Introduction

Sudden cardiac death (SCD) in young athletes is a devastating event that may be preventable by effective pre-participation screening; however, there is no universal screening method for the conditions associated with SCD. The American Heart Association (AHA) and the Association for European Paediatric Cardiology (AEPC) both recommend a screening history and physical exam (H&P) be performed. AEPC guidelines also recommend a 12-lead ECG be performed before clearing an athlete to play. We sought to conduct a meta-analysis of the literature between 2015 and 2020 to compare the value of H&P to that of a 12-lead ECG as a screening tool for true cardiac disease.

Methods

Data Sources- A systematic search of MEDLINE, EMBASE, and PubMed was conducted for studies published between January 1st, 2015 and June 30th, 2020 for original research articles investigating the ability of various screening procedures to identify true cardiac disease.

Inclusion Criteria- • Published in English • Prospective and retrospective studies • Athletes 10 – 35 years of age • Use of both ECG and H&P in screening for cardiac disease Data Extraction- Data were extracted by one author (IK) and then reviewed by another (AH) for accuracy. Four studies were excluded after data extraction had begun due to some categories used in our analysis not being reported.

Statistical Methods- For each study, the association of ECG with true cardiac diagnoses and the association of H&P with true cardiac diagnoses were quantified as odds ratios. Meta-analysis of log odds ratios using a random-effects model with restricted maximum likelihood estimation was conducted with the MAJOR module in jamovi (https://www.jamovi.org), based on the metafor package in R (Viechtbauer, Journal of Statistical Software, 36; 2010).

Results

Nine studies were identified for use in our meta-analysis. There were 28,011 patients included in our meta-analysis from 7 countries. Their ages ranged from 11 to 35 years old, with 21,574 (77%) patients specified as male. 12,415 patients identified as Caucasian, 1,963 patients identified as Black, and 430 identified as Asian/Pacific Islander. A further 1,160 identified as other/unknown, and 11,882 patients did not identify their race.

Association of H&P with true cardiac disease- The random-effects model applied to the 9 studies, which showed moderate heterogeneity (I²=55%), yielded a statistically significant (Z=10.4, p<0.001) back-transformed odds ratio of 60 (95% confidence limits: 28 to 130).

Association of ECG with true cardiac disease- The random-effects model applied to the 9 studies, which showed high heterogeneity (I²=79%), yielded a back-transformed odds ratio of 3.4 (95% confidence limits: 0.92 to 12) that was not statistically significant at the 5% level (Z=1.84, p=0.066).

Discussion

We sought to compare how identification of cardiac disease in young athletes compared using H&P vs. a 12-lead ECG. Our results revealed that the odds of identifying true cardiac disease were statistically significant when utilizing ECG, whereas the association between H&P and identifying cardiac disease had no statistical significance. The ECG screening was particularly effective at identifying WPW, long QT syndrome, and cardiomyopathies, all of which are known conditions associated with increased risk for SCD. Coronary anomalies and other structural defects, which are also SCD-associated, were not able to be found by ECG. When considering the clinical significance of this study, limitations exist. Reading ECG’s is not a standardized tool and varies from one study to the next. Therefore, ECG’s must be interpreted by a doctor who specializes in ECG reading.

Conclusions

The odds of identifying cardiac disease in young athletes is higher and statistically significant (odds ratio of 60; p<0.001) when utilizing ECG, compared with H&P (odds ratio of 3.4; p=0.066), which was not a statistically significant method of identifying cardiac disease. We conclude that a 12-lead ECG as a screening tool misses the odds of identifying true cardiac disease in young athletes; however, the absolute numbers of identifying true positive patients is very low when compared to the overall population. Utilization of an ECG for screening of young athletes is labor intensive and costly, but our results suggest that it could be a more effective tool than a traditional H&P in the right setting with sufficient resources and adequate medical support.