



Living the Best Life with a single ventricle



Exercise and the Fontan heart

Exercise prescription !!

Graham Stuart

Hon Assoc Professor, Sports and Exercise Cardiology

Bristol Congenital Heart Unit

Monday 25th September 2024

Disclosures

Congenital Cardiologist since 1993

NHS for 42 years

Clinical and research interest



Remember Suzie when she was a Ward sister

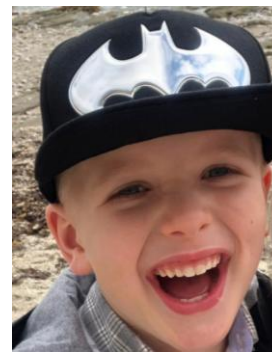
Children's Hospital, Ladywood



I am at the grandfather stage in life !



AGS in couple of years ?



Harry & Elsie

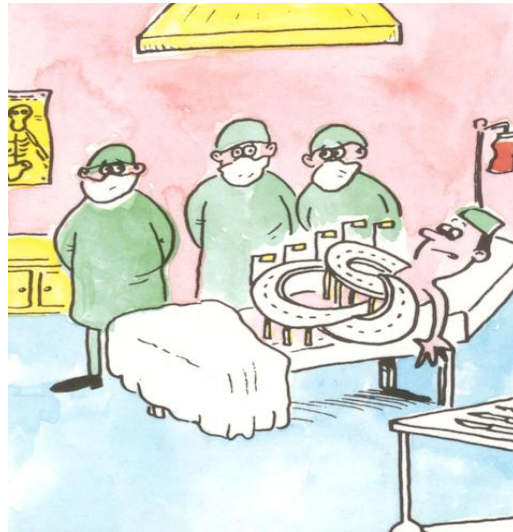
Arlo & Peggy

Rune dressed as Pumpkin!

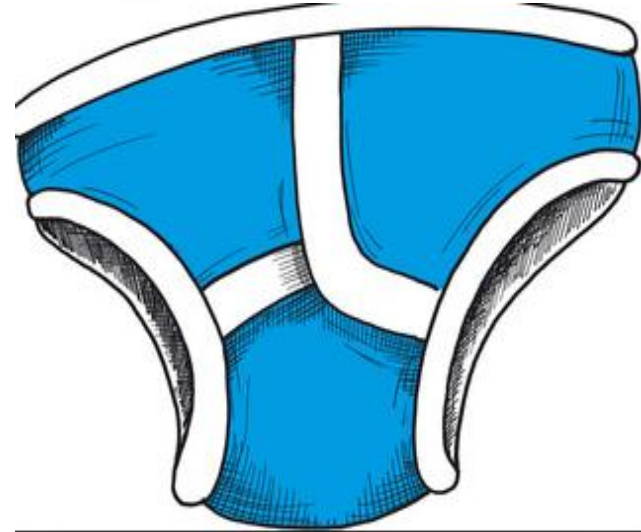
Exercise is *really* important for patients with CHD !



