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ORIGINAL ARTICLE

# Risk of cardiovascular disease in soccer referees: a cross sectional study

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## Abstract

**Introducrion:** although the mortality rate among soccer players is low, it causes much impact on the entire community and is a fascinating conundrum.

**Objetive:** to evaluate the cardiovascular risk of soccer referees, to describe the frequency of cardiovascular risk considering age groups younger and older than 35 years old and to relate the Framingham and PROCAM indices for the comparison of cardiovascular risk in soccer referees.

**Methods:** We analyzed 50 referees of Paulista Soccer Federation subjected to clinical and laboratory based evaluations at the Center for Sports Health at the Faculty of Medicine of ABC, and were divided into two groups: lower and higher than 35 years of age. For analysis involving all variables of the study it was initially carried out as a descriptive evaluation of the entire group, and then the Framingham and PROCAM methods were applied in a two-dimensional way. Finally, the logistic regression analysis was applied. Anthropometric statistics, blood pressure, laboratory tests and ergospirometric values were within normal limits.

**Results:** referees older than 35 years old presented significant increased values of waist circumference, body mass index, glucose blood levels, lower VO2max and higher cardiovascular risk according to Framingham and PROCAM.

**Conclusion:** the risk for coronary heart disease was higher in referees older than 35 years old.

**Keywords:** soccer referees, athletes, electrocardiogram, sudden cardiac death, cardiovascular risk factors, myocardium protection.

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**Why was this study done?**
To analyze whether coronary heart disease is a preferred cause of sudden death for athletes aged over 35 years. Coronary diseases tend to present with a higher incidence in older age groups, which it becomes possible to qualify and quantify the risk of atherosclerotic disease.

**What did the researchers find?**
Framingham risk scores showed the risk of having a 1% chance of developing cardiovascular diseases in 10 years is six times greater. Framingham indices proved to be good markers for risk factors in relation to age and more reliable than PROCAM. Furthermore, Framingham risk score is a good marker for risk factors in relation to age and more faithful than the PROCAM score, that the risk for coronary heart disease was higher in referees aged over 35 years.

**What do the findings of this study demonstrate?**
The Framingham risk score is a good marker for risk factors in relation to age and more reliable than the PROCAM score, with a higher r risk for coronary heart disease being in referees aged over 35 years than younger. The exposure of referees to other causes of heart disease did not differ significantly in relation to the groups with ages above and below 35 years. Furthermore, we highlight that this population is specifically of soccer referees, with a lifestyle characterized by the professional activities developed.

## INTRODUCTION

In the professional sport, it becomes increasingly evident the valorization of the athletic conditions to support the competitive requirements. Particularly in soccer, the participants are required to perform more dynamic activities with multiple functions and, consequently, the competitions are becoming more exhausting. There is an opportunity for fatalities and the paradox that physical activity is blamed as the cause of health problems, including cardiovascular disease[1,2].

In this context, the specialized research literature for soccer mentions the occurrence of Sudden Cardiac Death in young athletes (before the age of 35), preferentially as a result of congenital cardiac anomalies in older athletes due to atherosclerotic coronary disease, as a primary cause [3].

The soccer referee appeared in the late 19th century, actually in 1868. However, most regulations were restricted to rules, federations and players. According to estimates of the Union of Soccer Referees of São Paulo State, there are approximately 76 thousand soccer referees working in the most diverse championships worldwide.

Elite referees can travel distances of nine to 14 km during a soccer match, of which sixteen to 17% are held in high intensity for short or long routes with speeds between fifteen and 18 km/h and make short jolts between 0.5% and 12% of the total starting time4. It was estimated that approximately 60% of the distance covered be contingent on the maximum oxygen consumption ($VO^{2max}$) and the anaerobic threshold (submaximal resistance index)[4,5]. In this sense, referees are subject to the same adverse measures of professional soccer players including sudden cardiac death[4].

In light of the above, it is obligatory to investigate subjects who are notoriously exposed to high intensity physical exercise stress, such as soccer referees, in order to identify whether classification in the levels of cardiovascular risk and preventive treatment are capable of reducing risk of sudden death. Thus, we aimed to evaluate the cardiovascular risk of high performance soccer referees.

## METHODS

This is a cross-sectional study performed in a non-probabilistic sample for convenience, derived from information collected from medical records of the Medical Statistics Service. Data were obtained through clinical evaluation information and subsidiary examinations of 50 high performance field soccer referees of the Paulista Soccer Federation (PFF), during a pre-season training period of the 2009 Brazilian soccer championship.

