Prevalence of atrial fibrillation in the 65 or over Polish population. Report of cross-sectional NOMED-AF study

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Editorial
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ABSTRACT

Background: Atrial fibrillation (AF) is the most common cardiac arrhythmia, characterized by an increased risk of thromboembolic complications that can be markedly reduced with anticoagulation. There is a paucity of studies assessing the total prevalence of AF in national populations.

Aims: To assess the nationwide prevalence of AF in a population of adults ≥65 old and to determine the impact of duration of electrocardiogram (ECG) monitoring on the number of newly detected AF episodes.

Methods: The NOMED-AF study (ClinicalTrials.gov; NCT: 0324347) was a cross-sectional study performed on a nationally representative random sample of 3014 Polish citizens 65 years or older. Final estimates were adjusted to the national population. All participants underwent up to 30 days of continuous ECG monitoring. Total AF prevalence was diagnosed based on the patient's medical records or the presence of AF in ECG monitoring.

Results: The prevalence of AF in the Polish population ≥65 years was estimated as 19.2% (95% confidence interval [CI], 17.9%–20.6%). This included 4.1% (95% CI, 3.5%–4.8%) newly diagnosed cases and 15.1% (95% CI, 13.9%–16.3%) previously diagnosed cases and consisted of 10.8% (95% CI, 9.8%–11.9%) paroxysmal AF and 8.4% (95% CI, 7.5%–9.4%) persistent/permanent AF. The incidence of all paroxysmal AF events as a function of ECG monitoring duration increased from 1.9% (95% CI, 1.4%–2.6%) at 24 hours to 6.2% (95% CI, 5.3%–7.2%) at 4 weeks.

Conclusions: The prevalence of AF in elderly adults is higher than estimated based on medical records only. Four weeks of monitoring compared to 24-hour ECG Holter allow detection of 7-fold more cases of previously undiagnosed paroxysmal AF.

Key words: atrial fibrillation, long-term ECG monitoring, population prevalence, silent atrial fibrillation

WHAT'S NEW?

The true prevalence of atrial fibrillation in Poland in the elderly population is significantly higher than estimated based on medical records only. Systematic, populational long-term electrocardiogram monitoring for up to thirty days is feasible and increases the number of detected atrial fibrillation cases twice compared to 1-week monitoring.

INTRODUCTION

Atrial fibrillation (AF) is the most common cardiac arrhythmia [1] characterized by an increased risk of thromboembolic complications, including ischemic stroke (IS). The risk of IS can be markedly reduced with anticoagulation. Nonetheless, approximately 16% of cryptogenic stroke cases are still related to AF [2] because AF often remains undiagnosed.

Despite tremendous interest in AF and its epidemiology during recent years, there is a paucity of studies directly assessing the total prevalence of AF in national populations, using representative methods and diagnostic approaches recommended by clinical guidelines.

Existing national estimates of the proportion and numbers of AF patients are derived from analyses of registry data and modeling studies rather than direct surveys [1, 3], often including only diagnosed cases of AF [4]. More detailed studies are available for selected subgroups such as post-stroke patients [5], subjects with implanted pacemakers or implantable cardioverter defibrillators [6], voluntary screening program participants [7], smartwatch users [8, 9], and local communities. While these estimates are often generalized to national populations, unproven assumptions of negligible selection bias make them less trustworthy. The published estimates for the same population differ from one another considerably.

Fewer data are available for the prevalence of undetected AF in an entire national population. This is important because these individuals represent a missed opportunity for stroke prevention. Previously unknown AF is a common finding in patients hospitalized with acute stroke. According to registry data, previously undetected AF was found in 8.1% of post-stroke patients in Sweden [10]. Even more cases are detected if patients' electrocardiogram (ECG) is monitored for longer than routine 24-hour Holter recording [11].

The main objectives of this article are (1) to assess the prevalence of AF in a nationally representative sample of Polish adults 65 years or older, including asymptomatic cases, using a clinical diagnostic approach based on current guidelines; and (2) to evaluate the impact of ECG monitoring duration on the number of newly detected paroxysmal cases of AF.

METHODS

The NOMED-AF is a cross-sectional study to estimate the prevalence of AF, including undetected AF, in the population of Polish citizens aged 65 years or older. The study was conducted from March 15, 2017 to March 10, 2018. It complied with the Declaration of Helsinki and was approved by the Local Bioethical Committee of the Silesian Medical Board (26/2015) and registered on ClinicalTrials.gov (NCT03243474). Details of the study design were published elsewhere [12].

