Plenary 1: The Gut Microbiome and Health

Nutritional impacts on immunity, microbiome and metabolic health: lessons from insects

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Background

Macronutrients (protein, fats and carbohydrates) are fundamental dietary components, yet the question of what represents a macro-nutritionally balanced diet and how this maintains health and longevity remains unanswered. We have developed a set of state-space models called the Geometric Framework (GF) to capture the multidimensional nature of nutritional requirements, the relative values of foods in relation to these requirements, the behavioural and physiological responses when feeding on diets of varying composition, and the growth and performance consequences of being restricted to particular dietary regimes. We have also derived the necessary theory for defining health and performance in relation to nutrient intake, for describing key nutritional traits, and assessing trade-offs between different responses. I begin by introducing these models and then show how they have been used to tease apart the interactions between nutrient balance, life-history theory, immunity, gut microbiome, ageing, obesity and cardiometabolic health. Along the way I will use examples spanning insects to humans.

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Investigating the role of the gut microbiota in health and disease: when bigger may sometimes be better

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The fields of nutrition applicable to humans and livestock both share a need for advances in our understanding of microbial biology, because the gut microbiota provide a functional and dynamic interface between host genotype, dietary patterns, and lifestyle, with commensurate effects on their nutrition and health. For numerous reasons, small animal (especially rodent) models will remain a principal resource to explore these relationships with respect to human health and bionutrition, but can the metagenomic analyses of the gut microbiota from "large" animals offer anything more (or different)? This invited presentation will provide a working definition of metagenomics, and by using specific examples, affirm there are mutual benefits for bionutrition and livestock agriculture that can arise from metagenomics studies of the gut microbiota of "large" animals, as affected by dietary patterns and/or interventions.

Plenary 1: The Gut Microbiome and Health

The interactions of gut microbiota with diet and functional gut symptoms

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Background

Recent clinical studies including high quality randomised controlled trials have shown the influence of diet on functional gut symptoms, particularly those associated with irritable bowel syndrome (IBS). This is particularly the case with poorly absorbed short-chain carbohydrates (fodmaps), which can trigger symptoms, and their reduction in the diet can lead to marked improvement in all the symptoms of irritable bowel syndrome [1]. Fodmaps act via luminal distension and increasing luminal water content via three main mechanisms – osmotic effect increasing water content in the intestinal lumen, their fermentation by bacteria to gases (hydrogen, carbon dioxide and methane), and the preferential production of hydrogen over methane [2,3]. It is not surprising then that intestinal microbiota are intimately involved in the genesis of functional gut symptoms. However, their potential involvement in the genesis of symptoms is much greater than that due to the cross-talk between microbiota and the enteric nervous system, which itself is critical to the genesis of such symptoms. For instance, metabolic products from bacteria can directly interact with cells and receptors that potentially can change the function or sensitivity of the gut. With the use of dietary manipulation, particularly of carbohydrates in the management of functional gut symptoms, the intestinal microbiota will change in response to alteration of metabolic substrates. The health implications of such changes in the longer term are uncertain, but it is possible that, for example, a low fodmap diet might be detrimental to colonic epithelial health due to the reduction of prebiotic intake [4]. Such issues need to be teased out and studied. The final issue is whether the intestinal microbiota might be abnormal ('dysbiosis') in patients with IBS and that such perturbations might be pathogenically associated with the development of IBS in the first place. While dysbiosis has been reported in patients with IBS, consistency of changes has not been the rule and further work is required. Thus, an intriguing multi-faceted puzzle confronts us in functional bowel disorders where gut microbiota may be intimately involved in the genesis of symptoms, in the efficacy of dietary (and some other) treatments, and in the underlying cause of the conditions.

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Plenary 2: Taste Receptors and the Gut-brain Axis: Emerging Nutrition Science to Impact Obesity?

A taste for energy: fatty and sweet

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Background

For all but the past 10,000 years, hominin species (2 legged primates) on the human evolutionary tract have been hunter-gatherers, and over millions of years of natural selection our senses were developed and refined to help us navigate the local environment. Of critical importance was the ability to make correct food choices, and the sense of taste informed the huntergatherer about the suitability of food for consumption. When a potential food was placed in the mouth, the five taste primaries informed on essential nutrients and toxins: sweet elicited by sugars reflecting carbohydrate; umami elicited by glutamic and other amino acids reflecting protein content; salt elicited by sodium and other ions (Na^+) reflecting mineral content; sour elicited by free hydrogen ions (H^+) reflecting excessive acidity; and bitter reflecting potential toxins in foods. There are currently investigations around a taste component to fat or fatty acids, which are relevant to this topic. In concert with the taste quality is a hedonic response and sweet, salty and umami qualities are appetitive and encourage consumption, whereas excessive sour and bitter are aversive and promote rejection of the food. Decisions on whether to swallow or spit the food were critical to preservation of life. During species evolution, appetitive responses to foods that contained fats, salt, and sugars ensured these biologically prized, yet scarce nutrients were consumed. Appetite is an evolutionary relic that our food supply is based upon, and our appetite is leading us down a path to disease states rather than survival.

Whilst largely speculative at this stage, the link between taste, food consumption and weight portrays an intriguing paradigm for excess food intake and obesity, *i.e.,* decreased taste sensitivity is associated with excess intake, which in turn leads to obesity (1).

The inability of humans to adequately regulate fat consumption is a salient contributor to the development of obesity. The macronutrient fat within foods is detected at various stages of consumption, during which their digestive products, fatty acids, interact with chemosensory cells within the oral epithelium (taste receptor cells) and gastrointestinal (GI) tract (enteroendocrine cells). This chemoreception initiates functional responses, including taste perception, peptide secretion and alterations in GI motility, that may play an important role in liking of food, appetite regulation and satiety (2).

Whilst many factors are known to contribute to the consumption of excess energy intake, and thus the development of obesity, fat intake remains a salient environmental contributor due to its high energy density, palatability and weak effects on satiety following an eating episode (3).

The evidence for sweet taste sensitivity or preference leading to greater consumption of sweet foods is limited. The sweet taste receptor dimer (T1r2 and T1r3) located on the tongue has also been found in the GI tract and is involved in the secretion of gastrointestinal satiation peptides with potential effects on glucose homeostasis, regulation of insulin secretion, appetite and gut motility. Glucose transporters, sodium-glucose cotransporters and APT-gated K^+ which play an important role in glucose homeostasis and metabolism throughout the body and in specific organs (i.e. gut), have been suggested to be T1r-independent mechanisms for detecting sugars.

Recent advances in our knowledge surrounding chemoreception in the mouth and GI tract, alongside their fundamental role in regulating energy intake, has prompted us to question the importance of these nutrient-detection systems, how they may be altered (compromised) in different metabolic states as well as the functional consequences of such differences. This paper will summarise the evidence surrounding the actions of fatty acids and sugars, their functions primarily within the oral cavity, and also GI tract including perception, satiety, energy intake, and perhaps predisposition to obesity.

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Source of funding

Plenary 2: Taste Receptors and the Gut-brain Axis: Emerging Nutrition Science to Impact Obesity?

A taste for protein balance: umami/savoury

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Background

The main function of the taste system is to read the nutritional value of foods which will determine cognitive decisions related to food intake. In the last decade a boost in taste research has evolved after the discovery of taste receptors (TR). As a result, our understanding of the involvement of taste in food intake mechanisms has advanced significantly, particularly after the discovery of a full TR network outside the oral cavity. TR in and outside the mouth are involved in the orchestration of hormonal responses to dietary nutrients whilst the nutritional status, in turn, seem to determine specific appetites manipulating taste sensitivity. The current paper reviews the TR repertoire that senses dietary protein in and outside the oral cavity, and the potential role in appetite control.

Umami/savoury taste receptors and dietary protein

Full proteins from meals are usually not perceived by our taste sensors but protein-derived nutrients, such as L-Glutamic acid (Glu) and other L-amino acids (L-AA) and peptones, seem to trigger umami and savoury flavours. Most protein-rich dietary ingredients consist of small peptides or unbound amino acids (in mM amounts) sufficient to stimulate taste in the tongue. Nucleotides (e.g. Inositol Monophosphate) seem to act as allosteric enhancers of umami taste. Umami taste is known to be mediated by the heterodimeric receptor T1R1/T1R3. In addition to Glu, the affinity and array of other L-AA that stimulate the T1R1/T1R3 is species dependent. However, additional receptors exist for Glu and other L-AA and peptides (1). Metabotropic glutamate receptors (mGluR 1 and 4) have also been involved in umami sensing. Furthermore, it has recently become apparent that at least three more receptors respond to dietary protein-related nutrients in oral and non-oral tissues: GPRC6A, CaSR and GPR92. The mGluR1,4 respond exclusively to one agonist Glu whereas the other receptors are promiscuous and respond to several L-AA and nucleotides (T1Rs), several basic or aliphatic L-AA (GPRC6A), aromatic L-AA (such as L-Phenylalanine –Phe-) and divalent cations (CaSR), and peptones (GPR92).

Amino acid sensing, energy homeostasis and appetite.

The umami/savoury receptors described above have been found in stomach, intestines, hypothalamus and heart among other tissues. Glu is a major energy source in the GIT and plays a central role in enterocyte metabolism implicated in the transamination and the tri-carboxilic acid cycle pathways. The TRs expressed in cells of the enteroendocrine system seem to be involved in orchestrating the absorption of amino acids and peptides by enterocytes (2) and in initiating signalling events that will modulate the hunger-satiety cycle. In stomach, Glu stimulated gastric secretion and motility in humans. The sensing of aromatic (e.g. Phe) and basic L-AA and peptones results in increased gastrin secretion and plasma levels of CCK. In the intestine L-AA and peptones seem to be related to the release of incretins (GIP, GLP-1 and GLP-2). Peptones have also been found to stimulate CCK and incretin release in the GIT. Consequently Glu seem to have the potential to reduce weight gain and Phe to reduce food intake in humans (3).

Finally, in the central nervous system, the umami T1R1 and T1R3 have been found in the hypothalamus and their expression levels respond to the nutritional status of an individual. For example, food deprivation increases the Tas1R1/Tas1R3 expression in the hypothalamus (4). Recent equivalent findings by our group regarding feed deprivation and TR expression using pig as a model will be discussed.

Conclusion

The umami taste machinery is present in non-taste tissues such as the GIT where it appears to play a pivotal role in L-AA sensing, absorption and the hunger-satiety cycle. Overall our knowledge on dietary protein sensing suggests that L-AA and protein hydrolysates are perceived in enteroendocrine cells in the gut and these may play an important role in protein-induced satiety. A better understanding of these mechanisms has the potential to shed light on some human food-related disorders such as anorexia or obesity.

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Plenary 2: Taste Receptors and the Gut-brain Axis: Emerging Nutrition Science to Impact Obesity?

Bitter: a taste against toxins and drugs?

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Background

Bitter is one of our five basic taste qualities. On the one hand bitterness indicates the presence of harmful substances in food and mediates rejection, thereby minimizing the risk of food intoxications. On the other hand numerous bitter substances are harmless or even healthy. Therefore, intake of food containing such bitter compounds would be rather beneficial. Consistent with this, we accept and enjoy numerous bitter foodstuffs and beverages (1). Thus, it appears that bitterness is a prominent factor for food preferences and aversions and that the organism is able to distinguish toxic from harmless or healthy food.

Objective

Our work aims at elucidating the molecular and cellular basis of bitterness perception and how bitterness influences ingestive behavior.

Methods

To this end we use an integrative approach involving human psychophysics and genetics, receptor expression assays, genetically-modified mice, neurophysiological recordings, molecular biological and cell biological methods as well as behavioural studies.

Results

Functional expression of bitter taste receptors cloned from fish, frog, chicken, mice, and man demonstrated that they fall into different categories. 'Generalist' receptors that are very broadly tuned to detect numerous structurally diverse compounds, moderately tuned receptors that recognise an intermediate number of substances, and 'specialists' for single or very few chemicals. In addition, humans possess two receptors that are sensitive to bitter compounds that share common chemical substructures. Moreover, most bitter compounds activate several receptors. These results explain why few receptors suffice to mediate perception of countless bitter chemicals and indicate the presence of a combinatorial activation pattern for bitter receptors (2). Notably, bitter taste receptors appear to possess only a single binding pocket in which they accommodate their structurally diverse ligands through different contacts with the amino acids lining the binding pocket (3). The binding pockets appear to be optimised to recognise many ligands at the expense of binding affinity for a specific substance (4). Intriguingly, bitter receptors are susceptible to potent blocking agents present in the same food as the bitter compounds themselves, a phenomenon relevant for the perceived bitterness of that food and compound mixtures (5). Frequent polymorphisms in bitter taste receptor genes generate receptor variants that differ in sensitivity for their cognate compounds and explain variations in bitterness perception in the population (6) that probably influence food preferences.

Only distinct subsets of the bitter taste receptor repertoire are expressed in bitter sensing receptor cells in the mouth generating a population of functionally distinct but overlapping bitter-sensitive cells (7, 8) which allow animals to respond variably to oral administration of bitter compounds. Functionally distinct but overlapping response profiles are also found in neurons of the peripheral and central gustatory system.

Conclusions

Bitter taste involves a limited number of receptors; their molecular receptive ranges allow recognition of the innumerable bitter chemicals. Bitter receptor cells and bitter processing neurons display functionally distinct but overlapping response profiles. In this way a potentially fatal block of bitter perception through potent bitter blockers present in food or by desensitization mechanisms is minimised. Functionally distinct pathways of bitter detection and processing may act as different input channels into neural circuits critical for gustatory learning to avoid or accept bitter food.

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Source of funding

Concurrent Session 1: Appetite

Proteomics of dietary restrictions

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Background

It is well known that moderate reduction in nutrient intake known as dietary restriction (DR) slows ageing and some age-related illnesses. With recent concerns of obesity and its health associated diseases, considerable research is focused on finding a balanced diet. Of particular interest is the dietary restriction (DR) regimen that examines the effects of carbohydrate and protein ratios on health, reproductive capacity and lifespan. The study of dietary effects has been performed on several model organisms and this work utilises the common fruit fly (Drosophila melanogaster) and the Australian neriidae, to reveal the DR effects by comparative proteomics.

Objective

Understanding dietary restriction effects of carbohydrate and protein ratios on protein expression associated with health and lifespan through fly model systems (Australian neriidae and Drosophila melanogaster).

Design

Flies grown on diets with different protein and carbohydrate ratios were sampled for proteomic analysis. Individuals were sacrificed at various ages to gauge the effects of treatments on protein expression and the changes in the proteome that occur with ageing. Flies were frozen, homogenised and centrifuged to extract their protein content. The protein analysis experiments included separation by gel electrophoresis followed by in-gel digestion protocols and mass spectrometry identification.

Outcomes

Adult dietary restriction (DR) utilizing the Australian neriid flies revealed an increase of approximately 65% in their mean lifespan. Whilst DR had no overall effect on male fertility, it showed pronounced effects on females with undeveloped ovaries. Preliminary studies of both fly model systems revealed that some proteins are differentially expressed as a function of varying the carbohydrate to protein ratio of the feed, and these proteins are both sex- and diet-dependent. These studies are being repeated with a larger set of flies for further confirmation.

Conclusion

Dietary restrictions were shown to extend the lifespan of the Australian neriid flies with some pronounced effects on female reproductive systems. Comparative proteomics of both fly model systems revealed sex-specific changes in the levels of some proteins as a function of dietary variation of carbohydrate to protein ratio.

Source of funding

Postprandial total adiponectin response to a high-fat versus an isoenergetic low-fat meal in lean, healthy men

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Background

Evidence suggests that an acute systemic inflammatory response is invoked following the intake of a high-energy meal. Postprandial regulation of adiponectin, an adipose tissue-derived, anti-inflammatory hormone, remains inconclusive.

Objective

To examine the postprandial effect of a high-energy test-meal on plasma adiponectin, glucose, insulin and triglycerides and to investigate any differential effect on these parameters following a high-fat (HF) versus an isoenergetic low-fat (LF) test-meal.

Design

Seventeen lean, healthy males (BMI 22±0.5 kg/m^2, age 21±0.5 y; mean±SD) participated in this randomised, single-blind, cross-over study. A HF test-meal (5001 kJ, 45 g fat) and a LF test-meal (5003 kJ, 15 g fat) were consumed by each subject on two separate occasions. Blood samples were collected by venepuncture at baseline (0 h), 1 h and 3 h following ingestion of each test-meal. Plasma adiponectin was measured by ELISA and glucose, insulin, and triglycerides by standard methodology. Data underwent repeated measures ANOVA and were expressed as mean ± SEM ($P<0.05$).

Outcomes

At baseline, there was no significant difference between the two treatments in circulating adiponectin, glucose, insulin, or triglycerides ($P>0.05$). When analysed independent of treatment, adiponectin, insulin, and triglycerides increased significantly (time, $P<0.05$) whilst glucose decreased significantly (time, $P<0.05$) over the 3 h postprandial period. There was no differential effect of the HF versus the LF test-meal on adiponectin, glucose, or insulin (time*treatment $P>0.05$). However, triglycerides were significantly higher following the HF test-meal (time*treatment $P<0.01$).

Conclusion

This study showed a postprandial increase in plasma total adiponectin in response to a high-energy test-meal but no differential effect of a HF versus an isoenergetic LF test-meal. Further research is necessary to elucidate the postprandial effect of dietary fat on circulating adiponectin.

Source of funding

Concurrent Session 1: Appetite

Fructose consumption modulates postprandial lipid levels and inflammatory mediators in healthy subjects

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Background

Epidemiological and animal studies have demonstrated a relationship between fructose consumption and risk of developing obesity, diabetes and cardiovascular disease. Mechanisms by which dietary fructose mediates metabolic changes are poorly understood.

Objective

To compare the effects of fructose, glucose and sucrose consumption on post-prandial lipemia and inflammation markers.

Design

This was a randomised controlled, cross-over, intervention trial involving healthy male and female adults (n=14). After an overnight fast, participants were given a drink containing 50g of either fructose or glucose or sucrose dissolved in water. Blood samples were collected at baseline, 30, 60 and 120 minutes post intervention for the analysis of blood lipids, glucose, insulin and high sensitivity C-reactive protein (hs-CRP).

Outcomes

As expected, glucose and sucrose supplementation initially resulted in a significant increase in glucose and insulin levels and returned to near baseline values within 120 minutes. Fructose consumption however did not alter blood glucose or insulin levels (P>0.05). The change in plasma total, LDL and HDL-cholesterol (measured as area under curve, AUC) was significantly higher when participants consumed fructose compared with glucose or sucrose (P<0.05). Change in plasma triglyceride (measured as AUC) levels, however, remained unchanged regardless of the dietary intervention. The change in hs-CRP (measured as AUC) was also significantly higher in subjects consuming fructose compared with those consuming glucose (P<0.05), but not sucrose (P=0.07).

Conclusion

Fructose consumption exaggerates postprandial lipemia and inflammation, thereby potentially increasing the risk of developing obesity and related diseases.

Source of funding

Origin of the appetite hormones found in human milk

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Background

Breastfed infants self-regulate their nutrient intake, with long-term benefits including protection against obesity. This is thought to be partly conferred via appetite-controlling hormones present in human milk. Many studies have posed that these hormones originate from the maternal bloodstream, but it is unclear whether they are also synthesised endogenously in the mammary gland.

Objective

In this study, we examined whether appetite hormones are synthesised in the mammary epithelium in women.

Design

Rare specimens of the human resting and lactating breast were stained for the appetite hormones, leptin and its receptor, ghrelin, adiponectin, and resistin. Flow Activated Cell Sorting FACS was used to analyse cells derived from human milk for subpopulations expressing these appetite hormones.

Outcomes

Leptin and its receptor were expressed in both the resting and lactating mammary epithelium, with higher expression in the latter. Similar levels of expression where seen in the ducts of the resting and lactating breast, but at lower levels than in alveoli. Both luminal and myoepithelial cells were positive for leptin and its receptor, however the latter was more prominent in the luminal layer. Heterogeneity in expression was also observed between the two epithelial layers and amongst different lobules for all appetite hormones examined, which were more strongly expressed in the lactating than the resting breast. The presence of positive cells in the ductal and alveolar lumen suggests that they are shed into breastmilk. *Ex vivo* FACS analysis of breastmilk cells showed that the majority of cells were leptin-positive, which was in agreement with the high number of positive cells seen in the lactating epithelium. Leptin was expressed in mature cells, such as lactocytes and myoepithelial cells, as well as in stem cells.

Conclusion

We provide evidence that appetite hormones are synthesised endogenously in the female breast, with a marked upregulation during lactation. This now indicates that a proportion of the appetite hormones in human milk originate from the lactating epithelium. In addition to contributing to infant appetite regulation during breastfeeding, these hormones may be involved in other cell functions in the breast. The mammary cells synthesising these hormones can be easily accessed via breastmilk to study of their role in both the breastfed infant and the lactating breast.

Concurrent Session 1: Appetite

Do older Australians eat enough legumes?

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Background

Legumes are a low glycaemic index food that provide a cheap dietary source of plant protein and dietary fibre. Evidence suggests higher intakes of legumes are associated with a decreased risk of all-cause mortality and cardiovascular disease mortality. Few population studies from Australia have previously investigated legume consumption and health outcomes.

Objective

The aim of this study was to assess population level intake of legumes in older Australians and to assess the relationship between diet quality and legume consumption.

Design

In a cohort of older Australians (50+ years), who participated in the Blue Mountains Eye Study (BMES) at baseline in 1992-1994 and two follow ups at five year intervals. Legume intake and diet quality were calculated from a food frequency questionnaire (FFQ). The Total Diet Score (TDS) is a measure of adherence to the Australian Adult Dietary Guidelines. Scores were allocated to 10 components reflecting intake of selected food groups and nutrients as well as optimal choice. Adjusted mean differences between baseline and five and 10 years respectively of serves per week of legume intake were calculated.

Outcomes

The proportion of older adults who consumed at least two serves of legumes per week increased from 19.1% to 22% 10 years later. Overall, weekly serves of legumes increased significantly at five years and 10 years (0.19 ± 2.65 and 0.22 ± 2.52 respectively). A higher proportion of older adults who consumed at least two serves per week of legumes had the highest TDS score with a significant trend for decreasing proportions with decreasing quintile of TDS. Mean TDS scores were highest in the highest quintile of legume consumption and significantly different to all other quintiles of legume consumption.

Conclusion

Legume consumption in Australia is low; less than 1 in 4 older adults consumed the recommended two serves per week of legumes. Increased legume consumption was associated with better diet quality which could lead to improved health outcomes.

Source of funding

Load-dependent effects of oral whey protein on gastric emptying, gut hormone release, glycaemia and energy intake in lean males

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Background

Ingested nutrients modulate gastrointestinal (GI) function, including rates of gastric emptying (GE) and gut hormone release, which are associated with postprandial glycaemia and energy intake (EI). We have reported that whey protein, infused intraduodenally (ID) to bypass oro-gastric influences, at rates mimicking the normal range of GE (0.5 - 3 kcal/min), stimulated pyloric motility, gut hormone and insulin release, and suppressed EI in a load-dependent manner, and maintained normoglycaemia. Whether these load-related effects remain when protein is ingested orally, allowing gastric mechanisms to come into play, is unclear.

Objective

To assess 1) the load-dependent effects of oral protein on GE, GI hormones, glycaemia and EI, and 2) whether EI suppression is related to GE and GI hormone release.

Design

Eighteen healthy, lean males (age 24.7 ± 3 yr, BMI 22 ± 1 kg/m^2) received, on three occasions, in randomised, double-blind order, iso-osmolar, lime-flavoured, equally palatable drinks (450 mL) containing 30 (L) or 70 (H), g intact whey protein, or a saline control (C). Immediately after the drink (ie t=0), GE (3D ultrasound) and glucagon-like peptide-1 (GLP-1), glucagon, insulin release, and blood glucose were measured every 15 min for 180 min. EI was quantified at a buffet-style lunch (t=180-210 min).

Outcomes

Oral whey protein slowed GE (r=0.9), stimulated GLP-1 (r=0.89), insulin (r=0.9) and glucagon (r=0.95) (all $P<0.05$) load-dependently, and normoglycaemia was maintained. L and H reduced EI compared with C (both $P<0.05$), with no differences between them. EI was inversely related to half-emptying time (T_{50}) (r=-0.49) and GLP-1 (r=-0.46), insulin (r=-0.53), and glucagon (r=-0.47) release (all $P<0.01$).

Conclusion

Oral protein slowed GE, and, like ID protein, stimulated GI hormone release in a load-dependent fashion, without changes in blood glucose. Despite these potent GI effects, the lack of suppression of EI between L and H suggests a threshold load for oral protein to suppress EI, as well as a potential role of additional mechanisms in determining EI.

Source of funding

Concurrent Session 2: Micronutrient Nutrition

Twenty-four hour urinary excretion of iodine and sodium in New Zealand adults

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Background

The consumption of salt in food, including iodised salt, is difficult to quantify and hampers dietary assessment of iodine and sodium. Because 90% of iodine and sodium is excreted in the urine, the collection of twenty-four hour (24hr) urine samples can provide a more accurate estimate of intakes of both nutrients.

Objective

The aim of this study was to assess the iodine and sodium status of a representative sample of New Zealand (NZ) adults.

Design

Between Feb-Oct 2012 adults aged 18-64 yr were randomly selected via the electoral roll from the cities of Wellington and Dunedin, NZ; a snowballing technique was also employed to reach the projected sample size of 300 adults. Participants had their height, weight, and blood pressure measured and completed a questionnaire that included information on socio-demographic characterstucs and diet. Participants also collected a 24hr urine sample.

Outcomes

A higher proportion of participants (n=301) in this study were of NZ European and Other ethnicity, of higher socioeconomic status, and of a healthy body weight than the 2006 NZ census data. The mean urine volume was 2.0 L. The mean (95% CI) 24hr urinary iodine excretion was 124 (117,132) μg/day and 32 (27,37) percent of the population had a 24hr urinary iodine excretion <100 μg/day (i.e. the EAR for iodine). The mean (95% CI) 24hr urinary sodium excretion was 3373 (3208,3539) mg/day and 76 (71,81) percent of the population had a 24hr urinary sodium excretion >2300 mg/day (i.e. the UL for sodium). For both iodine and sodium, males had a higher excretion than females (p<0.01), and the number of serves of bread was positively associated with excretion (p<0.05). There was a significant association between 24hr urinary iodine excretion and 24hr urinary sodium excretion (p=0.001).

Conclusion

NZ adults have adequate intakes of iodine and high intakes of sodium. The consumption of bread, now made with iodised salt, is positively associated with both iodine and sodium intakes. Strategies to reduce the salt content of bread to lower sodium intakes needs to be monitored as this may adversely impact on iodine intakes.

Source of funding

Zinc supplementation increases expression of cytokines in Type 2 diabetes mellitus

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Background

Type 2 diabetes mellitus (DM) is associated with low grade inflammation that may be modulated by nutrients such as zinc and alpha-linolenic acid (ALA). Cytosolic zinc is regulated by two zinc transporter families, which are responsible for zinc efflux (ZnT) or import (ZIP). The relationship between the regulation of zinc transporters by cytokines and zinc homeostasis in Type 2 DM is unclear.

Objective

To investigate the effects of zinc and ALA supplementation on cytokine and zinc transporter gene expression in peripheral blood mononuclear cells (PBMC) in women with Type 2 DM.

Design

Post-menopausal women with Type 2 DM were recruited for a 12 week zinc and/or ALA supplementation trial. Participants were randomised to 4 groups, receiving 40 mg of zinc (n=11), 1200 mg of ALA (n=10), both zinc and ALA (n=9) or placebo (n=10). Blood samples were collected at baseline and week 12. RNA was extracted from PBMC and expression of zinc transporters and cytokines were analysed using Taqman real-time PCR.

Outcomes

Tumour neurosis factor alpha (TNF-α) expression was up-regulated 28% (P<0.05) after zinc treatment. Fold changes of interleukin-1β (IL-1β) and IL-6 expression tended to be higher in zinc treated groups (P=0.055; P=0.17, respectively). There were no significant differences in the fold changes of zinc transporters. Positive correlations between fold changes of TNF-α, ZIP1 and ZIP3 expression were found with zinc treatment (P<0.05). IL-1β fold change was associated with fold changes of ZnT5, ZnT7 and ZIP1 in the zinc treated groups (P<0.05). Correlations between fold changes in IL-6 and ZnT5, ZnT6, and ZnT7 found in groups without zinc treatment were disrupted in the presence of zinc supplementation. In the absence of zinc treatment, change in TNF-α was positively correlated with fold changes of intracellular zinc transporters (P<0.05). ALA treatment had no significant effect on cytokine expression.

Conclusion

This preliminary analysis suggests that zinc up-regulates the expression of TNF-α and to a lesser extent IL-1β in PBMC, which are associated with changes of zinc transporter expression in Type 2 DM.

Source of funding

Concurrent Session 2: Micronutrient Nutrition

Salt intake and taste sensitivity in CKD patients

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Background
Taste abnormalities are common in Chronic Kidney Disease (CKD). Early research indicates a relationship between habitual salt intake and taste sensitivity in the general population, but this relationship has not been well-explored in CKD.

Objective
This study will explore the relationship between habitual salt intake and taste sensitivity in patients with CKD.

Design
The TASTE CKD study was a cross-sectional study of adult stage 3-5 CKD patients, from a large tertiary hospital. Taste assessment was performed according to ISO method of investigating sensitivity of five basic tastes (sweet, sour, salty, umami and bitter) in 2ml colourless solution which the participants tasted, then identified and rated perceived strength (sensitivity) on a 10cm visual analogue scale. Sodium intake was measured using a validated food frequency questionnaire (FFQ) and discretionary salt use was also reported. Diabetes status, GFR, serum bicarbonate, serum urea and smoking status were collected and assessed as potential confounders. The relationship between taste and sodium intake or discretionary salt use was assessed by correlation (sensitivity) and chi-square (identification of solutions) with multiple linear regression used to assess potential confounders.

Outcomes
A total of 100 participants aged 64.9±14.1 yrs completed the trial. Mean sodium intake from FFQ was 137±56 mmol /day and 29% met the recommended salt intake target of < 6g salt/day. Total sodium intake was inversely correlated with umami sensitivity rating (p=0.02, r=-0.25), while frequency of discretionary salt usage was inversely correlated with salt sensitivity rating (p=0.02, r=-0.25); and both relationships remained following adjustment for confounders. Participants with intake within guidelines (< 6g salt/day) were more likely to correctly identify the salty and umami solutions with than those with intakes above this (salty 89% versus 61% correct; p<0.01; umami 74% vs 44% correct p<0.01), and these remained when adjusting for confounders.

Conclusion
These data suggest that sodium intake and discretionary salt use were independently related to taste sensitivity for both the umami and salt tastes in this population. This may highlight a key barrier to adherence to a low sodium diet for CKD patients.

Source of funding

Dietary iron intake and iron status in female blood donors

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Background
Regular blood donations are required to ensure an adequate blood supply. In Australia, 30% of blood donors are women and their increased physiological need combined with regular blood donations puts them at risk of low iron status. Understanding dietary factors that help maintain appropriate iron stores is essential.

Objective
To compare dietary iron sources and total iron intake between female blood donors with 'sufficient' and 'low' iron status.

Design
Female blood donors aged 20-40 yrs were recruited from three blood donation centres in Sydney. A food frequency questionnaire was used to determine nutrient intake and iron contribution from food groups. Supplement use was determined via questionnaire. Serum ferritin concentrations were determined from a venous blood sample.

Outcomes
Complete data was available from 158 women blood donors (mean(SD) age 29.6 (5.5) yr, BMI 24.4 (3.4) kg/m^{2}). Participants were divided into 'sufficient' (40%) and 'low' (60%) based on serum ferritin concentrations above or below 20 µg/L. No significant differences were observed between total dietary iron intake (sufficient: 16.2(4.8) mg/day, low: 16.0(5.0) mg/day p=0.70)) and iron intake from food and supplements ((median (IQR) 17.2(13.7-22.1) mg/day, 15.6(12.3-20.0) mg/day) p=0.07). Both groups obtained the majority of their dietary iron from vegetable dishes (28%, 30% sufficient and low respectively), followed by cereal products (4% both groups), then meat products (2% both groups). Participants with low iron status consumed less vitamin C (median (IQR) 194.6(154-267.5) vs. 243.9 (169.6-333.7) mg p=0.08) and more caffeine (118.8(80.8-193.7 IQR) vs. 77.5(33.3-181.1) mg p=0.02) than those in the sufficient group, indicating potentially less iron bioavailability.

Conclusion
Dietary sources of iron in the female donor population could be improved to ensure appropriate iron status is maintained. Increasing intake of bioavailable iron through increased consumption of meat and vitamin C and decreased caffeine intakes in combination with iron supplementation should be investigated as strategies to improve iron status.

Source of funding

Concurrent Session 2: Micronutrient Nutrition

Iron intakes of Australian infants and toddlers

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Background
Iron deficiency continues to be the most common nutritional deficiency worldwide and infants are at particular risk. Preventative food-based strategies require knowledge of current intakes and sources of iron, yet few data are available for Australian infants.

Objective
To determine iron intake and food sources of iron for children aged 9 months and to identify factors associated with iron intakes.

Design
Dietary data were collected from 485 infants at 9 months of age via three telephone-administered 24-hr multi-pass recalls in the Melbourne Infant Feeding, Activity and Nutrition Trial Program. Nutrient intakes were estimated using AUSNUT2007. Food sources of iron were determined for each infant. Feeding practices and socio-demographic data were assessed for associations with iron intakes. Inadequate iron intakes were defined as intakes below the Australian/New Zealand Estimated Average Requirement for iron for 7-12 month olds (ie 7 mg/d).

Outcomes
Mean (SD) iron intakes were 9.1 (4.3) mg/d. Major sources of iron were infant formula and fortified infant foods (70% of total dietary iron intake) and cereals (14%). Meat, fish and poultry contributed only 5% of total iron intake [mean (SD): 0.5 (0.6) mg/d]. Iron intakes for boys [mean (SD): 9.6 (4.5) mg/d] were greater compared to girls [mean (SD): 8.5 (4.0) mg/d] (P=0.006). Infants who were currently breastfeeding had lower iron intakes [mean (SD): 6.3 (3.9) mg/d] compared to those who were never breastfed [mean (SD): 11.4 (3.8) mg/d] or those who had stopped breastfeeding [mean (SD): 11.2 (3.2) mg/d] (P<0.001). Iron intakes were positively correlated with vitamin C (r=0.61, P<0.0001) and calcium (r=0.76, P<0.0001) intakes and negatively correlated with age of introduction to solid foods (r=-0.16, P=0.001). Thirty-two percent of infants were at risk of inadequate iron intakes.

Conclusion
Despite the consumption of iron-fortified foods, up to a third of Australian infants are at risk of inadequate iron intakes. As late infancy is a period of rapid growth and high iron requirements, dietary strategies focusing on improving infants' intakes of iron are necessary.

Source of funding

Regional differences in salt intake in Australia

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Background
Knowledge of salt consumption levels is essential to develop population salt reduction policies. However, little is known about the factors affecting within-country regional differences of salt intake in Australia.

Objective
To determine if there are regional differences in salt intake in Australia using 24 hour urine collections and identify potential predictors of the regional differences.

Design
A total of 1169 adults, comprising 547 males and 622 females with a mean age of 57(±13)(SD) years (range 20 to 88 years) from four population groups provided 24-hour urine collections (2009 to 2012) to estimate daily salt intake: 1) 351 residents of Melbourne; 2) 246 residents across regional Victoria; 3) 157 farmers across Victoria; 4) 415 residents of Lithgow (regional New South Wales). ANOVA was used to identify regional differences in means and least squares regression analysis was used to identify predictors of regional differences in salt intake.

Outcomes
Mean salt intake (grams/day±SEM) differed between regions: 1) 8.2±0.2, 2) 7.7±0.2, 3) 9.6±0.3, 4) 8.8±0.2 (ANOVA P<0.001). However regional differences were largely attenuated after adjustment for gender, age, and weight. For example: the difference between Lithgow (4) and regional Victoria (2) was reduced from 1.1±0.3 to 0.3±0.1; and the difference between farmers (3) and Melbourne (1) was reduced from 1.3±0.3 to 0.6±0.2. Gender, age and weight were significant predictors of salt intake (all P<0.001). Males had a higher salt intake than females, increasing age was associated with decreased salt intake, and increased weight was associated with a higher salt intake. SEIFA, as a population indicator of socioeconomic status, was not significant in the regression model for salt intake but was significant in regression models for potassium and sodium to potassium ratio with increasing socioeconomic disadvantage associated with lower potassium intake and higher sodium to potassium ratio (P<0.001).

Conclusion
There were significant regional differences in salt intake for four Australian population groups, which were largely due to gender, age and weight.

Source of funding

Concurrent Session 3: Human Gut Microbiota

Uremic toxins originated from gut microbiota: Are they associated with inflammation and oxidative stress in CKD?

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Background
Indoxyl sulphate (IS) and p-cresyl sulphate (PCS) are two novel toxins solely produced by the disturbed gut microbiota observed in high concentrations in chronic kidney disease (CKD). Despite the emerging role of IS and PCS as key nephro- and cardiovascular toxins, their association with inflammation and oxidative stress is yet to be explored in the CKD population.

Objective
To investigate the relationship between IS and PCS and inflammation and oxidative stress in patients with moderate CKD.

Design
Cross-sectional observational study measuring serum concentrations of total and free IS and PCS (by ultra-performance liquid chromatography) in CKD patients. These toxins were compared with inflammatory markers (interferon gamma [IFN-γ], interleukin-6 [IL-6] and tumor necrosis factor-alpha [TNF-α]), antioxidants (glutathione peroxidase [GPx] and total antioxidant capacity [TAC]) and pulse wave velcity (PWV, a marker of arterial stiffness) by multiple linear regression.

