5L3DVCG-AI for identification of cardiac pathology in a mixed population

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Purpose of the study

- Artificial Intelligence (AI) and access to a large global clinical data repository have the potential to boost the performance of Vectorcardiography (VCG) beyond conventional techniques [1,2].
- Quantifying cardiovascular risk (CVR) according to SCORE2, QRISK3 or ASCVD is not always feasible, especially in hard to reach populations.
- The modified PROCAM-Score (CVRF-Score) is a validated alternative [3].

Hypothesis

5L3DVCG-AI is superior to CVRF-Score to differentiate between patients with low and high risk of coronary heart diseases (CVD)

References: [1] Meier, Clinical cardiology, 1987; [2] Braun, J Electrocardiology, 2020; [3] Schmidt-Lucke, Circulation, 2005

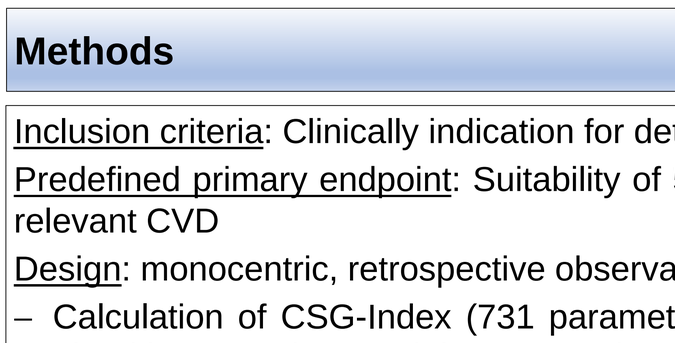
Methods

Inclusion criteria: Clinically indication for detection of CVD

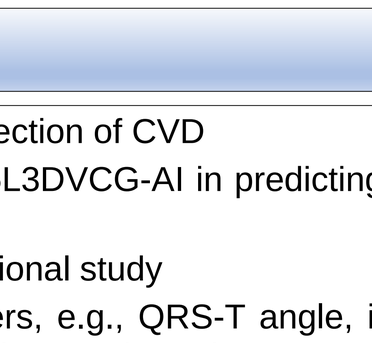
Predefined primary endpoint: Suitability of 5L3DVCG-AI in predicting clinical relevant CVD

Design: monocentric, retrospective observational study

- Calculation of CSG-Index (731 parameters, e.g., QRS-T angle, in-house algorithms on time and frequency domains, such as beat moments) by 5L3DVCG-AI
- CSG-Index-based classification as high or low CVD risk [-1 to 1] (CSG-Index cut-off: -0.27)
- Conventional CVRF-Scoring from risk factors (mod. PROCAM-Score[3])
- Confirmation of CVD at practitioners' discretion blinded to the CSG-Index
- Cardiac pathology was defined as presence of either CVD, LVH, valve defects, diastolic dysfunction, HFrEF, HFpEF, arrhythmias, BBB, pacemaker
- Definition of clinical status of CVD (control: no signs or symptoms of CVD; subclinical findings of CVD; overt clinical signs and / or symptoms of CVD)



(1) Five electrodes are attached to the body for signal recording. (2) The collected data is transmitted to the manufacturer's web service and processed using an AI algorithm. (3) After a few minutes, the result is available in the form of a report.



(A) Positioning of the electrodes in a geometrically predefined position. (B) Extract of characteristic parameters recorded by 5L3DVCG-AI. (C) Neural network architecture: Ensemble of five feedforward neural networks.

