Prevalence of Electrocardiographic Findings in Elderly Individuals: The Sao Paulo Aging & Health Study

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Abstract

Background: The determination of the prevalence of electrocardiographic alterations in the older age strata of the Brazilian population represents important information with clinical and epidemiological purpose.

Objective:To verify the prevalence rates of atrial fibrillation, enlarged Q/QS waves (Minnesota code 1.1-1.2) and left bundle branch block.

Methods: In a population-based study, 1,524 participants (921 women and 603 men) aged > 65 years and living in Sao Paulo, Brazil, were submitted to electrocardiographic assessment at rest as well as anthropometric and blood pressure measurements, in addition to fasting blood collection for the measurement of glycemia, total cholesterol and fractions.

Results: The age-adjusted prevalence for enlarged Q/QS waves was12.1% (men, 17.2%; women, 9.6%), 2.4% for atrial fibrillation (men 3.9%; women, 2.0%); and 3.1% for left bundle branch block (men, 3.1%; women, 3.8%). For atrial fibrillation (both sexes), enlarged Q/QS waves (men) and left bundle branch block (women) there was an increase in frequency according to the age stratum. After adjusted for age, sex, diabetes mellitus and dyslipidemia, the odds ratio among the frequencies of enlarged Q/QS waves; arterial hypertension was 2.4 (95% CI: 1.4 -3.9) being 5.1 (95%CI: 1.8 -14.4) for women and 1.7 (95%CI: 0.95-3.1] for men.

Conclusion: The comparison of these data with those from other studies showed a high prevalence of enlarged Q/QS waves in this population, with a direct association with the prevalence of arterial hypertension. (Arq Bras Cardiol 2009; 93(6):602-607)

Key Words: Aged; electrocardiography; coronary disease; atrial fibrillation; bundle-branch block.

Introduction

The age limit for preventive cardiology measures has ceased to be considered, in view of the most recent guidelines[1,2]. However, how to screen elderly people living in poor and deprived neighborhoods is a challenge for public health programs, mainly in societies with a fast demographic and epidemiologic transition. One example of this society is Brazil, where the proportion of people over 65 years old increased from 5.1 per cent in 1970 to 8.6 percent in 2000 and this proportion will be 18% in 2050[3]. The epidemiologic transition has happened too fast from infectious to chronic diseases and since the 1970s , the main cause of death have been cardiovascular diseases, mainly stroke. In 2005, two thirds of cardiovascular deaths occurred among people over 65 years old[4]. Eighty percent of the Brazilian population lives in towns and the pace of urbanization was one of fastest in the world[5]. In the metropolitan areas as in the city of Sao Paulo, the main Brazilian metropolitan area, elderly people living in deprived areas are mainly from rural origin. Migration and urbanization are both associated with an increased incidence of high blood pressure[6] and the impact of hypertension among people living in these neighborhoods in the city of Sao Paulo can be confirmed by the observed two-fold increased risk of death from stroke when compared to the affluent areas of the city[7]. It is important that all interventions be guided by cost-effectiveness results. However there are controversies among public health policy makers about the priorities concerning cardiovascular prevention. One classical way is to always consider primary prevention as the priority[8]. In contrast, an alternative way, considering reduced costs, is to target preventive measures for higher-risk population subsets at high-risk of cardiovascular disease[9]. The cardiovascular risk factor screening approach ["high-risk strategy"] is restricted due to limitations of the classical risk score, such as the one from the Framingham Heart Study, for use in other populations. It underestimates the risk in participants from deprived population such as manual workers[10].

Apart from its use in clinical practice, the electrocardiogram (ECG) is widely used to screen and detect heart disease, being an inexpensive and relatively easy-to-use tool to verify

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the burden of cardiovascular disease in the population context. Since the introduction of the Minnesota Code[11], prevalence of coronary heart disease has been described by applying its rules, including the diagnosis of probable coronary heart disease, in which the presence of large Q waves on the ECG tapes is mandatory. Moreover, an electrocardiogram is useful to detect atrial fibrillation, one risk factor for stroke[12] and left branch bundle block, a hallmark of advanced hypertensive or coronary heart disease, or both[13]. However, recently the "Leyden 85-plus", a prospective study comparing electrocardiogram and medical records as predictors of cardiovascular deaths in an affluent society did not support that routine ECG is effective in older people[14].