Outcomes
A total of 149 CKD patients (59% male; age 60 ± 10 years; 44% diabetic; eGFR mean 40 ± 9ml/min/1.73m^2 (range 25-59)) were evaluated. Serum free and total IS were independently associated with serum IL-6, TNF-α and IFN-γ, whereas free and total PCS was only associated with IL-6 (all<0.01). Free IS and PCS were independently associated with serum GPx (both p<0.05), but not with TAC. Futher, PCS, free and total, were independently associated with PWV (both p <0.02).

Conclusion
Both gut-generated uremic toxins, IS and PCS, were independently associated with a select panel of increased inflammatory and decreased antioxidant markers. PCS was also associated with increased arterial stiffness. Intervention studies targeting intestinal production of IS and PCS, such as pre- and/or probiotic therapy, is warranted in the CKD population to modulate toxin production and assess their impact on these mechanistic factors and cardiovascular end points.

Source of funding

Fermentation of bacterial cellulose and its pectin composites

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Background
From the plant's perspective, the cell wall (pCW) is important for providing the plant shape and form, and a barrier to the external environment. It is also related to the nutritional benefits of the plant. Analyzing the potential health benefit of pCW polysaccharides directly, is difficult because it is naturally heterogeneous. The bacterium *Gluconacetobactor xylinus* ATCC 53524, which produces extracellular cellulose, was used as a model to mimic the plant cell wall assembly and to incorporate cell wall polymers, such as Pectin.

Objective
To compare the large intestinal bacterial fermetability between bacteria cellulose (BC) and its pectin composites (BCP) (with different degree of esterification (DE) (BCP30DE and BCP60DE).

Design
Ga. Xylinus ATCC 53524 was cultured in Hestrin Schramm (HS) medium (pH 5.0) for 48 h to produce bacteria cellulose (BC) pellicles, while for 96 h with pectin solution (30DE or 60DE) to form bacteria cellulose pectin (BCP) composites. Half of each pellicle was freeze-dried and ground, while the other half was ground fresh. Both dry and fresh pellicles were used as substrates for *in vitro* batch culture fermentation. Homogenised pig faeces were used as inoculum. Cumulative gas production was measured at regular time intervals during the fermentation, as well as the end-products (SCFA and NH4$^+$) at 96h.

Outcomes
BCP30DE and BCP60DE pectin samples had similar gas production kinetics both in fresh and dry samples.
Dry samples were fermented more rapidly than fresh samples for all three substrates. This may be due to the smaller pieces which are easier for the bacteria to attach to and metabolise. Pectin composites started producing gas faster; while BC had a longer lag phase. This suggested that pectin-containing pCW was more easily fermented by some of the fecal bacteria, whereas faecal bacteria only adapt to utilization of BC after a longer time.

Conclusions
This *in vitro* method can be used as a stable and repeatable model to predict the functions of pCW in the large intestine in terms of fermentation.

Source of funding

Concurrent Session 3: Human Gut Microbiota

Minimising the impact of high fructose foods for patients with irritable bowel syndrome: investigating the use of added glucose to assist with fructose absorption

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Background
Malabsorption of fructose occurs in 40% of healthy Australians but may be a major problem for individuals with Irritable Bowel Syndrome (IBS). The addition of glucose has been shown to assist in free fructose absorption in test solutions and juices however this effect has never been investigated using whole foods.

Objective
To investigate the effect on fructose absorption when glucose was added to foods with naturally high levels of free fructose.

Design
A randomised, single-blinded, crossover intervention trial was conducted with 18 fructose malabsorbers (9 healthy, 9 with IBS). The two test diets were low in potentially fermentable carbohydrates (FODMAPs) and were given for 2 days. On day 2, both diets contained foods high in free fructose with one test diet containing equimolar amounts of glucose. Breath samples were collected hourly and a bowel symptom questionnaire was completed.

Outcomes
Breath hydrogen production significantly increased (p=0.002) upon the inclusion of high fructose foods (3626±2314ppm/16hr to 7113±3594ppm/16hr). The addition of glucose significantly reduced breath hydrogen (4656±2813ppm/16hr; p=0.009). Fifteen of the 18 individuals had a reduction in breath hydrogen with the addition of glucose to the high fructose foods. Symptoms also significantly increased (p=0.035) with high fructose foods. This increase was not seen with the addition of glucose (p=0.552).

Conclusion
The results of this study show that the addition of equivalent levels of glucose to foods high in free fructose may be a successful strategy to reduce malabsorption of fructose in known fructose malabsorbers.

Effects of *Lactobacillus casei* spp Shirota on gastrointestinal symptoms and fermentation patterns in patients with IBS: a randomised, placebo-controlled trial

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Background
Although probiotics hold promise for the treatment of irritable bowel syndrome (IBS), studies have had varying success and predictive factors of therapy response have not been defined. A pilot study by Barrett et al. 2008 has demonstrated that *Lactobacillus casei* spp Shirota *(LcS)* administration may alter fermentation patterns with improved IBS symptoms.

Objective
To determine if *LcS* therapy specifically modifies gut symptoms and fermentation patterns in patients with IBS, and to examine its effect on fructose absorption.

Design
IBS patients undertook a double-blind, randomised trial of either 6.5×10^9 cfu (one bottle) *LcS* or placebo. This was followed by a six-week period each of open-label *LcS* therapy and withdrawal phase. Breath hydrogen responses to lactulose (15 g) and, in some patients, fructose (35 g) were evaluated before and at the end of each phase. Gastrointestinal symptoms were measured on a 100 mm visual analogue scale (VAS).

Outcomes
A total of 45 IBS patients (23 *LcS*, 22 placebo) completed the double-blinded phase. A similar proportion of *LcS*- (38%) and placebo-treated patients (44%) no longer had an early breath response to lactulose. No changes were found between treatment arms for overall IBS symptoms and the proportion with complete fructose absorption (27% vs 33%). In the open-label phase, patterns of lactulose breath response were similar between those receiving 12- vs 6 weeks of *LcS* (33% vs 42%; *p*=0.85). Of the symptoms assessed, only stool satisfaction improved in patients having 12-weeks of *LcS* (median IQR: 28[17-36] mm vs week 6 (43[30-51] mm; *p*=0.03, Wilcoxon signed ranks). Complete fructose absorption occurred in similar proportions of patients receiving 12 vs 6 weeks of *L*cS (*p*=0.67; chi-square). Overall symptom changes were not associated with changes in breath response to lactulose during both treatment phases (*p*>0.05).

Conclusion
Therapy with *LcS* did not modify abdominal symptoms, alter fermentation patterns, or fructose absorption capacity in patients with IBS. Fermentation patterns of lactulose is not useful to predict response to probiotic therapy in IBS.

Concurrent Session 3: Human Gut Microbiota

Red-fleshed apples, flavonoids, and gut microbiota

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Background

Apples are good sources of dietary fibre, vitamin C, and phytochemicals including flavonoids. Their consumption is associated with reduced risk of chronic diseases by influencing blood sugar regulation, lowering of blood lipids, reducing food intake, and modification of gut microbiota.

Objective

To determine the effects of high flavonoid red-fleshed apple consumption on gut microbiota in healthy mice.

Design

A red-fleshed apple was genetically engineered from the `Royal Gala' variety by over-expression of the MYB transcription factor, *MYB10*, which regulates flavonoid biosynthesis. MYB10 apples had higher concentrations of polyphenols (anthocyanins, flavanols, flavonols) than the `Royal Gala' apples. Six week old mice were fed AIN-76A diet supplemented with 20% freeze-dried finely ground white fleshed `Royal Gala' apple (flesh & peel, cortex only) or MYB10 red fleshed apple (flesh & peel, cortex only) for 21 days. Weight gain, food intake and faecal output were recorded for each 7 day period. Colonic microbiota numbers were determined by real-time PCR.

Outcomes

Diet affected all the attributes measured. Weight gain was significantly higher (*P*=0.009) for the mice fed the control diet (AIN-76A). There was no effect of diet on food intake. Fibre intake was significantly lower ($P < 0.001$) for the mice fed the control diet. Faecal dry matter output was significantly greater from the mice fed *MYB10* apple ($P < 0.001$) than for those fed the `Royal Gala' apple which in turn was significantly greater than that for the mice fed the control diet. Total bacteria and the *Bacteroides-Prevotella-Porphyromonas* group in the colon were significantly higher ($P < 0.001$) in the mice fed *MYB10* apple (flesh & peel). *Bifidobacterium* spp. levels were highest ($P < 0.001$) for the mice fed the `Royal Gala' apple diets.

Conclusion

The consumption of red-fleshed apple positively affected gastrointestinal physiology and the composition of the gut microbiota. These potential health benefits following the consumption of red-fleshed apples provide impetus for hastening the development of such varieties through traditional breeding activities.

Source of funding

Probiotic bacteria and glycaemic control: a randomised controlled trial

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Background

Evidence from animal and *in vitro* models suggest a role of probiotic bacteria in improving glycaemic control and delaying the onset of type 2 diabetes. However, the evidence from controlled trials in humans is limited. **Objective**

To determine if probiotic bacteria, in a whole food (yoghurt) or isolated (capsules) form, can improve biomarkers of glycaemic control.

Design

Following a 2-week washout period, 156 overweight men and women over 55 y (mean age: 67 ± 8 years; mean BMI: 31 ± 4 kg/m^2) were randomised to a 6-week, factorial, parallel, double-blinded study. The four intervention groups were: A) probiotic yoghurt plus probiotic capsules; B) probiotic yoghurt plus placebo capsules; C) control milk plus probiotic capsules; and D) control milk plus placebo capsules. Outcome measurements including fasting glucose, insulin, glycated haemoglobin and Homeostasis Model Assessment of Insulin Resistance (HOMA-IR), were performed at baseline and week 6.

Outcomes

Probiotic yoghurt resulted in higher HOMA-IR (0.32 ± 0.15, P=0.038), and no significant effect on other measures of glycaemic control (P>0.05), relative to the milk control group. Probiotic capsules resulted in higher fasting glucose (0.15 ± 0.07 mmol/L, P=0.037), and no significant effect on other measures of glycaemic control (P>0.05), relative to placebo capsules. Sensitivity analysis did not identify other variables as contributing to these potentially adverse findings.

Conclusion

Data from this study does not support the hypothesis that probiotic bacteria, either in isolated form or as part of a whole food, benefit short-term glycaemic control. Indeed, there is weak data for an adverse effect of probiotics on glucose homeostasis.

Source of funding

Plenary Session 3: A New Look at Dietary Fibre

Plant polysaccharides – architecture, molecular organisation and implications for health

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Background

Plant polysaccharides, primarily in the form of starch and plant cell walls, are a major contributor to dietary energy and food architecture respectively. The properties of polysaccharides are characteristic of their molecular shape, which is determined by the geometry of the linkages between monosaccharide building blocks more than the nature of constituent monosaccharides. Despite their apparently hydrophilic nature, many polysaccharides are poorly soluble or insoluble, primarily because of a tendency to associate into larger structures either with themselves (e.g. starch granules, cellulose fibres), other polysaccharides (e.g. plant cell walls) or other molecules relevant to nutrition (e.g. polyphenols, enzymes, bile). This diversity of interactions provides a richness of behaviour in the digestive tract which belies the relatively simple chemistry of polysaccharides, and can control diverse properties such as enzyme digestion rates, nutrient bioaccessibility, gastro-intestinal passage rate, and microbial fermentation rate and end-products (1).

Enzyme digestion rates

Architecture and molecular organization control the intrinsic rate of starch digestion by alpha-amylase through two generic mechanisms, namely control of access of enzymes to starch, and modulation of enzyme action once enzymes have access to starch. Slowing down this rate can be achieved through the type of starch, the presence of soluble plant polysaccharides, or encapsulation within plant cells or food matrices. This can result in reduced rates of post-prandial blood glucose increase and/or increased levels of the resistant starch which escapes digestion in the small intestine and provides a fermentation substrate for colonic microflora. However, it is not only the intrinsic digestion rate which is impacted by plant polysaccharides but also gastric residence time and both small intestinal and colonic passage rates. It is the interplay of digestion rates and passage rates that ultimately contributes the food factors which influence both glycemic response and resistant starch levels. Whilst considerable progress has been made in deriving fundamental structure-digestibility relationships for e.g. cereal grains (2) and starch granules (3), less progress has been made on the interplay between enzyme digestion and digesta passage rates. The same principles that apply to starch digestion also apply to lipid and protein digestion but have not been investigated as systematically, neither has there been much progress in understanding how plant polysaccharides influence the amount of pancreatic enzyme activity secreted in response to food intake.

Nutrient bioaccessibility

Plant polysaccharides provide the basic structure of foods derived from cereals, fruits and vegetables through their often thin but tough and dense cell walls. This has three consequences for the release of nutrients from the food matrix during digestion. Firstly, small hydrophilic molecules such as simple sugars are released slowly from pieces of e.g. fruits and vegetables, providing a structural rationale for attenuated glycemic responses (4). Secondly, lipophilic molecules such as carotenoids are prevented from being released from food by a single intact cell wall, as there is no mechanism available for them to pass across the wall to potential emulsifying bile salts (5). Finally, hydrophilic polyphenols and phenolic acids bind to cell wall structures sufficiently tightly that they are not released under gastric or small intestinal conditions (6).

Microbial fermentation

Macronutrients which survive enzyme digestion in the small intestine and micronutrients which are not bioaccessible in the small intestine pass into the colon, together with all non-starch polysaccharides, the combination of which provide energy sources for the growth of microflora with production of beneficial fermentation products provided that the bulk of the fermentation is based on carbohydrate rather than protein. The molecular organisation of plant polysaccharides influences the rate and end-products of fermentation, with a small amount of a readily fermentable substrate able to stimulate fermentation of much more intractable polysaccharides such as cellulose (7) when present as a composite material such as found in plant cell walls. Plant cellular architecture can also impact on fermentation kinetics, with dense structures such as grains fermenting slower as particle size increases, but open structures such as carrot particles fermenting more rapidly by providing a productive ecological niche for microflora to flourish in (8).

Conclusion

The diverse properties of plant polysaccharides cover a hierarchy of length scales from nm to cm which need to be taken into account in defining the basis for associated nutritional properties that may underlie health benefits (1).

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Plenary Session 3: A New Look at Dietary Fibre

Dietary fibre and satiation

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Given that many people in developed countries are living in an obesogenic environment, the identification of contributing factors and solutions are widely sought. A dietary component having a longstanding association with appetite control is fibre. Foods naturally high in fibre including fruit, vegetables, wholegrains and legumes also tend to have high water contents, high volume and low energy density. These nutritional qualities may themselves create a feeling of satisfaction independent of the fibre content. Further complications in the relationship between fibre and appetite are that fibre comprises a range of compounds having a variety of chemical compositions with the potential to exert different physiological effects.

In this talk I shall discuss aspects of fibre and appetite control with regard to definition, measures of satiety, mechanisms, published evidence and some of our own work.

Plenary Session 3: A New Look at Dietary Fibre

Feeding a hungry microbiome : fermentable fibre and the Australian paradox

DL Topping

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Background

Globally, many health authorities recommend greater consumption of dietary fibre (DF) in the expectation of lower risk of the "diseases of affluence". While there is a genetic component, it appears to be small. For colo-rectal cancer (CRC), >80% are thought to be due to environmental factors, notably diets high in energy-dense, refined foods. Evidence from population studies (such as EPIC) shows dose-dependent risk reduction with greater DF intake (1). DF intakes are low in many industrialised countries, consistent with this greater CRC risk. However, Australian DF consumption is high by international standards, largely as cereal fibre. This should have been protective but CRC rates remain stubbornly high (and rising). This paradox is explicable by re-examining the role of individual DF components and how they affect health outcomes.

Resistant Starch and Dietary Fibre

The current high interest in fibre stems from the early work of British Medical Officers in Africa. They noted that the (black) natives ate unrefined cereal staples and were essentially free of the modern diseases affecting Europeans living in the same region. This difference was ascribed to the apparently high level of DF in the native foods (2). DF resists human small intestinal digestion and, given the limited analytical technology available then, became identified as (largely) insoluble cereal fibre ie roughage. This concept readily explained the faecal bulking and laxating effects of DF. Otherwise, the concept has proved very disappointing. Newer analytical methodologies have revealed that fibre is actually a complex mixture of (largely) plant carbohydrates. Principally, these are non-starch polysaccharides (NSP) and starch escaping small intestinal digestion (resistant starch, RS). NSP were thought to be the most important fibre components but it has emerged that African NSP intakes are low but their RS intakes are high due to their culinary practices which favour RS formation (3). Fibre carbohydrates are fermented by the human large bowel microbiome with short chain fatty acids (SCFA) principally acetate, propionate and butyrate as main end products. As in herbivores, SCFA are used by the human host and mediate many of the actions ascribed to fibre itself. Butyrate is thought to be particularly important in maintaining a normal colonocyte population (4). Generally, the cereal NSP in Australian foods have low fermentability but that of RS is high and favours butyrate production. Faecal SCFA levels (including butyrate) are elevated in low risk populations consistent with more RS intake. RS levels in modern processed foods are very low suggesting that risk of CRC and related diseases is a deficiency – the hungry microbiome. It is very difficult (and expensive) to change manufacturing processes so feeding the microbiota needs new ingredients for consumer foods. High amylose maize starch (*Hi-maize*™) is an example of this. CSIRO is developing new cereals including high amylose barley and wheat for this purpose. Human studies show it is possible to raise faecal SCFA to levels found in low risk population but individual responses may vary. Other data show that raising large bowel SCFA can also modify biomarkers favourably, consistent with lower disease risk (4).

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Dairy Australia Lecture

Dairy fats, cardiovascular and metabolic diseases: lessons from epidemiologic studies

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Background

Current dietary guidelines emphasise lowering consumption of food sources of saturated fat, including whole fat dairy products, as an important strategy to promote health (1-4). These guidelines are based upon findings from animal and human studies linking higher intakes of total saturated fat to higher concentrations of plasma lipids and atherosclerosis (5). However, meta-analyses that systematically combined results from large studies have shown no evidence of harmful effects of total saturated fat intake or dairy consumption on cardiovascular disease and diabetes (6-8). In addition, results from recent epidemiologic studies have shown beneficial effects of dairy fat and dairy foods on cardiovascular disease outcomes and metabolic disorders (9-14). What are the factors that may help elucidate the conflicting results of prior studies? Which conclusions can be drawn based on this body of evidence?

The objective of this lecture is to discuss available evidence from epidemiologic studies evaluating cardio-metabolic effects of dairy fat and dairy food consumption.

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Source of funding

Muriel Bell Lecture

Omega-3's: Food for the Brain

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Optimal brain function is vital throughout all stages of life. It is important to optimise brain development during childhood, maintain optimal functioning throughout adulthood, and defer cognitive decline in old-age. The omega (n)-3 polyunsaturated fatty acids (PUFA) derived from marine sources may play an important role in achieving these objectives. This review will explore the role of n-3 PUFA on cognitive function during childhood, adulthood and old-age. The n-3 PUFA's were discovered only four decades ago when two Danish physicians, Jørn Dyerberg and Hans Olaf Bang, undertook an expedition to the north-west coast of Greenland in August and September 1970, in their quest to find out why Greenland Eskimos rarely develop heart disease or diabetes, despite a high-fat diet consisting mainly of food provided by the sea (whale and seal meat, fish, sea birds). They discovered omega-3 fatty acids in the blood of the Eskimo's - fatty acids with 18-22 carbon atoms and a signature double bond located between the third and the fourth carbon atoms as counted from the methyl end of the fatty acid carbon chain (n, or omega). Today, we know that n-3 PUFA's affect various biological and physiological processes and have wide-ranging health benefits including brain health and function. The human brain is the most lipid rich organ in the body, only surpassed by adipose tissue. The long chain (LC) n-3 PUFA, docosahexaenoic acid (DHA, C22:6), is the dominant n-3 PUFA in the brain and affects numerous neuronal and glial cell processes. DHA is incorporated into neuronal membrane glycerophospholipids at the *sn*-2 position where it plays an essential role in neurogenesis, neuroplasticity, neurite outgrowth, synaptogenesis and membrane fluidity which in turn supports membrane protein function, gene-expression and signaling events. DHA also improves vascular tone which is likely to increase cerebral blood flow during cognitive tasks. Unesterified DHA, released from glycerophospholipids by phospholipase A2, counteracts neuroinflammation and increases neuronal survival via downregulation of inflammatory cytokine production and release of neuroprotectins and resolvins (1, 2, 3). Studies in animal models which involved dietary n-3 PUFA depletion have shown decreased brain DHA levels, particularly in the frontal cortex and hippocampus areas, with reciprocal increased levels of the n-6 PUFA, docosapentaenoic acid (DPA, C22:5) which in turn affected brain function, including changes in learning, memory, auditory and olfactory responses (3, 4, 5). These effects were, however, restored by repletion with dietary DHA (5). Basic research therefore provides strong support for the notion that DHA should have cognitive-enhancing effects in humans. Research on the effects of DHA in terms of its effect on cognitive function in children, adults and older adults using randomised controlled trials (RCT) have been inconsistent with some showing benefits while others failed to show any effects. Many of the RCT had intrinsic design limitations which hampers drawing conclusions regarding their efficacy. The limitations include small dosages, small sample size, short duration and most studies did not take into account baseline n-3 PUFA status and the potential response modulating effects of age, gender and apolipoprotein E (*ApoE*) genotype (a major genetic risk factor for Alzheimer's disease). A small number of studies in mainstream healthy primary school children indicate that DHA supplementation may improve learning (e.g. reading), cognitive function and behavior and disadvantaged children and children with lower literacy ability may benefit more. With regard to cognitive functioning during adulthood we showed, in the only robust RCT in young healthy adults whose habitual diets were low in DHA, that DHA supplementation improved memory and the reaction time of memory. An important finding from this study was that the response was modulated by gender and potentially by *ApoE* genotype (1). Observational studies in older adults showed inverse correlations between fish intake, dietary and biomarker levels of LC n-3 PUFA and age-related cognitive decline. Although evidence from RCT is inconsistent, some studies suggest that DHA may be of benefit for older adults with age-related cognitive decline or mild cognitive impairment, but not patients with Alzheimer's disease. It is too early to make dietary recommendations specifically for LC n-3 PUFA and cognitive function. In the meantime we should aim to achieve the Australian-New Zealand suggested dietary targets (SDT) for LC n-3 PUFA: adult men: 610mg/d; women: 430mg/d or two fatty seafood meals per week. However, large proportions of the New Zealand and Australian populations do not or rarely consume seafood. Consumption of LC n-3 supplements may also be an option to increase intakes. We have shown that erythrocyte LC n-3 PUFA status can be equally enhanced by consumption of either 2 servings of oily-fish per week or daily dosages of supplements (6). Other strategies to increase intake include consumption of foods enriched in LC n-3 PUFA, which are currently limited in NZ. In conclusion, LC n-3 PUFA's may have cognitive advantages, and individuals with low intakes may benefit from increasing their intakes. The major challenges ahead are to design and conduct robust RCT, to provide the evidence-base for dietary recommendations, and to develop sustainable strategies for consumers to meet the dietary recommendations.

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Concurrent Session 4: Fibre and Carbohydrates

The roles of cellulose in controlling the bioaccessibility of dietary polyphenols

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Background

There has been an increasing interest in the roles of dietary fibre in controlling the bioaccessibility and bioavailability of phenolic compounds. Previous studies showed that polyphenols from black carrot juice bind strongly to bacterial cellulose (BC) and pectin composites. However, the mechanism behind the binding/release of polyphenols to/from plant fibre is still not well understood.

Objective

The aims of this study were: i) to investigate binding capacity, binding characterisation and mechanisms for the interactions of diverse polyphenols with cellulose; and ii) to examine the release of polyphenols associated with cellulose under the conditions of the digestive system.

Design

BC composites, synthesised by *Gluconoacteobacter xylinus* (strain ATCC 53524), were incubated in pure polyphenol solutions at different concentrations, for various exposure times from 1 min to 24 h. All experiments were conducted in the dark, at 4°C, on an orbital shaker (100 rpm). Following the binding assays, the release of polyphenols from cellulose was investigated by employing a two-stage *in vitro* digestion model. Confocal laser scanning microscopy (CLSM) was used to visualise bound polyphenols on BC composites.

Outcomes

The interactions between different polyphenol classes and BC composites occurred spontaneously, rapidly, and to different extents (up to 25% w/w). Confocal images visually show the binding of auto-fluorescent polyphenols onto cellulose frameworks. In addition, the adsorption capacity of polyphenols significantly ($P<0.05$) increased with an increase in initial polyphenol concentration and contact time. This allowed Langmuir binding isotherms to be applied to determine quantitative aspects of the adsorption. Under the conditions of simulated gastric and small intestinal digestion, the release of bound polyphenols from cellulose was relatively limited. There were up to 50% and 70% of anthocyanins and phenolic acid, respectively, still bound to cellulose after digestion.

Conclusion

The results provide mechanistic insight into the important roles of plant cell walls on the bioaccessibility of dietary phenolic compounds. The results also suggest that dietary fibre can interact with polyphenols and transport most of the bound polyphenols through the digestive tract to the large intestine.

Source of funding

Effects of soluble fibres on the amylolysis of raw and cooked starches

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Background

The rate and extent of starch digestion is receiving much attention in the context of the global obesity pandemic, and as a likely risk factor for type II diabetes. Among non-starch components, several studies have demonstrated that the presence of soluble dietary fibre in the diet attenuates the rate and extent of digestion of starch and absorption of glucose both in vivo and in vitro.

Objective

To identify mechanisms underlying observed glycemia-reducing effects of soluble fibres.

Design

The in vitro amylolysis of granular and cooked maize starch and the diffusion of glucose in the presence of 1% and 2% soluble fibres (arabinoxylan (wheat and rye) and mixed linkage beta-glucan (barley and oat)) were studied under no mixing, 200 rpm and 750 rpm mixing conditions.

Outcomes

The presence of soluble fibres increased viscosity by ca 10x and 100x for 1% and 2% concentrations respectively. Despite this large difference in viscosity, measured digestion and mass transfer coefficients were only reduced by a factor of 1.5 to 2.5 at the same mixing speed. In contrast, introduction of shear (mixing) in the digesting and diffusing medium significantly increased the rate of digestion and mass transfer of the glucose. This effect is such that mixing at high shear conditions negates the hindering effect of the increased viscosity imparted by the presence of soluble fibre.

Conclusion

Considering the modest reduction of in vitro starch hydrolysis and glucose diffusion at increased viscosity of the hydrolysing and diffusing medium respectively, the current results suggest that the beneficial effects of soluble fibres on post-prandial glycaemia in terms of attenuation of the overall rate and extent of dietary starch conversion to blood glucose levels is not simply due to the direct effect of viscosity on amylolytic digestion or product mass transfer rates.

Source of funding

Concurrent Session 4: Fibre and Carbohydrates

Mechanisms behind effects of cereal soluble dietary fibres on blood lipids

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Background

Viscous soluble dietary fibres (SDFs) such as β-glucan (βG) and arabinoxylan (AX) lower plasma cholesterol and triglycerides (TAG). The main proposed mechanism is that SDF impairs the reabsorption of bile salts (BS) into the enterohepatic circulation causing an excess excretion in the faeces which leads to a decrease in blood cholesterol.

Objective

To investigate whether a soluble wheat arabinoxylan-rich fraction (AXRF) added to the diet lowers blood cholesterol and triglycerides by the same mechanism as βG; and test how the SDFs interact with the BS micelles *in vitro*.

Design

In vivo experiment: Four groups of 8-wk-old pigs (n=40) were fed a low or high meat diet with or without AXRF for 4 wk, after which blood and digesta samples were collected. *In vitro* experiments: ^{13}C Nuclear Magnetic Resonance (NMR) and small angle X-ray scattering (SAXS) were used to probe direct binding between SDFs and BS micelles. A dialysis membrane mimicking the unstirred water layer lining the intestinal lumen was used to investigate whether the SDFs affect the rate of diffusion of BS micelles.

Outcomes

In vivo: AXRF significantly decreased blood BS concentrations in hepatic portal (HP) (P=0.003) and jugular veins (JV) (P=0.001) and TAG in JV (P=0.02) but with no effect on plasma cholesterol. The decrease in plasma TAG was consistent with a delay in the digestion of TAG, leading to a difference in FA digestibility (AXRF 90.4%; without AXRF 96%). No excess BS was found in the intestinal contents of the AXRF diets. *In vitro:* ^{13}C NMR & SAXS: No direct strong binding of SDFs to the BS micelles but dynamic association was observed. SDFs of different molecular weights slowed the rate of diffusion of the BS with viscosity and not concentration being the controlling parameter.

Conclusion

AXRF slowed intestinal lipid uptake but did not affect BS excretion which is consistent with lower plasma TAG and no change in cholesterol concentration. Viscosity and therefore molecular weight might be involved in TAG management by SDFs.

Source of funding

Fibre interactions with polyphenols and implications for gut release

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Background

The bioaccessibility of polyphenols and hence the bioavailability of these compounds is directly affected by plant cell wall (PCW) fibre in plant-based foods.

Objective

This study aims to characterise the mechanism(s) behind the binding of hydrophilic polyphenols with PCWs and their release during upper gastrointestinal digestion, and thereby provide an approach to assessing potential transportation of polyphenols to the colon.

Design

Binding interactions between hydrophilic polyphenols (anthocyanins and phenolic acids (PAs)) with PCW components were evaluated using the bacterial cellulose–pectin PCW model system and a black carrot puree system. Release of bound polyphenols was assessed using acidified methanol. *In vitro* gastric and small intestinal (S.I.) digestion was used to assess digestive release.

Outcomes

The majority of available polyphenols (60-70%) bound to PCW material with only 20-30% of anthocyanins and PAs respectively being released with acidified methanol. There was minimal (<2%) polyphenol release during *in vitro* gastric and S.I. digestion with confocal laser scanning microscopy showing localised binding of anthocyanins to PCW material both before and after upper gastric digestion.

Conclusion

Anthocyanins and PAs which bind to PCW matter had minimal release after simulated gastric and S.I. digestion. This indicates that PCW bound polyphenols are able to be transported to the colon where they would be expected to be released during fibre fermentation by gut bacteria and may therefore impact on gut health and microbiota populations.

Source of funding

Concurrent Session 5: Fats and Oils

Dietary alpha-linolenic acid decreases the docosahexaenoic acid composition of plasma phosphatidylcholine in young adult women

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Background
Results from a national survey of adult New Zealanders showed that sex differences exist in the n-3 long chain polyunsaturated fatty acid composition of plasma phospholipid. Women have a lower molecular percent of eicosapentaenoic acid (20:5n-3) and higher docosahexaenoic acid (22:6n-3) in plasma phospholipid compared with men.

Objective
To examine the effect of fish oil, a source of eicosapentaenoic and docosahexaenoic acids, compared with flaxseed oil, a source of alpha-linolenic acid (18:3n-3), on the long chain n-3 polyunsaturated fatty acid composition of young adult women.

Design
Three hundred and four women (mean age 22.1 y) were randomised to receive 1, 2, 3, 4, 5, 6, 10, or 15 ml per day of fish oil (n=234) or 10 ml per day of flaxseed oil (n=70) for fourteen days. Fatty acid composition of plasma phosphatidylcholine was measured at day 0 and day 14. Plasma total-, LDL-, and HDL-cholesterol as well as triacylglycerol were also measured at days 0 and 14.

Outcomes
The increase in the molecular percent of eicosapentaenoic acid in plasma phosphatidylcholine with fish oil was dose dependent. An equivalent increase of 0.7 mol% eicosapentaenoic acid in plasma phosphatidylcholine was achieved with 0.3 g/day of dietary eicosapentaenoic acid or 6 g/day of dietary alpha-linolenic acid – a twenty fold difference in relative bioavailability. Of particular note was that consumption of 6 g/day of alpha-linolenic acid for fourteen days decreased docosahexaenoic acid in plasma phosphatidylcholine by 0.3 mol% (95%CI, -0.6 to 0.0; $P = 0.004$). For the combined group of women who consumed any fish oil (n=234), mean plasma triacylglycerol concentration decreased significantly from 1.13 mmol/ L to 0.96 mmol/L (16% reduction, $P < 0.001$) and mean LDL cholesterol concentration increased by 7% ($P < 0.001$).

Conclusion
In this group of young adult women, dietary alpha-linolenic acid increased eicosapentaenoic acid but decreased docosahexaenoic acid composition of plasma phosphatidylcholine. Fish oil consumption decreased mean plasma triacylglycerol concentration.

Source of funding

Postprandial lipemia following consumption of saturated fat and omega-6PUFA rich diets: interactions with omega-3PUFA

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Background
Consumption of foods high in saturated fatty acids (SFA) has been associated with elevated blood lipid levels and consequently with increased risk of chronic diseases. However, studies on animal models have demonstrated that dietary SFA raise blood lipid (cholesterol and triglyceride) levels only when the diet is deficient in omega-3 polyunsaturated fatty acids (omega-3PUFA).

Objective
To examine the postprandial effects of omega-3PUFA supplementation on plasma lipid profile when the background diet is high either in SFA or in omega-6 polyunsaturated fatty acids (omega-6PUFA).

Design
The study was a randomised controlled, cross-over, dietary intervention trial involving 17 healthy women aged 18 to 65 years. Blood was collected after an overnight fast, then subjects consumed a single meal consisting of 3 capsules of omega-3PUFA (1.8g), 200mL water and 150g mashed potato mixed with either 38g butter (Meal A, high SFA) or 32g sunflower oil (Meal B, high omega-6PUFA). Blood samples were then collected at 1, 3, 4 and 6 hours post meal consumption. Following at least one week washout, the same procedure was repeated, following consumption of the alternate meal. Blood lipid profile (cholesterol, LDL-cholesterol, HDL-cholesterol and triglycerides) was measured at each time point.

Outcomes
The change in plasma triglycerides (measured as area under the curve) was significantly higher when participants consumed omega-6PUFA plus omega-3PUFA, compared with the SFA plus omega-3PUFA meal (P=0.0309). A trend for higher change in plasma triglycerides in pre-menopausal women was also evident (P=0.0663). No significant difference was observed in plasma total, LDL and HDL-cholesterol.

Conclusion
Change in plasma cholesterol was similar when subjects consumed either SFA or omega-6PUFA in association with omega-3PUFA. However, omega-3PUFA supplementation appears to be more effective in controlling post-prandial levels of plasma triglycerides when the background diet contains SFA rather than omega-6PUFA.

Source of funding

Concurrent Session 5: Fats and Oils

Short term bioavailability of docosapentaenoic acid (DPA, 22:5n-3) and eicosapentaenoic acid (EPA, 20:5n-3) in the rat

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Background

Fish oil has three main active omega 3 ingredients, known as eicosapentaenoic acid (EPA, 20:5n-3), docosapentaenoic acid (DPA, 22:5n-3) and docosahexaenoic acid (DHA, 22:6n-3). There have been lots of studies on fish oil and on pure EPA and DHA; however, few studies on pure DPA.

Objective

This study compared the incorporation of DPA and EPA into different tissues, and examined whether DPA feeding will result in greater loss of fatty acids in faeces of rats than EPA or olive oil.

Design

Male Sprague Dawley rats were randomly assigned to three groups of six, and were fed a semi synthetic high fat diet (23.5% fat) for 9 days. The test omega 3 fatty acids (EPA & DPA, 250 mg/animal/day, free fatty acid form) or olive oil (250 mg/animal/day) were added to the high fat diet on days 5, 6 and 7.

Outcomes

Dietary EPA and DPA appeared in the faeces when fed, and there was a 4.6-fold greater appearance of DPA compared with EPA (1.9% dose fed in DPA group). However, the total amount of faecal fat did not differ significantly between the groups. At the conclusion of the study (day 9), it was found that dietary EPA and DPA were associated with significantly increased EPA and DPA levels in the liver compared with olive oil fed group. DPA and EPA feeding increased the DPA and DHA level, respectively in the heart. Both EPA and DPA feedings increased the n-3 LCPUFA concentration in the liver and heart compared with the olive oil feeding or the initial data. DPA or EPA feeding did not affect the plasma fatty acid composition.

Conclusion

This study confirmed earlier findings that EPA and DPA have different metabolic fates. Although DPA was found in the faeces in larger quantities than EPA, both EPA and DPA were readily bioavailable to rats, and did not result in increased amount of faecal fat.

Source of funding

Plasma phospholipid classes and fatty acids indicative of dairy food consumption associate with diminished insulin resistance

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Background

Consumption of dairy food based on raised plasma fatty acid levels of ruminant origin has been reported to be associated with lower risk of type 2 diabetes.

Objective

To determine whether certain phospholipid species indicate dairy consumption and are associated with insulin sensitivity.

Design

Insulin sensitivity (IS) or resistance (IR) were established by Matsuda index (IS) and plasma insulin, HOMA-IR, and insulin$_{AUC120miin}$ after oral glucose load (all IR) in 86 overweight subjects with metabolic syndrome. Plasma phospholipids and fatty acids were measured by lipidomics. Food records including dairy products were collected. Linear regression analysis adjusted for multiple comparisons and possible confounders was conducted.

Outcomes

Phospholipids, total lysophosphatidylcholine (LPC) and total lyso-platelet-activating-factor (lysoPAF) and fatty acid C17:0 correlated significantly with serves of dairy foods and also associated positively with IS (Matsuda index P=0.001, 0.001, 0.04 respectively) but negatively with all 3 indices of IR (P for fasting insulin (P.<0.05 for all), HOMA-IR (P<0.05 for all), insulin$_{AUC120min}$ (P=0.01, 0.01 and 0.02 respectively). LPC stimulates glucose uptake through *GLUT4.* Lyso opposes thrombotic and inflammatory effects of platelet-activating factor.