Study sample

The sample consisted of 3014 randomly chosen individuals, representative of the general, noninstitutionalized Polish population aged 65 or older. The multistage, stratified, and clustered sampling procedure was used. Details of the sample selection procedure are provided in the Supplementary material. In short, the whole territory of the country was stratified into 59 geographical strata. Then, separately in each stratum, municipalities were sampled with the probability proportional to population size. In each municipality, one or more villages or streets were drawn. Finally, individual respondents were selected randomly. The sampling frame consisted of all individuals living in selected villages/streets, aged 65+, recorded in the PESEL database (national registry covering all Polish citizens). Similar numbers of men and women were selected in each age category (65–69, 70–74, 75–79, 80–84, 85–89, and 90+ years). This resulted in oversampling of older age groups. This was done to ensure that the size of the final subsample of the most aged subjects would be enough for separate analyses. The oversampling was corrected with weights to get population estimates at the statistical analysis stage.

For each of the 3000 participants, another 9 subjects living in the same cluster were drawn. These "spare" addresses were used in a predefined random order only if the address of the primarily chosen subject was incorrect or an individual refused to participate in the study.

Patients' inability to answer the questionnaire (i.e., because of dementia) did not exclude them from the study. In such cases, caregivers or close family members were asked to provide information. This was done to avoid selection bias towards the healthier part of the population. Patients with already diagnosed AF were included. The only exclusion criteria were the lack of the subject's consent or presence of factors preventing the study nurse from contacting an individual (extremely rare).

Data collection

A trained nurse interviewed each study participant at home using a standardized questionnaire. The questions relevant to the current analysis included previous diagnosis of AF, symptoms related to AF incidents, and existence of

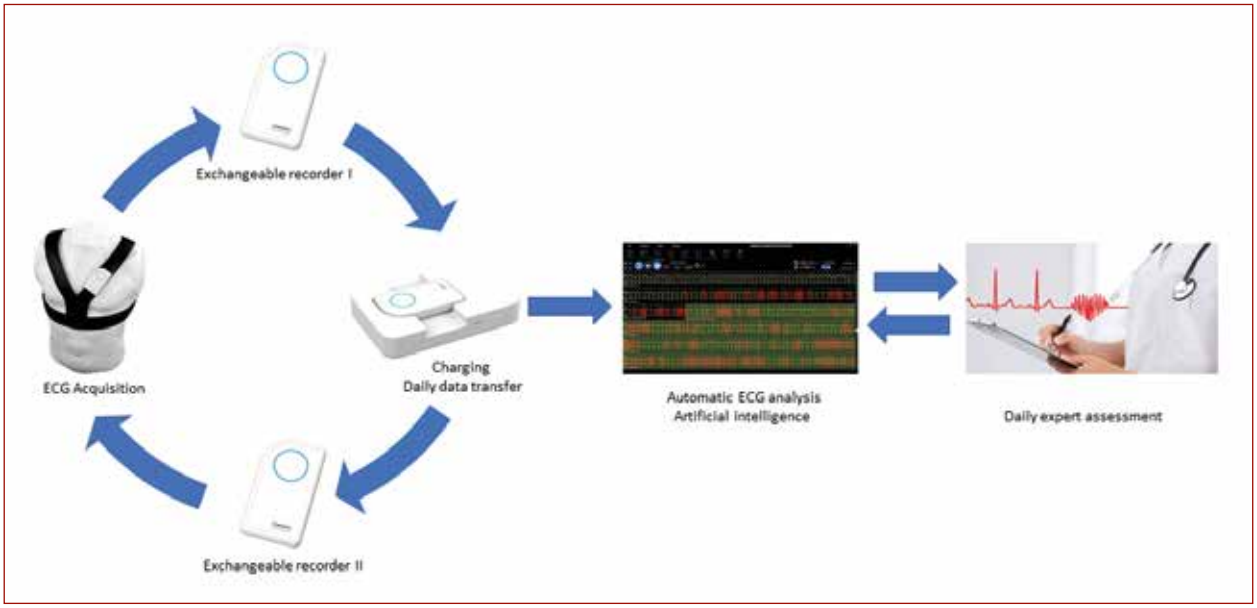

Figure 1. The scheme of the atrial fibrillation monitoring system used in the study
Abbreviations: ECG, electrocardiography

other cardiovascular diseases, diabetes, and chronic kidney disease. The nurse also collected data needed to calculate the CHA_2DS_2-VASc score.

