Assessment of Fitness in Cerebral Palsy

Edward A. Hurvitz, M.D.
Dept. of PMR
The Cerebral Palsy Program
The Human Performance Laboratory
The University of Michigan, Ann Arbor

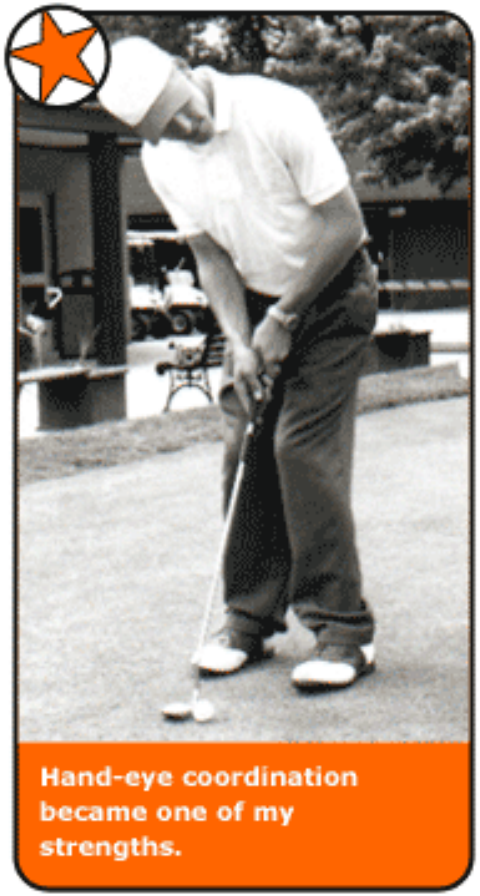
Physical Fitness

- 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

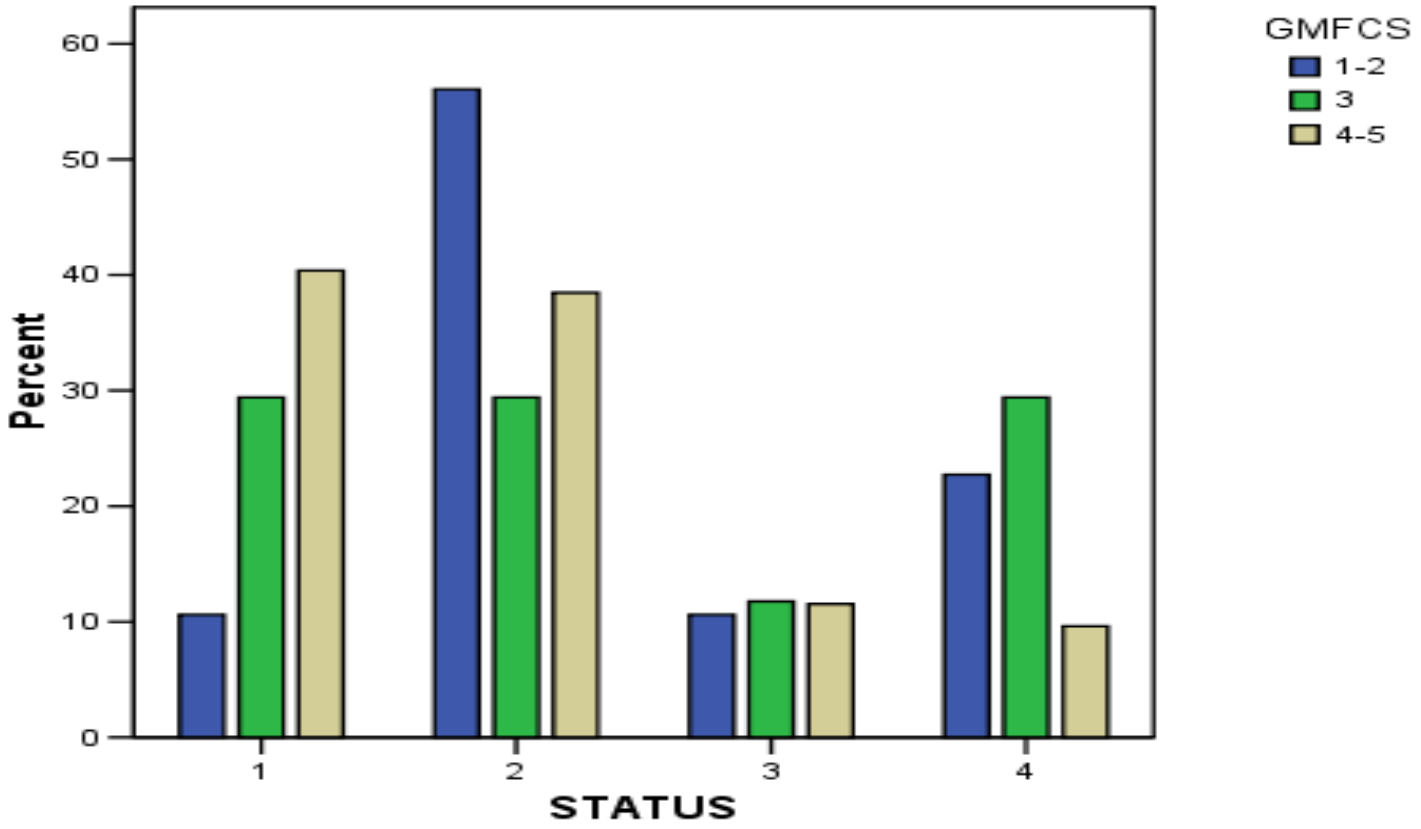
- Metabolic
- Morphologic
- Bone Integrity