Conclusion

Phospholipids LPC and lysoPAF and fatty acid C17:0 are good indicators of full-fat dairy intake which is more likely to associate with insulin sensitivity than with insulin resistance.

Source of funding

Concurrent Session 6: Animal Production

The protective role of milk lactoferrin on early weaning diarrhea in piglets

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Background
Lactoferrin is a natural rich compound in the milk of mammals that has been shown to play many biological functions in infants including regulation of immune response and protection against microbial infection. **Objective**
To investigate the effects of dietary supplementation of lactoferrin on gut maturation, intestinal micro-flora and early weaning diarrhea in newborn piglets.

Design
Fifty-four 3-day-old male piglets (Sus scorfa Landrace×Large White F1) were randomly allocated to one of three groups fed milk replacer supplemented with bovine milk lactoferrin (bLF) for five weeks: group 1 control: 0.05g/L with no added bLF, group 2: 0.5g/L of bLF and group 3: 1g/L of bLF. The descending colonic contents were collected for colonic bacterial community using qPCR. The faecal consistency score of piglet was monitored daily throughout five weeks.

Outcomes
Our results showed that the piglets administered lactoferrin significantly delayed the onset of food transition diarrhea; reduced the incidence, frequency and duration of diarrhea with a dose response relationship (P<0.05). There was no difference in 16S rDNA copies of total bacteria, Bifidobacteria and Lactobacillus per gram of colonic contents among the groups, however, the copy number of E.coli was reduced by 6% and 4% in high and low dose group than the control group (P<0.05).

Conclusion
Dietary lactoferrin supplementation improved gut comfort, gut development and alleviated non-infectious diarrheal symptoms. This benefit may result from the well-known immune-boosting activity of Lactoferrin.

Source of funding

Preferred food of breeding Kakapo the perfect calcium package for egg and chick development?

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Background
The large NZ native parrot, Kakapo, is under threat of extinction. They breed only in years when the local podocarps, including rimu (*Dacrydium cupressinum*) are fruiting heavily, and the fruit are the preferred food both in the diet of breeding females and for provisioning chicks. Attempts to provide a supplementary food during years of poor fruit supplies have failed to encourage breeding. Nutrient analysis of rimu berries reveals high calcium content (8.4mg/g dry matter) which would be essential for both egg shell production and the growing skeleton of the chick. Vitamin D is also critical for these processes and for the maintenance of calcium homeostasis, but the source of vitamin D for these nocturnal, ground-dwelling vegetarians is unknown.

Objective
To explore the vitamin D status of adult Kakapo, and to investigate the possibility that rimu berries provide vitamin D as well as calcium, thus differentiating them from the supplementary foods provided by Conservation staff.

Design
Previously collected and frozen serum from 10 adult birds (6 females, 4 males) was assayed by Canterbury Health Laboratory for $25(OH)D_3$ and D_2. Previously frozen rimu berries were analysed by the Massey University Nutrition Laboratory for vitamin D_3 and D_2.

Outcomes
Vitamin D status of the 10 adult birds was very low; mean 4.9 nmol/l, range 1 – 14 nmol/l $25(OH)D_3$. No $25(OH)D_2$ was detected in any of the birds. High levels of both D_2 and D_3 were found in the rimu berries.

Conclusion
Traditionally it has been considered that vitamin D_3 is the animal form and D_2 is the plant form of this endogenously produced secosteroid. However, D_3 has very recently been reported in the leaves of plants of the *Solanacae* family (tomato, potato, capsicum). The avian vitamin D receptor (VDR) is thought to have a much greater affinity for the D_3 form, whilst most mammals are able to utilise D_2 almost as efficiently as D_3. If rimu fruit are able to provide breeding Kakapo with D_3, and are a plentiful source of calcium, they could be the perfect food package for breeding and nesting birds, and could explain why previous attempts to provide alternative foods have been unsuccessful in stimulating the birds to breed or providing adequate nutrition for nestlings when the rimu crop fails.

Source of funding
Not applicable

Concurrent Session 6: Animal Production

Muscle antioxidant potential and oxidative process of meat in lambs fed traditional diets

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Background
Nutrient variation and diet type may impact antioxidant potential (vitamin E) in muscle, and free radical formation through lipid, protein or DNA damage, leading to changes in oxidative process in muscle.

Objective
To investigate the effect of commonly fed diets on muscle antioxidant potential and resistance to oxidative process.

Design
Lambs (n = 84) were randomly allocated to treatments by liveweight: Lambs finished on lucerne pasture (T1); Lambs finished on annual ryegrass with sub clover pasture (T2); Lambs finished on standard commercial feedlot pellets (T3); Lambs finished on a combination of annual ryegrass based pasture (as in T2) and feedlot pellets (first 2 weeks at 300 g/day/head and the remaining 4 weeks 500 g/day/head, T4). After 6 weeks of feeding, lambs were slaughtered and longissimus muscle samples collected. Antioxidant potential and the formation of lipid oxidative substances (malandialdehyde = MDA) were measured at 24 h and 120 h post-mortem, respectively.

Outcomes
Vitamin E concentration in muscle was highest in T2, lowest in T3 and modest for T1 and T4; the values were 2.10, 2.91, 0.73 & 2.16 mg/ kg meat for T1, T2, T3 & T4, respectively ($P<0.001$; SED = 0.11). The corresponding values for formation of lipid oxidative substances were 1.47, 0.70 , 1.77 & 1.05 MDA mg/ kg meat ($P<0.001$; SED = 0.25).

Conclusion
It was shown that higher antioxidant potential in muscle provides resistance to oxidation as shown by lower levels of lipid oxidative substances. Greater oxidative potential in muscle tissues may help to lower oxidative stress in animals leading to better production and quality.

Source of funding

Assessing equine body composition using bioelectrical impedance spectroscopy

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Background
In many situations, including clinical assessment of hydration and the design of feeding and training regimens for horses, it is desirable to have an accurate measure of body composition. Equine body composition is usually estimated subjectively from body condition score. Bioelectrical impedance spectroscopy (BIS) provides an inexpensive and rapid technique that is widely used to assess human body composition.

Objective
To determine resistivity coefficients for BIS analysis in horses and to validate the BIS technique against the reference method of deuterium dilution for prediction of total body water (TBW).

Design
Twelve standard-bred geldings with a mean body weight of 490.5 kg ± 35.2 kg were used in this study. Venous blood samples were obtained at time 0 (prior to dosing), and intervals up to 300 min post-infusion of a solution of $NaBr/D_2O$ (1 g D_2O kg^{-1} and 0.75 mmol NaBr kg^{-1} body-weight). BIS measurement (ImpediVet, ImpediMed Ltd.) was performed using needle electrodes located along the mid-line of the body (wing of the atlas to ipsilateral tuberal ischia). TBW was determined from deuterium dilution and extracellular water space from Br dilution. Resistivity coefficients were derived from these and the BIS data and TBW predictions were calculated using proprietary software. Validation of these coefficients and prediction of TBW was performed in an independent group of 6 horses.

Outcomes
Mean values of 558.7 ± 143.7 and 1517.0 ± 322.8 ohm.cm were obtained for extra- and intracellular resistivity coefficients, ρe and ρi, respectively. In the validation study, measured TBW was 271.6 ± 22.2 L, while the predicted TBW was 262.9 ± 32.9 L ($P > 0.05$, paired t-test); an underestimate of 3.2%; equivalent to a predicted % fat-free mass (%FFM) of 82.4 ± 7.3% compared to a measured %FFM of 80.8 ± 4.8%. TBW volumes were highly and significantly correlated ($r = 0.93$; $P = 0.008$) with limits of agreement (2SD) of ± 29.1 L (11.1%).

Conclusion
Once fully validated, BIS could provide horse owners and clinicians with a simple and inexpensive tool to monitor body composition and aid in management decisions to improve animals' health and welfare.

Source of funding

Concurrent Session 7: Bioactives

Phytochemicals in Australian papaya cultivars: the effect of maturity and cooking

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Background

Carica papaya commonly known as papaya or paw paw, is widely cultivated for its edible fruits. However, the predominate use as a ripe fresh fruit in Western culture is different to the Asian use where immature green fruit as well as leaves are commonly used as a food and for health benefits due to the phytochemical and enzymatic composition. To date, there is little information available on the phytochemical composition of Australian papaya cultivars as well as on the impact of maturity and cooking on these bioactive compounds.

Objective

To measure the effect of maturity and cooking on phytochemical composition and antioxidant capacity of fruit and leaves of four commercially available Australian papaya cultivars (RB1, RB2, RB4 and YB1).

Design

Four different stages of fruit maturity (stage 1: fruits with yellow area of 0–25% of the skin; stage 2: 25–50%; stage 3: 50–75%; and stage 4: 75–100%) and traditional Asian cooking methods were tested. Flesh, peel and leaves were analysed for ascorbic acid, carotenoids and polyphenols (HPLC) as well as antioxidant capacity (ORAC and total phenolic content (TPC)).

Outcomes

Phytochemical composition and antioxidant capacity varied across different cultivars, maturity stages and plant parts. RB4 had the highest β-carotene content at mid maturities (0.72 mg/100g FW) followed by RB2 (0.68 mg/100g FW), RB1 (0.59 mg/100g FW) and YB1 (0.28 mg/100g FW). Ascorbic acid was relatively high and ranged from 40.2-61.2 mg/100g FW. The highest antioxidant capacity could be measured in leaves (young and mature; ORAC: 93.2-185.2 µM trolox equivalents/g FW; TPC: 148-210 mg gallic acid equivalents/100g FW). Amongst maturity stages, cultivars at mid maturities (stage 3) exhibited the highest ORAC; whereas cooking leaves and unripe fruit resulted in significant reduction of ORAC activity. Polyphenols such as quercertin, kaempherol and coumaric acids were identified in papaya leaves.

Conclusion

The utilisation of unripe papaya fruit and leaves, as it is common practice in Asian countries, seems to be favourable in retaining high levels of dietary phytochemicals/antioxidants. However, a significant loss or change in bioactive compounds could be observed after cooking.

Source of funding

Chilli intake has beneficial effect on postprandial glucose in people with type-2 diabetes

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Background

We have previously shown a potentially beneficial role of chilli in improving postprandial glucose metabolism in healthy, but overweight individuals.

Objective

To compare the effects of a bland meal and a chilli-containing meal, at the end of a bland diet and a chilli-containing diet respectively, on postprandial plasma glucose, insulin and cytokines (IL-6, IL-10 and TNF-α) in twenty-five type-2 diabetics.

Design

Participants (11 male, 14 female; aged 63.1±7.1 years) consumed a bland diet, followed by a similar diet with 30 g/day of 'Freshly chopped chilli' blend (Masterfoods™; 62% cayenne chilli) every day for one-week each. Use of other spices was restricted to minimum amounts in both dietary periods. Postprandial glucose and insulin profiles were assessed in response to a standard bland meal and to a chilli-containing meal at the end of each respective dietary period. Meals were iso-caloric and provided the same amounts of protein, carbohydrates and fat.

Outcomes

There was no significant difference between fasting plasma glucose concentrations at the end of chilli and bland dietary periods (P=0.58). Area under the curve for glucose (AUC_{gluc}) *after* the chilli meal was approximately 25% lower than AUC_{gluc} *after* the bland meal (P=0.035). In contrast, $AUC_{insulin}$ was significantly higher *after* the chilli meal compared to the bland meal (P=0.025). Although plasma glucose peaked at 60 min post-meal for both meals, the peak concentration for the chilli meal was 1.8 mmol/L (95% CI -0.9 to -2.69 mmol/L) lower than the peak for the bland meal (P=0.0002). IL-6, IL10 and TNF-α were not significantly different between the two meals.

Conclusion

Chilli may have beneficial hypoglycaemic effects in type-2 diabetes. Further studies are required to elucidate mechanisms and test whether these beneficial effects can be maintained over long-term.

Source of funding

Concurrent Session 7: Bioactives

Phytochemicals in Kwai muk, an unexploited tropical fruit grown in Queensland, Australia

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Background
Tropical fruits are a popular target of health-conscious consumers worldwide. The phytochemical composition of these "Exotics" is of particular interest due to the potential health benefits of these compounds.

Objective
(1) to determine the phytochemical composition of Kwai muk (*Artocarpus hypargyreus*), a jackfruit relative and unexploited tropical fruit grown in North Queensland; (2) to assess the release/bioaccessibility (*in vitro*) of its main phytochemicals as an initial measure to predict their potential bioavailability.

Design
Kwai muk fruit extracts were analysed for anthocyanins, quercetin glycosides and carotenoids by HPLC-PDA-ESI-MS (LC-MS). Whole fruits were blended and the resulting puree subjected to simulated gastric and small intestinal digestion. The release/bioaccessibility of anthocyanins and quercetin glycosides was analysed by LC-MS.

Outcomes
Six anthocyanins could be identified in Kwai muk fruit (10.5 mg/100 g fresh weight (FW) in total) with cyanidin-3-glucoside, cyanidin-3-rutinoside, and pelargonidin-3-glucoside as the main pigments. Furthermore, several quercetin glycosides could be quantified with a total concentration of 8.4 mg/100 g FW. In addition to these hydrophilic compounds, 4 carotenoids could be detected in Kwai muk with β-carotene (16.5 µg/g FW) as the major one followed by α-carotene (2.4 µg/g FW), zeaxanthin (2.0 µg/g FW) and lutein (1.6 µg/g FW). A bioaccessibility of 37% for anthocyanins and 25% for quercetin glycosides was estimated after the *in vitro* digestion procedure.

Conclusion
The total anthocyanin content of Kwai muk is in the same range as reported for gooseberries, red currants and strawberries and its quercetin glycoside content is comparable to blueberries. The total carotenoid content was relatively low. The *in vitro* digestion of Kwai muk resulted in a relatively high release/bioaccessibility of anthocyanins and quercetin glycosides which is a basic requirement for their bioavailability and subsequent bioactivity. Although based solely on *in vitro* experiments at this stage, the present study could clearly identify Kwai muk as a promising candidate for follow-up studies evaluating its "full" nutritional/dietary value for humans.

Source of funding
The Queensland Government.

Increases in plasma lutein through supplementation are correlated with increases in physical activity and reductions in sedentary time in older adults

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Background
Cross-sectional studies have reported positive relationships between serum lutein (LT) and zeaxanthin (ZX) concentrations and higher physical activity levels, but it is not clear whether the association is causal.

Objective
The purpose of this study was to determine whether increasing plasma concentrations of LT and ZX through supplementation, with full cream milk as the delivery vehicle, could increase physical activity.

Design
Forty-four older adults (BMI, 25.3 ± 2.6 kg/m^2; age, 68.8 ± 6.4 yr) not meeting Australian physical activity guidelines (150 min/week of moderate to vigorous activity) were randomised to consume capsules containing 21 mg of LT and 0.9 mg of ZX or placebo capsules daily with 250 ml of full cream milk for 4 weeks and encouraged to increase physical activity. Physical activity was assessed by accelerometry (daily activity counts and sedentary time).

Outcomes
Thirty-nine participants competed the study (LT and ZX supplements = 19, Placebo = 20). LT and ZX supplements increased plasma LT ($139 \pm 57\%$, P<0.001) and ZX concentrations ($15 \pm 14\%$, P=0.04) compared with placebo. Percentage change in plasma LT was positively associated with the percentage change in average daily physical activity counts (r=0.36, P=0.03). Absolute and percentage changes in plasma LT were inversely associated with absolute (r=-0.36, P=0.03) and percentage changes (r=-0.39, P=0.02) in sedentary time. There was a trend for an inverse relationship between the change in plasma ZX concentration and time spent in sedentary activity (absolute change, r=-0.30, P=0.07; percentage change, r=-0.32, P=0.06).

Conclusion
Regular supplementation of LT and ZX increased plasma LT, which was associated with increased physical activity and reduced sedentary time in older adults. Larger trials should evaluate whether these changes in physical activity patterns are sufficient to provide health benefits over the longer term.

Source of funding
Funding for the study was provided by Meiji Co., Ltd, Tokyo, Japan.

Concurrent Session 7: Bioactives

Mastication influences carotenoid bioaccessibility from plant tissue *in vitro*

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Background
Tropical fruits contain carotenoids encapsulated in a cellular tissue structure, but nutritional recommendations are usually based on extracted contents of raw plant material. This does not reflect changes of physiological mastication and gastrointestinal processes including the action of digestive enzymes, pH effects or micellarisation. Moreover, interactions of phytonutrients and plant cell walls/components are not well-understood, and carotenoids have different bioaccessibility, depending on their organelle environment within the plant cell.

Objective
To examine the degree of mastication and effect of resulting particle sizes on the rate of carotenoid bioaccessibility after *in vivo* mastication and *in vitro* gastrointestinal digestion of mango fruit flesh.

Design
Fine and coarse chewers were selected by screening 20 healthy participants for *in vivo* mastication, and instructed to chew cubed mangoes and expectorate when they 'desired to swallow'. The collected boli were fractionated via a wet sieving method through five aperture sizes ranging from 5.6-0.075 mm, and each individual fraction was subjected to an *in vitro* gastric and small intestinal digestion model. β-carotene and violaxanthin were then chemically extracted and analyzed via HPLC with detection at 453 nm.

Outcomes
Bioaccessibility of carotenoids was highest in the smallest fraction consisting of 0.5-0.075 mm fragmented cells and lowest in large boli clumps of dispersed plant cell clusters and fiber network (>2.8 mm). Particle size profiles varied significantly (P=0.03) between fine and coarse chewing, suggesting that the degree of habitual mastication influences *in vitro* carotenoid release. Pureed mango showed 67% release after *in vitro* digestion, which is twice that of the masticated samples, emphasising the role of cell rupture during mastication in determining bioaccessibility.

Conclusion
Increased bioaccessibility with smaller particle sizes, is consistent with plant cell walls as physical barriers to the release of carotenoids. It is preferable to have an *in vivo* mastication step, as a size reduction technique prior to *in vitro* digestive processing.

Source of funding

TaqIB polymorphism in the *CETP* gene influences lipid responses to consuming kiwifruit in hypercholesterolaemic men

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Background
Fruit and vegetables are key elements of a cardioprotective diet, but benefits on plasma lipids, especially HDL cholesterol (HDL-C), are inconsistent both within and between studies.

Objective
We investigated whether four selected HDL-C-related polymorphisms (*CETP Taq1B*; *APOA1* -75G/A; *LIPC* -514C→T; *LIPG* I24582) modulate the plasma lipid response to a kiwifruit intervention.

Design
This is a restrospective analysis of data from our 12-week randomised controlled cross-over trial. Eighty-five hypercholesterolaemic men completed a 4-week healthy diet run-in period before randomisation to one of two 4-week intervention sequences of two green kiwifruit/day plus healthy diet (intervention) or healthy diet alone (control). Anthropometric measures and fasting blood samples were taken at baseline 1, after run-in (baseline 2) and treatment periods. The trial was registered with the Australian New Zealand Clinical Trials Registry (ACTRN12610000213044).

Outcomes
At baseline 2, *B1/B1* homozygotes of the cholesterol ester transfer protein (*CETP*) *Taq1B* gene had significantly higher total cholesterol (TC)/HDL-C, triglyceride (TG)/HDL-C and apolipoprotein (apo)B/apoA1 ratios and small-dense LDL (sLDL), compared to *B2* carriers. A significant *CETP Taq1B* genotype x intervention interaction was seen for the TG/HDL-C ratio (*P*=0.03). *B1/B1* homozygotes had a significantly lower TG/HDL-C (-0.23±0.58 mmol/L, *P*=0.03) ratio after the kiwifruit intervention, compared to control, whereas *B2* carriers were not affected. Lipid response was not affected by other gene polymorphisms.

Conclusion
In conclusion, the significant decrease in the TG/HDL-C ratio in *B1/B1* homozygotes, suggest that regular inclusion of green kiwifruit as part of a healthy diet may improve the lipid profiles of hypercholesterolaemic men with this genotype.

Source of funding

Concurrent Session 7: Bioactives

Dietary supplementation with docosahexaenoic acid (DHA) rich oil normalises hippocampal gene expression in diabetic mice

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Background

Deleterious effects of diabetes on cognitive function have gained particular attention in the recent years. The hippocampus, a limbic structure of the brain which is associated with higher brain functions such as memory formation and cognitive function, appears to be particularly vulnerable to the neurotoxic effects of metabolic insults such as in diabetes. A number of pharmacological and non-pharmacological interventions are being investigated to prevent or delay the onset of cognitive impairment and associated neurodegeneration.

Objective

To investigate the effects of dietary supplementation with DHA rich oil on hippocampal gene expression in streptozotocin (STZ) induced diabetic mice.

Design

Male C57Bl/6 mice were randomly divided into three (n=6 each) groups; control, diabetic and diabetic + DHA group. Diabetic groups received 50mg/kg of STZ for five consecutive days and the control group were treated with an equal volume of citrate buffer. Following the confirmation of diabetes, all the three groups were put on semi-pure AIN93G diet and treatment group was supplemented with DHA rich oil for six weeks. Animals were sacrificed and genome-wide expression profiling was carried out from the hippocampi of all the three groups. Genes of interest were selected based on fold change ≥ 1.2, statistical significance of P≤0.05 and genes that are involved in cognitive functions, synaptic plasticity and memory formation. Selected gene were further analysed by RT-qPCR.

Outcomes

More than 350 genes were differentially expressed, of which 23 had increased expression. Interestingly, insulin like growth factor II (Igf-II) & Sirt1 had increased expression accompanied by decreased expression of TNF-α, Il-6 & ApoE in the DHA rich oil supplemented as opposed to non-supplemented diabetic group.

Conclusion

Dietary supplementation with omega-3 polyunsaturated fatty acids (DHA) reduces hippocampal expression of genes involved in inflammation and increases expression of those promoting neurogenesis in diabetic conditions.

Source of funding

Concurrent Session 8: Dietary Assessment

Validation of the nutrition screening tool 'Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II' among people in advanced age

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Background
There is no gold standard for the detection of malnutrition in community-dwelling octogenarians and it remains under-diagnosed and under-treated. For a screening tool to be effective it must be valid to the population group and setting of its intended use.

Objective
To determine the validity of the nutrition screening tool 'Seniors in the Community: Risk Evaluation for Eating and Nutrition, version II' (SCREENII) among a purposive sample of octogenarians.

Design
A cross-sectional validation study in the Bay of Plenty involving 45 community-living residents aged 85-86 years. Equal proportions of participants were recruited at low, medium and high nutrition risk based on their SCREENII score 12 months prior. Nutrition risk was assessed using SCREENII. Demographic and health data were established. Using established criterion a dietitian's nutrition risk rating assessment ranked participants from low risk (score of 1) to high risk (score of 10). The assessment included a medical history, anthropometric measures and dietary intake. Dietary intake was established from three 24-hour multiple pass recalls. A Spearman's correlation determined the association between the SCREEN II score and the dietitian's risk score. Receiver operating characteristic (ROC) curves were completed to determine the sensitivity and specificity of the cut-off point for high nutrition risk.

Outcomes
The SCREEN II score was significantly correlated with the dietitian's risk rating (rs = -0.76 (p<0.01). A newly defined cut-off point <49 was established for high nutrition risk derived from ROC curves and AUC (0.87, p < 0.01); sensitivity 90% and specificity 86%.

Conclusion
SCREEN II is a simple, easy to use, 14 item questionnaire and appears to be a valid tool for detection of nutrition risk people aged 85-86 years.

Source of funding

Reliability and validity of a short tool assessing Australian toddlers' dietary risk

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Background
Identifying toddlers at dietary risk is crucial for determining who requires intervention to improve dietary patterns and reduce health consequences.

Objective
We aimed to determine the reliability and validity of a new simple tool that assess dietary risk patterns of Australian toddlers.

Design
The 19-item Toddler Dietary Questionnaire (TDQ) was developed based on Australian dietary guidelines and recent toddler dietary intake data (14m, n=552; 24m, n=493). It assesses the previous week's intake of 'core' (e.g. fruit, vegetables, dairy, meat, water) and 'discretionary' (high-fat, -sugar and/or –salt foods, sweetened beverages) food-groups, which is evaluated using a scoring system to determine total dietary risk (0-100; higher score=higher risk). Parents (n=111) of children aged 12-36 months completed the TDQ for their child and 2-4 weeks later completed a second TDQ and a validated Food Frequency Questionnaire (FFQ). FFQ data were converted to a third TDQ and risk score calculated. Test-retest reliability and relative validity of total dietary risk scores and cross-classification of risk scores into categories (low, moderate, high, very high) were assessed.

Outcomes
Reliability testing showed dietary risk scores between two administrations of the TDQ were highly correlated (ICC=0.91) but significantly different (mean ± SD: 28.0 ± 8.9 v 28.3± 9.4, p=0.005). Dietary risk scores between the TDQ and FFQ were highly correlated (r=0.81) and not significantly different (p=0.157), suggesting ability to identify dietary risk based on the TDQ at the individual and group level. Participants were classified into the same (reliability n=87, 78%; validity n=84, 76%) or adjacent (reliability n=24, 22%; validity n=26, 24%) dietary risk category.

Conclusion
The TDQ is a moderately reliable and valid assessment tool that screens toddlers to identify those at-risk requiring intervention. It can be used for population health monitoring, evaluating interventions and furthering our understanding of the relationship between dietary risk and health outcomes, including the development of childhood obesity.

Source of funding

Concurrent Session 8: Dietary Assessment

A revised index to assess diet quality of older Australian adults

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Background
Many Australians are not meeting current dietary guidelines putting them at greater risk of diet-related disease. It is important to investigate the dietary patterns of specific population groups in relation to compliance with dietary guidelines to inform future nutrition interventions.

Objective
To develop a diet quality index that reflects the 2013 Australian Dietary Guidelines and to determine the diet quality of a population-based sample of older adults.

Design
The cross-sectional study involved participants aged 55-65 years old living in Victoria (n=3968, 48% male) recruited from the electoral roll. Participants completed a postal questionnaire including a 111-item food frequency questionnaire and questions on sociodemographic characteristics and other health behaviours (smoking, physical activity). A revised version of a previous dietary guideline index (DGI) was developed to assess adherence to the Australian Dietary Guidelines and used to measure diet quality. The revised DGI included 13 components scored between 0-10 resulting in a total DGI score ranging from 0 to 130, in which a higher score indicates better diet quality. Associations were tested using one-way ANOVA and T-tests. All analyses were stratified by sex. Data are presented as mean DGI ± standard deviation.

Outcomes
Women had a higher DGI than men (89±14 vs. 81±15, P<0.01). Those with a university degree or higher had a better diet quality than those with no formal qualifications (86±13 vs. 77±15, P<0.01 for men; 92±12 vs. 86±15, P<0.01 for women). No significant differences in diet quality were observed according to employment status or retirement status. Diet quality was also associated with other health behaviours with better diet quality in both men and women who never smoked compared to regular or occasional smokers (84±13 vs. 71±15, P<0.01 for men; 84±15 vs. 91±13, P<0.01 for women) and higher diet quality in those meeting current physical activity recommendations compared to those not meeting recommendations (84±14 vs. 79±15, P<0.01 for men; 92±12 vs. 86±14, P<0.01 for women).

Conclusion
Adherence to dietary guidelines is greater among women, those with a higher education level and among those displaying other positive health behaviours. Further investigation of diet quality among older adults will help inform future strategies for nutrition intervention.

Diet quality is associated with physical and mental health status of older Australians

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Background
Diet quality is associated with chronic disease and mortality in older adults. It is unclear if diet quality is also related to overall mental and physical health status.

Objective
To examine associations between diet quality and self-reported physical and mental health status two years later in older men and women.

Design
Analysis was based on Victorian adults (n=2457, 1150 men and 1307 women) participating in the Wellbeing, Eating and Exercise for a Long Life (WELL) study, a population-based longitudinal cohort study. Participants aged between 55 and 65 years completed a postal survey at baseline and after two years. Diet quality at baseline was assessed via the revised Dietary Guidelines Index (DGI-2013) using data from an 111-item food frequency questionnaire. The DGI-2013 is scored between 0 and 130, with higher scores reflecting adherence to the Australian Dietary Guidelines. The Short-Form General Health Survey (RAND-36) assessed self-reported health status at two years, with higher scores reflecting better mental and physical health across eight domains. RAND-36 and DGI-2013 were grouped by median and quartile cut-points respectively for analysis. Associations between diet quality and health status were assessed separately for men and women using logistic regression adjusted for age, education, smoking, physical activity, BMI and menopausal status in women. Odds ratio (OR) and 95% CI for the top quartile compared to lowest is reported.

Outcomes
Diet quality was associated with greater self-reported general health (men: 1.72, 1.17-2.52; women: 2.07, 1.45-2.94). Diet quality was also associated with greater self-reported vitality (1.67, 1.13-2.48) in men. In women, diet quality was associated with better physical functioning (1.49, 1.04-2.13) and mental well-being (1.52, 1.08-2.14). Diet quality was not associated with role limitations due to physical health or emotional problems, bodily pain or social functioning scales.

Conclusion
Older adults who adhere to the Australian Dietary Guidelines report better health status. Further investigation is required to determine if diet can influence maintenance of health over time in an ageing population.

Concurrent Session 8: Dietary Assessment

Australian diet quality scores as predictors of type 2 diabetes risk?

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Background
Predefined diet quality scores represent the best available evidence of what constitutes a healthy diet, which enables examination of associations between overall dietary pattern and health status.

Objective
To evaluate the association between two diet-quality scores designed for use in the Australian population with risk of type 2 diabetes.

Design
A total of 8370 nationally representative Australian mid-aged women free of diabetes participating in the Australian Longitudinal Study on Women's Health were included in the study. Dietary Guideline Index (DGI) and the Australian Recommended Food Scores (ARFS) were computed from the baseline validated food frequency questionnaire. The association between diet scores and type 2 diabetes were assessed using multiple logistic regression adjusted for total energy intake, demographics and lifestyle factors. Incidence of type 2 diabetes was self-reported.

Outcomes
During six years of follow-up, 311 incident cases of type 2 diabetes were reported. DGI score was inversely associated with type 2 diabetes risk (relative risk [RR] comparing the highest to the lowest quintile was 0.51; 95% CI 0.35-0.76; P=0.01). There was no significant association between ARFS score and type 2 diabetes (RR= 0.99; 95% CI 0.68-1.43; P=0. 60).

Conclusion
This prospective study suggests that DGI but not the ARFS score is a predictor of type 2 diabetes risk.

Source of funding

Strong association of farming with chronic energy deficiency in rural south India

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Background
Under-nutrition and anaemia present enormous public health burdens in low income countries.

Objective
We examined factors associated with chronic energy deficiency (CED) and anaemia in disadvantaged Indian adults.

Design
In 11 villages in the Rishi Valley region of Andhra Pradesh, India, we collected information on socio-demographic factors, physical activity, anthropometry, blood haemoglobin concentration, and daily household food intake. These data were used to calculate body mass index (BMI), basal metabolic rate (BMR), daily energy expenditure, and energy and nutrient intake. We used multivariable backward stepwise logistic regression to assess socioeconomic and lifestyle factors associated with CED (defined as BMI<18.5 kg/m^2) and anaemia.

Outcomes
Data were available for 1178 individuals (45% male, median age 36 yrs (inter quartile range (IQR) 27–50). In total, 45% of adults were at risk of CED. No associations were found between total energy intake and risk of CED. Low income, belonging to traditionally marginalised groups and involvement in farming were positively associated with CED. Median iron intake was 43.4 mg/day (IQR 34–55) in males and 35.7 mg/day (IQR 26–46) in females. Dietary iron intake, at or above the recommended level, was not associated with anaemia in women (univariable OR: 1.23, CI: 0.73–2.10) or men (univariable OR: 0.39, CI: 0.14–1.04).

Conclusion
Unmeasured factors such poor iron absorption or high iron loss may contribute to the presence of anaemia in this population. Better nutrition plus reduced exposure to gastrointestinal parasites through improved farming practice may help to reduce CED and anaemia in this population.

Source of funding

Concurrent Session 8: Dietary Assessment

Estimation of dietary flavonoid intake and cognitive performance in older adults with Alzheimer's type dementia

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Background

Dietary flavonoid intake has been associated with improved cognitive performance and cognitive evolution with age. The total dietary intake and significant sources of dietary flavonoids in older Australians living with a neurodegenerative disease has not been assessed and may differ from current estimations for adults (65+yrs).

Objective

To estimate the total dietary intake and main sources of flavonoids in older Australians with Alzheimer's type dementia and to assess the relationship between dietary flavonoid intake and cognitive performance.

Design

Data from a 24-h diet recall in adults (65+yrs) with Alzheimer's type dementia (n=49) was cross-referenced with the *USDA database* for the flavonoid content of selected foods (release 3.1, 2013). A battery of cognitive assessments measured verbal learning and memory, working memory, semantic memory, short term memory and executive function. Bivariate correlations with Pearson and Spearman coefficients were performed and repeated after controlling for education.

Outcomes

Total flavonoid intake of 510mg/day (88% being flavon-3-ols) is lower than the Australian +65yrs estimation of 575mg/day. Black tea (80%) was the most significant dietary source of flavonoids followed by green tea (7.5%), red wine (4.5%), apples (1.7%) and oranges (1.6%) with their respective fruit juices. Total flavonoid intake and some cognitive outcomes were significantly correlated with the strongest relationship shown for tasks assessing semantic memory (r=0.319 p=0.025), including correlations for the flavonoid subclasses flavonols (r=0.321 p=0.025) and flavon-3-ols (r=0.323 p=0.023). Participants who displayed greater depressive symptoms consumed less flavonoids (r=-0.328 p=0.021). After controlling for education, the direction and magnitude of association between flavonoid intake and cognitive outcomes remained, however were no longer significant.

Conclusion

For older adults with Alzheimer's disease total flavonoid intake is lower than current Australian estimations but contributions of dietary sources are similar. The identified association between cognitive functioning, depression and flavonoid intake in adults with Alzheimer's disease warrants further research in a larger sample to identify whether dietary interventions may be indicated.

Concurrent Session 9: Food Choice

Can the Garden to Table programme improve children's fruit and vegetable consumption?

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Background

New Zealand children are not meeting fruit and vegetable recommendations. Garden to Table, an in-school cooking and gardening programme, offers a potential solution.

Objective

To evaluate the effects of Garden to Table participation for at least one school year on children's fruit and vegetable consumption and variety of intake, and their fruit- and vegetable-related knowledge, attitudes and self-efficacy.

Design

An epidemiological study comparing the amount and variety of fruit & vegetables consumed, and knowledge, attitudes and self-efficacy related to fruit and vegetables of two groups of children: 158 students aged nine to 11 years who had been in the Garden to Table programme for at least one school year, and 128 students from control schools, matched for year level. Quantitative evaluation used adapted versions of the Ministry of Health's 2002 National Children's Nutrition Survey food frequency questionnaire and the children's questionnaire used in the Stephanie Alexander Kitchen Garden evaluation. P<0.05 was used to indicate statistical significance.

Outcomes

No significant difference was found in the proportion of children meeting recommended overall fruit and vegetable intake between Garden to Table (38.8%) and control groups (39.8%), p=0.29. However, when individual reported fruit and vegetable consumption was summed, fruit and vegetable intakes were significantly greater in the control group (P=0.02 for both), but ranged from zero to 16 and from zero to 39.2 serves per day, respectively, indicating unreliable reporting. Significant gender and year-level interactions were present for vegetable and fruit variety, respectively, with boys in the Garden to Table group consuming 2.93 (0.18, 5.69) more vegetables per week than boys in the control group (p=0.02), and year 5 control participants consuming 3.43 (1.59, 5.27) more fruit per week than year 5 Garden to Table participants (p<0.01). The Garden to Table group had significantly greater scores for attitudes and knowledge. There were no significant differences in self-efficacy or cooking- and gardening-related behaviour scores.

Conclusion

The Garden to Table programme improved children's knowledge and attitudes about fruit and vegetables. However, further longitudinal research, using reliable assessment methods, within constraints of school settings is needed to evaluate consumption of fruit and vegetables.

Source of funding

The sensitivities to different bitter compounds sharing the same taste receptor are correlated in human adults

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Background

Bitter taste perception is activated by 25 different bitter taste receptors (T2R). Responsiveness to the bitter taste genetic biomarker 6 n-propylthyouracil (PROP) has been related to control of food intake, alcoholism and taste thresholds to other compounds. Based on this, the population is divided into PROP hyper, normal and hypo tasters. However, we hypothesise that the sensitivity to bitterness is related to specific bitter T2R variants and independent to other bitter sensitivities such as PROP.

Objective

To investigate the trend in taste perception of eight bitter compounds and relate it to PROP taste status in human adults.

Design

A 4 session, random, within-subject design with 34 panellists was adopted to study the individual intensity rating of 8 bitter agents (PROP, Phenylthiocarbamide (PTC), Gentian and Quassia extracts, Quinine Hydrochloride (QHCl), Caffeine, sinigrin and saccharin) that had the potential to activate different and/or shared, the same/multiple T2R. The intensities of these agents and NaCl solution (reference) were rated on Labelled Magnitude Scales (LMS). Intensities were rated relative to the sensations experienced in the mouth. Palate was cleansed using spring water and granny smith apple. Intensity rating of all bitter agents was replicated in different day sessions.

Outcomes

Each panelist had a unique profile in their intensity ratings. Consistent with previous literature PROP & PTC sensitivities were highly correlated (P<0.001). In addition, Sinigrin was also highly correlated with PROP (P<0.001). However, no other tastant seem to be correlated with PROP. In contrast, bitterness of Caffeine, Quassia & Gentian were found significantly correlated with QHCl (P<0.001). Most correlations seem to be linked to activation of at least 1 common T2R: T2R38 (PROP, PTC and Sinigrin), T2R4/46/47 (Quassia & Gentian), T2R14(Gentian, Quassia & Caffeine). However, QHCl does not activate any common T2R with the other bitter compounds.

