The prevalence of wide QRS complex (≥110 ms) among the population, depending on sex, age and place of residence

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Aim. To assess the prevalence of wide QRS complex (≥110 ms) among the population, depending on sex, age, place of residence (urban or rural area), the presence of obesity and cardiovascular disease.

Material and methods. The analysis was based on the ESSE-RF study (n=17364, men — 38%). Twelve-lead resting electrocardiography (ECG) data from the regions participating in the study were analyzed according to the Minnesota code manual. Patients were divided into groups of QRS <110 ms and ≥110 ms (wide QRS).

Results. QRS groups did not differ in heart rate and age. The prevalence of wide QRS complex in the population amounted to 17,2%. Men were likely to have wide QRS than women (18,5% and 16,2%, respectively, p<0,0005) due to the increased frequency of "preblock" QRS duration (110-119 ms; 12,3% vs 10,9%, respectively, p<0,025). The prevalence of QRS ≥120 ms in the sex groups was the same, almost 7%. The prevalence of widened QRS in the population significantly exceeded other unfavorable prognostic ECG indicators, such as major ECG abnormalities, conduction disorders, abnormal Q wave (QS). The prevalence of wide QRS complex increased with age from 11,1% to 19,2, (p<0,001). The highest increase in prevalence of wide QRS complex was observed after 55 years; nondynamic periods were recorded in men from 25, and in women from 35 to 54 years. In contrast to women, the prevalence of wide QRS in men did not depend on the place of residence (18,6% in urban and 18,3% in rural areas); in rural women this parameter was observed as often as in men. This may indicate a more severe epidemiological situation of cardiovascular disease in rural residents. Obesity, high blood pressure, and a history of coronary artery disease were more common in the group of wide QRS complex.

Conclusion. For wide QRS complex, the same age and sex relationships are characteristic as for the basic routine ECG indicators. The prevalence of wide QRS in the population exceeds major ECG abnormalities, conduction disorders, abnormal Q wave (QS). In rural residents, the increased prevalence of wide QRS is probably due to the greater prevalence of obesity and hypertension.

Key words: QRS ≥110 ms, prevalence of wide QRS complex, age and sex characteristics.

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Electrocardiographic (ECG) predictors of fatal and nonfatal cardiovascular events are still of great interest. The search for new significant prognostic parameters continues. In recent years, wide QRS complex (≥110 ms) considers as one of these parameters.

It is known that diseases leading to changes in cardiac size and structure, such as hypertension (HTN), myocarditis, heart defects, coronary artery disease (CAD) and myocardial infarction, heart failure, are often accompanied by impaired conduction and decreased ventricular depolarization [1, 2]. The latter, in turn, are associated with left ventricular dysfunction, morbidity and mortality. For example, people with left bundle branch block are 10 times more likely to have death as the first manifestation of cardiovascular disease (CVD) than without it [3]. "Preblock" QRS duration (100-120 or 90-120 ms) is also associated with an increased cardiovascular risk. Thus, the QRS duration of 102±25 vs 97±20 ms in the Oregon Sudden Unexpected Death Study was independently associated with sudden cardiac death [4], and in patients with aortic stenosis, but without complete bundle branch blocks, QRS ≥100 ms vs QRS <85 ms — with an increase in the risk of sudden death by 5 times, cardiovascular death by 2,5 times [5]. An increased risk of death and hospitalization was also found in patients with atrial fibrillation with QRS within 90-119 ms [6]. The closest associations were revealed for the "preblock" QRS duration ≥110 ms. Patients with QRS duration ≥110 ms have a 2,5 times higher risk of sudden cardiac death even after adjustment for demographic and clinical risk factors. According to authors from Thomas Jefferson University, QRS duration ≥110 ms without bundle branch blocks is an independent predictor of death from non-ST elevation myocardial infarction, as well as the ventricular arrhythmias within 30 days or 1 year after the event [7].

Despite the great deal of clinical data on the prognostic value of different QRS duration (>90, 100, 110, 120 ms, etc.), the epidemiological characteristics of this ECG indicator, including "preblock" QRS, have not been studied enough.

The aim was to assess the prevalence of wide QRS complex (≥110 ms) among the population, depending on sex, age, place of residence (urban or rural area), the presence of obesity and CVD.