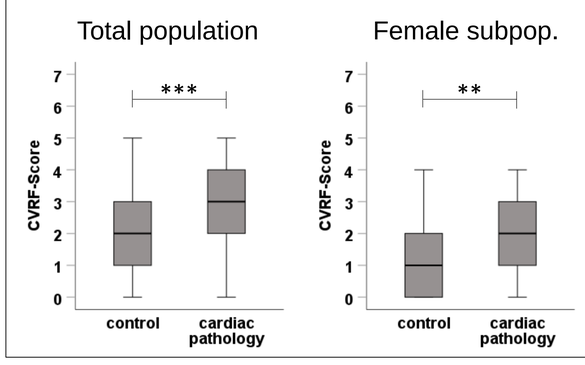
Results

Demographic Data

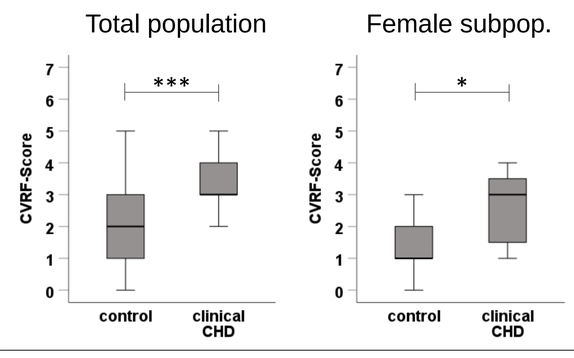
Patient characteristic	Total population	Female subpopulation
n	299	118
Gender [m:f]	181:118	–
Age [years]	56.7 ± 16.7	57.5 ± 16.0
Body Mass Index [kg * m^{-2}]	26.0 ± 5.2	25.2 ± 6.0
CVRF-Score[3] [0 – 7]	2.3 ± 1.3	1.5 ± 1.2
Smoking	20.4%	23.7%
Diabetes	8.3%	5.9%
Hypertension	44.2%	42.4%
HLP	53.5%	50.0%
Family history	2.3%	2.5%

Inclusion of 327 patients, 299 patients with complete data for analyses.
16% had arrhythmias or conduction disturbances (AF, PM, BBB), 15% had previous PCI or CABG

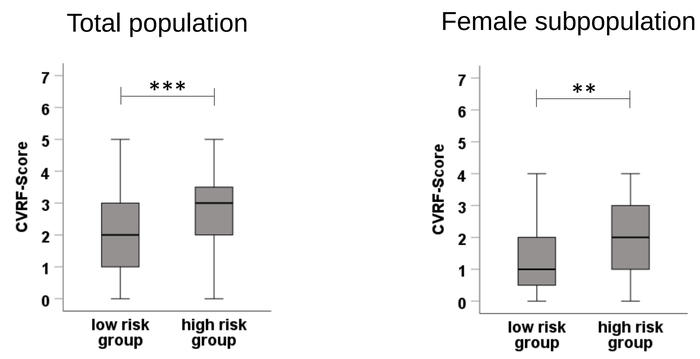
CVRF-Score differentiated controls and patients with cardiac pathology



CVRF-Score differentiated controls (no signs or symptoms of CVD) and patients with CVD