Conclusion

Bitterness of different compounds are correlated when they activate at least one common bitter T2R with the exception of QHCl. The correlation of QHCl with other bitter compounds needs further investigation.

Source of funding

Not applicable.

Concurrent Session 9: Food Choice

Culinary practices and exposure to children's vegetable liking and consumption

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Background
Vegetables are the food category least accepted by children, which is a key reason for their low intake.

Objective
The objective of this study was to determine children's experiences with, and liking and consumption of vegetables in relation to the way they are prepared, and to compare low and high vegetable consuming children.

Design
Questionnaire data for five common vegetables were collected from parents for their child (n 82, 5-6 years, sample balanced for vegetable consumption; low $\leq$ 1, high $\geq$ 2 serves /day). Parents indicated for each vegetable which of 13 preparations the child had consumed before, the child's liking and consumption frequency of those vegetable preparation combinations they had consumed before, and addition of any flavourings. Data were analysed with ANOVA and Chi-square, with $P \leq 0.05$ as a criterion for statistical significance.

Outcomes
Parents used many different preparations for vegetables consumed by children, including serving in mixed dishes. Flavourings (salt, fats and sauces) were frequently used in all preparations with exception of raw preparation. Preparation affected liking and consumption frequency, and its effect on liking was vegetable specific ($P < 0.0001$). Low vegetable consumers liked vegetables less than high vegetable consumers ($P < 0.0001$), and had fewer experiences with vegetables and preparations ($P < 0.0001$). Liking and consumption frequency were associated (r 0.64, $P < 0.0001$), supporting the notion that increasing liking is a viable way to increase consumption. As exposure to vegetables has been shown to increase liking, results suggest that lower liking of low vegetable consumers is in part a factor of their environment. To increase vegetable intake in children: 1) vegetable-specific preparation strategies that consider sensory preferences and nutritional recommendations can be promoted, and 2) the child's vegetable exposure environment can be enlarged by increasing frequency and variety with which vegetable types and preparations are offered.

Conclusion
Preparation influences liking and consumption of vegetables, but its influence is the same on children of low and high vegetable consumption. However, low vegetable consumers have fewer experiences known to promote vegetable acceptance.

Source of funding
Not applicable.

Dairy food on the first daily occasion of eating

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Background
Dairy food intake by Australian children is substantially lower than recommendations from the age of 4 years, and decreases as a percentage of energy intake as children grow older. Breakfast skippers are recognised to have a lower dairy food intake but breakfast is usually self-defined by study subjects, or defined as food eaten during a specific time period.

Objective
To explore factors associated with dairy food consumption on the first daily occasion of eating Australian children.

Design
The Computer Assisted Personal Interview 24-hour dietary recall data of 4487 children aged 2 to 16 years participating in the 2007 Australian National Childrens Nutrition and Physical Activity Survey was used in this analysis. An occasion of eating was defined as all caloric food and drink consumed in a time interval provided that there was not more than 60 minutes between consumption of any of the items. Logistic regression was used to describe factors that were associated consuming dairy food on the first occasion of eating.

Outcomes
Dairy food was consumed on the first occasion of eating by 82 to 66% of boys, and 78 to 54% of girls (decreasing with age group from 2-3 years to 14-16 years). This was more than twice the prevalence of consuming dairy food on the second or third occasion of eating for each age group (P<0.001). Dairy food was less frequently consumed at the first occasion of eating if the subject was a girl, was older, the first occasion occurred before 0600 h or after 0900 h, or if the first occasion of eating occurred outside of home (all independent associations with P<0.001). The day of record being a school day or not a school day was not independently associated with a dairy food being consumed on the first occasion of eating.

Conclusion
The first occasion of eating is important for dairy food intake. Dairy food intake at this eating occasion or a nutritional equivalent should be encouraged for older children (especially girls)

Source of funding
Dairy Australia.

Concurrent Session 9: Food Choice

Antenatal knowledge of infant feeding recommendations and feeding intention amongst primiparous Queensland women

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Background

Amongst Australian mothers, duration of exclusive and any breastfeeding does not meet national goals. Few Australian women are aware of National Health and Medical Research Council (NHMRC) recommendations regarding the duration of exclusive breastfeeding, nor of its specific benefits to their infants.

Objectives

To assess antenatal knowledge of Australian infant feeding recommendations and the health benefits of breastfeeding amongst primiparous Queensland women. To describe feeding intention in this group and test the hypothesis that antenatal knowledge of recommendations predicts feeding intention for the infant's first year.

Design

Data collection was part of the Feeding Queensland Babies Study, a prospective questionnaire-based study of infant feeding attitudes and behaviours amongst primiparous women in Queensland. Data were taken from Antenatal and Demographic surveys. A knowledge score was calculated for each participant using responses to a set of questions relating to infant feeding.

Outcomes

Breastfeeding was selected by 85% of respondents as the best way to feed a baby, while 11% selected mixed formula and breastfeeding. Of women intending to breastfeed, 84% reported intention to do so for at least six months, and 18% for 12 months. More than a quarter of women indicated intention to introduce foods other than breast milk before five months of infant age. Knowledge Score was found to be positively correlated with intention for duration of any breastfeeding (R=0.31; P<0.001) and for later introduction of foods other than breast milk (R=0.30; P<0.001), though awareness of the specific benefits of breastfeeding was poor.

Conclusion

Knowledge of the benefits of breastfeeding and of recommended feeding transitions predicts intention for breastfeeding and the introduction of foods other than breast milk congruent with NHMRC recommendations for the first year. Enhancing women's understanding of breastfeeding's specific benefits and the reasons for advised scheduling of feeding transitions may enhance adherence with recommendations.

Source of funding

Not applicable

Family food involvement, frequency of family dinner meals and dietary patterns among Australian children

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Background

Involvement in meal preparation and eating meals with the family are associated with better dietary patterns in adolescents, however little research has included older children or longitudinal study designs.

Objective

To examine cross-sectional and longitudinal associations between family food involvement, family dinner meal frequency and dietary patterns during late childhood.

Design

In this three-year longitudinal study, surveys and food frequency questionnaires were completed at home by parents of 188 children from Greater Melbourne, Australia at baseline in 2002/03 [mean (SD) age = 11.2 (0.6) yrs] and at follow-up in 2006 [mean (SD) age = 14.2 (0.6) yrs]. Principal components analysis (PCA) was used to identify dietary patterns. Factor analysis (FA) was used to determine the principal factors from six indicators of children's family food involvement. Multiple linear regression models were used to predict the dietary patterns of children and adolescents from baseline indicators of children's family food involvement and frequency of family dinner meals. Models were adjusted for child gender, BMI z-score, maternal education, and clustering by school. Longitudinal models were adjusted for baseline dietary intake.

Outcomes

PCA revealed two distinct dietary patterns, labelled a "healthful" pattern and an "energy-dense" pattern. FA revealed one distinct factor for family food involvement. Family food involvement score (ß=0.55, 95% CI: 0.02, 1.07) and eating family dinner meals daily (ß=1.11, 95% CI: 0.27, 1.96) during late childhood were positively associated with the "healthful" pattern cross-sectionally among boys. Eating family dinner meals daily was inversely associated with the "energy-dense" pattern among boys (ß=-0.56, 95% CI: -1.06, -0.06). No significant longitudinal associations were found among boys and no associations were found among girls.

Conclusion

Involvement in family food and eating dinner with the family during late childhood may have a positive influence on boys' dietary patterns. No evidence was found to suggest the effects on dietary patterns persist into adolescence.

Source of funding

Concurrent Session 9: Food Choice

Assessment of diet and other chronic disease risk factors amongst the Sudanese immigrants in Queensland, Australia

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Background

Health and dietary habits of any society that migrates into another are influenced by acculturation. Sudanese immigrant to Australia cannot be an exception. Data are limited on the effects of dietary and lifestyle change among Sudanese and other Africans in Australia. Very limited studies have been conducted on dietary acculturation among Africans in Australia.

Objective

This study was aimed to assess the effects of diet and other lifestyle acculturation as contributing factors to chronic disease amongst Sudanese immigrants in Queensland.

Design

The study was a cross-sectional design that used quantitative and qualitative methods to collect data. Three hundred and fourteen adults were randomly selected to participate in the study. Data were collected on food consumption habits, childhood nutrition, health status and anthropometric measurements. Lifestyle habits such as alcohol consumption and smoking were also collected. Analyses were done to estimate prevalence of overweight and obesity. Relationships were examined among chronic disease risk factors and their link to diet. Focus group discussions were held to determine factors that contribute to food and lifestyle choices.

Outcomes

Result shows that 30.9% of the population were overweight, 20% obese and 32% were underweight. Females were 2.4 times more likely to be obese than males. The proportion of those underweight were higher among males (4.5%) than females (1.5%). Overweight and obesity were found to be higher amongst those under-nourished in childhood than those well-nourished and are associated with hypertension and type 2 diabetes mellitus. Alcohol and smoking remain less common than in the general community. However, relationship exists between them and the self-reported poor health status. Majority reported improvement in their health. Majority of the population consume more animal products than the plant. Choices of food are determined by taste, knowledge of the food items in the market and how they are cooked as well as cultural value of the food items.

Conclusion

Dietary and lifestyle acculturations appear to be contributing factors to chronic disease incidence among the Sudanese immigrant community in Queensland.

Source of funding

Not applicable

Plenary Session 4: Tropical Fruits and Vegetables

Tropical fruits and vegetables: an overview of their nutritional qualities and opportunities for enhancement

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Background

Tropical fruit and vegetables are naturally the major food and nutrition source in tropical countries, especially areas relying on local or subsistence agriculture. They used to be only occasionally consumed in Western countries with temperate growing conditions. However the internationalisation of trade, the search for novel crops and human migration patterns have seen both the availability and use of tropical products soar well above what it was in past decades. Their importance and impact on nutrition and health therefore deserves more focus. Excluding citrus and avocado as subtropicals, banana and plantain account for 61% of world tropical fruit production by weight followed by the group of mangoes, mangosteen and guavas (17%), pineapple (9%) and papaya (5%) with all other tropical fruit accounting for only 8% (1). Likewise vegetables from tropical climates that were confined to ethnic consumption in Western countries are now more commonly consumed and provide health and nutrition benefits. These vegetables include items such as bamboo shoots, bitter melon, lotus root, snake bean, yam, okra, taro and, although not strictly tropicals, various Asian leafy vegetables of the brassica family, like bok choy, choy sum, and gai lan and wombok, have entered Western diets.

Nutritional features

Tropical fruit and vegetables are valuable sources of macro and micronutrients such as vitamins. Many tropical products also have specific pharmacological activity and have been used as traditional medicines and health supplements. However it is the wide taxonomic base of tropical fruit and vegetables that opens up the potential for broader intake many and varied phytochemical health compounds (2). The basic families of phytochemical structures comprising polyphenols (such as flavonoids and their derivatives), simple phenolics (such as hydroxycinnamic acids) and terpenoids (such as carotenoids) are similar across all the plant kingdom. The individual derivatives, like caffeic acid, anthocyanins, quercetins and glycosinolates, are also often the same although there are many other derivatives and some unique structures. When consumed as part of a varied diet these compounds add to the more limited or narrow base of biochemicals in traditional western fruit and vegetables and should reinforce the synergistic benefits of eating fruits and vegetables (3).

Nutraceutical and functional food uses

Ethnopharmacological uses of tropical products have persisted but the cultural beliefs and traditional practices that accompany them have not often translated into application in Western societies. Some functional and nutraceutical properties have been commercialised often using a traditional back-story to aid marketing. Principle examples can be found in the promotion of products like noni (*Morinda citrifolia*) and açaí berry (black drupes of *Euterpe oleracea* palm) where marketing hype on traditional health uses predated the development of evidence for health claims (4). However other examples like the digestive health and cardiovascular protective properties of papaya (papain) and pineapple (bromelain) protease (5) and the pain relieving properties of capsaicin from chilli peppers have been proven by research and exploited in nutraceuticals. This has even extended to the marketing of chocolate as healthy due to its procyanidins and flavonoids specifically epicatechin whose microbial metabolites can lower blood pressure (6). Despite the research to date, much further work is still required to characterise the full health properties of even common products like resistant starch in green banana and the anti-diabetes activity of bitter melon and okra.

Potential for enhancement of phytochemical content

The phytochemical content of fruits and vegetables exists to protect and help the plant function and have not usually been optimised for human health. There are some minor examples such as natural selection of coloured flesh banana cultivars resulting in high carotenoid levels. Genetic engineering is also being used, such as to boost the vitamin and mineral content to alleviate malnutrition in some African societies that depend on banana as a staple food. In general however much more potential exists for selective breeding programs to create cultivars of tropical fruit or vegetables enhanced in critical nutrients. Examples achieved to date include 5-fold enhanced zeaxanthin in tropical sweet corn, 10-fold enhanced vitamin C in super sweet hybrid pineapples and high lycopene content in red papaya and water melon. Further examples could be developed as both health products for inadequate diets and to increase nutrient densities at lower energy intake for avoidance of weight gain.

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Plenary Session 4: Tropical Fruits and Vegetables

Mango fruit genomics: flavour, colour and nutritional bioactives

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Background

Mango (*Mangifera indica* L.) is an important tropical horticultural crop and iconic fruit for Australia. It is thought to be an allotetraploid (2n = 40 chromosomes) species with an estimated genome size of 440 mega base pairs. Total global production in 2010 exceeded 38 million tones, with India, China, Thailand, Pakistan, Mexico and Indonesia the largest producers.

The Australian mango industry is predominantly based on the variety 'Kensington Pride' which is popular with consumers but has a number of agronomically undesirable characteristics that impact fruit quality and productivity. The *Australian National Mango Genebank* is a large collection of genetically diverse mango varieties and related *Mangifera* species which are used as breeding parents to contribute to mango tree and fruit quality improvement (1). Using traditional breeding and selection approaches may take many years to lead to the release of a new variety. Like in other horticultural crops such as kiwifruit and apple, use of genetic and genomic data to support breeding efforts can achieve mango improvement more efficiently through marker-assisted selection.

For this purpose the *Queensland Mango Fruit Genomics Initiative* was instigated in 2006, a multidisciplinary program involving researchers with expertise in mango breeding, variety selection, physiology, molecular biology, biochemistry, genetics, bioinformatics, and food & nutrition science (2). This enabled the integration of phenotyping, genetics and genomics and fruit metabolomics for mango improvement. To facilitate the various research components and allow networking, a web-based *Mango Genomics Information System* http://mango.qfab.org was established which is accessible to collaborating scientists and institutions. We have identified candidate genes and gene products that control fruit flavour and colour, and have identified aroma volatiles from ripe fruit for a number of mango varieties. A database of mango expressed sequence tags (ESTs) and genomic sequences has been assembled and mined to discover genes and molecular markers for key fruit quality and health traits. Sensory and chemical flavour profiles for mango varieties have also been generated and linked to the genomic and phenotypic data.

Mango fruit bioactives and bioactivities

Tropical fruits such as mango are highly valued by consumers, but their nutritional and pharmacological benefits are poorly understood (3). Therefore, we have investigated nutritionally relevant biological activities associated with signature components, extracts and fractions from mango fruit flesh and peel, to investigate the hypothesis that bioactive compounds in mango modulate intracellular processes resulting in potential positive health benefits. To identify potential nutritional bioactives, mango fruit fractions and signature molecules were identified that show bioactivities in cell-based assays, which are considered predictive of human health biomarker benefits.

We have shown that bioactive compounds in mango modulate a group of transcription factors known as peroxisome proliferator-activated receptors (PPARs) that are increasingly linked to the differentiation and proliferation of some cancer cell lines. The mango signature compounds norathyriol, an active metabolite of mangiferin, and quercetin were shown to inhibit the ability of ligands to activate PPAR-mediated transcription. Effective extraction and fractionation methodologies were developed to assess biological activities associated with mango fractions. Many of the fruit extracts were effective in inhibiting the proliferation of human breast cancer cells *in vitro*, but there were significant fruit-to-fruit variability in quantitative responses (4).

Mango peel extracts were shown to affect adipogenesis in a pre-adipopocyte cell line model, using high content imaging. Peel extracts from one variety in particular was highly potent in inhibiting adipogenesis. There were clear differences between extract fractions derived from different mango varieties in their capacity to affect lipid accumulation in adipocyte cells, suggesting that variation in phytochemical composition, especially polyphenolic antioxidants, between cultivars may be important for these activities and that mango peel may be a potential source of nutraceuticals (5).

To link chemically identified bioactive compounds in mango fruit to the genes involved in their biosynthesis, we have identified ESTs that are predicted to play a role in the flavonoid secondary metabolite pathway that leads to important bioactive compounds such as epicatechin digallate. Mango peel was found to accumulate high transcript levels for key proteins that control flux in the pathway in ripe fruit, like anthocyanin reductase. Bioactive compounds, expressed genes and pathway enzymes identified in this work may enable breeders to 'custom design' new mango varieties to meet consumer expectations for quality, flavour, appearance and health benefits.

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Plenary Session 4: Tropical Fruits and Vegetables

Can eating kiwifruit pave the way to health?

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Background

Whole foods, such as fruit, contain many nutrients and bioactive compounds that may positively contribute to good health. Increasing evidence suggests that kiwifruit in particular contribute a number of health benefits (1). Research into their health benefits has focussed on the cultivars *Actinidia deliciosa* cv. 'Hayward' (green kiwifruit) and *Actinidia chinensis* cv. 'Hort 16A', ZESPRI (gold kiwifruit).

Compared with other commonly consumed fruit, both green and gold kiwifruit are superior in nutrient density, containing exceptionally high levels of vitamins C, E, K, folate, carotenoids, potassium, fibre and phytochemicals (1). All of these are associated with health benefits, but as part of the whole fruit matrix they may also act in synergy to attain numerous and enhanced health benefits (1).

Consuming kiwifruit as part of a healthy diet may improve metabolic markers in those with abnormalities such as dyslipidaemia, moderately increased inflammation and hypertension. Effects include increased HDL-C, and decreased triglycerides, hs-CRP, IL-6, platelet aggregation and blood pressure. These effects are possibly due to the combined effects of vitamin C, E and polyphenols (2, 3, 4, 5).

Gold kiwifruit consumed together with iron-rich meals improves poor iron status (6), likely due to the high vitamin C, carotenoid and citric acid contents. Green kiwifruit are high in the proteolytic enzyme, actinidin, and both soluble and insoluble fibre with high water-retaining capabilities which aid indigestion and improve laxation through faecal bulking and softening. As a rich source of antioxidants, kiwifruit may protect the body from endogenous oxidative damage with possible protection from CVD and cancer via its effects on oxidative stress (5).

Kiwifruit may support or enhance immune function and immune response. The incidence of upper respiratory tract infections may be reduced; specifically incidence and severity of cold or flu-like illness in at-risk groups such as older adults and preschool children (7, 8). However, kiwifruit are allergenic and although symptoms in most susceptible individuals are mild, severe reactions have been reported.

While many research gaps remain, the health benefits demonstrated so far, suggest that kiwifruit should be a key fruit for inclusion in diets where the focus is on increasing whole fruit and vegetable consumption for improved health and disease prevention. For those wanting to follow a preventive food-based strategy, eating kiwifruit may pave the way to better health.

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Source of funding

Concurrent Session 10: Nutrition in Childhood

Immune cells in breastmilk increase during infections of the mother and infant

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Background

Human colostrum is rich in immune cells, which protect the infant from infections at a period when it is most vulnerable. Very little is known about the content of mature breastmilk in immune cells and how they respond to infections of the mother-infant dyad.

Objective

We examined the effect of the health status of the mother and the infant on breastmilk immune cells and other immunological factors at different stages of lactation.

Design

Thirty-one breastfeeding dyads were recruited over a wide range of lactation stages (1-43 months). Breastmilk was collected when both the mother and infant were healthy and when either or both of them had a systemic or local infection. Breastmilk cells were isolated and stained for Flow Activated Cell Sorting analysis for the pan-immune marker CD45, and immune cell subtypes via co-staining for CD14, CD3, CD4, CD8, CD56, CD19, and CD15.

Outcomes

Under healthy conditions, breastmilk contained 0-2% of immune cells (0-1,365 immune cells/mL breastmilk). This increased to up to 94% of total cells (2,594,982 leukocytes/mL breastmilk) when either the mother or the infant had an infection. The most pronounced increase in immune cells was observed during mastitis ($P<0.001$), in which the majority of cells were activated T-cells. Upon recovery from the infection, immune cell levels rapidly returned to the low baseline level of ≤2%. Similar responses were observed for immunoglobulins and lactoferrin, however they were less consistent and not as rapid compared to the cellular response. Different infections had distinct immune cell subtype profiles, with T-cells differing the most between infections ($P<0.004$).

Conclusion

These findings further elucidate the dynamic nature of breastmilk cellular content, which responds not only to infections of the mother, but also to the immunological needs of the infant. The rapid response of immune cells to infections and the distinct profile of these cells observed in different infections suggest the potential of breastmilk immune cells to be used as diagnostic tools for the health status of the lactating breast as well as the infant.

Source of funding

Differences in nutrient intake of Australian schoolchildren on school vs. non-school days

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Background

The 2007 Australian National Children's Nutrition Physical Activity Survey (ANCNPAS) revealed that schoolchildren do not comply with the dietary recommendations for saturated fat, total sugars and sodium, all of which are implicated in obesity risk. Little is known regarding differences in intake of these nutrients on school versus non-school days, this information can be used to inform targeted healthy eating strategies for the school and home environment.

Objective

To examine differences in energy, fat, carbohydrate and sodium intake on school day versus non-school days in a nationally representative sample of Australian schoolchildren aged 6-16 years.

Design

Analysis of the 2007 ANCNPAS was conducted. Food and beverage intake was determined in 2921 children via one 24-hr dietary recall. Independent t-tests were used to assess differences in mean intake of energy (kJ), total fat (g), saturated fat (g), total sugars (g), sodium (mg) and sodium density (mg/1000 kJ) on school vs. non-school days. A school day was defined as Monday-Friday, a non-school day included Saturday, Sunday and public/school holidays.

Outcomes

The average age of participants was 11.0 (SD 3.1) years. Participants age, gender and socioeconomic background did not differ between recalls completed on a school vs. a non-school day (all $P>0.05$). Schoolchildren consumed significantly more energy (9257 vs. 8836 ~ 5% increase), total fat (80 vs. 72 g/d ~ 10% increase), saturated fat (35 vs. 32 g/d ~ 9% increase), sugars (138 vs. 127 g/d ~ 8% increase) and sodium (2782 vs. 2613 mg/d ~ 7% increase) on non-school days compared to school days (all $P<0.05$). There was no difference in sodium density between the two day types (307 vs. 300 mg/1000kJ, $P=0.11$).

Conclusion

Important differences in the intake of energy, saturated fat and sugar exist on non-school days compared to school days in Australian schoolchildren. To improve the diets of schoolchildren there is scope for strategies that target non-school day eating practices.

Source of funding

Concurrent Session 10: Nutrition in Childhood

Anaemia of pregnancy, perinatal complications and children's developmental vulnerability

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Background
Iron deficiency is a major cause of anaemia among pregnant women and may be associated with complications of pregnancy and poorer child development.

Objective
The objective was to examine whether anaemia of pregnancy was associated with perinatal complications and children's developmental vulnerability at school entry.

Design
In a population-level study, government administrative datasets containing perinatal data and children's development were linked. Perinatal data from 1999-2005 was collected via routine reporting procedures at the South Australian Department of Health. Development was collected by teachers during a nation-wide census of children attending their first year of school in 2009, using the Australian Early Development Index (AEDI). Children in the lowest 10% of AEDI scores are indicative of developmental vulnerability. Poisson regression was used to examine associations between anaemia and developmental vulnerability, with adjustment for potential confounding. Multiple imputation was used to explore bias due to missing covariables.

Outcomes
The prevalence of anaemia of pregnancy was 7% (n=8764/124061). Women with anaemia of pregnancy were less likely to have elective Caesarean section (11.7% vs 12.9%) but more likely to have antepartum haemorrhage (6.1% vs 3.5%) and postpartum haemorrhage (9.8% vs 6.1%), compared with women without anaemia of pregnancy. Neonates of anaemic women had slightly lower birth weight (mean difference -46 g (95% CI -33, -58) and gestational age (mean difference -0.3 wk (95%CI -0.3, -0.4)) compared with neonates of non-anaemic women, and there were no differences in 5-minute APGAR scores. Anaemia of pregnancy was associated with higher developmental vulnerability in unadjusted analyses (relative risk 1.31 (95% CI 1.16, 1.46), n=13505) but was strongly attenuated after adjusting for maternal, obstetric and sociodemographic confounders and imputation (relative risk 1.11, 95% CI 0.96, 1.27, n=13654).

Conclusion
In this population of South Australian women, anaemia of pregnancy was associated with perinatal complications but not with children's developmental vulnerability at school entry.

Source of funding
Not applicable.

The importance of assessment of growth of infants at presentation or admission to a tertiary paediatric hospital: are we missing something?

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Background
Infants who present or are admitted to hospital with illness or those with inadequate growth and development are often those at risk of decreased nutritional status. However, presentation or admission to a paediatric hospital does not imply assessment. Weight, length or head circumference as an assessment of growth may not be routinely completed which may lead to poor nutritional status or growth being undiagnosed.

Objective
The aim of this study was to identify if the measurement of weight, length and head circumference as an assessment of growth was documented in charts of infants presenting and/or admitted to hospital.

Design
A systematic random sampling of hospital charts of 464 infants (260 male, 204 female, 0-1 year) who had presented to the emergency department between 1st July and 30th June 2012 were retrospectively audited during November – December 2012. This was 10% of presentations of infants to the emergency department in the financial year and was chosen as representative of the general population of infants attending the hospital.

Outcomes
The mean age of the presenting infants was 171 days**.** Birth weight was recorded in 22% of charts and presentation weight in 59%. Length (2%) and head circumference (3%) were poorly recorded in the majority of charts. Infrequent charting of a bare weight (2%) and percentiles (6%) was found.

Conclusion
Assessment of growth as a marker of illness or nutritional deficit has been poorly assessed in this group. This is a missed opportunity to assess infant growth in this population which has been found to be at risk of decreased nutritional status. Identification and treatment of growth deficits are a cost effective method of optimising infant health.

Source of funding

Concurrent Session 10: Nutrition in Childhood

Fruit and vegetables consumption among primary children in New Zealand

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Background

Existing literature concludes that children's intake of fruit and vegetables is inadequate and declining, as an international trend.

Objective

To describe the fruit and vegetable consumption patterns and to examine factors contributing to the current situation of inadequate and declining fruit and vegetable consumption among primary school children in New Zealand.

Design

This multi-phase project consisted of both quantitative and qualitative data collection methods. Two visual evaluation techniques were selected for assessing fruit and vegetables preferences and consumption. There were 1184 children who participated in a school-wide exercise exploring children's food choices and 160 children participated in a photo journal exercise. Each technique was implemented, conducted and analysed utilising quantitative observational research strategies. Six peer group interviews were conducted with 18 girls and 18 boys to gain an understanding of the issues surrounding the decline of children's fruit and vegetable consumption.

Outcomes

The results indicated that when given free choice only 2.3% of the children were willing to have five types of fruit and vegetables within a 24 hour period. The photo journal exercise indicated that 8.5% of the sample consumed five servings of fruit and vegetables, two and three serves respectively. The results indicated that children know and understand the importance of eating fruit and vegetables. However, children hold a greater preference for other food choices and therefore their fruit and vegetable knowledge often does not translate to consumption behaviour. Peer group interviews revealed that children hold strong negative thoughts about the fruits and vegetables they dislike, which was largely based on sensory elements. Furthermore, a major barrier to consumption was the perceived risks children associated with eating fruits and vegetables which stemmed from their uncertainty about the outcomes of consumption.

Conclusion

These results indicated that the model of associated risk was a valuable tool to explain children's fruit and vegetable consumption behaviours and to assist in the development of future intervention campaigns.

Source of funding

Not applicable.

Altered body composition in childhood cancer survivors

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Background

The body composition of childhood cancer survivors (CCS) is important to understand because poor body composition can potentially contribute to the development of other long term health problems.

Objective

The aim of this study was to examine the body composition, energy intake and activity level of CCS.

Design

This study involved 47 CCS who were attending the After Cancer Care Clinic, Queensland Children's Cancer Centre, Australia. This cross-sectional study measured height, weight, body mass index, percent fat via measures of air displacement plethysmography and body cell mass via measures of total body potassium. Body composition was compared to age and sex matched healthy controls using independent t-tests. Energy intake and physical activity by three day diet diary was also assessed in a sub-group of 32 children.

Outcomes

The population had a mean age of 14.2 ± 3.7 years and a mean time since active treatment of 9.2 ± 2.9 years. There was no significant difference in the height, weight and body mass index z scores between the CCS and controls. However, the study group had significantly higher percent fat (mean = $25.6\pm9.1\%$; p=0.001) and significantly lower body cell mass (mean=18.0 ± 6.5kg; p=0.0004) than the healthy controls (mean percent fat=20.0 ± 8.5; mean body cell mass=23.1 ± 7.8). Sixty-four percent of the CCS subgroup met their estimated energy requirement; while 18% were consuming more than 110%EER and 18% were consuming less than 75%EER. Thirty-six percent of the group participated in less than the recommended 1 hour of moderate-to-vigorous activity per day.

Conclusion

This study demonstrates that obesity and low body cell mass is a concern for CCS. Childhood cancer survivors would benefit from a program aimed to decrease fat and increase cell mass through a targeted diet and physical activity program.

Source of funding

Funding by Queensland Children's Medical Research Institute and The University of Queensland.

Concurrent Session 10: Nutrition in Childhood

Nutrition and body composition in children with feeding difficulties

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Background

Childhood feeding difficulties have been linked to nutrient deficiencies and poor growth, which may have immediate and long-term health impacts.

Objective

This study describes baseline data for children 2-6 years presenting to a research clinic for intervention to treat feeding difficulties, and aimed to evaluate the relationship between diet, growth, and body composition measures, and compare different clinical subgroups.

Design

Data are presented for 45 children with autism spectrum disorder (ASD) (53.2±10.6 months), and 36 children with no significant medical history (non-medically complex group, NMC) (49.2±11.8 months). Baseline information was collected through parent questionnaires, prospective 3-day diaries, anthropometrical measures, and bioelectrical impedance analysis (BIA) using a BodyStat Quadscan device. Relationships were assessed using correlation, groups were compared using independent t-tests, and intakes were compared to Estimated Average Requirements (EAR) or Adequate Intakes (AI), as appropriate, using paired t-tests.

Outcomes

Children with ASD presented with significantly higher mean±SD z-scores for height (ASD 1.11±0.30; NMC 0.87±0.36; P<0.05) and weight (ASD 1.04±0.31; NMC 0.80±0.32; P<0.05) than the NMC group. Mean z-scores for BMI were above the population mean but were not significantly different between the groups (ASD 0.77±0.35; NMC 0.67±0.31). Children from both groups demonstrated inadequate intake of fibre (78.2±42.8%, P<0.001), vitamin D (59.6±42.1%, P<0.001), and vitamin E (76.6±66.9%, P<0.05). A large proportion of children were exceeding their maximum daily limit for sodium intake (64%, n=52), and this was positively correlated with weight (r=0.37, P<0.001) and BMI (r=0.37, P<0.001). A subset of children (n=15) who complied with BIA testing all presented with body fat percentages over the 95th percentile as per suggested reference values.

Conclusion

Children with feeding difficulties do not necessarily present with 'failure to thrive', and can even present as over-fat. Nutrient deficiencies and excessive sodium intake appear common. This has significant implications for long term health.

Source of funding

Introduction of complementary foods in contemporary Australian infants, what and when?

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Background

The nature of infant feeding can have a significant impact on short term and long term health. As such national recommendations exist that state infants should be exclusively breast fed until around six months of age at which time complementary foods should be introduced.

Objective

We wished to establish the extent to which breastfeeding exclusivity and duration and the introduction of foods other than breast milk were in line with recently released Australian infant feeding guidelines, amongst a contemporary cohort of primiparous women and their infants in Australia.

Design

The Feeding Queensland Babies Study is a questionnaire-based longitudinal birth cohort study of infant feeding attitudes and behaviours. The data presented here were extracted from the demographic survey and from questionnaires administered at four (n=110) and six (n=204) months of infant age. Data were collected by self-administered questionnaire both online and on paper between October 2010 and September 2011. Participants were healthy primiparous Australian women aged between 18 and 40 years recruited by convenience sampling in Queensland, Australia.

Outcomes

Breastfeeding initiation in this cohort is higher than 97%, however by 4 months of age 25% of mothers had completely ceased any breastfeeding, 41% of infants had been given formula and 22% introduced to baby cereal. By 6 months of age, 99% of infants had been introduced to non-milk foods, most commonly at a rate of one new food every three to five days. In those mothers who had completely ceased breast feeding before 6 months of age the median age of cessation was 8.5 weeks.

Conclusion

Contemporary prospective data on infant feeding has value in describing trends that may influence the health outcomes of a generation of Australian children. Even in this group of relatively well-educated Australian women, premature cessation of breastfeeding and the early introduction of foods other than breast milk to infants demonstrate behaviours not congruous with evidence-based guidelines.

Source of funding

Concurrent Session 11: Public Health and Food Security

Nutritional impact of phytosanitary irradiation on fruits and vegetables

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Background
Low level irradiation of fruits and vegetables is an alternative to pesticides for quarantine treatment for insect pest control across Australian state borders. Earlier reviews of higher irradiation doses state that Vitamin C and β-carotene are sensitive to irradiation. Fruits and vegetables are significant dietary sources of these nutrients. However the effect of low level irradiation on nutritional value of these foods is not well known.

Objective
The objectives of this study were to: (i) quantitatively assess the effects of phytosanitary irradiation (≤ 1 kGy) on the nutrient content of fruits and vegetables, (ii) compare the nutrient levels in irradiated fruits and vegetables with the naturally occurring variation in nutrient content, and (iii) consider any losses in the context of dietary intakes in Australia and New Zealand.

Design
EBSCOHost was used to search for published literature on the effects of ionising irradiation at doses of ≤ 1 kGy on fruits and vegetables, and on the extent and sources of natural variation in nutrient composition of fruits and vegetables. Dietary intake data were obtained from National Nutrition Surveys conducted in Australia and New Zealand between 1995 and 2007.

Outcomes
Ten published papers measured the effects of ≤ 1 kGy irradiation on β-carotene levels in fruit, with no losses of β-carotene reported. Thirty-two publications measured vitamin C levels after irradiation with ≤ 1 kGy in fruits (29 studies) and vegetables (3 studies). Of these, nine reported vitamin C losses following irradiation in fruit. These losses depended on cultivar and/ or storage. However, in the majority of these cases the vitamin C content of irradiated fruit remained within the range of natural variation. After comparing these effects to dietary consumption patterns, it was evident that these changes were unlikely to impact on dietary vitamin C intakes in Australia and New Zealand.

Conclusion
Phytosanitary irradiation of fruits and vegetables has minimal impact on nutrient composition, particularly when vitamin levels in irradiated produce are considered in the context of natural variation. In combination with dietary intake data, we conclude that irradiation of fruits and vegetables with ≤ 1 kGy as a quarantine treatment does not pose a nutritional risk to the Australian and New Zealand populations.

Source of funding
Not applicable

Secular trends in consumption of food groups among New Zealand adults

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Background
Many factors contribute to changes in the food choices of a population—including technological changes, trade agreements, globalisation and cultural shifts. In order to give realistic food-based guidelines that reflect current eating patterns it is important to document changes in the consumption of food groups.

Objective
To examine changes in food consumption choices of New Zealand (NZ) adults, aged 19 years and above, between the NZ 1997 National Nutrition Survey (NNS97) and the 2008/09 Adult Nutrition Survey (ANS 2008/09).

Design
The ANS 2008/09 (n=4721) and the NNS97 (n=4636) were cross-sectional surveys of nationally representative samples of NZ adults. A computer based multiple-pass 24-hour diet recall was used for the collection of dietary intake data. Logistic regression models were created to examine changes in the percent reporting each food group between the two surveys with survey year, sex and age group (19-31, 31-50, 51-70, 71+ years) as the variables of interest.

Outcomes
Compared to NNS97, in ANS08/09 both males and females were less likely to report bread, potatoes, beef, breakfast cereal, milk, cheese, butter, pies, biscuits, cakes and puddings (all $P<0.001$). In contrast there was an increase in the percent reporting rice and rice dishes ($P<0.001$), and among females increases in snacks (eg, crisps, extruded snacks) and snack bars ($P=0.006$) and pasta and pasta dishes ($P=0.017$). There was no evidence for change in other food groups such as poultry, pork, sausages, eggs. Although food choices were associated with age, there were few differential changes between the surveys by sex or age group.

Conclusion
The results indicate shifts in the frequency of consumption from the traditional NZ foods of bread, beef, potatoes and vegetables towards more rice and rice dishes across all age groups. Declines in butter, pies, biscuits, cakes and puddings are in congruence with dietary guidelines, although in females, snacks and snack bars are alternative choices.

Source of funding
The NZ Ministry of Health funded the surveys, which were undertaken collaboratively with the University of Otago. The NZ Crown is the owner of the copyright for the survey data. The results presented in this paper are the work of the authors.

Concurrent Session 11: Public Health and Food Security

Clarifying issues surrounding per capita sugar consumption in Australia

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Higher folic acid intake does not affect all-cause mortality

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Background

The Australian Bureau of Statistics (ABS) no longer collect per capita sugar (sucrose) consumption data. Reporting of this data by various agencies has since become confused. Recent independent analysis using ABS data have been challenged and alternative methods suggested as more robust.