Material and methods

The analysis included the ECG of 17364 men and women aged 25-64 years as part of random samples of the population in regions participating in the ESSE-RF study (2012-2014). The study was approved by the ethics committees of three research centers: National Medical Research Center for Preventive Medicine; Almazov National Medical Research Center; National Medical Research Center of Cardiology. All participants signed an informed consent.

In all regions participating in the study, ECG was recorded on a PadSy ECG management system (MedSet, Germany), followed by the transfer of digitized ECG information to the Federal Database located in the National Medical Research Center for Preventive Medicine (Moscow). Twelve-lead ECG was recorded in the supine position, at rest, according to standard methodological requirements. ECG analysis and coding according to the Minnesota code manual was carried out by two specialists of National Medical Research Center for Preventive Medicine. The third specialist was involved in disputed cases. ECGs were classified into two groups (QRS <110 ms, QRS ≥110 ms), and for a more detailed analysis, into 3 groups (QRS <110 ms, 110-119 ms and ≥120 ms). Heart rate (HR) was calculated by the RR interval.

The prevalence of QRS ≥110 ms was estimated in sex and age groups, depending on place of residence (urban or rural area), as well as among people with general or abdominal obesity, with high BP ≥140/90 mm Hg at the examination time or history of CAD, as well as among people with major ECG abnormalities (Table 1).

History of diseases was assessed by interviewing subjects. People with a history of disease included those who answered in the affirmative the question: "*Have you ever been told by a doctor or other medical professional that you have myocardial infarction or coronary artery disease?*". BP was measured on the right hand three times with a 5-minute interval in the sit-ting position using an OMRON M3 Expert monitor (Japan). In individuals with a body mass index >30 kg/m^2, obesity was recorded; in men with a waist circumference ≥102 cm (for women ≥88 cm) — abdominal obesity.

Results

The characteristics of the subjects are presented in Table 2. The mean age in groups with different QRS duration did not statistically differ. Men were slightly younger than women in all categories studied. The prevalence of obesity and history of CAD prevailed in women, and elevated BP — in men.

Before the analysis start, the groups with normal and wide QRS complex (QRS <110 ms vs QRS ≥110 ms) were compared by HR (Table 3). The compared groups with QRS <110 ms and QRS ≥110 ms did not differ in HR, either in the population as a whole or in sex groups. Although in women, compared with men, HR was 2-3 bpm higher, regardless of the QRS duration. At the same time, women were on average 2,6 years older than men, but these differences were not significant (Table 2).

Prevalence, age and sex differences. The prevalence of wide QRS ≥110 ms among all subjects was 17,2%. In men, this ECG sign was more common than in women (18,5% vs 16,2%, respectively; p<0,0005) (Figure 1). These differences were characteristic of all age groups.

An increase in the prevalence of wide QRS complex with age was observed regardless of sex (from 11,1% to 19,2%, p<0,001); the greatest increase (by 5%) was recorded after 55 years. At the same time, an increase in the prevalence of QRS ≥110 ms in men began only after 45 years, while in women — from 25-34 years, remaining on a plateau for the next 20 years (35-54 years). In addition, the proportion of women with wide QRS ≥110 ms in the last age group was more than 2 times higher than the youngest group (18,6% in 55-64 vs 8,9% in 25-34 years old) (Figure 1).

Table 1

Major ECG abnormalities

ECG abnormalities	2009 Minnesota code
Major Q/QS waves	Minnesota codes 1-1-1 through 1-2-7
Major ischemia	Minnesota codes 4-1 or 4-2, (ST abnormalities), 5-1 or 5-2 (T wave abnormalities), no 3-1 and 3-3 (LVH)
Major arrhythmias and conduction defects	
Atrial fibrillation or flutter	any of group of Minnesota codes 8-3
A-V conduction defect	Minnesota codes 6-1 or 6-2 (third and second degree A-V block), 6-8 (artificial pacemaker)
Ventricular conduction defect	Minnesota codes 7-1 or 7-2 (Complete left or right bundle branch block), 7-4 (intraventricular block), 7-8 (bifascicular block)

Abbreviations: A-V — atrioventricular, ECG — electrocardiographic.

