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Pre-Participation Screening of Athletes: Primary Health Care Physicians' Knowledge, Experience, and Approach in Turkey

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Pre-participation screening (PPS) is crucial for assessing the competitive athletes since their risk of sudden death is higher than non-athletes. In Turkey, PPS is performed at the primary health care setting by primary care physicians (PCPs) who are family medicine specialists (FMSs) or general practitioners (GPs). Although there are national guidelines, there is no legal regulation for this process. This study aims to evaluate PCPs' knowledge, experience, and approach about PPS. We prepared an online survey for PCPs and used non-probabilistic sampling. PPS attitudes and practices were analyzed and compared according to factors such as experience, education, and being GP or FMS. Of the 214 PCPs included in the study, 39.3% were female. The mean age was 44.9 years (SD:8.88). The average work experience was 7.9 years. Most participants were aware of their authorization to perform PPS (89.7%) and had previously prepared it (90.2%). However, 6.5% of them felt confident in performing PPS. Only 13.1% were aware of the guidelines. Almost 25% of the participants stated being informed about the subject at some part of their career, but this did not affect the confidence or referral decisions. In addition to medical history and physical examination, further testing was considered necessary by 96.3% of the participants. Significantly more tests were ordered by GPs than FMSs (p=0.026 and p=0.011, respectively). The accurate referral decision ratio was 59.3%, without difference between FMSs and GPs (p=0.216). We found that awareness of the guidelines was low among PCPs who lack confidence in PPS. These factors collectively increased the tendency for unnecessary further testing and referral. Therefore, the PPS implementation into medical school and residency curriculums and national legal regulation for the process is a necessity in Turkey.

INTRODUCTION

Sudden cardiac death (SCD) is an unexpected natural death due to a cardiac cause within 1 hour from the onset of a person's symptoms without any prior condition [1]. SCD incidence ranges from 1/40,000 to 1/80,000 athletes per year [2]. Although SCD is rare, it is tragic as the athletes are young and seemed healthy. Also, it has been

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Abbreviations: PPS, Pre-Participation Screening; PCP, Primary Care Physician; FMS, Family Medicine Specialist; GP, General Practitioners; SCD, Sudden Cardiac Death; AHA, American Heart Association; cFMR, Contractual Family Medicine Residents.

Keywords: screening, sports medicine, Turkey, primary health care, family medicine, athlete health

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shown that the SCD risk for young competitive athletes is 2.5 times higher than that of non-athletes [3]. Participating in sports is considered a trigger in the presence of an underlying cardiovascular condition rather than a risk factor itself [4]. Therefore, the implementation of pre-participation screening (PPS) is highly critical to prevent SCD by detecting at-risk athletes and early intervention.

The most primitive form of PPS is the commonly used Physical Activity Readiness Questionnaire (PAR-Q), which includes seven questions to tell the participant whether a physician control is necessary or not before starting physical activity [5]. Currently, for sports activities at a competitive level, PPS performed by a physician is mandatory, but the content is variable.

There are currently two main guidelines for PPS, one from Italy and the other from the United States. In Italy, PPS performed by a sports medicine specialist and which includes a 12-lead electrocardiogram (ECG), has been mandatory since 1982 [6-8]. On the contrary, in the US, screening is performed at a primary health care setting by taking a medical history and physical examination using the American Heart Association (AHA) recommendations. AHA recommends the 14-element pre-participation cardiovascular screening for competitive athletes [9]. Seven of these 14 elements account for personal history (chest pain, syncope/presyncope, exertional fatigue, previous heart murmur, hypertension, previous restriction from sports, previous heart-related testing). Three of the 14 elements account for family history (sudden or unexpected death before 50 years of age, disability due to heart disease before 50 years of age, any diagnosis of certain cardiac conditions). The remaining four are physical examination elements (heart murmur, femoral pulses, brachial artery pressures, and physical stigmata of Marfan syndrome). Any positive so-called abnormal screening warrants further evaluation and ECG.

The Seattle Criteria for ECG interpretation in athletes was published in 2012 by international experts; it includes information about which ECG findings could be normal for an athlete's heart and which are abnormal [10-13]. Normal means common training-related ECG alterations are considered normal variants that do not require further evaluation in asymptomatic athletes. Whereas abnormal implies that the findings are unrelated to regular training or not expected to be a physiological adaptation to exercise, suggestive of an underlying cardiovascular condition, and requires further evaluation. The criteria were revised in 2017 and accepted internationally [14]. The application of the revised criteria increases the quality of screening by reducing false positive results [8]. The European Society of Cardiology SCD task force also published a guideline in 2015, which is more extensive and includes management [15].

In Turkey, screening can be performed at a primary health care setting by primary care physicians (PCPs) who have either of the following two titles: family medicine specialist (FMS) or general practitioner (GP). In Turkey, medical school is a 6-year program, including at least a 4-week mandatory internship at a primary health care setting. GPs complete a 3-week orientation program to become a PCP after graduation. FMSs complete a 3-year family medicine residency program. There is also a small population of contractual family medicine residents (cFMRs) who are PCPs working as GPs and continue their family medicine residency training at the same time. Although it is done mainly in a primary health care setting, PPS can also be performed by internal medicine specialists, cardiologists, and sports medicine specialists in hospitals.

