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Geographic and socio-demographic differences in uptake of population-based screening for atrial fibrillation: The STROKESTOP I study

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ABSTRACT

Background: The rationale behind screening for atrial fibrillation (AF) is to prevent ischemic stroke. Socio-demographic differences are expected to affect screening uptake. Geographic differences may provide further insights leading to targeted interventions for improved uptake. The objective of this study was to evaluate geographic and socio-demographic differences in uptake of AF screening in the population-based study STROKESTOP I.

Methods: STROKESTOP was carried out in two Swedish counties with a total population of 2.3 million inhabitants. Half of the residents aged 75–76 years were randomized to the screening arm: invitation to clinical examination followed by ambulant ECG recording. Information on each invited person's residential parish (n = 157) was used. On parish-level, aggregated data for the participants and non-participants, respectively, were obtained with respect to socioeconomic variables: educational level, disposable income, immigrant and marital status. Geo-maps displaying participation ratios were estimated by hierarchical Bayes methods.

Results: The overall participation rate was similar in men and women but lower in Stockholm, 47.6% (5665/11,903) than in Halland, 61.2% (1495/2443). Participation was clearly associated with the socioeconomic variables. Participation not taking into account socioeconomy varied more markedly across the parishes in the Stockholm county (range: 0.65–1.26) than in the Halland county (0.94–1.27). After adjustment for socioeconomic variables, a geographic variation remained in Stockholm, but not in Halland.

Conclusion: Participation in AF screening varied according to socioeconomic conditions. Geographic variation in participation was marked in the Stockholm county, with only one screening clinic. Geo-mapping of participation yielded useful information needed to intervene for improved screening uptake.

1. Introduction

Atrial fibrillation (AF) is the most common clinical arrhythmia and AF is associated with an increased risk of ischemic stroke [1]. In many cases, AF is paroxysmal and with little or no symptoms, making diagnosis challenging. It has been suggested that asymptomatic AF represents one third of the total AF population, but the prevalence of silent AF is not entirely known since existing data are based on single ECG recordings [2] or data from pacemaker populations [3].

Data from the Swedish stroke register show that one third of stroke cases were associated with AF [4] and this share would probably increase even further if more extended ECG recordings were applied among these patients. Since AF may be completely asymptomatic, many patients have an ischemic stroke as their first manifestation of the arrhythmia.

Oral anticoagulation (OAC) treatment is recommended for all patients with AF and thromboembolic risk factors [5]. This recommendation is regardless of AF type, i.e. permanent, persistent or paroxysmal arrhythmia. Treatment with oral anticoagulants offers efficient protection against AF related stroke.

The prevalence of AF is high and the arrhythmia may be asymptomatic, and the protective effect of OAC is considerable, knowing that the consequences and costs connected to a complication like ischemic

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Table 1
Number of invited persons and participants in a population-based screening study for atrial fibrillation carried out in the counties of Stockholm and Halland, Sweden: the STROKESTOP I study.

	Stockholm county		Halland county		Stockholm	Halland County
	Invited	Participants	Invited	Participants		
Total	**11,903**	**5665 (47.6%)**	**2443**	**1495 (61.2%)**		
By gender						
Women	6505	3095 (47.6%)	1276	766 (60.0%)	p = 0.9684[a]	p = 0.2329
Men	5398	2570 (47.6%)	1167	729 (62.5%)		
By education level						
Primary school	3425	1263 (36.9%)	1063	585 (55.0%)	p < 0.0001	p < 0.0001
Secondary school or higher	8139	4332(53.2%)	1355	902 (66.6%)		
Other/unknown	339	70(20.6%)	25	8 (32.0%)		
By disposable income[b]						
Low	5611	2101 (37.4%)	1457	815 (55.9%)	p < 0.0001	p < 0.0001
Medium	4902	2713 (55.3%)	788	548 (69.5%)		
High	1372	847 (61.7%)	198	132 (66.7%)		
Unknown	18	4(22.2%)	0	-		
By immigrant background						
Born in Sweden	9196	4684 (50.9%)	2187	1395 (63.8%)	p < 0.0001	p < 0.0001
Born outside Sweden	2707	981 (36.2%)	256	100 (39.1%)		
By marital status						
Married	6336	3327 (52.5%)	1466	499 (66.0%)	p < 0.0001	p < 0.0001
Divorced	2496	1076 (43.1%)	353	186 (52.7%)		
Widow/widower	2102	897 (42.7%)	486	278 (57.2%)		
Unmarried	962	358 (37.2%)	137	63 (46.0%)		
Unknown	7	7 (100%)	1	1 (100%)		

[a] p-Values are calculated with chi-two test from differences between SES variable categories in Stockholm and Halland counties.
[b] "Low", <15,000 Euro/year; "Medium", 15,000–30,000 Euro/year; "High", >30,000 Euro/year.

stroke are vast; AF seems to fulfill criteria for screening, at least in certain high-risk groups.

