NMDS311
Sports Nutrition

Session 2

Body Composition and Nutrition Assessment

Nutritional Medicine Department
Sports Nutrition
Session 2

Body Composition and Nutrition Assessment

• Body composition assessment methods

• Application and limitations of methods

• Measuring nutritional status
Learning Outcomes

• Examine methods for assessing body composition

• Exploring the gold standard assessment tools for measuring body composition

• Examine methods for assessing nutritional intake
Body Composition
Assessment methods
Why Assess Body Composition

- Monitor growth, development, maturation & age related changes
- Identification of ideal physique... morphological optimisation
- Talent Identification
- Objective assessment of intervention
  - Training
  - Diet
  - Rehabilitation program

Optimal Body Composition

Body composition influences performance

- Excess body fat influences ability to move body weight – acceleration, vertical jump

- Lighter body weight means less energy is required to carry one’s weight – better power : weight ratio

- Leanness desirable in aesthetic sports

- Low body weight may negatively impact contact sport
Optimal Body Composition

When selecting a tool for monitoring body composition, consider the following:

- Validity
- Reliability
- Availability & expertise required
- Cost & time effectiveness
- Invasiveness
- Health risk
- Athlete friendly
Measuring Body Composition

- Body Mass Index (BMI)
- Waist Circumference (WC)
- Densitometry
- Skinfolds
- Dual X-ray Absorptiometry (DXA)
- Magnetic Resonance Imaging (MRI)
- Air Displacement Plethysmography (ADP) measured using a (BODPOD)

http://recwell.umd.edu/bodpod
Class Activity

Divide class into 7 groups, with a method assigned to each group.

Groups to spend 2-3 minutes researching the methods, followed by a class discussion.

- Body Mass Index
- Waist Circumference
- Densitometry
- Skinfolds
- Dual X-ray Absorptiometry (DXA)
- Magnetic Resonance Imaging (MRI)
- Air Displacement Plethysmography (BODPOD)
Use of Body Composition

Body composition goals must be reviewed in relation to functional capacity and individual performance.

- Athletes are successful across a range of body compositions in a particular sport

- Body composition measurements can be useful for:
  - Determining suitability for weight category sports
  - Screening to monitor health risk associated with very low body weight/fat
  - Research efficacy of interventions
  - Longitudinal tracking of changes
Applications and Limitations of Methods
Skinfolds

• Current “benchmark” used amongst elite sporting teams around the world to assess fat mass amongst athletes

• ISAK accreditation is a worldwide recognised course undertaken by those looking to perform standardised skinfold assessments on athletes (recreational to elite)

• ISAK accreditation enables practitioners to reliably ‘mark up’ an individual based on certain landmarks on a person using their skeletal structures to pin point the site. This allows the practitioner to find the same landmark each time they undertake a skinfold assessment
Skinfolds

• Combined measurement of body mass, skinfolds ± girths, lengths & breadths

• Robust measures not influenced by factors likely to vary depending on client presentation
  • Hydration status
  • Food & fluid intake
  • Exercise

Skinfolds

- Provides feedback on changes in body composition & disease risk
- Mobile & relatively inexpensive
- Demands highly skilled technicians (ISAK Accredited)
Skinfolds

Limitations

• Little insight into qualitative changes in total or regional lean mass (LM)
• Total LM can be estimated from fractionation technique but not very sensitive
• Full anthropometric assessment takes 40mins to conduct – time consuming
Skinfolds

8 sites of measurement

• Bicep
• Subscapular
• Tricep
• Iliac Crest
• Supraspinale
• Abdominal
• Thigh
• Calf

Retrieved from http://www.topendsports.com/testing/bodyfat-skinfolds.htm
BODPOD

• Technique for measurement of body density based on basic gas laws

• Describes inverse relationship between pressure & volume in 2 enclosed chambers

• Quick, comfortable, automated, non-invasive & accommodates a range of subject types

• Siri equation used to calculate body composition

Associated assumptions
Dual Energy X-ray Anthropometry (DXA)

Retrieved from http://www.bodyandbone.com
Dual Energy X-ray Anthropometry (DXA)

- ‘Gold Standard’ for measuring bone mineral content (BMC) and bone mineral density (BMD)
  - Diagnose osteopenia and osteoporosis

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Fast (~10-15mins)</td>
<td>Cannot cross compare between machines</td>
</tr>
<tr>
<td>Provide regional body composition</td>
<td>Expensive equipment</td>
</tr>
<tr>
<td>Low radiation dose (~5% of flight)</td>
<td>Tough to transport</td>
</tr>
<tr>
<td>Sequential measurements</td>
<td>DXA bed is smaller than typical physique of many athletes</td>
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<tr>
<td>Non-intrusive</td>
<td>Requires a trained technician to operate</td>
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<tr>
<td>Suitable for most athletes</td>
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How Do We Scan Tall and Big People?

“Big People” Study

• Subjects
  • 30 active individuals, >190cm tall
• 1 Day study, 5 scans of various positioning

Source: http://www.viralhoops.com/tallest-basketball-players-ever/

(Nana, Slater, Hopkins & Burke, 2012)
### Effect of Daily Activities

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 2</th>
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<tbody>
<tr>
<td><strong>Morning</strong></td>
<td><strong>Morning</strong></td>
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<tr>
<td>DXA 1 (F)</td>
<td>DXA 4 (F)</td>
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<tr>
<td>Reposition</td>
<td>Meal</td>
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<tr>
<td>DXA 2 (F)</td>
<td>DXA 5</td>
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<tr>
<td>Daily</td>
<td></td>
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<tr>
<td>Activities</td>
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<tr>
<td>Afternoon</td>
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<tr>
<td>DXA 3</td>
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</table>

