

Introduction

This issue of *Vital* reports on key insights from the symposium, 'Getting the Balance Right: Novel approaches for addressing dietary imbalances' held on the 12th June 2014.

In summarising, symposium chairperson and DAA Chief Executive Officer, Clare Hewat, concluded that when it comes to chronic disease prevention, maintaining a healthy weight is critical but questions still remain about the most effective dietary approach.

For now, what is apparent is that the approach will most likely differ according to differences in nutritional requirements and ecological circumstances. In addition, the impact of interactions between foods which make up the total diet as well as lifestyle factors, such as physical activity and sleep, should also be considered.

Symposium speakers:

David Raubenheimer, University of Sydney – Evolution, not revolution: Lessons from nutritional ecology

Anne-Louise Heath, University of Otago – Over-fed and under-nourished

Robin Daly, Deakin University – Nutrition, inflammation and ageing

Zumin Shi, University of Adelaide – How can high vegetable intake be related to obesity?

Tania Markovic, University of Sydney – Are there more efficient diet and exercise strategies for preventing diabetes?

Conference report available

Presentation slides, the webinar recording and short video interviews with each of the keynote speakers are available on DINER and at www.mla.com.au/nutrition-symposium

A healthy weight starts with protein

Protein leverages energy

The protein leverage hypothesis suggests that a decrease in the proportion of energy from protein will increase the amount of carbohydrate and fat eaten and importantly, that this will increase energy intake. Professor Raubenheimer and colleague Professor Simpson developed the protein leverage hypothesis using nutritional geometry, a modelling approach which explores the interactive effect of nutrient appetite on macronutrient intake and subsequent energy intake in response to foods available for consumption.

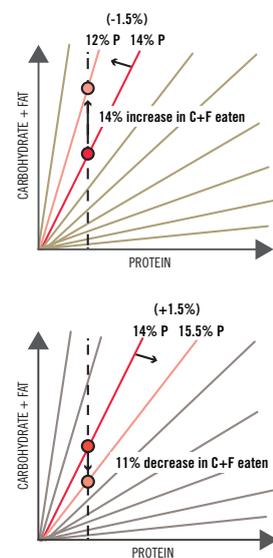
Unlike most studies in nutrition which focus on single macronutrients, this integrated approach is distinctive in that it considers the macronutrient mix and explores how feeding patterns in different species, including humans, respond to dietary imbalances caused by changes in their ecological environment.

Their findings show that like orangutans, the human 'physiological' appetite prioritises protein over non-protein energy. This means that ecological changes which dilute the protein energy of the diet will drive increased food and energy intake until the biologically determined 'protein target' is met. Conversely, those that increase the concentration of dietary protein energy will reduce energy intake.

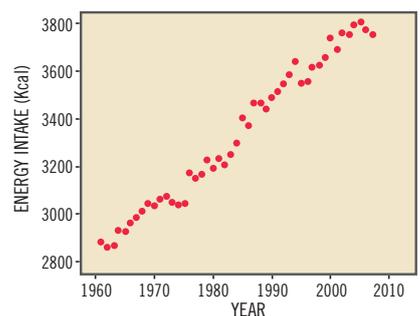
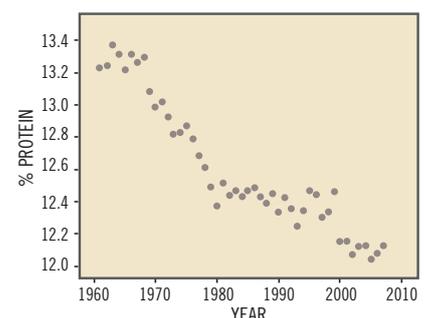
This prediction is reflected in evolutionary changes in the human diet which started out as a relatively high protein diet of around 25 to 30% energy from protein, largely from lean meat and low GI vegetables. With the rise of agriculture and industrialisation, the availability of foods rich in energy from carbohydrates and fats has increased, reducing the proportion of protein energy in the diet.

With increasing mass production and global distribution of inexpensive fats and carbohydrates, the trend towards a protein-dilute diet has become part of a "nutrition transition", a global increase in obesity and metabolic disease. The impact of this is evident in the US diet where protein energy has progressively decreased and energy intake and obesity have increased.

