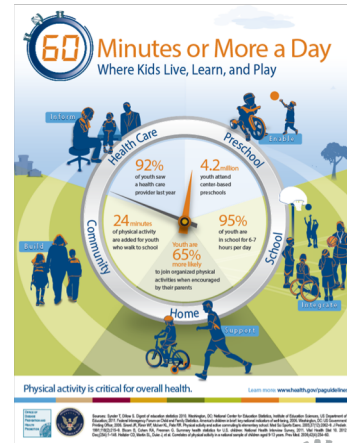


Physical fitness : advice in healthy children

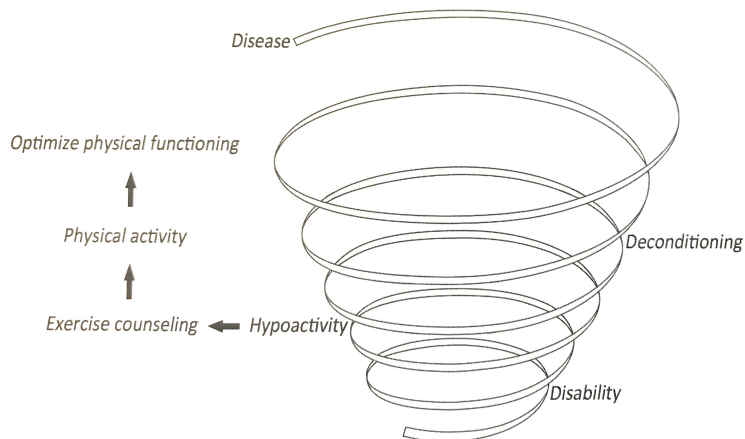
FITT	Cardiovascular (aerobic) training	Interval training	Muscle strength (resistance) training
Frequency	≥3 times/week	≥3 times/week	2-3 times/week
Intensity	Moderate-to-heavy exercise (VO _{2peak} 40–85%)	3–5 min of light-to-moderate baseline exercise (VO _{2peak} 20 to 59%) interrupted 6–8 times by 1–3 min bouts of very intense exercise (VO _{2peak} >85%)	High (50–70% MVC)
Time	20–60 min	In total 20–60 min	2–3 min per muscle group (about 8–20 repetitions), in total ≥30 min
Type	Running, jumping, cycling, swimming, football	Running, jumping, cycling, swimming	Push-ups, sit-ups/crunches, pull-ups, handgrips, squats, climbing, martial arts, rowing

MVC, maximal voluntary contraction; VO₂, oxygen uptake or oxygen consumption; Interval training can be used alternatively with aerobic training in healthy children.⁹



3 / TIME TO MOVE

Chronic disease: spiral of disability



4 / TIME TO MOVE

Influencing factors

heart transplantation

- chronotropic incompetence
- residual lesions
- systolic function
- diastolic function

post liver transplantation

- chronic immunosuppression
- hypertension
- transplantation itself
- underlying disease

post stem cell transplantation

- cardiotoxic medication
- corticosteroids
- radiation
- complications

post kidney transplantation

- dialysis (hemo/PD)
- catheters
- longterm chronic hospital visits

**immobilisation
overprotection**

5 / TIME TO MOVE



evaluation of fitness

field tests



laboratory tests



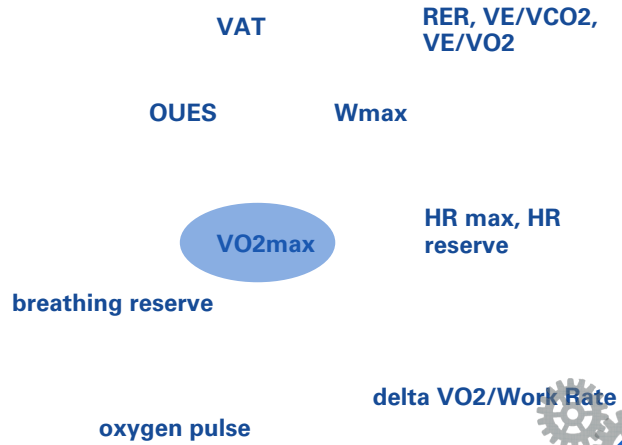
6 / TIME TO MOVE

Evaluation of physical fitness in children: CPET

- ▶ bicycle vs treadmill
- ▶ duration, ramp
- ▶ indications
- ▶ contra-indications



