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Improving electrocardiogram interpreting skills among primary care physicians in Turkey

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Aim: To investigate the improvement in electrocardiogram (ECG) interpreting skills after a standardized ECG interpreting program as a continuous medical education activity among primary care physicians.

Materials and methods: The study was conducted in Turkey between December 2006 and October 2010. Out of the 81 provinces in Turkey, 17 were randomly selected and all physicians were invited to take the course on a voluntary basis and in total 798 physicians agreed to participate. The course was a half-day program. A test was applied to the participants before and after the training. The results of 781 participants were analyzed.

Results: Of the participants, 417 (59.1%) were men and 288 (40.9%) women. The participants had graduated between 1977 and 2009. Mean scores participants received from the pretest and final test were 31.0 ± 21.9% and 86.3 ± 14.4%, respectively ($t = -58.4$, $P < 0.001$). Of the participants, 673 (86.2%) failed and 108 (13.8%) passed the pretest, whereas 23 participants (3.0%) failed and 746 participants (97.0%) passed the final test ($\chi^2 = 1083.6$, $P < 0.001$).

Conclusion: Structured education programs like this one have a positive contribution to the knowledge and skills of physicians. Undergraduate and postgraduate education on ECG interpretation should be arranged for primary care physicians.

Key words: Electrocardiogram, primary care, medical education

Introduction

Electrocardiogram (ECG) is one of most classic methods of examination in general medical practice (1,2). After more than 100 years of practical use, it is indispensable in the diagnosis and follow-up of cardiac diseases (3). The fact that cardiovascular diseases rank top in the worldwide most common causes of mortality makes ECG much more important (4). Hence, it is essential that primary care physicians possess the necessary knowledge and skills to interpret this simple, non-invasive, and inexpensive test.

The ECG is a basic, easy, and handy tool, very useful for the right approach in patients with suspected heart disease. The test provides important information on the heart rhythm and is essential for the diagnosis and therefore treatment of arrhythmic problems. It gives also information on the ventricular dimensions and volume and/or pressure overload of one or both ventricles. In case of malformation, the test enables the physician to suspect the type of malformation (5).

Studies have shown different values of ECG depending on the context and disease. ECG has a relatively low sensitivity (6), but its specificity is calculated to be between 43% and 99% for different diagnoses (7-9). The ECG, in addition to history taking and physical examination, can prevent 1 out of 5 referrals in primary care (10).

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Despite automatic evaluation programs of ECG, which are nowadays almost standard, physicians should understand the ECG well, and must be able to correct frequent inaccuracies in the automatic evaluations (3). However, the confidence and knowledge of general practitioners in interpreting the ECG are inadequate (11).

Based on the aspects above, we hypothesized that an ECG interpreting skills course prepared from the point of view of family medicine should improve the knowledge and skills of primary care physicians. To test this hypothesis, we prepared a standardized education program as a continuous medical education activity in primary care and investigated the posteducational improvement in the participants' knowledge and skills.

Materials and methods

Setting

The study was conducted in Turkey among physicians working in primary care. During the study, approximately 20,000 primary care physicians were working in the 81 provinces in Turkey.

Population

The population of the study consisted of all physicians working in primary care in Turkey. Out of the 81 provinces, 17 were randomly selected and all physicians were invited to take the course on a voluntary basis and in total 798 physicians agreed to participate. Seventeen participants did not complete the course and so the results of 781 (4% of total population) participants were analyzed.

Data collection

The study was conducted between December 2006 and October 2010. The data were collected through a questionnaire comprising demographic features and test questions developed by the researchers. Test questions were prepared to evaluate the knowledge and skills of the participants. In order to assess their theoretical knowledge we asked multiple choice questions and to assess their practical skills we asked the participants to interpret ECGs. At the beginning, a set of 50 questions was prepared. After the application of the 50-question test to a group of 20 general practitioners outside the study population, the 10 best questions were selected in view of the questions' difficulty and discrimination levels. The test consisted of 5 multiple choice questions related to ventricular hypertrophy, electrical conduction velocity, rhythm, ischemia, and basic pattern of ECG; and 5 reasoning questions related to atrial fibrillation, left ventricular branch block, atrioventricular block, ischemia, and myocardial infarction aiming to determine ECG interpretation skills. Each question had a score of 10 points. The cut-off value for passing the test was set at 60%.

The same test was applied to each participant right before (pretest) and after the course (final test). The participants were asked to complete the exam within 30 min. Test scores were calculated separately as pretest, final test, theory, and practical scores.

