhythmia by using pulse palpation. Healthcare providers, especially nurses, should pay close attention to assessing for the presence or absence of IPs and monitor for arrhythmias in elderly patients with reduced pulmonary function.

List Of Abbreviations

AF: atrial fibrillation; ANOVA: analysis of variance; ARIC: Atherosclerosis Risk in Communities; BMI: body mass index; BP: blood pressure; CI: confidence interval; COPD: chronic obstructive pulmonary disease; ECG: electrocardiogram; ESC: European Society of Cardiology; FEV_1: forced expiratory volume in one second; FVC: forced vital capacity; FVCp: predicted FVC; HDL: high-density lipoprotein; IP: irregular pulse; KNHANES: Korea National Health and Nutrition Examination Survey; PFT: pulmonary function test; RP: regular pulse; SAFE: Screening for Atrial Fibrillation in the Elderly; TC: total cholesterol; TG: triglycerides; WC: waist circumference

Declarations

Ethics approval and consent to participate

The original national data was approved by the Institutional Review Board (IRB : 2012-01EXP-01-2C) of the Korean Centers for Disease Control and Prevention, and all participants were requested to submit written consent before study participation. The protocol of this study complies with the principles of the Helsinki Declaration and was approved by the IRB (2015-03-027) of H University Medical Center.

Consent for publication

Not applicable

Availability of data and materials

The data sets used in this article can be available from the Korea Centers for Disease Control and Prevention website (https://knhanes.cdc.go.kr/knhanes/sub03/sub03_02_02.do).

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

JKP and SHK analyzed data and made substantial contributions to research design and the acquisition, analysis, and interpretation of data. JKP, SYH and JHS helped to draft the manuscript and revise it critically for important intellectual content. All coauthors have read the final version of the manuscript.

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Tables

Table 1 General Characteristics

	Irregular pulse (n=61)	Regular pulse (n=2286)	*p*
	n (%)		
Age (yr)	73.0 (71.7–74.3)	72.2 (71.9–72.5)	.214
Age ≥75 years	16 (32.2)	528 (31.0)	.881
Sex (male)	29 (45.8)	979 (40.5)	.493
Chronic disease			
Hypertension	45 (75.6)	1384 (62.6)	.088
Diabetes mellitus	15 (28.1)	407 (18.9)	.154
COPD diagnosed by a physician	2 (2.0)	19 (1.0)	.373
Congestive heart failure	2 (3.5)	47 (2.5)	.660
Angina	2 (1.6)	112 (4.5)	.126
Previous stroke	4 (6.2)	68 (3.1)	.200
Previous myocardial infarction	4 (3.9)	154 (6.4)	.389
Hyperlipidemia			
Hypercholesterolemia	8 (13.5)	502 (22.8)	.150
Hypertriglyceridemia	5 (9.4)	331 (18.2)	.151
Hypo-HDL cholesterolemia	15 (31.9)	614 (30.3)	.855
Thyroid disease	0 (0.0)	62 (2.6)	.334
Medication use, n (%)			
Antihypertensive drugs	37 (58.5)	1152 (51.2)	.477
Antidiabetic drugs (including insulin)	11 (21.4)	366 (16.0)	.379
Lipid-lowering drugs	4 (5.7)	327 (12.8)	.136
Cigarette smoking status			.703
Current smoker	8 (10.1)	254 (11.7)	
Ex-smoker	17 (32.3)	627 (26.8)	
Non-smoker	34 (57.6)	1367 (61.5)	

Alcohol consumption frequency			.022
≤1 time/month	44 (74.6)	1590 (70.8)	
2–4 times/month	2 (3.4)	284 (12.7)	
2–3 times/week	3 (5.1)	184 (8.2)	
≥4 times/week	10 (16.9)	187 (8.3)	
Amount of alcohol			.611
None	32 (57.9)	1051 (49.0)	
1–4 servings	20 (34.6)	977 (42.0)	
5–9 servings	6 (5.8)	185 (7.6)	
≥10 servings	1 (1.7)	34 (1.4)	
Physical activity			
Walking	21 (27.6)	885 (38.1)	.202
Moderate activity	2 (6.6)	207 (9.1)	.640
Strenuous activity	3 (4.0)	204 (8.2)	.205

COPD chronic obstructive pulmonary disease, HDL high-density lipoprotein.

Continuous variables are presented as the mean (95% confidence interval), and dichotomous variables are presented as n (%).

Table 2 Physiological Data

	Irregular pulse (n=61)	Regular pulse (n=2286)	*p*
BMI, kg/m^2	24.8 (23.9-25.8)	24.2 (24.0-24.4)	.168
WC, cm	87.6 (84.7-90.5)	84.9 (84.2-85.5)	.065
Blood pressure, mmHg			
Systolic	130.8 (125.8-135.9)	130.2 (129.3-131.1)	.811
Diastolic	72.1 (68.5-75.8)	74.3 (73.8-74.9)	.235
Heart rate, bpm	66.0 (62.4-69.6)	69.2 (68.6-69.8)	.085
Pulse pressure, mmHg	58.7 (54.4-62.9)	55.9 (55.2-56.6)	.193
White blood cell count, $\times 10^3/mm^3$	6.3 (5.6-7.1)	6.1 (6.0-6.3)	.616
Fasting glucose, mg/dL	104.7 (98.4-110.9)	102.7 (101.6-103.9)	.546
eGFR, mL/min/1.73 m^2	76.3 (72.7-79.9)	78.9 (77.7-80.1)	.165
TC, mg/dL	185.7 (174.4-197.0)	193.0 (190.9-195.1)	.208
HDL-C, mg/dL	46.8 (43.5-50.1)	46.6 (46.0-47.2)	.875
TG, mg/dL	125.6 (106.7-144.6)	141.0 (136.7-145.3)	.117

BMI body mass index, WC waist circumference, eGFR estimated glomerular filtration rate, HDL-C high-density lipoprotein cholesterol, TC total cholesterol, TG triglycerides. Continuous variables are presented as the mean (95% CI).