7 / TIME TO MOVE



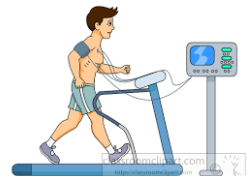
Studies: aims & objectives

3 studies

- ▶ liver transplantation
- ▶ hematopoietic stem cell transplantation
- ▶ liver, kidney or heart

evaluation

- ▶ assess physical fitness
- ▶ assess potentially influencing factors; investigate correlations
- ▶ evaluate quality of life (QOL); correlation with physical fitness

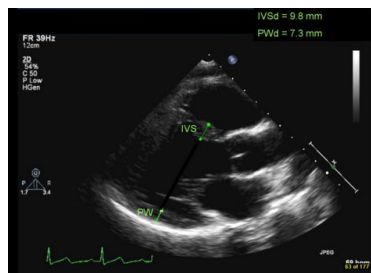
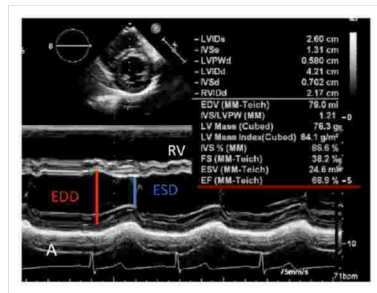


8 / TIME TO MOVE

methods: echocardiography

LV systolic function:
Ejection fraction
fractional shortening

LV wall thickness
IVSd – IVSs
LVPWd – LVPWs
LVEDd - LVEDs

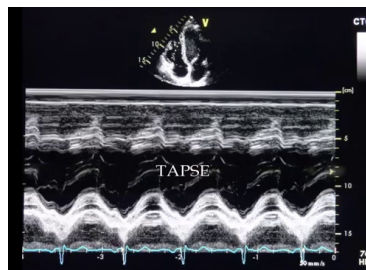
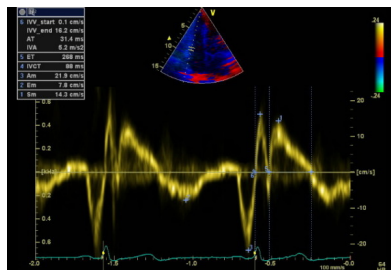


9 / TIME TO MOVE

methods: echocardiography

LV diastolic function:
PW doppler: E/A
Tissue doppler: E/E'

RV systolic function
TAPSE



10 / TIME TO MOVE

methods: PedsQL™

The PedsQL™
Measurement Model for the
Pediatric Quality of Life Inventory™

James W. Varni, Ph.D.

PedsMetrics™
Quantifying the Qualitative™

“health related quality of life”

Questionnaire with different domains:

- school functioning
- emotional
- social
- physical

- 2 extra domains
- psychosocial
- total

scoring: 0 - 4, scored on 100
Mean on 100%

In the past ONE month, how much of a problem has this been for you ...

ABOUT MY HEALTH AND ACTIVITIES (problems with...)	Never	Almost Never	Sometimes	Often	Almost Always
1. It is hard for me to walk more than one block	0	1	2	3	4
2. It is hard for me to run	0	1	2	3	4
3. It is hard for me to do sports activity or exercise	0	1	2	3	4
4. It is hard for me to lift something heavy	0	1	2	3	4
5. It is hard for me to take a bath or shower by myself	0	1	2	3	4
6. It is hard for me to do chores around the house	0	1	2	3	4
7. I hurt or ache	0	1	2	3	4
8. I have low energy	0	1	2	3	4

ABOUT MY FEELINGS (problems with...)	Never	Almost Never	Sometimes	Often	Almost Always
1. I feel afraid or scared	0	1	2	3	4
2. I feel sad or blue	0	1	2	3	4
3. I feel angry	0	1	2	3	4
4. I have trouble sleeping	0	1	2	3	4
5. I worry about what will happen to me	0	1	2	3	4