Characteristics of the subjects

Parameters	Number of subjects, n:		
	Men	Women	Total in population
Total of subjects aged 25-64 years:	6656	10708	17364
25-34 years	1661	1861	3518
35-44 years	1423	2062	3478
45-54 years	1728	3158	4898
55-64 years	1844	3627	5470
Mean age, years	45,0±11,8	47,6±11,3	46,3±11,5
Mean age (years) in the group with QRS <110 ms	44,6±11,8	47,1±11,3	45,1±11,6
Mean age (years) in the group with QRS ⩾110 ms	47,2±12,0	50,1±10,7	48,6±11,3
Place of residence: Urban area	5439	8566	14005
Rural area	1265	2233	3498
Obesity, % (n)	27,8	32,0*	30,7 (5890)
Abdominal obesity, % (n)	26,0	38,6*	34,0 (6613)
Increased blood pressure, % (n)	45,0	37,0*	40,1 (8858)
History of coronary artery disease, % (n)	23,2	33,2*	29,3 (2649)
Major ECG abnormalities, % (n)			6,8 (1176)

Note: * — differences between men and women at p<0,0005.
Abbreviations: ECG — electrocardiogram.

Mean heart rate in groups with QRS <110 ms and QRS ⩾110 ms in men, women and in the population

Parameter — Groups:	Men		Women		P men vs women	Total in population	
	n	M±m.	n	M±m.		n	M±m.
1. QRS <110	5387	67,15±0,15	8830	69,33±0,11	<0,001	14217	68,50±0,09
2. QRS ⩾110	1272	66,56±0,37	1879	69,79±0,27	<0,001	3151	68,49±0,22
Significance of differences, p in groups 1 vs 2		>0,05		>0,05			>0,05
Total	6659	67,03±0,14	10709	69,41±0,10	<0,001	17368	68,50±0,08

The analysis of age dynamics among three groups with QRS duration <110 ms, 110-119 ms and ⩾120 ms showed that wide QRS occurred with age not so much due to intraventricular block (QRS ⩾120 ms), but due to an increase in the prevalence of "pre-block" QRS duration (110-119 ms) (Figure 2). It should be noted that "preblock" QRS was more common in men than women (12,3% vs 10,9%, p<0,025). QRS duration ⩾120 ms in the sex groups was almost the same (6,7% in women and 6,8% in men). Thus, the revealed higher prevalence of QRS ⩾110 ms in men was due to an increase of "preblock" QRS duration (110-119 ms).

Urban-rural residence. In men living in urban and rural areas, QRS ⩾110 ms was found with the same frequency (18,6% and 18,3%, respectively; p>0,05), while in women, this indicator was less common for urban residents and compared to men, regardless of place of residence (Figure 3).

QRS duration and diseases. To determine the cause of revealed differences in wide QRS prevalence in various categories of subjects and taking into account the higher prevalence of some CVDs and metabolic disorders in rural residents [8, 9], the relationship of wide QRS with obesity, high BP and CAD was analyzed.