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

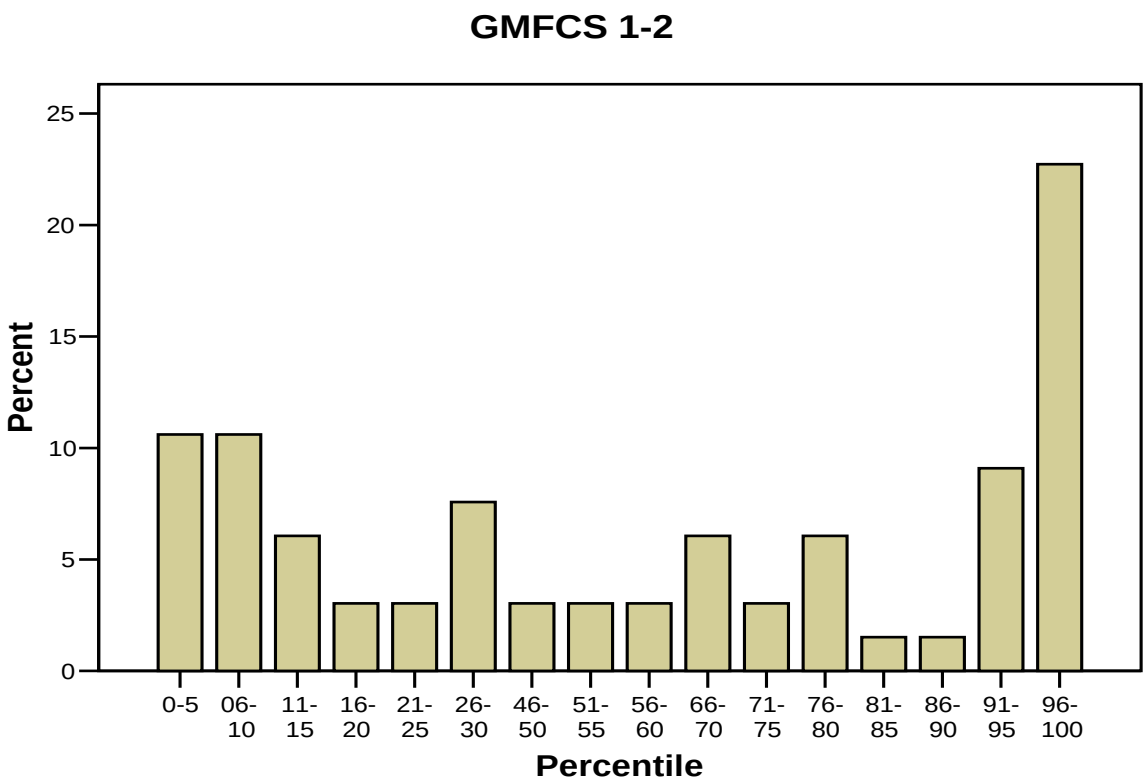
Figure 2. Weight status by GMFCS level



Underwt Normal At Risk Overwt

BMI, GMFCS I-II

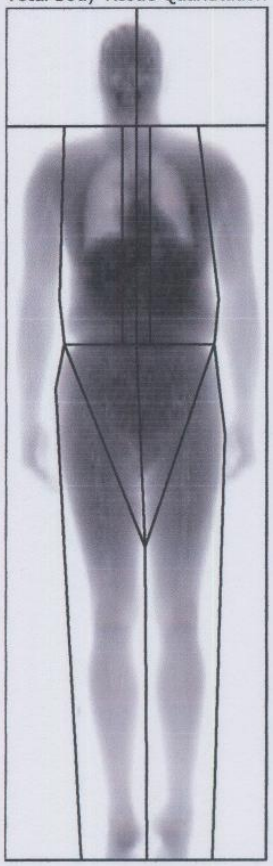
Figure 1. Distribution of Percentiles for

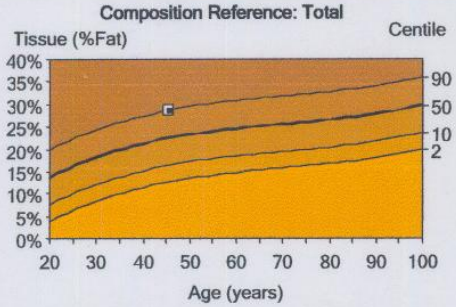


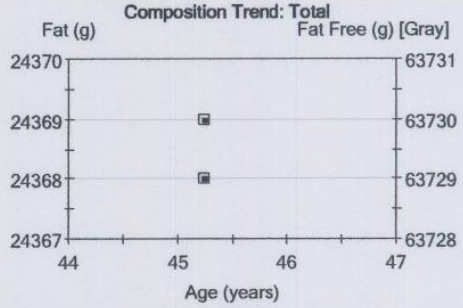
University of Michigan
General Clinical Research Center
Ann Arbor, MI 48109

Patient:	ID-107	**Facility ID:**	
Birth Date:	4/18/1962 45.2 years	**Referring Physician:**	2137-Dr. Hurvitz
Height / Weight:	75.0 in. 196.0 lbs.	**Measured:**	7/13/2007 8:52:58 AM (10.51)
Sex / Ethnic:	Male White	**Analyzed:**	7/13/2007 9:27:38 AM (10.51)

Total Body Tissue Quantitation







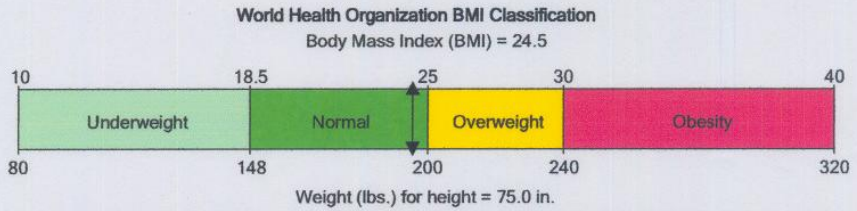
Trend: Total

Measured Date	Age (years)	Tissue (%Fat)	Centile[2,3]	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

COMMENTS:

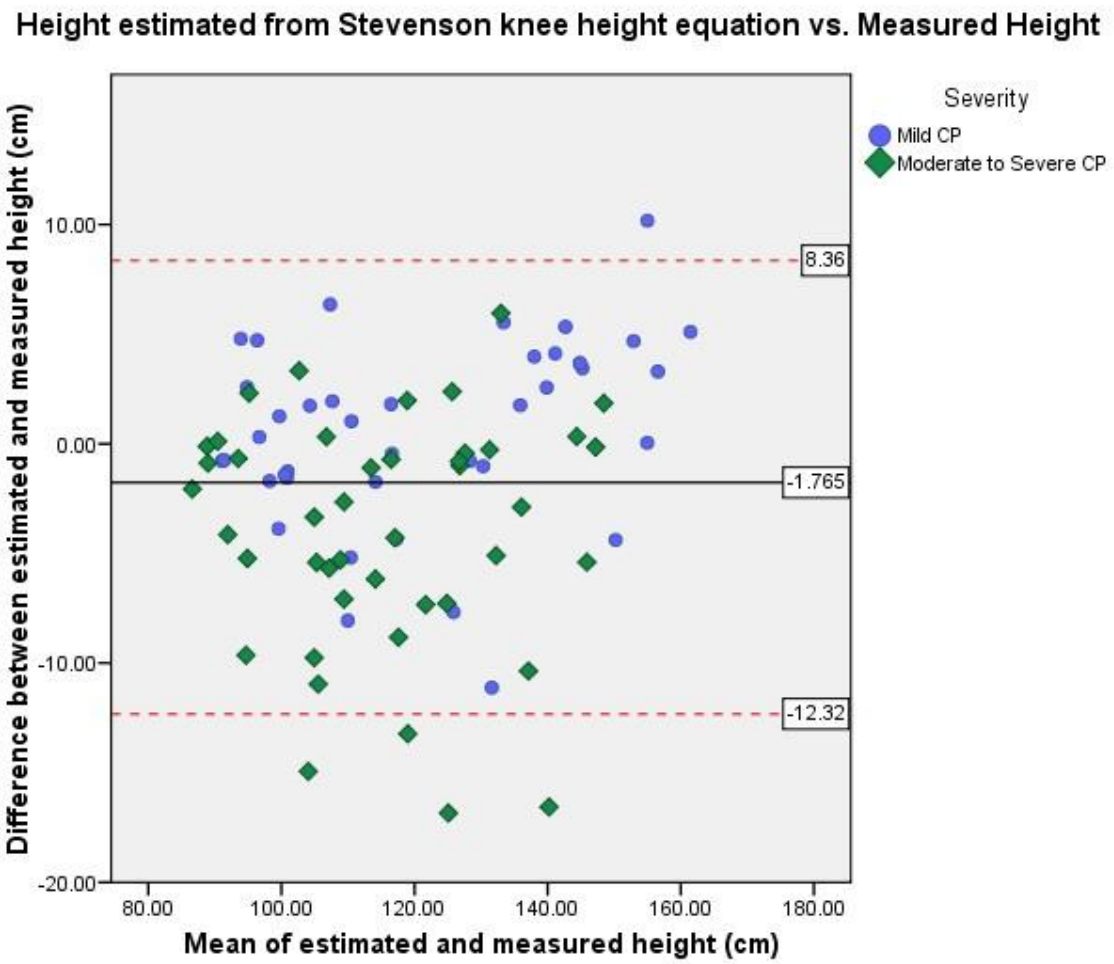


Challenges of Measurement Body Composition