The Turkish Medical Association prepared the "Primary care pre-participation screening guideline" for PCPs in 2018. The guideline includes the compulsory elements of history and physical examination together with a visual version of the revised Seattle Criteria [16]. The Turkish Ministry of Health published the "Personal health statement form for single physician health status report" in 2017; this is a medical history form that the physician could fill out as part of the history-taking or could be filled out by the patient [17]. It questions several symptoms for cardiovascular, respiratory, gastrointestinal, urogenital neuropsychiatric systems, family history, and any history of substance abuse or tobacco usage. Although there are national guidelines and standardized health statements, these documents come short of ensuring standardization of the evaluation process, as there is no legal enforcement for their PPS application.

This study aims to evaluate primary care physicians' (PCPs) knowledge, experience, competency, and approach about PPS. Secondly, we aimed to analyze the relationship between PPS attitudes and practices according to factors such as duration of work experience, having received education on the subject, and being a general GP or FMS. The results of this study reveal the current situation in Turkey regarding the PPS approach of PCPs and provide baseline information on the necessity of PPS training at the undergraduate level from medical faculty and also at the postgraduate level during residency or an orientation program.

MATERIALS AND METHODS

The current study protocol was approved by the Koç University Institutional Review Board (approval number: 2019.073.IRB3.048). Online informed consent was obtained from the participants.

Participants and Setting

Non-probabilistic sampling was used. Physicians were reached through social media platforms where PCPs are members. The online survey was kept active from 14th February 2019 to 14th March 2019. The inclusion criteria were were working actively as a PCP in a primary healthcare setting in Turkey.

The Survey

The survey was prepared using the software Qualtrics XM (Provo, UT, USA). We constructed the survey questions according to the Turkish Medical Association primary care pre-participation screening guideline, Turkish Ministry of Health Personal Health Statement Form, and the 14-element AHA recommendations for the pre-participation cardiovascular screening of competitive athletes [16,18]. The survey consisted of five parts and 32 questions in total. All of the questions were structured or semi-structured.

Demographic features, including age, gender, history of competitive sports, medical school graduation year, and having received education on SCD in sports and PPS, were collected. Their education on SCD and PPS during medical faculty, residency, or orientation program was questioned along with the work experience in years. FMSs and cFRMs were taken together for the final analysis. Their awareness of the authorization for PPS and the Turkish Medical Association guideline was asked. Whether they feel confident about performing PPS or not was questioned. Their previous PPS experience was asked, along with the contents of their practice and the usage of the guidelines on PPS.

Application of the guidelines, like the 14 elements of the AHA, was evaluated by asking what should be included in an ideal PPS. First, they were asked whether the patient's history, family history, physical examination, ECG, echocardiogram, exercise stress test, pulmonary function test, chest X-ray, blood, and urine tests are necessary or not for the assessment of an athlete. It was given that the athlete in question has no complaints or findings. Next, the elements of these subgroups were asked in matrix questions if the participant marked any of them as necessary. The full list of the questioned elements is given in Appendix A, Supplementary Table 1. The details about further testing, such as the blood test content, were questioned if they were marked as necessary for the preceding question. Awareness of the Seattle criteria was asked directly as a multiple-choice question (whether they have heard/know the criteria) and evaluated indirectly by 27 referral questions. For 27 ECG findings, of which 16 should be referred according to the revised Seattle Criteria [14], participants were asked whether the condition requires a referral or not. Being a competitive athlete at any stage of their life was asked, assuming that they underwent PPS as a patient and expecting them to be more vigilant on this issue.

Anything other than a medical history and a physical exam was considered to be further testing in the absence of any symptoms and signs. Thus, further testing requests were accepted as an indirect measure of defensive medical decision making and the costly part of the PPS [19]. The necessity for ECG, echocardiogram, exercise stress test, blood and urine tests, chest X-ray, and pulmonary function tests were questioned along with the content of ordered blood and urine tests. AHA score is calculated separately for each participant. The maximum AHA score was 14, which is the number of elements in the AHA screening guideline [13]. Each criterion chosen as necessary by the participant was marked as one point, meaning that a higher AHA score is better.

The accurate referral ratio was calculated in the form of a referral score, where the total score is 27. We separately calculated the referral score out of 27 for each participant. It showed us how many of the referral decisions were correct out of 27 ECG findings asked. The correct referral decision was considered as i) referring to the patients that require further investigation based on the 16 of the 27 criteria and ii) not referring the patients that have a normal athlete's heart based on the 11 of the 27 criteria.

As an additional output of our study, we wanted to increase the awareness of PCPs on the topic. We prepared the following materials ready to be delivered to them upon their request i) the Turkish Medical Association primary care pre-participation screening guideline, ii) Personal Health Statement Form of the Turkish Ministry of Health, iii) the 14-element AHA recommendations for the pre-participation cardiovascular screening of competitive athletes, iv-v) two different studies that showed the effect of the implementation 12-lead ECG to PPS and compared the Italian and American systems, and vi) original and revised Seattle Criteria [7,9,11-14,16,18].