Table 3 Spirometry Data

	Irregular pulse (n=61)	Regular pulse (n=2286)	*p*
FVC, L, 95% CI	2.84 (2.67-3.01)	2.95 (2.91-2.99)	.208
Predicted FVC, %	85.9 (82.6-89.2)	90.6 (89.9-91.2)	.005
Predicted FVC <80%, n (%)	25 (42.7)	449 (19.3)	<0.001
FEV_1/FVC	0.72 (0.70-0.75)	0.73 (0.73-0.74)	.656
FEV_1/FVC <0.7, n (%)	19 (37.5)	650 (29.9)	.293
FEV_1, L	2.03 (1.93-2.13)	2.14 (2.11-2.17)	.040
Predicted FEV1, %	88.7 (84.8-92.7)	93.3 (92.4-94.2)	.027
Interpretation, n (%)			.037
Normal	27 (40.1)	1334 (57.7)	
Restrictive	15 (22.4)	302 (12.4)	
Obstructive	19 (37.5)	650 (29.9)	

FVC forced vital capacity, FEV_1 forced expiratory volume in 1 s.

Table 4 Logistic Regression analysis of Pulmonary Function for Irregular Pulse

	Adjusted OR[†]	95% CI	*p*
FVC, L			
Quartile 1 (FVC <2.44)	6.55	1.53–28.00	.011
Quartile 2 (FVC 2.44–2.89)	2.22	0.50–9.88	.294
Quartile 3 (FVC 2.90–3.52)	3.00	0.96–9.32	.058
Quartile 4 (FVC ≥3.53)	1		
Predicted FVC, %	0.98	0.96–1.00	.052
Predicted FVC <80%	2.61	1.33–5.11	.005
FEV1, L			
Quartile 1 (FEV1 <1.83)	5.52	1.49–20.39	.011
Quartile 2 (FEV1 1.83–2.14)	4.80	1.26–18.29	.022
Quartile 3 (FEV1 2.14–2.54)	3.06	1.06–8.89	.040
Quartile 4 (FEV1 ≥2.54)	1		
Predicted FEV1, %	0.99	0.97–1.00	.065
Interpretation			
Normal	1		
Restrictive	2.45	0.95–6.33	.065
Obstructive	1.95	0.92–4.12	.079
Restrictive or obstructive	2.14	1.04–4.41	.040
COPD diagnosed by a physician	1.18	0.12–11.73	.885

COPD chronic obstructive pulmonary disease, FVC forced vital capacity, FEV_1 forced expiratory volume in 1 s.

[†]Odds ratios were obtained from a logistic regression model adjusted for age, sex, BMI, waist circumference, chronic diseases, thyroid disease, medications, smoking status, alcohol consumption, and physical activity.

Figures

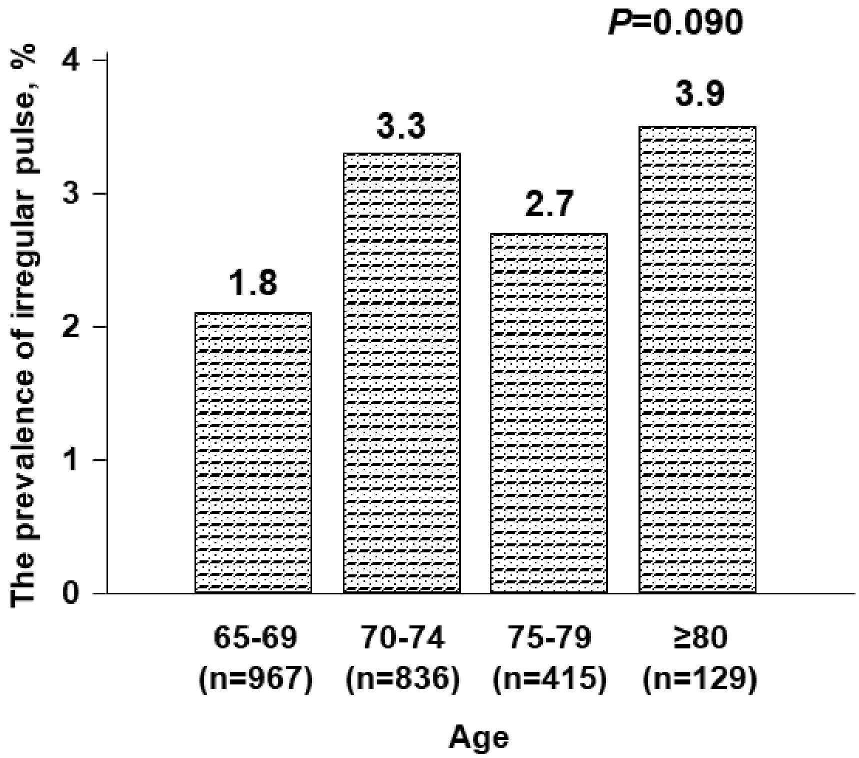

Figure 1

Figure 1

Prevalence of irregular pulse in the general population ≥65 years old.