

PHYSICAL PERFORMANCE, EXERCISE TRAINING AND BODY COMPOSITION □IN CONGENITAL HEART DISEASE

Camilla Sandberg

Physiotherapist, PhD

Heart center, Umeå University hospital

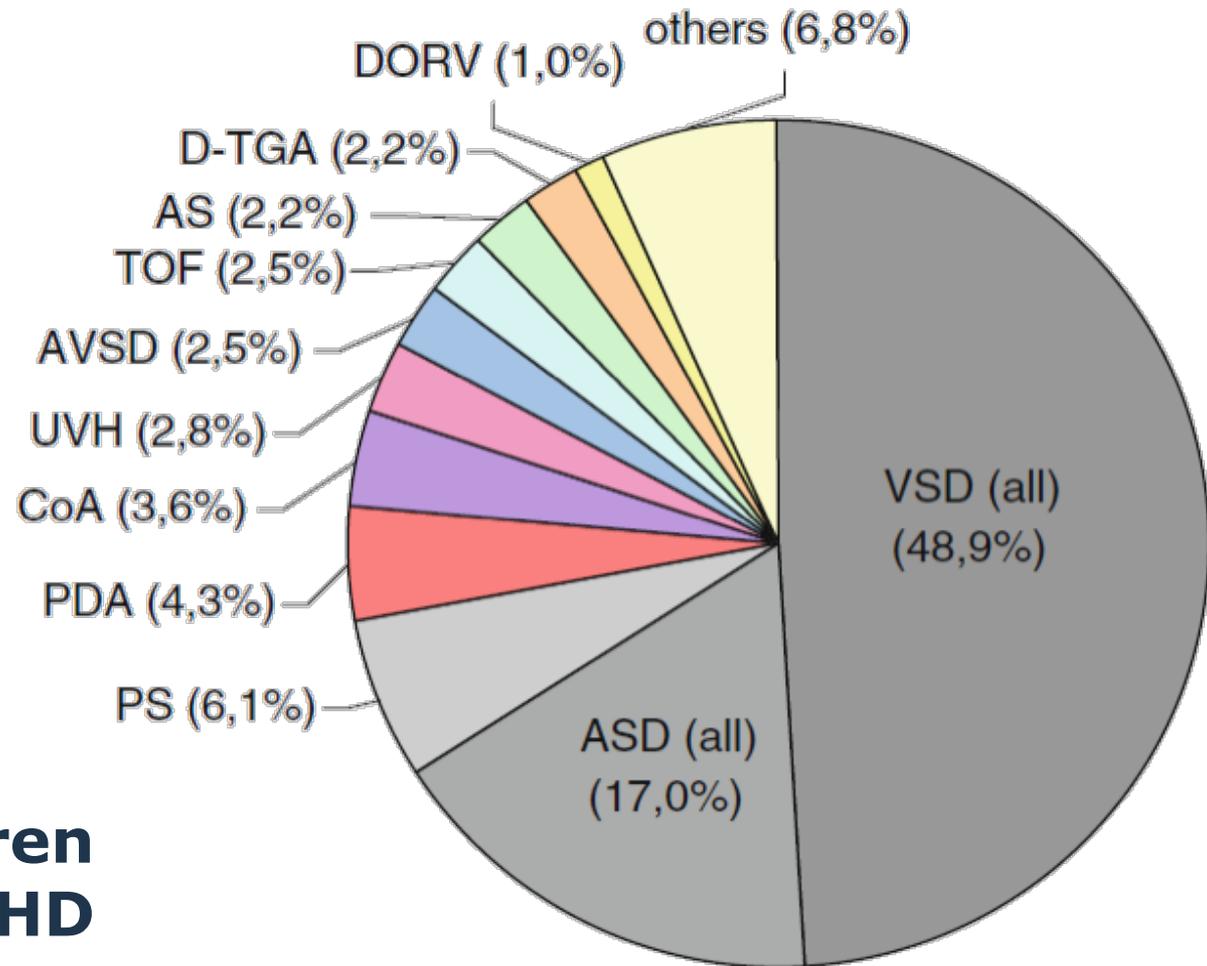
Department of Public health and Clinical medicine and