Moreover, height and weight were measured using portable scales. Blood pressure was measured during two separate visits at home using validated automated oscillometric devices. Urine and fasting blood samples were collected and processed in the central laboratory.

Long-term ECG monitoring

Thirty-day, surface, 2-lead ECG recording was attempted in each study subject, including respondents with already diagnosed AF. Comarch Healthcare (Kraków, Poland) developed and manufactured a dedicated ECG monitoring system specifically for this study. The system consisted of a vest equipped with ECG leads, two exchangeable recorders, and a docking station allowing to charge recorders and transmit data. Another recorder was connected at the same time to the vest and recording. ECG data were transmitted to a central database using GSM technology (Figure 1).

The ECG recording was screened automatically for AF and atrial flutter episodes lasting longer than 30 seconds, using software developed and validated especially for the study. Episodes of atrial fibrillation/atrial flutter lasting longer than 30 seconds were automatically detected by AF detection algorithms of the analytical platform. Finally, each of the automatically detected episodes was reviewed by expert cardiologists.

Laboratory analyses

A trained nurse collected blood for N-terminal pro-B-type natriuretic peptide (NT-proBNP) measurements in the respondent's home into a lithium heparin tube. The collected sample was processed in a local laboratory within a maximum of four hours; the plasma was separated and then frozen at temperatures of –20° C and transported to the central laboratory in Gdańsk, Poland, on dry ice. NT-proBNP concentration was determined using the immune chemiluminescence method on the Immulite 2000 analyzer (Siemens Healthineers, Erlangen, Deutschland).

Outcomes

The presence of AF was established based on the patient's medical records assessed for all subjects by the trained study nurse on-site, confirmed by ECG record/monitoring (all participants had long-term ECG monitoring). The new AF cases (not previously detected) were established based on up to 30 days of surface ECG monitoring for episodes of AF lasting 30 seconds or longer. Newly diagnosed AF was defined as AF found in patients without previous history of this arrhythmia in available medical documentation. In this article, the term AF refers both to atrial fibrillation and atrial flutter.

Patients were diagnosed with paroxysmal AF if the duration of the recorded longest arrhythmia event was shorter than 7 days. All other cases were considered persistent/permanent. We analyzed both as one group because it is not always possible to distinguish between persistent and permanent AF using patients' medical documentation.

Silent AF (SAF) was defined as AF without typical clinical symptoms [13] (both previously known and newly diagnosed).

Definitions of exposure variables

The major exposure variable was the duration of ECG monitoring. The total number (including newly detected) cases of paroxysmal AF was reported.

Sex, age, and comorbidities were assessed by study questionnaires. Obesity was defined as a body mass in-

dex (BMI) value >25 kg/m^2, based on measured height and weight. Hypertension was diagnosed if, during two separate visits, the measured patient's systolic blood pressure was ≥140 mm Hg or diastolic blood pressure was ≥90 mm Hg or if the subjects were taking any antihypertensive agents during the preceding two weeks. Diabetes was defined as HbA1c ≥6.5% or the use of antidiabetic drugs. Chronic kidney disease was defined as an estimated glomerular filtration rate value <60 ml/min/1.73 m^2 (based on the Chronic Kidney Disease Epidemiology Collaboration formula) [14] or urine albumin/creatinine ratio ≥30 mg/g. The CHA_2DS_2-VASc score was calculated based on the mentioned above diagnoses and questionnaire data [15].

Statistical analysis

The statistical analysis was conducted using the IBM SPSS statistic v. 19 (IBM Corp, Armonk, NY, US).

The categorical variables were expressed as numbers and percentages, whereas continuous parameters were expressed as mean (standard deviation). The χ^2 and McNemar tests were used to compare categorical variables. Student's t-test was used to compare continuous variables. In the case of continuous variables, the normality of distribution was confirmed using the Kolmogorov-Smirnov test. For all comparisons, a two-tailed P <0.05 was considered significant.

Oversampling of elderly age groups was addressed using weights, which corrected the age and sex structure of the sample to the structure of the Polish population. Statistical analyses accounted for complex survey design. Prevalence and 95% confidence intervals (95% CI) were reported.

Finally, for each patient with paroxysmal AF, the number of hours of ECG monitoring before the first recorded AF event (lasting at least 30 seconds) was assessed. Based on these data, the relationship between the duration of ECG monitoring and the number of AF cases was assessed.