Emphasis was especially placed on exposure to risk factors for coronary artery disease, conceivably more responsible for sudden death, when congenital heart disease was excluded.

All subjects were acquiesced to clinical and laboratory evaluations at the Center for Health in Sport of the Faculty of Medicine of ABC (FMABC). The referees were split into two age groups, according to the median of their ages. One of the groups consisted of trained individuals < 35 years old while the other group was made up of referees > 35 years old.

All participants were informed of the objectives of this research and signed the confidential informed consent form. This work was approved by the research ethics committee of the University of Santo Amaro (number 038/2011).

The inclusion criteria were: elite referees of the gold series of the Paulista Soccer Federation; registered for participation in the São Paulo professional soccer championship in 2009; eligible for pre-participative evaluation and have completed the entire series of tests considered indispensable for the present study. Preliminary evaluations were undertaken to determine anthropometric data, nutritional status, psychological conditions, ophthalmologic, dermatological and musculoskeletal examinations.

In the appraisal, the following issues were considered.

Family history: Occurrence of one or more relatives with disease or death from cardiac disease aged less than 50 years; Report of cardiomyopathy, coronary artery disease, Marfan syndrome or long QT syndrome, severe cardiac arrhythmias, or other cardiovascular diseases.

Personal history: Syncope or pre-Syncope; Chest pain or discomfort; Lack of air or fatigue disproportionate to the effort made; Palpitations or irregular heartbeat.

Physical examination: Physical and/or ocular signs of Marfan Syndrome; Decreased femoral artery pulses or "tardus"; meso- or telo- systolic murmurs; Second abnormal heart sound (single or with fixed unfolding with breathing); Heart murmurs (grade 2/6 systolic or diastolic of any intensity); Irregular heart rate; Bilateral blood pressure greater than 140/90 mmHg in more than one measurement.

Biochemical tests: High density lipoprotein (HDL), low density lipoprotein (LDL), very low density lipoproteins (VLDL), triglycerides (TG) and fasting blood glucose levels (Glic) were analyzed. The biochemical blood tests were processed by the Clinical Laboratory of FMABC, certified by controlab and ANVISA. The reference standards were considered according to the Guidelines of the Brazilian Society of Cardiology.

Ergospirometry: The following parameters were analyzed: Ergospirometry (Ergo), Maximum heart rate (HRmax), Maximum oxygen consumption ($VO_{2max}$) and Anaerobic threshold (LA). The ergospirometric data were obtained through the Centurion 200 Treadmill and Micromed® BRA ECG. Protocol: start with 10 km/h - 1% inclination and increase of 1 km every minute. Gas analyzer: Vmax, Encore 29 c, Sensormedics®, USA. Program 20-21. Gases in two torpedoes: (1) - oxygen ($O_2$); 26% and (2) - Carbon Dioxide ($CO_2$): 4%, oxygen ($O_2$) = 16% and Nitrogen ($N_2$).

Echocardiogram: Two-dimensional echocardiogram (ECO) with Doppler was obtained by Esaote® model AV3 Partner with 2.5 MHz transducer with color flow mapping.

Electrocardiogram: The electrocardiographic tracings were performed by the Ecafix® CardioPerfect 5.0 device coupled to a microcomputer with compatible HD and a 1.4 MB drive 60 Hz filter. Approved by the Food and Drug Administration (FDA), the records were taken at rest, on days when they had not performed exercises, and according to the best clinical practice. The interpretation of the ECG abnormalities was completed by an experienced specialist and according to the criteria established by Corrado *et al.*[6], for which they were classified into two categories:

• Group 1: commonly observed in trained athletes (over 80%) sinus bradycardia, first-degree AV block, V1 notch QRS or incomplete right bundle branch block, early repolarization, LVH criteria according to voltage increase in V5 and V6 consistent with the athlete's age, ethnicity and degree of physical fitness, and which does not require additional testing.

• Group 2: less common ECG changes (less than 5%) and need to be better evaluated to exclude cardiovascular diseases: T-wave inversion, ST-segment depression, pathological Q-waves, left atrial enlargement, QRS shift to the left, left/right anterolateral hemiblock, right QRS deviation/left posterolateral lower hemiblock, right ventricular hypertrophy, complete left or right bundle branch block, long or short QT interval, early ventricular repolarization Brugada like, ventricular arrhythmias.