Department of Community health and rehabilitation, Umeå University, Sweden



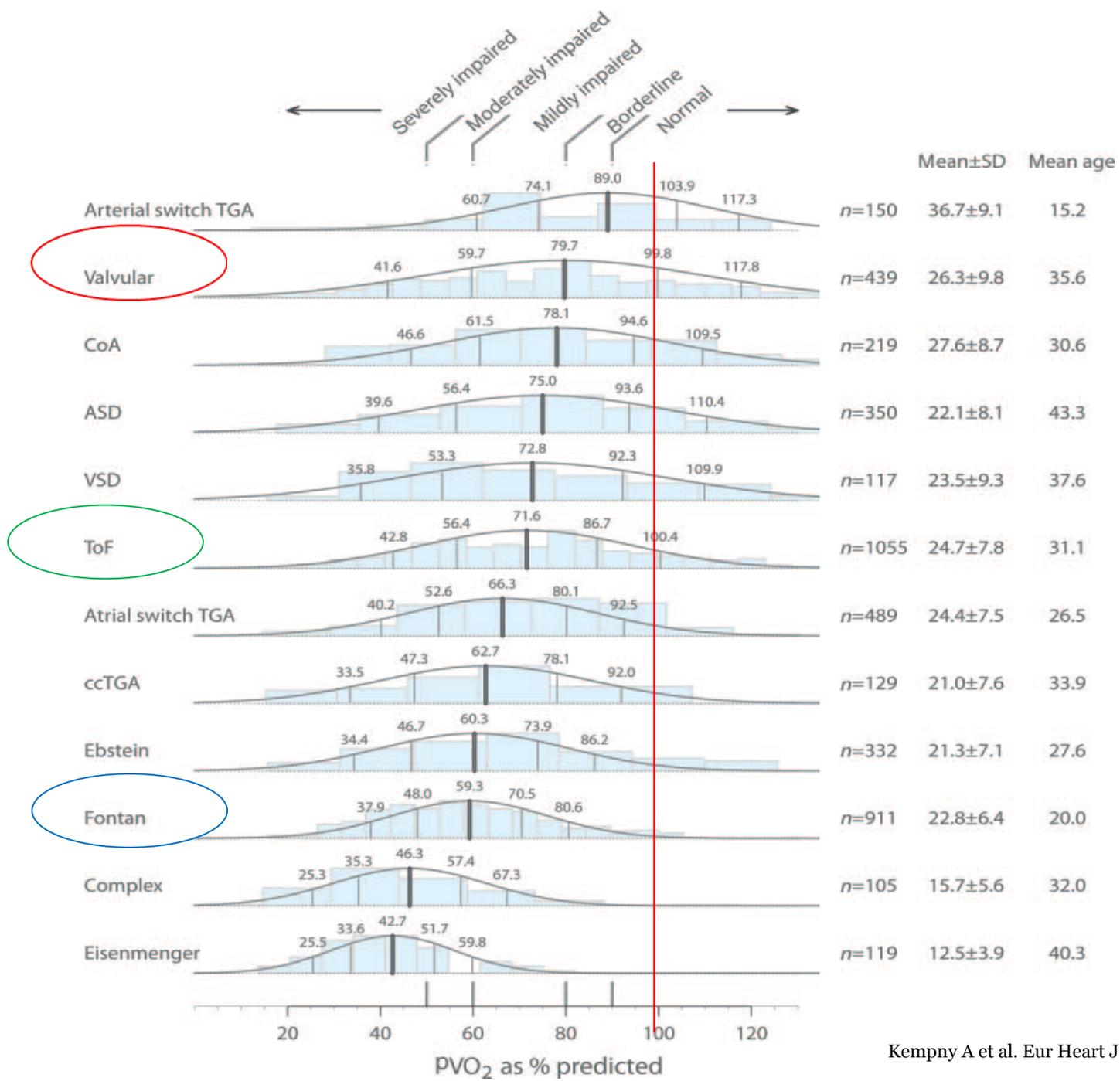
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CHD - Heterogenous disease



**1:100 children
born with CHD**





FACTORS RELATED TO LIMITED AEROBIC CAPACITY

- Ventricular function -
Stoke volume
- Heart rate

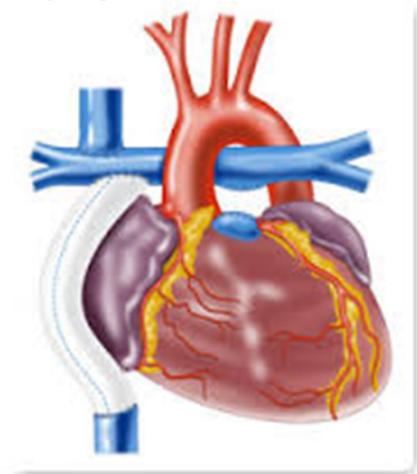
} Cardiac output

- Muscle function
- Pulmonary function
- Pulmonary blood flow
- Cyanosis
- Physical activity



VENTRICULAR FUNCTION (STROKE VOLUME)

- Valvular stenosis/regurgitation, shunt, hypertension
- Right ventricle as systemic ventricle (TGA)
- Absence of sub pulmonary ventricle (TCPC)



HEART RATE

- Chronotropic incompetence
- Complex heart lesion
- Increasing age
- Sick-sinus, Beta blockers, injury during surgery



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Muscle function

- Impaired muscle endurance
 - Impaired muscle strength
 - Impaired muscle metabolism
-
- Connection muscle strength – peak aerobic capacity (peak VO_2)



Sandberg C, European Journal of Preventive Cardiology. 2015;22(12):1523-30.