RESULTS

Among 7429 individuals eligible to participate, 3014 were interviewed, resulting in a response rate of 41%. This corresponds to a recent response rate of 44% in the National Health and Nutrition Survey (Continuous NHANES 2017–2018) among subjects aged 60 or older [16]. The reasons for non-participation are provided in Supplementary material, *Figure S1*. The complete characteristics of the study sample and corresponding estimates of the nationwide population are shown in Table 1. Compared to the group with no AF, individuals with newly diagnosed AF seemed to be less burdened by comorbidities included in the analysis than those with already diagnosed AF. Only stroke, chronic kidney disease, and abnormal levels of NT-proBNP were significantly more frequent in the population with newly diagnosed AF compared to the no-AF population.

ECG monitoring

Among the 3014 participants, an ECG signal was acquired in 2974 (98.7%). The mean duration of ECG acquisition was 21.9 (9.1) days, and 90.2% of the acquired ECG signals were eligible for analysis.

Based on medical history and long-term ECG monitoring, atrial fibrillation was confirmed or newly diagnosed in 680 participants (Table 1). Five hundred and fifteen subjects (75.7% of all with AF) experienced AF episodes registered by the ECG monitoring system and confirmed by the cardiologist during the monitoring period. In the remaining individuals, AF was documented based on medical history.

Prevalence of atrial fibrillation

After long-term monitoring, the prevalence of AF in a population of Polish citizens aged ≥65 years was 19.2% (95% CI, 17.9%–20.6%). This included 4.1% (95% CI, 3.5%–4.8%) of newly diagnosed cases and 15.1% (95% CI, 13.9%–16.3%) of previously diagnosed. This indicates that 21.4% (95% CI, 18.4%–24.7%) of all AF cases in the population remain undiagnosed. The percentage of newly diagnosed AF was somewhat lower in patients with obesity (19%), diabetes (16%), and much lower in patients with coronary heart disease (9%). Notably, 20% of AF cases in post-stroke patients were undiagnosed.

The most frequent type of AF was paroxysmal in 10.8% (95% CI, 9.8%–11.9%), followed by persistent/permanent in 8.4% (95% CI, 7.5%–9.4%). The prevalence of AF was higher in men than in women (23.3%; 95% CI, 21.2%–25.4% vs. 16.6%; 95% CI, 14.9%–18.3%; P <0.001) and was higher with increasing age, reaching 31.9% (95% CI, 28.3%–35.9%) among individuals aged ≥85 years (Table 2).

The prevalence of SAF was 3.5% (3.0%–4.1%), and the majority of the newly diagnosed cases were SAF (76%).

Effect of long-term ECG monitoring on AF detection

Among subjects without persistent or permanent AF, the percentage of individuals with recorded AF increased with the duration of monitoring. AF was detected in 1.9% (95% CI, 1.4%–2.6%) and 6.2% (95% CI, 5.3%–7.2%) if subjects were monitored for 24 hours and 4 weeks, respectively. This translates into 3.2-fold more AF cases detected and an absolute difference in diagnosed cases of 4.3% (95% CI, 3.6%–5.1%) in subjects monitored for 4 weeks vs. 24 hours.

The number of newly detected paroxysmal AF was 7-folded higher if patients were monitored for 4 weeks vs. 24 hours: 2.8% (95% CI, 2.3%–3.5%) vs. 0.4% (95% CI, 0.2%–0.6%), difference 2.5% (95% CI, 2.0%–3.1%). ECG monitoring for 1 week allowed for detection of 1.4% (95% CI, 1.1%–1.9%) of new cases of AF, which is 3.5-fold more than after 24-hour monitoring (Figure 2).