Previous studies on AF screening are small to moderate in size and often conducted in a single community and using single 12-lead ECG recordings. The yield of new AF diagnosis in these studies was 1–2% [2].

We conducted a pilot trial on community based AF screening 2010–2012 using ambulatory handheld ECG recording [6]. In this pilot trial, participation in the screening program was lower in areas with many immigrants and in areas with high incidence of ischemic stroke [7]. In order to further study the concept of AF screening, a randomized, multicenter trial (STROKESTOP I) was initiated [8]. Baseline results and analysis on cost-effectiveness have been published [9,10]. Since participation was lower among patients with the highest stroke risk in our pilot study, factors affecting screening uptake need to be identified in order to improve participation.

1.1. Objective

The objective of this study was to evaluate geographic and sociodemographic differences in screening uptake in STROKESTOP I.

2. Methods

The description of the study, which involved intermittent registration of ECG over a two-week period, has been published previously [8]. In brief, all inhabitants born in 1936 and 1937 in Stockholm county (n = 23,888), urban area, and Halland region (n = 4880), rural area, were identified by their unique civil registration number and thereafter randomized to the screening or to the control cohort in a 1:1 fashion after stratification for region, year of birth and gender. Non-responders received one reminder in Halland and two reminders in Stockholm.

The intention-to-screen populations comprised 11,903 persons (5398 men, 6505 women) in Stockholm county and 2443 persons (1167 men, 1276 women) in Halland county. In Stockholm one screening clinic was set up, whereas six clinics were set up in Halland (one in each municipality). Data were collected between March 2012 and May 2014.

2.1. Data

The STROKESTOP database comprises information on each invited person's residential parish (99 parishes in Stockholm, 58 in Halland). Statistics Sweden provided, for each parish, aggregated and sex-specific data for the participants and non-participants, respectively, on each of the following socioeconomic variables: educational level classified based on the number of school years completed (≤9 years, i.e. primary school; ≥10 years, i.e. gymnasium/pre-university level and university level), disposable income (<15,000 Euro/year, referred to as "*low*", 15,000–30,000 Euro/year, "*medium*", >30,000 Euro/year, "*high*"), immigrant (no, i.e. born in Sweden; yes, i.e. born elsewhere) and marital status (unmarried, married, divorced, widow/widower). Invited persons who were not possible to classify based on the information in the national registers were grouped into an "other/unknown" category of the variable at issue.

2.2. Statistical methods

p-Values for the null hypothesis of equal participation in men and women, and for each socioeconomic variable were obtained by Chi-square test.

Geo-maps of Stockholm and Halland, respectively, displaying spatially smoothed participation ratios were estimated by hierarchical Bayes methods. A parish-specific participation ratio is based on the observed-to-expected participation, where the expected number of participants was obtained from the sex-specific rates for the total study population of each county. Hence, parishes with participation rates <1 had lower participation than the average in the county. Spatially smoothed participation rates were obtained by running the fully, hierarchical Bayesian mapping model (the Besag-York-Mollié model) implemented in the Rapid Inquiry Facility (RIF) program [11,12]. This procedure allows parish-specific participation rates to be smoothed towards global and local mean participation rate levels across the county, yielding "shrinkage" of the conventional observed-to-expected ratios — in line with principles for multi-level modeling [13]. The corresponding statistical certainty geo-maps were obtained by calculating the posterior probabilities of a parish-specific participation rates >1 given the data, denoted Pr(CR > 1|data), using the Bayesian approach. A parish with data yielding strong statistical evidence of elevated participation, more precisely Pr(CR > 1|data) > 0.80, was colored green in the certainty geo-map. By contrast, a parish with lowered participation rate, Pr(CR < 1|data) > 0.80, was colored red. The remaining parishes were colored yellow. The choice of 0.80 for identifying an area with elevated/lowered participation rate has been shown to provide a cut-off with reasonable sensitivity and high specificity [14].

Spatially smoothed participation rates with adjustment for each socioeconomic variable (referred to as *adjusted* participation ratios) were estimated in the same way, after further stratification of data by the socioeconomic variable at issue.

The statistical computations were performed by using IBM SPSS 20.0.2 and, for the spatial analyses, the Rapid Inquiry Facility free software [19].

The study complies with the Declaration of Helsinki, and the protocol was approved by the regional ethics committee (DNR 2011–1363–31/3). Informed consent was obtained from all participants in the screening program. ClinicalTrials.gov identifier: NCT01593553.

3. Results

Overall participation in the screening program was lower in Stockholm, 47.6% (men and women equal rates), than in Halland, 61.2% (men: 62.5%; women: 60.0%) calculated on an intention-to-screen basis (Table 1). Participation was clearly associated with the