Joint Impact of Lower Extremities in Obese and Overweight Children

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Impact
340 Million Children
Aged 5-19 in 2016

World Health Organization (WHO)
Consequences

COMPLICATIONS OF CHILDHOOD OBESITY

Psychosocial
- Poor self-esteem
- Depression
- Eating disorders

Neurological
- Pseudotumor cerebri

Pulmonary
- Sleep apnoea
- Asthma
- Exercise intolerance

Cardiovascular
- Dyslipidaemia
- Hypertension
- Coagulopathy
- Chronic inflammation
- Endothelial dysfunction

Gastrointestinal
- Gallstones
- Steatohepatitis

Endocrine
- Type 2 diabetes
- Precocious puberty
- Polycystic ovary syndrome (girls)
- Hypogonadism (boys)

Renal
- Glomerulosclerosis

Musculoskeletal
- Slipped capital femoral epiphysis
- Blount’s disease
- Forearm fracture
- Flat feet
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How Childhood Obesity affects Joint Pain

Consequences
Overview

- Background
- Previous Studies
- Proposal
Defining Childhood Overweight and Obesity

- Body Mass Index

\[
BMI = \frac{\text{weight in kilograms}}{\text{height in meters}^2}
\]

- Overweight: BMI > 25
- Obese: BMI > 30

World Health Organization
Gait Comparison Studies
- Elongation of Cycle Length
- Greater Midstance Duration
- Widened Bases of Support by having their “toes-out” to increase stability
- Foot Supination → Calf Rotation
- Increased Pelvic Obliquity Range of Motion
- Reduced Early Stance Knee Flexion Angles

Comparison

Increased Stress → Pain

- Many studies report children experience lower extremity pain
  - Hips, Knees, Ankles, Feet
- As weight increases, more pressure on joints and cartilages
- Sets up Soft Tissue for Inflammation
How do you Reduce the Stress??

- Studies suggest exercise programs and nutrition guides
Reduce Joint Pain by Modifying Gait
Previous Studies

Implications

- Singh 2016
  - Fatigue from cardiovascular activities leads to increase in joint moments
  - This increase leads to problems performing physical activities
Previous Studies

Real time wearable sensors

- Hanlon 2009
  - Force sensitive resistors and accelerometers
  - Can be placed according to what needs to be measured
  - Can give real time data that is useful to user
Previous Studies

Gait Modification

- Reinbolt 2007
  - Nonsurgical approach as an alternative to surgery
  - Can be done in various ways to affect different joints
  - Gait modification -> Gait retraining
Proposed Research

Subject Pool

- 40 Members
- Ages 9 - 12
- Overweight or Obese

Task

- Collect Data and Analyze for Stresses and Forces on joints
  - Control - before modifications
  - Gait Modification
Proposed Research

Use motion capture and force plates to gather relative data

- Inverse dynamics package
- OpenSim

Use data to make a proposed gait modification

- Examples that will be tested
  - More “toe-in” stance
  - More bend in knee during early stance phase
No modification, normal walking gait

Participants walk with a more “toe-in” stance and higher knee flex

Sensors and force plates save data and compare to initial

Participants are asked to adjust their stance again based on Data 2

Final data is collected and compared to previous

Final data is collected and compared to previous
Proposal

Future project:

- Use result from experiment to make a sensor package
- Sensor package can be worn during daily activities
- Links to phone for real time results and suggestions
- Suggestions on gait modification tips and other fun stuff
Questions?
References