Statistical Analysis

Our outcome measures included self-competency of PCPs, awareness of the Turkish Medical Association guideline and the Turkish Ministry of Health Personal Health Statement Form, requests for further testing, knowledge about the AHA screening and Seattle Criteria, AHA score, and accurate referral ratio.

StataMP13 (StataCorp. 2013. Stata Statistical Software: Release 13. College Station, TX: StataCorp LP.) was used for descriptive and inferential analyzes. The Shapiro-Wilk test was used to assess normality. Mean with a standard deviation (SD) was used to analyze the normally distributed data. Median with 25 and 75 percentiles (p) was calculated for the not normally distributed data. Chi-square and Fisher exact tests were used for categorical outcomes. Mann-Whitney *U* test was used to

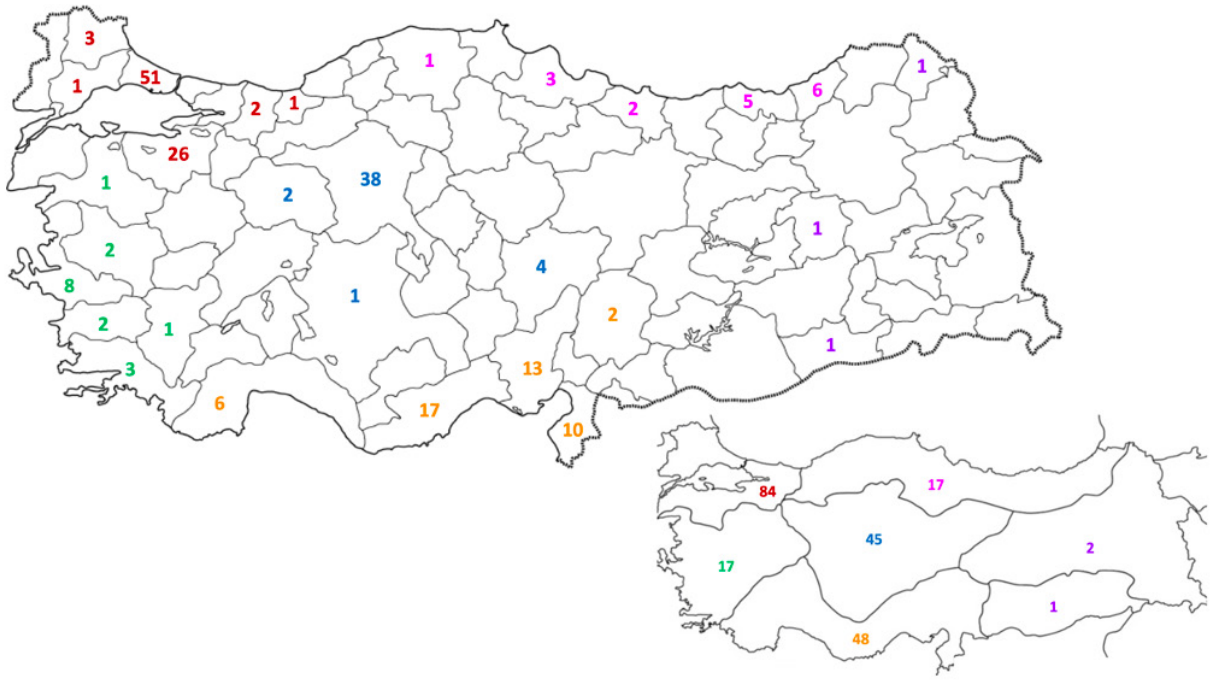

Figure 1. Participants from seven regions and 29 cities in Turkey*. Each color represents Turkey's different geographical regions. *Turkey has seven regions and 81 cities.

analyze the non-parametric data of the AHA score and referral score. We accepted a p-value less than 0.05 as significant.

RESULTS

A total of 312 physicians participated in our survey study. Inconsistent (2) and incomplete surveys (96) were excluded. Finally, 214 participants were included for analysis. Almost 60% of the participants were male (n=128); the mean age was 44.88 (SD: 8.88, min 24, max 65). Seventy participants (32.7%) were competitive athletes at some point in their lives. Nine participants contacted us to receive the literature on PPS.

Mean work experience as PCP was 7.91 years (min 1, max 28, SD: 3.83), where 21.0% of participants had less than five years, and 79.0% had five or more years. The majority of the participants (82.2%) were GPs, 14.5% were FMSs, and 3.3% were cFMRs. The participants were practicing in all of the geographical regions of Turkey; the majority (60.3%) have been practicing in the following cities: Istanbul (51, 23.8%), Ankara (38, 17.8%), Bursa (26, 12.2%), Izmir (8, 3.7%), and Antalya (6, 2.8%) (Figure 1).

Only 23.8% of the participants reported taking a course on SCD in sports and PPS of athletes as part of their medical school curriculum; whereas, more than one-third of them (35.5%) did not remember whether they did or not. When education about the subject was questioned at the postgraduate level, 32.3% of FMSs and 71.4% of cFMRs reported being informed. Almost 15.0% of FMSs (14.8%) did not recall this information More remarkably, when asked whether the relevant information was given during the orientation program to the GPs, only 13 GPs (7.4%) recalled being educated on the subject, 19.3% did not remember, and 73.3% reports not being educated at all (Figure 2).