The city of Sao Paulo presents one of the most striking social contrasts. Although it has a complex medical care system, many very low-income people live in the metropolitan area. It is a unique opportunity to perform new preventive medicine strategies, allying new medical technologies for people at high-risk of cardiovascular death, such as the elderly living in deprived areas. One possible consequence is a large secondary prevention cardiovascular program to be applied to low-income and middle-income countries[15].

Methods

This was an ancillary study addressing electrocardiographic changes using a cross-sectional population-based design. This study enrolled residents of an economically deprived area of São Paulo, Brazil as part of a collaborative investigation about dementia among Brazil and Cuba, called "The Sao Paulo Aging & Health Study (SPAH)". The main objectives of this study are to analyze environmental and genetic risk factors for dementia of genetically mixed populations in Brazil and Cuba. The SPAH design, methods and population characteristics are available elsewhere[16].

Sample

The catchment areas were chosen from 66 predetermined census sectors in the area of Butantan, a neighborhood located in the Western side of the city of São Paulo, which has a very low-income population. The sample size calculation was based on the expected association between general dementia and individual racial admixture, the objective of the main study. All individuals aged 65 years and over who were residents in the chosen area were included.

Procedures

The duration of the study was a two-year period, from May 2003 to April 2005.

A group of interviewers trained to work in the present study carried out the recruitment and interviewing of the participants. All those aged 65 years and over who accepted to participate in the study were interviewed. This means that in households with two or more elderly individuals, all of them were invited to participate. All participants were assessed for dementia, socioeconomic characteristics, lifestyle, and cardiovascular risk factors. Age was classified in four age strata: 65-69, 70-74, 75-79, and over 80 years. Educational level was classified according to the number of school years. Place of birth was classified as from the rural area, from another town rather than the city of São Paulo and those born in the city.

Interviews were carried out in the house of the participants by a trained staff. After this, a nurse visited the home to obtain anthropometric measures [weight, height, and blood pressure] and draw blood samples. Finally, patients were invited to perform a resting electrocardiogram at the hospital facility. For handicapped participants, the electrocardiogram was performed at home. Electrocardiogram technicians used a Dixtal EP-3 equipment [Sao Paulo, Brazil] to perform the 12-lead electrocardiogram. All tapes were reviewed by two independent cardiologists, who classified the ECG records as (1) normal/other changes; (2) atrial fibrillation; (3) left-bundle branch; (4) probable coronary heart disease according to the Minnesota Code [codes 1.1-1.2, large Q/QS waves]. [11] When there was a disagreement between the two cardiologists, the opinion of a third cardiologist was requested.

The diagnosis of hypertension was considered when the subject was taking antihypertensive drugs or had at least one measurement of systolic blood pressure > 140 mmHg or diastolic blood pressure > 90 mmHg. All measurements were performed by nurses at the individuals' homes using an automatic device (Omron). Diabetes was defined when the subject was using insulin and/or oral hypoglycemic drugs or had a fasting blood glucose > 126 mg/dl. Dyslipidemia was considered when the subject was taking statins or fibrates or the low-density-lipoprotein cholesterol [LDL] level was > 160 mg/dL. LDL was calculated using Friedewald equation [total cholesterol minus [high-density lipoprotein cholesterol plus 0.2 x triglycerides].

Data analysis

The establishment of the prevalence of electrocardiographic changes was carried out by age strata: 65-69 years, 70-74 years, 75-79, and over 80 years. The overall prevalence was adjusted for age, considering the age structure of the city of São Paulo, Brazil where the proportion of the population over 65 years is 7.5%.

Data entry was carried out twice using the program Epidata 3.0, and the validity check was carried out to identify and correct data entry errors. Data was analyzed using the software program SPSS 14.0. The Chi-square test was used to measure the association between socioeconomic and cardiovascular risk factors and electrocardiographic findings. Logistic regression was performed to verify confounding factors. A p value < 0.05 was considered statistically significant.