drugs / operations 9/10



lifestyle 1/10



Regular Exercise

- general health benefits

Diabetes

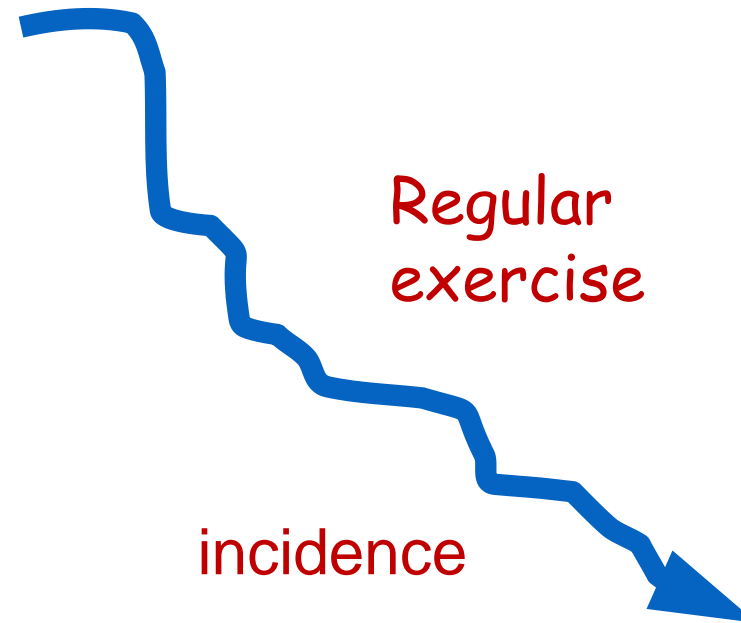
Lipid profile

Cancer colon/breast/prostate

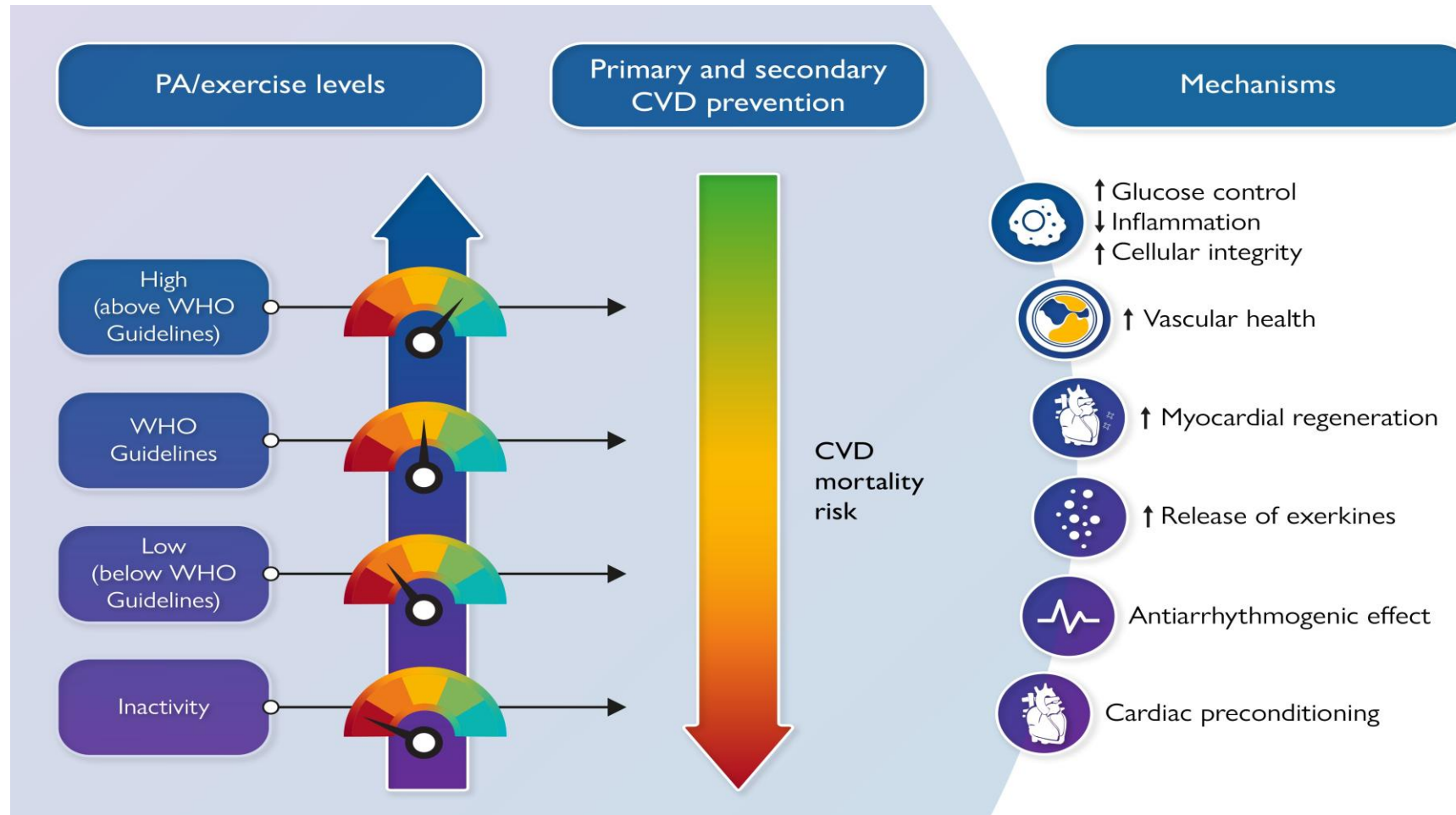
Osteoporosis

Anxiety/depression

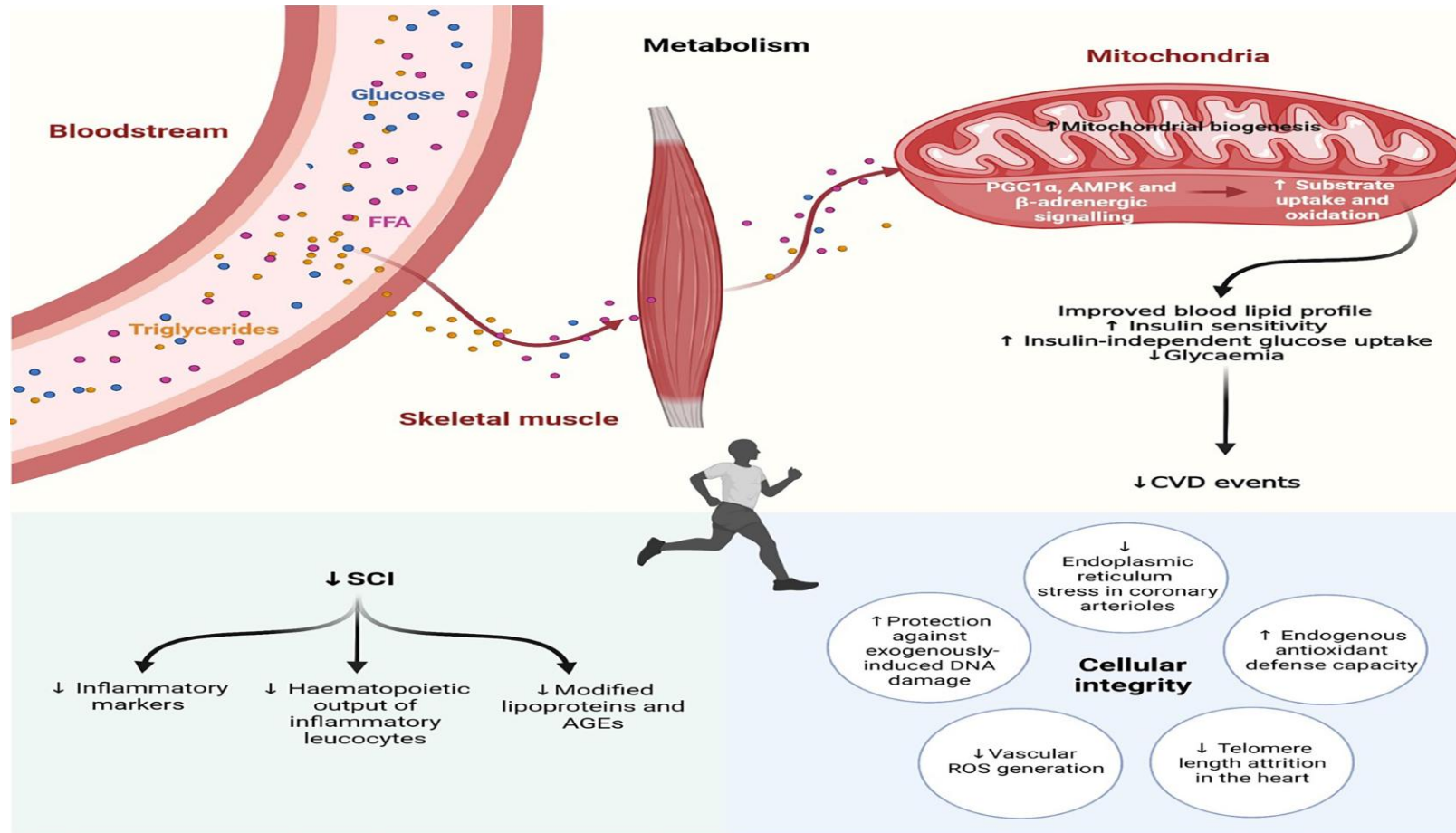
Dementia



Summary of the main effects of regular physical activity (PA) and exercise on cardiovascular disease (CVD). ...