The "protein leverage hypothesis"



Obesity and % protein (USA)



Dietary % protein had decreased with the rise in obesity in the USA

Target iron & zinc

with obesity in infancy

Double burden of disease

As excessive weight gain between 0-2 years of age is a risk factor for obesity in later life and with 1 in 5 Australian children aged 2-3 years overweight or obese, there is much interest in effective dietary strategies for preventing weight gain in the early years.

Optimal nutrition in the first 1000 days, the period from conception to the second birthday, is not only important for obesity prevention, it is also critical for healthy growth and brain development. Approximately 25% of the brain is formed at birth and most of the remaining 75% by 2 years of age. Consequently, developmental score at 22 months is an accurate predictor of education outcome at 26 years.

Adequate intake of iron and zinc is particularly important during this period because the health consequences of iron and zinc deficiency can be severe. Adverse consequences include poorer cognition, delayed development, poor growth, and recurrent infections.

There is some evidence of inadequate intakes of both iron and zinc in Australian toddlers. Whilst evidence on the prevalence of iron and zinc deficiencies in Australian babies and toddlers is limited, there have been reports of levels of iron deficiency of as high as 30% in babies aged 6 to 24 months, often related to high cow's milk intake¹. Recent data suggests levels in toddlers 12 to 24 months of 10% for iron deficiency and 32% for zinc deficiency.²



For this reason, the NHMRC Infant Feeding Guidelines recommend introduction of iron-rich first foods, such as red meat and iron-fortified cereal, at around 6 months of age when iron stores will have become depleted.

This means that early childhood feeding strategies, such as baby-led weaning, which aim to promote maintenance and development of the internal satiety cues which regulate energy intake in early infancy should integrate dietary strategies for optimising iron and zinc intake.

Novel approach for prevention

Dr Heath, Associate Professor Taylor, and their research team at the University of Otago are currently undertaking a randomised controlled trial with 200 infants to determine whether a novel approach to complementary feeding using foods that an infant can feed themselves can prevent the development of overweight in infants and toddlers without compromising iron status or growth – the Baby Led Introduction to SolidS (BLISS) study.

In this study, red meat is a key component of the dietary recommendations as there is evidence that intakes are below recommendations. In another study by this research team, the Toddler Food Study, increased consumption of red meat, such as beef and lamb, was shown to maintain iron levels, preventing the decrease in toddlers' iron status seen in the placebo group.³

The findings from the BLISS study will provide important clues for addressing the double burden of disease during this critical life stage.

References

1. Oti-Boateng P et al. Iron status and dietary iron intake of 6-24-month-old children in Adelaide. *Journal of Paediatrics and Child Health*. 1998;34:250-253.
2. Zhou SJ et al. Nutrient intakes and status of preschool children in Adelaide, South Australia. *MJA* 2012;196(11):696-700
3. Szymlek-Gay EA, Ferguson EL, Heath AL et al. Food based strategies improve iron status in toddlers: a randomized controlled trial. *American Journal of Clinical Nutrition* 2009;90(6):1541-1551.



A healthy weight starts with protein

(continued)

Differences in susceptibility to obesity

Differences in ecological circumstances may explain why some populations are more susceptible to obesity than others. For instance, economics may explain the higher percent energy from cheaper non-protein energy in the diets of low socio-economic status groups who are at increased risk of obesity.

Climate change is another example of ecological change that could reduce the proportion of protein energy in the diet with studies suggesting an increase in atmospheric carbon dioxide could increase the carbohydrate to protein ratio of plants by 54% which would affect the nutritional composition of both plant and animal source foods.

At a biological level, those with reduced protein efficiency and consequently higher protein requirements (either as a result of exposure to a high protein diet or as a result of being obese) will be even more susceptible to protein leverage. So whilst protein drives energy intake, the amount required to maintain a healthy weight will depend on biological requirements and ecological factors.

Higher protein

for healthy ageing

Inflammation, bone and muscle health

Whilst chronic inflammation has been linked to many chronic diseases, its impact on muscle and bone health and subsequent risk of fractures, mobility and disability is particularly pertinent for healthy ageing. There is some evidence that higher levels of pro-inflammatory markers have been associated with greater bone and muscle loss and functional capacity in older people.

Professor Daly's interest in inflammation stems from evidence suggesting increasing muscle mass and function through exercise and diet has the potential to reduce circulating inflammatory markers and hence optimise muscle health - important aspects of quality of life in older people.

