Influence of nutritional and non-nutritional dietary components on appetite, motivation to eat and body weight

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The research leading to these results has received funding from the European Community’s Seventh Framework Programme and Scottish Government
It is now accepted that there are many nutritional and non-nutritional factors that will influence appetite, motivation to eat and body weight.

NON-NUTRITIONAL INFLUENCES ON APPETITE, MOTIVATION TO EAT AND BODY WEIGHT
- Palatability
- Sensory variety
- Snacking and frequency of eating
- Portion size
- Stress
- Food addiction

NUTRITIONAL INFLUENCES ON APPETITE, MOTIVATION TO EAT AND BODY WEIGHT
- Diet composition
- Energy density
- Dietary fibre

Diet and lifestyle change to address chronic ill health and promote healthy ageing

Dietary choices are a key component of 'health' behaviour - what people choose to eat ultimately determines the relationship between diet and health.

Promoting healthier dietary choices and exploiting habitual choice?

- Reformulation

Bringing together academics, policy makers and the food and drink industry

Multidisciplinary approaches – molecular/mechanistic, sensory, psychological, economic

Behaviour change – a non-invasive approach to managing the epidemic of non-communicable disease

Shoppers prioritise health ahead of ethics and the environment

Importance of differing factors in product choice

1. Price 91%
2. Promotions 68%
3. Quality or performance 63%
4. Taste or smell 53%
5. Healthy option 49%
6. Use by or sell by date 47%
7. Familiarity 46%
8. Brand 35%
9. Ease of use 20%
10. Ethical or eco-friendly 19%

Q. Rank your five most important considerations when shopping. Please think about the individual food and grocery products that you buy.

IGD ShopperVista July 2013, Base: all main grocery shoppers
Palatability

- The palatability of a food can be thought of as its sensory capacity to stimulate ingestion of that food.

- Palatability of the food is jointly determined by the nature of the food (odour, taste, texture and state), the sensory capabilities and metabolic state of the subject, and the environment in which the food and subject interacts.

- Palatability is not stable; indeed, the palatability of a food typically declines as its own ingestion proceeds, ‘sensory-specific satiety’.

- Commercially available foods are largely designed to maximize both the sensory and dietary parameters, which make foods appealing to enhance consumer demand and repeat sales.

- More food is often consumed in the presence of other people, a phenomenon known as ‘social facilitation of energy intake’, a feature of social eating.

- ‘Buffet effect’ – more variety offered = we eat more.

Sensory Variety

- Increasing the variety of sensorially distinct but nutritionally similar foods increased food intake.
- Energy intake and resulting weight gain because subjects actively increased the amount of food they ingested in response to the variety offered in lean men.
- Restrained eating in obese men.

- Combinations of sensory attributes associated with mixtures of fat and sugar can have a large effect on EI at a specific feeding episode.
- This suggests that increases in EI will be promoted by the combination of sensory attributes of foods.

Knowledge about the importance of palatability and food intake in the long-term and how to alter food processing to maximize palatability of food during weight loss is likely to be a future research area.

Snacking

There are two alternative hypotheses about how snacking may influence EI and body weight:

(i) snacking helps ‘fine tune’ meal-time EIs to match intake with requirements,
(ii) habitual consumption of calorific drinks and snacks between meals is a major factor driving energy intake up and predisposing people to weight gain

No universal definition of a ‘snack’, either by time of day (e.g. inter-meal interval) or size (‘small meal’) or nutrient profile (food group) or structure (e.g. solid/liquid)

- Obese people ingest more energy than non-obese people, therefore it might be reasonable to assume that meal size is a key factor in overconsumption in obesity
- The evidence in relation to meal patterns, appetite, EI and body weight is indirect and fragmentary
- Cross-sectional studies tend to support no or a negative relationship between meal frequency and body mass index (BMI)
- Snacker’s report consuming more energy than do non-snackers, but these people may be more physically active and use snacking to modify energy intake
Frequency of eating

- Habitually skipping breakfast is associated with a higher BMI in observational studies in adults and consuming breakfast is associated with achieving and maintaining weight loss (but depends on usual eating pattern)

- Targeting the importance of a single eating episode for intervention has proved largely unsuccessful for weight control

- Controlled lab studies used small-portion feeding regimes (‘nibbling’) versus isocaloric, larger portion feeding regimes (‘gorging’), to assess eating frequency and regularity on energy and nutrient metabolism, reporting no metabolic advantage of either regime

There is no strong relationship between eating frequency and obesity

Future research focus

On timing of eating (chrono-nutrition) - there is evolving interest in ‘meal size’ at breakfast for assisting weight loss Vs evening meals, but mechanisms not clearly understood

“breakfast like a king and dine like a pauper”
Portion size: supersize me!