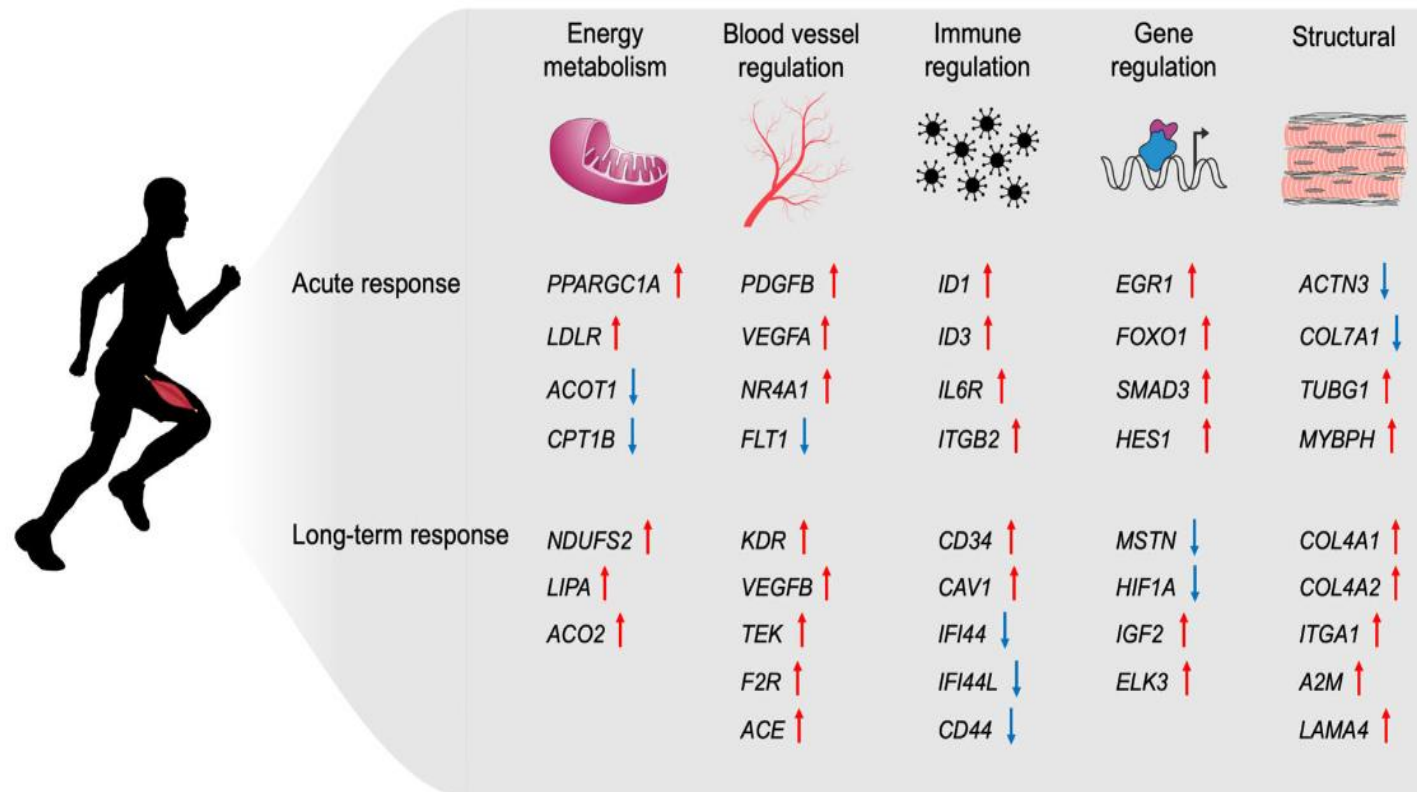


Main mechanisms explaining improvements in metabolism, inflammation, and cellular integrity induced by ...