Diet and inflammation

Given that an increase in inflammation can have a catabolic effect on muscle tissue, there has been considerable interest in evaluating the role that various lifestyle factors, particularly diet and exercise, may have on circulating pro- and anti-inflammatory cytokines.

While this is important as it may provide some information on the underlying mechanism(s) by which diet and exercise might improve health outcomes, it is important to note that a range of other lifestyle related factors [smoking, alcohol, obesity and the presence of a chronic disease(s)] can have a marked effect on inflammation.

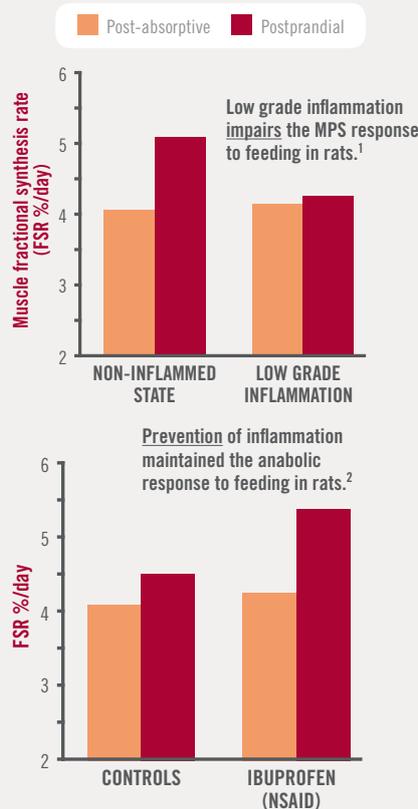
Thus, the key question that needs to be addressed is whether any dietary and/or exercise related improvements in inflammation are associated with clinically meaningful improvements in health outcomes, such as muscle mass, size and strength.

Obesity has been shown to be associated with an increase in circulating inflammatory markers, with evidence that adipocytes or fat cells can release a range of inflammatory markers which can contribute to systemic, low-grade, chronic inflammation that can consequently accelerate muscle loss and led to sarcopenia.

When it comes to diet, studies investigating the effect of vitamin D on inflammation suggest nutrient adequacy may be the best approach since the benefits of supplementation are only evident in those with low vitamin D status but not in those who are generally healthy.



Effects of inflammation on muscle protein synthesis (MPS)



References

1. Balage M, Averous J, Rémond D, et al. Presence of low-grade inflammation impaired postprandial stimulation of muscle protein synthesis in old rats. *Journal of Nutritional Biochemistry* 2010;21(4):325-331.
2. Rieu I, Magne H, Savary-Auzeloux I et al. Reduction of low grade inflammation restores blunting of postprandial muscle anabolism and limits sarcopenia in old rats. *The Journal of Physiology* 2009; 587, 5483-5492.
3. Daly R, O'Connell S, Mundell N et al. Protein-enriched diet, with the use of lean red meat, combined with progressive resistance training enhances lean tissue mass and muscle strength and reduces circulating IL-6 concentrations in elderly women: a cluster randomized trial. *American Journal of Clinical Nutrition* 2014; 99(4):899-910.

Protein for muscle and brain health

Maintaining an adequate dietary protein intake is critical for muscle health because of its role in promoting a positive muscle protein balance. There is a growing body of evidence that older people need more protein than younger people to build muscle mass.

Professor Daly's research shows that a higher protein diet of around 1.3g/kg body weight combined with progressive resistance training was effective for reducing inflammation and improving muscle health, including muscle mass and strength in older women.³

In this study, red meat was a key source of protein and consequently, this diet was high in zinc, which also plays a role in inflammation and is often lacking in the diet of older people.

An increase in serum insulin-like growth factor-1 (IGF-1) was another important outcome of this study and since it is also important for brain health and cognitive function, Professor Daly is conducting another study to determine the benefits of combining a higher protein diet (using red meat consumed three days per week) with progressive resistance training on both muscle health and cognition in older adults.

Meal composition & health outcomes

Lessons from China

Analyses of food patterns make it possible to investigate how interactions between the foods that make up the total diet influence health outcomes differently, depending on the population. Dr Shi's longitudinal analyses of a large Chinese cohort illustrate how associations between food and health outcomes can differ between populations as a result of differences in meal choices and preparation practices.