Although their education on the topic was limited, the majority (89.7%) were aware of their authorization, and 90.2% had previously given health reports for sports participation. Nevertheless, only 14 (6.5%) stated as being confident. Twenty-eight (13.1%) were aware of the presence of the Turkish Medical Association guideline, and 12 (6.2%) used it for their previous reports. Although being low for both groups, awareness of the guideline was found to be higher among the FMSs and cFMRs compared to GPs (18.4% and 11.9%, p=0.048). Moreover, again being low for both groups, confidence was higher among GPs who were educated at the orientation program (23.1% vs 4.3%, p=0.013) (Table 1).

Almost 80.0% of the participants had never heard of Seattle Criteria. Awareness of the criteria was low regardless of their work experience, being a specialist, or being educated at any level (p>0.05 for all) (Table 1). Being a competitive athlete at any stage of their lives was not found to be associated with an increase in their confi-

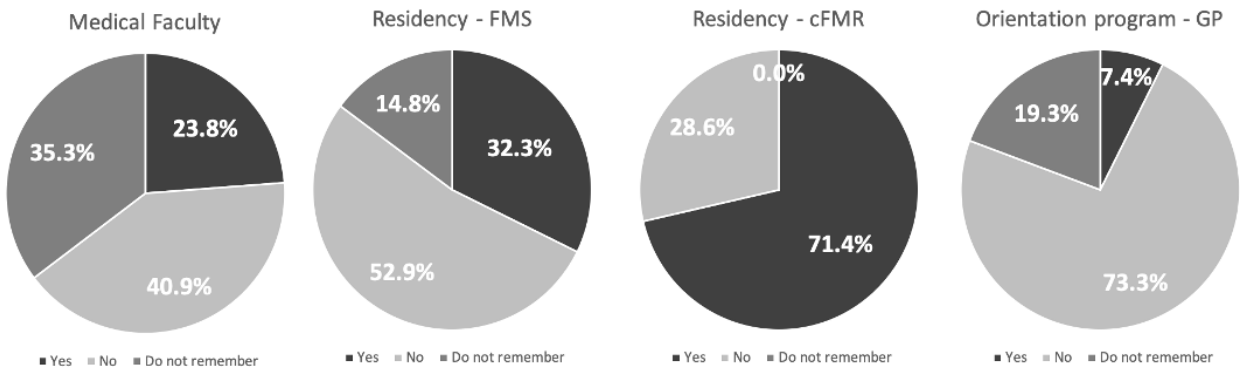

Figure 2. The pie chart shows the percentages of participants' pre-participation screening education at different levels. Darker color represents for the percentage of the participants who answered affirmatively. cFMR: contracted family medicine resident.

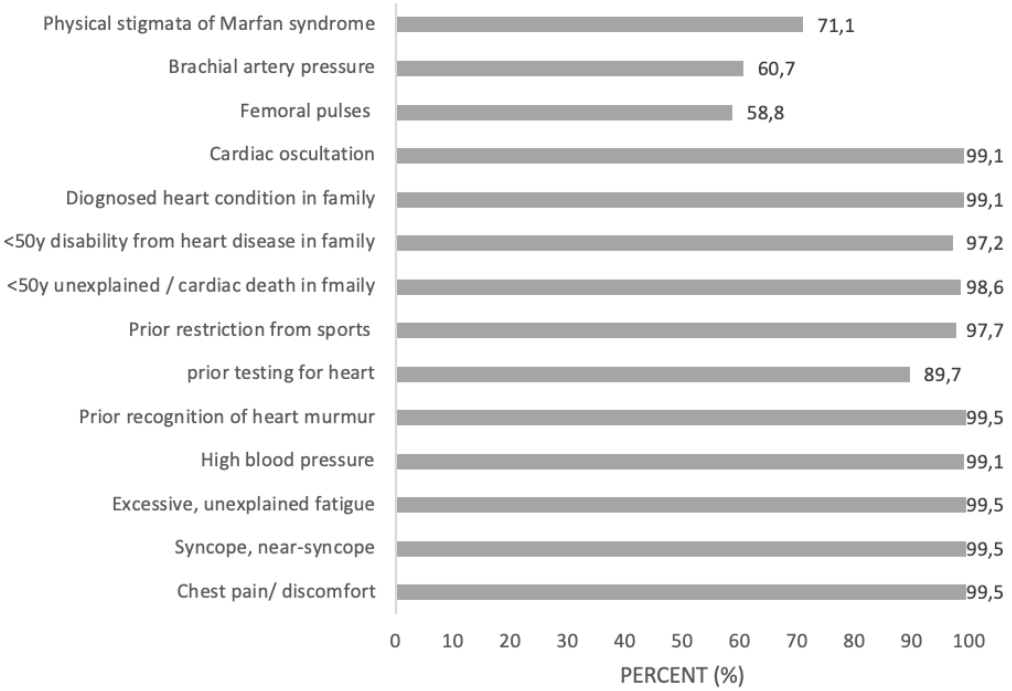

Figure 3. The American Heart Association's 14-element screening guide given on the Y-axis. The percentage of participants marked that element as necessary given on the X-axis. <50y: younger than 50 years.

dence or awareness ($p>0.05$ for all).