- 2 day study, 5 DXA scans
- 31 people (16M, 15F), 16-40 years old, physically active (exercise >4hr/week, >190cm tall)
- Meal = breakfast (200-2000ml)

(Nana, Slater, Hopkins & Burke, 2012)

- Machine & Technician Error (TEM)
- Biological variation (random)
- Minimum biological variance (best practice)
- Effect of intervention
Effect of Daily Activities

- Daily activities (including food & fluid intake) increases body composition estimates & technical error of measurement
  - Increase LM and sometimes FFM
- Cannot apply “adjustment factors” to account for the amount & timing of food intake
- Easiest and most practical way is to have a standardised scanning protocol
  - Fasted and rested (no exercise)
  - Standardised clothing, positioning & analysing the scan
  - Limited number of technicians
  - Confidentiality & body image issues
Results

Substantial Increase in FM and LM

No substantial difference

Substantial increase in FM

(Nana, Slater, Stewart & Burke, 2015)
Conclusion

• In simulating tall subjects, summation of partial scans that included the head scan overestimated whole-body composition by ~3 kg of lean mass and ~1 kg of fat mass, with substantial technical error of measurement.

• In simulating broad subjects, summation of right and left body scans produced no substantial differences in body composition than those of the whole-body scan.

• Summing partial DXA scans provides accurate body-composition estimates for broad subjects, but other strategies are needed to accommodate tall subjects.
Dual Energy X-ray Anthropometry (DXA)

While DXA is a valuable physique assessment tool, it isn’t without issues. Results influenced by:

- Presenting physique traits
- Hydration status
- Gastrointestinal contents
- Subject positioning
Dual Energy X-ray Anthropometry (DXA)

- Difficulty in determining body composition of trunk
- Variability in results due to different machines and software
- Access to suitably trained technicians
- Limited scanning area
- Low dose radiation exposure
- Expense
Further Reading

Reliability Of Dual-energy X-ray Absorptiometry In Assessing Body Composition In Elite Athletes by Alisa Nana

Bioelectrical Impedance Analysis (BIA)

- Most readily available technique
- Involves low level electrical current passing through the body and resistance to flow measured
- Tissues with high water & electrolyte content are highly conductive
  - Blood, muscle
- Anhydrous tissues are highly resistive
  - Fat, bone, air-filled spaces
BIA

• Provides detailed reports of:
  • Fat
  • Protein
  • Mineral
  • ICW (intracellular water), ECW (extracelluar water)
  • Regional distribution
  • Metabolic rate
    • Rapid
    • Readily portable
    • Non-invasive
    • Relatively inexpensive

BIA

• Measure height and weight at time of assessment
• Fasting, no alcohol for > 8 hours
• Avoid consuming food and fluid prior to assessment
• Document menstrual cycle
• Ambient skin temperature
BIA

• Subject position
  • Supine for 5-10 min
  • Abduction of arms @ 300
  • Abduction of legs @ 450
  • Specific electrode placement

• Race specific equations

• Special consideration for clients with disease

Retrieved from http://www.newhealthadvisor.com/images/1HT08512/Bioelectric%20Impedance%20Analysis.jpg
BIA

• While BIA is cheaper and thus more readily accessible, measurement error tends to be greater

• Standardisation of methodology & presentation of client are critical

• Hydration critical amongst athletic populations

• Beware of some derived results (embedded equations)
Measuring Nutritional Status

Measuring Nutritional Status

How can we determine what an athlete is consuming?

• Prospective methods
  • 3-7 day dietary survey
  • 3-7 day weighted record

• Retrospective methods
  • 24 hour recall
  • Food frequency questionnaire
  • Diet history

Measuring Nutritional Status

3 Day Dietary Survey

• Try to represent normal eating pattern by including 2 week days and 1 weekend or a combination of heavy, light and rest training days

• Reliable indicator of energy and macronutrient intake

• Other nutrients may require longer periods of assessment due to compliance issues (iron, beta carotene)
Measuring Nutritional Status

• Training and verbal education may be needed beforehand for accurate portion estimation

• Athletes tend to be more motivated than other groups however under-reporting is still a major limitation

• Athletes recording intake may inadvertently not consume extra due to being conscious of intake
Measuring Nutritional Status

What tools can be used to assess dietary intake?
Measuring Nutritional Status

What tools can be used to assess dietary intake?

- National Food Guides
  - Australian Guide to Healthy Eating (AGTHE)
  - New Food Pyramid
  - Core food groups

- Australian Dietary Guidelines
  - Dietary Guidelines for Adults

- Nutrient Reference Values (NRVs)
  - E.g. EAR, RDI, AI, UL, AMDR

Source: https://www.eatforhealth.gov.au/
# Class Activity

Fill in this Ready Reckoner of common food options – Foodzone

<table>
<thead>
<tr>
<th>Food</th>
<th>Energy</th>
<th>Carbohydrate</th>
<th>Protein</th>
<th>Fat</th>
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<td></td>
<td>kJ</td>
<td>(g)</td>
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<td><strong>Slice of bread</strong></td>
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<td><strong>½ cup of cooked rice</strong></td>
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<tr>
<td><strong>1 cup of cooked pasta</strong></td>
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<td><strong>¼ cup of mixed nuts</strong></td>
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<tr>
<td><strong>200g of plain greek yoghurt</strong></td>
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<td><strong>250ml of FF milk</strong></td>
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<tr>
<td><strong>1 tbsp. of P/Butter</strong></td>
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<tr>
<td><strong>1 apple</strong></td>
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<tr>
<td><strong>100g of chicken</strong></td>
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<td><strong>150g of s/potato</strong></td>
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<tr>
<td><strong>50g of avocado</strong></td>
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References


References

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