- Since the 1970’s, the portion size of commercially available foods and beverages has increased, a trend observed in a variety of settings including restaurants, supermarkets, but also in the home environment.

- Lab studies examining a single-meal eating episodes have suggested increased portion size promotes increased EI.

- There is a clear relationship between amount served and amount consumed, even when participants serve themselves.

- The ‘bottomless soup bowl experiment’, where subjects received tomato soup with a hidden self-filling tube consumed 73% more soup (113 kcal), compared to when refilled by a server.
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- Studies in a more natural environment, cafeteria-style restaurant or workplace, have also indicted that increasing the size of a meal portion by 50% increases intake and no apparent compensatory reduction in intake, even when studied for a month.

- Self-reports of food intake also suggest poor regulation with increased portion size.

- One study reports men and women eating 19.4MJ extra (a 16% increase in EI) over an 11d period when provided with larger portions, which would equate to a 0.5kg weight gain.

- This feature of modern eating behaviour has, in particular, been the focus of media attention with ‘supersize’ portions being blamed for the rise in obesity in children and adults.
Portions for weight loss

• The ready availability and low cost of large portions of energy dense foods can contribute to a positive energy balance over a prolonged period.

• However, the data do not prove that portion size plays a role in aetiology of obesity, and there is little evidence that decreasing portion size is acceptable or effective for weight control.

• Smaller-portion controlled foods or marketing of foods for ‘dieting’ is not straightforward, since consumers equate large portions with good value and small portions with feeling deprived.

• Consumers very good at estimating satiety (expected satiety) and this influences portion size before eating.

• Improving consumer awareness about nutritional information at point-of-sale and incentives for the food industry to offer a variety of portions are likely to be future incentives considered by policy makers to control food provision within the ‘obeseogenic’ eating environment.
Stress

- The workforce of Britain is becoming obese with 65% of our fire-fighters are now overweight, 30% of office workers and 47% of offshore shift workers overweight
- One in five workers in Europe are employed on shift work involving night work and over one in 20 work extended hours
- Stress influences eating such that 40% people overeat and 40% under-eat and 20% do not change their eating habits, in response to stress; the type of stress is important
- People who work shifts are at greater risk of health issues, especially those who have changing shift patterns


Modern lifestyles, particularly shift work, have changed the daily rhythms of life, but is this a cost to health? What preventative measures for employers and employees can be taken? How about tackling healthy, nutritious food provision?

Workplace health initiatives are growing in number and scope, as employers come to realize that addressing employee health & wellness is linked to increased productivity and reduced absenteeism, and that the return on this strategic investment and overall health cost savings are high: a need for evidence based practices.
Food addiction

- Evidence for addiction to specific macronutrients i.e. ‘food addiction’ is lacking in humans.
- “Eating addiction” describes a behavioural addiction and is not necessarily associated with obesity.
- Where obesity is the result of marginal overconsumption of calories over an extended period, it will not benefit the individual to believe that their weight problems can be laid at the door of ‘food addiction’.
- Behavioural addiction focussed on food may be relevant to a small subgroup of individuals with aberrant eating behaviour, like in binge-eating disorder.
- The brain does not respond to nutrients in the same way as addictive drugs such as heroin or cocaine.
- People develop a psychological compulsion to eat, driven by the positive feelings that the brain associates with eating. This is a behavioural disorder and could be categorised alongside addictions conditions such as gambling disorder.

Focus on tackling the problem of obesity should be moved from food itself towards the individual's relationship with eating.
https://www.futurelearn.com/courses/nutrition-wellbeing/

• Free online course to tackle diet and lifestyle myths
• 4 week online course
• Starts in January 2016
• Register now!
**Diet composition**

The dietary macronutrients are those that provide energy and are protein, fat, carbohydrate and alcohol.

It is generally accepted that diet composition strongly affects *ad libitum* energy intake, under laboratory and free-living conditions with protein highlighted as the most satiating macronutrient.

- **Fat** produces potent oral stimulation (positive feedback) that facilitates intake.
- **Alcohol** is exceptional in that its ingestion can stimulate EI, and so induces counter-compensatory feeding behaviour.
- Both the type and amount of **carbohydrate** consumed influences many ingestive processes.
- Recent findings suggest that an elevated **protein** intake seems to play such a key role in body-weight management.