History taking, family history taking, and physical examination were considered necessary by 94.9%, 94.4%, and 97.2% of the participants, respectively. Surprisingly, 96.3% of the participants requested at least one further test. Ordering ECG was considered to be necessary by 89.7% of the participants. There was no association between ordering ECG and work experience years, being a specialist, or being educated at any level (Table 1).

All of the further tests are requested more by the GPs compared to FMSs, but the difference was significant only for pulmonary function tests (60.2% vs 33.2%, $p=0.003$), blood tests (77.8% vs 60.5%, $p=0.026$), and urine tests (34.7 vs 13.2, $p=0.011$) requests. There was no association between the request for further tests and the number of years of work experience. Only the proportion of those PCPs with exercise stress test requests of PCPs with less than five years of experience is significantly higher than those with five years of experience or more (68.9% vs 49.7%, $p=0.022$). Postgraduate education during residency or orientation program had no effect on further testing (Table 1).

The full list of the results regarding the content of the history and physical examination was presented in

Table 1. The comparisons according to work experience years (<5y vs ≥5y), residency training (GPs vs FMSs & cFMRs) and whether education given at any level (medical faculty for all PCPs, residency training for FMSs and cFMRs, orientation program for GPs).

Variable (%)	**All**	**Work Experience**			**Residency Training**			**Education Medical Faculty** (all PCPs)			**Education Residency Training** (FMSs and cFMRs)			**Education Orientation PRG** (GPs)		
		<5y	**≥5y**	**p**	**GP**	**FMS and cFMR**	**p**	**YES**	**NO**	**p**	**YES**	**NO**	**p**	**YES**	**NO**	**p**
Knows authorization	89.7	91.1	89.4	0.729	89.2	92.1	0.593	94.1	88.3	0.236	100.0	87.0	0.145	100.0	88.3	0.192
Feels confident	6.5	6.7	6.6	0.320	5.7	10.5	0.375	9.8	5.5	0.146	13.3	8.7	0.225	23.1	4.3	**0.013**
Aware of guideline	13.1	13.3	13.0	0.131	11.9	18.4	**0.048**	15.7	12.3	0.528	20.0	17.4	0.839	23.1	11.0	0.198
Never heard the Seattle Criteria	78.0	75.6	78.7	0.651	77.3	81.6	0.561	72.6	79.8	0.278	73.3	87.0	0.290	61.5	78.5	0.160
Core screening																
History	94.9	97.8	94.1	0.465	94.3	97.4	0.693	98.0	93.9	0.239	100.0	95.7	0.413	92.3	94.5	0.745
Family history	94.4	97.8	93.5	0.467	93.8	97.4	0.697	94.1	94.5	0.922	100.0	95.7	0.413	100.0	93.3	0.333
Physical exam	97.2	100.0	96.6	0.347	96.6	100.0	0.594	96.1	97.6	0.580	100.0	100.0	1.000	100.0	96.3	0.482
Further test	96.3	95.6	96.5	0.779	97.2	92.1	0.136	96.1	96.3	0.937	93.3	91.3	0.821	92.3	97.6	0.274
ECG	89.7	86.7	90.5	0.419	90.3	86.8	0.556	88.2	90.2	0.689	86.7	87.0	0.979	92.3	90.2	0.803
ECHO	66.8	73.3	65.1	0.297	67.0	65.8	0.881	70.6	65.6	0.513	60.0	69.6	0.544	46.2	68.7	0.096
Exercise stress test	53.7	68.9	49.7	**0.022**	55.1	47.4	0.385	56.9	52.8	0.608	40.0	52.2	0.463	61.5	54.6	0.628
Pulmonary function test	55.6	60.0	54.4	0.505	60.2	34.2	**0.003**	58.8	54.6	0.596	33.3	43.5	0.532	61.5	58.9	0.852
Chest X-ray	43.9	44.4	43.8	0.937	46.6	31.6	0.091	51.0	41.7	0.245	40.0	26.1	0.367	46.2	46.6	0.974
Blood test	74.8	68.9	76.3	0.307	77.8	60.5	**0.026**	72.6	75.5	0.676	66.7	65.2	0.927	61.5	77.9	0.179
Urine test	30.8	20.0	33.7	0.076	34.7	13.2	**0.011**	37.3	30.8	0.256	26.7	13.0	0.290	30.8	33.7	0.827
AHA score (/14 median)	13	13	13	0.229	13	14	0.184	14	13	**0.033**	14	13	0.058	14	13	0.320
AHA score =14 (%)	41.1	46.7	39.6	0.395	38.6	52.6	0.112	54.9	36.1	**0.022**	73.3	39.1	**0.039**	30.8	39.3	0.545
Referral score (/27 median)	16	16	16	0.239	16	16	0.216	16	16	0.630	16	16	0.093	16	16	0.418

Bold written p-values are significant. cFMR: contracted family medicine resident, FMS: family medicine specialist, GP: general practitioner, PCP: primary health care physician, <5y: less than five years, ≥5y: five years or more.