## Framingham and PROCAM indexes

The risk of developing cardiovascular disease is contingent on multiple variables that interrelate with each other, increasing the probability of developing atherosclerotic coronary disease. Each of the risk factors is assigned a value that reflects greater or lesser potential impact on the development of cardiovascular disease and the implementation of preventive measures, and likelihoods, when applied early, to avert the onset of this disease.

The Framingham risk index was constructed based on the Framingham study, a prospective observational survey developed in the small northeastern city of the United States of America[7]. This study evaluated blood pressure, smoking, lipid profile and other characteristics of 5,300 individuals of different ethnicities residing in Framingham, aged between 30 and 74 years at the time of the initial observation, as well as their causes of death and disease.

This index analyzes the cardiovascular risk in relation to the chance of developing stroke, acute myocardial infarction and cardiovascular death for the subsequent 10 years. The Framingham cardiovascular risk index8 has the characteristic of categorizing the variables into a smaller number of sections or sections without significant differentiation of body mass, age, gender, total cholesterol, HDL, presence or absence of smoking and Diabetes Mellitus, systolic and diastolic blood pressure values. Total points represent the percentage of cardiovascular risk (acute myocardial infarction, stroke and cardiovascular death) in the following 10 years.

The PROCAM index[9] is a cardiovascular risk index based on a European study that commenced in 1979 and was completed in 1985. A total of 5159 individuals, all males, aged 35 to 65 years. The PROCAM index identified the following variables: age, LDL-cholesterol, HDL-cholesterol, Triglycerides (this is the only criterion that considers it directly), smoking, Diabetes Mellitus, systolic blood pressure and family history (this variable is considered only by this risk score). The total points represent the risk of cardiovascular disease (acute myocardial infarction, stroke and cardiovascular death) in the ensuing 10 years.

## Statistical analysis

The qualitative variables were presented in terms of their absolute and relative values. The quantitative variables were presented in terms of their central tendency and dispersion values[10].

The group was arranged by age group: age less than 35 years and greater than or equal to

## RESULTS

**Table 1:** Descriptive analysis of age, anthropometric data and physiological variables of the total group of soccer referees.

| | Minimum | Maximum | Mean | Standard deviation |
|---|---|---|---|---|
| Age (years) | 25.00 | 44.00 | 34.80 | 4.65 |
| Body Mass (Kg) | 60.40 | 100.50 | 75.96 | 8.45 |
| Abdominal circunferente (cm) | 62.00 | 100.00 | 84.57 | 6.32 |
| Stature (m) | 1.67 | 1.94 | 1.79 | 0.06 |
| BMI (Kg/m2) | 19.30 | 27.15 | 23.59 | 2.01 |
| Systolic blood pressure (mmHg) | 100.00 | 150.00 | 124.80 | 11.82 |
| Diastolic Blood Pressure (mmHg) | 60.00 | 90.00 | 80.90 | 6.68 |

35 years. To verify the association between the qualitative variables and the study group, the Chi-square test and/or Fisher's exact test[11] were applied. The normality and homogeneity of the data were obtained through the Kolmogorov-Smirnov and Levene tests, respectively[10]. For the variables that satisfied these two credentials parametric tests were used Student (t-test), else non-parametric tests were applied (Mann-Whitney U test)[10,11].

Table 2 presents the descriptive analysis for the variables: age, body mass, stature, BMI, SBP, DBP, abdominal waist. It is detected that the mean age of this group is approximately 35 years and that the mean values of both anthropometric and physiological parameters do not present significant deviations from the reference parameters, according to the SBC Guidelines.

It is observed in Table 2 that the mean values

**Table 2:** Descriptive analysis of biochemical, analysis of ergospirometric variables and echocardiogram measurements of the total group of soccer referees.