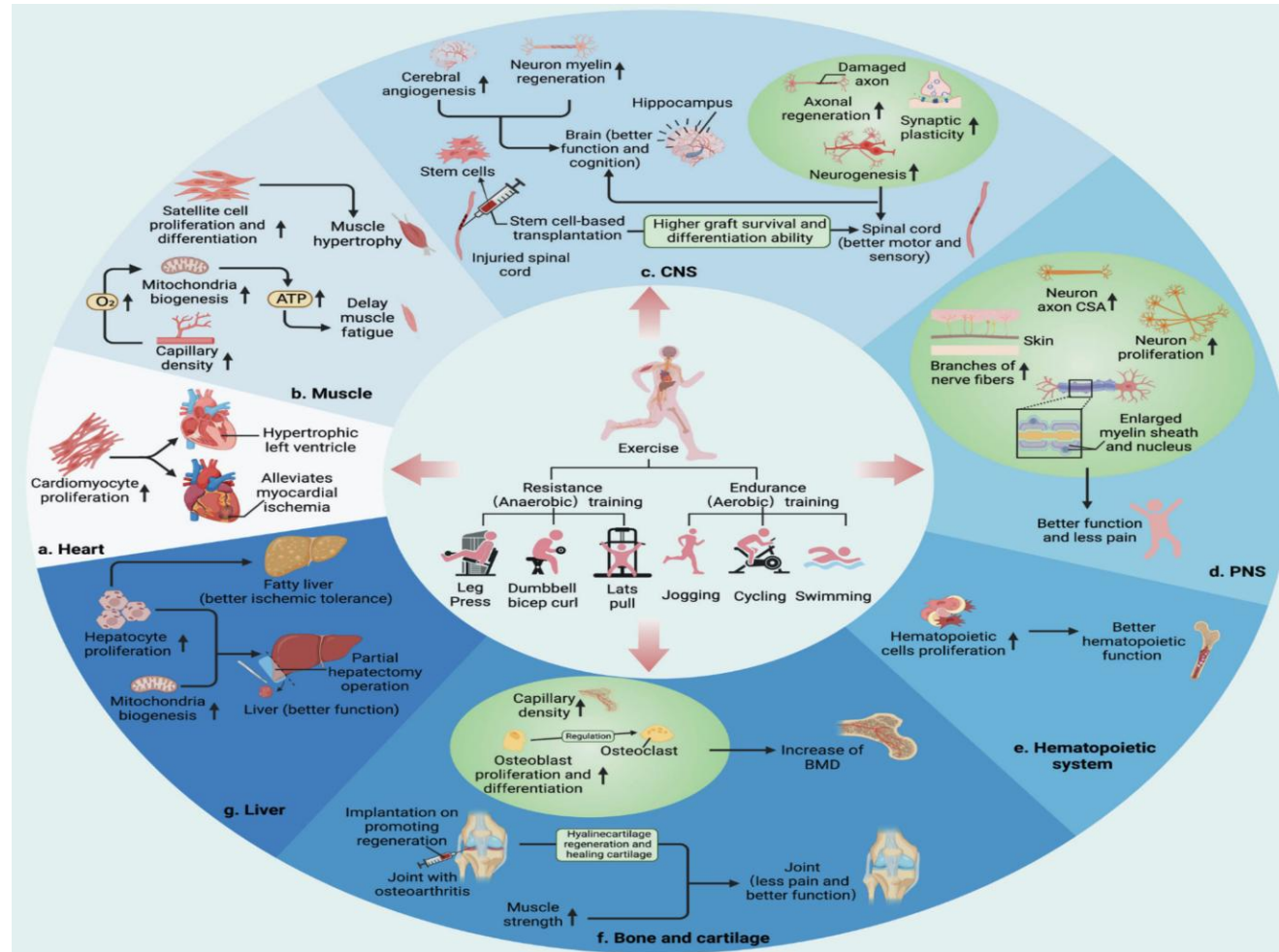
Mechanism of exercise benefit

gene adaptation in skeletal muscle: epigenetics!



Mechanism of exercise benefit

exercise induced tissue regeneration



Exercise and the Fontan Heart

Exercise training increases the **number** and **diameter** of arterial blood vessels in skeletal muscle and myocardium

Exercise training **improves** cardiac function, **reduces** valve regurgitation.
.....acts a bit like ACEI !

Exercise **reduces** vascular stiffness, **reduces** blood pressure

Exercise **increases** skeletal muscle efficiency
increases number and size of mitochondria

How does exercise treatment compare with antihypertensive medications? A network meta-analysis of 391 randomised controlled trials assessing exercise and medication effects on systolic blood pressure

Huseyin Naci,¹ Maximilian Salcher-Konrad,¹ Sofia Dias,^{2,3} Manuel R Blum,^{4,5,6} Samali Anova Sahoo,⁷ David Nunan,⁸ John P A Ioannidis^{5,6,9}

“The SBP- lowering effect of exercise among hypertensive populations appears similar to that of commonly used antihypertensive medications “

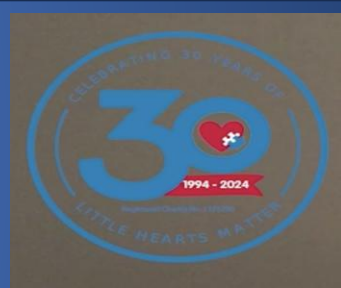


CELEBRATING 30 YEARS OF LHM SUPPORT

Little Hearts Matter is the only UK charity with
dedicated support for people with half a heart.

Registered charity number: 1123290

Living the Best Life with a single ventricle

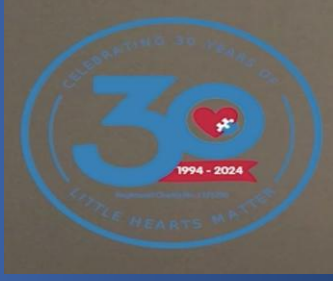


- General health benefits of exercise
- CVS benefits of Exercise
- What about post Fontan?



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Living the Best Life with a single ventricle



Can a Home-based Cardiac Physical Activity Program Improve the Physical Function Quality of Life in Children with Fontan Circulation?

Roni M. Jacobsen, MD,* Salil Ginde, MD,*† Kathleen Mussatto, PhD, RN,† Jennifer Neubauer, RN, MSN, CPNP,* Michael Earing, MD,*† and Michael Danduran, MS, RCEP-ACSM†§

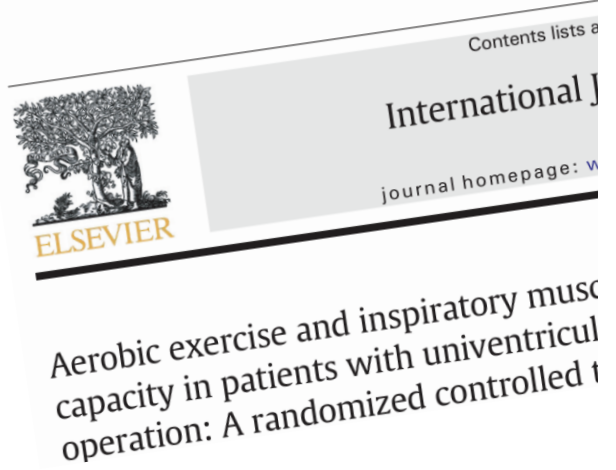
Congenit Heart Dis. 2016;00:00–00

Aerobic exercise and inspiratory muscle training increase functional capacity in patients with univentricular physiology after Fontan operation: A randomized controlled trial

Aida Luiza Ribeiro Turquetto ^{a,*}, Marcelo Rodrigues dos Santos ^a, Daniela Regina Agostinho ^a, Ana Luiza Carrari Sayegh ^b, Francis Ribeiro de Souza ^a, Luciana Patrick Amador ^a, Renata Schiezzari Ru Barnabe ^a,



Downloaded from <http://heart.bmj.com/>
 Heart Online First published



European Journal of Preventive Cardiology (2024) **31**, 389–399
<https://doi.org/10.1093/eurjpc/zwad286>

FULL RESEARCH PAPER

Physical activity

Leg-focused high-weight resistance training improves ventricular stroke volume, exercise capacity and strength in young patients with a Fontan circulation

Linda E. Scheffers ^{1,2,3,4}, Willem A. Helbing ^{1,5*}, Thomas Pereira ¹, Elisabeth

Physical exercise training in patients with a Fontan circulation: A systematic review

Scheffers et al

-16 studies of exercise intervention

Exercise training in Fontan patients is

- is safe
- has positive effects on
 - exercise capacity,
 - cardiac function
 - quality of life

Longitudinal Outcomes of Patients With Single Ventricle After the Fontan Procedure

- Ped Heart Network
- Longitudinal survival study
n=543
- 90% survived to adult life
independent of ventricular morphology,
- Gradual fall in exercise tolerance

“ Future interventions might focus on preserving exercise capacity ”



Yves d'Udekem, M.D., Ph.D.