Cardiovascular risk classification with 5L3DVCG-AI is reflected by CVRF-Score

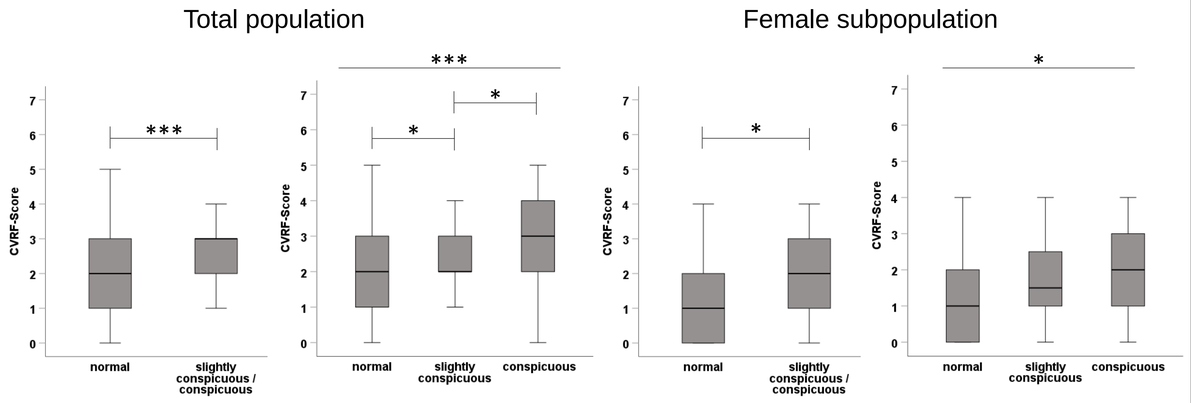


ECG at rest was not able to differentiate between CVD and controls

Risk estimation with 5L3DVCG-AI in mixed population

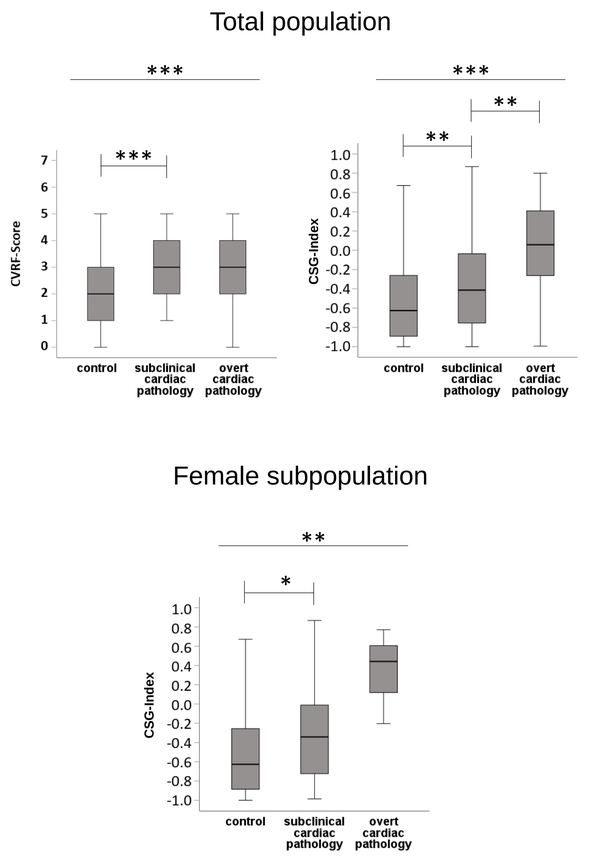
CSG-Index reliably identified healthy controls without signs or symptoms of CVD (negative predictive value = 0.88).

Cardiovascular risk classification with 5L3DVCG-AI in CHD

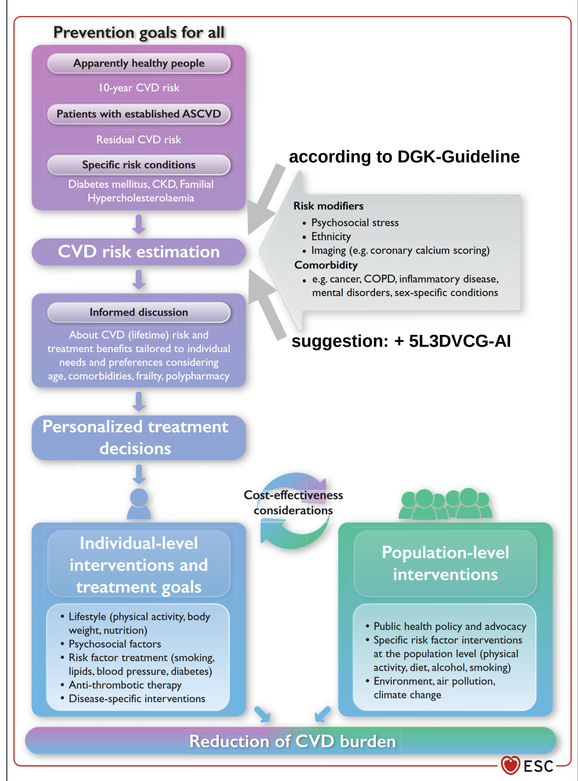


5L3DVCG-AI (P-Factor) correlates with CVRF-Score (ρ=0.71, p<0.001)

Strong correlation of CSG-Index and cardiac pathology



5L3DVCG-AI for early risk estimation for non-invasive detection of CVD



Predictors for cardiac pathology

	Total population			Female subpopulation		
variable	**β**	**T**	**p-value**	**β**	**T**	**p-value**
CSG-Index	0.26	4.69	<0.001	0.24	2.64	0.01
CVRF-Score	0.22	3.87	<0.001	0.18	1.97	0.051

Conclusion

- AI further improves the easy-to-use and inexpensive 5L3DVCG
- 5L3DVCG-AI identifies asymptomatic females at high risk for CVD
- CSG-Index differentiated between no signs and symptoms of CVD and patients with cardiac pathology or CVD
- 5L3DVCG-AI identifies patients at risk for CVD and cardiac pathology
- 5L3DVCG-AI opens up a diagnostic window for early detection of CVD
- CSG is superior to CVRF-Score in differentiating people at risk of CVD or cardiopathology, especially for women and hard-to-reach population

Poster: 1093, related talk: 118

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