| **Biochemical analysis** | **Minimum** | **Maximum** | **Mean** | **Standard deviation** |
|---|---|---|---|---|
| Total cholesterol (mg/dl) | 112.00 | 357.00 | 199.30 | 48.22 |
| HDL (mg/dl) | 37.30 | 78.00 | 59.18 | 10.57 |
| LDL (mg/dl) | 47.40 | 279.70 | 119.73 | 46.23 |
| Triglycerides (mg/dl) | 40.00 | 416.00 | 106.78 | 67.37 |
| Glycemia (mg/dl) | 71.00 | 143.00 | 97.88 | 12.01 |
| Ergospirometric variables | Minimum | Maximum | Mean | Standard deviation |
| Anaerobic Threshold (km/h) | 12.00 | 16.00 | 13.78 | 1.13 |
| Maximum oxygen consumption (ml/kg/min) | 39.84 | 66.79 | 54.78 | 5.46 |
| Maximum heart rate (bpm) | 161.00 | 212.00 | 183.78 | 10.63 |
| Maximum test speed (Km/h) | 14.00 | 19.00 | 16.70 | 1.12 |
| Duration of the exam (min) | 7.00 | 12.00 | 9.57 | 1.06 |
| Echocardiogram measurements | Minimum | Maximum | Mean | Standard deviation |
| Aorta (mm) | 15.00 | 39.00 | 31.05 | 5.44 |
| Left Atrium (cm) | 19.00 | 40.00 | 35.39 | 5.57 |
| Diastolic Diameter VE (cm) | 24.00 | 56.00 | 46.98 | 7.42 |
| Systolic Diameter VE (cm) | 16.00 | 36.00 | 29.63 | 4.50 |
| Percentage Change | 33.00 | 43.00 | 36.83 | 2.31 |
| Eject Fraction (%) | 61.00 | 73.00 | 65.83 | 2.95 |
| Diastolic thickness of the interventricular septum IV (mm) | 8.00 | 12.00 | 9.39 | 1.02 |
| Systolic thickness left ventricular posterior wall (mm) | 8.00 | 11.00 | 9.39 | 0.92 |

of the biochemical variables are within the normality standards, while they are for the minimum rates, the HDL is well below the preferred one, and for the maximum rates, values of Triglycerides, Total Cholesterol glycemia, values are above the reference standards.

In Table 2, the parameters are normal, highlighting high values of maximal oxygen consumption, suggesting that the group is representative of high performance athletes conditioned by physical exercises, namely, in "hearts of athletes".

**Table 3:** Distribution of electrocardiograms abnormalities of the total group of soccer referees (50 traces - 64 abnormalities)

| Common Abnormalities | N | % |
|---|---|---|
| Sinus Bradycardia | 18 | 11.52 |
| Incomplete right bundle branch block or Precordial derivation | 18 | 11.52 |
| Early repolarization | 11 | 07.04 |
| Left ventricular hypertrophy | 8 | 05.12 |
| Ectopic atrial rhythm | 2 | 01.28 |
| Total common abnormalities | 57 | 36.48 |
| Unusual abnormalities | | |
| Wave inversion T” | 1 | 0.64 |
| Segment depression ST | 0 | 0.00 |
| Pathological “q” waves | 0 | 0.00 |
| Left atrial overload | 0 | 0.00 |
| Left anterosuperior hemiblock | 2 | 01.28 |
| BCRE / BCRD | 0 | 0.00 |
| QT Long / short | 0 | 0.00 |
| Ventricular arrhythmia | 0 | 0.00 |
| Brugada like | 2 | 01.28 |
| WPW | 1 | 0.64 |
| Total abnormalities | 6 | 3.84 |
| Total abnormalities in the 50 traits | 64 | 100.0 |

The mean quantitative standards for the echocardiograms described for the total group of referees presented in Table 5 are within the normality ranges. The maxima are consistent with those obtained in subjects conditioned by physical exercises, namely, in “hearts of athletes “.

It can be observed in Table 3 that the common electrocardiographic changes regarded as because

**Table 4:**

| Anthropometric variables | Less than 35 years | Greater than or equal to 35 years | Level of significance |
|---|---|---|---|
| Body mass (Kg)<br>μ ± dp<br>Minimum - maximum | 76.65 ± 9.89<br>60.4 – 100.5 | 75.22 ± 6.68<br>63 – 88 | P=0.56 |
| Abdominal circunferente (cm)*<br>μ ± dp<br>Minimum – maximum | 81.98 ± 6.22<br>62 – 90.5 | 87.50 ± 5.12<br>78 – 100 | p<0.001 |
| Stature (m)*<br>μ ± dp<br>Minimum - maximum | 1.81 ± 0.06<br>1.7 – 1.9 | 1.77 ± 0.06<br>1.7 – 1.9 | p=0.016 |
| BMI (kg/m2)*<br>μ ± dp<br>Minimum - maximum | 23.03 ± 2.11<br>19.3 – 26.2 | 24.20 ± 1.73<br>20.8 – 27.2 | p=0.036 |
| Analysis of resting values | Less than 35 years | Greater than or equal to 35 years | Level of significance |
| PAS (mmHg)<br>μ ± dp<br>Minimum - maximum | 123.85 ± 10.61<br>100 – 150 | 125.83 ± 13.16<br>100 – 150 | p=0.68 |
| PAD (mmHg)<br>μ ± dp<br>Minimum - maximum | 80.96 ± 5.66<br>70 – 90 | 80.83 ± 7.76<br>60 – 90 | p=0.88 |
| Analysis of the lipidprofile and glycemia | Less than 35 years | Greater than or equal to 35 years | Level of significance |