Division Chief, Cardiac Surgery; Co-Director, Children's National Heart Institute, Children's National

EDITORIAL COMMENT

Cardiorespiratory fitness, not the severity of the condition dictates late outcomes after Fontan procedures

“the only advice that I will keep giving to the young patients who are coming to see me after Fontan procedures is “exercise, exercise, exercise!””

Yves D'Udekem

2020 ESC Guidelines on sports cardiology and exercise in patients with cardiovascular disease

Recommendations	Class ^a	Level ^b
Participation in regular <u>moderate</u> exercise is recommended in all individuals with CHD. ^{588,591–594,619}	I	B
A discussion on exercise participation and provision of an <u>individualized exercise prescription</u> is recommended at every CHD patient encounter. ^{574,597,598,617}	I	B



ESC

European Society
of Cardiology

European Heart Journal (2020) **41**, 4191–4199
doi:10.1093/eurheartj/ehaa501

CURRENT OPINION

Congenital heart disease

Recommendations for participation in Competitive Sport in adolescent and adult athletes with CHD

Individualised exercise prescription recommended !

EAPC /AEPC Consensus Document Physical Activity in Children with cardiovascular diseasedue for publication 2025

Parental recommendations and exercise attitudes in congenital heart disease

Curtis A Wadey¹, Fiona Potter³, Nurul H Amir⁴, Lynsey Forsythe⁵,
A Graham Stuart⁵, Williams¹

in > 20 years!

- Questionnaire UK 2022
 - Social media / CHD net
- 83 respondents
 - 7.3 +/-5yrs (0-20)
 - 72% *never received* activity advice
 - 10% *inconsistent* advice
 - Parental attitude important





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Living the Best Life with a single ventricle



How do we go about providing an
exercise prescription to a post Fontan
single ventricle patient?



Exercise Prescription

factors to consider

- Think about it !

Promotion of Physical Activity for Children and Adults With Congenital Heart Disease : A Scientific Statement From the American Heart Association

Patricia E. Longmuir, Julie A. Brothers, Sarah D. de Ferranti, Laura L. Hayman, George F. Van Hare, G. Paul Matherne, Christopher K. Davis, Elizabeth A. Joy and Brian W. McCrindle

Circulation 2013,127;2147-2159

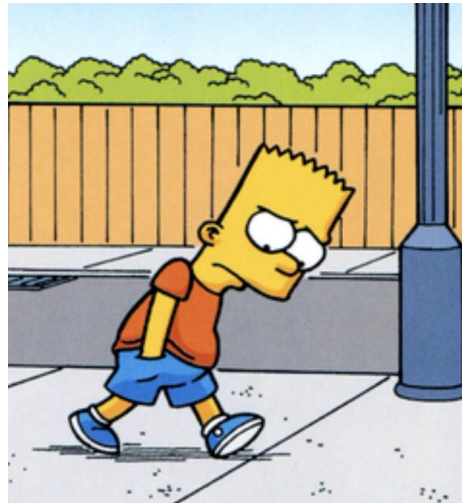
“Counselling to encourage daily participation in appropriate physical activity should be a **core component of every patient encounter**....”

Exercise Prescription

factors to consider

- Think about it !
- Patient beliefs /wishes

Ask what form of exercise/PA they enjoy and what they would like to do !



Walking



Sport



Gamification

Exercise Prescription

factors to consider

- Think about it !
- Patient beliefs /wishes
- Family beliefs

START EARLY !



Exercise Prescription

factors to consider

- Early discussion *infancy/preschool*
- Realistic goals and outcomes
- Involve whole clinical team
 - Nurse specialists
 - Cardiologists/junior medical staff
 - Psychologists/physiologists
- Involve school
- Future proof – sports / patients change !

Exercise Prescription

consensus recommendations

2020 ESC Guidelines on sports cardiology and exercise in patients with cardiovascular disease

The Task Force on sports cardiology and exercise in patients with cardiovascular disease of the European Society of Cardiology (ESC)

Authors/Task Force Members: Antonio Pelliccia* (Chairperson) (Italy), Sanjay Sharma* (Chairperson) (United Kingdom), Sabiha Gati (United Kingdom), Maria Bäck (Sweden), Mats Börjesson (Sweden), Stefano Caselli (Switzerland), Jean-Philippe Collet (France), Domenico Corrado (Italy), Jonathan A. Drezner (United States of America), Martin Halle (Germany), Dominique Hansen (Belgium), Hein Heidbuchel (Belgium), Jonathan Myers (United States of America), Josef Niebauer (Austria), Michael Papadakis (United Kingdom), Massimo Francesco Piepoli (Italy), Eva Prescott (Denmark), Jolien W. Roos-Hesselink (Netherlands), A. Graham Stuart (United Kingdom), Rod S. Taylor (United Kingdom), Paul D. Thompson (United States of America), Monica Tiberi (Italy), Luc Vanhees (Belgium), Matthias Wilhelm (Switzerland)

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Eur Heart J. 2021 Jan 6;42(1):17-96

All cardiology including CHD

Recommendations for participation in competitive sport in adolescent and adult athletes with Congenital Heart Disease (CHD): position statement of the Sports Cardiology & Exercise Section of the European Association of Preventive Cardiology (EAPC), the European Society of Cardiology (ESC) Working Group on Adult Congenital Heart Disease and the Sports Cardiology, Physical Activity and Prevention Working Group of the Association for European Paediatric and Congenital Cardiology (AEPC)