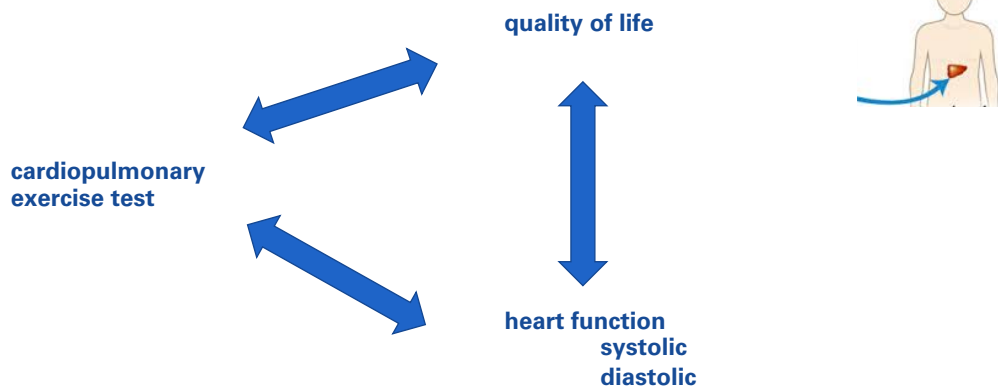
HOW I GET ALONG WITH OTHERS (problems with...)	Never	Almost Never	Sometimes	Often	Almost Always
1. I have trouble getting along with other kids	0	1	2	3	4
2. Other kids do not want to be my friend	0	1	2	3	4
3. Other kids tease me	0	1	2	3	4
4. I cannot do things that other kids my age can do	0	1	2	3	4
5. It is hard to keep up when I play with other kids	0	1	2	3	4

ABOUT SCHOOL (problems with...)	Never	Almost Never	Sometimes	Often	Almost Always
1. It is hard to pay attention in class	0	1	2	3	4
2. I forget things	0	1	2	3	4
3. I have trouble keeping up with my schoolwork	0	1	2	3	4
4. I miss school because of not feeling well	0	1	2	3	4
5. I miss school to go to the doctor or hospital	0	1	2	3	4

11 / TIME TO MOVE

Evaluation of Exercise Performance, Cardiac Function, and Quality of Life in Children After Liver Transplantation

Kristof Vandekerckhove, MD,¹ Ilse Coomans, MEng,¹ Elke De Bruyne, MSc,² Katya De Grootte, MD,¹ Joseph Panzer, MD,¹ Daniel De Wolf, PhD,¹ Jan Boone, PhD,³ and Ruth De Bruyne, PhD⁴



12 / TIME TO MOVE

Transplantation 100, no. 7 (July 2016): 1525–31.
<https://doi.org/10.1097/TP.0000000000001167>

CPET after liver transplantation

	LT patients	Controls	P
Age, y	11.6 ± 2.9	11.6 ± 2.9	0.941
Boys/girls	15/13	15/13	
Weight, kg	40.9 ± 13.1	40.2 ± 15	0.664
Length, cm	148.6 ± 17.3	148.7 ± 17.3	0.896
BMI	17.6 ± 2.2	17.5 ± 2.7	0.865
BSA, m ²	1.28 ± 0.28	1.27 ± 0.31	0.870
Systolic BP, mm Hg	106 ± 14	109 ± 13	0.968
Diastolic BP, mm Hg	70 ± 9	67 ± 8	0.700
Time after transplant, y	8.2 ± 3.7		
Age at transplantation, y	3.3 ± 3.1		
Primary immunosuppressive therapy			
Tacrolimus		22/28 (79%)	
Cyclosporine A		6/28 (21%)	
Mycophenolate		6/28 (21%)	
Corticosteroids		3/28 (11%)	
On antihypertensive medication, %		10/28 (36%)	
Indication for LT			
Biliary atresia		12/28 (43%)	
Metabolic disorders		4/28 (15%)	
Autoimmune disorder		1/28 (3%)	
Progressive familial intrahepatic cholestasis			
Other ^a		3/28 (11%)	
Major complications		8/28 (28%)	
Posttransplant cirrhotic disease		19/28 (6%)	
Acute cellular rejection		6/28 (68%)	
Chronic rejection		2/28 (7%)	
Biliary complications		5/28 (18%)	
Pretransplant food allergy		7/28 (25%)	
Other ^b		3/28 (11%)	