Results

In this cross-sectional study, addressing elderly people through systematic door knocking, 21,727 households were identified within the catchment-area boundaries, totaling

2,266 people. Of them, 1,600 agreed to participate in this ancillary study. The electrocardiogram was performed during a second visit to the household, when it was verified that 46 individuals had moved, 21 had died, six had a permanent pacemaker and three had Parkinson's disease with tremors. Therefore, 1.524 participants were submitted to an electrocardiogram.

Table 1 shows the sociodemographic characteristics of the studied population according to gender. Almost two-thirds of the sample consisted of women who were slightly older when compared to men. This population was not very old; less than one third of them were older than 75 years. Only 10% had been born in the city and two-thirds were rural migrants. The illiteracy rates were higher among women. High blood pressure was diagnosed in almost 80% of the sample; diabetes in one quarter and high LDL-cholesterol rates were diagnosed in one quarter of the women and one-sixth of the men.

The age-adjusted prevalence of atrial fibrillation in this population was 2.4%, being 2.0% in women and 3.9% in men. Prevalence of atrial fibrillation increased with age for both sexes. The presence of probable CHD, considering the frequency of Q/QS wave area, was 12.1% for both sexes, with a higher prevalence among men (17,2%) when compared to women (9.6%). Prevalence of left bundle-branch block was 3.1% with no difference between sexes.

Table 1 – General Characteristics of Men and Women in the Sample

Characteristics	Women	Men	p-value
	n = 921 [60.4]	n = 603 [39.6]	
Mean age and standard deviation [years]	72.5 [6.4]	71.8 [6.1]	0.045
Age-strata, n [%]			
65-69	383 [41.6]	278 [46.1]	0.32
70-74	243 [26.3]	152 [25.2]	
75-79	172 [18.7]	97 [16.1]	
≥ 80	124 [13.5]	76 [12.6]	
Place of birth, n [%]			0.22
Rural	608 [66.2%]	393[65.3%]	
town	215 [23.4%]	129[21.4%]	
city	95 [10.3%]	80[13.3%]	
School years, n [%]			< 0.001
Illiterate	344 [37.4]	158 [26.2]	
1-4.0 years	493 [53.5]	365 [60.5]	
> 4.0 years	84 [9.1]	80 [13.3]	
Hypertension*, n [%]	736 [81.1]	453 [77.0]	0.06
Diabetes†, n [%]	214 [24.0]	128 [22]	0.35
Dyslipidemia‡, n [%]	219 [23.3]	85 [13.6]	< 0. 001

** systolic blood pressure > 140 mmHg or diastolic blood pressure > 90 mmHg or current use of antihypertensive drugs; † fasting blood glucose > 126 mg/dl or current use of insulin and/or oral hypoglycemic drugs; ‡ Low density cholesterol fraction > 160 mg/dl or current use of statins or fibrates.*

The effect of age shown at table 2 was more evident in women for atrial fibrillation and probable CHD, and in men for atrial fibrillation and left block bundle branch.

The association between sociodemographic variables and cardiovascular risk factors with electrocardiographic abnormalities is presented in table 3. The variables place of birth and school years were not associated to any of ECG changes. Among the cardiovascular risk factors, only high blood pressure was associated to probable CHD. Using logistic regression, the odds ratio for the association of "probable CHD" and hypertension was 2.4, considering age-strata as covariate (95% confidence interval from 1.4 to 3.9). The inclusion of sex, diabetes and high LDL-cholesterol did change materially this measure. Analyzed separately by gender, the odds ratio adjusted for age-strata, diabetes and cholesterol for women was 5.1 (95% confidence interval from 1.8 to 14.4). In contrast, the odds ratio for men was 1.7 (95% confidence interval from 0.95 to 3.1).

