Fitness for Transplant Recipients
How Important Is it?

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Physical Activity and Health
A Report of the Surgeon General

REVISED and Updated:
Physical Activity Guidelines
Advisory Committee Report, 2008
The Benefits of Regular Physical Activity
Surgeon General’s Report on Physical Activity and Health

- Reduces the risk of dying prematurely
- Reduces the risk of dying from heart disease
- Reduces the risk of developing diabetes
- Reduces the risk of developing high blood pressure
- Helps reduce blood pressure in people who already have high blood pressure
- Reduces feelings of depression and anxiety
- Helps control body weight
- Helps build and maintain healthy bones, muscles and joints
- Helps older adults become stronger and better able to move about without falling
The Benefits of Regular Physical Activity
Surgeon General’s Report on Physical Activity and Health

Regular physical activity can help people with chronic, disabling conditions:
- improve their stamina and muscle strength
- improve psychological well-being and quality of life by increasing the ability to perform activities of daily life
Exercise in Organ Transplantation

- So, why would transplant recipients be any different than the general population?
- OR perhaps physical activity is MORE important for tx recipients because of:
  - The deconditioning experienced prior to transplant
  - High prevalence of CV risk factors
  - Tendency for excessive weight gain
  - Need for complete rehabilitation
FACT:

- Exercise capacity as measured by peak oxygen uptake (VO$_2$peak) is low in ESRD patients treated with hemodialysis.
- Over 45 studies that document low levels of exercise capacity and/or physical functioning
Measurement of “peak oxygen uptake” (VO$_2$ peak) 

O$_2$ in - O$_2$ out = O$_2$ used
Oxygen Uptake in Adult Hemodialysis Patients *

(*Average VO_2 peak in 14 studies - pre EPO *)
FACT:

Exercise capacity as measured by peak oxygen uptake (VO$_2$peak) increases soon after successful kidney transplant (~28% within 8 weeks post surgery, with no exercise training)

Oxygen Uptake in Adult Transplant Recipients

maximal oxygen uptake (ml/kg/min)

age

Before Transplant
After Transplant

sedentary normal males
sedentary normal females

8 weeks 12 weeks
FACT:

- Exercise capacity as measured by peak oxygen uptake (VO₂peak) increases with exercise training in kidney transplant recipients.

  Kempeneers, et al 1990,
  Miller, et al 1987
  van De Hamm, 2006
Oxygen Uptake in Adult Transplant Recipients

Before Transplant
After Transplant
Trained after Transplant

maximal oxygen uptake (ml/kg/min)

sedentary normal males
sedentary normal females

trained for transplant games competition

Exercise initiated 2wks post tx - 1 year

age
Health-Related Fitness and Quality of Life in Organ Transplant Recipients: Exercise testing of Participants at the 1998 U.S. Transplant Games

P. Painter
M. Luetkemeier
GE Moore
S Dibble
G Green
J Myll
L Carlson

Transplantation 64: 1795-1800, 1997
Demographics
Transplant Games Testing

- N= 128 (selected on order of receipt of registration: 412 registered)
  - Kidney (n=76)
  - Liver (n=16)
  - Heart (n=19)
  - Lung (n=6)
  - P/K (n=7)
  - Bone Marrow (n=4)
- Ave age: 45.9 ± 11.2
- Time post tx: 8.1 ± 10.5
- Highest level of education: 15.5 ± 2.3
- Active 76.6%
“Active” Criteria

- 3 x per week or more of ‘aerobic’ activity
- >20 minutes per session
- Intensity described as “somewhat hard” or greater
Testing

- Maximal Treadmill testing with VO2 measurements
- Isokinetic Muscle testing
- Underwater weighing (% fat, lean mass, fat mass)
- SF-36 Questionnaire
Body Composition: Transplant Games Participants

* p<.05 compared to active
Differences in Exercise Capacity between Active and Inactive RTX Recipients

