Psychological inflexibility, eating habits and changes in BMI: Results from a nationwide prospective study of mid-age NZ women

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Health Risks Associated with Obesity

- Physical disabilities
- Psychological issues (binge eating disorder)
- Cardiovascular disease
- Cancer (endometrial, breast, colon)
- Type 2 diabetes

World Health Organization, 2013
Weight Gain Among Adults

• Among adults ages 35-69 at baseline, women gained more weight than men over 5 years
  • Women: +2.4 kg (SD 5.2)
  • Men: +1.5 kg (SD 4.8)

  Ball, Crawford, Ireland & Hodge, 2003

• Middle-aged women gain approximately 0.5-1.0 kg per year

  Sternfeld et al., 2008; Sternfeld et al., 2004; Williams et al., 2006; Brown et al., 2005
## Mid-age New Zealand Women’s Body Mass Index

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Year</th>
<th>35-44</th>
<th>45-54</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overweight (%)</td>
<td>1997</td>
<td>29.0</td>
<td>35.4</td>
</tr>
<tr>
<td>BMI 25.0 - 29.9</td>
<td>2003</td>
<td>25.4</td>
<td>29.4</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>31.6</td>
<td>33.2</td>
</tr>
<tr>
<td></td>
<td>2011</td>
<td>27.3</td>
<td>34.0</td>
</tr>
<tr>
<td>Obese (%)</td>
<td>1997</td>
<td>18.1</td>
<td>28.2</td>
</tr>
<tr>
<td>BMI &gt; 30.0</td>
<td>2003</td>
<td>23.2</td>
<td>26.5</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>26.9</td>
<td>30.2</td>
</tr>
<tr>
<td></td>
<td>2011</td>
<td>30.1</td>
<td>30.8</td>
</tr>
</tbody>
</table>

Ministry of Health, NZ
Existing obesity interventions

• Dieting leads to short-term weight loss
• Regain is observed from 6 months on
• Return to baseline weight by 5.5 years

Ulen, Huizinga, Beech & Elasy, 2008

• ~30%-35% of lost weight regained in 1st year after treatment

Wadden, Butryn & Byrne, 2004
Research question

• What modifiable factors are associated with the prevention of weight gain among mid-age women?
Psychological Flexibility & Eating Behavior

• Ability to experience the present moment (difficult emotions, thoughts, memories – e.g. about food or body, or body sensations – e.g. cravings, hunger) while engaging in behavior that is consistent with one’s chosen values

Sandoz, Wilson, Merin & Kellum, 2013; Hayes, Luoma, Bond, Masuda & Lillis, 2006
Intuitive Eating

• Eating in response to hunger and satiety cues and unconditional permission to eat when hungry

  Tribole & Resch, 2003; Tylka, 2006, 2013

• Associated with lower BMI

  Madden, Leong, Gray & Horwath, 2012

• Associated with weight maintenance

  Bacon, Stern, Van Loan & Keim, 2005

• Prevents 2-year weight gain

  Hawley et al., 2008
Women’s Lifestyle, Eating Habits and Wellbeing Study

• Does psychological flexibility predict women’s BMI change or BMI stability?
Proposed Model

3-year food-related behaviors
- Binge eating
- Dieting
- Food intake
- Intuitive eating
- Speed of eating

Baseline psychological inflexibility
(AAQ-II, Bond et al, 2007)

3-year BMI change/stability
Women’s Lifestyle, Eating Habits and Wellbeing Study

• Postal survey
  – 2009
    • 2,500 women ages 40-50 randomly selected from NZ electoral rolls to participate in a nationwide survey of lifestyle, eating habits and wellbeing
    • 1,601 responders (66% response rate)
    • 1,435 consented to participate in longitudinal study
  – 2012
    • 1,025 women participated in 3-year follow-up survey (78% retention rate)

Design and study methods:
Leong, Madden, Gray, Horwath, *J of the Academy of Nutrition and Dietetics*, 2012
Leong, Madden, Gray, Horwath, *J of the American Dietetic Association*, 2011
## Self-reported Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Baseline</th>
<th>2-year follow-up</th>
<th>3-year follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height and weight $^1$</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Demographics</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Psychological flexibility (AAQ-II) Bond, Hayes, Baer, Carpenter, Orcutt &amp; Zettle, 2007</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intuitive eating Tylka, 2006</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Speed of eating Otsuka et al., 2006</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Binge eating</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Food intake Russell, Parnell &amp; Wilson, 1999</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Physical activity, smoking status</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Menopause status</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Thyroid condition</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