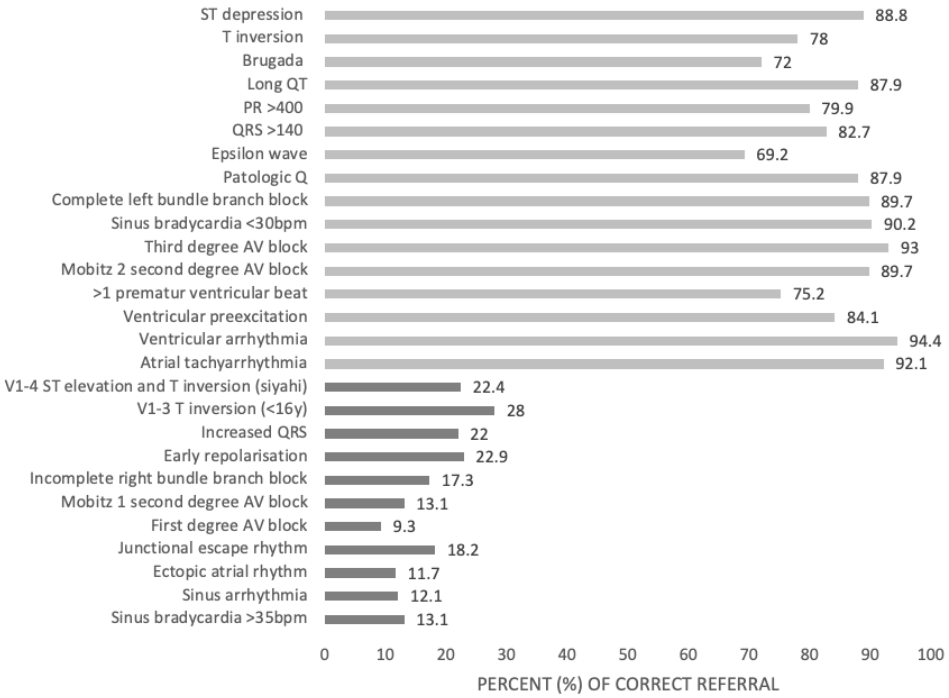

Figure 4. Y axis includes the given ECG findings and x axis shows the percentage of correct referral among participants. The last 11 cases (given in darker grey) do not need referral. <16y: younger than 16 years, bpm: beat per minute.

Appendix A, Supplementary Table 1. Briefly, all of the cardiac symptoms in history were marked as necessary by more than 99% of the participants, and all of the cardiovascular system-related questions were chosen as necessary by more than 97% of the participants. Cardiac auscultation was found to be necessary by 99.1% of the participants. However, the proportion was lower for the other cardiovascular examination components, such as bilateral radial pulse check (74.1%) and bilateral brachial artery pressure measurement (59.1%).

Ten out of the AHA's 14 criteria were considered to be necessary by more than 97% of the participants: seven of these 10 being more than 99%. The remaining four were previous cardiac tests for history (89.7%), femoral pulses (58.8%), brachial artery pressure (60.7%), and Marfanoid appearance (71.1%) for physical examination (Figure 3). The mean and median for the AHA score of participants were 12.64 (SD: 1.57, min 3, max 14) and 13 (25^{th} percentile: 12 and 75^{th} percentile: 14), respectively. Residency training, work experience years, or education at residency or orientation program had no association with the score. On the other hand, scores of those who reported being educated at medical school were higher (p=0.033, median 14 vs 13) (Table 1).

There were 88 participants (41.12%) with a full AHA score (14 out of 14). Residency training, the years of work experience, or education at the orientation program had no association, whereas being educated at undergraduate level increased AHA score (14 vs 13, p=0.033). The proportion of those with the full AHA scoring score was higher among the PCPs educated during the medical school (54.0% vs 36.1%, p= 0.022) or the residency (73.3% vs 39.1%, p=0.039) (Table 1).

The overall referral rate was 83.9%. When grouped according to the Seattle Criteria, 84.7% of the findings requiring referral were referred. On the other hand, 82.7% of the findings not requiring referral were also referred. This resulted in 82.7% wrong referral decisions and an unknown number of unnecessary workups. The questioned ECG findings and their correct referral proportions were given in Figure 4. Overall, the accurate decision was more than half. Distribution of the referral score was asymmetric with mean 15.45 (min 7, max 21, SD: 1.88) and median 16 (25^{th} percentile: 15 and 75^{th} percentile: 16). The total years of work experience, residency training, or education at any level showed no significant association with referral score (Table 1).

DISCUSSION

The aim of this study was to evaluate the PCPs' knowledge, experience, and approach in Turkey regarding the PPS of the athletes, and to the best of our knowledge, this is the first study from Turkey. We believe that

our study results provided an evidence base for SCD and PPS to be brought to the agenda in Turkey. Our results point out the insufficiency of education and lack of standardization and regulation for PPC of the athletes in Turkey.