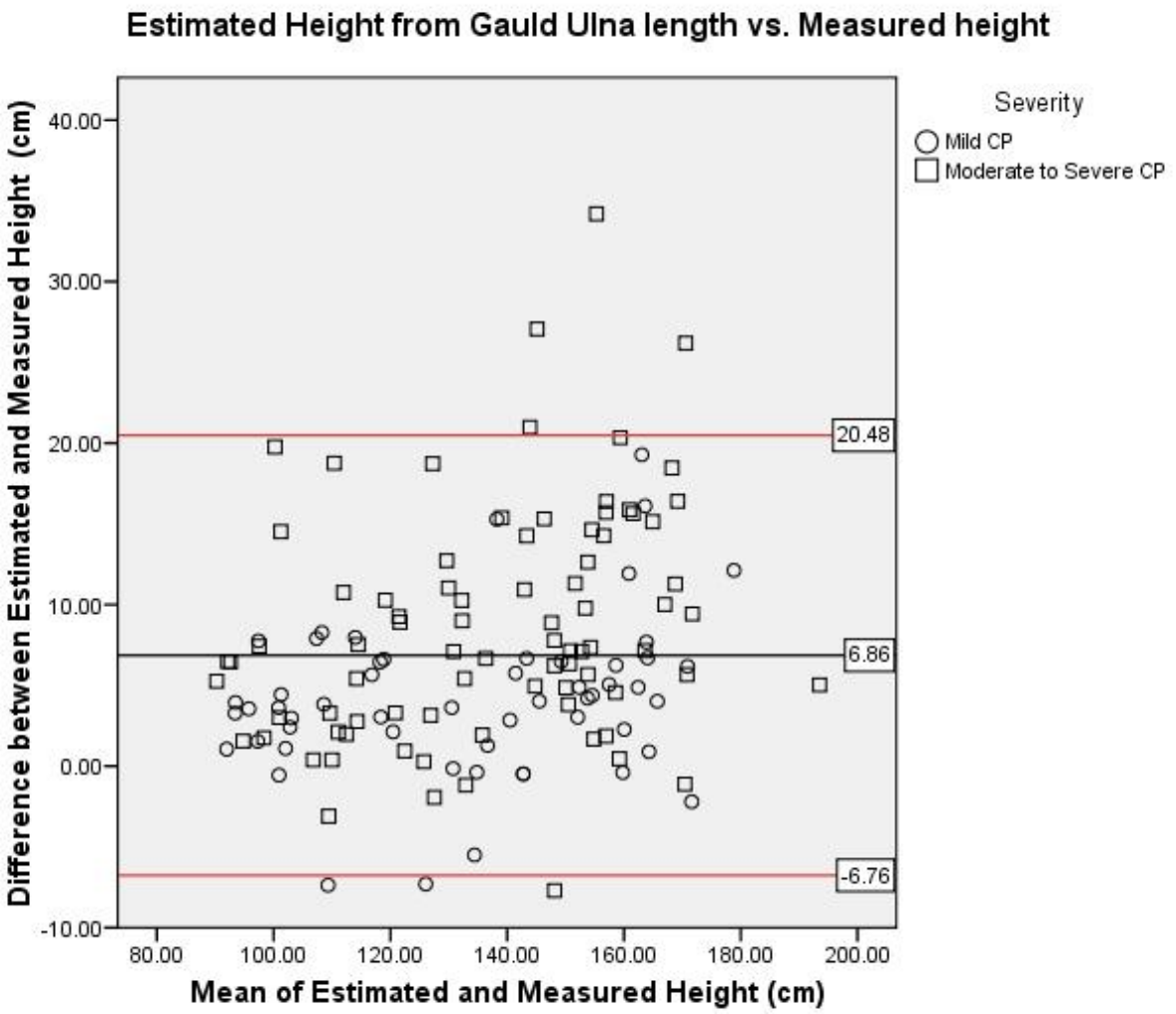
- BMI
- Height Measurement
- Accuracy vs. Simplicity