- * p<.01 compared to inactive
- # p<.01 compared to HD

**Percent of Age Predicted VO2**

- **Active**
- **Inactive**

**Hemodialysis**

**TxG**
SF-36 Scales Scores: Transplant Games Survey

SF-36 Scales Scores: Transplant Games Survey

Scale Scores

PF  RP  BP  GH  VT  SF  RE  MH

p=.05  p=.08  p=.07  p=.05  p=.03

active  inactive
Oxygen Uptake in Adult Transplant Recipients

- Before Transplant
- After Transplant
- Trained after Transplant

Maximal oxygen uptake (ml/kg/min)

Age

Trained for transplant games competition
Transplant games athletes

Sedentary normal males
Sedentary normal females

Exercise initiated 2wks post tx - 1 year
A Randomized Trial of Exercise Training following Renal Transplantation

Patricia Lynn Painter
Lisa Hector
Karen Ray
Liliana Lynes
Suzanne Dibble
Steven M. Paul
Stephen L. Tomlanovich
Nancy L. Ascher


Transplant Rehab Intervention Project

NIH/NINR: RO1 NR02880
Purpose:

to determine the effects of exercise training over the first year post kidney transplant on health-related fitness (cardiorespiratory fitness, muscle strength, body composition and health-related quality of life).

Transplant Rehab Intervention Project
Study Design

Baseline testing (2 mo post tx) (n=177)

randomize

exercise* usual care

6 month retest

12 month retest (n=95)

Transplant Rehab Intervention Project
Testing

- Maximal Treadmill testing with VO2 measurements
- Isokinetic Muscle testing
- Dexa (% fat, lean mass, fat mass)
- SF-36 Questionnaire

Intervention

- Independent Home Exercise
  - cardiovascular
  - 3x or more/week
  - 30 min or more/session
## demogrpahics

<table>
<thead>
<tr>
<th>Demographic Category</th>
<th>Exercise (n=54)</th>
<th>Usual Care (n=43)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (mean +/- S.D.)</strong></td>
<td>39.7 ± 12.6</td>
<td>43.7 ± 10.7</td>
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<tr>
<td><strong>Gender (n) (%)</strong></td>
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<tr>
<td>males</td>
<td>30 (55.5)</td>
<td>30 (69.1)</td>
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<tr>
<td>females</td>
<td>24 (44.4)</td>
<td>13 (30.2)</td>
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<tr>
<td><strong>Ethnicity (n)(%)</strong></td>
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<tr>
<td>Caucasian</td>
<td>27 (50)</td>
<td>20 (46.5)</td>
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<td>Hispanic</td>
<td>12 (22)</td>
<td>10 (23.3)</td>
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<td>African American</td>
<td>6 (11)</td>
<td>6 (13.9)</td>
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<tr>
<td>Asian</td>
<td>5 (9)</td>
<td>4 (9.3)</td>
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<tr>
<td>Other</td>
<td>4 (7)</td>
<td>3 (6.9)</td>
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<tr>
<td><strong>Cause of Renal Failure (n)(%)</strong></td>
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<td></td>
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<tr>
<td>Glomerulonephritis</td>
<td>10 (18.5)</td>
<td>2 (4.6)</td>
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<tr>
<td>Hypertension</td>
<td>9 (17)</td>
<td>8 (18.6)</td>
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<tr>
<td>diabetes mellitus</td>
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<td>8 (18.6)</td>
</tr>
<tr>
<td>lupus</td>
<td>6 (11)</td>
<td>3 (6.9)</td>
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<td>PCKD</td>
<td>1 (1.8)</td>
<td>5 (11.6)</td>
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<tr>
<td>IGA nephropathy</td>
<td>4 (7.4)</td>
<td>2 (4.6)</td>
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<tr>
<td>Unknown</td>
<td>7 (12.9)</td>
<td>6 (13.9)</td>
</tr>
<tr>
<td>Other</td>
<td>14 (25.6)</td>
<td>9 (20.9)</td>
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<tr>
<td><strong>Type of Transplant (n) (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadaveric</td>
<td>35 (64.8)</td>
<td>25 (58.1)</td>
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<tr>
<td>Living related</td>
<td>15 (27.7)</td>
<td>17 (39.5)</td>
</tr>
<tr>
<td>Living unrelated</td>
<td>4 (7.4)</td>
<td>1 (2.3)</td>
</tr>
</tbody>
</table>

