Practical measures to enhance satiety and weight control

James Stubbs
Issues

Bridging the energy gap(s).

Diet and weight control solutions.

Exercise and weight control solutions.

The law of diminishing returns.

Integrated solutions: The need to develop personalised route-finders to a healthy body weight.
The first challenge to those trying to manage their weight: prevention of weight gain.

Energy gap 1: energy deficit required to prevent weight gain.
The second challenge to those trying to manage their weight: weight loss.

- **Energy gap 1**: energy deficit required to prevent weight gain
- **Energy gap 2**: energy deficit required to lose ~1-2lb (0.5-1.0 kg) per week.
The third challenge to those trying to manage their weight: long term maintenance of weight loss.

Energy gap 1: energy deficit required to prevent weight gain.
Energy gap 2: energy deficit required to lose ~1-2lb (0.5-1.0 kg) per week.
Energy gap 3: energy required to maintain this weight loss-value less clear.
Satiety is important for weight control. The main reasons for breaking a previous diet.

- Being hungry
- I stopped dieting once I'd lost weight
- Restricted foods
- Lack of support
- Having to eat different meals to my family
- Lack of convenience
- Slimming didn't fit in with my home life
- Slimming didn't fit in with my working life
- The diet wasn't working

n = 157 Slimming World Target Members
Our 3 main practical challenges

**Prevention of weight gain:** relatively easy- not something we often conduct trials on. If we can do this for the whole population in our lifetimes we will have done a good job (J.O. Hill, pers comm.).

**Weight loss:** not so difficult in the short term, much harder in the long term.

**Maintenance of weight loss:** the continuing challenge for the future. People fail to maintain weight loss because they either compensate or lose compliance with their weight-control behaviours.
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How does diet composition influence satiety?

Preloading studies where energy density is not controlled.

These satiety relationships have been used to develop the Slimming World dietary system.

Reproduced from Westrate et al. (1992).
How does diet influence energy intake in real life?

Effect of diet composition on energy intake in 76 adults

%ED
%Fat
%CHO
%Protein
%Water

Energy Intake (MJ/d)

% energy Intake, % total water/d, ED (MJ/kg)

n=76

[Stubbs et al. Critical reviews in Food Science and Nutrition (2000); 40: 481-515]
Energy density of foods in the Slimming World system. We encourage people to eat more of the least energy dense foods.
<table>
<thead>
<tr>
<th>Consensus?</th>
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</table>

**BNF ‘Feed Yourself Fuller’ Chart**

<table>
<thead>
<tr>
<th>Energy Density kcal/g</th>
<th>Very Low</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Cucumber 0.10</td>
<td>Mixed salad 0.19</td>
<td>Chicken noodle soup 0.19</td>
<td>Broccoli 0.33</td>
</tr>
<tr>
<td>0.6</td>
<td>Carrots 0.35</td>
<td>Orange 0.37</td>
<td>Pear 0.40</td>
<td>Apple 0.47</td>
</tr>
<tr>
<td>1.5</td>
<td>Broccoli &amp; asparagus 0.50</td>
<td>Vegetable soup 0.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>Vegetable stew w/ noodles 0.83</td>
<td>Mixed berries w/ low fat yogurt, crunchy oat cereal &amp; honey</td>
<td>Spaghetti Bolognese w/ lean mince, vegetables &amp; wholewheat spaghetti</td>
<td>Low fat yogurt 0.70</td>
</tr>
<tr>
<td>9.0</td>
<td>Strawberries &amp; cream 1.6</td>
<td>Chocolate mousse 1.8</td>
<td>Spaghetti Bolognese w/ lean mince &amp; cheese</td>
<td>Lasagne 1.9</td>
</tr>
<tr>
<td></td>
<td>Cheese 4.2</td>
<td>Chocolate biscuit 4.9</td>
<td>Chocolate 5.2</td>
<td>Crisps 5.3</td>
</tr>
<tr>
<td></td>
<td>Roasted peanuts 6.0</td>
<td>Mayonnaise 6.9</td>
<td>Butter/margarine 7.4</td>
<td>Vegetable oil 8.9</td>
</tr>
</tbody>
</table>

**Vegetables**
- Broccoli
- Carrots
- Orange
- Pear
- Apple

**Fruits**
- Cucumber
- Mixed salad
- Chicken noodle soup
- Broccoli & asparagus
- Vegetable soup

**Prepared Foods**
- Vegetable stew w/ noodles
- Mixed berries w/ low fat yogurt, crunchy oat cereal & honey
- Spaghetti Bolognese w/ lean mince, vegetables & wholewheat spaghetti
- Low fat yogurt
- Strawberries & cream
- Chocolate mousse
- Spaghetti Bolognese w/ lean mince & cheese
- Lasagne
- Cheese
- Chocolate biscuit
- Chocolate
- Crisps
- Roasted peanuts
- Mayonnaise
- Butter/margarine
- Vegetable oil
And paradoxically, by choosing the right foods you can eat more and lose more weight.

Decreasing dietary fat is associated with only a small decrease in body weight.


Does it follow that high protein & low GI diets will be more effective?

Because the low fat food revolution was of limited success, various attempts have been made to re-enforce the fat reduction message, by adding additional dietary recommendations.

The most notable of these have been the high protein (sometimes low carbohydrate) and the low glycemic index approach.
Effect of an ad libitum high protein, low fat* diet on body weight- this is as good as it gets

*30% of total energy from fat.

Relationship between dietary macronutrient composition and body weight. GI in itself has little effect.

