Presenter Disclosure Information

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*Experimental Modest Weight Gain Increases 24-h Blood Pressure in Lean Healthy Subjects: Implications of Increased Visceral Fat*

**FINANCIAL DISCLOSURE:**

No relevant financial relationship exists.
Experimental Modest Weight Gain Increases 24-h Blood Pressure in Lean Healthy Subjects: Implications of Increased Visceral Fat

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Background

Excess Adipose Tissue

• Obesity (BMI ≥30 kg/m²) is a leading cause of morbidity and mortality

• Different obesity phenotypes related to disease risk → Regional adipose tissue distribution
  • Upper-body vs lower-body
  • Subcutaneous vs visceral fat depots
Excess Visceral Fat and Disease Risk

- Higher prevalence of CV and metabolic risk factors and disorders\(^1,2\)
- Independently linked to BP\(^3,4\) and HTN prevalence and incidence\(^5\)

**Limits**
- Observational studies
- High-risk populations
- Office BP

\(^1\) Vega et al., J Clin Endocrinol Metab 2006
\(^2\) Mahabadi et al., Eur Heart J 2009
\(^3\) Rhéaume et al., Hypertension 2009
\(^4\) Hayashi et al., Circulation 2003
\(^5\) Chandra et al., J Am Coll Cardiol 2014
Aims

• To determine whether experimental modest weight gain raises ambulatory blood pressure in healthy individuals

• To identify any relationship between changes in blood pressure and changes in regional fat distribution
Method

Study Population

• 26 nonobese, healthy subjects, aged 18-48 yr
• Exclusion criteria:
  • BMI $\geq$30 kg/m$^2$
  • Smoking
  • Postmenopausal
  • Medical and/or psychiatric disorders
  • Medication use
Study Outline

- Physical exam
- OGTT
- VO₂ exercise test
- Polysomnography
- Blood test

**WEIGHT MAINTENANCE**

- BASELINE
  - 8 weeks
- FOLLOW-UP

**WEIGHT GAIN**

- BASELINE
  - 8 weeks
- FOLLOW-UP

**SCREENING**

- Randomization

**OVERFEEDING:** 400-1200 extra kcal/day
Measures

- Blood pressure
  - Office
  - 24-h ABPM
- Body composition
  - Dual-energy X-ray absorptiometry (DEXA)
  - Abdominal CT
- Blood specimens
  - Lipids, glucose, insulin, adipokines
### Results

#### Demographics, Body Composition and Adipokines

<table>
<thead>
<tr>
<th></th>
<th>Weight Gainers (n=16)</th>
<th>Weight Maintainers (n=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Follow-up</td>
</tr>
<tr>
<td>Age, yr</td>
<td>30.4±6.6</td>
<td>-</td>
</tr>
<tr>
<td>Gender Male, n</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>71.9±12.9</td>
<td>75.6±13.4***</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>23.5±3.5</td>
<td>24.8±3.6***</td>
</tr>
<tr>
<td>Total Body Fat Mass, kg</td>
<td>21.9±8.3</td>
<td>25.2±8.6***</td>
</tr>
<tr>
<td>Total Body Fat-Free Mass, kg</td>
<td>46.9±9.3</td>
<td>47.3±9.7</td>
</tr>
<tr>
<td>Visceral Fat Area, cm²</td>
<td>61.6±32.7</td>
<td>75.5±30.9**</td>
</tr>
<tr>
<td>Subcutaneous Fat Area, cm²</td>
<td>135.5±77.4</td>
<td>167.9±82.9***</td>
</tr>
<tr>
<td>Leptin, ng/mL</td>
<td>7.3±4.6</td>
<td>11.7±5.9***</td>
</tr>
<tr>
<td>Adiponectin, ng/mL</td>
<td>7324±3874</td>
<td>8986±5463*</td>
</tr>
</tbody>
</table>

Within-group comparisons: *p<0.05; **p<0.01; ***p<0.001
Ambulatory Blood Pressure

24-h Systolic Blood Pressure

24-h Mean Arterial Pressure

24-h Pulse Pressure

- No significant changes in 24-h DBP and 24-h HR after overfeeding
- No significant changes in Office BP
Correlates of Changes in BP

- Weight Maintainers
- Weight Gainers

Δ MAP, mmHg

Δ Weight, kg

Spearman’s ρ = 0.161
P = 0.432

Δ MAP, mmHg

Δ Total Body Fat, kg

Spearman’s ρ = 0.022
P = 0.917

Δ MAP, mmHg

Δ Abdominal Visceral Fat, cm²

Spearman’s ρ = 0.452
P = 0.02
Case Example

27 yr male, BMI 24.5 kg/m²
Weight gainer

Baseline

Follow-up

Body weight: + 4.5 %
Visceral fat: + 44 %
Subcutaneous fat: + 35 %
24-h SBP/DBP/MAP: + 5/1/3 mmHg
Discussion

• Elevation in 24-h ABP after 5% weight gain in healthy subjects

• Positive relationship between changes in BP and visceral fat accumulation
Potential Mechanisms

• Visceral fat accumulation may cause increase in BP through greater secretion of:
  
  FREE-FATTY ACIDS

  ANGIOTENSINOGEN

  PRO-INFLAMMATORY CYTOKINES

• A third factor may drive increases in both visceral fat and BP
  • HPA axis activation
Clinical Implications

• Visceral adiposity may contribute to obesity-related HTN

• Modest weight gain may increase BP if fat accumulation is predominantly visceral

• Weight loss interventions targeted at visceral fat reduction
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