Objective

To assess and clarify underlying factors associated with per capita sugar consumption, and to challenge the accuracy of a suggested alternative method, derived from Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) data.

Design

Green Pool Commodity Specialists liaised with ABS and, using their methodology, calculated per capita sugar consumption 1970-2011 (reported elsewhere). Detailed analysis on domestic sugar sales, imports and exports of sugar and sugar in manufactured products was carried out. Per capita consumption using ABARES data was calculated from published export and production statistics for the same time period. ABARES was compared to ABS, and regression analysis carried out to examine trends over time.

Outcomes

ABS per capita sugar consumption adjusted for refined sugar and sugar in manufactured products, imports and exports. ABARES did not consider any imports of refined sugar, estimated to amount to a 70,000 tonne error in 2011. Imports and exports of sugar-containing products were also disregarded by ABARES. In contrast, ABS data showed imports of sugar in manufactured products increased over time (67,903 mt in 1999 to 174,497 mt in 2011), while exports of sugar in manufactured products continued to fall (195,981 mt in 2005 to 148,913 mt in 2011). Between 1991 and 2011 exported blended ingredients contained on average 45-50% sugar. Using ABS data, regression analysis showed a downward trend in per capita sugar consumption (R^2=0.53). In contrast the ABARES data was highly variable, with a slight upward trend observed (R^2=0.0057).

Conclusion

Adjustment of the data for import and export of sugar and sugar containing manufactured products substantially affects estimates of per capita sugar consumption. ABS remains the most robust and accurate data series compared to any alternative.

Source of funding

Background

Although folic acid fortification is beneficial in early fetal life, there is debate about whether of increasing folic acid intake by adults has benefits and/or adverse effects. All-cause mortality provides an overall summary of health impacts. Reviews to date of the effects of folic acid on all-cause mortality have restricted their searches to trials that investigated cardiovascular outcomes only. Some of these trials have included patients with life-threatening conditions such as end-stage renal failure.

Objective

We wished to capture all relevant trials of folic acid reporting all-cause mortality in groups who would reflect the general population.

Design

We searched Medline using PubMed and Cochrane CENTRAL from 2001 to 16th May, 2013 using a formal strategy to find trials using folic acid but without limiting the search to specific outcomes. We used EPPI Reviewer 4 to manage and code the database of records and StatsDirect to calculate an overall relative risk (RR) weighted using the inverse variance method.

Outcomes

A total of 5357 records were retrieved, which yielded 4216 after duplicates were removed. After screening titles and abstracts against criteria for population (adult, specified disease conditions), design (trial), duration (minimum of one year), intervention (folic acid), 4035 records were excluded. A total of 23 trials reporting mortality results remained after full-text scrutiny and linking multiple papers from the same study. The dose of folic acid ranged from 0.4mg/day to 5mg/day. In addition to 11 trials investigating cardiovascular-related outcomes, there were four trials of recurrence of colorectal adenoma, seven trials of effects on cognitive outcomes and one study in hip fracture patients. The overall RR 0.99 (95% CI:0.92-1.05). I^2 of 11.4% (95% CI: 0%- 46.8%) indicates that most variation in results across the trials can be attributed to chance. There is no indication of publication bias in the funnel plot.

Conclusion

The average dose used in the large trials which drive the meta-analysis, were approximately 10-fold high than the amount delivered by mandatory fortification. These results provide reassurance about the overall effect on adult health.

Source of funding

None.

Concurrent Session 11: Public Health and Food Security

The carbon dioxide equivalent emissions of foods in the meat and meat alternatives food group in New Zealand

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Paper withdrawn

Background

Global warming and climate change, caused by greenhouse gas emissions (GHGE), is a significant problem facing today's society. International research estimates that 15-30% of global emissions can be attributed to food production and many of the foods with the highest emissions are protein rich foods in the meat and meat alternatives food group.

Objective

The aim of the study was to estimate the GHGE of foods produced in New Zealand from the meat and meat alternatives food group using Life Cycle Assessment.

Design

Seven farms participated in the study, which produced eggs (intensive and free range), chicken, farmed salmon, lamb, beef and pork. Information was collected on the inputs (e.g. fuel use, electricity use, feed requirements, irrigation, fertiliser and pesticide use, animal housing, machinery usage and soil type) and outputs (e.g. manure management, meat, fish or egg production, wool and other relevant co-products) of each farm. A theoretical model was built to estimate emissions from tofu manufactured from imported soybeans. The system boundary was from the cradle to the supermarket. Data was analysed using SimaPro 7 software.

Outcomes

The carbon emissions from each food per kg of raw food were as follows; lamb 11.2 CO_2e/kg, beef 10.4 CO_2e/kg, salmon 8.9 CO_2e/kg, pork 6.2 CO_2e/kg, chicken 2.4 CO_2e/kg, eggs (free range) 2.1 CO_2e/kg, eggs (intensive) 1.9 CO_2e/kg, and tofu 1.2 CO_2e/kg. The carbon emissions from each food per kg of protein were as follows; salmon 49.3 CO_2e/kg, lamb 49.1 CO_2e/kg, beef 34.1 CO_2e/kg, pork 26.9 CO_2e/kg, eggs (free range) 15.8 CO_2e/kg, tofu 15.1 CO_2e/kg, eggs (intensive) 14.8 CO_2e/kg and chicken 9.8 CO_2e/kg. The carbon emissions per portion followed a similar pattern to per kg of protein.

Conclusion

This is the first study to compare GHGE in a range of foods produced and consumed in New Zealand. In order for New Zealanders to reduce their personal GHGE they could consume less red meat, less farmed fish and more eggs, chicken and plant-based meat alternatives such as tofu.

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Concurrent Session 11: Public Health and Food Security

Under-reporting remains a key limitation of self-reported dietary intake: an analysis of the 2008/09 New Zealand Adult Nutrition Survey

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Background
The most recent New Zealand Adult Nutrition Survey (ANS 08/9) revealed a substantial increase in measured body weights compared to the previous 1997 National Nutrition Survey (NNS97). Conversely, self-reported energy intakes decreased.

Objective
To determine if energy intake was reported accurately in the ANS 08/9 datasets by gender, age, ethnicity, and body size.

Design
Survey analysis was conducted on 3919 participants (1715 men and 2204 women aged 15+yrs) who completed the 24h dietary recall in the ANS 08/9. Under-reporting was assessed using the ratio of reported energy intake to estimated resting metabolic rate (EI:RMRest) with a cut-off limit of <0.9 (EI:RMRest) to identify under-reporters. Results were compared across important subgroups.

Outcomes
Overall, 21% men and 25% for women were classified as under-reporters (individual EI:RMRest <0.9). Significantly greater levels of under-reporting were revealed for Pacific people (33%), compared to European (23%, $p<0.001$) and Maori (26%, $p=0.007$). The prevalence of under-reporting was lowest in the youngest age group (15-18yrs, 19%) and greatest in oldest age group (65+yrs, 34%; $p<0.001$). More people with overweight (25%) and obesity (30%), under-reported intakes compared with those with normal body weight (16%, $p<0.001$). Compared with the NNS97, a substantial increase in under-reporting prevalence was evident in almost every subgroup.

Conclusion
Over the past decade under-reporting prevalence increased substantially across almost all subgroups, and a systematic bias was observed with significantly greater levels of under-reporting among Pacific and older people, and people with overweight, and obesity. Care should be taken when interpreting self-reported energy intake data from dietary surveys.

Source of funding

Feasibility of a multi-sectoral approach to improving food systems in remote Indigenous Australia

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Background
The high prevalence of nutrition-related disease contributes significantly to the 20 year difference in life expectancy of Indigenous Australians relative to the overall Australian population. The 'Good Food System', a five-year project, worked with four remote Aboriginal communities in Australia, to develop a participatory planning and learning approach to provide communities with the tools to support the development of a healthy eating environment.

Objective
To test the feasibility of the 'Good Food System' approach through assessing uptake and engagement of key stakeholders in each of the participating communities.

Design
An annual planning workshop in each community and quarterly follow-up meetings were held with a multi-sector group led by a local Aboriginal community co-ordinator and external facilitator. Starting dates, number of meetings, number of participants, participant's background and minutes of the meetings in each of the communities were recorded during the project. This information was collated and analysed to provide an assessment of engagement and level of participation in each community.

Outcomes
In three of the four communities it was shown that representatives from different sectors in the community met on a regular basis over an extended period of time and that membership of the multi-sector groups grew as awareness of the multi-sectoral nature of food security increased. The difficulties experienced by one community in meeting on a regular basis show that in certain contexts such a model may be difficult to maintain.

Conclusion
Through meeting regularly and engaging in a structured participatory planning and learning approach, a group of people including sectors concerned with food can build a collective understanding of the food system. This approach has the potential to enhance capacity to make decisions to influence improvements in the food system, to appraise the performance of the food system and prioritise actions. This takes place through supporting each other, sharing experiences, and building a sense of accountability to progress change.

Source of funding

Concurrent Session 12: Nutrition Links to Chronic Disease

Bone and muscle interaction in Inflammatory Bowel Disease

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Background
Poor bone health is increasingly reported in young individuals with inflammatory bowel disease (IBD). Lean tissue mass (LTM) has a strong influence on the skeleton during growth, but there is little information on this relationship in the young IBD population.

Objective
To assess if there was a deficit of total body bone mineral density (aBMD) in children and adolescents with IBD, and if it was due to an intrinsic bone problem, reduced LTM, or a combination of both.

Design
Seventeen children with ulcerative colitis (UC) and 57 children with Crohn's disease (CD) underwent total body DXA scans (GE Lunar Prodigy, v11.4). Information from these scans (aBMD; bone mineral content (BMC); LTM), along with age and height, were converted to Z-scores using the paediatric control database at The Children's Hospital at Westmead. These Z-scores were used in a 4-step algorithm to answer: (1) was aBMD low for age; (2) were they short; (3) was LTM appropriate for height; and (4) was there enough BMC for the amount of LTM? Z-scores were compared with zero using single sample t-tests.

Outcomes
The UC cohort showed: (1) normal aBMD for age (Z-score =0.02, ns); (2) normal height for age (Z-score =0.04, ns); (3) less LTM for height (Z-score =-1.00, P=0.02), and (4) normal BMC for LTM (Z-score =0.15, ns). The CD cohort showed: (1) less aBMD for age (Z-score=-0.84, P=0.00); (2) reduced height for age (Z-score=-0.32, P=0.04); (3) lower LTM for height (Z-score=-1.07; P=0.00), but (4) normal BMC for LTM (Z-score=0.03, ns).

Conclusion
Young individuals with UC showed normal aBMD and height, less LTM, but normal muscle-bone interaction. Conversely, individuals with CD appeared to have a secondary bone deficit, where the disease and/or treatments may have altered LTM resulting in a reduction in aBMD. These data support the need to improve LTM via sound nutritional and physical support in individuals with IBD with a special focus on individuals with CD.

Source of funding

Sex-specific associations of plasma omega-3 fatty acid profiles and mortality from cardiovascular disease and cancer in a community-based longitudinal study

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Background
Intakes of long-chain omega-3 and omega-6 fatty acids (FAs) are thought to have an important role in the onset and progression of both cardiovascular disease and cancer. However, the associations between biomarkers of these FA intakes and mortality are inconclusive.

Objective
To prospectively assess plasma biomarkers of omega-3 and omega-6 FAs in relation to overall mortality, and mortality from both cardiovascular disease and cancer in a community-based 16-year follow-up study in Australia.

Design
We measured plasma phospholipid omega-3 (eicosapentaenoic acid (EPA), docosapentaenoeic acid (DPA), docosahexaenoic acid (DHA), and total) and omega-6 FAs (linoleic acid, arachidonic acid, and total) among 1010 adults aged 25 to 75 (44% men) in an Australian community in 1996 as part of an ongoing skin cancer study. Levels of each FA were divided into sex-specific thirds. Deaths till March 2012, and causes of death, were assessed using the National Death Index. Hazard ratios (HR) were calculated using Cox regression analyses.

Outcomes
At follow-up 83 men and 64 women had died. After adjustment for potential confounding factors, men in the highest third of plasma EPA at baseline showed a 50% lower risk of all-cause mortality compared with the lowest third (HR 0.50, 95% CI 0.27–0.91; *P*-trend=0.022). Men in the highest third of DPA had a 62% reduced risk of cardiovascular mortality (multivariable HR 0.38, 95% CI 0.15–0.94; *P*-trend=0.030). No other significant associations were observed among men. For women, none of the plasma FAs was significantly associated with mortality from any cause.

Conclusion
Relatively high DPA in plasma may be protective from cardiovascular mortality and relatively high EPA may reduce the risk of all-cause mortality among men but not women. Further longitudinal studies with sex-specific analyses are needed to clarify the associations in general populations.

Source of funding

Concurrent Session 12: Nutrition Links to Chronic Disease

The association between obesity and asthma is driven by female reproductive stage

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Background
Asthma and obesity are associated conditions. We previously found an association between obesity and neutrophilic airway inflammation in females with asthma.

Objective
Oestrogen stimulates leptin production which, in turn, promotes neutrophilia. Thus, we hypothesised that hormones and female reproductive stage has a role in the obese-asthma association.

Design
Non-obese (BMI<30kg/m^2) (n=68) and obese (BMI≥30kg/m^2) (n=111) males and females with asthma were recruited from Newcastle, NSW, Australia. Females were divided into reproductive aged (<45 years of age, n=27) and older (>50 years of age, n=44) groups. Plasma oestrogen and leptin were measured, and sputum neutrophil count and percentage was determined.

Outcomes
In reproductive aged females, sputum %neutrophils were significantly elevated in obese (51.0±20.7%) compared with non-obese (26.8±19.4%, *p*=0.014) asthmatics, whereby airway neutrophils increased by 1.4% for every one unit increase in BMI (β[95%CI] = 1.4[0.3,2.6], *p*=0.017). Furthermore, plasma oestradiol concentration was positively associated with airway neutrophil count in reproductive aged females (*r*=0.496, *p*=0.019), while there was a non-significant association between plasma leptin and %airway neutrophils (*r*=0.267, *p*=0.187). In older females, sputum neutrophils were similar in obese (51.0±24.0%) and non-obese asthmatics (45.1±20.6%, *p*=0.412). There was no association between sputum %neutrophils and BMI in males (*p*=0.509).

Conclusion
This study suggests that the association between obesity and neutrophilic airway inflammation occurs in younger females, who tend to exhibit a more gynoid-pattern of obesity and have higher oestrogen and leptin concentrations. This association was not apparent in older females or males, suggesting that the beneficial effect of 'leanness' in relation to obesity-induced asthmatic airway inflammation may be related to differences in sex hormones.

Source of funding

Metabolic differences between glucose and fructose in the liver

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Background
The increasing prevalence of obesity in the United States shows an almost parallel trend with the increased consumption of high fructose corn syrup (HFCS), a caloric sweetener, which is high in fructose (55%) compared to sucrose (50% fructose).Due to differences in metabolism of fructose and glucose, the increase in fructose consumption has been suggested to be involved in the pathogenesis of obesity and related metabolic disorders such as non-alcoholic fatty acid liver disease (NAFLD).

Objective
In this study we investigated the role of dietary fructose in the hepatic storage of triglycerides and glycogen.

Design
We investigated the effects of consuming an isocaloric high-glucose (n=20), a glucose-fructose (n=20), or a high-fructose diet (n=20) for ten weeks in terms of triglyceride and glycogen storage in the livers of mice (C57Bl/6J) (Protein 20.2 E%; CHO 43.9 E%; Fat 35.9 E%). Triglycerides were measured after an enzymatic hydrolysis with lipases, where quinomeimine was coloured and its absorbance was measured. For the measurements of glycogen, we made use of a colorimetric determination with iodine and absorbance was measured as well.

Outcomes
The relative liver weight (mg/g tissue) in females was significantly higher in the fructose group compared to the glucose group and also significantly higher compared to the glucose-fructose. The absolute hepatic triglyceride content, in milligrams, in females, was significantly higher for the fructose group compared to the glucose group, and significantly higher for the fructose group compared to the glucose-fructose group. Furthermore, this study found that the triglyceride content (mg/g tissue) was significantly lower in the glucose-fructose group in females compared to males. The glycogen content (mg/g tissue), in males, was significantly lower in the glucose-fructose group compared to the glucose group. In females the glycogen content was significantly lower in the fructose group compared to the glucose group.

Conclusion
A high-fructose diet for ten weeks causes an increase in triglyceride storage, as well as a decrease in the glycogen storage in the liver in female, but not in male mice.

Source of funding
Not applicable

Concurrent Session 12: Nutrition Links to Chronic Disease

Bioelectrical impedance measurement of body composition in obese adolescents

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Background
Body mass index (BMI) is a commonly used marker of adiposity. However, it does not differentiate between fat mass (FM) and fat-free mass (FFM). In the clinical setting, methods to assess body composition are frequently required, including the assessment of weight loss interventions which may incorporate physical activity where the relative contributions of FM and FFM to BMI may change. Bioelectrical impedance analysis (BIA) is recognised as a quick and simple method of determining body composition.

Objective
To compare body composition measures from the Tanita 8-electrode stand-on BIA monitor (MC-180MA) with reference data obtained by dual-energy X-ray absorptiometry (DXA) and to develop a bioelectrical impedance equation for obese Australian adolescents.

Design
DXA (Lunar Prodigy) and BIA measurements were performed in 66 obese adolescents (age: 10-18 y, BMI: 22-48 kg/m^2). Resistance (R) and reactance (Xc) at frequencies 5, 50, 250 and 500 kHz were obtained from MC-180MA and used to generate a prediction equation for FFM using a double cross-validation method.

Outcomes
Compared to DXA, the MC-180MA in-built prediction software overestimated FFM by 9.1%, and underestimated FM and % body fat (%BF) by 10.3% and 10.8%, respectively. Correlations between MC-180MA and DXA measurements varied from $r = 0.65$ (%BF) to $r = 0.86$ (FFM, FM) and was poor ($r = 0.24$) when %BF was >50%. The closest predictions of DXA measures of body composition were obtained by applying the MC-180MA raw data (R,Xc) to previously published bioimpedance spectroscopy and BIA equations derived in similar populations. The self-developed equation (FFM = 0.589R50 + 0.213weight – 2.849sex + 5.657) performed equally well with a bias of 0.4 kg (1%) but with relatively wide limits of agreement (± 15%).

Conclusion
Body composition of groups of obese Australian adolescents can be determined using the raw data from the MC-180MA and derived equations. Body composition data provided by the in-built software MC-180MA is less accurate and is not recommended.

Source of funding

"The Scarborough Fair Trial": effects of increased vegetables and fruit on adiponectin levels in postmenopausal women

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Background
Increased vegetables/fruit may reduce bone loss at midlife by provision of micronutrients for bone formation, buffer precursors to reduce potential renal acid load (PRAL) and anti-inflammatory phytochemicals. Adiponectin is an anti-inflammatory marker positively associated with both increased bone loss and increased fracture risk as well as Mediterranean and plant based diets.

Objectives
To assess effects of increased intake of vegetables/fruit on adiponectin levels and urinary calcium excretion in post menopausal women.

Design
Two intervention groups (A,B) of healthy, postmenopausal women (N=50) increased intake of vegetables/fruit to ≥9 servings/day (three months) with one group selecting from a specific range containing phytochemicals attributed with lowering bone resorption. A control group (C) (N=43) consumed their usual diet. Primary outcome variables included adiponectin and urinary electrolytes (calcium and potassium). PRAL was determined from three day diet diaries.

Outcomes
Urinary potassium excretion (mmol/day) increased in groups A and B (86, 85) but also C (104, P>0.05), however calcium excretion reduced in A and B (-26,-24%) compared to C group (2%, P<0.05). Groups A and B had lowered estimated PRAL (-17,-22mEq/day) compared to C (-1.6mEq/day, P<0.001). Adiponectin levels were modulated downward in all three groups. Adiponectin reduced the most in intervention group women with osteoporosis and significant osteopenia compared to women with normal bone mineral density (P<0.003) There were no significant differences between the two intervention groups in adiponectin or calcium excretion.

Conclusion
Calcium excretion decreased in intervention groups with lowered PRAL. Decreased levels of adiponectin and increased urinary potassium excretion were seen in all three groups. The reduction in adiponectin differs from previous observational research showing increased levels associated with plant based diets and may reflect a more positive environment for bone maintenance at midlife.

Trial No: ACTRN 12611000763943

Source of funding

Concurrent Session 12: Nutrition Links to Chronic Disease

Acute effects of chlorogenic acid on nitric oxide status, endothelial function and blood pressure in healthy volunteers: a randomised trial

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Background
There is mounting evidence that specific dietary polyphenols can enhance vascular health by augmenting nitric oxide.

Objective
Our aim was to investigate the acute effects of chlorogenic acid, an important dietary phenolic acid present in coffee (400 mg, equivalent to 2 cups of coffee), on nitric oxide status, endothelial function and blood pressure.

Design
Healthy men and women (n=23) were recruited to a randomised, double-blind, placebo-controlled, cross-over trial. Acute effects of chlorogenic acid (400 mg, an intake equivalent to 2 cups of coffee) were compared to placebo. Nitric oxide status, assessed by measuring plasma S-nitrosothiols+nitroso species (RXNO), nitrite and nitric oxides (NOx), and plasma chlorogenic acid and its metabolites were measured at 150 min. Endothelial function, determined by flow mediated dilatation of the brachial artery, was assessed at 120 min, and blood pressure was measured at baseline and 60, 90, 120 and 150 min.

Outcomes
Chlorogenic acid resulted in significantly higher plasma concentrations of chlorogenic acid (P<0.001). Relative to control, mean post-treatment systolic blood pressure (-2.41 mm Hg, 95% CI: -0.03, -4.78; P=0.05) and diastolic blood pressure (-1.53 mm Hg, 95% CI: -0.05, -3.01; P=0.04) were significantly lower with chlorogenic acid. Markers of nitric oxide status (P>0.10) and the measure of endothelial function (P=0.60) were not significantly influenced.

Conclusion
Chlorogenic acid can lower blood pressure acutely; an effect which if sustained would benefit cardiovascular health.

Source of funding

Postpartum BMI and change over time: associated factors including dietary restraint and weight concern

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Background
Postpartum weight retention has been associated with a greater longitudinal risk of obesity. Identifying factors associated with weight status in the postpartum period is necessary to inform intervention development.

Objective
To determine whether weight concern or dietary restraint scores were concurrently and prospectively associated with maternal BMI at 4 and 14 months postpartum.

Design
A total of 698 primigravid mothers were recruited from postnatal wards in Brisbane and Adelaide. Maternal weight and height were measured by trained assessors at T1 (4 mo postpartum) and weight again at T2 (14 mo postpartum). A self-administered questionnaire at T1 was used to assess a range of socio-demographic variables, mothers' dietary restraint and weight concern. Multivariable linear regression analyses were conducted to examine the association between dietary restraint and weight concern with BMI at T1 (n=558), and T2 (n=386). All analyses were stratified by weight status at T1 (<25 kg/m^2 vs ≥25 kg/m^2) and adjusted for key covariates.

Outcomes
Complete data for 558 mothers (mean age at delivery = 30.16 years, SD=5.19, 60% university educated, mean BMI = 26.00 kg/m^2, SD=5.17) was available at T1 and for 386 mothers at T2. At T1 286 were 'healthy weight' (<25 kg/m^2) and 272 were 'overweight' (≥25 kg/m^2). For mothers who were 'healthy' or 'overweight' at T1, higher weight concern (but not dietary restraint) was associated with higher BMI at T1 (β=0.30 and β=0.31, ps<0.001). Controlling for T1 BMI, higher dietary restraint (but not weight concern) at T1 was associated with lower BMI at T2, but only in mothers who were 'overweight' at T1 (β=-0.10, p=0.002).

Conclusion
Weight concern appears to reflect current weight status rather than be a predictor of future weight. However dietary restraint appears to be a factor that may influence postpartum weight loss/gain over time, at least in overweight women. Further research into the mechanisms through which level of dietary restraint may influence weight gain or loss in postpartum women is warranted.

Source of funding

Concurrent Session 9: Food Choice

How will global food systems cope with the world future demand for food?

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Abstract not received at time of going to print.

Concurrent Session 9: Food Choice

Policy and development implications of food security and nutrition situation in East Africa

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Background

This report focuses on five eastern Africa countries which form the East African Community (EAC). The EAC is an intergovernmental organisation comprising five countries in the African Great Lakes region of Burundi, Kenya, Rwanda, Tanzania and Uganda. The geographical region encompassed by the EAC covers an area of 1.8 million square kilometres, with a combined population of about 132 million according the July 2009 estimates.

Two types of data sets are used to compare the social and political variables and their food security and nutrition outcome performance in the five countries. These are Global Food Security Index (GFSI) data compiled by the Economist Intelligence Unit (EIU) and Hunger and Nutrition Commitment Index (HANCI) compiled by the Institute of Development Studies (IDS) of the Sussex University in UK. The GFSI include three groups of indicators namely food affordability (comprising of food consumption as a share of household expenditure, proportion of population under global poverty line, gross domestic product per capita, and presence of food safety net programs), food availability (sufficiency of supply, dependency on chronic food aid, agricultural infrastructure, volatility of agricultural production, and political stability risk) and food quality and safety (diet diversification, nutrition standards and micronutrient availability). On the other hand, the HANCI compares 45 developing countries (including all the five countries of the EAC) for their performance on 22 indicators of political commitment to reduce hunger and undernutrition. It focuses at three areas of government action: Policies and programmes, Legal frameworks, and Public expenditures.

For the overall GFSI on a scale of 100 score points, Uganda appears to be leading with 41.5 points followed by Kenya (37.2 points) and Rwanda (29.6), while Tanzania (26.6) and Burundi (22.9) are at the bottom. However, for the case of HANCI, the results are different whereby the Tanzania government appears to be more committed to eliminating hunger and undernutrition with a score of 201 points followed by Rwanda (179) and Uganda (173). Kenya and Burundi are the last with scores of 114 and 86, respectively.

Despite the differences in the five countries in terms of the said sets of indicators, these countries are all faced with similar food security challenges, which include: Low and unstable agricultural production and productivity occasioned by over-reliance on rain-fed agricultural production systems; inadequate infrastructure such as transport, communication, storage and processing facilities that hinders access to factor and product markets; and increased frequency and severity of extreme weather such as floods and drought as a result of global warming and climate change, adversely affecting food production. Others include prevalence of HIV/AIDS and other tropical human and animal trans-boundary diseases that not only divert the already constrained resources from agricultural production but also waste the labour force; and inappropriate and low adoption of production methods due to inadequate research and extension services.

In attempting to fight the existing food insecurity situation, the EAC member states have come up with a Five Year Food Security Action Plan (2010 – 2015). The Action Plan has identified the following seven priority areas:

- Provision of enabling policy, legal and institutional framework
- Increase food availability in sufficient quantity and quality
- Improved access to food
- Improved stability of food supply and access in the EAC Region
- Enhance the efficiency of food utilization, nutrition, and food safety
- Implementation strategy and monitoring
- Resource mobilization and time frame.

Conclusion

With the variations in both GFSI and HANCI among the five countries of the EAC, the region provides a good opportunity for researchers to investigate the relationship between GFSI outcomes and HANCI performance. Similarly, while the member states are currently in a process of economic and political integration, it will be interesting to see whether the integration can also result into harmonization of the indicators.

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Concurrent Session 9: Food Choice

Coming out of the pantry: unpacking household food insecurity in Australia

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Australia is badged as being food secure. Government regularly promote a vigorous agricultural system that can feed three times our current population [1]. This approach to food security focuses on the quantity of food produced and fails to take into consideration the other dimensions outlined in the definition.

The FAO's Committee on World Food Security has recently reiterated that food and nutrition security are not separate constructs. In acknowledging this, the 2012 definition states that "food and nutrition security exists when all people at all times have physical, social and economic access to food, which is safe and consumed in sufficient quantity and quality to meet their dietary needs and food preferences, and is supported by an environment of adequate sanitation, health services and care, allowing for a healthy and active life" [2].

Failure to consider food and nutrition security as a single entity has resulted in the siloing of each. Food security is the remit of agriculture; nutrition security is the remit of health. As a result, the most recent policy responses, the National Food Plan and Australian Dietary Guidelines, fail to join the dots between food, nutrition and health as an undeniable human right. The National Food Plan focuses on food as a commodity with calls to increase food production to stimulate economic growth and to ensure regional food security [3]. The focus is on quantity rather than quality; on national perspectives rather than the realties for households and families.

National figures purport that food insecurity affects only 5% of our population; over one million Australians [4]. However, the single question used in national health surveys "in the last 12 months have you run out of food before you could afford more", measures only one dimension at the more severe end of the food security continuum. Recent studies have shown that the question underestimates the prevalence of food insecurity at a population level by approximately 5% [5]. Food insecurity is therefore a reality for potentially two million Australian households. In disadvantaged communities, using more nuanced measurement, the prevalence of food insecurity is approximately 25% of households [6].

In addition, to the measurement tool being flawed, monitoring of food security in Australia is at best ad hoc, the latest available national figures come from the 2004-05 National Health Survey. Such infrequent surveillance combined with poor measurement fails to provide opportunities to assess the impact of local, global and national events on the food system, its sequelae at the household level, and diet quality.

The failure to consider food and nutrition security as integrated concepts, the lack of sensitive measurement and consistent surveillance and the focus on the right of individual consumer choice means that food security is not a salient political issue. As such, a food safety net for families, households and individuals at most risk is not currently on the agenda. This is despite acknowledgement that those on income support are unable to meet the demands of rising living expenses.

Currently, strategies to address food insecurity in Australia have a heavy reliance on the use of emergency food relief and/or on individualised responses such as education, budgeting and cooking skills. Other more community-based strategies such as community gardens assume participants are socially connected and have the capacity to engage. Key structural barriers such as income sufficiency and the nutritional adequacy of the food supply are rarely considered.

This paper explores strategies in use to provide a food safety net and questions their ability to meet the United Nations tenet for human dignity. It will describe a rights based approach to food and nutrition security in Australia and discuss key areas for advocacy.

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Concurrent Session 9: Food Choice

Household food security in New Zealand: Hunger amidst abundance

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New Zealand is a major global food producer and exports more than US$20 billion of food and beverage products each year. Our government aims to triple food and beverage exports in the next 15 years. Yet less than two thirds of New Zealand (NZ) households (59%) were classified as *fully/almost fully food secure* in the most recent national survey (2008/09) [1], down from 76% in the previous survey (1997). Seven per cent of households were classified as having *low food security* meaning they reported 'relying on others for food or money for food' and/or 'using special food grants or food banks to acquire the food they needed'.

Household food security is achieved when there is assured access to sufficient food that is nutritious, of good quality, safe, meets cultural needs, and has been acquired in socially acceptable ways. It is closely related to family resources, disposable income and socioeconomic position. In NZ, income is the strongest predictor of food insecurity (OR 4.9, 95% CI 4.0-5.9 for lowest household income quintile versus highest) [2]. Maori and Pacific peoples are also disproportionately affected. Only 35% of Maori and 26% of Pacific peoples were *fully/almost fully food secure* in 2008/09 compared with 64% of NZ European and Others [1].

The global economic recession and increased food prices have placed additional stress on many NZ families. In 2009, the Food Price Index (FPI) increased by 7% compared with a 3% increase in the overall cost of living (CPI). The average NZ household spends 12% of their total income on food but the share varies substantially according to income level (8% in the highest income quintile versus 26% in the lowest income quintile) [3].

The ENHANCE project was undertaken to clarify the contribution and interaction of various environmental factors to food security for Maori, Pacific and low-income families, and to identify how these factors might be modified to improve food security [4]. Findings showed that key areas to intervene to enhance food security relate principally to availability of money within households to spend on food; the cost of food; and food purchasing influences such as cooking skills, access to traditional food sources, and community markets/gardens. The ENHANCE report recommended 10 interventions to improve food security. This presentation will focus on two of the most frequently suggested strategies: economic instruments (food subsidies) and provision of free or subsidised food in schools.

The SHOP trial demonstrated previously that price discounts (12.5%) on healthier supermarket foods led to significant and sustained increases in healthy food purchases [5]. Our successor study, SPEND, has estimated the impact of a range of pricing strategies (including subsidies on healthy foods) on population diets, mortality and inequalities. Estimation of food price elasticity (PE) data (percentage change in purchased quantity or demand with a 1% change in price) for major commonly consumed food groups demonstrated greater sensitivity to price changes among low-income groups and Maori (own-PE values -0.30 stronger in lowest versus highest household income quintile, and -0.26 stronger amongst Māori

compared to non-Māori) [3]. Modelling the impact of food subsidies on NZ population health is currently underway and results will be presented at the conference.

The Fruit in Schools programme started in NZ primary schools in 2006. This was followed by the Fonterra Milk in Schools programme piloted in 2012, and rolled out nationally in 2013. Most recently, the government joined forces with the private sector to offer a free school breakfast programme to all primary schools in areas of high deprivation. An overview of these programmes will be provided and evidence regarding their likely impact on household food security will be reviewed.

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Poster Session 1: Wednesday 4 December
Group 1 – Determinants of Food Choice

P001

Taste-related nutrient sensors: analogies between humans and pig

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Background
The pig is increasingly being used as a model for understanding human nutrition, mainly due to similarities in physiology, the omnivore diet and genomics. The taste system in humans is diverse with taste receptors (TR) identified and confirmed to be expressed not only in the oral cavity, but also in a wide range of tissues including, for example, the tongue, stomach, large and small intestines, and liver. A systematic study of the TR repertoire in pig has not been reported to date and it is hypothesised that the taste machinery will share significant homologies with the human.

Objective
The aim of this study is to determine whether concordance exists between the expression profiles of taste receptor genes in humans compared to pigs in the gastrointestinal tract.

Design
Six Large-White pigs were anaesthetised and sacrificed and various tissues were collected including tongue (3 papillae: circumvallate, fungiform and foliate), stomach antrum, stomach ridge, duodenum, jejunum, ileum, colon proximal, colon distal, caecum and liver. Using real time PCR assays, the relative gene expression levels for our candidate taste receptor genes Tas1R1, Tas1R2, Tas1R3, 16 Tas2Rs, mGLUR1, mGLUR4, GPR120, GPR40, GPR41, GPR43, GPR84, GPRC6A, were determined for each tissue.

Outcomes
With the exception of Tas1R2 which was only found to be expressed in liver and tongue, all of the other candidate genes were confirmed to be significantly expressed in all of the tissues investigated. In the tongue as well as in non-oral tissues, of the three Tas1R genes, Tas1r3 was the most abundantly expressed. This is expected as Tas1R3 is the common subunit for both sweet and umami taste receptor dimers. Preliminary results suggest that Tas1R3 is most abundantly expressed in the stomach ridge, an area possibly being subjected to high cellular turnover. **Conclusion**

These findings further confirm the relevance of using the pig as a model system for human research. Our data should provide the necessary background for further investigations into the potential links that may exist between the expression levels of taste receptor genes and effects from nutritional paradigms.

Source of funding

P002

High dietary soluble fibre affects taste receptor expression in pig stomach

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Background
Sweet and umami tastes are perceived by the Taste Receptor Type 1 (T1R) family of GPCRs which includes T1R1, T1R2 and T1R3. Previous data from our lab shows that Tas1R genes are not only expressed in the tongue, but also in non-oral tissues of pigs (e.g. GIT), consistent with other rodent and human studies. Since the activation of these receptors is believed to influence the hunger-satiety cycle, their expression levels may be altered by dietary composition. Therefore, we hypothesise that fibre-rich diets will impact the expression level of Tas1R genes.

Objective
We aimed to investigate the effect of arabinoxylans (AX) and β-glucans (BG) on the relative level of expression of Tas1R genes in porcine oral and non-oral tissues.

Design
Large-White pigs (n=18; 23.9kg±2.4kg) were used, with 6 pigs allocated to each of 3 diets. The control diet was a wheat starch base (17.4 MJ/kg DE; 197g/kg crude protein; 14.4g/kg dig Lys). The treatment diets were iso-energetic to the control diet, but with starch being exchanged for 10% soluble arabinoxylan and 10% soluble β-glucan, respectively. Pigs were blocked by litter and randomly assigned to the diets. Two meals per day were provided for 2 weeks, following a 1 week adaptation period and access to water was *ad lib*. Following anaesthesia and exsanguination, tongue papillae and a range of other non-oral tissues were collected and frozen in liquid nitrogen. Following RNA extraction and cDNA synthesis, qPCR was perfomed using TBP and GAPDH as reference genes. Statistical analysis using ANOVA and Tukey's Honestly Significant Difference test was carried out in R.

Outcomes
Fibre did not affect the expression level of the Tas1R genes in the tongue (P>0.05). None of the iso-energetic diets resulted in growth changes (data not shown); suggesting that Tas1R expression in the tongue may rather be associated with energy homeostasis. However, pilot data suggests a lower expression of Tas1R1 and Tas1R3 in the stomach ridge associated with fibre diets.

Conclusion
High levels of soluble arabinoxylans or β-glucans in iso-energetic diets did not affect the expression level of Tas1Rs in the pig tongue, however pilot data suggests that the diets were associated with lower expression levels of the Tas1R1 and Tas1R3 (encoding the umami receptor) in the stomach ridge.

Source of funding

Poster Session 1: Wednesday 4 December
Group 1 – Determinants of Food Choice
P003

The effect of umami and fatty tastes on satiety, food preference and energy intake

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Background

Protein rich foods seem to be effective in enhancing satiety. Several mechanisms have been related to the satiation effect, including some related to sensory perception. Sensory specific satiety (SSS) consists of a decrease in sensory pleasure for a food after repeated consumption. However, the role of taste in SSS has not been studied in depth. We hypothesise that taste cues alone will trigger SSS.