Saris WHM et al., Int J Obes 24:1310, 2000
We are now in a position to focus on several practical aspects of diet composition simultaneously, to enhance satiety.

Low carbohydrate and low GI diets are a case in point-changing GI changes some/many of these attributes.
It is important to exploit practical attributes of a food that will limit energy intake and weight gain.

- Water content: High
- Fat content: Low
- Energy density: Low
- Carbohydrate content: Depends on type
- Physical structure: Solid is more satiating
- Fibre content: High—especially cell walls in fruit and vegetables
- Orosensory Properties: Need to maintain
- Protein content: Relatively high

But **practically**, weight control is not all due to diet by a long way…….
Practically, diet needs to be considered in the context of other behaviours. Between-subject variation in energy balance on a day-to-day basis.

N=102

Dietary

Residual (unexplained)

Phenotypic

Sex

BMI

Restraint

RMR

Total Energy Expenditure

% water

Energy density

% fat

% CHO

% protein
Bridging the energy gap(s).

Diet and weight control solutions.

Exercise and weight control solutions.

The law of diminishing returns.

Integrated solutions: The need to develop personalised route-finders to a healthy body weight.
Physical activity alone also results in modest weight loss.

Weight loss (kg)

Control Group  
Exercise Group

*P<0.05 vs control group

Duration of each study ranged from 4 to 12 months.

..And a lot of exercise is required to keep the weight off

Schoeller et al conducted a prospective study in 32 women who had lost an average of 23 kg. Then followed for 12 mo.

<table>
<thead>
<tr>
<th>EE (x RMR)</th>
<th>Wt regain in 12 mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.89</td>
<td>2.5</td>
</tr>
<tr>
<td>1.64</td>
<td>9.9</td>
</tr>
<tr>
<td>1.44</td>
<td>7.0</td>
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</table>

Estimated threshold for weight maintenance was 47 kJ/kg/d or 3.75 MJ/d for an 80 kg adult. (885 kcal/d).

This is not practical for an overweight/obese person just starting to lose weight.
The ability of very overweight people to begin exercising is limited: lower VO₂ max.

We regularly meet people with a VO₂ max of 20-30 ml per kg/min.

Broeder et al. (1992) AJCN, 55; 795-801
Why can’t people just become and stay more active?

- For some obese walking costs 50% of Vo2 max.
- Physical exertion can be quite aversive to the unfit - relapse rates are extremely high at 70-80%.
- People often overestimate their energy expended in activity (King et al 1997), and overcompensate energy intake.
- The average consumer does not know how much energy they expend - they can’t measure it – what they “measure” is exertion!
- Society does not encourage increased activity in our everyday lives.
- Exercise is largely a segregated activity and should be “socialised”.
Practically, people need to take small incremental steps to become and stay more active.

- Getting people habituated to physical activity is key.
- Numerous studies suggest it is important for weight loss maintenance.
- Commitment to change (or exercise) and steps to behaviour change are practical models to get people into the habit of being active.
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Integrated solutions: The need to develop personalised route-finders to a healthy body weight.
Cross-talk between intake & expenditure: we compensate better for energy deficits rather than surfeits.

Longer-term practical solutions need to take this into account.
Energy intake and energy expenditure tend to compensate for substantive negative energy balances. Weight loss therapies based on diet, exercise or drugs alone are subject to the laws of diminishing returns.

The more rapid or extreme the energy deficit, the greater the rate of compensation.

Compensation (degree and type), varies between individuals.

Behavioural mechanisms of compensation are quantitatively more important than metabolic changes.

The other reason people fail to maintain weight loss is they lose compliance with their weight control behaviours.
Issues

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Integrated solutions: The need to develop personalised route-finders to a healthy body weight that out-race the cross talk between intake and expenditure.
Diminishing returns: no weight loss trajectory in healthy people ever follows a straight line.

*30% of total energy from fat.

Integrating activity with dietary approaches to weight management.

- As time progresses absolute weight loss diminishes - be it due to diet or exercise.
- Most people begin to diet first and exercise second.
- We need to incrementally build exercise and additional weight control behaviours into dietary regimes, to assist in the prevention of weight gain and re-gain.
- As people become more mobile they become more active, as they become more active they become habituated to physical activity more -then they start to exercise.
The more weight control behaviours you employ, the greater the weight loss.

*P<0.05 vs medication alone.

Science has told us how we have got into this mess and made a number of generic recommendations for how to get out of it.

We all know what to do but there is a need to turn recommendations into reality, policy into individual long-term lifestyle change.

We need to implement a range of credible applied solutions that enable people to navigate to and stay at a healthy body weight. New maintenance strategies are needed.

Integrating activity with dietary approaches to weight management.
What about all of this unexplained variance in energy intake?

Currently not mechanistic or medical—Its mainly social and behavioural!
Conclusions

Bridging the energy gap(s). Need both diet and exercise.

**Diet and weight control solutions.** Diet helps get us through energy gaps 1 and 2 but becomes subject to the laws of diminishing returns. Diet seems to work best initially.

**Exercise and weight control solutions:** It seems we need to add in exercise and other weight control solutions to overcome the effects of cross-talk between intake and expenditure when energy balance is negative. More strings to your bow…
Conclusions

Also need an infrastructure of psychological and group support.

Socialising not medicalising weight control solutions.

**Integrated solutions:** The need to develop personalised behavioral route-finders to a healthy body weight.

Rather that match people to treatments - need to provide a portfolio of approaches to enable people to choose the solutions that best suit their individual lifestyle needs….

..and continually support them in achieving sustained lifestyle change.