^a Other: Caroli disease, Origer Hajjar, hemochromatosis, Wilson disease, idiopathic biliary cirrhosis.
^b Other: hepatotoxicity due to iron overload, specific posttransplant hepatitis polyclonal hypergammaglobulinemia of unknown origin.
 BSA, body surface area; BP, blood pressure.

13 / TIME TO MOVE

31 patients vs. 31 healthy controls

indications:

- biliary atresia**
- metabolic disorder**
- autoimmune**
- other**

immunosuppressant

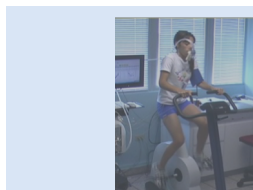
- tacrolimus**
- cyclosporin A**
- mycophenolate**

complications

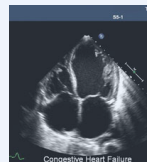
- rejection**
- pre-tx cirrotic disease**
- biliary complications**



Results: CPET after liver transplantation



- ↓ **VO2 max (absolute, %)**
- ↓ **duration**
- ↓ **load**
- ↓ **VAT**



- ↓ **LV diastolic function**
- ↓ **increased wall thickness**

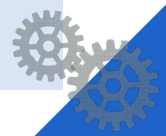
The PedsQL™
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PedsMetrics™
 Quantifying the Qualitative™

- ↓ **total**
- ↓ **emotional**
- ↓ **school**
- ↓ **psychosocial functioning**

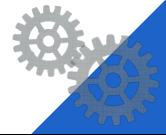
14 /



Results: CPET after liver transplantation

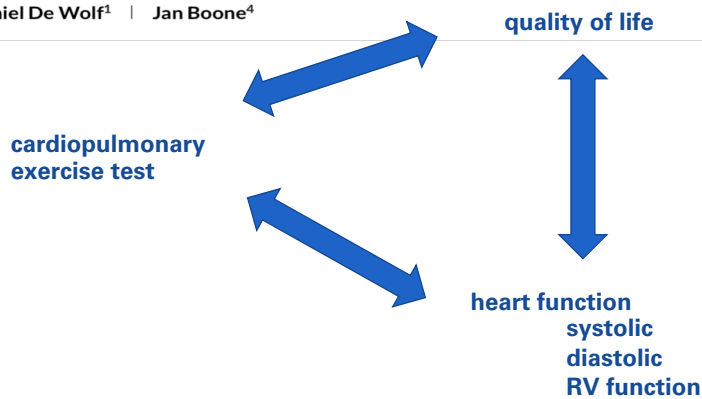
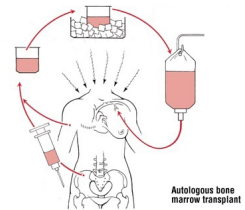
- ▶ age at tx or time since -> no impact on CPET
- ▶ physical functioning ~ CPET
- ▶ younger age at tx -> more diastolic dysfunction
- ▶ antihypertensive treatment: ↓ physical fitness

15 / TIME TO MOVE



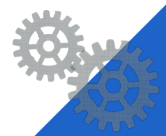
Evaluation of cardiopulmonary exercise testing, heart function and quality of life in children after allogeneic hematopoietic stem cell transplantation

Kristof Vandekerckhove¹  | Kathleen De Waele² | Aurelie Minne¹ | Ilse Coomans
Katya De Groote¹ | Joseph Panzer¹ | Catherine Dhooge³ | Victoria Bordon³ |
Daniel De Wolf¹ | Jan Boone⁴



16 / TIME TO MOVE

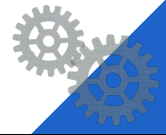
Pediatr Blood Cancer. 2019;66:e27499.
<https://doi.org/10.1002/pbc.27499>