He identified four food patterns using factor analysis which he described as 'macho', 'sweet tooth', 'traditional' and 'vegetable-rich'. The 'macho' had more meat and alcohol than the other patterns, whereas the 'vegetable-rich' pattern had a higher proportion of whole grains, fruits and vegetables.

Weight gain with vegetables

Surprisingly, only the 'vegetable-rich' eating pattern was positively associated with weight gain after 5 years of follow up. The 'traditional' pattern was inversely associated with weight gain and there was no significant change in weight in those in the 'macho' and 'sweet tooth' eating patterns.

It is important to understand the context when interpreting these findings as in China vegetables tend to be eaten stir fried with vegetable oil rather than in their raw form. Consequently, in this population, vegetable oil intake increased as vegetable intake increased contributing to the higher energy intakes and subsequent weight gain in the 'vegetable-rich' dietary pattern.

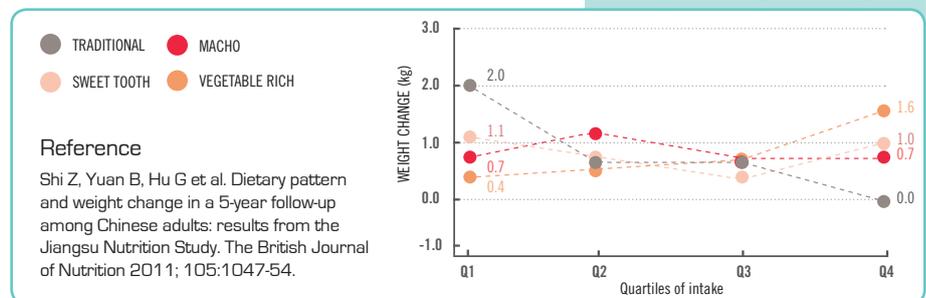
Differences in rice intake may also be contributing to weight gain in the 'vegetable-rich' compared to the 'traditional' dietary pattern. Rice intake was inversely associated with 5-year weight gain and Dr Shi speculated that the higher water content of rice compared to wheat products may contribute to a lower energy intake.

The meal context

Despite the positive association with weight gain, the 'vegetable-rich' dietary pattern was inversely associated with all-cause mortality and sleep quality, suggesting other aspects of the diet and lifestyle, associated with this dietary pattern are protective.

These findings suggest that eating the recommended amount of vegetables does not necessarily decrease the risk of obesity and suggest it may be more effective to frame recommendations pertaining to diet and disease risk in terms of meal composition and structure.

Dietary patterns and 5-year weight change



PREVIEW

defining effective diet & lifestyle for diabetes prevention

Sustained weight loss critical

Large intensive lifestyle interventions studies in adults with impaired glucose tolerance around the world have consistently shown that sustained weight loss is highly effective for reducing risk of type 2 diabetes.

Whilst this evidence highlights the importance of maintaining weight loss, it doesn't tell us which diet is the most effective in terms of achieving weight loss; preventing weight regain; reducing cardiovascular risk factors; or adherence.

Higher protein, low GI for weight maintenance

As all of these factors are relevant in the prevention of type 2 diabetes and its complications, PREVIEW, a large international study, is currently being

undertaken to define an effective dietary and lifestyle regime for diabetes prevention.

PREVIEW follows on from the Diogenes study which showed that a high protein, low GI diet was most effective for preventing weight regain following weight loss.

Cross disciplinary approach

A cross disciplinary approach has been adopted to determine whether a high protein, low GI diet is more effective in preventing type 2 diabetes than current dietary recommendations and whether the most effective physical activity regime is high intensity or moderate intensity.

The impact of a high protein, low GI and high intensity physical activity regime on sleeping pattern and stress will also be determined as these lifestyle factors can influence weight maintenance.

Behaviour change is another important aspect of the intervention as low self-efficacy and lack of social support can contribute to a relapse back to an earlier, unhealthy behaviour.

These findings will provide a considerable amount of new knowledge to inform the development of guidelines on diet and lifestyle recommendations to prevent type 2 diabetes.

Reference

Larsen TM, Dalskov SM, van Baak M et al. Diets with high or low protein content and glycemic index for weight-loss maintenance. *The New England Journal of Medicine* 2010; 363(22):2102-13.

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