The results showed that the prevalence of obesity, regardless of type (general or abdominal), increased BP, history of CAD in groups with wide QRS complex is higher both in the population (Figure 4) and in sex groups. Among people with QRS ⩾120 ms, the number of patients with these diseases was about
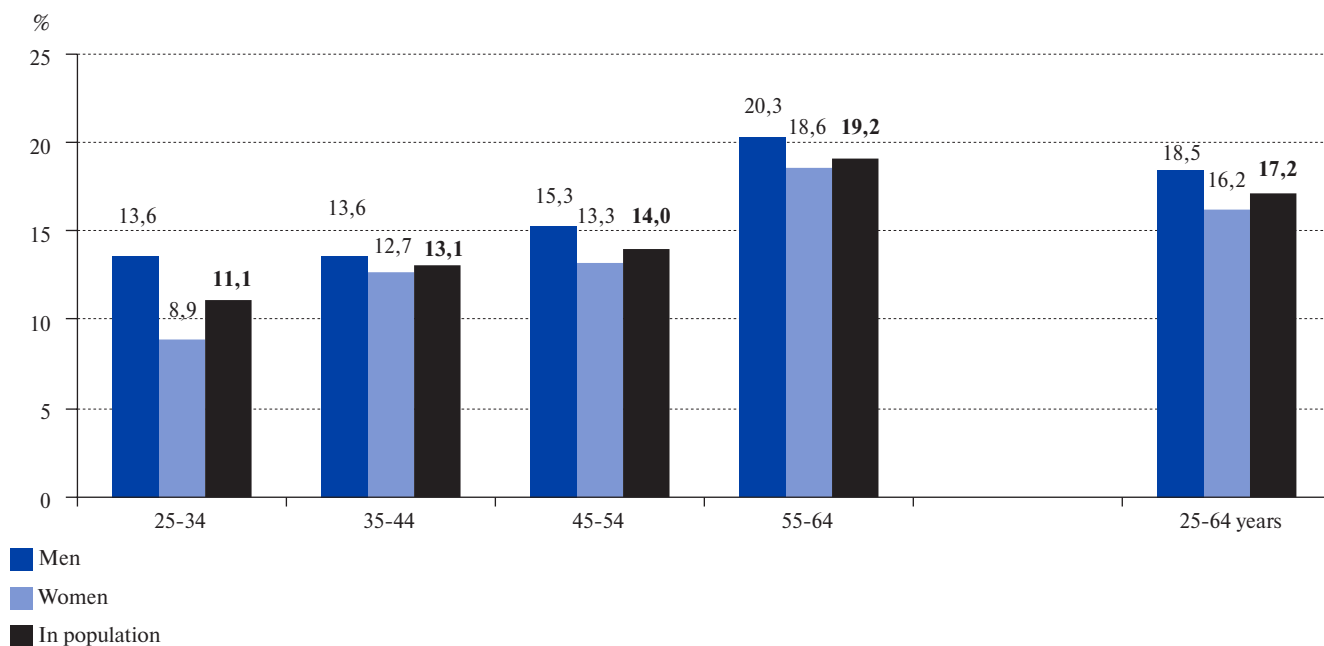
Figure 1. Prevalence of QRS ⩾110 ms in the population and sex groups depending on age (%).
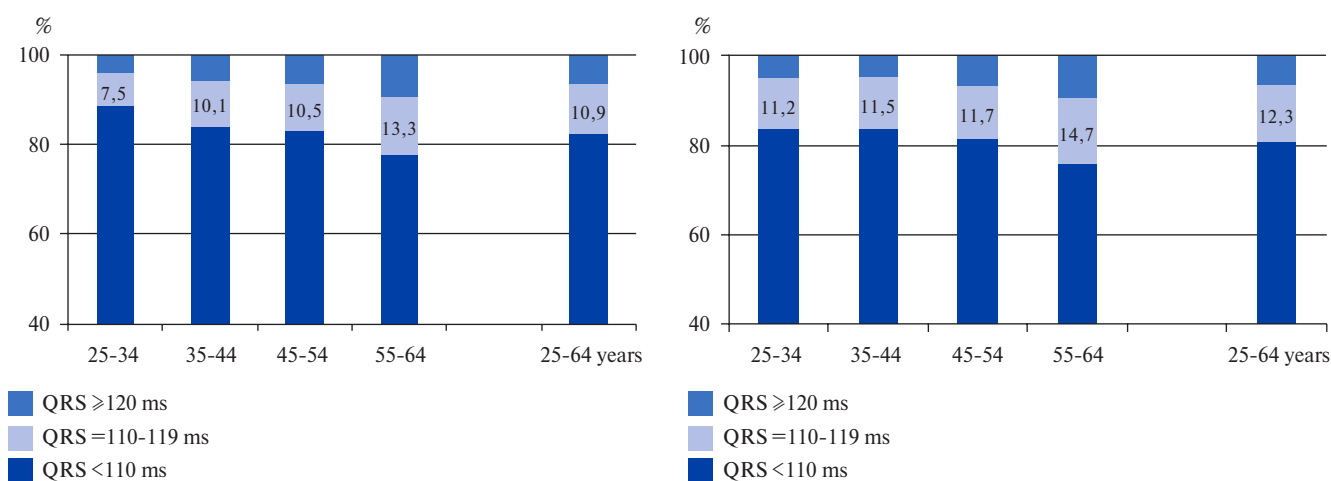

Figure 2. Distribution of QRS duration among women (left diagram) and men (right diagram) depending on age (%).
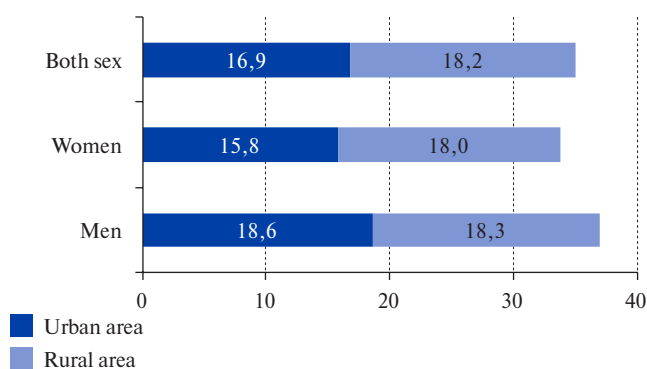

Figure 3. Prevalence of QRS ⩾110 ms in men and women depending on the place of residence (%).