Course details

The program was a half-day course using interactive education methods. Its aim was defined as "To equip the participants with the basic skills necessary for ECG interpretation in primary care". We had the following course objectives:

At the end of the half-day course, the participants should be able to:

- Recognize a normal ECG
- Distinguish the most common ECG diagnosis encountered in primary care
- Explain physiological cardiac electrical conduction
- Follow a systematic approach in ECG interpretation

The course program was applied in the following order: application of pretest, sharing of important experiences about ECG, interactive presentations of ECG interpretations, workshops of ECG interpretation, and application of final test. Number of participants in each course was restricted to 25 doctors. The course was applied by 2 trainers.

Statistical analysis

The data were analyzed using a statistical software package. Frequency distribution, chi-square test, dependent samples t test, McNemar test, and Pearson correlation analysis were used in the data analysis. The significance level was set at $P < 0.05$.

Results

A total of 781 primary care physicians participated in the study. The mean age was 34.3 ± 5.9 years. Of the participants, 417 (59.1%) were men and 288 (40.9%) women. The participants had graduated between 1977 and 2009 and mean graduation year was 1997.5 ± 6.1.

Ninety (11.5%), 273 (35.0%), 184 (23.6%), 137 (17.5%), and 97 (12.4%) physicians participated in the study in 2006, 2007, 2008, 2009, and 2010, respectively.

Perceptions of the participants' own knowledge about ECG and the difficulty in ECG interpretation are shown in the Table.

Of the participants, 211 (28.5%) reported that they had not had any postgraduate training in ECG interpretation. Two hundred sixty-two participants (46.9%) reported that they were never ordering ECG for their patients.

Mean scores participants received from the pretest and final test were 31.0 ± 21.9% and 86.3 ± 14.4%, respectively. Using a dependent samples t test, a significant difference was found between pretest and final test scores ($t = -58.4$, $P < 0.001$).

Of the participants, 673 (86.2%) failed and 108 (13.8%) passed the pretest, whereas 23 participants (3.0%) failed and 746 participants (97.0%) passed the final test. These results showed a significant difference between the pretest and final test ($\chi^2 = 1083.6$, $P < 0.001$; Figure 1).

Participants' theoretical and practical scores on the pretest and final test are shown in Figure 2. There was a 247% increase in theoretical scores between the pretest and final test, whereas the increase was 314% in practical scores. A significant difference was found between pretest and final test scores of theoretical and practical scores (t and P respectively, –42.6, <0.001 and –52.1, <0.001).

Pearson correlation analysis was used to evaluate the relationship between graduation year and practical pretest scores. The results showed a significant positive relationship between graduation year and practical pretest scores ($r = 0.120$, $P = 0.006$).

Discussion

The posteducational significant improvement in correct answers to the theoretical and practical questions in our study suggests that such structured education programs have positive contribution to the theoretical knowledge and practical skills of physicians.

Seven out of 10 participants' reporting insufficient knowledge in ECG interpretation, as well as 4 out of 5 participants' reporting that ECG reading is difficult, supports the idea that primary care physicians are not qualified enough in ECG interpretation. Medical education and postgraduate education should be regarded as the source of this problem that doctors face in their practice. As in many countries, ECG education makes up a very small part of medical

Table. Participants' opinions about their own ECG interpretation knowledge and skills.

		n (%)	χ^2, P*
How do you grade your own ECG interpretation?	*Sufficient*	19 (2.7)	*485.5, <0.001*
	Intermediate	201 (28.1)	
	Insufficient	496 (69.2)	
	Total	716 (100)	
How difficult is ECG interpretation in your opinion?	*Very difficult*	107 (15.6)	*843.6, <0.001*
	Difficult	452 (66.1)	
	Easy	120 (17.5)	
	Very easy	5 (0.7)	
	Total	684 (100)	

Chi-square test used. *Correlation is significant at the 0.001 level (2-tailed).