The proportion of FMSs among all the PCPs in Turkey is around 10% [20]. In our study, most of the participants were GPs (82.2%), and the proportion of FMSs among all PCPs was 14.5%, similar to Turkey's real ratios.

The major outcomes consisted of further test requests, application of AHA criteria, and correct referral rates. Further test requests were prevalent among GPs, overall application of AHA criteria was low, and the referral rate was high. The years of work experience were not significantly associated with any of the outcomes, and this may indicate that the subject could not be learned via experience. Hence, integrating the topic to the undergraduate medical education or as part of postgraduate medical education at residency and orientation level is crucial.

Although the participants were aware of their authorization and were using it, awareness of the guidelines and criteria was low (13.1%). Further test request rate was detected as high as 83.9%; this might be due to the physicians' low confidence and knowledge about PPS. Furthermore, the high referral ratio with low accuracy should have contributed to a high unnecessary testing rate. The lack of standardization of the PPS could be the main reason for both the high level of further testing and referral, along with low self-confidence [21]. Furthermore, high further testing and referral rates could be interpreted as defensive medicine signs, especially considering the absence of legal regulations on unnecessary testing and referrals.

Although all further testing elements were requested more by GPs, there was no significant difference between GPs and FMSs other than the order of the pulmonary function test, blood, and urine tests. The similarity of the tested outcomes between these groups, along with the low education level on the PPS, suggests an inadequacy in the current education in Turkey rather than individual failure.

Having been trained in medical school significantly increased the correct AHA score (median 14 vs 13) and full score percentage (54.9% vs 36.1%). Similarly, having been trained during FMS residency was associated with a higher rate of the full score (73.3% vs 39.1%). GPs who received orientation training had higher self-confidence than other PCPs (23.1% vs 4.3%); however, this was not reflected in their AHA scores. Based on this result, it can be said that even basic training on PPS can be beneficial; on the other hand, the impact of training should be evaluated. When the results on the PPS content were evaluated carefully, the percentage of the participants who consider the patient history and physical examination is not 100%; meaning that some of the athletes are given participation reports without a thorough history and physical exam.

Our study has several limitations. Our study's generalizability is limited due to the non-probabilistic sampling and low participation rate. Our sample size (n=214) was relatively lower than Akman's study (n=299) [20]. The survey's low completion rate (69.23%) might be due to survey's length and long matrix questions. Since non-probabilistic sampling was used, it can be assumed that already interested PCPs were more likely to participate in the study. Therefore, the survey results might have resulted better than the reality of the PPS. As in the nature of a survey study, it is not possible to validate the participants' answers and assess the real practice of the PCPs. Our results might reflect what should be included in PPS rather than what actually happens in the clinics. For example, 58.8% of the participants marked bilateral femoral pulse check as part of the physical exam as necessary. However, the percentage of the physicians who check the femoral pulses bilaterally was expected to be lower than that. Recall bias should also be kept in mind as the survey questions past experiences.

The leading causes of SCD vary among different regions, so the screening should be adjusted accordingly. Pigozzi et al. states the most common causes of SCD at 2003 as hypertrophic cardiomyopathy in North America (the United States and Canada), arrhythmogenic cardiomyopathy in Italy, myocarditis in Germany, and Marfan Syndrome in China [22]. Although the epidemiology might be different today, it is essential to know the characteristics of the country prior to preparation of a guideline. There is no data for Turkey, showing neither the incidence nor the leading cause of SCD in athletes. For standardization and regulation of PPS, epidemiology of SCD in Turkey should be investigated as it will affect the screening program's content. A recent case report published in Turkey showed that a patient with a pre-excitation syndrome was diagnosed during a PPS performed in primary health care setting [23]. Although this has demonstrated the importance of the PPS at primary health care setting, there is no study evaluating the current practice of PPS in Turkey.

As shown by the results of this study, PPS in Turkey lacks standardization, education on SCD is insufficient, and physicians have a tendency towards defensive medical decision making. Considering these points, a simple medical history and physical exam such as the 14 elements of AHA, followed by a routine ECG at a primary health care setting could be effective in terms of disburdening the physician by standardization and providing simple and comprehensive screening for athletes.

The regulation from the Ministry of Health as in Italy, awareness of the legal consequences of inadequate

PPS as in United States, and also the publicity of SCD would be influential for the application of appropriate PPS.

There are also opposing ideas in the literature for screening. One review states three points: i. an estimated 0.001% of young athletes die suddenly every year, ii. up to 30% of the screened may be referred, iii. screening would not detect around 25% of those at risk. It concludes that the cardiovascular screening of young athletes is unlikely to be beneficial [24]. Another review assessing the risks and costs of screening with a focus on legal regulations and the ethical implications concluded that the mandatory universal screening is not warranted at this time, and the athlete and the parents should be informed comprehensively on the topic [25]. Therefore, we need an alternative to screening, that is, to act in an emergency. To achieve this goal, we need an emergency action plan, an automated external defibrillator, and trained staff for cardiopulmonary resuscitation [26]. The investigation of the presence of emergency action plan, automated external defibrillator, and ambulance in Turkish football leagues revealed that only 27.6% of the teams had cardiopulmonary resuscitation training programs, and only 5.2% of the stadiums had automated external defibrillators [27].