Segmental Measures

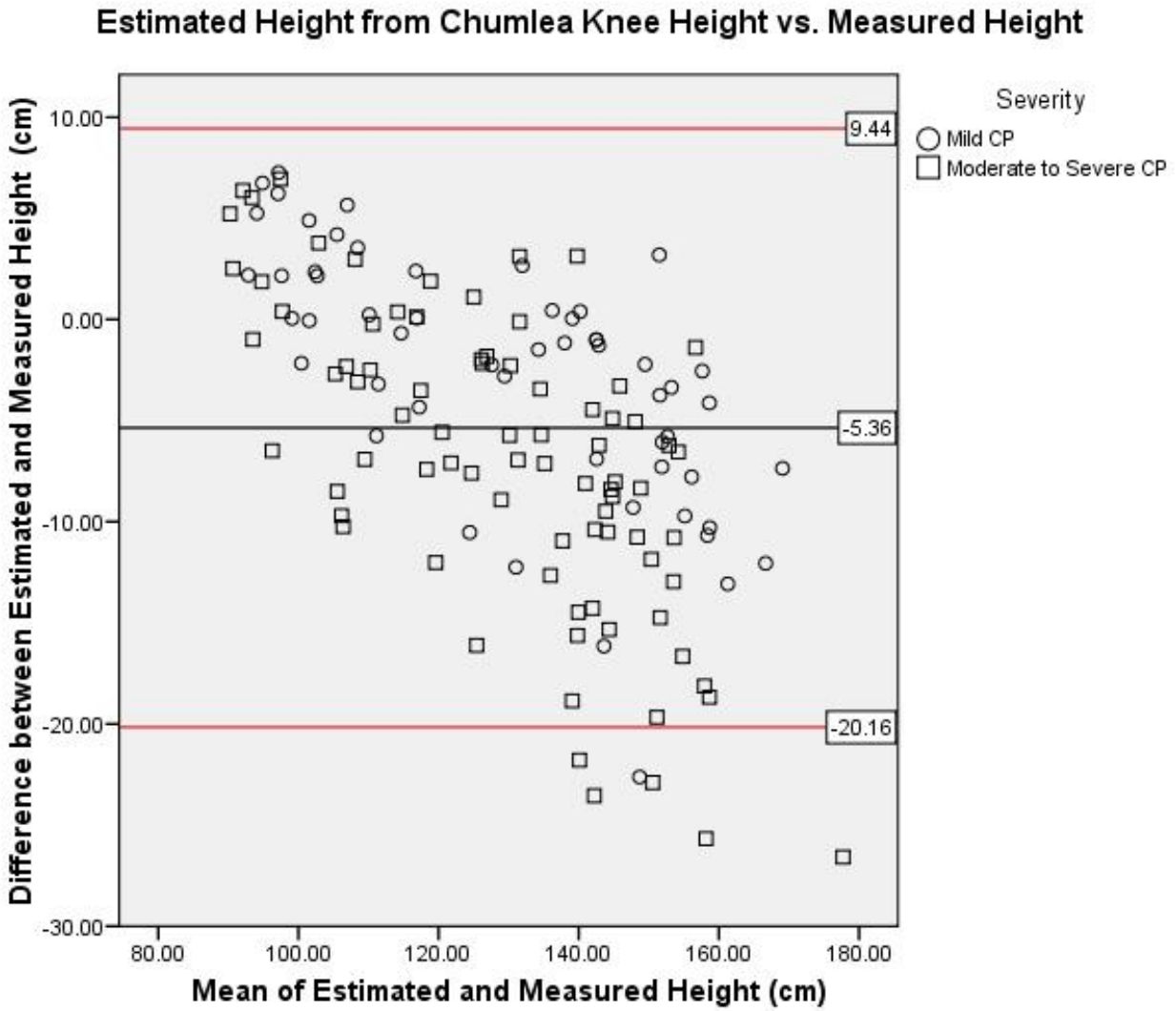
Estimation of Height with Knee Heights



Height Estimation with Ulna Length

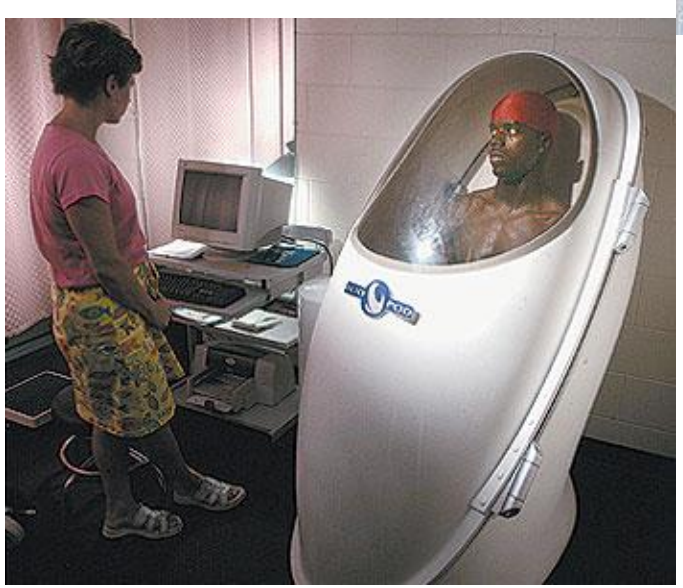


Knee Height, Equation for Non-CP



Measuring Body Composition

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 Acitivity in CP

- Maltais et al, Med Sci Sport Ex 2005 37:347-353
  - Energy cost of walking predicts physical activity
- Bandini et al, Pediatric Research 1991 29:70-77
  - Adolescents, decreased TEE/RMR and FFM

