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Electrocardiographic Changes Improve Risk Prediction in Asymptomatic Persons Age 65 Years or Above Without Cardiovascular Disease

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ABSTRACT

BACKGROUND Risk prediction in elderly patients is increasingly relevant due to longer life expectancy.

OBJECTIVES This study sought to examine whether electrocardiographic (ECG) changes provide prognostic information incremental to current risk models and to the conventional risk factors.

METHODS In all, 6,991 participants from the Copenhagen Heart Study attending an examination at age ≥65 years were included. ECG changes were defined as Q waves, ST-segment depression, T-wave changes, ventricular conduction defects, and left ventricular hypertrophy based on the Minnesota code. The primary endpoint was fatal cardiovascular disease (CVD) event and the secondary was fatal or nonfatal CVD event. In our study, 2,236 fatal CVD and 3,849 fatal or nonfatal CVD events occurred during a median of 11.9 and 9.8 years of follow-up.

RESULTS ECG changes were frequently present (30.6%) and associated with conventional risk factors. All ECG changes except 1 univariably predicted both endpoints. Event rates of ECG changes versus no ECG changes were respectively 41.4% versus 27.8% and 64.6% versus 50.8%. When added to existing risk scores, ECG changes independently increased the risk of both endpoints. Fatal CVD events: hazard ratio (HR): 1.33 (95% confidence interval [CI]: 1.29 to 1.36; $p < 0.001$) and fatal or nonfatal CVD events: HR: 1.21 (95% CI: 1.19 to 1.24; $p < 0.001$). When added to conventional risk factors, continuous net reclassification improvement was 42.3% (95% CI: 42.0 to 42.4; $p < 0.001$) for fatal and 29.2% (95% CI: 28.4 to 29.2; $p < 0.001$) for fatal or nonfatal events. Categorical net reclassification was 7.1% (95% CI: 6.7 to 9.0; $p < 0.001$) for fatal and 4.2% (95% CI: 3.5 to 5.6; $p < 0.001$) for fatal or nonfatal events.

CONCLUSIONS Simple assessment of the existence of ECG changes improves risk prediction in the general population of persons age ≥65 years. (J Am Coll Cardiol 2014;64:898–906) © 2014 by the American College of Cardiology Foundation.

By 2050, 25% of persons alive in the Western world are expected to be ≥65 years (1). This demographic transition will be a major socioeconomic challenge in the coming decades and all possible efforts undertaken to minimize the morbidity of this increasingly growing population are needed to limit healthcare expenses and facilitate later retirement from the labor market.

Cardiovascular disease (CVD) will remain a leading cause of morbidity in the Western world (2), and in this context, preventing its occurrence in the healthy, older persons at increased risk is essential. However, little is known on how to perform individual risk assessment in this age group. Risk prediction models that are otherwise recommended for this purpose in the middle-age population are not

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suitable in older persons, as they are derived from populations of none or only few persons age ≥65 years (3,4). Moreover, conventional risk factors are not as influential in the development of CVD in this age group as they are in the middle-age population (5), and consequently, other risk markers are needed.

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Electrocardiographic (ECG) changes carry a large potential of such a marker. Their prevalence increases rapidly in this age group (6); they are easily assessed in most clinical settings; and they are a marker of direct pathology, representing at least some level of subclinical, cardiac impairment. In addition, the past 50 years, a number of studies have shown that ECG changes are strongly associated with future CVD in persons who are not previously diagnosed with the condition (7–12).

Although use of the ECG in risk prediction is not currently recommended in asymptomatic individuals (13), it may be very well suited for this purpose in the subgroup of persons age ≥65 years. Therefore, we hypothesized that risk prediction of persons age ≥65 years would be improved by adding ECG changes. To test this, we examined whether adding ECG changes to the European Heart Score (3), the Framingham Global Risk Score (14), and the conventional risk factors would contribute with incremental prognostic information and improve risk prediction.

METHODS

STUDY COHORT. The Copenhagen City Heart Study was initiated during a 2-year period from 1976 to 1978. At that time, a random sample of 19,329 mainly white Caucasians living within a well-defined area of the inner Copenhagen City Boundary was randomly selected and invited to participate (participation rate: 74% [n = 14,223]). In the subsequent examinations, the surviving participants were invited again, and the cohort was supplemented with persons from the younger strata (Figure 1). For the present purpose, only persons who have attended an examination at an age ≥65 years and were free from CVD at the time of the examination were included. Persons with missing ECG were excluded.

All subjects gave informed consent to participate, and the Regional Ethical Committee for Medical Research in Copenhagen approved the study.

CONVENTIONAL RISK FACTORS. Conventional risk factors were defined as risk factors from either the European Heart Score or the Framingham Global Risk Score, which include the following: increasing age; systolic blood pressure; total cholesterol; male sex; current smoking; and diabetes. They were assessed as follows. Blood pressure was measured after 5 min of rest using the left arm with a cuff adjusted to arm circumferential. Smoking status was self-reported. Total cholesterol was measured at all examinations,

ABBREVIATIONS AND ACRONYMS

CI = confidence interval
CVD = cardiovascular disease
ECG = electrocardiogram/electrocardiographic
HR = hazard ratio
ICD = International Classification of Diseases
IQR = interquartile range
NRI = net reclassification index

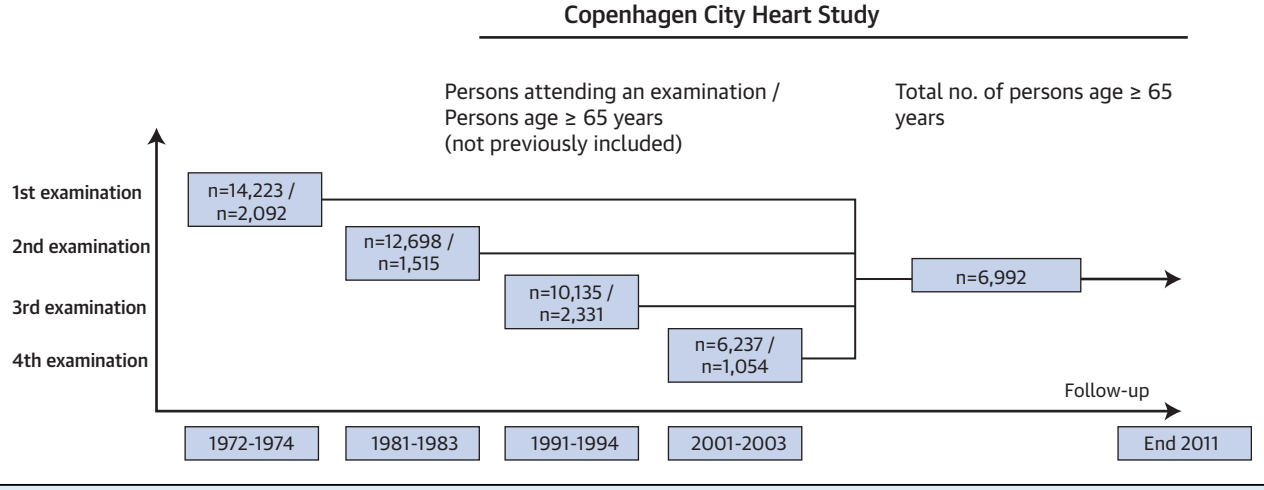

FIGURE 1 Participants Included in the Present Cohort of Persons Age ≥65 Years

For each examination, the total number of persons attending and the total number of persons age ≥65 years are shown. The persons age ≥65 years were pooled in the present cohort. A person could only be included once in the present cohort.