Kröönström LA, Int J Cardiol. 2014;170(3):358-63.

Cordina R, Heart. 2013;99(20):1530-4.

Greutmann M, Heart. 2011;97(14):1164-8.



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Pulmonary function

- More common in complex CHD
- Hypoplasia
- Restrictivity



Pulmonary blood flow

- Right ventricular outflow tract restriction
- Passive pulmonary blood flow
- Increased pulmonary blood pressure



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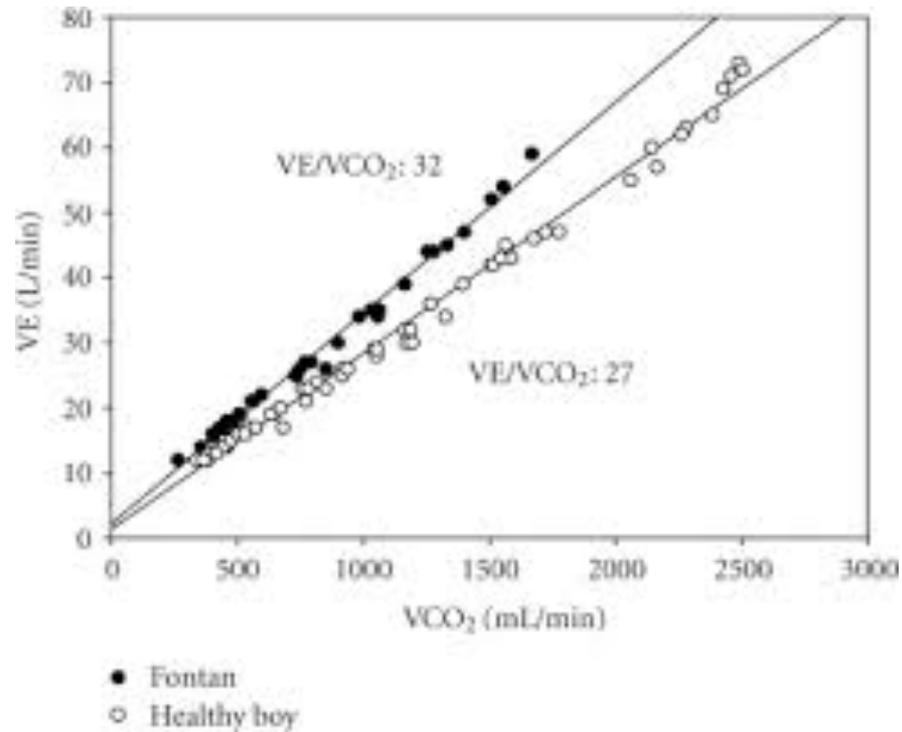
} Cardiac output

- Muscle function
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- **Cyanosis**
- Physical activity



CYANOSIS

↑ CO₂ in blood → ↑ ventilation



Ten Harkel et al. International Journal of Pediatrics 2010(18) · September 2010



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- Pulmonary blood flow
- Cyanosis
- Physical activity??





Canadian Journal of Cardiology ■ (2016) 1–7

Clinical Research

Habitual Physical Activity in Adults With Congenital Heart Disease Compared With Age- and Sex-Matched Controls

Camilla Sandberg, RPT, MSc,^{a,b} Jeremy Pomeroy, PhD,^c Ulf Thilén, MD, PhD,^d
Anna Gradmark, MD, PhD,^a Karin Wadell, RPT, PhD,^b and Bengt Johansson, MD, PhD^a

80 adults with CHD
32 women
Mean age 37.0 ± 15.3 years
Complex lesions n=40
Simple lesions n=40