With the ever-increasing obesity problem comes the search for effective dietary strategies to:

(i) prevent weight gain,
(ii) promote weight loss,
(iii) maintain a lower body weight.

One diet does not achieve all of this for all people!
Satiety and weight control

• Increased protein intake during calorie deficit is beneficial for appetite control
• Around 30% protein, 30% fat and 40% carbohydrate from energy
• The amount of protein is more important than the type
Energy density

Energy density (ED) is the amount of energy in a particular weight of food (kJ/g). A diet that is low in ED will induce an energy deficit, determined by the rate (volume over time) at which low ED foods can be digested and absorbed.

- Dietary ED tends to act as a **constraint** on feeding behaviour, influencing satiety or the feeling of fullness after eating.
- It is influenced by:
  - the moisture content of food (adding weight with no calories e.g. ‘lite’ mousse),
  - fibre content (adding volume with limited calories),
  - macronutrient composition, mainly from fat content, because of its high energy content per g.
- One classic experiment on how ED affects satiety and food intake, is the provision of a soup-based preload before eating, which reduces EI at the next meal.
- Interestingly, provision of a glass of water does not have the same effect on satiety as incorporating it into food to lower ED, also suggesting a role for viscosity on gut responsiveness.
- Energy-containing drinks (fizzy, alcohol, milk or juice) appear to increase daily intake in free-living adults aged 18-75 years, in comparison to days when they are not consumed, suggesting these extra calories are not compensated for in subsequent eating.

Effects of dietary fibre on appetite, energy intake and body weight –

- Reduces energy density
- Diverse chemical structure and physicochemical properties (viscosity, solubility, fermentability) – polymers and linkages – influence effect size
- More viscous fibres (pectins, β-glucans, guar gum) have greater effect on subjective appetite and acute energy intake
- Overall (in RCTs) fibre intake reduced long term energy intake by 2.6%, and body weight by 0.4% per 4 weeks (320g in 80kg)

FOOD-GUT-BRAIN AXIS

School age ————> Old age

- **FOOD**
  - High protein diary based drinks
- **GUT**
  - Nutrient release of gut satiety peptides
- **BRAIN**
  - FMRI brain mechanisms of food reward

**Measurements**
- Milk drink
- Blood samples
- MRI Scan

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Food as part of the solution for obesity?

- Fuller for longer - a range of products which address different parts of the satiety cascade, and different food ‘occasions’

- Benefits to the consumer of enhanced satiety beyond weight loss or weight maintenance – e.g. satisfaction post-meal, managing eating behaviour across the day (coping with hunger), self-control and self-efficacy, success in compliance with weight management

- Energy density, food matrix, fibre, protein, plant products

- Better controlled/standardized trials; mechanism of action

- Reassessment of current EFSA guidelines to provide some likelihood of a health claim around satiety being granted

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Working with the stakeholders – product ranges based on the scientific evidence base

**INDUSTRY** - Rowett work forms basis of ‘Fuller Longer’ range at M&S launched in Jan 2010

**NGO** - Rowett work with WWF to examine sustainable diets


**KNOWLEDGE EXCHANGE** - Opportunities with different audiences
The word ‘diet’ comes from the ancient Greek word ‘diatia’ – meaning a lifelong regimen for health

BBC iWonder – How we fought fat throughout history

Influence of nutritional and non-nutritional dietary components on appetite, motivation to eat and body weight

- One diet does not fit all - We do not understand the variability in psychological and behavioural parameters of hunger/satiety and food preference during energy deficit (exercise or diet induced) across the life course, and how these manipulations relate to gut hormones, neural activation and energy metabolism

- Appetite control - Understanding the role of eating patterns and diet composition on calorie intake and body weight is clearly important for the development of dietary strategies that encourage body weight control

- Eat when not hungry - People do not always eat in response to a physiological hunger cue and modulating behaviour needs to account for common psychological influences (e.g. stress)

- Non-nutritional factors - It is accepted that these factors can contribute to passive overconsumption of calories, at least in the short term, and that these attributes have a major contribution to the reward value of food
Acknowledgments

‘Healthy safe diets’ & Health impacts of sustainable ingredient selection in the food and drink industry
http://www.abdn.ac.uk/rowett/research/strategic-partnership.php

Full4Health http://www.full4health.eu

NeuroFAST http://www.neurofast.eu

SATIN http://www.satin-satiety.eu

www.abdn.ac.uk/rowett

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Thank you, Questions?

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