**Continuation - Table 4:**

| Anthropometric variables | Less than 35 years | Greater than or equal to 35 years | Level of significance |
|---|---|---|---|
| Total cholesterol (mg/dl)<br>μ ± dp<br>Minimum - maximum | 190.42 ± 44.16<br>112 – 306 | 208.92 ± 51.47<br>127 – 357 | p=0.18 |
| HDL (mg/dl)μ ± dpMinimum - maximum | 59.42 ± 10.95<br>37.3 – 75.6 | 58.93 ± 10.39<br>47.8 – 78.0 | p=0.87 |
| LDL (mg/dl)μ ± dpMinimum - maximum | 109.76 ± 43.23<br>47.4 – 227.0 | 129.71 ± 47.86<br>53.3 – 279.7 | p=0.14 |
| Triglycerides (mg/dl)<br>μ ± dp<br>Minimum - maximum | 111.85 ± 85.68<br>40 – 416 | 101.29 ± 40.38<br>41 – 178 | p=0.58 |
| Glycemia (mg/dl)*<br>μ ± dp<br>Minimum - maximum | 94.08 ± 9.14<br>78 – 107 | 102.00 ± 13.50<br>71 – 143 | p=0.021 |
| Analysis forergospirometric | Less than 35 years | Greater than or equal to 35 years | Level of significance |
| Anaerobic Threshold(km/h)¥<br>μ ± dp<br>Minimum - maximum | 13.77 ± 0.99<br>12 – 16 | 13.79 ± 1.28<br>12 – 16 | P=0.95 |
| Maximum oxygenconsumption(ml/kg/min)*.&<br>μ ± dp<br>Minimum - maximum | 56.42 ± 4.27<br>48.3 – 66.8 | 53.01 ± 6.11<br>39.8 – 64.7 | p=0.028 |
| Maximum heart rate (bpm)&<br>μ ± dp<br>Minimum – maximum | 184.50 ± 11.58<br>161 – 212 | 183.00 ± 9.68<br>165 – 211 | P=0.62 |
| Maximum test speed (Km/h)&<br>μ ± dp<br>Minimum - maximum | 16.72 ± 1.02<br>15 – 18 | 16.68 ± 1.25<br>14 – 19 | P=0.91 |
| Duration of the exam (min)¥<br>μ ± dp<br>Minimum - maximum | 9.48 ± 0.92<br>7 – 11 | 9.68 ± 1.21<br>7 – 12 | P=0.65 |
| Echocardiograms Variables | Less than 35 years | Greater than or equal to 35 years | Level of significance |
| Aorta (mm)<br>μ ± dp<br>Minimum – maximum | 29.84 ± 6.40<br>15 – 37 | 32.09 ± 4.35<br>16 – 39 | p=0.22 |
| Left Atrium (cm)<br>μ ± dp<br>Minimum – maximum | 34.16 ± 6.77<br>19 – 40 | 36.45 ± 4.15<br>19 – 40 | p=0.22 |
| Diastolic Diameter VE (cm)<br>μ ± dp<br>Minimum - maximum | 45.42 ± 8.62<br>24 – 55 | 48.32 ± 6.08<br>25 – 56 | p=0.35 |
| Systolic Diameter VE (cm)<br>μ ± dp<br>Minimum - maximum | 28.84 ± 5.54<br>16 – 36 | 30.32 ± 3.36<br>17 – 34 | p=0.40 |
| Percentage Change<br>μ ± dp<br>Minimum – maximum | 36.42 ± 1.77<br>34 – 40 | 37.18 ± 2.68<br>33 – 43 | p=0.41 |
| Eject Fraction (%)<br>μ ± dp<br>Minimum – maximum | 65.32 ± 2.47<br>62 – 71 | 66.27 ± 3.30<br>61 – 73 | p=0.44 |

**Continuation - Table 4:**

| Anthropometric variables | Less than 35 years | Greater than or equal to 35 years | Level of significance |
|---|---|---|---|
| Diastolic thickness of theinterventricular septum IV (mm)<br>μ ± dp<br>Minimum - maximum | 9.58 ± 1.07<br>8 – 12 | 9.23 ± 0.97<br>8 – 11 | p=0.37 |
| Systolic thickness left ventricular posterior wall (mm)<br>μ ± dp<br>Minimum - maximum | 9.47 ± 0.96<br>8 – 11 | 9.32 ± 0.89<br>8 – 11 | p=0.58 |

of physical conditioning are in a significantly larger number than those considered uncommon.

