Diet, Obesity and Asthma

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OUTLINE:

• What is asthma?
• Obesity and asthma
• Diet Quality and Asthma
• Myth busters
• Take home messages
Asthma is... a chronic inflammatory disorder of the airways in which many cells and cellular elements play a role.

Inflammation occurs in asthma because... asthmatics exhibit an exaggerated immune response to stimuli (e.g. allergens and viruses).

Chronically inflamed airways become hyperresponsive, obstructed and have limited airflow, leading to recurrent episodes of wheezing, breathlessness, chest tightness and coughing.
What is Asthma?

Air enters respiratory tract via mouth and nose and enters bronchial tubes.

Smooth muscle thickens, contracts and becomes hyperresponsive.

Damage to airway epithelium.

Excess mucus.

ASTHMA: Inflamed bronchial tube.

NORMAL bronchial tube.
Global Burden of Asthma

Prevalence:
- 300 million people worldwide
- Increased over time
- Higher in westernised countries (including New Zealand)

Causes:

Host Factors:
- Genetic
- Sex

Environmental:
- Allergens: eg dust mite, pollens
- Infections (early childhood)
- Occupational exposure
- Smoking (active/ passive)

- Diet (nutrient intake/ obesity)
Our diets are out of balance

NZ Health Survey 2013-14

Weight Status
- 75% adults overweight or obese
- 33% children overweight or obese

Diet Quality
- 35% don’t eat 3 serves of vegetables/day
- 40% don’t eat 2 serves of fruit/day
- 29% choose white bread
- 31% regularly add salt to food
- 76% eat processed meat ≥ once per week
- 35% consume fast food ≥ once per week
- 43% drink soft drink ≥ once per week
Obesity rates high and increasing (New Zealand 30%*)

Obesity/overweight increases asthma risk by 40-90%

Obesity complicates asthma management:

↓ lung function/volumes

↑ medications (ICS and bronchodilators)

↑ symptoms

↑ exacerbations

↓ QOL

*NZ Health Survey

(Beuther, 2007)
Mechanisms complex:

- Anatomical, inflammation ??
- Neutrophilic airway inflammation increased in obese asthma (Scott, Garg, Gibson, Wood. *Eur Respir J*, 2011)
- Explains the lack of response to corticosteroids???
### Weight Loss TREATMENT OPTIONS

<table>
<thead>
<tr>
<th>Treatment</th>
<th>BMI Category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25-26.9</td>
</tr>
<tr>
<td>Diet, Physical activity, Behaviour therapy</td>
<td>+</td>
</tr>
<tr>
<td>Pharmacotherapy</td>
<td>+</td>
</tr>
<tr>
<td>Surgery</td>
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(From NHMRC Clinical Practice Guidelines for Management of Overweight and Obesity)

‘..all studies published to date show that weight loss in obese asthmatics improves asthma control.’
Weight Loss IN ASTHMA

- **Bariatric Surgery**
  All studies (many poor quality) show improvements in asthma:
  - **Follow-up:** 1-7 yrs
  - **Weight loss:** 5 - 20 kg/m²
  - **Outcomes improved:** lung function, AQoL, symptoms, airway hyperresponsiveness, medication use; remission

- **Pharmacotherapy**
  One study, Dias-Junior (2014):
  - Diet restriction *plus*
    Sibutramine (Serotonin-reuptake inhibitor) *and*
    Orlistat (pancreatic enzyme inhibitor)
  - RCT, 6 months, n=33 severe asthmatics
  - 7.5% weight loss, ACQ, FVC, symptoms, use of rescue meds improved
## Weight Loss IN ASTHMA