Werner Budts^{1,2†}, Guido E. Pielels^{3*†}, Jolien W. Roos-Hesselink⁴, Maria Sanz de la Garza⁵, Flavio D'Ascenzi⁶, George Giannakoulas⁷, Jan Müller⁸, Renate Oberhoffer⁸, Doris Ehringer-Schetitska⁹, Vesna Herceg-Cavrak¹⁰, Harald Gabriel¹¹, Domenico Corrado¹², Frank van Buuren¹³, Josef Niebauer¹⁴, Mats Börjesson¹⁵, Stefano Caselli¹⁶, Peter Fritsch¹⁷, Antonio Pelliccia¹⁸, Hein Heidbuchel¹⁹, Sanjay Sharma²⁰, A. Graham Stuart³, and Michael Papadakis²⁰

Eur Heart J. 2020 Nov 14;41(43):4191-4199

All CHD – adults and adolescents

1

History and Physical Examination

- symptoms
- past cardiac history
- *Exercise history*
 - *Type / Frequency*
 - *Supplements / drugs*
- Know details of CHD
- comorbidity

1

History and Physical Examination

2

Assessment of 5 basic parameters

- Ventricular function
- PA pressure
- Assessment of aorta
- Assessment of arrhythmia
- Saturations *rest/exercise*

1

History and Physical Examination

2

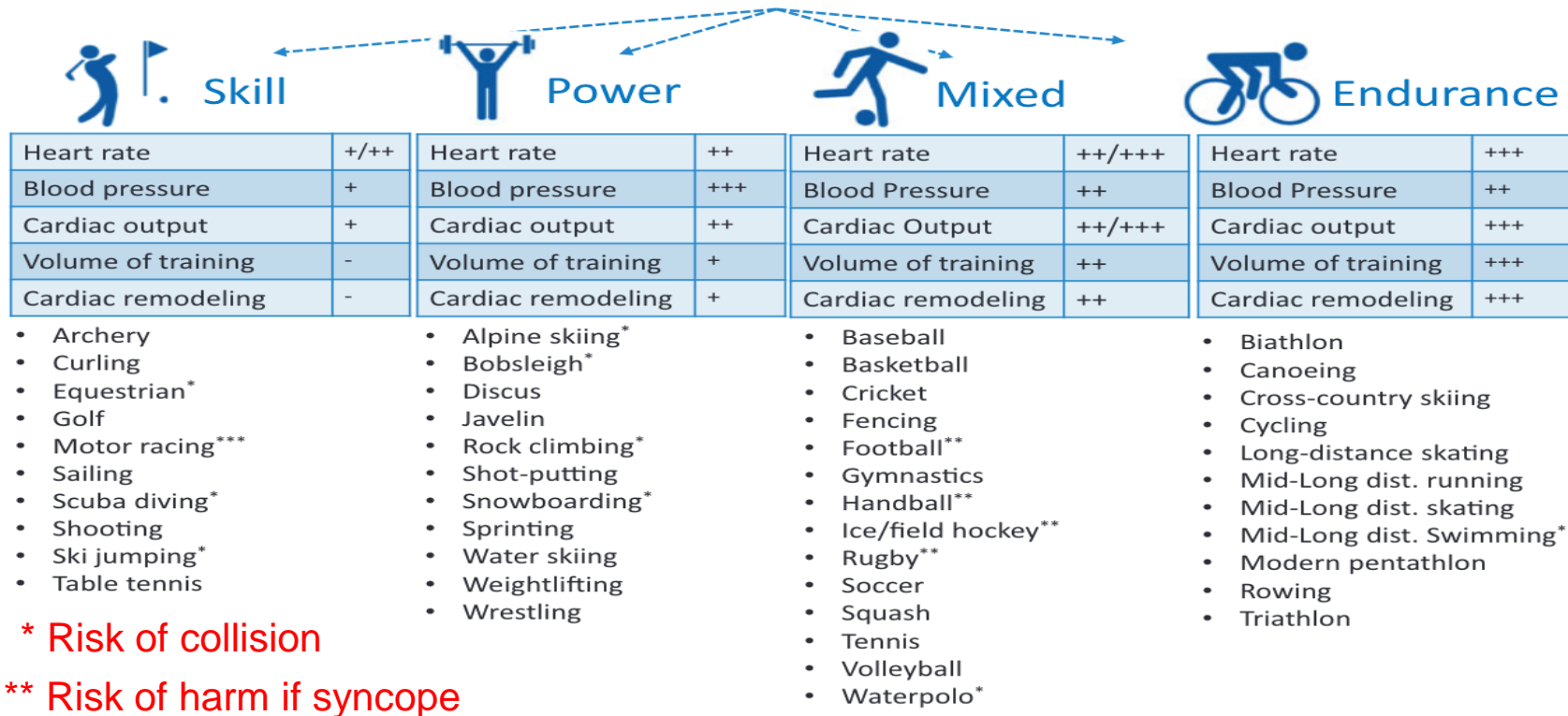
Assessment of 5 basic parameters

3

Recommendation: type of exercise

ESC Classification of Sports

Sport Disciplines



1

History and Physical Examination

2

Assessment of 5 basic parameters

3

Recommendation: type of exercise

4

CPET..... ?? *Exercise echo*

*Exercise related BP / Saturations / Arrhythmias
Peak VO₂ / Borg scale*

1

History and Physical Examination

2

Assessment of 5 basic parameters

3

Recommendation: type of exercise

4

CPET..... ?? *Exercise echo*

5

Recommendation: relative intensity

ESC Guidelines on sports cardiology and exercise in patients with cardiovascular disease

Table 4 Indices of exercise intensity for endurance sports from maximal exercise testing and training zones