Table 1. Characteristics of the study sample and estimates for the population

Clinical characteristics	Total population	No AF	Newly diagnosed AF	Previously diagnosed AF	Total population	No AF	Newly diagnosed AF	Previously diagnosed AF	*P*-value (newly diagnosed vs. no AF)	*P*-value (previously diagnosed vs. no AF)
	Sample size, n (%)	Sample size, n (%)	Sample size, n (%)	Sample size, n (%)	Population estimate, % (95% CI)	Population estimate, % (95% CI)	Population estimate, % (95% CI)	Population estimate, % (95% CI)		
Male sex	1535 (50.9)	1122 (48.1)	93 (66.4)	320 (59.3)	39.3 (37.7–41)	37.3 (35.5–39.2)	53.9 (45.7–61.9)	45.9 (41.8–50.2)	<0.001	<0.001
Female sex	1479 (49.1)	1212 (51.9)	47 (33.6)	220 (40.7)	60.7 (59.0–62.3)	62.7 (60.8–64.5)	46.1 (38.1–54.3)	54.1 (49.8–58.2)		
Age group, years										
65–74	1204 (39.9)	1035 (44.3)	34 (24.3)	135 (25)	55.8 (54.1–57.5)	59.8 (57.9–61.6)	36.2 (28.4–44.8)	39.8 (35.5–44.2)		
75–84	1114 (37)	819 (35.1)	60 (42.9)	235 (43.5)	31.1 (29.6–32.6)	29.2 (27.6–30.9)	39.3 (31.8–47.3)	39.2 (35.1–43.4)	<0.001	<0.001
≥85	696 (23.1)	480 (20.6)	46 (32.9)	170 (31.5)	13.1 (12.4–13.8)	10.2 (11.9–100)	18.6 (31.6–100)	21 (18.3–24.1)		
Comorbidities										
Stroke	366 (12.2)	246 (10.5)	22 (15.7)	98 (18.1)	10.8 (9.8–11.9)	9.6 (8.5–10.9)	15 (10.9–20.2)	16.1 (13.5–19)	0.007	<0.001
Coronary heart disease	666 (22.3)	444 (19)	20 (14.3)	202 (37.4)	20.1 (18.7–21.7)	17.6 (16.2–19.2)	12.3 (8.1–18.3)	35.8 (31.3–40.5)	0.08	<0.001
Hypertension	2433 (81.2)	1856 (79.5)	114 (81.4)	463 (85.7)	80.9 (79.4–82.2)	79.4 (77.7–81)	81.5 (74.1–87.2)	88.6 (85.6–91)	0.55	<0.001
Obesity	923 (31.2)	686 (29.4)	47 (33.6)	337 (62.4)	33.1 (31.4–34.9)	31.5 (29.6–33.6)	34.5 (27.3–42.4)	41.1 (36.6–45.7)	0.46	<0.001
Diabetes	881 (29.2)	628 (26.9)	44 (31.4)	331 (61.3)	28.2 (26.6–29.8)	26.2 (24.4–28)	28.1 (22.1–34.9)	39.2 (35–43.5)	0.57	<0.001
Chronic kidney disease	1005 (34.4)	695 (29.8)	62 (44.3)	270 (50)	27.8 (26.3–29.4)	24.7 (23–26.4)	35.6 (28.6–43.2)	42.8 (38.4–47.2)	0.002	<0.001
Heart failure	673 (22.3)	396 (17)	24 (17.1)	286 (53)	18.3 (17.0–19.8)	13.7 (12.4–15.1)	13.7 (9–20.5)	44.4 (39.8–49.1)	0. 99	<0.001
NT-pro BNP >125 ng/ml	2288 (75.9)	1690 (72.4)	117 (83.6)	481 (89.1)	73.4 (71.6–75.1)	70.1 (68–72.1)	80.8 (73.5–86.5)	89.1 (85.4–91.9)	0. 006	<0.001
CHA_2DS_2-VASc, mean (SD)	4.0 (1.56)	3.9 (1.50)	4.0 (1.74)	4.8 (1.55)	3.9 (1.55)	3.7 (2.66–3.77)	3.9 (3.62–4.17)	4.7 (4.55–4.84)	0.18	<0.001

Abbreviations: AF, atrial fibrillation; CI, confidence interval; NT-proBNP, N-terminal pro-B-type natriuretic peptide; SD, standard deviation

There were no statistically significant differences in demographic and clinical characteristics (including age, sex, comorbidities, and CHA_2DS_2-VASc score) between individuals with newly diagnosed paroxysmal AF after one week vs. 4 weeks of monitoring (Table 3).

DISCUSSION

The main findings of our study are as follows: (1) almost one-fifth of Polish citizens aged ≥65 years suffer from atrial fibrillation; (2) the prevalence of AF in this population based on medical history alone underestimates the actual value by more than 20%; (3) the number of newly diagnosed cases of paroxysmal AF is six-fold higher if patients are monitored for 30 days vs. standard 24 hours.