### Lifestyle interventions

<table>
<thead>
<tr>
<th>Trial</th>
<th>N</th>
<th>Design</th>
<th>Weight loss</th>
<th>Outcomes improved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hakala, 2000</td>
<td>14</td>
<td>Uncontrolled, Diet</td>
<td>8 wk</td>
<td>13.7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PEF, FEV1, FVC</td>
</tr>
<tr>
<td>Aaron, 2004</td>
<td>58</td>
<td>Uncontrolled Diet and exercise</td>
<td>12 wk</td>
<td>17.4%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>FEV1, FVC, TLC</td>
</tr>
<tr>
<td>Johnson, 2007</td>
<td>10</td>
<td>Uncontrolled Diet (alt days)</td>
<td>8 wk</td>
<td>8%:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Symptoms, QoL, PEF</td>
</tr>
<tr>
<td>Stenius-Aarniala, 2000</td>
<td>38</td>
<td>Randomised Controlled, Diet</td>
<td>8 wk</td>
<td>I: 14.5%, C: 0.3%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>FEV1, FVC, dypsnea, exacerbations</td>
</tr>
<tr>
<td>Scott, 2012</td>
<td>45</td>
<td>Randomised Diet or ii. Ex or iii. Diet and Ex</td>
<td>10 wk</td>
<td>i. 8.5%, ii. 1.8%, iii. 8.3%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ERV, TLC, ACQ, AQoL</td>
</tr>
</tbody>
</table>
**Study: Weight loss via lifestyle intervention**

**Aim:** To compare the effect of 10 weeks calorie restriction and/or exercise on clinical outcomes in overweight and obese asthmatics.

**Inclusion Criteria:** Dr’s diagnosis of asthma, AHR, 18+ years, BMI 28-40kg/m², non-smoker, able to participate in exercise programme

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**45 Participants Randomised**

- **Diet (n=17)**
  - Total of ~4500 kJ / day
  - Meal replacements: 2/day
  - Main meal of choice (1/day) + snacks
  - Weekly dietetics counselling

- **Exercise (n=14)**
  - 1-week gym membership
  - Personal trainer: 1 hr / wk
  - Additional 2 sessions/ wk in own time
  - Daily steps increased by 10% /week to 10,000 steps

- **Combined (n=14)**
  - Diet + exercise

*(Scott et al. Clin Exp Allergy, 2012)*
Weight loss data....

<table>
<thead>
<tr>
<th>% Weight Loss</th>
<th>Diet</th>
<th>Exercise</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Dietary restriction needed to achieve significant weight loss
- Exercise and combined groups maintained muscle mass

*(Scott et al. Clin Exp Allergy, 2012)*
# Predictors of weight loss success

(Scott et al, Respirology, 2015)

<table>
<thead>
<tr>
<th>%Weight Change</th>
<th>Unadjusted Model</th>
<th>Final Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R² = 0.517</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td><strong>Variable (baseline)</strong></td>
<td><strong>β-Coefficient (95% CI)</strong></td>
<td><strong>p-value</strong></td>
</tr>
<tr>
<td>AQLQ Score</td>
<td>1.7 (0.2, 3.2)</td>
<td>0.027</td>
</tr>
<tr>
<td>FEV₁/FVC</td>
<td>0.1 (-0.01, 0.26)</td>
<td>0.064</td>
</tr>
<tr>
<td>ACQ Score</td>
<td>-1.4 (-3.4, 0.6)</td>
<td>0.158</td>
</tr>
<tr>
<td>Sex</td>
<td>-3.0 (-5.6, -0.4)</td>
<td>0.024</td>
</tr>
<tr>
<td>Age (years)</td>
<td>-0.01 (-0.1, 0.1)</td>
<td>0.819</td>
</tr>
<tr>
<td><strong>Intervention:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E vs D</td>
<td>-6.8 (-9.9, -3.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>E vs D+E</td>
<td>-6.8 (-9.7, -3.9)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Weight loss improves ERV, asthma QoL and ACQ

- Small improvements in weight lead to increased QoL and Asthma Control in majority of participants

*(Scott et al. Clin Exp Allergy, 2012)*
5-10% weight loss should be advocated

Realistic goal leading to clinically improved:

- QoL in 85% of patients
- ACQ in 58% of patients
Diet Quality (**AND** quantity) important

Features of the Obesogenic Diet:

- MACRONUTRIENT SURPLUS
- FAST or ‘PROCESSED’ FOODS
- LOW IN FRUIT AND VEGETABLES
- LOW IN WHOLE GRAINS

Diet Quality

DIETARY FAT

ANTIOXIDANTS

FIBRE
Saturated fat and inflammation

Saturated fatty acids: (Hotamisligil, 2008)
- Directly induce Toll-like receptors (TLRs) and lipid sensors
- Transmit stress signals following binding to FABPs
  - Activate/ inhibit nuclear receptors that modulate inflammation
  - Activate the unfolded protein response
Dietary Antioxidants and Inflammation

In asthma...inflammatory cells are chronically activated
Low fibre diet and Inflammation

Dietary fibre (soluble fibre):
- Fermented by bacteria in the gut to produce short chain fatty acids (SCFA)
- SCFA activate free fatty acid receptors (GPR43/41)
- Anti-inflammatory mediators produced

Low fibre diet leads to worsening of airway inflammation in animals (Maslowski, Nature, 2009)

(Modified from Li et al, Nature, 2010)
Stable asthmatics (n=51)
- Fasted, medications withheld
- High or low fat meal then bronchodilator
- Bronchodilator response reduced at 4hr
- Inflammation increased at 4hr

Study: FAST FOOD DIETS

HIGH FAT MEAL
2 Hash browns
Sausage & Egg Muffin
Sausage Muffin

LOW FAT MEAL
Yoghurt

%Neutrophils
%Eosinophils
TLR4 exp

(Wood et al, J Allergy Clin Immunol, 2011)
Study: LOW FRUIT & VEGETABLE INTAKE

N=136 asthmatics

RCT: High F&V diet (≥ 5 serves vegetables, ≥ 2 serves fruit) vs Low F&V diet (≤ 2 serves vegetables, ≤ 1 serve fruit)

Low F&V diet:

- Kaplan Meier survival curve: time to exacerbation

Cox proportional hazards model: Low F&V: 2.3 times more likely to exacerbate

(Wood et al, Am J Clin Nutr, 2012)
High quality diets should be advocated for asthma:

- Avoid fast foods
- Increase F&V intake

Refer Eating and Activity Guidelines
NZ Ministry of Health
Mythbusters
Supplements & Dietary Restriction

• No definitive evidence to support use of vitamin, mineral or herbal supplementation to improve asthma

• *Some* evidence of benefit exists for:
  ❖ Fish oil and low salt diets (exercise induced asthma only)
  ❖ Chinese/ Indian Herbal medicines
  ❖ Caffeine

• No evidence to support elimination of foods (eg dairy) to improve asthma *except in case of food allergy* *
  *confirm with immunologist

*NB: Dairy foods don’t lead to asthma symptoms, mucus production or weight gain*
~50% of asthmatics modify their diet in an attempt to control their asthma.

Food triggers may include: food additives, eggs, nuts, legumes, fish & shellfish, wine, soy, wheat, salt (incl MSG), chocolate.

These are specific to individuals and avoidance should not be generally adopted by asthmatics.

True prevalence of food-induced asthma <1% in adults (Woods, 96)

Response to Question ‘Have any of these foods made you cough, wheeze of feel short of breath?’

(adapted from Thien, 1996)
Take home messages:

• Weight loss by any method: bariatric surgery, pharmacotherapy and lifestyle interventions (dieting & exercise) is effective in asthma

• 5-10% weight loss should be advocated as a realistic goal leading to clinically significant improvements in:
  ✓ QoL in 85% of patients
  ✓ ACQ in 58% of patients

• Improving diet quality as well as quantity improves asthma outcomes. Recommend:
  ✓ Reduced intake of fast foods
  ✓ High fruit and vegetable diet

• Dietary supplementation or restriction diets not supported by strong evidence in general asthma population