It is observed in Table 4 that, although the variables shown are within the reference standards, there is a significant difference between the groups regarding abdominal waist, body mass index and height. The athletes in the younger age group are taller, have lower waist circumference and lower body mass index than those belonging to the older age group, which appear to be within physiological variability.

Table 4 reveals that the mean values of systolic and diastolic pressures are within the normal range. It is also revealed a distribution above the reference standards, however no significant difference between groups was observed.

In addition, Table 4 demonstrates the statistical similarity between the age groups for all means of the values of the biochemical variables presented, except for glycemia. But, deviations from normality are observed when the maximum or minimum values of each variable are considered.

Finally, Table 4 shows the values obtained by ergospirometry for both age groups, displaying only a significant difference in the maximum oxygen consumption when compared to the athletes of the highest age group. Note the superiority of maximal oxygen consumption for both groups.

In Table 5, despite the great occurrence of electrocardiograms considered to be regular

**Table 5:** Numbers and percentages of electrocardiograms of 50 soccer referees according to age groups and qualified as normal, common and unusual according to Corrado *et al.*[12].

| Eletrocardiograms | Less than 35 years Nº (%) | Greater than or equal to 35 years Nº (%) | Total | Test $X^2$ |
|---|---|---|---|---|
| Normals | 6<br>23.07% | 6<br>25.00% | 12 | p=0.58 |
| Common | 18<br>69.23% | 14<br>58.33% | 32 | |
| Icomuns | 2<br>7.69% | 4<br>16.66% | 6 | |
| Total | 26 | 24 | 50 | |

**Table 6:** Descriptive analysis of cardiovascular risk estimated by the soccer referees for qualitative gross values of the scores according to FRAMINGHAN and PROCAM.

| Escore FRAMINGHAM (%) | Nº | % |
|---|---|---|
| 0.00 | 11 | 22.4 |
| 2.00 | 8 | 16.3 |
| 3.00 | 19 | 38.8 |
| 4.00 | 5 | 10.2 |
| 5.00 | 4 | 8.2 |
| 10.00 | 2 | 4.1 |
| Escore PROCAM (%) | | |
| 1.00 | 41 | 85.4 |
| 1.10 | 2 | 4.2 |
| 1.30 | 1 | 2.1 |
| 1.60 | 1 | 2.1 |
| 2.30 | 1 | 2.1 |
| 5.10 | 1 | 2.1 |
| 5.70 | 1 | 2.1 |

**Table 7:** Descriptive analysis for the risk of cardiovascular disease over 10 years of PROCAM and Framingham arranged by study group.

| Risk | Under 35 years old | Greater than or equal to 35 years | Level of significance |
|---|---|---|---|
| Framingham | | | |
| Mean (dp) | 1.63 (1.41) | 3.75 (2.29) | P<0.001 |
| Minimum - maximum | 0 – 4 | 0 – 10 | |
| PROCAM | | | |
| Mean (dp) | 1.05 (0.27) | 1.41 (1.24) | P=0.01 |
| Minimum - maximum | 1 – 2.30 | 1 - 5.70 | |

¥ Teste U de Mann-Whitney.

there were no significant differences in relation to age groups. Note the unfamiliar tracings on six electrocardiograms.

There is a statistically significant difference from the viewpoint of the two study methods. where the risk is greater in the age group over 35 years.

Logistic regression analysis was performed. with age (above or below 35 years) as the dependent variable (response) and the other variables as independent variables. Table 7 displays that the score obtained by the Framingham indexes was the only statistically significant variable revealing that the risk of having a 1% chance of developing cardiovascular diseases in 10 years is six times higher than those who have less than 1% chance.

Regarding the risk analysis, the descriptive analysis of the risk score values for the whole group was first performed, then the risk analysis was arranged by study group for 10 years from the current date.