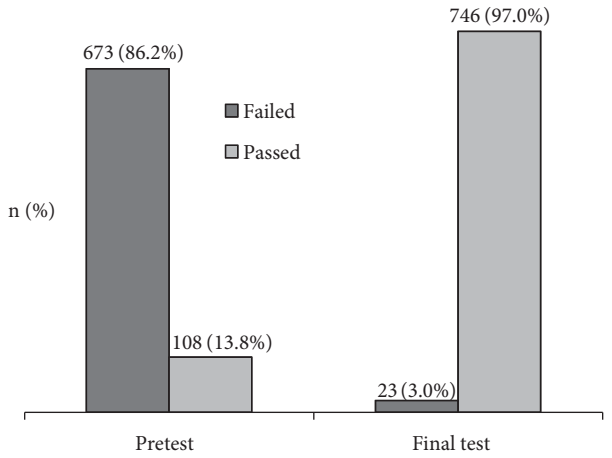
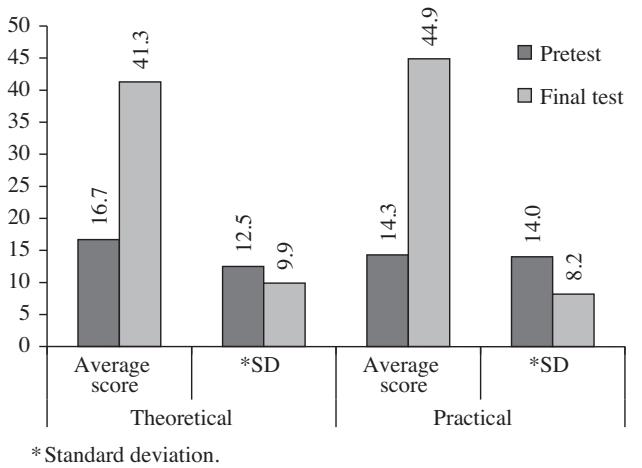


Figure 1. Rates of pass and fail in the pretest and final test.



* Standard deviation.

Figure 2. Theoretical and practical scores on the pretest and final test.

education in Turkey. Unfortunately, there are insufficient efforts to make up for it after graduation. Parallel to this, we found that one third of our participants had not received any previous education regarding ECG.

ECG is a useful instrument, in addition to history taking and physical examination, because it changes the general practitioner's management of patients with suspected cardiovascular symptoms or disease (10). It is the most common clinical tool for detection and diagnosis of heart disease, and is especially useful for detecting conditions related to abnormalities of cardiac rhythm (12-14). ECG interpretation in acute chest pain can be also highly specific for diagnosing myocardial infarction (15). The responsibility for correctly interpreting an ECG lies with the physician, who should be able to recognize patient-dependent errors, operator-dependent errors, and artifacts (12).

The reason for giving more correct answers to the practical questions than to the theoretical ones can be linked to the practical orientation of the course, which is actually an indicator that increasing practical skills is possible with the given course design. Even though it was not evaluated in our study, it is known that physicians cannot find time to read in order to improve themselves. A previous study showed that time allocated weekly for medical reading in Norway was 3 h among family physicians and 4.5 h among hospital doctors (16).

The relatively high age of our participants may have made it difficult for them to remember the knowledge gained in medical school. Theoretical scores of the pretest were higher than the practical scores. This may be a result of the doctors' hesitation to ask for and interpret ECGs. As a result, we assume that practical skills have evaporated with time while at least some of the theory knowledge remained. On the other hand, the bigger increase in the practical scores when compared with the theory at the end of the course may be attributed to the course structure's focusing on practice and experiential learning.

While it is normally expected that practical knowledge improves over time, practical pretest scores in our study were higher in recent graduates. This is in accordance with the above explanation of young graduates having fresh skills coming from medical school while older colleagues lose their skills over time due to lack of use.

If we intend to improve the skills of our physicians in interpreting ECG, their knowledge of ECG interpretation skills should be reinforced periodically after graduation. There is a need for education programs on ECG that should start at undergraduate level and be supported by postgraduate education programs, attracting primary care physicians (17). On developing the education program, frequent disorders in primary care and physicians' learning needs should be considered (18).

Since continuous medical education (CME) and quality improvement have the same scope of providing the best health care for the population,

education programs should be integrated with quality improvement activities and especially with clinical guidelines.

The present study has some limitations. It evaluates the effect of education right after the course. Long-term impact could be evaluated by repeating the test after some time and observing the participants in their clinical settings.

In conclusion, interpretation of ECG makes up only a small part of medical education. This study shows that undergraduate and postgraduate education programs on interpreting skills of ECG are essential. Primary care physicians should not be expected to be at the same level with the cardiologist when interpreting ECG. However, a standard postgraduate CME program can minimize the difference between individual competencies, as well as preventing medical malpractice and wasting of resources due to unnecessary referrals and advanced investigations.

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