Despite our limitations, our study should shed light on the topic as the first one investigating the PCPs' PPS approach at the primary health care settings in Turkey. One of the major outcomes from our study was that it revealed the inadequacy of education at all levels of medical education, insufficiency of regulation and extensive use of further testing without indication. Further studies should focus on the epidemiology of SCD in Turkey to create a PPS or emergency action plan, standardize it by regulations PPS and implement it to medical school and also postgraduate education. Further studies with more participants on the subject should fully evaluate the PCPs' actual daily practice in Turkey.

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Appendix A: Supplementary Table 1: Matrix questions from the Turkish Medical Association guideline, "Turkish Ministry of Health" health information form and AHA criteria.

History	Selected as Necessary (%)
Marital status	9.55
Educational status	20.00
Occupation	59.09
Vision (visual defects, strabismus, etc.)	85.91
Hearing (hearing loss, tinnitus, etc.)	87.73
Cardiac disease (valve, arrhythmia, failure, etc.)	99.09
Chest pain	99.55
Chest tightness	100.00
Palpitations	100.00
Cyanotic lips	99.09
Dizziness	99.55
Syncope, presyncope	99.55
Early / excessive fatigue	99.55
High blood pressure	99.09
Previously diagnosed murmur, extra heart sounds	99.55
Previously performed cardiac tests	90.00
Previous disqualification from sports	97.73
Respiratory disease (asthma, COPD, etc.)	99.09
Dyspnea	98.64
Cough	82.27
Gastrointestinal disease (celiac, ulcer, etc.)	45.45
Diarrhea, constipation	36.82
Supplements (vitamins, protein powder, etc.)	63.64
Diet (protein, vegetarian, vegan, etc.)	54.55
Musculoskeletal disease	91.36
Rheumatologic disease	86.36
Muscle weakness, cramps	90.45
Joint pain, limited range of motion	92.27
Previous sports injuries (fracture, dislocation, muscle / tendon injury, etc.)	88.18
Neurological disease (epilepsy, etc.)	98.64
Tremor, loss of sensation	90.45
Severe headache	91.82
Loss of balance	97.27
Chronic infections (tuberculosis, hepatitis, etc.)	77.27
Common infections (tonsillitis, otitis, urinary tract infections, etc.)	53.18
Intestinal parasites	22.73
Hormonal disorders (diabetes, goiter, etc.)	87.73
Polyuria, polydipsia	75.91
Kidney disease (stone, cystic, etc.)	56.36
Dysuria	39.09
Undescended testes (<7y)	29.55

Menstrual cycle	33.64
Psychiatric diseases (autism, ADHD, etc.)	70.00
Medications	95.00
Allergies	78.18
Previous operations	86.82
Previous hospitalizations	71.36
Organ failure	94.09
Cancer	87.73
Edema	70.00
Weight loss, anorexia	77.27
Teeth and gingiva problems	31.36
Easy nerves / anger	57.27
Sleep apnea, daytime sleepiness	73.18
Habits (smoking, alcohol, etc.)	86.82
Devices (eyeglasses, lenses, hearing devices, orthosis, etc.)	85.45

Family History	**Chosen as Necessary (%)**
Allergies	56.82
Musculoskeletal diseases	63.18
Sudden death before age of 50, unknown cause	98.18
Sudden cardiac death before age of 50	98.18
Cardiac related morbidity before age of 50	96.82
Diagnosed cardiac disease (cardiomyopathy, long QT, etc.)	98.64
Chronic infections (tuberculosis, hepatitis, etc.)	64.09
Chronic diseases (cardiovascular, renal, hypertension, diabetes, goiter, etc.)	90.00
Psychiatric diseases	60.91
Consanguineous marriage	37.27
Sister / brother death	78.64

Physical Examination	**Chosen as Necessary (%)**
Height and weight	88.18
Radial pulse (unilateral)	78.64
Radial pulses (bilateral)	74.09
Femoral pulse (unilateral)	52.27
Femoral pulses (bilateral)	57.73
Brachial artery pressure (unilateral)	65.45
Brachial artery pressure (bilateral)	59.09
Marfanoid stigmata	69.55
Cachexia, obesity	88.64
Head and neck examination	63.64
Scalp and skin examination (dermatitis, warts, pigmentation, etc.)	21.82
Ear nose throat examination (oropharynx, tympanic membranes, etc.)	41.36

Cardiac auscultation (murmur, extra heart sounds, etc.)	97.73
Varicosis (extremities, trunk, neck)	71.36
Pulmonary auscultation (rales, rhonchi, wheeze, etc.)	95.00
Thoracic vibration	63.64
Thoracic cage inspection (asymmetry, pectus carinatum/ excavatum, etc.)	88.18
Abdominal examination (intestinal sounds, organomegaly, etc.)	56.36
Urogenital examination	22.27
Musculoskeletal examination	82.73
Neurological examination	86.82
Psychiatric evaluation	60.91
Vision (Snellen)	74.55
Hearing	70.91