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# Congenital and Exercise

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March 6<sup>th</sup> 2015



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European Heart Journal  
doi:10.1093/eurheartj/eh433

**CURRENT OPINION**

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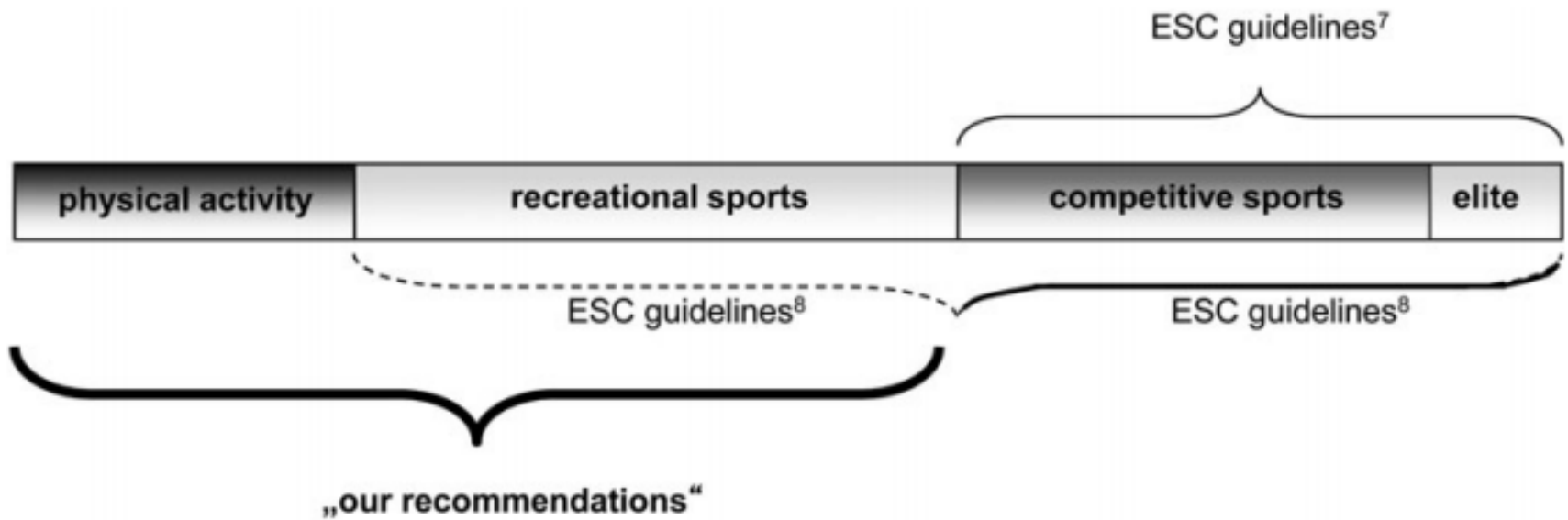
# Physical activity in adolescents and adults with congenital heart defects; individualized exercise prescription<sup>†</sup>

**Werner Budts<sup>1,2\*</sup>, Mats Börjesson<sup>3</sup>, Massimo Chessa<sup>4</sup>, Frank van Buuren<sup>5</sup>, Pedro Trigo Trindade<sup>6</sup>, Domenico Corrado<sup>7</sup>, Hein Heidbuchel<sup>1,2</sup>, Gary Webb<sup>8</sup>, Johan Holm<sup>9</sup>, and Michael Papadakis<sup>10</sup>**