CPET after HSCT

- ▶ 43 HSCT patients
- ▶ age 13.6+/-3.4 yrs
- ▶ age at HSCT 7+/-4.6 yrs, time since HSCT 6.6+/- 4.5yrs
- ▶ MDS 6 / ALL 11 / AML 7 / JMML 2
- ▶ ¾ cyclofosfamide; ½ anthracyclines; 1/3 TBI
- ▶ GVH : 1/4

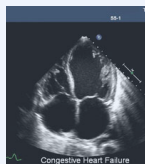
17 / TIME TO MOVE



CPET after Stem cell transplantation



- ↓ VO2 max (34.7 ml/kg vs. 46.3ml/kg)
- ↓ duration
- ↓ load
- ↓ VAT



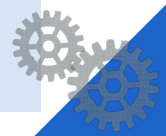
- ↓ systolic function (11%)
- ↓ RV systolic function (20%)
- ↓ LV diastolic function
- ↓ wall thickness
- Increased lv diameter

The PedsQL™
Measurement Model for the
Pediatric Quality of Life Inventory™

James W. Varni, Ph.D.
PedsMetrics™
Quantifying the Qualitative™

- ↓ total
- ↓ emotional QOL

18 /



CPET after Stem cell transplantation

- ▶ later after hsct -> better LV function
- ▶ left ventricular dilatation -> ↓ VO2 max
- ▶ anthracyclines -> ↓ VO2max
- ▶ TBI -> ↓ psychosocial functioning
- ▶ lower physical fitness -> ↓ social functioning

19 / TIME TO MOVE



CPET after solid organ transplantation: comparison liver / kidney /heart

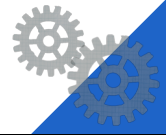
- ▶ Aim:
 - ▶ Compare levels of deconditioning in different patient groups
 - ▶ Matched controls
- ▶ Methods:
 - ▶ 2012-2016: evaluation of children 6 -16 yrs after kidney, liver, heart tx
- ▶ Comparison of exercise test parameters

20 / TIME TO MOVE

CPET after Solid organ Transplantation

	transplant patients (n=51)	controls (n=51)	p-value
Age (yrs)	12.6±3.6	12.6±3.5	NS
Boys/girls	29/22	29/22	
Weight(kg)	44.3±16.1	43.7±14.9	NS
Length(cm)	150.3±18.4	152.8±17.9	NS
BSA BSA (m2)	1.35±0.34	1.35±0.31	NS
Transplant type (liver/kidney/heart)	31 / 13 / 6		
Time post transplant	6.7±4.3/6.9±4.1/1.8±3.3		
Age at transplant	4.5±4.8/8.4±4.3/12.7±2.8		
Heartrate rest (bpm)	95.5±13.4	94.5±12.4	NS
VO2rest(ml)	329.7±120.8	332.1±135.1	NS
VO2rest/kg (ml/kg)	7.7±3.2	7.8±2.4	NS