For most cardiovascular risk factors (i.e., hypertension, hypercholesterolemia, obesity, diabetes, etc.), country-level prevalence estimates are derived from nationally representative surveys [17, 18]. However, knowledge about the prevalence of AF at a population level is incomplete, derived from generalized estimates of registry data, local community samples, and modeling studies. Unfortunately, these designs are potentially more susceptible to both selection and information bias than studies utilizing population-representative random samples. For example, registry-based studies do not include undiagnosed disease cases and may ignore unknown fractions of unreported cases. Population-based cohort studies or clinical studies usually tend to exclude subjects with immobilizing comorbidities or dementia. As these conditions are associated with a higher probability of AF, excluding these patients may result in an underestimated prevalence of AF when their results are generalized to the entire population. Recent studies of smartphone users like the Apple Heart Study [8] are also not designed to assess the prevalence of AF in the general population because they include only selected participants (smartphone users, volunteers).

This leads to equivocal estimates of AF prevalence. For example, the data analysis derived from the ATRIA study estimated the total prevalence of diagnosed AF in a cohort of large northern California health maintenance group organizations as 3.8% in adults older than 60 years. These estimates, considered representative of the California state population, were later used to project the expected future prevalence of AF in the United States [4]. In contrast, Turakhia et al. [3], using commercial and Medicare administrative claims databases, estimated the prevalence of

Table 2. Estimates of the prevalence of all AF and previously diagnosed AF in 65+ Polish population by sex, age, existing comorbidities, and CHA_2DS_2-VASc score. Point estimates and 95% CI. *P*-value by the McNemar test for the difference between all and previously diagnosed AF cases. Thirty days of ECG monitoring significantly increased estimates of AF prevalence in the whole 65+ population and analyzed subgroups

Subgroup % (95% CI)	Total			Paroxysmal			Persistent or permanent		
	All	Previously diagnosed	*P*-value	All	Previously diagnosed	*P*-value	All	Previously diagnosed	*P*-value
All	19.2 (17.9–20.6)	15.1 (13.9–16.3)	<0.001	10.8 (9.8–11.9)	8.1 (7.2–9.1)	<0.001	8.4 (7.5–9.4)	7.0 (6.2–7.9)	<0.001
Male sex	23.3 (21.2–25.4)	17.6 (15.8–19.6)	<0.001	13.1 (11.4–14.9)	9.6 (8.1–11.2)	<0.001	10.2 (8.8–11.8)	8.1 (6.8–9.5)	<0.001
Female sex	16.6 (14.9–18.3)	13.4 (12.0–15.0)	<0.001	9.3 (8–10.8)	7.1 (6–8.4)	<0.001	7.2 (6.1–8.6)	6.3 (5.3–7.6)	<0.001
Age group, years									
65–74	13.4 (11.9–15.1)	10.7 (9.4–12.3)	<0.001	8.6 (7.3–10.1)	6.8 (5.6–8.2)	<0.001	4.8 (3.8–6.1)	4.0 (3.1–5.1)	<0.001
75–84	24.2 (21.7–26.8)	19 (16.8–21.5)	<0.001	13.2 (11.2–15.3)	10.0 (8.3–11.9)	<0.001	11 (9.4–12.9)	9.1 (7.5–10.8)	<0.001
≥85	31.9 (28.3–35.9)	24.2 (21.1–27.6)	<0.001	14.4 (11.8–17.3)	9.1 (7.2–11.4)	<0.001	17.6 (14.5–21.1)	15.2 (12.3–18.5)	<0.001
Comorbidities									
Stroke	28.1 (24.3–32.3)	22.4 (18.9–26.4)	<0.001	12.4 (9.8–15.5)	9.7 (7.4–12.6)	<0.001	15.7 (12.8–19.1)	12.7 (10.1–16)	<0.001
Coronary heart disease	29.2 (25.9–32.7)	26.6 (23.4–30.1)	<0.001	14.8 (12.2–17.9)	13.3 (10.8–16.3)	<0.001	14.4 (12–17.2)	13.3 (11–16.1)	<0.001
Hypertension	20.6 (19.2–22.2)	16.5 (15.1–17.9)	<0.001	11.9 (10.7–13.2)	8.9 (7.9–10.1)	<0.001	8.8 (7.8–9.9)	7.6 (6.6–8.6)	<0.001
Obesity	22.9 (20.3–25.7)	18.6 (16.2–21.3)	<0.001	11.8 (9.7–14.2)	8.9 (7–11.2)	<0.001	11.1 (9.4–13.2)	9.7 (8.0–11.6)	<0.001
Diabetes	25.0 (22.5–27.8)	21.0 (18.6–23.5)	<0.001	12.9 (11–15)	10.7 (8.9–12.6)	<0.001	12.2 (10.3–14.3)	10.3 (8.6–12.3)	<0.001
Chronic kidney disease	28.2 (25.2–31.4)	22.9 (20.1–26)	<0.001	13.5 (11.4–16.0)	10.1 (8.2-12.4)	<0.001	14.7 (12.6–17.1)	12.8 (10.8–15.1)	<0.001
CHA_2DS_2-VASc, mean (SD)	4.5 (1.70)	4.7 (1.63)	0.07	4.3 (1.66)	4.5 (1.65)	0.13	4.8 (1.73)	4.9 (1.59)	0.35