Transplant Rehab Intervention Project
Activity Participation: Transplant Rehab Intervention Project (kidney)

% Reporting Regular Physical Activity*:

- **Baseline**: 50% (intervention), 47% (usual care) - N.S.
- **6 months**: 58% (intervention), 42% (usual care) - p = 0.06
- **12 months**: 67% (intervention), 36% (usual care) - p = 0.02
Transplant Rehab Intervention Project (kidney)

PEAK VO2 (ml/Kg/min)

BASELINE  6 MONTHS  12 MONTHS

Transplant Rehab Intervention Project (kidney)

Physiological Functioning (PF) Scale Score

BASELINE  6 MONTHS  12 MONTHS

* p<.01

intervention
usual care

Effects of Exercise Training on Quadriceps Muscle Strength (TRIP-Kidney)

- Extension Peak Torque (ft•lb)
  - Baseline
  - 6 months
  - 12 months

- Extension Peak Torque per body weight (%)
  - Baseline
  - 6 months
  - 12 months

Transplant Rehab Intervention Project
Oxygen Uptake in Adult Transplant Recipients

- Trained for transplant games competition
- Transplant games athletes
- Randomized controlled trial
- Exercise initiated 2wks post tx - 1 year

Before Transplant
After Transplant
Trained after Transplant

Sedentary normal males
Sedentary normal females
usual care

exercise

1 yr post Ktx (n=52) (n=46) Painter, 2002

HD (n=275)
Pre Post (n=20) (n=32) Painter, 1986 Painter, 2000

inactive active

Tx Games (n=97) (n=32)
x

exercise

* p<.01 compared to inactive or usual care
# p<.01 compared to HD

peak VO2 (ml/kg/min)
A Randomized Trial of Exercise Training following Liver Transplantation

Patricia Lynn Painter
Joanne B. Krasnoff
Andrea Vintro
Marylin Dodd
Steven Paul
Nancy Ascher

Krasnoff Transplantation 2006
Transplant Rehab Intervention Project
Purpose:

to determine the effects of an intervention of diet and exercise training over the first year post liver transplant on health-related fitness (cardiorespiratory fitness, muscle strength, body composition and health-related quality of life).

Transplant Rehab Intervention Project
Study Design

Baseline testing (2 mo post tx) (n= 165)

randomize

diet + exercise  usual care

6 month retest

12 month retest  (n=154)
(interv n=74)  (UC n = 80)
(adherers = 37)
Testing

- Maximal Treadmill testing with VO2 measurements
- Isokinetic Muscle testing
- Dexa (% fat, lean mass, fat mass)
- SF-36 Questionnaire
- Food Frequency Questionnaire

Intervention

- Independent Home Exercise
  - cardiovascular
  - 3x or more/week
  - 30 min or more/session
- AHA Step I-II diet

Bimonthly Phone Follow-up:
- Exercise physiologist
- Reg Dietitian

Transplant Rehab Intervention Project
Transplant Rehab Intervention Project (liver)

