Meta-Analysis of the Effectiveness of Screening History and Physical vs ECG in Detecting Conditions Associated with Sudden Cardiac Death in Young Athletes Over the Past 5 Years

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Introduction

- Sudden Cardiac Death (SCD) may be preventable with effective screening
- There is a disagreement on whether a 12-lead ECG should be performed when screening for conditions associated with SCD
- We conducted a meta-analysis of the literature between 2015 and 2020 comparing the effectiveness of a screening history and physical exam (H&P) to a 12-lead ECG as a screening tool for true cardiac disease

Methods

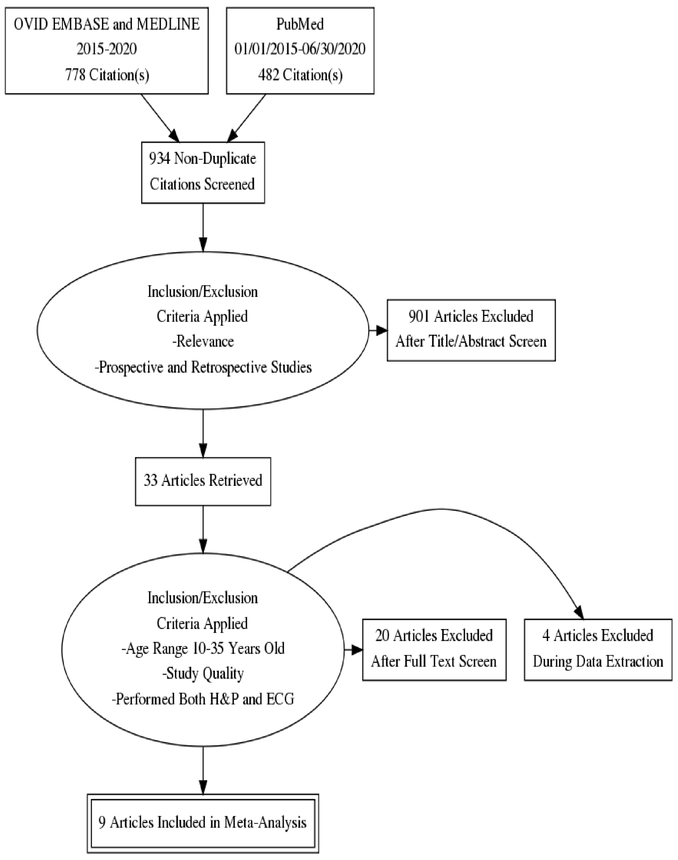

Fig. 1 PRISMA Diagram of Study Selection Process

Data Sources:

- PubMed
- EMBASE
- MEDLINE

Inclusion Criteria:

- Published between Jan 1, 2015 and June 30, 2020
- 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 extracted by NKG
- Reviewed for accuracy by AH
- 4 studies excluded after extraction

Statistical methods:

- Associations quantified as odds ratios
- Meta-analysis conducted in MAJOR module in jamovi
  - Based on metafor package in R
- Analysis done with log odds ratios using a random-effects model with restricted maximum likelihood estimation

Results

Author	Journal	Year	Country of Origin	# of Athletes Screened	Age Range(y), (mean) or [median] Age	Males, n (%)
Malhotra et al	New England Journal of Medicine	2018	United Kingdom	11168	15-17 (16.4)	10581 (95)
Drezner et al	Journal of the American College of Cardiology	2015	United States	790	17-25 (18)	444 (56)
McClean et al	Heart	2019	Qatar	1304	11-18 (15.1)	1304 (100)
Grazioli et al	European Journal of Preventative Cardiology	2017	Spain	1650	12-18 (15.09)	986 (60)
Conway et al	Clinical Journal of Sports Medicine	2020	United States	1686	16-25 [18]	993 (59)
Drezner et al	American Journal of Cardiology	2016	United States	5258	18-25 (20.1)	2892 (55)
McKinney et al	Canadian Journal of Cardiology	2017	Canada	714	12-35	Not Specified
Dhutia et al	Journal of the American College of Cardiology	2016	United Kingdom	4925	14-35 (19.9)	4068 (83)
Tischer et al	Scandinavian Journal of Medicine and Science in Sports	2015	Denmark	516	13-35 (21.58)	306 (59)
Total			7 Countries	28011	11-35	21574 (77)

Table 1 Study Characteristics and Baselines

Category (Abbr.)	Condition	# of Diagnoses
Arrhythmia, Other (A)	Atrial Fibrilation	1
Arrhythmia, Other (A)	PVC Frequent	1
Arrhythmia, Other (A)	Sustained Ventricular Tachycardia	1
Cardiomyopathy (CM)	ARVC	5
Cardiomyopathy (CM)	DCM	2
Cardiomyopathy (CM)	HCM	19
Cardiomyopathy (CM)	LVNC	2
Cardiomyopathy (CM)	Myocarditis	3
Coronary Anomaly (CA)	Anomalous Origin of Left Coronary Artery	1
Coronary Anomaly (CA)	CAA	3
Coronary Anomaly (CA)	Congenital Coronary AV Fistula	1
Long QT (LQT)	Long QT	8
Other	Aneurism w Aortic Root Dilation	1
Other	Aortic Coarctation	1
Other	ASD	4
Other	BAV	7
Other	Dextrocardia	1
Other	MVP	2
Other	Patent Foramen Ovale	2
Other	RV Compression from Pectus Excavatum	1
Sudden Cardiac Death, Unspecified Etiology (SCD)	Sudden Cardiac Death, Unspecified Etiology	2
SVT	SVT	2
WPW	WPW	57
	Total	127

Table 2 True cardiac conditions found across 9 studies. All are associated with SCD but other, which denotes conditions that were found but are not associated with SCD. Abbreviations are used as data labels in Fig. 2.