10-12% higher than among people with normal QRS duration. These differences were significant, while between groups with "preblock" and "block" QRS, the proportions of obese and CAD patients differ only as a trend (p<0,1). This may indicate that people with these diseases already have a "preblock" duration of ventricular depolarization (110-119 ms), indicating the presence of myocardial changes.

QRS duration and ECG abnormalities. Wide QRS was often combined with other ECG abnormalities. Among people with QRS ⩾110 ms, major ECG abnormalities characteristic of people with CAD were more common, accounting for 14,3% vs 4,7% in people with normal QRS duration (p<0,001).
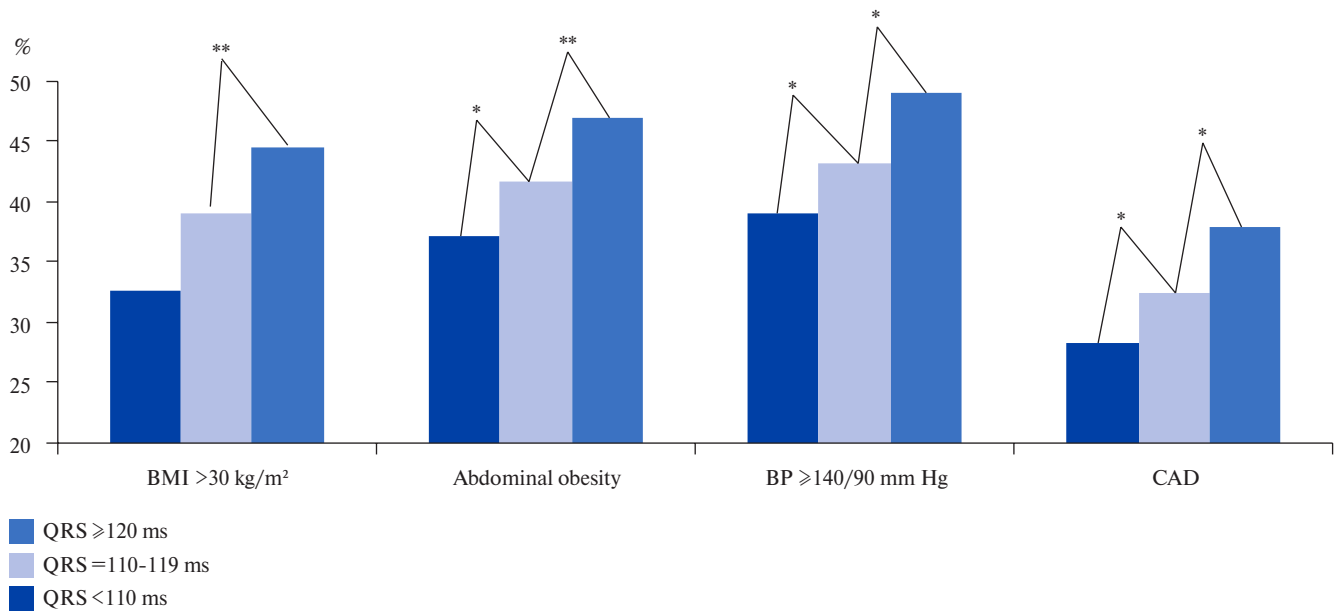
Figure 4. The proportion of individuals with general (BMI >30 kg/m²) and abdominal obesity, high blood pressure (≥140/90 mm Hg) and CAD in groups with different QRS duration (%).
Note: * — p<0,05, ** — p<0,1, other differences — p<0,0005.
Abbreviations: CAD — coronary artery disease, BMI — body mass index.

At the same time, sex differences in the prevalence of ECG with abnormalities were noted only among individuals with wide QRS: 16,6% in men vs 12,9% in women (p<0,01). The prevalence of major ECG abnormalities in men and women with normal QRS duration did not differ (4,6% and 4,9%, respectively; p>0,05). After excluding subjects with complete intraventricular block, similar proportions between the prevalence of major ECG abnormalities in groups with different QRS durations remained, but sex differences were not observed in the wide QRS group: prevalence of major ECG abnormalities was 9,9% in men and 9,6% in women with QRS ≥110 ms (p>0,05). Taking into account the same prevalence of complete bundle branch blocks in the analyzed sex groups, the latter seems natural.