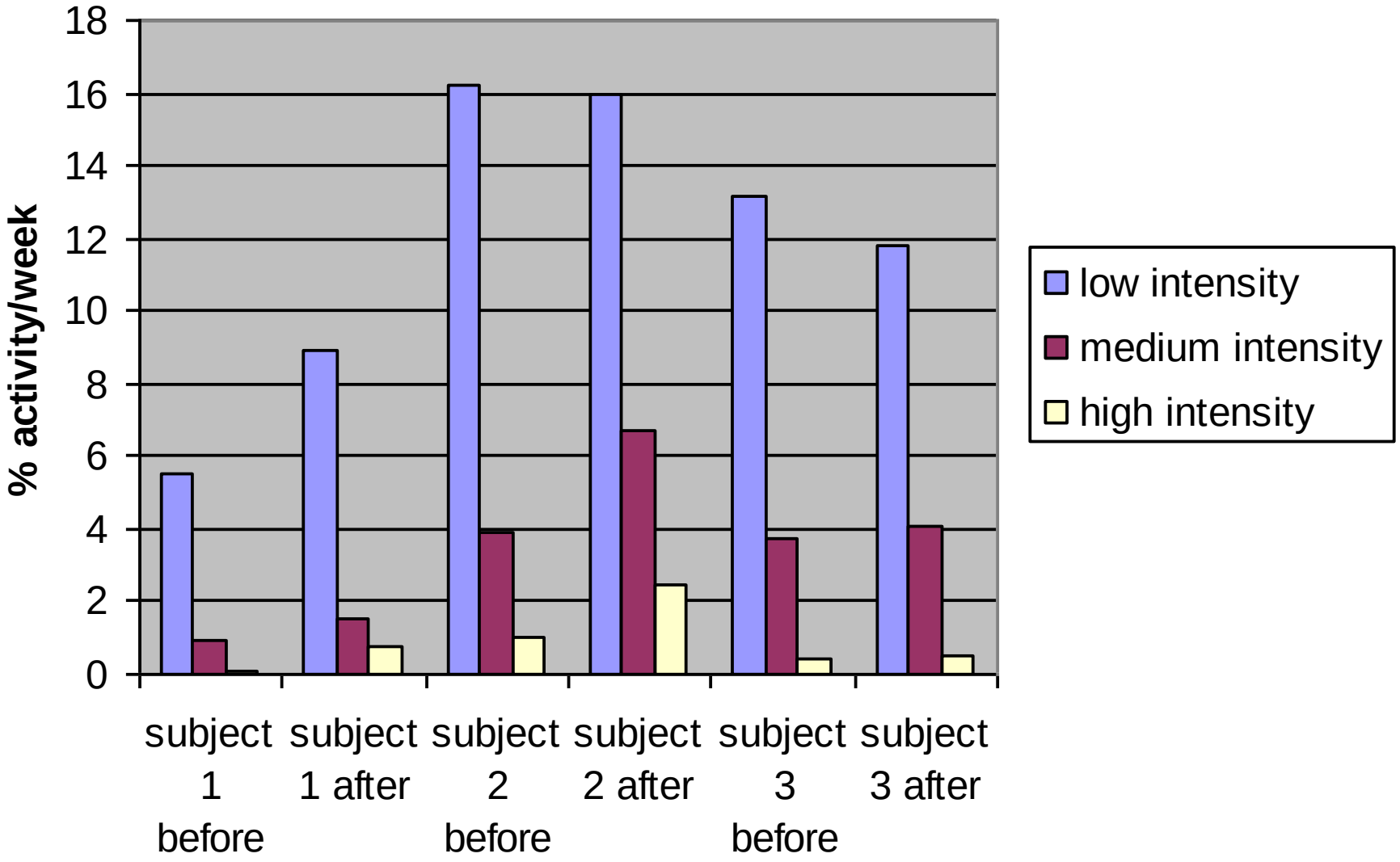
Challenges of Measurement Physical Activity

- 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



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

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 Compositon
  - Height (Knee Height), Weight
  - Triceps Skin fold
  - Mid-Arm Circumference
  - Waist circumference
- Aerobic Fitness
  - Walk test—3 vs. 5 vs. 6 minutes

Fitness Assesment

- 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 Assesment
  - Difficulties with standard assessments
  - Search for solutions
- Identifying the issues
  - Multisite clinic based study
  - Pave the way for more elegant studies