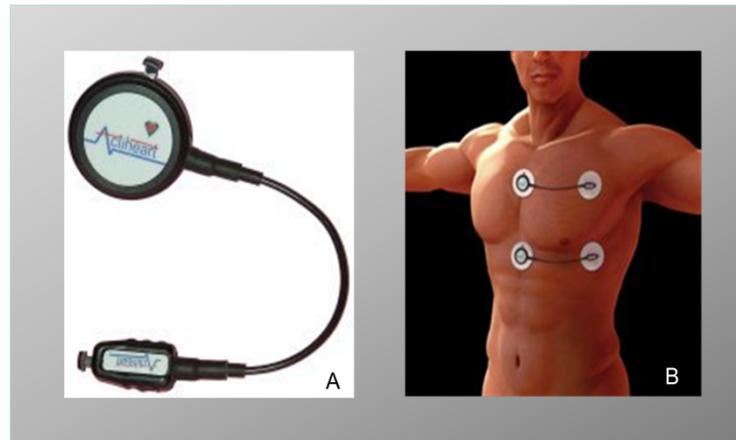
42 controls
16 women
 36.9 ± 15.0 years



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MATERIAL AND METHOD

- Actiheart, 4 days
- Time spent \geq moderate activity (≥ 3 MET)



RESULTS

- Equally active as their healthy peers
- \approx 50% did not reach current WHO recommendations on physical activity



Original Article

Objectively measured physical activity levels of young children with congenital heart disease

Nicola Stone,¹ Joyce Obeid,¹ Rejane Dillenburg,² Jovana Milenkovic,¹ Maureen J. MacDonald,³
Brian W. Timmons^{1,3}

- Children 3-5 years
- CoA n=6
- ToF n=4
- Accelerometer
- Equally active
- >50% did not reach recommendations



Reduced physical exercise and health-related quality of life after Fontan palliation

Eva R. Hedlund (eva.rylander-hedlund@karolinska.se)¹, Bo Lundell¹, Li Villard^{2,3}, Gunnar Sjöberg¹

Table 2 Self-reported exercise and accelerometry

	Patient	Control	p	Valid N patient	Valid N control
<i>Self-reported exercise</i>					
Physical exercise, minutes per week	113.5 ± 66.1	227.6 ± 147.2	<0.001	30	25
Physical exercise, mean intensity in Borg	13.0 ± 2.1	14.3 ± 1.9	<0.05	24	25
<i>Accelerometer</i>					
Total vector magnitude 7 days, counts	19.2 × 10 ⁶ ± 4.6 × 10 ⁶	18.9 × 10 ⁶ ± 4.7 × 10 ⁶	0.79	30	25
Sedentary %	48.6 ± 4.4	51.8 ± 5.2	<0.05	30	25
Light %	41.1 ± 3.3	38.4 ± 3.6	<0.01	30	25
Moderate %	10.3 ± 4.2	9.8 ± 3.7	0.67	30	25
Vigorous %	0	0		30	25

Values presented as mean ± 1SD.

Acta Paediatrica 2016, 105,1322-28



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Physical activity in adolescents and adults with congenital heart defects: individualized exercise prescription[†]

Werner Budts^{1,2*}, Mats Börjesson³, Massimo Chessa⁴, Frank van Buuren⁵, Pedro Trigo Trindade⁶, Domenico Corrado⁷, Hein Heidbuchel^{1,2}, Gary Webb⁸, Johan Holm⁹, and Michael Papadakis¹⁰

Review

Recommendations for physical activity, recreation sport, and exercise training in paediatric patients with congenital heart disease: a report from the Exercise, Basic & Translational Research Section of the European Association of Cardiovascular Prevention and Rehabilitation, the European Congenital Heart and Lung Exercise Group, and the Association for European Paediatric Cardiology

T Takken¹, A Giardini², T Reybrouck³, M Gewillig⁴, HH Hövels-Gürich⁵, PE Longmuir⁶, BW McCrindle⁷, SM Paridon⁸ and A Hager⁹