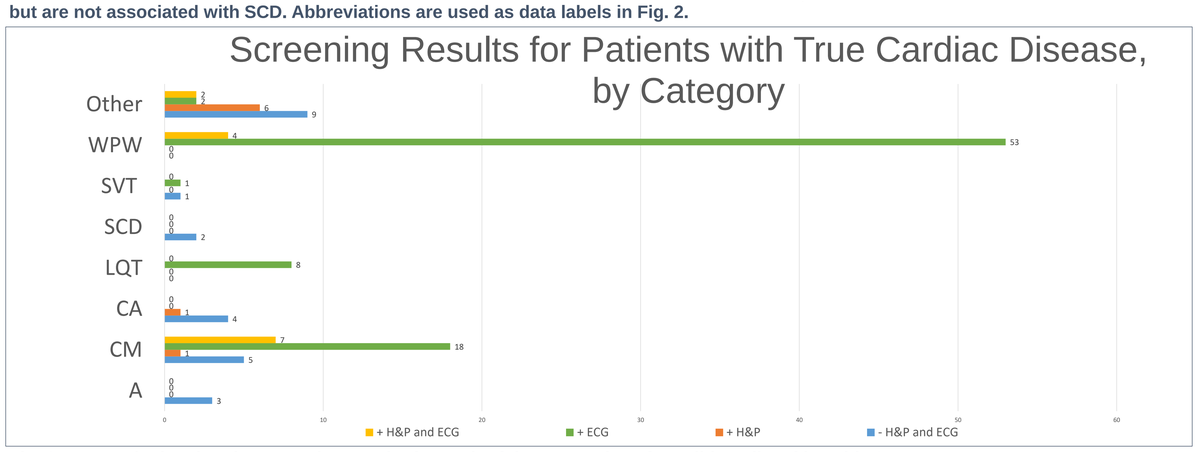

Fig. 2 Bar graph showing the screening results for each of the categories of conditions listed in Table 2.

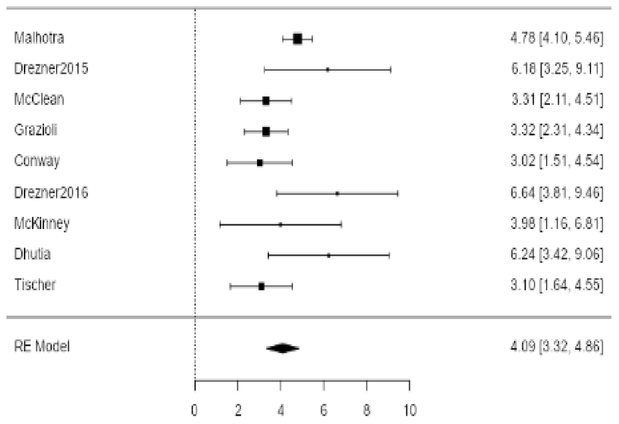

Fig. 3 Forest plot showing the results of 9 studies examining the association between ECG and true cardiac disease.

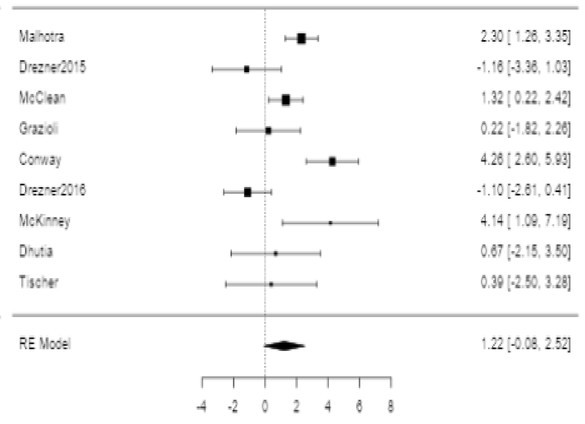

Fig. 4 Forest plot showing the results of 9 studies examining the association between H&P and true cardiac disease.

Association of ECG with true cardiac disease:

- Moderate heterogeneity – $I^2 = 55\%$
- Statistically significant back-transformed odds ratio of 60 ($z = 10.4$, $p < 0.001$)
- 95% confidence interval – 28 to 130

Association of H&P with true cardiac disease:

- High heterogeneity – $I^2 = 55\%$
- Not statistically significant back transformed odds ratio of 3.4 ($z = 1.84$, $p = 0.066$)
- 95% confidence interval – .92 to 12

Conclusions

- The odds of identifying true cardiac disease in young athletes are higher and statistically significant, while the same odds are lower and not statistically significant with H&P
- We conclude that the use of a 12-lead ECG improves the odds of detecting true cardiac disease, with the understanding that the absolute numbers of diagnoses will be low compared to the overall population
- Screening every athlete with a 12-lead ECG is labor-intensive and costly, but our results suggest that it is more effective than H&P in settings where resources allow