Assessment of Fitness in Cerebral Palsy

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Physical Fitness

- A set of attributes that people have or achieve relating to their ability to perform physical activity
Health Related Physical Fitness

- Cardiorespiratory Endurance
- Muscular Strength
- Muscular Endurance
- Body Composition
- Flexibility
Skill Related Physical Fitness

- Agility
- Balance
- Coordination
- Power
- Speed
- Reaction Time
Physiologic Physical Fitness

- Metabolic
- Morphologic
- Bone Integrity
Obesity in CP

- GMFCS III-V—poor growth
  - Stevenson et al., Pediatrics 2006: 118:1010-1018

- GMFCS I-II
  - Van der Slot et al, Disability and Rehabilitation 2007: 29:179-189
    - Men had lower body fat than controls based on skinfolds
BMI in CP

Figure 2. Weight status by GMFCS level

- Underwt
- Normal
- At Risk
- Overwt
Figure 1. Distribution of Percentiles for GMFCS 1-2
Patient: ID 101
Birth Date: 4/18/1962 45.2 years
Height / Weight: 75.0 in. 196.0 lbs.
Sex / Ethnic: Male White

Facility ID: 2137-Dr. Hurvitz

Total Body Tissue Quantitation

Composition Reference: Total

Centile

Fat (g)

Composition Trend: Total
Fat Free (g) [Gray]

24370
24390
24360
24370
63730
63729
63728

Trend: Total

Measured Date Age (years) Tissue (%Fat) Centile T. Mass (kg) Region (%Fat) Tissue (g) Fat (g) Lean (g) BMC (g) Fat Free (g)
7/13/2007 45.2 28.7 91 88.1 27.7 84,928 24,369 60,559 3,169 63,729

Trend: Fat Distribution

Measured Date Age (years) Android (%Fat) Gynoid (%Fat) A/G Ratio Total Body (%Fat)
7/13/2007 45.2 39.4 32.4 1.22 28.7

World Health Organization BMI Classification

Body Mass Index (BMI) = 24.5

Underweight Normal Overweight Obesity

Weight (lbs.) for height = 75.0 in.
Challenges of Measurement

Body Composition

- BMI
- Height Measurement
- Accuracy vs. Simplicity
Segmental Measures
Estimation of Height with Knee Heights

Height estimated from Stevenson knee height equation vs. Measured Height

- Mild CP
- Moderate to Severe CP

Mean of estimated and measured height (cm)

Difference between estimated and measured height (cm)
Height Estimation with Ulna Length

Estimated Height from Gauld Ulna length vs. Measured height

- **Severity**
  - ○ Mild CP
  - □ Moderate to Severe CP

### Graph Details
- **Y-axis**: Difference between Estimated and Measured Height (cm)
- **X-axis**: Mean of Estimated and Measured Height (cm)
- **Legend**:
  - 20.48
  - 6.86
  - -6.76
Knee Height, Equation for Non-CP

Estimated Height from Chumlea Knee Height vs. Measured Height

Severity
- Mild CP
- Moderate to Severe CP

Difference between Estimated and Measured Height (cm)

Mean of Estimated and Measured Height (cm)
More Advanced
Aerobic Capacity

- Lundberg, DMCN 1978 20:205-210
  - Lower level of fitness (HR response, O2 uptake)
- Tobimatsu et al, APMR 1998 79:991-3
  - Peak VO2 not different from controls
- Fernandez and Pitetti, multiple
  - Poor level of aerobic fitness, but responds to exercise
Challenges of Measurement
Aerobic Capacity

- Use of equipment
  - Varied population, varied ability

- Attaining VO2 max
  - Max vs. Peak
Exercise Testing
Physical Activity in CP

- Van der Slot et al, Disability and Rehabilitation 2007: 29:179-189
  - Hemiplegic CP, no difference from controls

- Maher et al, DMCN 2007:450-7
  - Adolescents, PAQ-A, Less activity, less structured, lower intensity
Physical Activity in CP

  - Energy cost of walking predicts physical activity

- Bandini et al, Pediatric Research 1991 29:70-77
  - Adolescents, decreased TEE/RMR and FFM
Challenges of Measurement Physical Activity

- Many surveys
  - Reliance on memory
  - Bias
- Activity monitors/Accelerometers
- Double labeled water
Accelerometers

- Activity counts
- Activity levels
- Subject input
- IDEAA—describes activity
Figure 5. Activity intensity before and after rhizotomy

- Subject 1: Before low intensity, After low intensity
- Subject 2: Before medium intensity, After medium intensity
- Subject 3: Before high intensity, After high intensity

% activity/week
- Low intensity
- Medium intensity
- High intensity
Strength

- Damiano et al, multiple
  - Children with cerebral palsy are weak, and can get stronger with exercise
  - They benefit functionally from this as well
- Macphail et al, DMCN 1995 37:763-775
  - Adolescents benefit from strengthening
- Ross and Engsberg, APMR 88:1114-20
  - Children-strength influences gait more than spasticity
Challenges of Measurement Strength

- MMT
  - Isolation of movement
  - Reliability and technique

- Handheld Dynamometer
  - Reliability and technique

- Biodex
  - Difficult to have in clinic
CPOP: Cerebral Palsy Outcomes Project

- **Objective:** To study relationships between Health / Fitness and Participation / QOL

- **Model**
  - Multisite—large population (500 from 6 sites)
  - Clinic based—less complex measures
  - Highly feasible assessment
  - Internet based data collection
Fitness Assessment

- **Body Composition**
  - Height (Knee Height), Weight
  - Triceps Skin fold
  - Mid-Arm Circumference
  - Waist circumference

- **Aerobic Fitness**
  - Walk test—3 vs. 5 vs. 6 minutes
Fitness Assessment

- **Flexibility**
  - Modified Apley test
  - Popliteal angle
  - Thomas test

- **Strength**
  - Hand held dynamometer—knee extension
  - Grip strength dynamometer
Summary

- Physical Fitness in Cerebral Palsy
  - On the research agenda

- Challenges of Assessment
  - Difficulties with standard assessments
  - Search for solutions

- Identifying the issues
  - Multisite clinic based study
  - Pave the way for more elegant studies