$^1$ Agreement between measured and self-reported height and weight described in Sharples, Crutchley, Garcia, Gray & Horwath, *NZ Med J* 2012
Data Collection
Survey Procedures

Dillman’s Validated Tailored Design Method

1. Questionnaire mailing
2. Thank you/reminder postcard
3. Replacement questionnaire to non-respondents
4. Final thank you/reminder postcard

Effectiveness of $5 incentive described in Boucher, Leong, Sharples, Gray & Horwath submitted Australian & NZ Journal of Public Health (April 2013)
### Sample Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Baseline (n=1,601)</th>
<th>3-year follow-up (n=1,015)</th>
<th>National data²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>45.5 (±3.2)</td>
<td>48.5 (±3.2)</td>
<td>-</td>
</tr>
<tr>
<td>BMI¹</td>
<td>25.8 (±1.2)</td>
<td>26.0 (±1.2)</td>
<td>27.1</td>
</tr>
<tr>
<td>Overweight</td>
<td>28.9%</td>
<td>29.9%</td>
<td>33.2%</td>
</tr>
<tr>
<td>Obese</td>
<td>20.9%</td>
<td>22.0%</td>
<td>30.2%</td>
</tr>
<tr>
<td>NZ European/other</td>
<td>80.5%</td>
<td>83.8%</td>
<td>73.4%</td>
</tr>
<tr>
<td>Māori</td>
<td>11.4%</td>
<td>9.8%</td>
<td>12.1%</td>
</tr>
<tr>
<td>University degree</td>
<td>32.2%</td>
<td>33.9%</td>
<td>17.7%</td>
</tr>
<tr>
<td>NZSEI 30-59</td>
<td>66.8%</td>
<td>65.3%</td>
<td>60.0%</td>
</tr>
<tr>
<td>AAQ-II³</td>
<td>27.9 (±10.27)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

¹ Geometric mean for BMI

² Population estimates for mean BMI of all adult women and rates of obesity among women aged 45-54 from New Zealand Health Survey 2006/07, ethnicity and education level from New Zealand 2006 Census, and total population New Zealand Socioeconomic Index distribution from New Zealand 1991 census

³ Higher AAQ-II scores indicate higher psychological inflexibility
Baseline Results

• Higher levels of psychological inflexibility were associated with
  – Increased odds of binge eating one or more times per week (OR 1.67/10 units, 95% CI: 1.48, 1.88, p < 0.001)
  – Increased odds of dieting (OR 1.33/10 units, 95% CI: 1.19-1.48, p < 0.001)

Regression models adjusted for age, ethnicity, socioeconomic status, thyroid condition, menopause status, physical activity, and smoking status
Baseline Results

• BMI was statistically significantly higher by 1.7% (95% CI: 0.7%-2.7%; p=0.001) for each 10-unit increase in psychological inflexibility.

• Total effect of AAQ on BMI
  – 85% mediated by binge eating
  – 8% mediated by burger consumption

Regression models adjusted for age, ethnicity, socioeconomic status, thyroid condition, menopause status, physical activity, and smoking status

Madden, Leong, Gray, Ciarrochi & Horwath, unpublished manuscript
Proposed Model

3-year food-related behaviors
- Binge eating
- Dieting
- Food intake
- Intuitive eating
- Speed of eating

Baseline psychological inflexibility
(AAQ-II, Bond et al, 2007)

3-year BMI change/stability
Psychological Inflexibility & 3-year Changes in BMI

• No association between AAQ-II scores and changes in women’s BMI (adjusted p=0.875) or BMI stability (adjusted p=0.058)

Regression models adjusted for baseline weight, ethnicity, socioeconomic status, and changes in thyroid condition, menopause status, physical activity, and smoking status
Proposed Model

3-year food-related behaviors
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Baseline psychological inflexibility (AAQ-II, Bond et al, 2007)