21 / TIME TO MOVE



CPET after Solid organ Transplantation

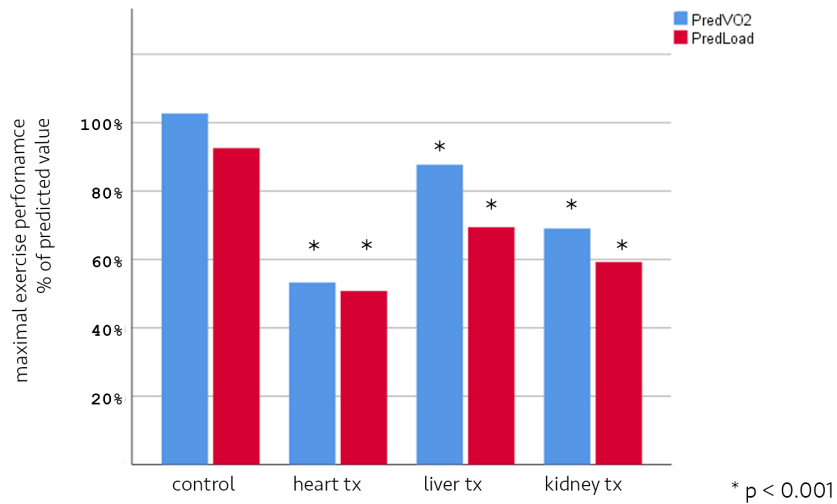
	Liver	Kidney	Heart	Control
VO2max/kg (ml/kg/min)	36.3±8.8***	30.5±6.4 ***	27.6±9.8 **	41.6±6.7
VO2max% (%)	87.7±15.1 ***	69.0±14.2 ***	61.8±24.0 **	99.4±15.1
Heartrate max (bpm)	173.3±18.7 **	175.8±14.9 *	143.7±15.2 ***	188.5±13.3
Duration (min)	8.6±2.7 ***	8.4±2.1 **	7.6±3.0 **	11.2±2.9
Load (%)	69.4±13.5 ***	59.2±16.2 ***	53.5±18.6 **	88.3±16.9
VAT (%)	53.6±10.8 **	49.8±9.4	58.3±19.6 **	47.4±8.9
HR at VAT	123.3±13.8	119.±23.7	109.3±13.3 **	124.2±12.6
RER	1.03±.04 **	1.16±0.07 *	1.1±0.2	1.09±0.08
VE (l/min)	49.7±24.3	64.9±22.2	47.7±26.0	59.5±24.0
VE/VO2	30.6±5.0 ***	28.3±3.2	28.3±26.6	26.6±3.7

22 / TIME TO MOVE

* p<0.05 ** P<0.01 ***p<0.001



CPET after Solid organ Transplantation



23 / TIME TO MOVE

What to do ?

Benefits of Early Mobilization After Pediatric Liver Transplantation*

Norihiko Tsuboi, MD¹; Miku Hiratsuka, RN¹; Setsushi Kaneko, RN¹; Nao Nishimura, MD¹; Satoshi Nakagawa, MD¹; Mureo Kasahara, MD, PhD²; Takeshi Kamikubo, MD, PhD³

- ▶ **Faster recovery**
- ▶ **better mobility**
- ▶ **Shorter LOS**

Outcome Measure	Pre-EM Period (n = 35)	Post-EM Period (n = 40)	p ^a
Length of PICU stay after surgery (d), median (IQR)	12 (6–31)	7 (6–11)	0.052
Length of hospital stay after surgery (d), median (IQR)	55 (37–99)	40 (31–54)	0.012

24 / TIME TO MOVE

Pediatric Critical Care Medicine 20, no. 2 (February 2019): e91–97.
<https://doi.org/10.1097/PCC.0000000000001815>

What to do ?

Influence of physical activity on cardiorespiratory fitness in children after renal transplantation

Riccardo Lubrano¹, Giancarlo Tancredi², Elena Bellelli¹, Isotta Gentile¹, Simona Scateni³, Raffaele Masciangelo⁴, Giovanna De Castro², Paolo Versacci³ and Marco Elli⁵

- ▶ Study of 52 children , exercised vs non exercised, controls vs tx
- ▶ Transplanted exercised children
 - ▶ level of sedentary controls
 - ▶ better than sedentary transplanted
- ▶ Exercise diminishes LV hypertrophy in exercised transplanted children

	Controls inadequately active	Controls adequately active	children inadequately active	children adequately active	Kruskal–Wallis test, P
RR max effort (acts per minute)	53.62 ± 7.2	53.07 ± 6.84	40.20 ± 6.3	41.48 ± 8.41	0.0001
HR max effort (beats per minute)	192.68 ± 9.63	197 ± 6.83	160.66 ± 23.78	170.30 ± 17.35	0.0001
Exercise time (min)	11.69 ± 1.13	13.72 ± 1.34	7.69 ± 2.00	10.35 ± 0.99	0.0052
VO ₂ max/kg (mL/min/kg)	32.62 ± 2.53	41.90 ± 5.66	24.79 ± 1.99	29.59 ± 4.28	0.0001

25 / TIME TO MOVE

Nephrol Dial Transplant (2012) 27: 1677–1681

What to do ?