Table 2 – Prevalence of Atrial Fibrillation, Probable Coronary Heart Disease and Left Bundle-Branch Block in the Population according to Gender and Age-strata

Electrocardiographic changes	Women N = 921 [60.4%]	Men N = 603 [39.6%]	p-value for sex difference
atrial fibrillation [n=37] [%]			
All ages,	18/921 [2.0%]	19/603 [3.2%]	0.2
65 - 69	4/383 [1.0%]	1/278 [0.4%]	
70 - 74	4/242 [1.6%]	6/152 [3.9%]	
75 - 79	2/172 [1.2%]	6/97 [6.2%]	
≥ 80	8/124 [6.4%]	6/76 [7.9%]	
p-value for trend	0.003	< 0.001	
age-adjusted prevalence	2.0	3.9	
probable CHD [n=185] n [%]			
All ages	86/921 [9.3%]	99/603 [16.4%]	<0.001
65 - 69	28/383 [7.3%]	37/278 [13.3%]	
70 - 74	22/242 [9.1%]	29/152 [19.1%]	
75 - 79	20/172 [12.8%]	17/97 [17.5%]	
≥ 80	16/124 [12.9%]	16/76 [21.0%]	
age-adjusted prevalence	9.6	17.2	
p-value for trend	0.03	0.08	
Left bundle branch block [n=48], n [%]			
all ages	28/921 [3.0%]	20/603 [3.3%]	0.8
65 - 69	11/383 [2.9%]	5/278 [1.8%]	
70 - 74	8/242 [3.3%]	5/152 [3.3%]	
75 - 79	5/172 [2.9%]	5/97 [5.1%]	
≥ 80	4/124 [3.2%]	5/76 [6.6%]	
p-value for trend	0.88	0.02	
age-adjusted prevalence	3.1	3.8	

Table 3 - Sociodemographic Characteristics and Cardiovascular Risk Factor [percentage] according to Electrocardiographic Abnormalities Using Univariate Analyses

	Atrial fibrillation [n=37]	Probable CHD [n=185]	Left bundle-branch block [n=48]
Sex, [%]			
Male [n=603]	3,2	16,4	3,3
Female [n=921]	2,0	9,3	3,0
p-value	0,17	<0,001	0,17
Place of birth, [%]			
Rural [n=1,001]	1,9	8,3	3,1
Town [n=344]	3,8	10,8	2,6
City [n=175]	2,3	9	4,6
p-value	0,14	0,27	0,48
School years, n[%]			
Illiterate [n=502]	2,8	10,2	3,8
1 to 4 years [n=852]	2,6	13,6	3,0
4 years [n=164]	0,6	10,4	1,8
p-value	0,27	0,13	0,44
Hypertension *, [%]			
No[n=307]	2,3	4,6	2,3
Yes[n=1,189]	3,3	10,1	3
p-value	0,32	<0,001	0,33
Diabetes †, n [%]			
No[n=1,279]	2,5	8,6	3
Yes[n=245]	2,0	10,9	4,1
p-value	0,67	0,19	0,36
Dyslipidemia‡, [%]			
No[n=1,220]	2,5	8,6	3
Yes[n=304]	2,0	10,6	3,9
p-value	0,56	0,25	

*CHD - Coronary Heart Disease; * systolic blood pressure > 140 mmHg or diastolic blood pressure > 90 mmHg or current use of antihypertensive drugs; † fasting blood glucose > 126 mg/dl or current use of insulin and/or oral hypoglycemic drugs; ‡ Low density cholesterol fraction > 160 mg/dl or current use of statins or fibrates.*

Discussion

In this first Brazilian population-based study carried out to evaluate the prevalence of electrocardiographic changes among elderly people living in a poor neighborhood, the prevalence rates of probable coronary heart disease, left bundle branch block and atrial fibrillation were high, which allowed us to consider that cardiovascular prevention is an important topic of the public health agenda in Brazil.