# Background

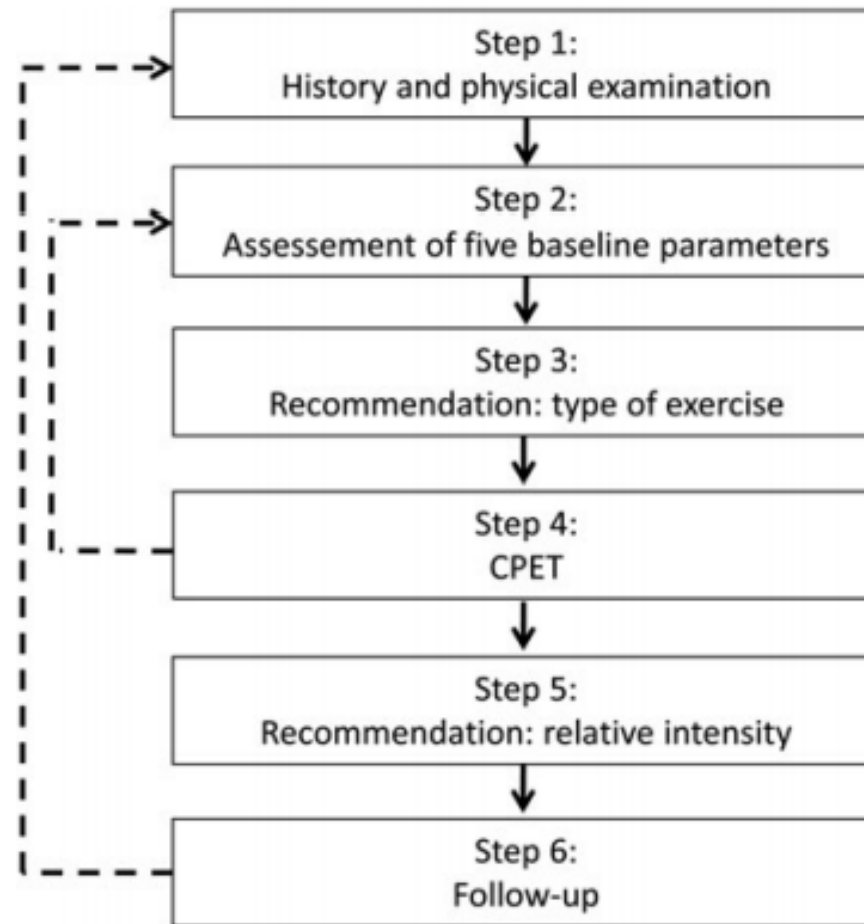
- The number of adults is expected to grow at a rate of 5% per/year
- Until recently we told congenital patients that they cant exercise
- only a minority of CHD patients (19%) receives formal physical activity advice
- Children with CHD are more likely to be overweight because of physical inactivity compared with children without CHD
- On the other end of the spectrum, young patients may reject exercise limitations and engage in unsafe sporting practices



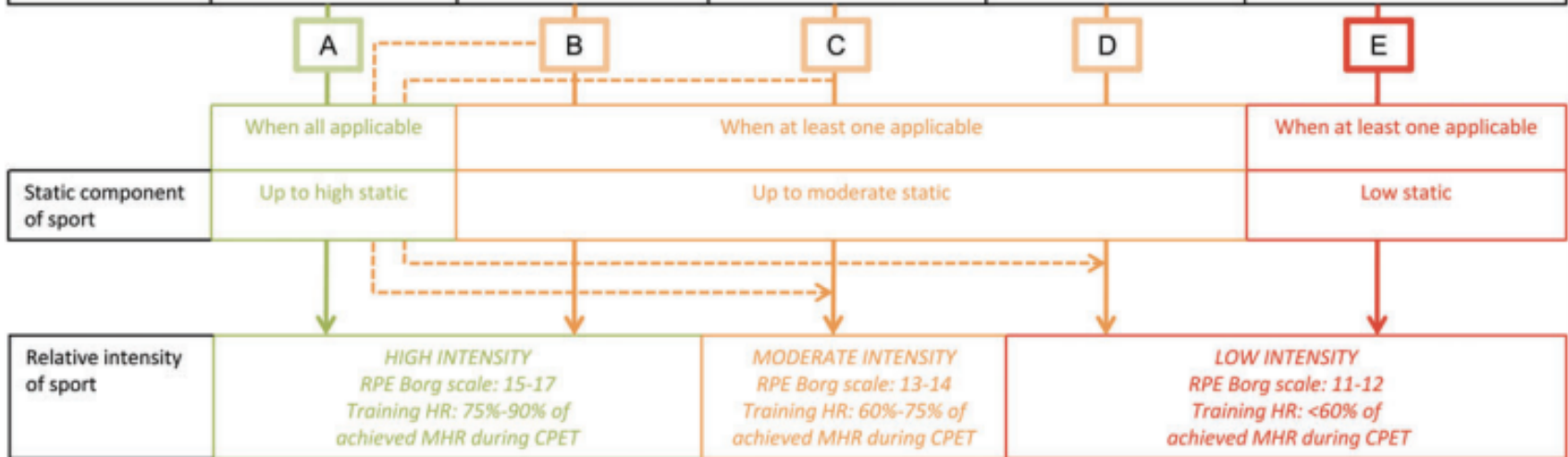
# Algorithm for evaluating Congenital HD patients



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1. Ventricles	No systolic dysfunction No hypertrophy No pressure load No volume load	No systolic dysfunction No hypertrophy Mild pressure load Mild volume load	Mild systolic dysfunction Mild hypertrophy  Single ventricle physiology Systemic right ventricle	Moderate systolic dysfunction Moderate hypertrophy Moderate pressure load	Severe systolic dysfunction Severe hypertrophy Severe pressure load Moderate/severe volume load
2. Pulmonary artery pressure	Low pulmonary artery pressure	Low pulmonary artery pressure	Mildly elevated pulmonary artery pressure		Moderately/severely elevated pulmonary artery pressure
3. Aorta	No/mild dilatation	Moderate dilatation	Severe dilatation	Dilatation approaching indication for repair	
4. Arrhythmia	No arrhythmia	No arrhythmia	Mild arrhythmic burden Non-malignant arrhythmia		Significant arrhythmic burden Malignant arrhythmia
5. Saturation at rest/during exercise	No central cyanosis	No central cyanosis	No central cyanosis	Central cyanosis	