**Table 8:** Univariate logistic regression analysis of anthropometric, biochemical and cardiorespiratory parameters of the soccer referees.

| Variable | Category | OR | IC95% |
|---|---|---|---|
| BMI (kg/m2) | Normal | 1.00 | - |
| | Overweight | 1.13 | 0.34-3.70 |
| Total cholesterol (mg/dl) | Normal (<200) | 1.00 | - |
| | Changed (≥200) | 2.24 | 0.72-6.95 |
| Triglycerides (mg/dl) | Normal (<150) | 1.00 | - |
| | Changed (≥150) | 0.84 | 0.19-3.58 |
| LDL (mg/dl) | Normal (<130) | 1.00 | - |
| | Changed (≥130) | 2.72 | 0.83-8.83 |
| LA (km/h) | Below average (<14) | 1.00 | - |
| | Above or equal to average (≥14) | 0.87 | 0.28-2.65 |
| Maximum heart rate (bpm) | Below average (<184) | 1.00 | - |
| | Above or equal to average (≥184) | 0.45 | 0.14-1.39 |
| Maximum oxygen consumption (ml/kg/min) | Below average (<55) | 1.00 | - |
| | Above or equal to average (≥55) | 0.62 | 0.20-1.89 |
| Framingham* | Less than 1% in 10 years | 1.00 | - |
| | More than 1% in 10 years | 6.19 | 1.17-32.61 |
| PROCAM | Less than 1 | 1.00 | - |
| | Greater than 1 | 7.67 | 0.85-69.54 |

## DISCUSSION

Our study was commenced to investigate the cardiovascular risk in elite soccer referees -- the data were collected during the pre-participatory evaluation of elite field soccer referees (gold category, A1 series). The referees were considered athletes and with regards this Castagna *et al.*[4] stated that these individual's cross distances of approximately thirteen kilometers in each game performing quick or less rapid movements comparable to those made in the competition by high performance soccer players. In this context, we cannot fail to consider them to be athletes[4].

These characteristics and the fact that they remained in their sporting activities at ages beyond than those attained by soccer players lead us to divide groups between above and below 35 years old.

The mean anthropometric data (body mass, abdominal waist, body mass index) and arterial pressures were found to be within the reference values. which allowed inference on those dedicated to the maintenance of physical fitness by balanced nutrition and appropriate physical conditioning.

Bearing in mind that the major causes of death in Brazil and worldwide are caused by cardiovascular diseases - particularly coronary diseases for soccer players - the risk factors involved in determining the magnitude of these athletes' exposure were identified and specially fixated.

It is worth highlighting that. for the youngest group. the causes would be consistently related to congenital cardiac anomalies whose responsibility would not present further controversy[13]. However, for athletes over 35 years old the primary etiology reported in the research literature would be atherosclerotic coronary artery disease which for this age group is more controversial.

For both primary prevention and prevention. pre-participatory assessments have not been sufficiently valued in contemporary sports practice giving rise to the publicity that is revealed worldwide when new cases of sudden death of professional athletes are reported further increasing the calamity. Thus, it is well known that the European, South American and African media divulge cardiac problems in athletes and referees who are exemplary. amongst them[14].

Regarding the prevention of cardiac disease - especially sudden cardiac death of any form - some of these athletes would have the possibility of being previously directed to the appropriate sports practice with their health conditions. and further avoiding the occurrence of the "*false paradox*."

Since 1982 in the Veneto region of Italy in order to prevent cardiovascular disorders. a law was disseminated by the Ministry of Health. obliging the athlete to undergo pre-participation examinations for sports activities[15]. As a consequence, there was a reduction in the rate of sudden cardiac death in athletes submitted to the pre-participatory evaluation. which in this region was lower than that found in the non-selected population, thus positively manipulating sports commentators. particularly in Europe. According to retrospective assessments. the reduction was mainly attributed to the identification and disqualification of cardiomyopathic patients participating in sporting events[16].

Our Institution has the vital requirements of support for the effectiveness of primary prevention. Extensive and in-depth examinations involving various specialties are offered and as such, the opportunity not only to diagnose but also to contribute to the production of technical information that can be directed to the needs of diagnosis and prevention in the sporting arena and further progress the knowledge in this field.

However, the pre-participatory evaluations of athletes in this study was unable to detect, clinically or in the laboratory a diagnosis of any disease that was able to eliminate them from their sporting activities. These included the use of illicit drugs, inadequate dietary supplements, visual disturbances, eating disorders, obesity and other conditions.

Nor there was any underlying cause that predisposed or aggravated the health status of athletes. since they were not carriers of preexisting diseases. and could regulate cardiac disease states. The main chance of cardiovascular disease risk was investigated. considering the age groups and according to the research literature the outlook of investigating the greater exposure to cardiovascular risk factors in athletes over 35 years old.