Rehabilitative intervention during and after pediatric hematopoietic stem cell transplantation: An analysis of the existing literature

Francesca Rossi¹ | Monica Coppo² | Giulia Zucchetti³ | Daniela Bazzano² | Federica Ricci⁴ | Elena Vassallo³ | Francesca Nesi³ | Franca Fagioli³

- ▶ 6 studies
- ▶ Improved VO₂max
- ▶ Better QOL
- ▶ Higher levels of fitness -> better QOL

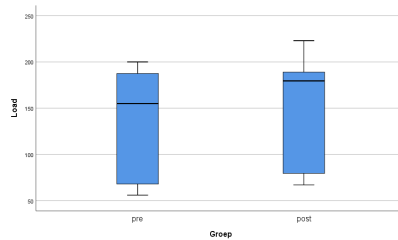
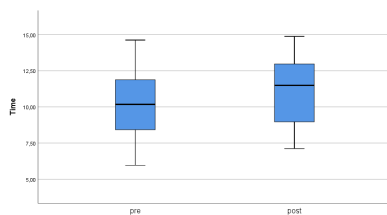
Most studies suggested that rehabilitative sessions have to last approximately 60 min and that patients have to do 3–5 sessions per week. Most suggested exercises were as follows: aerobic activities, strength training, and endurance/resistance training accompanied by articular motion, and stretching exercises.

26 / TIME TO MOVE

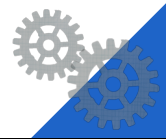
Pediatric Blood & Cancer 63, no. 11 (2016): 1895–1904. <https://doi.org/10.1002/pbc.26114>.

What to do ?

- ▶ **Pilot study - HSCT**
 - ▶ 6 patients 1 yr after HSCT
 - ▶ 3 month program with local physiotherapist, psychologist
 - ▶ Online evaluation system
 - ▶ Better load and exercise time, not yet VO2



27 / TIME TO MOVE



What to do ? – importance of participation in group

Original Article

Psychological benefits for children and adolescents who have undergone transplantation of the heart from participation in the British Transplant Games

Jo Wray,^{1,2} Tracy Lunnon-Wood²

¹Children's Outpatient Department, Royal Brompton and Harefield NHS Trust, Harefield Hospital, Harefield, Middlesex; ²Great Ormond Street Hospital for Children NHS Trust, London, United Kingdom

- ▶ **Study of 26 children , participating “Brithish transplant games” – 4 days**
- ▶ **Psychological evaluation:**
 - ▶ 13 domains
 - ▶ overall score

28 / TIME TO MOVE



What to do ? – importance of participation in group

Table 1. Mean scores for each construct, and total score before and after the Games.

Construct	Pre-Games	Post-Games	Comments
Mood state	4.00	4.23	
Confidence	3.58	3.81	
Able to participate in physical activities	3.56	3.88	
Anxiety	3.63	3.81	
Perceived activity levels	4.00	4.15	
Perceived physical health	4.26	4.35	
Self-esteem	4.41	4.35	
Popularity	3.78	3.77	
Physical ability	3.48	3.73	
Able to do things as well as others	3.70	3.85	
Self image	3.96	4.23	
Aggression	3.96	4.35	
Fatigue	3.59	3.46	
Total score	49.67*	52.15*	* p = .018

Meeting similar people – “a true peer group”
“Great to meet others who have been through the same stuff and understand what it is like – then you don’t have to explain anything.”

Increased self confidence
“I feel much more confident and able to do things and I am not so worried about everything any more.”

Hope for the future
“Although I only recently got my transplant I saw people running who had theirs more than 10 years ago! That was brilliant – realising that you can do all those things years later.”

Dislike of competitive element
“I didn’t like the running and stuff but I enjoyed meeting other people like me”.