Abbreviations: see Figure 1 and Table 1

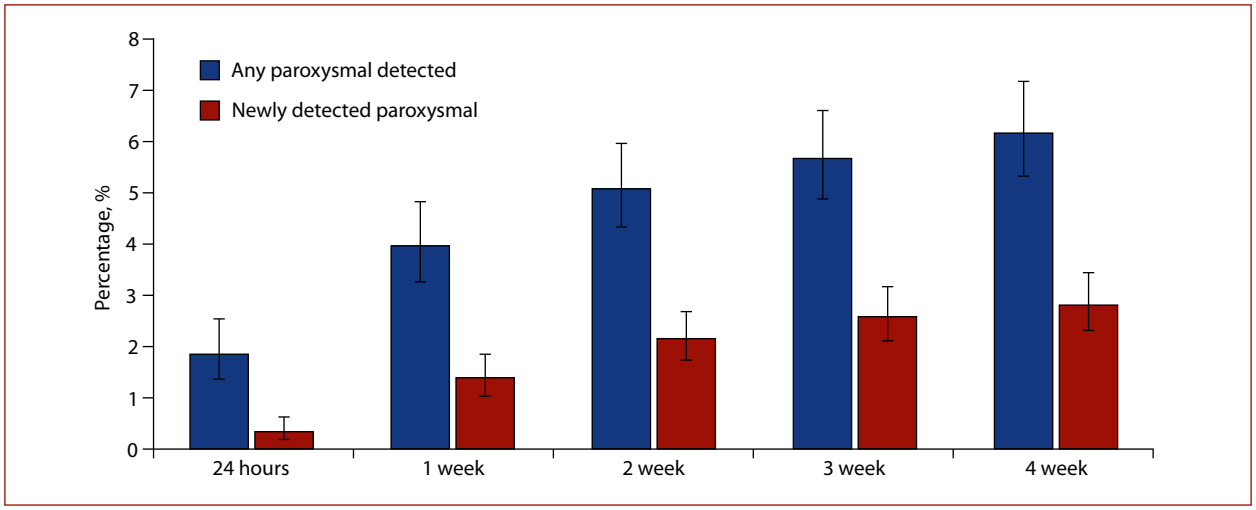

Figure 2. The prevalence (± 95% CI) of paroxysmal AF detected by long term ECG monitoring (total and newly detected) in Polish population ≥65 years as function of ECG monitoring duration. Detected prevalence after 4 weeks of monitoring was significantly higher than detected in 24 hours, 1 week, 2 weeks and 3 weeks in case of either any paroxysmal AF ($P<0.001$) or newly detected paroxysmal AF ($P<0.001$ — 4 weeks vs. 2, 1 weeks or 24 hours; $P = 0.031$ — 4 weeks vs. 3 weeks)

Abbreviations: see Figure 1 and Table 1

Table 3. Characteristics of newly diagnosed paroxysmal AF depending on monitoring time

Clinical characteristics	Diagnosed within 1 week (n = 44), % (95% CI)	Diagnosed between 1st–4th week (n = 42), % (95% CI)	*P*-value
Male sex	58.9 (44.1–72.3)	46.5 (33.7–59.9)	0.23
Female sex	41.1 (27.7–55.9)	53.5 (40.1–66.3)	
Age group, years			
65–74	44.4 (31–58.8)	36.4 (24.8–49.9)	0.70
75–84	36.5 (24.4–50.6)	39.4 (27.1–53.1)	
≥85	19 (9.7–34)	24.2 (13.9–38.8)	
Comorbidities			
Stroke	9.9 (4.9–18.7)	13.1 (7.4–22.2)	0.52
Coronary heart disease	15.4 (7.4–29.2)	8.2 (2.7–22.6)	0.33
Hypertension	87.0 (76.1–93.4)	84.7 (71.6–92.4)	0.72
Obesity	36.9 (25.1–50.5)	36.2 (24.6–49.6)	0.94
Diabetes	22.7 (13.7–35.2)	24.4 (15.6–36.2)	0.82
Chronic kidney disease	29.2 (19.1–42.1)	43.8 (30.3–58.4)	0.12
Heart failure	17.6 (7.8–35.1)	12.5 (7.1–21.3)	0.49
NT-proBNP >125 ng/ml	70.8 (55.5–82.5)	68.7 (54.4–80.2)	0.83
CHA_2DS_2-VASc, mean (SD)	3.7 (1.59)	3.9 (1.70)	0.70