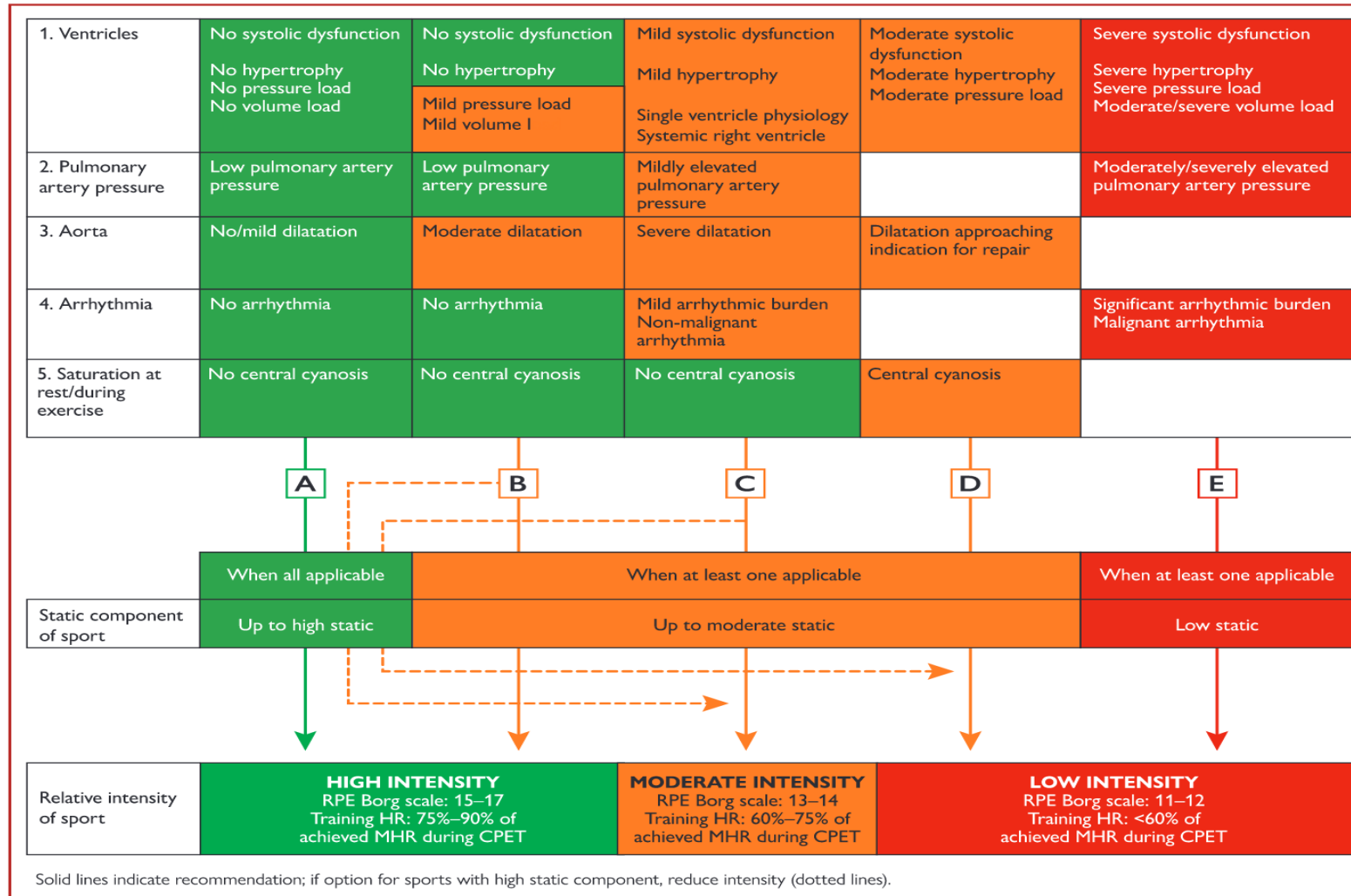
Intensity	VO_{2max} (%)	HR_{max} (%)	HRR (%)	RPE Scale	Training Zone
Low intensity, light exercise ^a	<40	<55	<40	10–11	Aerobic
Moderate intensity exercise ^a	40–69	55–74	40–69	12–13	Aerobic
High intensity ^a	70–85	75–90	70–85	14–16	Aerobic + lactate
Very high intense exercise ^a	>85	>90	>85	17–19	Aerobic + lactate + anaerobic

© ESC 2020

HR_{max} = maximum heart rate; HRR = heart rate reserve; RPE = rate of perceived exertion; VO_{2max} = maximum oxygen consumption.

^aAdapted from refs ^{84,85} using training zones related to aerobic and anaerobic thresholds. Low-intensity exercise is below the aerobic threshold; moderate is above the aerobic threshold but not reaching the anaerobic zone; high intensity is close to the anaerobic zone; and very intense exercise is above the anaerobic threshold. The duration of exercise will also largely influence this division in intensity.

ESC Guidelines on sports cardiology and exercise in patients with cardiovascular disease



1

History and Physical Examination

2

Assessment of 5 basic parameters

3

Recommendation: type of exercise

4

CPET..... ?? *Exercise echo*

5

Recommendation: relative intensity

6

Follow-up

Exercise Prescription

factors to consider

- Think about it !
- Patient beliefs /wishes
- Family beliefs
- Consensus recommendations and strategy
- Clinician factors !!

EXERCISE PRESCRIPTION

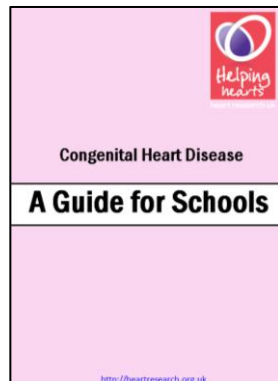
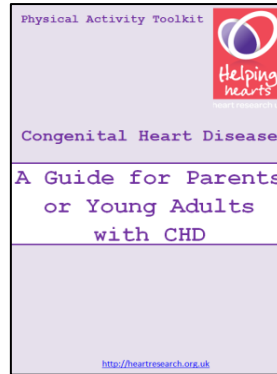
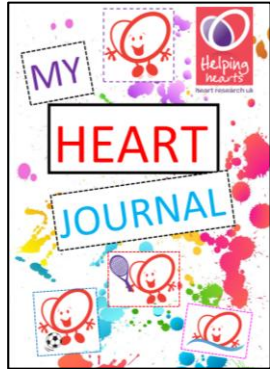
how to ensure compliance



There is compelling evidence that a physician's own attitude to exercise influences the exercise advice he gives to patients.