- **Adherers**: those who followed the exercise prescription for frequency, intensity and duration > 50% of the time.
- **Non adherers**: those who participated in exercise at the prescribed frequency, intensity and duration <50% of the time.
<table>
<thead>
<tr>
<th>demographics</th>
<th>Adherers (n=37)</th>
<th>Non Adherers (n=37)</th>
<th>Usual Care (n=80)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (F/M)(%)</td>
<td>51.2 ±11.4</td>
<td>51.3 ±11.8</td>
<td>50.7 ±9.6</td>
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<tr>
<td>age (yr)</td>
<td>43/57</td>
<td>41/59</td>
<td>39/60</td>
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<tr>
<td>Ethnicity (%)</td>
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<td></td>
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<tr>
<td>Caucasian</td>
<td>78.4</td>
<td>64.9</td>
<td>62.6</td>
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<tr>
<td>Hispanic</td>
<td>10.8</td>
<td>13.5</td>
<td>14.1</td>
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<tr>
<td>Asian/Pacific Islander</td>
<td>8.1</td>
<td>13.5</td>
<td>11.1</td>
</tr>
<tr>
<td>African American</td>
<td>2.7</td>
<td>8.1</td>
<td>8.1</td>
</tr>
<tr>
<td>Other</td>
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<td>3.0</td>
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<tr>
<td>Etiology (%)</td>
<td></td>
<td></td>
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<tr>
<td>Hepatitis B</td>
<td>8.1</td>
<td>8.1</td>
<td>7.0</td>
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<tr>
<td>Hepatitis C</td>
<td>32.4</td>
<td>46.5</td>
<td>47.5</td>
</tr>
<tr>
<td>Alcoholic Liver Disease</td>
<td>5.1</td>
<td>2.7</td>
<td>9.1</td>
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<tr>
<td>Primary Biliary cirrhosis</td>
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<td>7.1</td>
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<td>PSC</td>
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<td>16.2</td>
<td>7.1</td>
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<tr>
<td>Fulminant Failure</td>
<td>10.8</td>
<td>5.4</td>
<td>8.1</td>
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<tr>
<td>Other</td>
<td>18.9</td>
<td>21.6</td>
<td>14.1</td>
</tr>
</tbody>
</table>
Transplant Rehab Intervention Project (liver)

**VO₂ Peak** (ml·kg⁻¹·min⁻¹)

- **baseline**
- **6 month**
- **12 month**

- **adherers**
- **nonadherers**
- **usual care**

*p < .002*
Recommendations for Physical Activity for Treating Medical Conditions

- Regular Exercise is Recommended in National Guidelines for the following conditions:
  - Hypertension (JNC VII)
    - JAMA 289:2560-2572, 2003
  - Hyperlipidemia (NCEP III)
  - Cardiovascular Disease (NIH consensus Conference, 1993)
  - American Diabetes Association
GUIDELINE 14.2:
All dialysis patients should be counseled and regularly encouraged by nephrology and dialysis staff to increase their level of physical activity
Reasons for Recommending and Encouraging Physical Activity following Transplant

- Present for transplant with low levels of functioning
- Present for transplant physically inactive
- High prevalence of cardiovascular risk factors that may be modified by physical activity
- May attenuate weight gain
- Will OPTIMIZE functioning
- Will positively impact QOL
- ? Improve transplant outcomes?
Reasons for Recommending and Encouraging Physical Activity following Transplant (and for having a trained exercise physiologist as part of the care team)

- They are afraid to exert themselves
- They don’t know what to do for exercise
- They are weak, low functioning - need appropriate prescription for type, progression of exercise
- They need regular encouragement
- Will be a part of an overall positive lifestyle expectation following transplant
- Will provide an added level of medical surveillance
MESSAGES: How they are interpreted by Patients and/or Families

No information or encouragement is given for exercise...
No information or encouragement is given for exercise.

Exercise must not be important for people on dialysis or after transplant .....they didn’t say anything hmmm ....?????
“TAKE IT EASY”

Maybe I shouldn’t do anything…I need to take it easy!!!
“DON’T OVERDO IT”

Wow, maybe I shouldn’t be doing anything, since I might overdo it...???

*Patients may not know what their limits are, so they may feel that anything may be ‘overdoing it’*
Study Reveals Deadly Effects of Inactivity for Kidney Transplant Recipients
Kaplan-Meier curves of cardiovascular mortality according to gender-stratified tertiles of physical activity p<0.001

Zelle, et al
Kaplan-Meier curves of all-cause mortality according to gender-stratified tertiles of physical activity $p<0.001$)

Zelle, et al
Emerging Challenge In Gerontology: To Expand Active Life Expectancy

Jeff D. Williamson, M.D. Program Director, Sticht Center on Aging
Chief, Geriatrics & Gerontology Wake Forest University Baptist Medical Center
Emerging Concept (& Challenge):
Active Life Expectancy

Modified from Jeff Williamson, M.D., Chief of Geriatrics & Gerontology, Wake Forest Baptist Medical Center modified by P. Painter with permission
Emerging Concept (& Challenge): Active Life Expectancy

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Emerging Concept (& Challenge): Active Life Expectancy

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Thanks for your attention....

Let's get them MOVING!