European Journal of
**Preventive
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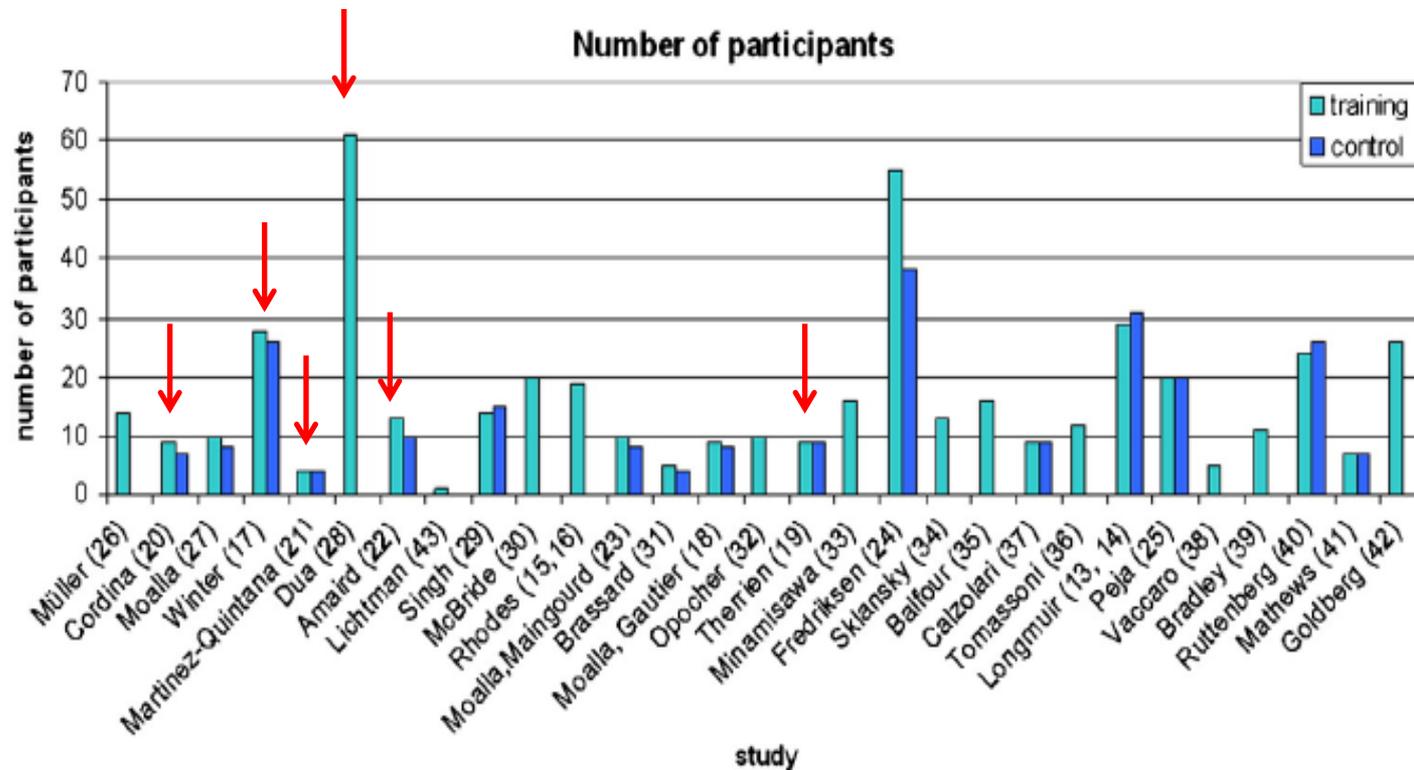


Fig. 1. Number of participants per study, if applicable; summarised per group. Ordered by year of publication, the oldest publication is placed last.

Duppen N, et al, systematic review of the effects of physical exercise training programmes in children and young adults with congenital heart disease, int J cardiol (2013)



PHYSICAL ACTIVITY AND EXERCISE

- General recommendations on physical activity to promote health - moderate activity:
 - ≈ 30 min/day for adults
 - ≈ 60 min/day for children
- Most persons with CHD can perform exercise training without restrictions
- Individually adjusted prescription is recommended



Home-Based Interval Training Increases Endurance Capacity in Adults with Complex Congenital Heart Disease

Camilla Sandberg^{a,b}, RPT, MSc, Magnus Hedström^a, MD, Karin Wadell^b, RPT, PhD, Mikael Dellborg^c, MD, PhD, Anders Magnusson^c, MD, Anna-Klara Zetterström^d, RPT, Amanda Ljungqvist^d, RPT and Bengt Johansson^a, MD, PhD.

Submitted



MATERIAL AND METHOD

Complex Congenital heart disease
eg. ToF, TGA, ccTGA Fontan/TCPC

23 adults (11 women)

33,9 ± 13,6 years



MATERIAL OCH METOD

- Incremental CPET
 - Peak VO_2 , peak work load, peak HR
- Constant work rate CPET
 - 75% of peak work load
 - Test duration (min)