Lobelo et al 2009 Br J Sports Med

Heart Research UK CHD Physical Activity Toolkit



Physical activity recommendations form	
Name:	
Source of condition:	Date:
Intensity of exercise recommended:	See separate page
Level of exercise recommended:	See separate page
Frequency of exercise recommended:	See separate page
Duration of exercise recommended:	See separate page
Mode of exercise recommended:	See separate page
Other considerations:	See separate page
Recommended activities:	
Other comments:	
Authorised by:	Validator / review date:
Printed / Produced / Approved / Checked / Signed / Date:	
Signed by (parent/carer):	

Unsure about exercising with a congenital heart condition?



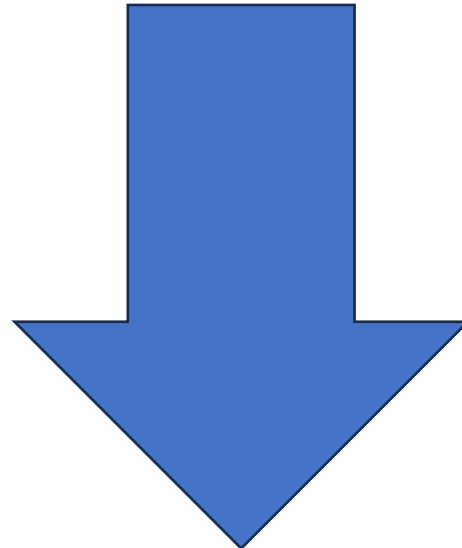
Check out our free Physical Activity Toolkit resources on our new website. Especially designed by experts for...

- ✓ people of all ages with a congenital heart condition
- ✓ family members of someone with a congenital heart condition
- ✓ school teachers of someone with a congenital heart condition

www.heartresearch.org.uk/chd



CHD Exercise Prescription Masterclasses



Zoom Masterclass
Spring 2025
date tbc

<http://heartresearch.org.uk/chd>

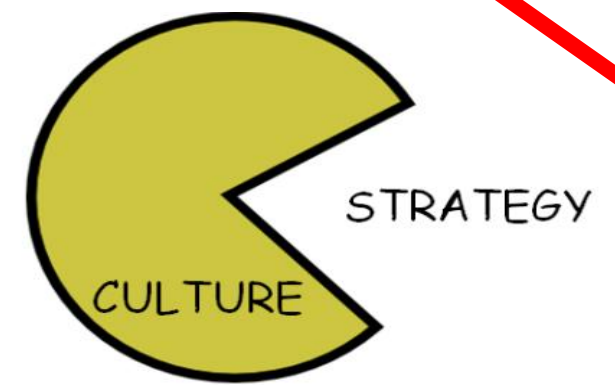
Twitter: @CHDToolkit

e mail: exercise@heartresearch.org.uk

Culture eats strategy
for breakfast.

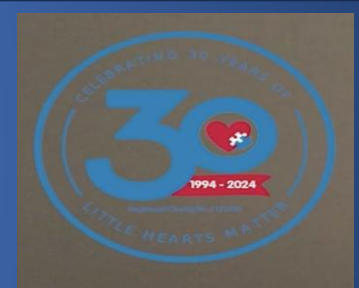
- Peter

Change medical culture!!





Living the Best Life with a single ventricle



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Hon Assoc Professor, Sports and Exercise Cardiology

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Monday 25th September 2024



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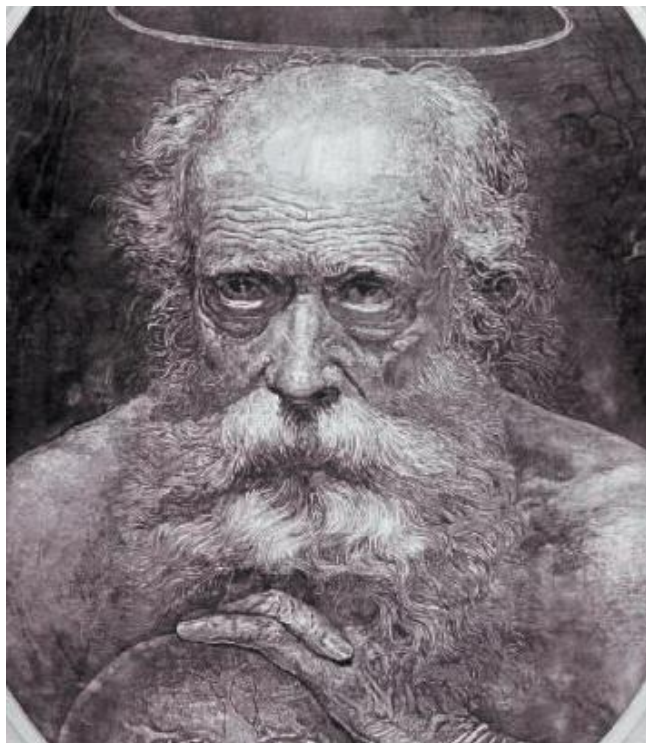
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Living the Best Life with a single ventricle



Hippocrates



“Father of medicine”
460-370 BC

“ If we could give every individual the right amount of *nourishment* and *exercise*, not too little and not too much, we would have found the safest way to health “

Regimen Book 1

Any Questions?



Exercise in CHD Research team



Craig Williams
Dan Dorobantu
Guido Pieles
Lynsey Forsyth
Nurul Amir
Nathan Riding
Curtis Wadey
Caroline Evans
Graham Stuart

F.I.T.T PRINCIPLE

Patients need more than activity suggestions...



Frequency



Intensity



Time



Type

- Longer fewer sessions v shorter more frequent.

- Magnitude of effort.

- Single session and overall training (months/years).

- Every 10 minutes counts.

- Frequency and time can be traded.

- Aerobic, Resistance, Dynamic, Static.



Review

Systematic review of the effects of physical exercise training programmes in children and young adults with congenital heart disease[☆]

- systematic review
- 31 studies
- 621 participants
- age 4-45yrs
- **No** safety issues identified

Conclusion

Participation in exercise program was safe AND improved physical fitness in patients with CHD.

Recommended

Patients with CHD should participate in exercise training programs.