The determination of prevalence rates of electrocardiographic abnormalities is crucial to implement preventive measures based on primary care clinics. Based on Bayes' theorem, the intrinsic value of one test is dependent on the findings in a general population. We chose "probable coronary heart disease" and left bundle branch block because they are associated to heart disease and atrial fibrillation is a risk factor for stroke. The majority of the studies on the prevalence of electrocardiographic changes have addressed middle-aged men[17]. However, our findings can be compared to other surveys. The Cardiovascular Health Study (CHS) showed a lower prevalence of "probable coronary heart disease" in the baseline examination of the cohort. Among 5,150 people living in the US, aged 65 years and over, major Q/QS waves were found in 5.2% of them and more than half of the cases had not reported a previous myocardial infarction[18]. In Hong Kong, a sample of a population-based study revealed a prevalence of probable CHD of 6% for men and 7% for women[19]. In the Netherlands, the "Leyden 85-plus study" showed a probable CHD prevalence of 9% among a population aged 85 years[20]. The findings of our study showed a higher prevalence of probable CHD when compared with an US American White and a Taiwan Chinese samples[21]. More recently, in China, a cross-sectional study revealed a prevalence of 9.4% for men and 8.8% for women aged 60 to 69 years-old[22]. It is consistent with the inter-countries comparison of cardiovascular diseases mortality rates showing that rates in Brazil are higher when compared to the USA and Asian countries[4]. The prevalence of atrial fibrillation in this Brazilian elderly sample [2.0% in women, 3.9% in men, 2.4% in both sexes] was similar to data from Busselton, Australia, where the prevalence of atrial fibrillation was 2.3% among individuals older than 60 years[23]. However, it was lower when compared to the baseline data of individuals aged 65 and over at from the American cohort study "The Cardiovascular Health Study" [4.8%, women; 6.2%, men][24], the Dutch cohort "The Rotterdan Study" [7.5%, women; 9.7%, men][25], and the "Leyden 85-plus study" (10%, aged 85 years)[20]. A comparison of 5-year age strata with the American study "Anticoagulation and Risk Factors in Atrial Fibrillation [ATRIA] Study"[26] showed lower values in our sample. An explanation for these findings is a survival bias due to the higher proportion of premature deaths due to stroke and heart disease among individuals living in this deprived neighborhood. Another reason is the difference between our sample and others from countries where the epidemiological transition is more advanced. This assertive is based on data from the Framingham Heart Study that showed that atrial fibrillation is becoming more prevalent, increasing in men aged 65-84 years from 3.2% in 1968-1970 to 9.1% in 1987-1989[27].

The prevalence of left-bundle branch block correlates with age and with the presence of cardiovascular disease. It is likely that the deleterious role of such conduction disorders in the progression to heart failure has been underestimated, because left bundle branch block may have a role in ventricular asynchrony and cardiac remodeling[28]. There have been few studies addressing the prevalence of bundle branch block and most of them showed frequencies similar to the ones obtained in our study[29].

The higher prevalence of hypertension and its association

with probable coronary heart disease in this sample is consistent with the burden of stroke mortality in Brazil. The highest stroke mortality rate observed in the Americas, mainly among women, is seen in Brazil[30]. The association of hypertension and incident cardiovascular diseases is more pronounced in the Brazilian population than that described in other longitudinal studies performed elsewhere[31].

This study had some limitations such as the lack of data about past medical history and the cross-sectional design. The results can be applied to a large segment of the Brazilian population of the same age and same socioeconomic status, as well as to other metropolitan areas of developing countries.

One next step is to verify the sensitivity and specificity of rest electrocardiogram in this population to adopt it as a screening tool. The findings of the "Leyden 85-plus"[14], regarding the superiority of medical records when compared to a routine electrocardiogram cannot be transported to a population with a lower socioeconomic status, such as the case of our sample.

The intervention proposal for this population is a large mass treatment with a four-drug regimen (aspirin, atenolol, captopril, lovastatin) for all patients with main electrocardiographic abnormalities. These medications have an affordable cost for the Brazilian Health System and they would postpone the incidence of heart failure and prevent mortality. This proposal is supported by several recent studies addressing cardiovascular prevention in low and middle-income countries[15,32].

Conclusion

Concluding, in this sample of elderly and low socioeconomic status individuals, the prevalence of coronary heart disease was higher, while the frequency of atrial fibrillation was lower, when compared to other countries.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

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