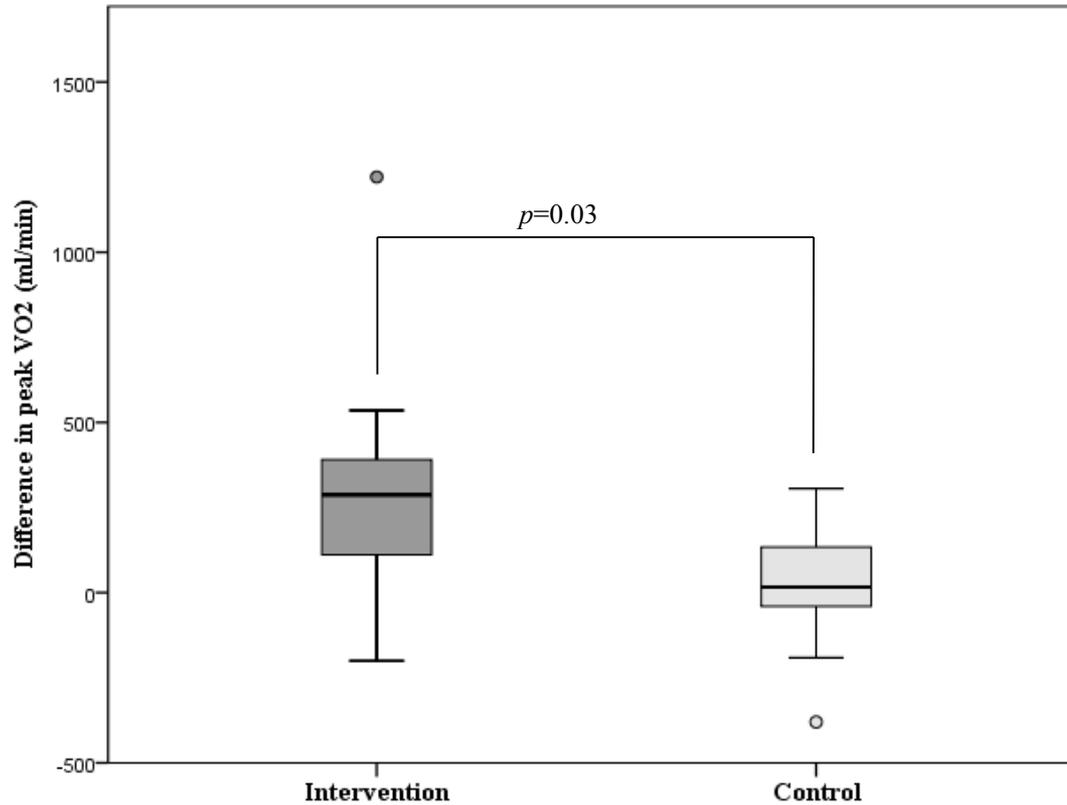
MATERIAL AND METHOD

- 13 exercise training, 10 control
- Home based interval training
 - Ergometer cycle
 - 40 min 3 t/w 12 weeks
 - 70-80% of peak VO_2
- Controls 12 weeks of everyday activities