Solid lines indicate recommendation ; if option for sports with high static component, reduce intensity (dotted lines)



# Variable definitions



**Table 2** Definition of variables

Variable	Definition
Ventricles	
Ventricular dysfunction	No: EF $\geq$ 55% Mild: 45% $\leq$ EF < 55% (or normal systemic right ventricle) Moderate: 30 $\leq$ EF < 45% Severe: EF < 30% (or impaired systemic right ventricle)
Ventricular hypertrophy	Left ventricle: No: septal/posterior wall thickness (cm): $\sigma^{\text{♂}} < 1.1$ $\text{♀} < 1.0$ ; LV mass (g): $\sigma^{\text{♂}} 88\text{--}224$ $\text{♀} 67\text{--}162$ Mild: septal/posterior wall thickness (cm): $\sigma^{\text{♂}} 1.1\text{--}1.3$ $\text{♀} 1.0\text{--}1.2$ ; LV mass (g): $\sigma^{\text{♂}} 225\text{--}258$ $\text{♀} 163\text{--}186$ Moderate: septal/posterior wall thickness (cm): $\sigma^{\text{♂}} 1.4\text{--}1.6$ $\text{♀} 1.3\text{--}1.5$ ; LV mass (g): $\sigma^{\text{♂}} 259\text{--}292$ $\text{♀} 187\text{--}210$ Severe: septal/posterior wall thickness (cm): $\sigma^{\text{♂}} \geq 1.7$ $\text{♀} \geq 1.6$ ; LV mass (g): $\sigma^{\text{♂}} \geq 293$ $\text{♀} \geq 211$ Right ventricle: qualitative echocardiographic evaluation
Ventricular pressure overload	No significant LVOT or RVOT gradient (peak systolic flow < 2.6 m/s), no obstruction in great vessels 2.6 m/s $\leq$ peak systolic velocity < 3 m/s for LVOT and RVOT obstructions and PPS; for coarctation of the aorta, arm-leg gradient < 20 mmHg 3 m/s $\leq$ peak systolic velocity $\leq$ 4 m/s for LVOT and RVOT obstructions and PPS Peak systolic velocity > 4 m/s for LVOT and RVOT obstructions and PPS; for coarctation of the aorta, clinical gradient $\geq$ 20 mmHg



# Variable definitions

## Ventricular volume overload

- No volume overload
- Mild volume overload
- Moderate/severe volume overload

Absent/mild valve regurgitation or shunt that do not cause significant chamber dilatation (parasternal views—long axis: LVEDD: 55–63 mm; LVESD 35–42 mm; RVEDD: 30–36 mm)  
Mild: dilated right or left ventricle by severe regurgitation, however with preserved systolic function  
Significant right or left ventricular dilatation with impaired ventricular function

## Ventricle physiology

Single ventricle or double ventricle  
Systemic left ventricle or systemic right ventricle

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## Pulmonary artery pressure

- Low PAP
- Mildly elevated PAP
- Moderately/severely elevated PAP

No PH: TVRV  $\leq$  2.8 m/s, systolic PAP  $\leq$  36 mmHg, and/or no additional echocardiographic variables suggestive of PH  
Possible PH: TVRV  $>$  2.8 m/s, systolic PAP  $>$  36 mmHg, and no signs of right ventricular systolic dysfunction  
High probability of PH: TVRV  $>$  2.8 m/s, systolic PAP  $>$  36 mmHg, and signs of right ventricular dysfunction

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## Aorta

- No/mild dilatation
- Moderate dilatation
- Severe dilatation
- Dilatation approaching indication for repair

Normal ( $\leq$  30 mm) or borderline sizes ( $<$  35 mm) of the aorta  
Aorta size  $\geq$  35 and  $<$  45 mm  
Aorta size  $\geq$  45 and  $<$  50 mm  
Aorta size  $\geq$  50 mm

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## Arrhythmia

- No arrhythmias
- Mild arrhythmic burden/non-malignant arrhythmias
- Significant arrhythmic burden/potentially malignant arrhythmias

Absence of/infrequent arrhythmias ( $<$  500/24 h) PVC if a Holter was done  
Frequent/coupled PVC and controlled atrial fibrillation/atrial flutter, which do not worsen with exercise  
Atrial fibrillation/atrial flutter, which worsen with exercise  
Non-sustained ventricular arrhythmias or sustained ventricular tachycardia

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## Saturation at rest/during exercise

- No central cyanosis

Absence of clinical signs; transcutaneous saturations within the range of 96–100%, at rest and during exercise