Objective

To investigate the efficacy of umami and fat taste (both important in meat flavour) to elicit SSS.

Design

A preload-test meal paradigm was used to compare the effects on SSS of the exposure to a chewing gum containing (i) no sapid substance, (ii) 0.5% umami (glutamate MSG), (iii) 0.5% fatty acid (Lauric acid LA) or (iv) combination of MSG and LA. On test days, panellists came in for breakfast after a 9-10 hour fast and were asked to chew gum with the different treatment compounds. Then, a multi-flavoured breakfast of champagne ham, boiled jasmine rice, pink lady apple and water was served and panellists were free to select what they wanted. Three hours later, they were served 1½ cheese and 1½ ham sandwiches along with water for lunch and were again free to select what they wanted. Hunger was recorded on a labelled magnitude scale (LMS) at regular intervals during the 3-4 hours between breakfast and lunch. All panellists attended 4 sessions and were exposed to all 4 treatments following a randomised complete block design.

Outcomes

No significant effects of treatment on the choice of breakfast meal components were seen. However, there was a significant effect ($P<0.05$) on water intake at lunch when gum containing 0.5% MSG was chewed (32 ml more than the control treatment). There was also a significant effect of the amount of protein consumed per 100kJ of crude energy consumed at lunch, which was higher when gum containing 0.5% LA was chewed ($P<0.05$) compared to all other treatments.

Conclusion

Exposure to fat taste resulted in a shift of preference towards a meal higher in protein content relative to energy consistent with the principles of SSS.

Source of funding

P004

Paper withdrawn

Poster Session 1: Wednesday 4 December
Group 1 – Determinants of Food Choice

P005

A points-based front-of-pack labelling system appropriately categorises Australian packaged foods and drinks

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Background
Policy for a front-of-pack nutrition labelling (FoPL) system was recently announced in Australia. A key element of this policy will be the nutrient assessment system that underpins the FoPL.

Objective
To apply the criteria of an existing points-based front-of-pack labelling system developed by the USA Institute of Medicine (IOM) to packaged products sold in Australia.

Design
The IOM's cut points for saturated fat, sodium and added sugars were used to allocate zero or one points for each nutrient, giving each product a score between zero and three. To be eligible for any points, products must satisfy an initial criterion for all three nutrients. A secondary criterion for each nutrient was then applied to determine the relevant point level. The criteria were applied to 20267 Australian packaged food and drink products in 62 food groups. Individual product data for added sugars were not available so were imputed by food group using an established method.

Outcomes
Of the total products 11170 (55%) gained zero points, 653 (3%) gained one point, 3252 (16%) gained two points, and 5192 (26%) products gained three points. Food groups in which all products received zero points due to added sugars ineligibility were confectionery, dairy desserts, ice cream and edible ices, jams, beverages and sugars. The majority (approximately 80%) of packaged vegetable and fruit products were granted three and two points, respectively. Most cereal-based products also received two or three points. More than 50% of milks were granted zero or one point. Most cheeses and processed meats received zero points, with three points being awarded to 68% of processed fish products and 61% of meat alternatives, such as tofu.

Conclusion
At the food group level, the IOM's criteria categorised packaged products broadly in line with the Australian dietary guidelines. Modified criteria for foods which provide other health benefits, such as dairy, may address the high proportion of these products scoring zero points. Further research should assess the alignment of the IOM's criteria with those to be used in the Australian health star labelling system and the implications for FoPL in Australia.

Source of funding
Not applicable.

P006

Social conventions and nutrition knowledge are collaborative forces on eating behaviours in women of reproductive age

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Background
Despite nutritional knowledge and interpretive education resources, young women often consume diets that fail to meet national dietary guidelines.

Objective
To identify the eating behaviours of women in their reproductive years and to determine the strength of the forces acting both for and against the consumption of nutritionally adequate diets.

Design
The analyses of dietary data from a randomised controlled trial (n=65) with control, pork meat, and iron supplement interventions encompassed young women's food records (950 record days), food frequency and eating behaviour questionnaires. Synchronous analyses of data from in-depth interviews with nutrition professionals and family sets of three generations of women (n=15) were analysed. Both quantitative (SPSS) and qualitative (NVivo 10) data analysis software were utilised. The University of Sydney Human Ethics Review Committee granted study approval.

Outcomes
All study sets failed to consume the dietary guidelines for any food group however women from the diet intervention set, who prepared and cooked at least 3 meals per week using pork meat, reported fruit intakes significantly higher (P<0.02) than the control set; consumed 3 meals a day while the control set omitted 2 meals / w (median, range 0-7); and had 45% of their meals nutritionally complete (control, 33%). Despite the familial and experiential differences of family sets, the most influential forces on the eating behaviours of young women came from childhood mother-daughter involvements and adolescent culinary training. As adults, the persuasive forces of familial or peer influence were negligible - the former avoided conflict over food intake, and the latter accepted an individual's right to food selections and behaviours. Nutrition knowledge was inconsistent with reported eating behaviours.

Conclusion
In young women home-cooking a meal using pork meat both elevated fruit intake and reduced meal omissions; and, in the absence of ill health, early learned social conventions influenced eating behaviours more than nutrition knowledge. The linking of recommended dietary intakes with social skill development as a child may embed lifelong attention to nutritional wellbeing.

Source of funding
Pork (CRC) and Australian Pork Limited grant.
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Poster Session 1: Wednesday 4 December
Group 1 – Determinants of Food Choice

P007

Does dietary intake influence self-perception of and actual appearance? A systematic review

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Background

A key motivator for dietary change among young adults is appearance. Appearance based interventions have been implemented in the areas of smoking cessation and sun protection with significant improvements in behaviour reported. Such an approach might also facilitate dietary improvement if dietary intake can be shown to influence appearance.

Objective

To evaluate the relationship between dietary intake and perceived or objectively measured physical appearance and also to determine the effectiveness of dietary interventions on perceived or actual appearance measures.

Design

A systematic literature search up to August 2012 was conducted across seven databases. Eligible studies that observed or altered dietary intake from either food groups, dietary supplements or both, and assessed appearance related outcomes as the primary outcome were included. Studies with participants aged <18 years, who were pregnant, had a history of eating disorders or those with chronic medical conditions were excluded. Two reviewers assessed included articles for methodological quality and performed data extraction using a standardised tool.

Outcomes

The search identified a total of 8022 articles of which 59 studies were retrieved and 26 articles met the inclusion criteria. Of the included studies, 15 were Randomised Controlled Trials (RCT's), four Case-Control and seven Cross-Sectional studies. The majority of the RCT's evaluated the effect of various dietary supplements on skin ageing, wrinkling and cellulite amongst females (age range 18-75 years). Only one RCT examined the effects of food groups on skin colour appearance. Significant improvements on facial skin wrinkling and cellulite were shown from consuming dietary supplements in 10 of the 15 RCT's, however these studies were of short duration, small sample sizes and were heterogeneous in study design and appearance related outcomes..

Conclusion

Currently there is not yet sufficient evidence on the effect of manipulating dietary intake on appearance outcomes. High quality studies are needed to provide stronger evidence.

Source of funding

P008

The science behind FoodSwitch: a smartphone application to help consumers make healthier food choices

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Background

Existing front-of-pack labelling schemes can be difficult for consumers to understand. More than 60% of Australians own a smartphone, and consumers are increasingly using smartphones to shop for food.

Objective

To describe the science behind the FoodSwitch smartphone application, which was developed to show consumers the nutritional characteristics of foods in an easy-to-understand format and to suggest similar healthier products.

Design

A database containing nutritional information and barcodes for 40,000 Australian packaged foods was created. All foods were categorised into >850 categories, with each item assigned traffic light colours indicating levels of total fat, saturated fat, sugar and salt based on the UK Food Standards Agency guidelines. Food Standards Australia New Zealand's nutrient profiling criteria was applied to each product to calculate which items appeared as healthier choices. Crowd-sourcing was utilised to engage consumers in the attainment of healthier choices.

Outcomes

When the barcode of a food product is scanned, FoodSwitch displays the level and traffic light colour for total fat, saturated fat, sugar and salt. A listing of healthier products is shown on the screen. FoodSwitch has been downloaded by >350,000 users to date, had >300 media clippings, and is being adapted for use in the UK, India and New Zealand. Crowd-sourcing resulted in 6,000 additional products added to the database in the first week. Nutritional information for >300 products is still sent in by users each week. Over 1000 consumer feedback emails have been received which have led to a filter within the app for hypertensives, SaltSwitch, being released as well as one for people with Coeliac Disease, GlutenSwitch.

Conclusion

In the absence of a consistent front-of-pack labelling scheme, FoodSwitch offers consumers a novel way to tell at a glance whether or not the products they buy are healthy, and offers them a list of healthier similar products they can select in the supermarket.

Source of funding

Poster Session 1: Wednesday 4 December
Group 1 – Determinants of Food Choice

P009

Prevalence and predictors of nut consumption: results from the 2008/09 New Zealand Adult Nutrition Survey

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Background
Regular nut consumption is associated with reduced cardiovascular disease risk. Insight into patterns and predictors of nut consumption may provide important information to inform strategies designed to encourage intake.

Objective
This study aimed to describe nut intake in terms of prevalence, mean population intake and mean portion size among nut consumers; and to identify predictors of nut consumption.

Design
Data from the 24-hour diet recalls from the 2008/09 New Zealand Adult Nutrition Survey (n=4721) was used to identify nut consumers, sources and predictors of nut intake.

Outcomes
The percentage of consumers on the recall day for whole nuts, nut butters, and nuts from hidden sources were 6.9%, 7.2% and 19.2% respectively. Population mean intakes were relatively low for whole nuts (2.8 g), nut butters (0.9 g) and nuts from hidden sources (1.5 g). Among consumers the mean portion size of whole nuts, nut butters, nuts from hidden sources, and all nut sources combined were 40.3 g, 12.9 g, 7.8 g, and 17.9g respectively. There was an association between nuts and age, with those aged 15-18 yr having the lowest whole nut consumption but the highest peanut butter consumption. The consumption of total nuts was positively associated with level of education and socioeconomic status, while whole nut consumption was inversely associated with BMI.

Conclusion
In conclusion, the low prevalence of nut consumption is of concern and new strategies to increase nut consumption are required. Future public health initiatives should be mindful of patterns and predictors of nut consumption.

Source of funding

P010

Barriers to and drivers of vegetable consumption: a case study

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Background
Most research on barriers to and drivers of vegetable consumption and purchase has used a generic category approach. A commodity specific approach may identify specific barriers and drivers that can be used to increase consumption of specific vegetable types.

Objective
The objective of this study was to identify drivers and barriers related to the purchase and consumption of two vegetable commodities: cauliflower and green beans.

Design
A literature review was conducted first. Then, two online nationwide surveys with Australian consumers (*n* 500 each, 18-65 years, consumers of each commodity) were conducted, one specific to each commodity. Buying of vegetables in two contexts (main meal and snack) was investigated in two conjoint experiments. Commodity attributes were presented as product profiles with colour, communication of sensory properties, health claims, price and convenience/portion varied by 3-4 levels each. Other measures included, liking (by participants, their children), food involvement attitudes, health and taste attitude, children's influence on food decision making and socio-demographics. Data were analysed with Conjoint Analysis software (SPSS v20.0).

Outcomes
Participants were most likely to buy the vegetable in their most typically sold form (white whole cauliflower, green beans sold loose) without sensory or health claim and at the lowest price. Attributes most important to purchase intent were colour (typical colour preferred), price (lowest price preferred), and pack format (regular format preferred). Health claims had a very small positive (FSANZ approved heart health; skin health) or no (calcium for green beans) effect. Children's liking was reported to be lower than adult's liking and limited purchase of cauliflower and green beans in more than three quarters of families.

Conclusion
Changing the attributes of specific commodities does not seem to have the potential to increase purchase and consumption. Rather than changing product properties, changing consumer behaviour towards the commodities is required, with sensory liking of adults and children identified as one of the key barriers.

Source of funding

Poster Session 1: Wednesday 4 December
Group 1 – Determinants of Food Choice

P011

Protein quality of orange-fleshed sweetpotato- and cereal-based complementary foods

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Background
Complementary food prepared from orange-fleshed sweet potato with soya bean and anchovy powder, denoted OFSP ComFa, is high in β-carotene, low in phytate and meets the Codex Alimentarius recommendations for macronutrients.

Objective
The objective was to compare the protein quality of OFSP ComFa with "Weanimix", a maize-based product enriched with anchovy, and "Cerelac", a commercial complementary food containing wheat.

Design
Test diets were prepared from OFSP ComFa, Weanimix and Cerelac and fed to 3-week old Sprague-Dawley weanling rats (53-67 g), for a 9-day period according to the method of Food & Agriculture Organization for assessing the Protein Digestibility Corrected Amino Acid Score (PDCAAS) of complementary food.

Outcomes
The OFSP ComFa, Weanimix and Cerelac met the protein quality required for complementary food. The PDCAAS was higher for the OFSP ComFa formulation than for Cerelac suggesting that sweetpotato-based complementary food might have higher protein quality than cereal-based food. OFSP ComFa could support adequate growth and is recommended for complementary feeding.

Conclusion
The OFSP ComFa, Weanimix and Cerelac met the protein quality required for complementary food. The PDCAAS was higher for the OFSP ComFa formulation than for Cerelac suggesting that sweetpotato-based complementary food might have higher protein quality than cereal-based food. OFSP ComFa could support adequate growth and is recommended for complementary feeding.

Source of funding

P012

LC-MS/MS quantification of Neu5Ac, Neu5Gc and KDN levels in conventional foods of China

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Background
Sialic acid (Sia), a family of 9-carbon sugar acid, is found terminal residues on mammalian glycoconjugates. They play an important role in cell recognition, cell-to-cell adhesion, receptor mediated cell signalling and modulation of immune function. *N*-acetylneuraminic acid (Neu5Ac) and *N*-glycolylneuraminic acids (Neu5Gc) are the two major forms of Sia in most mammalian tissues, but Neu5Ac is the predominant Sia in humans. A less common Sia is ketodeoxynonulosonic acid (KDN). Neu5Gc is absorbed into human tissues as a result of eating red meat and milk products, and is associated with inflammatory diseases in human (1). The concentration of Sia in China conventional food products is unknown.

Objective
To determine the concentration of Sia in uncooked red meat, poultry, seafood, milk and milk products.

Design
Twenty-one different types of fresh raw food and products were purchased from 3~5 different supermarkets. All tissues were homogenised and hydrolysed in 0.1mol/L trifluoracetic acid for 60 min at 80°C. The concentrations of Neu5Ac, Neu5Gc and KDN were analysed using a highly sensitive LC-MS/MS method (Agilent1100-Agilent 6430) with $^{13}C_3$-Neu5Ac as an internal standard. All samples were analysed in triplicate.

Outcomes
The concentration of total Sia (μg/g protein) in China raw animal derived food was the highest in crucian eggs (4574), followed by egg yolk (1110), egg white (368), cheese (289), milk (237) and yogurt (222), lamb (91), beef (77), golden pomfret (75), duck (68), pork (63) and chicken (57). Beef contained the highest levels of Neu5Gc (39%) followed by lamb (23%), pock (9%) and cow's milk (4.6%). KDN was the highest in cheese (27%), followed by yogurt (25%) and milk (12%). No Neu5Gc were detected in poultry. KDN was detected in crab.

Conclusion
Red meat and dairy products contain high Sias including Neu5Gc. The long-term impact of the uptake of the non-human Neu5Gc on health and disease remains to be determined.

Source of funding:

Poster Session 1: Wednesday 4 December
Group 1 – Determinants of Food Choice

P013

Intake of short chain fermentable carbohydrates (FODMAPs and prebiotics) in healthy individuals

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Background
A diet low in fermentable, short chain carbohydrates (low FODMAP diet) is increasingly used for managing irritable bowel syndrome (IBS) symptoms. There is also interest in health benefits of supplemental prebiotic oligosaccharides. However, dietary intake of both is unknown.

Objective
To determine the intake of FODMAPs and prebiotic oligosaccharides in a healthy Australian population.

Design
The Monash Comprehensive Nutrition Assessment Questionnaire (CNAQ) was validated against four 7-day food diaries in healthy volunteers (*Barrett JS, Gibson PR. JADA 2010;110*). Average FODMAP intake, including prebiotic fructo- (FOS) and galacto-oligosaccharides (GOS) were calculated using the Monash University FODMAP Food Composition Database. Quartile CNAQ data were calculated. Fructose intake was presented as total fructose and in excess of glucose. Sorbitol and mannitol intake was calculated, the most common polyols,

Outcomes
Mean (95% CI) intake of fructose (excess fructose) was 15.5g (14.0-17.1) (2.2g (1.8-2.6)) and 26.5g (24.6-28.4) (3.4g (2.9-2.9)) for the food diaries and CNAQ respectively. Lactose intake was 13.2g (11.8-14.6) and 19.9g (17.4-22.5), respectively. Total polyol intake was 1.5g (1.3-1.8) and 3.0g (2.5-3.5) respectively. Of particular interest was intake of prebiotic FOS and GOS with 3.8g (3.5-4.0) consumed on average according to food diaries (5.0g (4.6-5.5) on CNAQ). Quartiles of intake were created from the CNAQ data for future reference expressed as low, moderate, high and very high intake. Moderate intake of prebiotic FOS and GOS equated to 3.5g-4.6g per day.

Conclusion
This is the first time detailed data on normal FODMAP and prebiotic oligosaccharide intake has become available. Most healthy subjects consume prebiotics in submaximal doses, with possibility of putative health benefits from prebiotic supplementation. Benefits of prebiotic supplementation have substantial, dose-dependent inter-individual variance potentially confounded by dietary FOS and GOS intake. Analysis of intake of FOS and GOS should be taken into account in future prebiotic research.

Source of funding

P014

Flavonoid intake in a cystic fibrosis adult group – associations with BMI and age

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Background
Cystic fibrosis is an inherited condition which involves chronic inflammation and serious impairment of the gastrointestinal and respiratory systems. Intakes of certain flavonoids associate with gut microbiota composition changes. The gut microbiota in CF varies from that in the general population. Since gut microbiota may affect chronic inflammation, flavonoid intake may have potential in chronic inflammation management in CF

Objective
To investigate flavonoid intake in adults (>18 years) with CF and potential associations with age, gender and BMI.

Design
Adults with CF (n=17) recruited from Sydney and Brisbane were interviewed using a food frequency questionnaire (FFQ) validated for flavonoid intake. Data on age, gender and BMI were also collected. Flavonoid intakes were compared using one sample t-test with the general Australian population (NNS95). The effects of age, BMI and gender were tested using one-way ANOVA.

Outcomes
Total dietary flavonoid intakes were similar to the general Australian population, being 197mg/day for 19-24 years (n=3), 301mg/day for 25-44 years (n=12), 565mg/day for 45-64 years (n=2), and 314mg/day for all age groups (n=17). Tea flavonoids contributed 74% (232mg/day), comprising black tea (60%, 188mg/day) and green tea (14%, 45mg/day). Other major sources were cooked onions (5%, 17mg/day), apples (4%, 13mg/day), red wine (3%, 9mg/day), and oranges (3%, 8mg/day). Contributions of flavan-3-ols were lower and flavonols, flavanones, anthocyanidins higher compared to the general Australian population. Excluding tea, the major flavonoids were quercetin, epicatechin, hesperetin, cyanidin, catechin, malvidin and naringenin. Luteolin intake higher (p=0.018) in the overweight (25≤BMI <30, n=4) group than normal (18.5≤BMI<25, n=11) group. Intakes of catechin, epicatechin, myricetin and kaempferol for ages 19-24 years were all higher than ages 25-44 years (p<0.01) and >45 years (p<0.05).

Conclusion
Total dietary flavonoid intake in this group of adults with CF was similar to Australian norms. The association of luteolin intake with BMI, a major determinant of survival in CF, requires confirmation in a larger population.

Source of funding

Poster Session 1: Wednesday 4 December
Group 1 – Determinants of Food Choice

P015

The low FODMAP diet alters colonic microbiota compared to a typical Australian intake in patients with irritable bowel syndrome: a randomised controlled trial

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Background
The low FODMAP diet (LFD) is efficacious for managing symptoms seen in irritable bowel syndrome (IBS). Conversely, FODMAPs as fermentation substrates are a source of short-chain fatty acids (SCFAs) and some have prebiotic action, both being putatively important for health.

Objective
To compare the effects of the LFD with those of a typical Australian diet (Aust) on faecal microbiota composition and biomarkers related to colonic health in a single-blinded, randomised, cross-over, efficacy trial.

Design
Twenty-three IBS (6 male; median age 41 y) and six healthy (1 male; 31 y) subjects consumed two diets that were nutritionally matched, except for FODMAP content (LFD: mean [95%CI] 3.05[1.86-4.25] vs Aust: 23.7[16.9-30.6] g/day, both low lactose), for 21 d each with a ≥21-d washout. Subjects collected and immediately froze all stools passed from day 17-21 of each intervention diet. Faecal samples were assessed for pH, SCFA concentrations, and bacterial abundance and diversity by DGGE and QPCR.

Outcomes
In the IBS subjects, faecal pH was higher for LFD (7.41[7.26-7.55]) vs Aust (7.14[6.99-7.28]; P<0.001, paired t-test) although SCFA concentrations were unaffected by diet. Microbial diversity was increased by the LFD. Absolute and relative abundance of faecal bacteria differed between the diets, notably the relative abundance of butyrate-producing bacteria *C. coccoides* group (LFD 3.0[2.5-3.5]% vs Aust 20[17-23]%; P<0.001) and the mucus-associated bacterium *A. muciniphila* (LFD 0.02[0-0.03]% vs Aust (0.11[0.02-0.20]%; P=0.036) whereas *R. torques* was increased. Similar patterns in microbiota were observed for the healthy cohort.

Conclusion
Faecal microbiota composition of IBS and healthy subjects was markedly altered by the LFD. Increased diversity and substantial decreases in the abundance of key bacterial species suggest that the LFD may not be conducive to host health in the long term. The shift in microbiota was reflected in faecal pH but not in faecal SCFA levels.

Source of funding

P016

Prebiotic effects of kiwifruit on intestinal microbiota and gene expression in rats

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Background
The mammalian gastrointestinal tract harbours high densities of microorganisms. The symbiotic relationship between resident microbiota and intestinal epithelium is essential in maintaining intestinal homeostasis. Diet plays a vital role in shaping the diversity of microbiota as it provides the major source of substrates for microbial fermentation. Promoting the growth of beneficial gut microbiota through diet can influence host mucosal cellular development and physiology.

Objective
This study aims to evaluate the prebiotic effects of kiwifruit on large bowel health using the rat as a model of mammalian digestion.

Design
Four-week old Sprague-Dawley rats were randomly allocated to experimental diets containing 10% fresh homogenised Zespri® Green Kiwifruit (Hayward), Zespri® Gold Kiwifruit (Hort16A) or 10% glucose solution, and fed for 4 and 6 weeks (*n* = 8). Real-time PCR was used to quantify the caecum microbiota and colonic gene expression. Colon tissues were examined microscopically to determine the crypt depth and number of goblet cell per crypt.

Outcomes
Rats fed Zespri® Green Kiwifruit showed higher numbers of *Lachnospiraceae* compared to rats fed control diet at week 4 (*P* = 0.020). When rats fed Zespri® Gold Kiwifruit, there was a significant increase in *Lachnospiraceae* (*P* = 0.007) and total bacteria (*P* = 0.020). The colonic gene expression was altered by both kiwifruit varieties. At week 6, Zespri® Green Kiwifruit significantly enhanced the expression of mucin (MUC) 2 gene. Whereas, Zespri® Gold Kiwifruit fed rats showed higher expression of MUC3 (*P* = 0.004), trefoil factor 3 (*P* = 0.040) and toll-like receptor 4 (*P* = 0.008) compared to those fed control diet. Rats fed Zespri® Green Kiwifruit or Zespri® Gold Kiwifruit diet showed longer colon crypts and a greater number of goblet cells per crypt than the control rats (*P* < 0.05).

Conclusion
Kiwifruit diets enhanced caecum *Lachnospiraceae* numbers, colonic mucin gene expression and induced morphological changes in colonic mucosal architecture. Both kiwifruit varieties showed prebiotic effects by enhancing biomarkers that are known to promote large bowel health.

Source of funding

Poster Session 1: Wednesday 4 December
Group 1 – Determinants of Food Choice

P017

Repeatability of gastric emptying of sequential intra-gastric feeds in preterm infants

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Background
Delayed gastric emptying (GE) is associated with feeding intolerance and necrotizing enterocolitis. Limited knowledge of normal between feed variation makes delayed GE difficult to identify.

Objective
To determine whether infant GE patterns are repeatable for sequential feeds under identical conditions.

Design
Preterm infants (n=19) [birth gestation 31^{+3} weeks ($28-32^{+6}$); birth weight 1600 g (910-2370), corrected gestational age 33^{+3} weeks ($31^{+1} – 34^{+6}$)] were monitored at 30-min intervals over two consecutive intra-gastric tube feeds (n=29), starting prior to delivery of the first feed. Feeds were of identical volume and composition, and given in the same position. Stomach volumes were determined from ultra-sound images. Data analysis (linear mixed effect models, intra-class correlations (ICC), coefficients of variation (CV)) were performed using R 2.9.0

Outcomes
Maximum stomach volumes were seen immediately post feed and were on average 82% ± 21 (mean ± sd) of the delivered feed volumes. Although distinct differences between infant patterns were seen, within infant measurements at matched time points post-feed were found to be highly consistent (ICC 0.966, 95% CI (0.954, 0.975)). Intra-individual CV was 14% and inter-individual was 17%. Average difference between matched points was 1mL, which is within the expected error of the measurement technique. The largest between feed differences were seen in an infant with previous feed intolerance. Differences in feed duration (P<0.001) and observed curd volume (P=0.014) were associated with larger differences, but not with other measured factors.

Conclusion
GE occurred during feed delivery. Patterns of GE are repeatable for stable preterm infants fed milk of same volume and composition under identical clinical conditions.

Source of funding

P018

Acute nutrient reversal of insulin resistance in the rat is mediated by the gastrointestinal tract

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Background
The prevalence of obesity and type 2 diabetes (T2DM) is rapidly increasing in western countries, becoming a major health burden. T2DM is preceded by an insulin resistant state, where insulin sensitive tissues such as skeletal muscle and liver have a reduced response to insulin. Previous studies have shown that diet-induced insulin resistance can be reversed by a single glucose meal in rodents. We hypothesise that the change in whole body insulin action is regulated by factors released from the gastrointestinal tract in response to the glucose meal.

Objective
To investigate the role of the gastrointestinal tract in the reversal of high fat, diet-induced insulin resistance in rats.

Design
Male wistar rats weighing approximately 300g were fed either a standard rodent chow or lard based high fat diet for three weeks. Jugular vein cannulas were placed surgically in the third week. Insulin sensitivity was assessed using a hyperinsulinemic euglycemic clamp technique, clamping blood glucose levels between 5 and 6mM. The evening prior to the clamp, specific meals were administered. The high fat fed rats were divided into three groups and received either 250 kJ of high fat diet (n=7) or 250kJ high glucose diet (n=5) containing 5g glucose, or an intravenous (IV) glucose infusion with equivalent glucose to the oral glucose meal (n=6). Control rats received 250kJ of standard chow (n=7). Glucose infusion rates (GIR) were calculated from the clamp studies.

Outcomes
Rats in all fat fed groups had significantly greater body weight than chow fed rats (P<0.05). Rats fed high fat diet had significantly lower GIR (9.2±0.8 mg/kg/min) than chow fed rats (16.7±1.2 mg/kg/min, P<0.001), indicative of insulin resistance in fat fed rats. Fat fed rats infused with glucose (IV) were also insulin resistant (GIR (10.7±1.1 mg/kg/min, vs CHOW P<0.01), and were not different to high fat fed rats. Rats fed a single glucose meal instead of the usual fat meal had a significantly higher GIR (14.6±1.4 mg/kg/min) than high fat fed (P<0.01) or IV glucose (P<0.05) groups, and were not different to chow fed rats.

Conclusion
These results indicate that glucose-mediated reversal of whole body insulin resistance in fat fed rats is dependent on digestion and absorption by the gastrointestinal tract.

Source of funding

Poster Session 1: Wednesday 4 December
Group 2 – Nutrition in Pregnancy and Childhood

P019

Reducing the dietary intake of short chain carbohydrates (FODMAPs) to improve infantile colic: a pilot study

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Background

Infantile colic is the most common complaint for which parents seek professional advice during the first months of life and occurs equally in breast-fed and formulae-fed infants. Our research team has shown that poorly absorbed short chain carbohydrates - FODMAPs (Fermentable Oligo- Di- and Mono-saccharides And Polyols) can induce wind, bloating and abdominal pain in adults with irritable bowel syndrome (IBS). Characteristically these symptoms are similar in infant colic. Breast-feeding mothers with colicky infants contacted our department after successfully trialling our low FODMAP diet. Mothers are often advised to avoid certain 'gas-forming' foods (eg onions or legumes) although the scientific evidence supporting this advice is poor.

Objectives

To explore the potential role of FODMAPs in the genesis of symptoms associated with infantile colic.

Design

A pilot study including breast-feeding mothers of infants with colic was undertaken, where mothers were supplied with a low FODMAP diet for seven days. To date 10 mothers and their infants have been recruited, with an aim to recruit 15-20 in total.

Outcomes

In the infants studied to date, mean duration of crying time reduced from 162 ± 13 to 102 ± 18 min, (a reduction of 60 min or 42%; *P=0.001*) after the mothers consumed the low FODMAP diet. Crying duration decreased in all 10 infants.

Conclusion

The results from this preliminary work suggest the low FODMAP diet improves symptoms of infantile colic but further investigation is required. A randomised controlled trial is being planned on completion of this pilot study with the mechanism to be explored.

Source of funding

Not applicable.

P020

The cellular hierarchy of human milk: From pluripotent stem cells to lactocytes

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Background

During pregnancy and lactation, the breast undergoes extensive remodelling that supports the synthesis and delivery of milk to the newborn. This is facilitated via a controlled program of proliferation and differentiation of stem and progenitor cells. It has been suggested that these cells are present in human milk; however its cellular hierarchy and factors influencing it are largely unexplored.

Objective

We investigated the cellular composition of human milk, the properties of these cells and their origin.

Design

Breastmilk was collected from 90 lactating women from Australia and the USA, and cells were isolated and analysed *ex vivo, in vitro and in vivo*. The origin of the identified cell types was traced in human breast tissues.

Outcomes

Human milk was characterised by a pronounced cellular heterogeneity, including cell subpopulations expressing markers of pluripotent stem cells (OCT4, SOX2, NANOG, SSEA4, Tra-1-60/81, ESRRB); of hematopoietic stem cells (CD34, CD133); and of mammary stem cells (CD49f^{+}/CD29^{+}/CD24^{-/low}/CK5^{+}), epithelial progenitor cells (p63), lactocytes (β-casein, α-lactalbumin, lactoferrin) and myoepithelial cells (SMA, CK14). We showed that at least part of these cell types originated from the lactating mammary epithelium. Conversely, stem cells were rare in the resting breast. Breastmilk stem cells expressing pluripotency markers expanded in culture in spheroid assays revealing their self-renewing capabilities. When injected subcutaneously in SCID mice, they did not form tumours. *In vitro,* they differentiated into cells from all three germ layers. The stage of lactation influenced expression levels of some of the markers tested.

Conclusion

These findings demonstrate the high level of cellular heterogeneity in the lactating breast and in human milk, depicting the existence of a cellular hierarchy, at the pinnacle of which sits a stem cell population with potential pluripotency. These stem cells are non-tumorigenic and can be easily accessed via breastmilk for use in both lactation research and regenerative medicine.

Source of funding

Poster Session 1: Wednesday 4 December
Group 2 – Nutrition in Pregnancy and Childhood

P021

Effect of volume and macronutrients on gastric emptying in term breastfed infants: an ultrasonic assessment

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Background
Data is limited regarding the influence of the breastmilk components on the gastric emptying rate (GER) in term infants.

Objective
This study aimed to investigate the relationship between infant GER and macronutrient content of the consumed breastmilk, with the focus on milk proteins predominantly.

Design
Healthy, term, fully breastfed infants (n=11, aged 3 to 31 weeks) were examined, with ultrasound, before and after a feed, and then at 10-20 minute intervals until the next feed. Stomach volumes were calculated from transverse and sagittal ultrasound scans of the infant stomach. Images were graded for post-feed echogenicity of the stomach content. For each interval of gastric emptying the average GER (mL/min) was calculated. Milk intake was measured by the test-weigh method. Breastmilk samples (1-2 mL) were collected and analysed for lactose, fat, total protein and whey and casein protein.

Outcomes
Infant milk intake was not associated with any measured nutrients (P>0.420). Post-feed stomach volumes were negatively associated with casein levels (P=0.023) after accounting for the time since the end of the feed (P<0.001) and the milk intake (P=0.002), but were not associated with the other measured nutrients (P>0.134).

Conclusion
Protein content of the milk appears to play an important role in control of gastric emptying in term infants with higher casein concentration breastmilk emptying faster in the period prior to the next feed. Further investigation of the effect of casein on GER and appetite control is required.

Source of funding

P022

A preference for processed: a secondary analysis of pork intake in Australian children

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Background
Pork represents a core food which provides key nutrients such as protein, thiamin and selenium. Current dietary guidelines recommend limiting consumption of processed meats such as pork due to adverse health outcomes. **Objective**
To describe pork consumption patterns in the diets of Australian children, assess the contribution of pork to nutrient intakes and compare anthropometric characteristics between pork consumers and non-consumers.

Design
The study involved a secondary analysis of the 2007 Australian National Children's Nutrition and Physical Activity Survey. Pork and pork-containing dishes were identified and classified as fresh or processed pork. The contributions of total, fresh and processed pork to intakes of key nutrients were calculated. Weight, waist circumference and age and sex-specific body mass index (BMI) were compared between consumers and non-consumers of total, fresh and processed pork.

Outcomes
Data from 4487 children was available for use in this study. Of this sample, n=2245 (50%) reported consuming pork, of which n=310 (14%) consumed fresh pork, whilst n=2084 (93%) consumed processed pork. Total, fresh and processed pork all contributed substantially to intakes of protein, niacin and zinc. In addition, fresh pork contributed to intakes of thiamin, long chain omega-3, phosphorous and potassium. Total and processed pork contributed 12.2% and 13.0% of dietary sodium respectively. There were no significant differences between weight, waist circumference and BMI in consumers and non-consumers of total, fresh or processed pork (P>0.05).

Conclusion
In a nationally representative sample of Australian children, processed pork was the most frequently reported form of pork consumed, suggesting a deviation from dietary guideline recommendations. Pork contributed to intakes of a number of key nutrients, with no differences in anthropometric characteristics found between pork consumers and non-consumers.

Source of funding

Poster Session 1: Wednesday 4 December
Group 2 – Nutrition in Pregnancy and Childhood

P023

Impact of neonatal growth on IQ and behaviour at early school age

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Background
Feeding difficulties often emerge in the neonatal period and may affect infant growth. Faster growth in infancy is associated with better child development, although most studies involve children born preterm or low birth weight, rather than healthy term infants.

Objective
To examine associations of neonatal weight gain (NWG) and head circumference gain (HCG) with intelligence quotient (IQ) and behaviour at in childhood.

Design
We used data from the Promotion of Breastfeeding Intervention Trial (PROBIT), which involved infants born >2.5 kg and ≥37 weeks gestation. NWG and HCG were measured as the percent gain in weight and head circumference over the first 4 weeks, relative to birth size. IQ and behaviour were measured using the Wechsler Abbreviated Scales of Intelligence and the Strengths and Difficulties Questionnaire (SDQ), respectively. The SDQ was collected from parents and teachers. Associations between neonatal growth and children's IQ and SDQ were examined using mixed models to account for clustering of measurements, with adjustment for perinatal and sociodemographic factors.

Outcomes
Mean NWG was 26% (SD 105%) of birth weight. In fully-adjusted models, infants in the highest versus lowest quartile of NWG had 1.5 (95%CI 0.8, 2.2) higher IQ scores (n=13840). A weak negative (protective) association between NWG and SDQ total difficulties scores was observed for teacher-reported (β=-0.39, 95%CI -0.71, -0.08, n=12016), but not parent-reported SDQ (β=-0.12, 95%CI -0.39, 0.15; n=13815). Similar associations were observed with HCG and IQ and behaviour.

Conclusion
Faster weight gain in the 4 weeks after birth may contribute to children's IQ, but reverse causality (brain function affects neonatal growth) cannot be excluded.

Source of funding

P024

FODMAP intake in healthy children

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Background
The amount of FODMAPs consumed in the daily diet of children is currently not known. It is, therefore, difficult to determine dietary 'challenge' amounts for use in exclusion trials that should elicit symptoms in children with irritable bowel syndrome (IBS), but not in normal healthy children.

Objective
To quantify the daily FODMAP intake of normal healthy children in school years 1, 5 and 10.

Design
Diet records (24-hr) were collected as part of the Healthy Kids Queensland Study in 2006. These records were re-analysed in 2012 to obtain compositional information about FODMAP intake. Types of FODMAPs were grouped according to fructose in excess of glucose, lactose, total fructans (TF), galactooligosaccharides (GOS) and polyols. Data were analysed using t-tests, ANOVA and correlation.