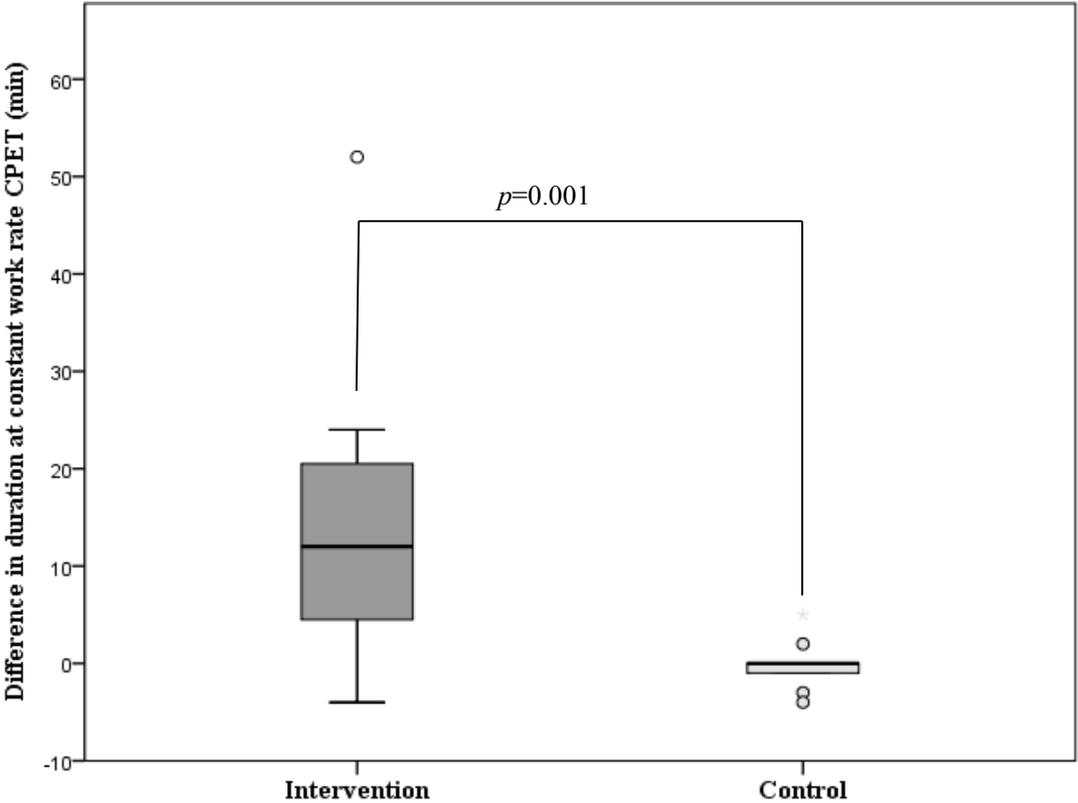
RESULTS PEAK VO₂

Figure 2



RESULTS AEROBIC ENDURANCE

Figure 1



DOES AEROBIC EXERCISE HAVE ADVERSE EFFECTS ON THE HEART?

- No adverse effect on ventricular function in short term

Winter M, et al. Eur Heart J. 2012;33(11):1378-85.

Shafer KM, et al. The Journal of Physiology. 2015. doi: 10.1113/JP270280.

Duppen N, et al. International Journal of Cardiology. 2015;179(0):97-104.

Winter M, European Heart Journal (2012) 33, 1378–13



MUSCLE TRAINING?



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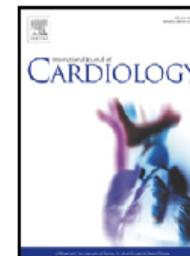


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International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard



Resistance training improves cardiac output, exercise capacity and tolerance to positive airway pressure in Fontan physiology[☆]

Rachael L. Cordina^{a,b}, Shamus O'Meagher^{a,b}, Alia Karmali^a, Caroline L. Rae^{c,d}, Carsten Liess^e,
Graham J. Kemp^f, Raj Puranik^{a,b}, Nalin Singh^{g,h}, David S. Celermajer^{a,b,*}

- Fontan/TCPC
- 6 training, 5 controls , 32±2 years
- Muscle training 60 min 3t/w 20 weeks
- Increased strength
- Increased muscle mass
- Increased peak VO₂ (increased stroke volume)

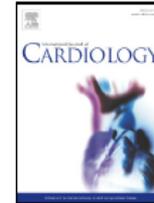




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Height, weight and body mass index in adults with congenital heart disease



Camilla Sandberg ^{a,g,*}, Daniel Rinnström ^a, Mikael Dellborg ^b, Ulf Thilén ^c, Peder Sörensson ^d, Niels-Erik Nielsen ^e, Christina Christersson ^f, Karin Wadell ^g, Bengt Johansson ^a

2424 patients (SWEDCON)

- 538 complex lesions (18-40 years)
- 1886 simple lesions (18-50 years)

4605 controls (SCB)

- 1845 (18-40 years)
- 2760 (18-50 years)



RESULT

Tabell 1. Height, weight and BMI in adult men and women with congenital heart disease.

	Complex lesions 18-40 years		Simple lesions 18-50 years	
	Men	Women	Men	Women
Height	↓	↓	↓	↓
Weight	↓	=	↓	=
BMI	↓	=	↓	=

BMI; body mass index.



RESULT

Table 3. Prevalence of underweight (BMI <18.5) and obesity (BMI>30) in adult men and women with congenital heart disease.

	Complex lesions 18-40 years		Simple lesions 18-50 years	
	Men	Women	Men	Women
Underweight (BMI<18.5)	↑	=	↑	=
Obesity (BMI >30)	=	=	=	↑

BMI; body mass index.



Lean mass deficits, vitamin D status and exercise capacity in children and young adults after Fontan palliation

- Body composition dual energy X-ray absorptiometry
- 50 patients Fontan circulation
- Median age 11.5 (range 5.1–33.5) years
- Results:
- Poor growth and marked lean mass deficits
- *Avitabile et al. Heart. 2014 November ; 100(21): 1702–1707*



Body mass index in adult congenital heart disease

Margarita Brida,^{1,2,3} Konstantinos Dimopoulos,^{1,4} Alexander Kempny,^{1,4}
Emmanouil Liodakis,¹ Rafael Alonso-Gonzalez,¹ Lorna Swan,^{1,4} Anselm Uebing,^{1,4}
Helmut Baumgartner,² Michael A Gatzoulis,^{1,4} Gerhard-Paul Diller^{1,2,4}

- 3069 ACHD patients (median age 32.6 years)
- Higher BMI was associated with lower mortality
- Symptomatic patients with complex cardiac defects
- Weight loss even higher risk of mortality.