Importance of participation in group : Ado - day

UITNODIGING
 Ben je tussen de 18 en 25 jaar oud en trek je er graag eens op uit?
KOM DAN NAAR DE 2DE YA-A!
 ONTMOETINGSNAMIDDAG VOOR JONGVOLWASSENEN
 MET EEN HARTAANDOENING
 13 oktober 2018 – Rozebruggen Gent

The broader perspective... chronic disease

Cardiopulmonary Exercise Performance Is Reduced in Congenital Diaphragmatic Hernia Survivors

Reduced Exercise Capacity in Children Born Very Preterm

Smith L, van Asperen P, McKay K et al. [See more](#)
PEDIATRICS (2008)

Exercise limitation, exercise testing and exercise recommendations in sickle cell anemia

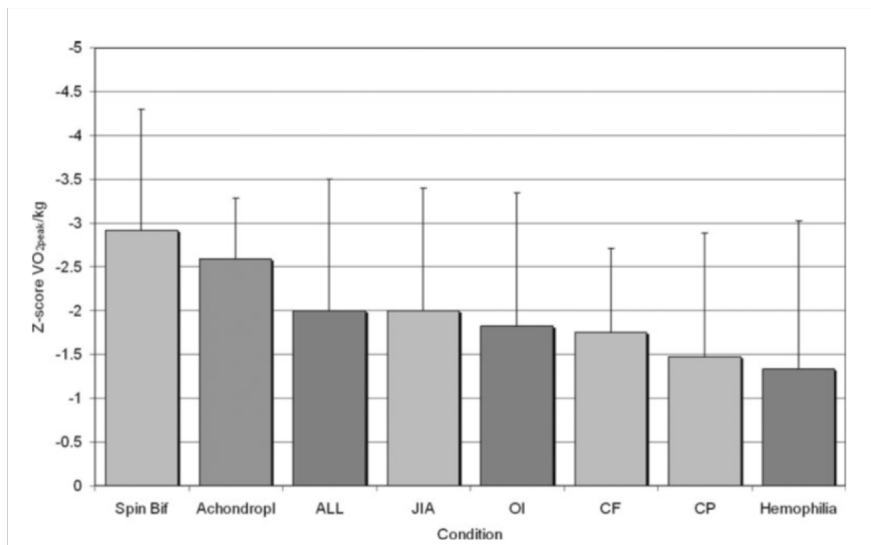
Aerobic Fitness in Children and Young Adults with Primary Ciliary Dyskinesia

Physical Fitness and Locomotor Skills in Children With Esophageal Atresia-A Case Control Pilot Study

Exercise performance and quality of life in children with cystic fibrosis and mildly impaired lung function: relation with antibiotic treatments and hospitalization



The broader perspective... chronic disease



32 / TIME TO MOVE

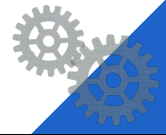


The broader perspective... chronic disease

Proposed Core Set for Outcomes in Exercise Training/Activity Promotion Studies

Fitness Component	Proposed Measure
Health-related fitness ^a	Aerobic capacity ($\dot{V}O_{2peak}$), muscle strength
Physical activity/inactivity	Directly measured (eg, pedometers, accelerometry, heart rate monitors, Global Positioning System monitors)
Health-related quality of life	Questionnaire
Fatigue	Questionnaire
Performance-related fitness ^b	6-Minute Walk Test, Shuttle-Sprint Test, Timed Up and Down Stairs, Timed Up and Go

33 / TIME TO MOVE



CPET: advantages



insight



improved diagnostic evaluation



guidance for rehabilitation



**self-esteem
parent anxiety**



opportunity for communication

34 / TIME TO MOVE



Practical: Pediatric exercise laboratory UZ Gent

- Children with chronic diseases
- Suspected diminished exercise performance
- Non-cardiac: preceding cardiac investigation
- Evaluation of exercise performance compared to healthy peers
- NOT sports screening

35 / TIME TO MOVE

future perspectives...

CPET :

- need for research trials
- broader framework
- individualized rehabilitation programs
- need for more guidelines
- new, less time consuming tests

36 / VOETTEKST

TIME to...

- ▶ **M**otivate
- ▶ **O**bjectify exercise performance
- ▶ **V**iew on obstacles
- ▶ **E**xplore rehabilitation possibilities

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All the children and their
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**Titel hoofdstuk
op verschillende
tekstregels**