Abbreviations: see Table 1

diagnosed AF in the United States in a population ≥65 years as 8.7% (95% CI, 8.6%–8.8%) and the prevalence of undiagnosed AF as 1.3% (95% CI, 0.9%–1.9%) [3]. The results from the ARIC study cohort, conducted in 2016–2017, show even higher numbers: total AF prevalence in individuals aged 75–94 years was estimated as 21.2% and 17.2% in white men and women, respectively [19].

The prevalence of AF estimated in our study (19.2%) is significantly higher than reported in the studies mentioned above, except for the ARIC study that also utilized continuous long-term ECG monitoring. There are several possible explanations for the higher prevalence in our data. First, it may reflect possible differences between the populations of the United States and Poland. This can be supported by ethnic differences (lower risk of AF in black people in the US while Polish citizens are almost all ethnically Caucasian) and differences in cardiovascular risk factors (higher prevalence of hypertension in Poland and a lower burden of obesity). However, previously reported estimates of AF prevalence in European countries, based on indirect estimators, also tended to be lower than in our study. For example, analysis of medical records from UK general practices resulted in an estimated prevalence of AF in subjects aged ≥85 years as 22.1% in men and 16.5% in women [20] while for a similar age group, our estimate was 31.9%.

The relatively high estimates in our study may also result from methodological differences. We undertook considerable efforts to minimize both selection and information biases. Selection bias was minimized by limiting exclusion criteria and interviewing patients at their homes, allowing even the most physically and mentally impaired subjects to be included in the sample. Information bias was reduced by a precise diagnosis of AF based on current clinical guidelines, a detailed review of medical documentation, and long-term ECG monitoring in every study participant, which could substantially decrease underreporting of AF. For example, 30-day monitoring increased the number of detected paroxysmal AF about 7-fold compared to standard 24-hour ECG recording. The diagnostic approach implemented in our study allowed us to detect 21% of the previously undetected AF that substantially contributed to the total number of cases.

Study strengths & limitations

To our knowledge, this is the first study estimating AF prevalence based on a nationally representative random sample, where all study participants were diagnosed in concordance with current clinical guidelines [21, 22].

All study visits and procedures were performed at patients' homes, allowing even severely disabled or demented patients to participate. This minimized selection bias of the study sample toward healthier subjects. Another unique feature is the evaluation of the relationship between the duration of ECG monitoring and the probability of detection of paroxysmal AF in the general population. Several earlier studies explored the importance of ECG monitoring longer than 24 hours, but they did it in highly selected populations such as patients with cryptogenic stroke or implantable devices [11, 23].

Our study also has several limitations. First, the response rate of 41% was relatively modest. This can potentially lead to selection bias. In recent years, it has become harder to reach high response rates in general population health surveys. For example, during NHANES 1999–2000, the reported unweighted response rate was 76% while in the recent edition (NHANES 2017–2018), this value was 48.8%, and even lower in older age groups [16].

Another limitation is the lack of complete, 30-day ECG monitoring in all patients. There is a possibility that some of the patients who were monitored for a shorter period without AF event, would have had AF detected if monitored for a longer time. This can result in some underestimation of AF prevalence.

Finally, our analysis is based on a representative sample of Polish citizens, and its results can be directly applied only to this population. The Polish population is entirely white, ethnically non-diverse, with universal access to healthcare. The prevalence of hypertension is relatively high (33% in adults 18+, using a 140/90 mm Hg threshold) while the prevalence of obesity (25%) is modest in European countries and much lower than in the United States.

CONCLUSIONS

The presented results suggest that AF prevalence can be higher in the population than previously estimated. Moreover, the longer-than-usual duration of ECG monitoring allows the detection of substantially more patients with previously unknown paroxysmal AF.

Supplementary material

Supplementary material is available at https://journals.viamedica.pl/kardiologia_polska

Article information

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