Outcomes
There were 2541 records for reanalysis. The number of records available for each year group and the age (mean±SD) of subjects were as follows: Yr1 n=234, 6.16±0.37yrs; Yr5 n=1383, 10.16±0.41yrs; and Yr10 n=924, 15.18±0.41yrs. Group mean height, weight and BMI z-scores were 0.30±0.98, 0.38±0.97 and 0.33±0.97, respectively. Excess fructose was found in 1109 (44%) records, and intakes were similar in years 1 and 5 (6.44±7.35g and 6.64±8.45 g, respectively), but Yr10 (5.31±7.11 g) was significantly higher than Yr5 (P=0.03). Intakes of lactose and GOS did not differ between years 1, 5 and 10 (group mean: 18.37±15.47 g, and 0.58±0.70 g, respectively). Intake of TF were significantly higher for Yr10 (5.12±7.24 g) compared to years 1 (3.81±4.19 g, P=0.01) and 5 (4.05±5.61 g, P=0.00), and intake of polyols were significantly different between Yr1 and Yr5 (1.57±1.63 g and 1.23±1.57 g, respectively, P=0.02), but not Yr10 (1.31±2.25 g). Intake of all five FODMAPs groups significantly increased with increasing energy intake (excess fructose r=0.12, P=0.00; lactose r=0.44, P=0.00; TF r=0.40, P=0.00; GOS r=0.19, P=0.00; polyols r=0.13, P=0.00), and energy intake significantly increased with increasing age (r=0.20, P=0.00).

Conclusion
Based on these data, children and adolescents have similar intakes of FODMAPs each day, with the exception of excess fructose, total fructans and polyols. This has implications for both clinical practice and research where elimination-challenge protocols for the low FODMAP diet to control symptoms in IBS are implemented.

Source of funding

Poster Session 1: Wednesday 4 December
Group 2 – Nutrition in Pregnancy and Childhood

P025

Nutrient intake in children with Crohn's disease: does it measure up?

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Background

Optimum nutrition in childhood is important for growth and development. Children with Crohn's Disease (CD) are at risk of malnutrition, and anecdotal evidence suggests that many children with CD avoid certain foods/food groups, and are often advised to increase fat intake, as a means of increasing their calorie intake. Increasing calorie intake without considering optimising micronutrient intake in these children may have long term health implications.

Objective

To determine the adequacy of usual dietary intake among a group of children with CD.

Design

All children completed 3-day diet records which were analysed using Foodworks® (Xyris software) to obtain daily nutrient intakes. Nutrient intakes were compared with the National Health and Medical Research Council (NHMRC) Estimated Average Requirements (EARs), or where appropriate, Adequate Intakes (AIs), using paired t-tests. Disease activity was assessed using the Pediatric Crohn's Disease Activity Index.

Outcomes

The cohort consisted of 19 children (8 F; 15 no disease activity, 4 mild disease activity) of mean±SD age 14.28±1.51 yrs. Their mean height, weight and BMI z-scores were -0.06±0.90, 0.01±1.14 and -0.03±1.12, respectively. The percentage of energy comprising carbohydrate, protein and fat intake was 45.78±8.96%, 17.49±3.87% and 33.88±4.94%, respectively. Of total fat intake, 41.81±6.58% was saturated fat (14.14±2.87% total energy). Suboptimum intakes were found for n-6 (74.80±29.10%, P=0.00), dietary fibre (60.55±26.06%, P=0.00), vitamin D (55.37±28.78%, P=0.00), vitamin E (61.16 ±26.40%, P=0.00), calcium (66.61±30.76%, P=0.00), magnesium (69.32±22.99%, P=0.00), and potassium (73.48±25.36%, P=0.00).

Conclusion

Mean percentage energy from fat was within the range recommended by the NHMRC, albeit at the higher end. However, percentage of energy comprising saturated fat exceeded recommendations, which is concerning for long term health risks such as coronary heart disease. In addition, this cohort had suboptimal intakes of several nutrients important for growth and development, in particular, calcium and vitamin D, which may compromise long term bone health.

Source of funding

P026

The iodine status of preschool aged children after the introduction of mandatory iodine fortification in bread

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Background

Food Standards Australia New Zealand (FSANZ) predicted that 6% of 2-3yr old children would attain an excessive iodine status following the introduction of mandatory iodine fortification in bread from 2009.The impact of iodine fortification on the iodine status of these children remains unknown.

Objective

To document the current urinary iodine concentrations (UIC) of children aged 2-3yr and identify any adverse effect associated with excessive iodine status.

Design

Fifty one children aged 2.00 and 3.99 years recruited from South East Queensland completed the survey (60% boys and 40% girls). UIC was determined from a spot morning urine sample and a spot afternoon urine sample collected on two consecutive days. Data were corrected for within-person variation before comparing the median UIC with the World Health Organisations' (WHO) criterion for assessing iodine nutrition. Food frequency questionnaires recorded the frequency of which iodine enriched and goitrogen foods were consumed over the past 12 months. In addition, 20% of participants provided a blood sample for analysis of; thyrotropin (TSH), free tetraiodothyronine (fT4), free triiodothyronine (fT3), Thyroglobulin (Tg) anti-thyroid peroxidase antibodies (TPOAb) and anti-thyroglobulin antibodies (TgAb).

Outcomes

The median UIC was 223 μg/L (6% <100 μg/L, 18% >300 μg/L). Foods positively associated with UIC were yoghurt (r = 0.27, P<0.05) and brassica vegetables (r= 0.29, P<0.03). There were no significant correlations between bread intake and UIC. The median value for thyroid analytes TSH, fT4, fT3, Tg, TPOAb and TgAb were 2.4 mU/L, 15 pmol/L, 6.1 pol/L, 12.8 ug/L, 42 U/mL and 26 U/mL.

Conclusion

The median UIC of children aged between 2-3yr is more than adequate (>200μg/L) according to WHO. Eighteen per cent of children were classified as iodine excessive (>300μg/L), which is higher than predicted. There appears to be no implication on thyroid function, as there were no associations between UIC and thyroid analytes. Bread consumption has no significant influence on the iodine status of children within this group. It is concluded that since the introduction of iodine fortification in bread, children aged 2-3 years have a more than adequate iodine status without adverse effect to their thyroid function.

Source of funding

Poster Session 1: Wednesday 4 December
Group 2 – Nutrition in Pregnancy and Childhood

P027

Australian children's consumption of caffeinated-formulated beverages

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Background

Excess consumption of beverages containing added caffeine is associated with negative health outcomes in children and adolescents. Data on the consumption of beverages containing added caffeine in Australian children and adolescents' are lacking.

Objective

To investigate the consumption patterns of caffeinated-formulated beverages (CFB), by age and socioeconomic status (SES) in a nationally representative sample of Australian children aged 2-16 years.

Design

Data from the 2007 Australian National Children's Nutrition and Physical Activity Survey were analysed (n=4487). CFB intake was determined using one 24-hr dietary recall. Soft drinks were defined using the AUSNUT2007 food database codes 115 and 116, CFBs were further defined, as soft drinks where caffeine was included in the AUSNUT2007 Database, and noted as an additive in the AUSNUT recipe file. SES was based on the highest level of education attained by the participant's primary caregiver. Descriptive statistics (%, mean (SD)) were used to determine intake of CFBs. Chi-squared analysis was used to determine the association between CFB consumption and demographic characteristics.

Outcomes

Older children were more likely to consume CFBs (P<0.001), 4%, 20%, 41%, and 35% of 2-3, 4-8, 9-13, and 14-16 year olds consumed CFBs respectively. Of the consumers, mean intakes (g SD) were 151(105) n=48, 287 (168) n=105, 442 (276) n=204, and 555 (340) n=285 of CFB for 2-3, 4-8, 9-13, and 14-16 year olds respectively. Low SES participants (38.2%) were more likely to consume CFBs than those of high SES (25.24%) (p=0.001), however the proportion of soft drinks that were caffeinated did not differ between the three SES groups, 43%, 45%, 43% in low, mid, and high respectively.

Conclusion

Consumption of CFBs was evident across all age groups, with the highest intakes in adolescents. Given the potential concern of caffeine on brain development, these data are concerning. The future Australian Health Survey data can be used to track CFB intakes in Australian children over time.

Source of funding

P028

Dietary sources of sodium in Victorian primary school children

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Background

Recent data indicates that Australian children are consuming excessive amounts of sodium. In the 2007 National Children's Nutrition and Physical Activity Survey (CNPAS) major sources of sodium for children aged 5-13 years were cereals and cereal-based products/dishes, meat and poultry products and milk products/dishes. **Objective**

To determine the major food sources of sodium in a sample of Victorian primary school children.

Design

A single three-pass 24-h diet recall was collected in a convenience sample of Victorian primary school children from independent schools. Sodium intake for food groups and subgroups was calculated using aggregate group data. The Food Standards Australian New Zealand food group classification system was used to define major and sub-major food groups.

Outcomes

Diet recalls were completed for 252 children at nine schools, with a mean age of 9.9 (SD 1.7) years, during 2010-11. The largest major food group sources of sodium were cereals and cereal-based products and dishes (46%), meat and poultry products and dishes (20%) and milk products and dishes (10%). Bread was the largest sub-major food group source of sodium (14%), followed by processed meat (11%), mixed dishes with cereal as the major ingredient (11%), gravies and savoury sauces (6%) and cheese (5%).

Conclusion

Results confirm previous findings using CNPAS data about dietary sources of sodium in Australian primary school-aged children. This evidence helps facilitate effective targeting of salt reduction measures for this age group.

Source of funding

Poster Session 1: Wednesday 4 December
Group 2 – Nutrition in Pregnancy and Childhood

P029

Iron deficiency in a cohort of Australian pregnant women

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Background
Iron deficiency (ID), the main cause of anaemia in pregnancy has been associated with low birth weight and preterm births. The iron status of pregnant women in Australian is unknown.

Objective
To determine the prevalence and risk factors of ID in a cohort of Australian pregnant women.

Design
The study included a random sample of 3084 women undergoing first trimester Down syndrome screening in 2007 with archived serum samples stored at a state laboratory. Laboratory information was linked to the Perinatal Data Collection, a statutory surveillance system of all births in NSW to obtain information on maternal demographics and risk factors. Blood samples were thawed and analysed for serum ferritin (SF; µg/L) and transferrin receptor (TfR; nmol/L). Total body iron (TBI; mg/kg) was calculated using an algorithm where positive values represent storage iron and negative values indicate ID.

Outcomes
Mean (SD) maternal age was 33 (4.9) years and gestational age (GA) was 12.0 (1.0) weeks. The prevalence (95% CI) of ID was 14.5% (95% CI: 13.2, 15.9). ID was more prevalent in nulliparous women (OR: 1.95; 95% CI: 1.54, 2.47), aged <25 years old (OR: 1.69, 95% CI: 1.12, 2.54) and with a body weight > 70kg (OR: 1.32: 95% CI: 1.01, 1.73). Multiple pregnancy, GA, smoking and socioeconomic status were not significantly associated with ID.

Conclusion
ID affects 1 in 7 women. Younger and heavier first time mothers are more at risk. Australia does not recommend routine iron supplementation in pregnancy, and consideration of the implications of this to high-risk women is needed.

Source of funding

P030

Prevalence of vitamin D deficiency in iron deficient and iron replete pregnant women

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Background
Iron and vitamin D deficiencies are common in pregnancy and could potentially be related. Liver conversion of vitamin D is reduced when iron is insufficient.

Objective
To determine the prevalence of vitamin D deficiency in iron deficient (ID) and iron replete pregnant women.

Design
Information for a random sample of NSW women with archived serum samples collected for first trimester Down Syndrome screening in 2007 at a state laboratory were linked to birth records for pregnancy-related information. Blood samples were analysed for serum ferritin (SF; µg/L), transferrin receptor (TfR; nmol/L), C-reactive protein (CRP; mg/L) and 25-hydroxyvitamin-D (25(OH)D; nmol/L). Women with inflammation (CRP>5) were excluded. Total body iron was calculated using an algorithm accounting for supply of storage and tissue iron where negative values indicate ID. Vitamin D deficiency was defined as <50 nmol/L.

Outcomes
Of 2570 women, mean age was 33 years (range: 16-48). Mean gestational age (GA) at sampling was 12.0 ± 1.0 weeks. The prevalence of ID was 14.3%. Vitamin D deficiency was more common in ID vs. iron replete women (36.8 vs. 27.9%, p=0.0005). Compared to iron replete women, the unadjusted odds of vitamin D deficiency in ID women was 1.51 (95% CI: 1.20, 1.90). Adjusting for age, GA, body weight, smoking, parity, multiple pregnancy and season of sampling, the odds ratio for vitamin D deficiency was 1.75 (95% C:1.34, 2.30) among women with ID compared to those without.

Conclusion
Routine screening and management of ID in pregnancy could be used to identify women at risk of vitamin D deficiency.

Source of funding

Poster Session 1: Wednesday 4 December
Group 2 – Nutrition in Pregnancy and Childhood

P031

Folic acid and iodine supplementation during pregnancy: knowledge, behaviour and practices of pregnant women and pharmacists

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Background
The NHMRC recommends supplementation with both folic acid and iodine during pregnancy. Health care providers, including pharmacists, may be an important source of advice regarding the importance of folic acid and iodine in pregnancy.

Objective
The primary objective of this research was to identify the knowledge, attitudes and practices of pregnant women regarding folic acid and iodine supplementation. A second objective was to assess whether pharmacists have sufficient knowledge about these nutrients to provide appropriate advice to pregnant women.

Design
A cross-sectional survey of pregnant women (N=152) in the Illawarra region of New South Wales was conducted. Information regarding folate and iodine knowledge and attitudes and supplement use among pregnant women was collected. Pharmacists (N=41) were recruited from all community pharmacies in the Illawarra to assess their knowledge of the nutrient supplements.

Outcomes
Most women (82%) reported using supplements during their pregnancy; 63% had started taking supplements before their pregnancy. Supplement use was more prevalent among pregnant women who were in the highest household income category compared to the lowest income category (69% vs 31%, P = 0.001). Seventy-six per cent of women understood that NTDs is the main health problem associated with inadequate intake of folic acid, while 40% of women could identify health problems associated with inadequate iodine intakes. Women with higher education had better knowledge about the importance of these nutrients in pregnancy (P<0.05). Most pharmacists had adequate knowledge and understanding about the role of folic acid in preventing NTDs in pregnant women, 73% of them knew the health problem associated with inadequate intake of iodine during pregnancy, and 27% knew the NHMRC recommended level of iodine during pregnancy.

Conclusion
Supplementation use was high among the pregnant women, but they had limited knowledge about folic acid and iodine. Pharmacists had good knowledge and understanding about folic acid supplementation during pregnancy, but their knowledge was more limited about iodine supplementation. This group may be a valuable, yet under-utilised source of nutrition education for pregnant women seeking advice at the point of sale.

P032

Food sources of added sugar intake among Australian children and adolescents

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Background
Added sugar intake is associated with several health issues such as childhood obesity. According to the World Health Organisation added sugar intake should contribute to less than 10% of energy intake. However, the added sugar intake of Australian children and adolescents previously reported by our research group is more than 12% of energy intake. Australian dietary guidelines recommend limiting consumption of food sources of added sugar as part of healthy eating practices. Therefore, it is important to identify the major food sources of added sugar in the diets of Australian children and adolescents.

Objective
To investigate the food sources of added sugar in the diets of Australian children and adolescents

Design
Data from the 2007 Australian National Children's Nutrition and Physical Activity Survey were used to assess the food sources of added sugar. After data cleaning for over and under reporters of energy intake (using the Goldberg cut-off), 4140 subjects provided plausible data for two 24-hour dietary recalls. Added sugar intake was determined using recipes, food labels and other added sugar estimation methods previously investigated by the research group. Major food sources of added sugar were identified and added sugar intake from these food sources were assessed using descriptive analysis, linear regression and independent t-test.

Outcomes
The results of the preliminary analyses for the major food sources of added sugar and their percentage contribution to daily added sugar intake were as follows: sugar sweetened beverages (SSB) 25%, cake and biscuits 13%, and chocolate and confectionaries 11%. The percentage of energy intake from the added sugar content of these food sources were 3.5%, 1.5% and 1.5%, respectively. As age increased, the added sugar intake from SSB (β=0.303, 95% CI: 0.041-0.049, P<0.05), cake and biscuits (β=0.035, 95% CI: 0.001-0.008, P<0.05), and chocolate and confectionaries (β=0.100, 95% CI: 0.009-0.017, P<0.05) also increased. Boys had significantly higher added sugar intake from SSB compared to girls (P<0.05).

Conclusion
Collectively, energy-dense, nutrient-poor food and drinks contribute greatly to daily added sugar intake. Therefore, limiting the consumption of these food sources could be one of strategies in the prevention of childhood obesity.

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P033

Intake of total and added sugars and nutrient dilution in Australian children and adolescents

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Background

Previous analyses of the 1995 Australian National Nutrition Survey revealed that among children and adolescents, high intake of added sugar was associated with nutrient dilution. Since then no recent data on this association were available and the dietary pattern of Australian youths may have changed, as suggested by the recent observation of a decline in apparent sugar consumption.

Objective

To examine the association between intake of sugars (total or added) and nutrient intake with data from the most recent Australian national nutrition survey, the 2007 Australian National Children's Nutrition and Physical Activity Survey (2007ANCNPAS).

Design

Data from participants (n = 4140; 51% male) who provided 2 x plausible 24 h recalls were included in the analysis. Reported intakes of nutrients and foods defined in the 2007ANCNPAS were analysed by age and sex specific quintiles of %energy from added sugars (%EAS) or total sugars (%ETS) using ANCOVA. Linear trends across the quintiles were examined using multiple linear regression. Logistic regression analysis was used to calculate the odds ratios of not meeting a defined Nutrient Reference Value for Australia and New Zealand per unit in %EAS or %ETS. Analyses were adjusted for age, sex BMI z-score and total energy intake.

Outcomes

Small but significant negative associations were seen between %EAS and most nutrient intakes (all $p < 0.001$). The associations were inconsistent between %ETS and nutrient intakes and even then they were smaller than that for %EAS. In general higher intakes of added sugars were associated with lower intakes of most core food groups, and higher intakes of non-core foods.

Conclusion

Assessing intakes of added sugars may be a better approach for addressing issues of diet quality than intakes of total sugars.

Source of funding

Poster Session 1: Wednesday 4 December
Group 3 – Phytochemicals and Micronutrient Nutrition

P034

Association of proanthocyanidin intake with renal function and clinical outcomes

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Background
Progression to chronic renal failure involves accelerated atherosclerosis and vascular calcification. Oxidative stress and endothelial dysfunction play a role in renal failure pathophysiology. In addition to improving vascular health and function, proanthocyanidins have been shown to exert renoprotective effects in animal models. Thus we hypothesise that proanthocyanidins may contribute to the maintenance of healthy renal function in elderly women at risk of chronic renal failure.

Objective
Determine the association of habitual proanthocyanidin intake with renal function and the risk of clinical renal outcomes in a population of elderly women.

Design
A total of 948 women aged over 75 years without prevalent renal disease were recruited to a 5-year prospective study. Proanthocyanidin consumption was determined using a validated food frequency questionnaire and the United States Department of Agriculture proanthocyanidin food content database. Associations between proanthocyanidin consumption and fasting baseline serum cystatin C were assessed. Five-year risk of renal disease-associated hospitalisations and deaths were determined using the Western Australia Data Linkage System.

Outcomes
Compared to participants with low consumption, participants in the highest tertile of proanthocyanidin consumption had a 9% lower baseline cystatin C concentration ($P<0.001$). High proanthocyanidin consumers were at a 50% lower risk of moderate chronic kidney insufficiency, and 65% lower risk of experiencing a 5-year renal disease event ($P<0.05$). The inverse association between proanthocyanidin consumption and renal disease events remained significant even when adjusted for confounders, including vascular and diet-related risk factors.

Conclusion
Increased consumption of proanthocyanidins was associated with better renal function and substantially reduced renal-disease associated events, supporting previous mechanistic and animal model data suggesting a reno-protective effect of proanthocyanidins. Proanthocyanidin intake should be further examined as a dietary contributor to better renal health.

Source of funding

P035

Black carrot polyphenols and their effect on plant cell wall fermentability

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Background
Polyphenols (PP) which are not bioaccessible for absorption during the gastric and small intestinal digestion process are transported to the large intestine.

Objective
The aims of the present study were to investigate the fermentability of black carrot puree fractions vs. a bacterial cellulose model, and to examine how dietary PP are metabolised by gut microbes in a model for the large intestine.

Design
Black carrot whole puree (BC-WP), as well as its fractions (pellet (BC-P) and supernatant (BC-S)) were subjected to *in vitro* batch fermentation. Bacterial cellulose: fresh (Bcell) and soaked in supernatant (Bcell-S), were used as a model system for plant cell walls (PCW). Gas production was monitored for 48 h of *in vitro* fermentation. Samples were taken during and at the end of the fermentation process and analysed for PP (anthocyanins/phenolic acids) and short chain fatty acids (SCFA).

Outcomes
BC-S had the highest maximum rate of gas production (R_{max}) (1.965 ml/h) followed by Bcell-S and BC-WP (1.455 ml/h and 1.445 ml/h, respectively), BC-P (1.205 ml/h), and Bcell (0.413ml/h). The concentration of SCFA ranged from 7.79 mmol/g DM after Bcell-S fermentation to 11.3 mmol/g DM after BC-S fermentation and was significantly higher for all substrates compared to the Bcell control (4.6 mmol/g DM). Non-acylated anthocyanins increased over the first 8 h of fermentation by 801 and 2259 nmol for BC-P and BC-S, respectively. Acylated anthocyanins decreased continuously (by 925 and 2179 nmol for BC-P and BC-S, respectively, after 8 h fermentation). Phenolic acids initially increased by 26 nmol and 121 nmol for BC-P and BCell-S, respectively, during the first 4 h confirming de-acylation of the acylated BC anthocyanins.

Conclusions
Bcell is a suitable model to investigate the role of PP during PCW fermentation, particularly in terms of its ability to bind the anthocyanins found in black carrot supernatant, thus providing a useful mimic of the vegetable cell wall. Black carrot PPs undergo intensive metabolism by the gut microbiota. Low concentrations of these compounds bound to Bcell significantly increased fermentability compared with the control. The increased SCFA may indicate a beneficial effect of the substrates in modulating gut fermentation.

Source of funding

Poster Session 1: Wednesday 4 December
Group 3 – Phytochemicals and Micronutrient Nutrition

P036

Combined dietary supplementation with resveratrol and docosahexaenoic acid affects hippocampal gene expression

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Background
A body of evidence has emerged in the last decade on the beneficial effects of resveratrol (RES) and docosahexaenoic acid (DHA) on cognitive functions and memory formation. RES is a polyphenol, a natural stilbene with health-related properties and has been shown to be a potent activator of Sirt1 which is a class III histone deacetylase involved in memory consolidation and also longevity. DHA is a long chain omega-3 polyunsaturated fatty acid abundantly present in neuronal membranes and has been shown crucial in preserving neuronal and brain function.

Objective
To determine the effects of dietary supplementation with a combination of RES and DHA on hippocampal gene expression in C57BL/6 mice.

Design
Male C57Bl/6 mice were randomly divided into control and intervention (n=6 each) groups. Animals were fed a semi-pure AIN93G diet. Intervention group received 50mg/kg/day of RES + 50mg/kg/day of DHA daily for six weeks. After six weeks all animals were sacrificed and hippocampi were processed for genome wide-expression analysis. Gene of interest was selected based on fold change and statistical criteria and were further analysed by qPCR. Pathway analysis was conducted using Database for Annotation, Visualization and Intergrated Discovery (DAVID).

Outcomes
RES+DHA diet group showed decreased expression of many genes with pro-inflammatory properties such as *Il6, Ifn2, Il15, Socs2, Socs5* and also showed decreased expression of *ApoE*. Additionally genes involved in antioxidant such as *Sod1*, *Sod2*, and *Hmox1* had increased expression in the combination group.

Conclusion
Combination of RES and DHA supplementation may complement each other in enhancing expression of genes involved anti-inflammatory and anti-oxidant pathways.

Source of funding

P037

Carotenoids and antioxidant capacity in microalgae from south-east Queensland, Australia

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Background
Carotenoids are receiving increased attention with the discovery of various health benefits in humans, such as prevention of age-related macular degeneration, cataract, and cardiovascular problems. Microalgae can be a sustainable source of carotenoids that can be cultured on non-arable land, warranting the need for finding locally available species with high carotenoid contents. Microalgal carotenoids are efficient scavengers of free radicals.

Objective
The objective of the present study was to screen for locally available microalgae containing high levels of carotenoids as well as antioxidant capacity to identify promising species for commercial production.

Design
Twelve microalgae species from south-east Queensland, Australia, were analysed for carotenoids (HPLC/LC-MS) by extracting their freeze-dried biomass in hexane and acetone. The *in vitro* antioxidant capacity of these microalgae was assessed by measuring the total phenolic content (TPC) and oxygen radical absorbance capacity (ORAC).

Outcomes
Among the species screened, the top four carotenoid producers (in particular for lutein) were *Tetraselmis suecica* (total carotenoid content: 6.40 mg/g dry weight (DW)), *Dunaliella salina* (6.36 mg/g DW), *Pavlova salina* (4.87 mg/g DW), and *Isochrysis galbana* (4.66 mg/g DW). TPC was low (highest for *D. salina;* 1.54 mg gallic acid equivalents/g DW). The ORAC values varied from 45 to 577 µmol trolox equivalents/g DW with *D. salina* having the highest ORAC.

Conclusion
The results indicate that *T. suecica, D. salina, P. salina* and *I. galbana* could be used for further studies to make them commercially suitable for carotenoid production.

Source of funding

Poster Session 1: Wednesday 4 December
Group 3 – Phytochemicals and Micronutrient Nutrition

P038

Bone health in cystic fibrosis: is the current analysis enough?

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Background
Low bone mineral accrual during puberty is reported in individuals with cystic fibrosis (CF). The evidence suggests these deficits are strongly associated with lean tissue mass (LTM), but this relationship has not been fully investigated.

Objective
To assess if a deficit of total body bone mineral content (BMC) in individuals with CF, was due to an intrinsic bone problem, reduced LTM, or a combination of both.

Design
Dual-energy X-ray absorptiometry (DXA, GE Lunar Prodigy, v11.4) was used to obtain total body BMC and LTM in 53 individuals with CF and 53 controls between the ages of 7 and 17 years. BMC and LTM age and height Z-scores were calculated using paediatric databases and applied in a 4-step algorithm to examine: (1) BMC for age; (2) height for age; (3) LTM for height; (4) BMC for LTM. Student t-tests were used to compare Z-scores of the CF cohort to those of the controls.

Outcomes
Compared to controls, pre-pubertal males with CF showed (1) normal BMC for age (control Z-score=0.32, CF Z-score=0.11; ns), (2) shorter height for age (control Z-score=1.08, CF Z-score=0.13; P=0.05); but (3) more LTM for height (control Z-score=-0.89, CF Z-score=-0.22; P=0.05), and (4) normal BMC for LTM (control Z-score=-0.47, CF Z-score=-0.27; ns). Pre-pubertal females and pubertal males with CF displayed non-significant deficits compared to the controls. Pubertal females with CF had (1) less BMC for age (control Z-score=0.31, CF Z-score=-1.04, P=0.02), (2) shorter height for age (control Z-score=0.38, CF Z-score=-0.40; P=0.03), (3) normal LTM for height (control Z-score=-0.67, CF Z-score=0.11, ns), and (4) less BMC for LTM (control Z-score=0.47, CF Z-score=-1.00, P=<0.01).

Conclusion
Compared to controls, the pre-pubertal CF groups and pubertal males with CF tended toward less BMC for age, primarily due to short stature and a normal muscle-bone interaction. Pubertal females with CF appeared to have a primary bone deficit; where BMC was not adapting adequately for the amount of LTM. These data support a need to consider height, improve bone accrual and LTM via sound nutrition/physical therapy in CF. Particular care is needed in pubertal females where the skeleton appears to adapt poorly to muscle strain.

Source of funding

P039

The risk of zinc deficiency does not differ between premenopausal female Australian blood donors and non-donors: a cross-sectional study

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Background
Despite increased awareness of the adverse health effects of zinc deficiency, few studies have evaluated zinc status in select population groups in Australia and none in blood donors.

Objective
In this study, we assessed zinc status in premenopausal Australian women based on blood donation status, and identified possible non-dietary predictors of serum zinc concentrations in blood donors.

Design
Serum zinc and C-reactive protein concentrations were measured on non-fasting venepuncture blood samples in a non-random cross-sectional sample of 163 female blood donors (defined as having donated a blood product in the 12 months prior to enrolment) and 91 females who did not donate blood in the previous 12 months. All women were premenopausal (mean age 28.5 years, SD 5.7 years).
Anthropometric, socio-demographic, and donation status data were collected. Serum zinc concentration measurement and the classification of low concentrations were in accordance with IZiNCG procedures.

Outcomes
Despite lower (P=0.02) serum zinc concentrations in blood donors (11.4 μmol/L; 95%CI: 11.3, 11.5 μmol/L) compared to non-donors (12.2 μmol/L; 95%CI: 12.1, 12.4 μmol/L), the prevalence of low serum zinc concentrations did not differ between the groups (P=0.64) and was 14.9% (95%CI: 10.0, 19.8%) for all women. In multivariate analysis, the use of oral contraceptive agents and drawing of blood samples after noon were independently associated with a 7.0% (95%CI: 0.2, 13.3%) and 6.3% (95%CI: 0.1, 12.2%) decrease, respectively, in serum zinc concentrations in blood donors (all P<0.05). The type of usual donation (whole blood, plasma, or both) was not associated with serum zinc concentrations (P=0.06).

Conclusion
The biochemical risk of zinc deficiency in premenopausal Australian women indicates a mild public health problem. The lower serum zinc concentrations in blood donors compared to non-donors were not associated with donor-related factors in this self-selected group.

Source of funding

Poster Session 1: Wednesday 4 December
Group 3 – Phytochemicals and Micronutrient Nutrition

P040

Zinc intakes and status in premenopausal Australian women

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Background
Few data describe zinc nutrition in the Australian population. Given the importance of adequate zinc nutriture, there is a need to investigate the relationship between dietary intake, major sources of zinc, and zinc status.

Objective
To investigate relationships between dietary zinc intake and zinc status in a convenience sample of premenopausal women.

Design
Premenopausal women aged 20-40 years were recruited across metropolitan Melbourne and Sydney to participate in this cross-sectional study. In total, 254 volunteers (mean age (SD): 28.5 (5.7) years) completed a food frequency questionnaire (FFQ) and a demographic and health background questionnaire, and provided a blood sample for analysis of serum zinc concentration by flame atomic absorption spectroscopy. Low serum zinc concentration was defined as per International Zinc Nutrition Consultative Group recommendations (AM fasting samples: <10.7 µg/L; AM other samples: <10.1 µg/L; PM samples: <9.0 µg/L).

Outcomes
Mean dietary zinc intake estimated using the FFQ was 10.5 mg/day (95% CI: 10.0-11.0 mg/day) and mean serum zinc was 11.9 µmol/L (95% CI: 11.5-12.2 µmol/L). Eleven percent of women were using dietary supplements containing zinc. There was no correlation between zinc intake and zinc status. Women with low serum zinc concentrations and women with normal concentrations (International Zinc Nutrition Consultative Group cut-off values) did not differ in dietary zinc intake or in use of supplements. The main contributors to dietary zinc intake were vegetables and legumes (20% of total dietary zinc intake), milk and milk products (16%), cereals (15%), and meat, poultry and seafood (14%).

Conclusion
Zinc status did not appear to be associated with zinc intakes in these self-selected premenopausal women. Vegetables and legumes were a major contributor to the women's intake of dietary zinc.

Source of funding

P041

Iodine intake of New Zealand children and adults post fortification of bread with iodine

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Background
Mandatory fortification of bread with iodine was introduced in 2009 to address the re-emergence of mild iodine deficiency in New Zealand (NZ) children and adults. The NZ Ministry for Primary Industries has since completed two analytical bread surveys to measure the iodine concentration of bread for sale in NZ. This analytical data can be used to obtain an estimate of iodine intakes post mandatory fortification.

Objective
To estimate the iodine intake of NZ children (5-14 yrs) and adults (18-64 yrs) following mandatory fortification of bread with iodine.

Design
Iodine intakes of NZ children 5-14 yrs were estimated using both the 2002 National Children's Nutrition Survey data and pre- and post- fortification levels of iodine in the Food Standards Australia New Zealand (FSANZ) dietary modelling tool, DIAMOND. In a separate study, a cross-sectional survey of NZ adults 18-64 yrs living in Dunedin and Wellington was conducted during February and November 2012. Participants completed a 24-hour urine collection, a demographic and iodine-specific food frequency questionnaire (FFQ), and had height and weight measured. The iodine-specific FFQ was used to derive an estimated iodine intake of NZ adults, using post-fortification levels of iodine in bread.

Outcomes
For NZ children, estimated mean iodine intakes were 145 µg/day (including 1g (48µg iodine) discretionary iodised salt). Children with iodine intakes less than the EAR reduced from 7% to <1% (pre- to post-fortification) when 1g iodised salt was included. Bread provides an estimated 48 µg of iodine per day, and up to 50% of the iodine intake for NZ children (excluding discretionary iodised salt). For NZ adults, estimated iodine intakes using the FFQ, including 1g discretionary iodised salt, were 132 µg/day. Iodine intake was associated with urinary iodine excretion (UIE) (P=0.003); however bread iodine intake and iodised salt use were not associated with UIE. Bread provides an estimated 35 µg of iodine per day, and up to 50% of NZ adults' iodine intakes.

Conclusion
Mandatory iodine fortification of bread has had a positive impact on the iodine intake of the NZ population. Discretionary iodised salt continues to provide an important source of iodine in the NZ diet.

Source of funding

Poster Session 1: Wednesday 4 December
Group 3 – Phytochemicals and Micronutrient Nutrition
P042

Paper withdrawn

P043

The effects of dietary iron intake on iron status in young women

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Background
Iron deficiency affects approximately 1 in every 5 young Australian females. Previous research on the relationship between total iron intake and iron status has produced inconsistent results. It has been suggested that intake of haem iron and iron absorption enhancers and inhibitors may be more predictive of iron status.

Objective
To determine whether total dietary iron intake is related to haematological iron status in women of child-bearing age.

Design
A cross-sectional study was conducted with women 18-35 years at the University of Newcastle, Australia in 2012. It included a food frequency questionnaire developed by the Cancer Council Victoria and haematological biomarkers of iron status. Recruitment was via University notice boards, social media and word of mouth.

Outcomes
Mean iron intake of the total sample (n=77) was 11.3±3.8mg/day. Only 3.6% of participants met the Recommended Dietary Intake for iron while 80% met the Estimated Average Requirement. There was no significant difference in total iron (mg) consumed per day between iron deficient and iron sufficient participants (11.5±5.7, 10.9±3.0 p=0.5513). There was no relationship between total iron intake and serum ferritin, sTfR-ferritin Index, or haemoglobin (p=0.32, p=0.35, p=0.58). There was also no relationship between these variables when vitamin C (p=0.88, p=0.34) or calcium (p=0.13, p=0.53) were included in the model. Some significant relationships between flesh food intakes and iron status were found. There was a positive correlation between ferritin and sausage intake (r=0.26, p=0.02) and negative correlations between sTfR-Ferritin Index and sausages (r=-0.34, p=0.007) and pork (r=-0.31, p=0.015.

Conclusion
While there was no relationship found between total iron intake and iron status, there were significant correlations between higher flesh food intakes and better iron status. This supports the concept that haem iron intake may be more important in determining iron status than is total iron intake. While haem iron data were not available for this analysis, the development of haem data for the FFQ is underway and should provide further insight into the relationship between iron intake and iron status.

Source of Funding

Poster Session 1: Wednesday 4 December
Group 3 – Phytochemicals and Micronutrient Nutrition

P044

The effects of nutrition knowledge on dietary iron intake in young women

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Background
Iron deficiency affects approximately 1 in every 5 young Australian females. Iron deficiency decreases several metabolic functions, impairs work performance and causes cognitive deficits during the early years of life and possibly into adulthood. Iron deficiency in young women is often a result of increased requirements caused by menstrual loss and childbirth. Previous research on the relationship between nutrition knowledge and dietary intake has produced inconsistent results. To date, no research has focused on knowledge of dietary iron and its effect on dietary iron intake.

Objective
To determine whether nutrition knowledge is related to dietary iron intake in women of child-bearing age.

Design
A cross-sectional study was conducted at the University of Newcastle, Australia in 2012 using a self-designed nutrition knowledge surrounding iron questionnaire and a food frequency questionnaire developed by the Cancer Council of Victoria. Eligibility criteria were that participants were female and aged between 18-35 years. Recruitment was conducted via University notice boards, flyers, Hunter Medical Research Institute volunteer register, social media and word of mouth.

Outcomes
A total of 107 participants with a mean age of 27.5 years completed the nutrition knowledge questionnaire. Fifty per cent of participants had nutrition knowledge scores in the middle tertile. Eighty per cent of participants knew the main function of iron in the body and that haem iron is more easily absorbed than non-haem iron. A positive correlation was shown between knowledge score and iron intake in mg/day (r=0.25, p=0.008).

Conclusion
This study found a significant positive association between nutrition knowledge surrounding iron score and total iron intake in the sample of 107 18-35 year old women. In young women with low knowledge scores, improving knowledge about dietary iron may be of value in increasing dietary iron intake.

Source of Funding

P045

Bioavailability of vitamin C from a common food source (kiwifruit) in young adult males

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Background
Vitamin C is an essential nutrient in humans and must be obtained through the diet. It is best obtained from fresh fruit and vegetables, but there is still debate around the recommended dietary intake for optimum health.

Objective
The aim of this study was to determine vitamin C uptake in healthy volunteers with after consuming Zespri® GOLD kiwifruit, a high vitamin C food, in order to determine the number of fruit required, and the time taken, to raise plasma vitamin C to healthy and optimal levels.