In the current evaluation. the electrocardiograms were classified according to Corrado *et al*.[6] and Corrado *et al.*[17] where normal conditions were observed.

It is vital to recognize that the Wolff Parkinson White syndrome was already known to an athlete as it was studied by a service specialist. not related to our Sport Health Center. The athlete followed the direction of the professional team. in which included conservative conduct and time-out from sporting activities.

Our Sports Health Center endorsed the surgical removal of the abnormal pathway. Another trajectory presented inversion of the T-waves in the left bipolar leads in the horizontal plane and two other tracings displayed *"Brugada Like"*. denominated morphology considered as an electrocardiographic phenotype that characterizes the Brugada Syndrome. The subject with this tracing was released from his occupational duties.

There is great difficulty in differentiating "the athlete's heart" from cardiomyopathies owing to the overlapping of clinical manifestations and minor conditions such as myocarditis. hypertrophic cardiomyopathies and right ventricular arrhythmogenic dysplasia. Yet, rigorous and focused evaluations with systematized procedures can achieve a significant contribution to the young athletes. with the necessary aids for the safe practice of competitive sports. It is entirely possible to discriminate patients with cardiac afflictions - mainly cardiomyopathies - from the structural re-models and even from those evidenced in the corresponding examinations due to the physical conditioning.

The two-dimensional evaluation so called for having the analyzes arranged by study group (age groups). Consisted of a tool with the purpose of seeking differences in clinical evolution between the two age groups.

No statistically significant changes were found to allow differentiation between them. It is worth highlighting that both groups were comparable in all approaches. including in relation to cardiovascular diseases. It is imperative to note that. despite the great prevalence of electrocardiograms considered normal and the recording of uncommon tracings in six electrocardiograms. no significant differences can

be observed in relation to the different age groups.

It should be recognized that in this appraisal stage that the correlation coefficient of Spearman exhibited a positive and statistically significant correlation between the 10-year risk measures obtained by Framingham and PROCAM ($p < 0.001$). It can be detected from the Framingham score that only two individuals have a risk of moderate to high cardiovascular disease in 10 years. On the PROCAM score no moderate to high risk cases were observed. It looks as if that the resulting PROCAM indexes are smaller than the indexes found by the Framingham score. It is also detected that the score obtained by the Framingham indices was the only statistically significant variable illustrating that the risk of having a 1% chance of developing cardiovascular diseases in 10 years is six times higher than those who have less than 1% chance.

It is worth noting that the contingent population is explicitly soccer referees. with a lifestyle characterized by their activities. Also other factors possibly related to physical conditioning may have influenced the outcomes obtained leading us to contemplate the possibility of alternative causes of heart disease and ultimately sudden cardiac death. which was not the objective of this study.

## CONCLUSION

The risk of coronary artery disease was higher in referees over 35 years of age.

The Framingham score is a good scorer for risk factors in relation to age and more faithful make the PROCAM score.

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**Resumo**

**Introdução:** embora a taxa de mortalidade entre os jogadores de futebol seja baixa, ela causa muito impacto em toda a comunidade e é um enigma fascinante.

**Objetivo:** avaliar o risco cardiovascular de árbitros de futebol, descrever a frequência de risco cardiovascular considerando faixas etárias menores e maiores de 35 anos e relacionar os índices de Framingham e PROCAM para comparação de risco cardiovascular em árbitros de futebol.

**Métodos:** foram analisados 50 árbitros da Federação Paulista de Futebol submetidos a avaliações clínicas e laboratoriais no Centro de Saúde Esportiva da Faculdade de Medicina do ABC, divididos em dois grupos: menores e maiores de 35 anos. Para a análise envolvendo todas as variáveis do estudo foi realizada inicialmente como uma avaliação descritiva de todo o grupo e, em seguida, foram aplicados os métodos de Framingham e PROCAM de forma bidimensional. Por fim, foi aplicada a análise de regressão logística. Estatísticas antropométricas, pressão arterial, exames laboratoriais e valores ergoespirométricos estavam dentro da normalidade.

**Resultados:** os árbitros com mais de 35 anos apresentaram valores significantemente aumentados de circunferência da cintura, índice de massa corporal, glicemia, menor VO2máx e maior risco cardiovascular segundo Framingham e PROCAM.

**Conclusão:** o risco de doença coronariana foi maior em árbitros com mais de 35 anos.

**Palavras-chave:** árbitros de futebol, atletas, eletrocardiograma, morte súbita cardíaca, fatores de risco cardiovascular, proteção do miocárdio.