Brida M, et al. Heart 2017;**0**:1–8. doi:10.1136/heartjnl-2016-310571

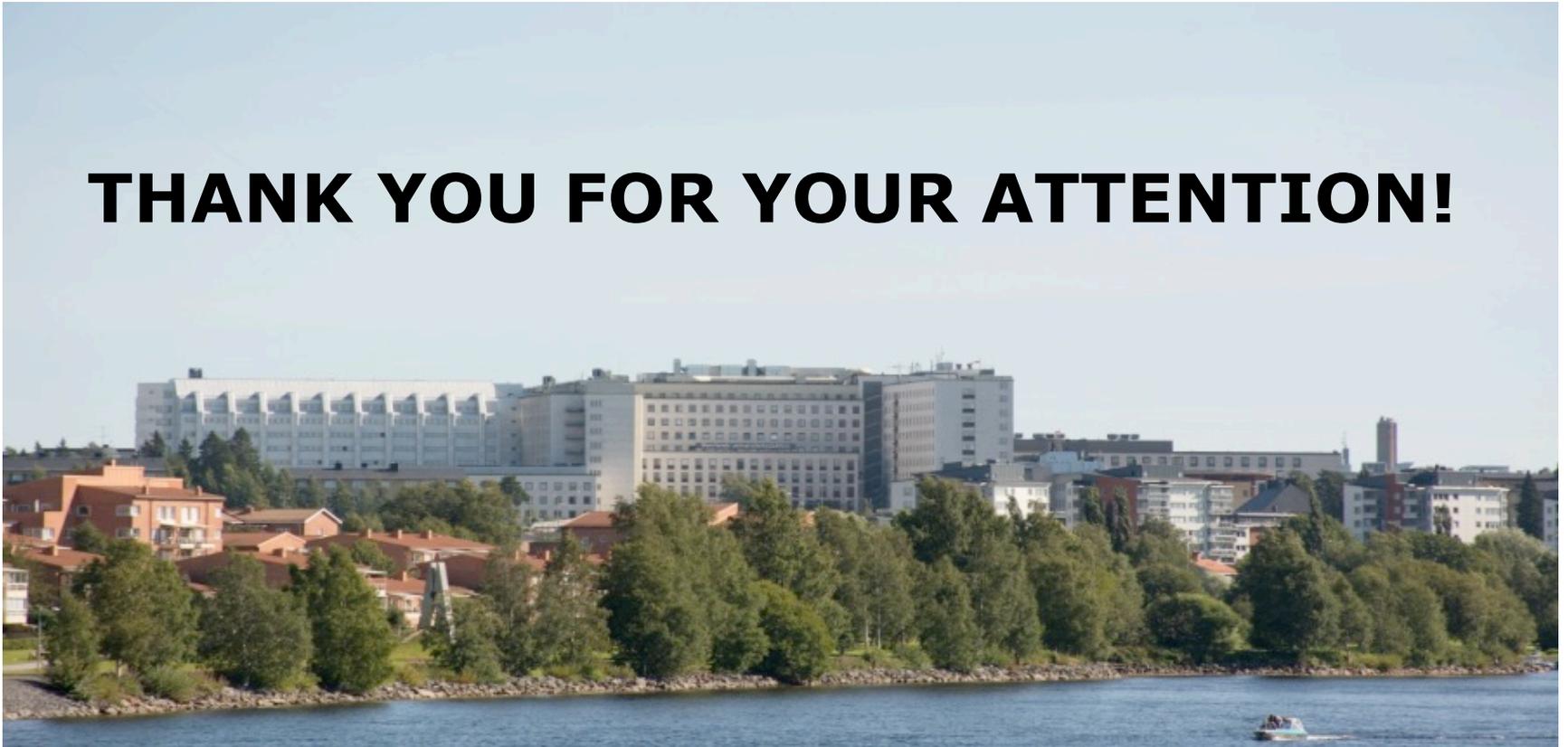


TAKE HOME MESSAGES

- Impaired aerobic capacity
- Multiple underlying factors
- Exercise training is safe and have positive effects
- Exercise training – prescribed individually
- Higher prevalence of lower BMI
- Low BMI associated with worse prognosis



THANK YOU FOR YOUR ATTENTION!



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