3-year BMI change/stability
## Baseline Psychological Inflexibility & 3-year Food-related Behavior

<table>
<thead>
<tr>
<th>Food-related Behaviors</th>
<th>n</th>
<th>Effect of 10-unit increase in AAQ-II score(^1) (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binge eating</td>
<td>843</td>
<td>OR 1.63 (1.34, 1.97)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Trying to lose weight (^2)</td>
<td>845</td>
<td>OR 1.32 (1.12, 1.55)</td>
<td>0.001</td>
</tr>
<tr>
<td>Intuitive eating</td>
<td>845</td>
<td>3.0 unit decrease (-3.70, -2.37)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Speed of eating</td>
<td>845</td>
<td>0.25 unit decrease (-0.51, 0.02)</td>
<td>0.066</td>
</tr>
</tbody>
</table>

\(^1\) Adjusted for baseline BMI, ethnicity, NZSEI score, and changes in thyroid condition status, menopause status, physical activity and smoking

\(^2\) Additional adjustment for quadratic term for baseline BMI
### Baseline Inflexibility & 3-year Food-related Behavior

<table>
<thead>
<tr>
<th>3-year Food-related Behavior</th>
<th>n</th>
<th>Effect of 10-unit increase in AAQ-II score (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food intake increased with higher inflexibility</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biscuits (chocolate or cream filled)</td>
<td>843</td>
<td>0.11 (0.01, 0.21)</td>
<td>0.032</td>
</tr>
<tr>
<td>Low-calorie soft drinks</td>
<td>843</td>
<td>0.20 (0.08, 0.32)</td>
<td>0.001</td>
</tr>
<tr>
<td>Meat pies or sausage rolls</td>
<td>844</td>
<td>0.33 (0.06, 0.61)</td>
<td>0.019</td>
</tr>
<tr>
<td>Fish (deep fried, battered, crumbed)</td>
<td>843</td>
<td>0.52 (0.23, 0.81)</td>
<td>0.001</td>
</tr>
<tr>
<td><strong>Food intake decreased with higher inflexibility</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruit</td>
<td>845</td>
<td>-0.08 (-0.15, -0.003)</td>
<td>0.041</td>
</tr>
<tr>
<td>Vegetable</td>
<td>844</td>
<td>-0.08 (-0.16, -0.01)</td>
<td>0.018</td>
</tr>
<tr>
<td>Fish (baked, grilled, tinned)</td>
<td>843</td>
<td>-0.09 (-0.17, -0.10)</td>
<td>0.029</td>
</tr>
<tr>
<td>Processed meat (salami, ham, bacon)</td>
<td>844</td>
<td>-0.13 (-0.23, -0.04)</td>
<td>0.004</td>
</tr>
<tr>
<td><strong>Alcohol intake</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6+ drinks on one occasion in past year</td>
<td>845</td>
<td>OR 1.18 (1.01, 1.37)</td>
<td>0.038</td>
</tr>
</tbody>
</table>

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1 Adjusted for baseline BMI, ethnicity, NZSEI score, and changes in thyroid condition status, menopause status, physical activity and smoking

2 Additional adjustment for quadratic term for AAQ-II score
Conclusions

• Tendency for an association between inflexibility and BMI stability
• Associations with food-related behaviors at 3-year follow-up
• Psychological inflexibility may influence predisposition to a higher BMI, but not stability/changes to BMI later in life
• Psychological flexibility associated with eating in accordance with hunger and satiety signals
Strengths
• Longitudinal data
• Good response and retention rates
• Representative
  – Māori
  – Socioeconomic status

Limitations
• Self-report data
• Less representative
  – Education
  – Non-Māori / non-NZ Euro
  – BMI > 30
Future Research

• Weight gain prevention intervention with ACT components
  – Increase awareness and acceptance of food-related thoughts/feelings and bodily sensations
  – Increase food-related behaviors that support one’s value of overall health and wellbeing
Acknowledgements

• Project funding: University of Otago, Department of Human Nutrition PBRF
• Travel funding: ANZACBS National Conference Scholarship
• Other team members: Heidi Sharples and Lindsay Bemelmans
• All survey participants
You're almost there! 😊
You may like to enjoy a cuppa while you do the rest.

and a TIMEMARK!