Despite the rather high prevalence of elevated BP in individuals with "preblock" and "block" QRS (Figure 4), left ventricular hypertrophy (LVH) in groups with different QRS duration did not differ significantly (1,7% in normal QRS group vs 2,2% in QRS ≥110 ms group; p>0,05). Although in men, the prevalence of LVH was expectedly higher compared with women (3,0% vs 0,9%, p<0,0005). No significant difference was found in groups with different QRS duration either in the population or in the sex groups.

Discussion

For the first time, the prevalence of wide QRS (≥110 ms) in the population of Russian men and women was presented, which was 18,5% and 16,2%, respectively, and in the sample in general — 17,2%. In the analyzed literature, we did not find data on the prevalence of QRS ≥110 ms in populations of other regions The prevalence of such unfavorable prognostic ECG indicators, such as major ECG abnormalities, is more often estimated. Comparison of the prevalence of the analyzed parameter with other unfavorable prognostic ECG criteria showed that the prevalence of wide QRS (≥110 ms) obtained in this analysis is higher than the prevalence of conduction disorders and major ECG abnormalities detected in the population (6,5% in the population, 7,0% in men and 6,3% in women). The higher frequency of wide QRS (≥110 ms) obtained in our study allows to expect a slightly larger number of adverse cardiovascular events in the population than is predicted by routine ECG analysis.

The sex relations and age dynamics of wide QRS obtained in the study are consistent with the results of other studies [2]. It has been shown that the association of QRS duration with morbidity and mortality depends on age [6]. Although almost all researchers recognize an increase in cases of wide QRS with age. Observation of 25-year-old men and women of white and black race with normal QRS duration (n=2537) at baseline after 20 years did not reveal modifiable risk factors leading to QRS >100 ms [10]. Researchers noted that in middle age there is an increased risk of QRS lengthening in white men with increased left ventricular mass index and QRS dura-

tion at a young age. The significant increase in the prevalence of wide QRS after 55 years in our study also corresponds to previous data on the frequency of conduction disorders, including intraventricular block [11, 12].

It can be assumed that the revealed differences in the prevalence of wide QRS depending on sex and place of residence are associated with special distribution of CVD and metabolic disorders in different population groups. Thus, the predominance of increased BP in the male population relative to the female has been shown in different countries [13], including in Russia according to the ESSE-RF study [8]. The differences can also be enhanced by the fact that the number of men being treated and controlling BP level is significantly less than of women: according to the study Boytsov S.A., et al. (2014), only 14,4% of hypertensive men successfully control the BP level vs one third of women with the same disease [9]. In rural residents, HTN prevalence, according to the same study, was higher regardless of sex.

The prevalence of obesity in the ESSE-RF study, on the contrary, was higher among the female population. However, the growth rate of obesity in men is significantly higher than in women: in men, increment of obesity since 2003 has more than doubled, in women — only by a few percent [8]. Obesity is not only associated with an increase in BP, but also with an increase in the number of ineffectively treated patients [14], which affects the frequency of HTN. Thus, the rather high frequency of wide QRS obtained in rural residents according to current study may be associated with a higher prevalence and worse control of obesity and HTN in this category of patients.

The parallelism of changes in QRS duration and the prevalence of obesity, increased BP and CAD (Figure 4) suggests the relationship of these phenomena. However, the relationship of these diseases with a decrease in ventricular depolarization and/or conduction disorders, which causes a lengthening of QRS ⩾110 ms, needs to be clarified in further studies.

Study limitations. To assess the prevalence of LVH in this study, generally accepted ECG criteria were used, namely Minnesota codes 3-1 and 3-3, corresponding to the Sokolov-Lyon voltage criteria, which are not sensitive enough.

Conclusion

The prevalence of QRS ⩾110 ms being an unfavorable prognostic ECG indicator was 17,2% among people aged 25-64 in the ESSE-RF study (18,5% in men and 16,2% in women).

QRS duration ⩾110 ms, like most other ECG disorders (except for ST-T wave abnormalities), prevails in men and increases with age.

The greater prevalence of wide QRS among men compared with women is due to the predominance of "preblock" QRS duration (110-119 ms) in male sample, and not cases of bundle branch blocks.

The results suggest that the greater prevalence of wide QRS in rural residents is due to the higher frequency of obesity, high BP and CAD in this category of population. However, this supposal requires further verification.

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