Design
Fifteen male university students with below average levels of plasma vitamin C were enrolled in the study. Weekly fasting blood samples were obtained for a four week lead-in period and following supplementation with, sequentially, half, one, two and three gold kiwifruit per day for four to six weeks each, followed by a final four week washout period. Plasma vitamin C levels were monitored and in addition, leukocyte and urinary vitamin C levels were determined.

Outcomes
The number of fruit and vegetable servings consumed per day at baseline, as determined from food and beverage records, was 3.7 ± 0.5 servings per day. This was not affected by the addition of one half or one kiwifruit per day, whereas addition of two and three kiwifruit daily resulted in only a small increase, to a maximum of six serves per day. However, supplementation with kiwifruit significantly increased the average daily intake of vitamin C and total intake reached 220 mg per day when two kiwifruit per day were consumed. Plasma levels increased accordingly, reaching concentrations above 60 μM with two fruit per day. Urinary output of the vitamin increased only after 2 or more fruit per day, indicating plasma saturation at this dosage. Leukocyte vitamin C levels increased with an intake of two kiwifruit/d and there was a significant correlation between plasma and leukocyte vitamin C ($R = 0.374$, with $P = 0.004$.)

Conclusion
These results clearly demonstrate the value and effectiveness of adding a high vitamin C-containing food like kiwifruit to the diet. In fact, given the variation in vitamin C content in commonly available fruit and vegetables, it is apparent that the 'five plus a day' message will not ensure sufficient delivery of vitamin C unless at least one of the five serves consists of a high value food such as kiwifruit.

Source of funding

Poster Session 1: Wednesday 4 December
Group 3 – Phytochemicals and Micronutrient Nutrition
P046

Improvements in iodine status of pregnant women three years after mandatory iodine fortification, but strategies to increase iodine supplementation still required

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Background

Mandatory iodine fortification of salt used in bread-making was introduced in Australia in October 2009. There has been little assessment of the effectiveness of the program to correct iodine deficiency in pregnant women.

Objective

To assess whether iodine intake, and knowledge and practices related to iodine nutrition, has improved in pregnant women following introduction of the mandatory iodine fortification programme.

Design

Surveys of pregnant women attending a single public antenatal clinic in a regional area of New South Wales were conducted pre-fortification (2008; n = 139) and 2 years (2011; n = 147) and 3 years (2012; n = 114) post-fortification. Median urinary iodine concentrations (MUIC) were assessed, according to supplement use. Knowledge and practices related to iodine nutrition were investigated using a self-administered questionnaire, and dietary iodine intake evaluated using a validated iodine-specific food frequency questionnaire (2011 and 2012 samples only).

Outcomes

Pre-fortification, women had mild to moderate iodine deficiency (MUIC (IQR) = 87.5 (62, 123.5) µg/L). Post-fortification, MUIC improved to 145.5ug/L (91, 252) in 2011 and 166 (97, 237) in 2012, indicating iodine sufficiency (≥150µg/L). However, only those women taking supplements containing iodine had MUIC in the replete range in both years surveyed post fortification (178ug/L vs. 109 ug/L (P<0.001) in 2011; and 202 µg/L vs. 124 µg/L (P < 0.05) in 2012). Despite bread being the vehicle for iodine fortification, dairy foods remained the major contributor to total iodine intake (58%). Overall knowledge regarding health implications of iodine deficiency, the need for supplementation, and identification of iodine rich food sources remained poor.

Conclusion

Iodine status of pregnant women has improved since the introduction of mandatory iodine fortification. However, supplementation and nutrition education is indicated during pregnancy.

Source of funding

Not applicable.

Poster Session 1: Wednesday 4 December
Group 4 – Body Weight Management

P047

Nutritional status of female adolescent ballet dancers

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Background
Ballet dancing has both physiological and aesthetic demands. Adolescent dancers face the further challenge of increased nutritional requirements associated with growth and development.

Objective
To investigate the nutritional status (dietary intake, body composition and iron status) of female adolescent ballet dancers living in Auckland, New Zealand and compare with guidelines for the general and sporting population.

Design
Forty seven female ballet dancers (13-18 yr) who danced at least one hour per day five days per week participated in this cross-sectional study. Weight, height and body mass index (BMI) were compared with BMI-for-age growth charts (Centers for Disease Control and Prevention). Body fat was measured using Dual-energy X-ray Absorptiometry (Hologic Discovery A). Dancers completed a 4-day estimated food record (analysed using Foodworks Version 7). Serum ferritin (SF), haemoglobin (Hb) and soluble transferrin receptor were measured.

Outcomes
Two (4.3%) dancers were underweight (<5th percentile) and three (6.4%) overweight (85th–95th percentile). The majority (89.4%) were of a healthy weight (5th–85th percentile). Body fat (mean±SD) was 23.5±4.1%. Food records (n=42) showed a mean energy intake of 8097.3±2155.6 kJ/day (48.9% carbohydrate, 16.9% protein, 33.8% fat, 14.0% saturated fat). Mean carbohydrate and protein intakes were 4.8±1.4 g and 1.6±0.5 g/kg body weight/day respectively, with over half of dancers (54.8%) consuming <5 g carbohydrate/kg/day, and 23.8% consuming <1.2 g protein/kg/day. More than 60% of dancers consumed less than the estimated average requirement (EAR) for calcium, folate, magnesium and selenium. Most dancers (78.6%) consumed below the recommended dietary intake and 14.3% below the EAR for iron. Mean iron intake was 12.7±5.8 mg/day. Thirteen (28.9%) dancers had suboptimal iron status (SF<20 µg/L). Four (8.9%) had iron deficiency (SF<12 µg/L, Hb≥120 g/L) and one (2.2%) had iron deficiency anaemia (SF<12 µg/L, Hb<120 g/L).

Conclusion
Female adolescent ballet dancers are at risk of iron deficiency, with nearly one third having suboptimal iron status. A number of dancers may be at risk of inadequate macro and micronutrient intakes based on dietary recommendations for the general and sporting population.

Source of funding

P048

Resting energy prediction equations for female patients with eating disorders

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Background
Resting energy expenditure (REE) of female patients with eating disorders can be predicted using a variety of different equations where indirect calorimetric measurements are clinically inappropriate or unavailable.

Objective
The aim of this study was to evaluate three available REE predictive equations against measured REE in a population of females with eating disorders.

Design
Fifty-four female patients with eating disorders aged 12-26 were measured using indirect calorimetry to determine REE. Three predictive equations (Schofield, Harris Benedict and Mifflin) were used to calculate the subjects' REE based on weight, height, gender and age. The Bland Altman method was used to determine how closely the predicted REE calculation compared to the measured REE.

Outcomes
Out of the three predictive equations, Schofield (1273.27±152.98) had the smallest average difference of -4kCal compared to the measured REE (1268.86±240.34). However, the error was not uniform across the spectrum of energy expenditure. The Harris Benedict (1328.10±104.81) had the largest difference compared to the measured REE, underestimating by 59kCal, while Mifflin (1250.19±131.31) overestimated by 18kCal.

Conclusion
The Schofield equation is the most appropriate method for predicting REE in females with eating disorders where indirect calorimetry measurements are clinically inappropriate or unavailable.

Source of funding

Poster Session 1: Wednesday 4 December
Group 4 – Body Weight Management

P049

Cold-induced thermogenesis in the metabolic syndrome: a randomised cross-over trial

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Background
Alterations in thermogenesis may contribute to the risk of obesity and the metabolic syndrome (MetS). Cold exposure stimulates non-shivering thermogenesis through increases in basal metabolic rates (BMR) and reductions in respiratory quotient (RQ).

Objective
To determine the acute effect of mild cold exposure on BMR, RQ and indices of thermoregulation in subjects with (MetS[+]) and without MetS (MetS[-]).

Design
Randomised cross-over trial conducted in an environmental chamber where ambient temperature was controlled. 12 MetS[+] adults (7 males, 5 females; median (SD) age 60 (12.75) yr.; mean BMI 29.06 (3.66) kg/m^{2}) and 10 MetS- adults (2 males, 8 females; median age 63 (10.75) yr.; mean BMI 24.71 (4.46) kg/m^{2}) were studied. Participants experienced either 20ºC or 25ºC for 1.5 h each, in a random order. Energy expenditure was measured by indirect calorimetry (Deltatrac II, Datex Finland).

Outcomes
BMR was higher by ~180 kJ/d at 20ºC but not statistically significant. The forearm to fingertip gradient (Fo-Fi, signifying vasoconstriction) was significantly greater at 20ºC ($P<0.001$), with tympanic temperature being significantly lower ($P=0.001$). Overall, MetS+ showed a lesser vasoconstriction compared to MetS- ($P=0.045$). This was due to no vasoconstriction at 25ºC and a small but significant vasoconstriction at 20ºC. In contrast, MetS- subjects displayed significant vasoconstriction at both temperatures. While adjustment for fat mass abolished the statistical effect, the trends in vasoconstriction, persisted. Adjusted BMR was non-significantly higher by ~ 230kJ/d in MetS+. There was no temperature x MetS interaction for any variables.

Conclusion
In response to mild cold, MetS+ subjects favour a greater non-shivering thermogenesis with less reliance on vasoconstriction.

Source of funding

P050

Regular versus low fat dairy: associations with metabolic risk factors in adolescence

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Background
Emerging evidence suggests that dairy fat may have a neutral or even protective effect on chronic disease risk in adults.

Objective
To investigate associations between consumption of regular versus low fat dairy products and metabolic risk factors in adolescents.

Design
In the Western Australian Pregnancy Cohort (Raine) Study, dairy intake was assessed using food frequency questionnaires in 860 adolescents (46.4% male) at both the 14 and 17-year follow-ups. We used generalised estimating equations to examine independent associations with metabolic syndrome as defined by International Diabetes Federation adolescent specific criteria and related metabolic risk factors. A range of potential confounding factors was considered for inclusion in the models.

Outcomes
Models were adjusted for age, total energy intake, misreporting status, BMI, physical activity, family income and whether or not they were breast fed. In girls, with each additional serve of regular fat dairy there was a factor change in the odds of metabolic syndrome of 0.67 (95% CI 0.45, 0.98). Also in girls, with each additional serve of low fat dairy there was a factor change in odds of metabolic syndrome of 1.55 (95% CI 1.11, 2.15) and an increase of 0.68 mmHg (95% CI 0.07, 1.30) in systolic blood pressure. There were no significant associations in boys.

Conclusion
In girls from 14 to 17 years, there was a decreased risk of metabolic syndrome with additional serves of regular fat dairy. There was also an increased risk observed with additional serves of low fat dairy, likely due to an associated increase in blood pressure. In contrast, in boys neither regular fat nor low fat dairy consumption was significantly associated with metabolic syndrome or metabolic risk factors. Regular fat dairy products can be good sources of omega-3 fats and fat-soluble vitamins which may be beneficial to metabolic health in adolescence. Changes in hormones during puberty may contribute to the observed gender differences.

Source of funding

Poster Session 2: Thursday 5 December
Group 5 – Nutrition and Chronic Conditions

P051

Glucose induced thermogenesis following cold exposure

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Background

Cold exposure stimulates adaptive changes in energy expenditure and thermoregulation via the sympathetic nervous system (SNS).

Objective

To determine the acute effect of mild cold exposure on fasting and postprandial changes in energy expenditure, blood pressure and indices of thermoregulation.

Design

A randomised cross-over trial was conducted in an environmental chamber where ambient temperature was controlled. Ten women of European origin, with mean (SD) age 55 (15) yr., BMI 26.2 (6.44) kg/m^2 and percentage fat 39 (7.87) % were studied. Participants experienced either 20° C or 25° C for 3.5 hr. each, where fasting measurements were made after 90 min of exposure and were followed by an oral glucose tolerance test (OGTT) for 120 min. Serial measurements of metabolic rate (indirect calorimetry), surface and tympanic temperature (in the ear, IET), blood pressures and plasma glucose, insulin, triacylglycerol (TAG) were made throughout. Paired t tests were used to compare fasting outcomes, as well as the postprandial response of each variable adjusted for its baseline value.

Outcomes

Fasting RQ and IET were significantly lower, while systolic/diastolic blood pressures and forearm to finger temperature gradient (signifying vasoconstriction) were higher at 20ºC. There was a trend for a higher BMR (P=0.055) but no differences in fasting glucose, insulin or TAG. Following OGTT, postprandial energy expenditure, blood pressures, 2h insulin and vasoconstriction was greater at 20ºC, while IET was significantly lower by ~0.3ºC. Postprandial RQ was not different between temperatures.

Conclusion

Short term exposure to mild cold increased fasting and glucose induced thermogenesis. Overall the data are indicative of a stimulation of the SNS.

Source of funding

P052

Effect of a prescriptive dietary intervention on psychological dimensions of eating behaviour in obese adolescents

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Background

Understanding the psychological dimension of eating behaviour in overweight adolescents could facilitate the effective tailoring of treatment to patient characteristics. **Objective**

To examine the effects of a prescriptive dietary intervention on external eating (eating in response to food cues), emotional eating and dietary restraint and their relation to weight loss.

Design

This is a secondary analysis of a 12-month randomised trial, the RESIST study, which examined the effects of two diets on insulin sensitivity. Participants were 109 obese 10- to 17-year-olds with clinical features of insulin resistance. The program commenced with a 3-month dietary intervention using a structured meal plan, with the addition of an exercise intervention in the next 3 months and followed by a 6 month maintenance period. This paper presents changes in eating behaviours measured by the Eating Pattern Inventory for Children during the first 6 months of the trial. As there was no difference between the diets on outcome of interest, both diet groups were combined for analyses.

Outcomes

After 6 months, the proportion of participants who reported consuming more in response to external eating cues decreased from 18% to 5% (P=0.003), whereas non- emotional eating increased from 48% to 64% (p=0.014). Dietary restraint and parental pressure to eat remained unchanged. A reduction in external eating (rho=0.36, P<0.001) and a reduction in dietary restraint (r=0.26, P=0.013) were associated with greater weight loss at 3 and 6 months, respectively.

Conclusion

In the short to medium term, a prescriptive dietary intervention approach is a suitable option for obese adolescents with clinical features of insulin resistance. It may reduce external and emotional eating and led to modest weight loss.

Source of funding

Poster Session 2: Thursday 5 December
Group 5 – Nutrition and Chronic Conditions

P053

A healthy dietary pattern is protective against non-alcoholic fatty liver disease in centrally obese adolescents

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Background
Non-alcoholic fatty liver disease (NAFLD) is commonly associated with obesity; however, not all obese individuals develop NAFLD.

Objective
We examined prospective associations between dietary patterns and NAFLD in a population-based cohort of adolescents with central obesity.

Design
Participants in the Western Australian Pregnancy Cohort (Raine) Study completed a food frequency questionnaire at 14 years and underwent liver ultrasound at 17 years. Healthy and Western dietary patterns were identified using factor analysis, resulting in z-scores for both patterns. Prospective associations between dietary patterns and risk of NAFLD in centrally obese adolescents were explored using multiple logistic regression, adjusting for potential confounders (n = 193).

Outcomes
A healthy dietary pattern was significantly associated with reduced risk of NAFLD (OR 0.60, 95% CI 0.39, 0.92; P = 0.018) and this trend was seen in both males and females. A Western dietary pattern was significantly associated with increased risk of NAFLD in females only (OR 1.96, 95% CI 1.05, 3.66; P = 0.034).

Conclusion
A healthy dietary pattern may protect against NAFLD in centrally obese adolescents.

Source of funding

P054

The relationship between personality and dietary intake in overweight and obese men

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Background
Personality may be one of many factors that influence diet. Evidence has shown that Conscientiousness may be positively associated with the consumption of fruit and vegetables. It is not known, however, if Conscientiousness predicts adherence to healthy dietary recommendations over time.

Objective
To assess whether Conscientiousness is associated with dietary intake, and predicts adherence to dietary recommendations in overweight and obese men.

Design
Fifty-four overweight or obese men who were enrolled in a 12-week randomised controlled trial to investigate the effect of weight loss on blood pressure were randomised to either an OZDASH-type (WELL) diet with specific dietary targets or to a low-fat diet with general guidelines (National Heart Foundation (NHF)). Subjects completed a Big Five personality questionnaire at baseline, and food frequency questionnaires, one-day food records and food group diary records at baseline and with varying frequency throughout the study. Correlations were used to investigate associations between personality and dietary intake at baseline, and general estimating equations were used to evaluate these associations throughout the intervention as a measure of adherence. Ethics approval was obtained from the Human Research Ethics Committee at Deakin University.

Outcomes
No associations were found at baseline or in the longitudinal analysis between Conscientiousness and consumption of fruit or vegetables. In the NHF group there was a positive association between Openness and fruit consumption (OR=8.67, 95% CI 2.47-30.29), and a negative association between Neuroticism and fruit consumption (OR=0.15, 95% CI 0.04-0.52). In a post-hoc finding, completers in the study had higher Conscientiousness (6.54, ± 1.08) than the non-completers (5.64, ±1.48; t (65) = 2.51, P = 0.015).

Conclusion
This study did not find any of the hypothesised associations between Conscientiousness and consumption of fruit and vegetables. However, the longitudinal associations between Openness and Neuroticism and fruit consumption may inform future research investigating the role of personality in adherence to dietary recommendations.

Source of funding
Not applicable.

Poster Session 2: Thursday 5 December
Group 5 – Nutrition and Chronic Conditions

P056

Energy and appetite regulating hormones: do they differ between males and females?

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Background
Energy and appetite regulating hormones have been proposed as playing a role in overweight and obesity and preliminary findings suggest a number of these differ between males and females.

Objective
To examine concentrations of appetite and energy regulating hormone profiles, in particular leptin, ghrelin and adiponectin, in overweight/obese males versus females.

Design
Laboratory analysis was conducted using stored blood samples collected at baseline from a completed weight loss randomised controlled trial (RCT). The RCT participants consisted of overweight (BMI 25-29.9 kgm-2) or obese (BMI 30-40 kgm-2) men and women aged 18 years or over. A sub-sample of 25 males and 35 females were selected. Concentrations of leptin, adiponectin and ghrelin (acylated and unacylated) were determined by enzyme-linked immunosorbent assay (ELISA).

Outcomes
Concentrations of leptin, unacylated ghrelin and adiponectin were all significantly higher in females than males (leptin: $p<0.001$; unacylated ghrelin: $p=0.022$; adiponectin: $p=0.016$). Although not significant, males had a higher baseline concentration of acylated ghrelin ($p<0.8098$). Within females, those categorised at overweight showed higher concentrations of acylated ghrelin (pg/mL [$p<0.0230$] and per kg/bw [$p<0.0036$]) and unacylated ghrelin (per kg/bw [$p<0.0396$]) compared with those classed as obese; those categorised as obese showed higher concentrations of leptin (pg/mL [$p<0.0285$]) than those in the overweight category. Males categorised as overweight showed higher concentrations of unacylated ghrelin (per kg/bw [$p<0.0229$]) than those in the obese category; those classed as obese showed higher concentrations of leptin (pg/mL [$p<0.0305$]) than those in the overweight category.

Conclusion
There are differences between males and females in concentrations of appetite and energy regulating hormones. The importance of these differences in achieving weight loss success warrants further investigation.

Source of funding
Not applicable.

P057

Can a commercial weight control program reduce obesity in the ADF?

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Background
Australian Defence Force (ADF) occupations vary greatly in their requirements for physical work. ADF members with physically arduous occupations, e.g. naval clearance divers and infantry soldiers, are largely protected against obesity. However, those with sedentary occupations are at increased risk of weight gain. Approximately 15% of ADF members are obese, a condition that is associated not only with an increased risk of chronic disease, but also with reduced military performance.

Objective
To investigate the potential for a commercial weight control program to assist in reducing the prevalence of obesity in the ADF.

Design
A 26-week program was conducted by Weight Watchers Australasia at four military bases. A total of 123 ADF members were recruited into the program, which was evaluated by DSTO-Scottsdale.

Outcomes
Despite a low attendance rate (37%) compared to civilian Weight Watchers at Work programs (~70%), mean weight loss was approximately 5% of initial body weight, a level that is associated with worthwhile clinical benefits. Weight loss among members who attended at least half the sessions (33% of those who enrolled) was more than three times the weight loss for those who attended fewer than half the sessions (9.2% vs 2.7%). Changes in waist circumference led to 26% of participants reducing their risk of CVD and type 2 diabetes by one category (from 'high risk' to 'increased risk', or from 'increased risk' to 'low risk'). The percentage achieving this result was three times higher among those participants who attended at least half the sessions compared to those who attended fewer than half (51% vs 17% respectively). The vast majority (96%) of participants who responded to a survey questionnaire (40% of those who enrolled) stated that they would recommend the program to others; 78% reported a 'positive' experience with the way the program was conducted; and 62% found the program 'very' or 'moderately' easy to follow.

Conclusion
The Weight Watchers program appears to be 'user friendly' to ADF members who wish to reduce their weight, and can lead to clinically important reductions in weight and waist circumference in the short term. Success depends at least partly on attending a majority of sessions.

Source of funding
Not applicable.

Poster Session 2: Thursday 4 December
Group 5 – Nutrition and Chronic Conditions

P058

Dietary intake of long chain omega-3 fatty acids in Australians at risk of heart failure

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Background

Chronic heart failure (HF) is a major cause of morbidity and mortality, and the HF burden is expected to grow with population ageing and increasing rates of obesity and diabetes. Long-chain omega-3 fatty acids are thought to be cardioprotective, and omega-3 supplementation has been shown to modestly reduce risk of mortality and hospitalisation in established HF.

Objective

This study aimed to examine omega-3 intake in a population at risk of developing HF.

Design

Four-day weighed food records, self-reported use of nutritional supplements, physical activity and quality of life were assessed in 460 participants from the SCREEN-HF study, a cross-sectional study designed to look at risk factors for HF and subsequent HF development. Inclusion criteria for SCREEN-HF were age >60 years with one or more of self-reported myocardial infarction or other ischaemic or valvular heart disease, atrial fibrillation, cerebrovascular disease, renal impairment or treatment for hypertension or diabetes for >2 years.

Outcomes

The SCREEN-HF Diet sub-study cohort had a mean age of 71.8 ± 6.3 years, 57% were male and fish oil supplements were taken by 32% of the cohort. Overall the mean daily intake of long chain omega-3's from diet (eicosapentaenoic acid [EPA] + docosapentaenoic acid [DPA] + docosahexaenoic acid [DHA]) was 499mg/d (95%CI:435-563mg, median=254mg). Mean intake of omega-3s from both dietary and supplemental sources was 659mg/d (588-730, 421). Omega-3 intake ≥1000mg/d was being achieved by 20.6% of the cohort. There were no significant sex-differences in omega-3 intake, nor were there significant differences in intake between those with or without a history of coronary artery disease. However those with a history of arrhythmia (29% of the cohort) had a significantly lower mean omega-3 intake (mean±SE) 413±40mg/d vs 536±44mg/d, (p=0.04).

Conclusion

In a population at risk of developing HF, intake of omega-3's was below that recommended for those with existing cardiovascular disease. While omega-3 supplements were being taken by around one-third of the cohort, only one in five had a total omega-3 intake of 1000mg/d or more.

Source of funding

P059

Associations between dietary patterns and blood pressure in a sample of Australian adults

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Background

Investigating effects on blood pressure (BP) of whole diets rather than individual nutrients can contribute to development of diet-based recommendations for the prevention of cardiovascular disease.

Objective

The objective of this study was to assess the relationship between dietary patterns and BP in a sample of free-living Australian adults.

Design

Dietary patterns were assessed using factor analysis (two baseline 24 h recalls, usual diet at baseline) of participants recruited to dietary intervention studies. Home BP was measured once per day, for 7 days prior to commencing any dietary intervention and the mean BP used.

Outcomes

Complete data from 251 participants (112 males; mean age 55.1 (9.1) (SD) years; BMI 29.5 (3.9) kg/m^2) was used in this analysis. Three dietary patterns were identified. The 'Convenience Diet' was positively associated with home systolic BP (β = 1.88, 95% CI 0.16, 3.60) after adjusting for age, gender, BMI, anti-hypertensive medication, smoking, education, physical activity and energy. This diet consisted of high consumption of low-fibre bread, unprocessed cereals, meat, poultry and egg dishes, mixed cereal dishes, seeds and nuts and low consumption of milk and yoghurt (low-fat), vegetable juice, vegetables and high-fibre bread. Higher consumption of this pattern was associated with a younger age and higher percentage of males. The two remaining patterns ('Traditional Australian' and 'Modern') were not associated with BP.

Conclusion

In this sample of Australian adults, a 'Convenience Diet' was associated with higher BP and thus chronic disease risk, supporting the evidence that diets high in sodium and low in vegetables and dairy are detrimental to cardiovascular health.

Source of funding

Poster Session 2: Thursday 4 December
Group 5 – Nutrition and Chronic Conditions
P060

Paper withdrawn

P061

Low vitamin D levels are associated with symptoms of depression in young adult males

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Background
Results from studies examining associations between serum 25-hydroxyvitamin D (25(OH)D) concentrations and depressive symptoms are equivocal.

Objective
We investigated the cross-sectional relationship between serum 25(OH)D concentrations and symptoms of depression, anxiety and stress in a population-based sample of young adults participating in the Western Australian Pregnancy Cohort (Raine) Study.

Design
Mental health symptoms were assessed at the 20 year follow-up using the 21-item Depression Anxiety Stress Scales (DASS-21). Associations between serum 25(OH)D concentrations and total DASS-21 scores and subscale scores of depression, anxiety and stress were explored in males and females using negative binomial regression, adjusting for age, race, BMI and physical activity (*n*=735). Models examining subscale scores were also adjusted for the other subscale scores.

Outcomes
After adjusting for confounders, an increase in serum 25(OH)D concentrations of 10 nmol/L decreased total DASS-21 scores in males by 9% (Rate Ratio 0.91; 95%CI 0.87,0.95; P<0.001) and depression subscale scores in males by 8% (Rate Ratio 0.92; 95%CI 0.87,0.96; P=0.001). However, in adjusted models there were no significant associations between serum 25(OH)D concentrations and symptoms of anxiety and stress in males. There were no significant associations between serum 25(OH)D concentrations and symptoms of depression, anxiety and stress in females.

Conclusion
We found an association between serum 25(OH)D concentrations and symptoms of depression, but not anxiety and stress, in males. Randomised controlled trials are necessary to determine any benefit of vitamin D supplementation in the prevention and treatment of depressive symptoms in young adults.

Poster Session 2: Thursday 4 December
Group 5 – Nutrition and Chronic Conditions

P062

Vitamin D predicts global positive and negative mood in men but not women

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Background
Previous research shows that a low circulating level of 25-hydroxyvitamin D [25(OH)D], a marker for vitamin D status, is associated with mood disorders including major depression, seasonal affective disorder and premenstrual syndrome. However, its direct relationship with mood has not been investigated to date.

Objective
We investigated whether serum 25(OH)D is associated with global positive and negative mood in a young sample.

Design
A total of 615 students (38% men, mean age 19y., range 17-25y.) were recruited in autumn in 2011 and 2012 in Dunedin (latitude 46ºS) for the Daily Life Study, a study of everyday experiences and wellbeing. They rated their typical moods for 9 positive and 9 negative items on a 1-5 scale and reported time spent outdoors daily for two weeks. Then they provided a blood sample for 25(OH)D analysis. Multivariate linear regression was used to examine associations between serum 25(OH)D and mood, adjusting for other predictors.

Outcomes
Mean serum 25(OH)D was 64.1 (SD=26.6) nmol/L. Women had higher 25(OH)D than men (68.7 vs. 56.5 nmol/L, *P*<0.001) even though they reported spending less time outdoors (P=0.001). Women also reported lower mean positive and higher mean negative mood than men (3.22 vs. 3.32 for positive, P=0.019; 1.88 vs. 1.78 for negative, P=0.029). Overall, 25(OH)D was a significant predictor of both global mean positive mood (P=0.001) and global mean negative mood (P=0.044) after adjusting for gender, age, ethnicity, BMI, and time spent outdoors during the previous two weeks. Secondary analyses were performed for men and women separately. 25(OH)D was not associated with mood in women, but it was strongly positively associated with positive mood (P<0.001) and strongly negatively associated with negative mood (P=0.005) in men.

Conclusion
In general, vitamin D level is associated with global positive and negative mood in young people. Higher vitamin D is associated with higher positive mood and lower negative mood. However, this association seems to apply to men only.

Source of Funding

P063

Mood and vitality improvement in young adult males following supplementation with gold kiwifruit, a high vitamin C food

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Background
Enhanced intakes of fruit and vegetables have been associated with improved wellbeing. These effects have been attributed to the phytonutrient content, but the particular components responsible for the observed health benefits have not been identified.

Objective
We investigated the effects of consumption of kiwifruit, a fruit rich in vitamin C and a number of other important micronutrients, on measures of mood and vitality.

Design
Young adult males (n=35) with low baseline vitamin C status were supplemented with either one half or two kiwifruit per day for six weeks. Profile of Mood States questionnaires were completed at baseline and biopsies of skeletal muscle (*vastus lateralis*) were carried out pre- and post-intervention.

Outcomes
No effect on overall mood was observed in the half kiwifruit/d group. However, a 35% (P = 0.06) decrease in total mood disturbance and a 32% (P = 0.063) decrease in depression were seen in the two kiwifruit/d group. Subgroup analysis indicated that participants with higher baseline mood disturbance exhibited a significant 38% (P = 0.029) decrease in total mood disturbance, as well as a 38% (P = 0.048) decrease in fatigue, 31% (P = 0.024) increase in vigour and a 34% (P = 0.075) decrease in depression, following supplementation with two kiwifruit/d. Dietary intakes and body status of specific micronutrients indicated a significant increase in vitamin C intakes and plasma levels. Baseline *vastus lateralis* ascorbate concentrations were ~16 nmol/g tissue. Following intervention with half or two kiwifruit/d this increased ~3.5-fold to 53 nmol/g and 61 nmol/g, respectively. Muscle ascorbate concentrations were highly correlated with dietary intake (R = 0.61, P < 0.001) and plasma concentrations (R = 0.75) in the range of 5-80 μmol/l.

Conclusion
Enhanced intake of kiwifruit by individuals with moderate mood disturbance can improve overall mood. This is likely to be due to the benefits associated with optimal vitamin C intake. In addition, human skeletal muscle is highly responsive to vitamin C intake and plasma ascorbate concentrations, and is likely to be prone to depletion following inadequate dietary intake.

Source of funding

Poster Session 2: Thursday 4 December
Group 5 – Nutrition and Chronic Conditions

P064

Unsaturated fat intakes and mental health outcomes in young Australian women

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Background

Rates of mental illness have been increasing worldwide. The rise in mental illnesses has correlated with changes in dietary intake of unsaturated fatty acids in western countries. Anxiety and depression are the most common forms, and women are more likely to suffer from these than men.

Objective

To determine if dietary intakes of unsaturated fatty acids are associated with mental health outcomes in young Australian women.

Design

A cross-sectional analysis of a sample of 7635 women (25-30 years) was conducted using data from the third survey (2003) of the young cohort from the Australian Longitudinal Study on Women's Health (ALSWH). Adjusted logistic regression models were used to examine associations between mental health outcomes [10-item Center for Epidemiological Studies Depression Scale (CESD-10), the Short Form Health Survey (SF-36) mental health subscale and self-report questions on depression and anxiety] and a variety of unsaturated fatty acids [individual omega 3 fatty acid intakes (alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA), docosahexaenoic acid (DHA)), total omega-3 intake, total long chain omega-3 intake, total omega-6 intake, intake of the omega 6 fatty acid, linoleic acid (LA), total omega-9 intake and intake of the omega-9 fatty acid, oleic acid (OA)].

Outcomes

Higher intakes of ALA were associated with decreased symptoms of depression, indicated by CESD-10 [p=0.040; OR=0.77, 95% CI:0.60,0.99] and the SF-36 mental health subscale [p=0.024; OR=0.73 95% CI:0.56,0.96]. Higher intakes of total omega-6 [p=0.019; OR=0.96, 95% CI:0.93, 0.99] and LA [p= 0.020; OR=0.96, 95% CI:0.93,0.99] were associated with decreased self-reported anxiety, while higher intakes of total omega-9 [p=0.041; OR=1.02, 95% CI:1.00,1.04] and OA [p=0.046; OR=1.02, 95% CI:1.00,1.05] were associated with increased anxiety.

Conclusion

This study found higher ALA intakes were associated with decreases in self-reported depression using both the CESD-10 and SF-36 mental health subscale. Total omega-6 and LA intakes were also associated with decreases in self-reported anxiety, while total omega-9 and OA intakes were associated with increases in self-reported anxiety. Some of these results are contrary to the established literature and warrant further investigations.

Source of funding

Not applicable

P066

Soft drink raises plasma uric acid in comparison to fruit: results from a four-week, randomised controlled trial

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Background

High intakes of sugary drinks are associated with increased risk of diabetes. It has been hypothesised that excessive fructose consumption, caused by overconsumption of sugary drinks, may be partly responsible. High fructose intakes are associated with elevated blood uric acid concentrations and insulin resistance and thus may increase risk of gout and diabetes. Fruits are also naturally high in fructose but also rich in other potentially beneficial nutrients so it is of interest to examine whether fructose in fruit has similar effects on metabolic risk as sugary drinks.

Objective

To examine the effect on serum uric acid and metabolic risk factors of consuming fructose from either whole fruit or sugar-sweetened softdrink in overweight adults.

Design

Forty-eight healthy, overweight (BMI≥ 28 kg/m^{2}) men (n=21) and women (n=20) were randomised to either a fruit (n = 19) or softdrink (n = 22) intervention for four weeks. The fruit group were provided with six items of fresh and dried fruit per day. The softdrink group was provided with 955ml of sugar-sweetened softdrink per day. The interventions were matched for both energy and fructose content. Total energy intakes were not controlled.

Outcomes

Serum uric acid concentrations were significantly reduced in men in the fruit group compared with those in the softdrink group after 4 weeks (difference 57.2 umol/l [95% CI: 16.4, 98.0], p= 0.008) but there was no difference amongst women (1.3 umol/l [95%CI: -9.5, 6.9], p= 0.295). There was no change in weight during the study and no difference between interventions (p=0.579), and there were no significant differences in any other risk factors associated with the metabolic syndrome.

Conclusion

This study showed a different effect of fructose consumed in sugar-sweetened softdrink compared with fruit. Fruit consumption resulted in a clinically significant reduction in serum uric acid concentrations in men with no other metabolic changes observed. These findings suggest no need to restrict fruit intake in individuals with elevated serum uric acid concentrations, such as those with gout.

Source of funding

University of Otago and Riddet Institute research grants.

Poster Session 2: Thursday 5 December
Group 6 – Fats and Oils

P067

Whole blood fatty acid profile and incidence of type 2 diabetes in older Australians

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Background
Limited prospective data on diabetes risk are available that use objective biomarkers of fatty acid (FA).

Objective
To determine association of whole blood FA concentrations with incident type 2 diabetes in older adults.

Design
A nested case-control study of 37 incident cases of type 2 diabetes and 150 population-based internal controls consisting of men and women aged 55–85 years from the Hunter Community Study (HCS) cohort. Cases were ascertained at the 5 year HCS follow-up in 2011. Fatty acid composition of whole blood samples collected at baseline was measured by using gas chromatography and incident diabetes was ascertained by self-reported questionnaire at follow-up.

Outcomes
After adjustment for potential confounding variables (age, gender, BMI, physical activity, intake of alcohol, total energy, carbohydrate, protein and fibre), increased concentrations of C20:4n-6, C18:3 n-3, C20:5n-3 and C22:6n-3 were associated with an increased odds of type 2 diabetes ($P<0.05$).

Conclusion
Higher whole blood concentrations of omega-3 and omega-6 FAs were associated with increased odds of type 2 diabetes

Source of funding
AA is supported by a scholarship from the Government of Saudi Arabia.

P068

DHA and EPA in older Tasmanian adults: plasma profile and dietary contributors

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Background
Adequate plasma DHA and EPA concentrations help prevent cognitive decline in older adults. Tasmania has the highest proportion of adults over 65 years in Australia but their PUFA status is unknown.

Objective
To investigate the plasma DHA and EPA status of healthy older Tasmanian adults and determine the main dietary contributors.

Design
Seventy-three self-selected, community-dwelling adults, 50 women (70±6.7 years) and 23 men (70±6.1 years), completed an on-line, semi-quantitative, long-chain omega-3 PUFA food frequency questionnaire (PUFA questionnaire v1, University of Wollongong). Participants also provided fasting blood samples for plasma phospholipid fatty acid analysis (Gas Liquid Chromatography; reported as % of phospholipid fraction).

Outcomes
Mean (± SD) plasma DHA and EPA concentrations of the whole group were 5.99±1.57% and 3.74±2.42% respectively. Participants consumed 0.38±0.33g DHA/day and 0.38±0.38 g EPA/day. The main dietary contributors were fish and fish oil supplements. Total DHA and EPA intake of people taking supplements (n=34) was 0.56±0.35g/day and 0.62±0.38 g/day, respectively. In contrast, the intake of DHA and EPA in non-supplemented participants (n=39) was 0.22±0.20 g/day and 0.17±0.22 g/day, respectively. Mean plasma DHA and EPA of participants ingesting fish oil supplements (DHA 6.42%, EPA 4.26%) were significantly higher (P=0.03) than non-supplemented participants (DHA 5.62%, EPA 3.28%). Even so, the plasma DHA and EPA concentrations of non-supplemented participants were twice that of participants of similar age groups in other Australian and international studies. This may be due to the higher intake of fish and lower intake of cereal and meat in our study participants.

Conclusion
The DHA and EPA status of this small group of self-selected older Tasmanian adults is robust, even those not ingesting fish oil supplements.

Source of funding
Not applicable.

Poster Session 2: Thursday 5 December
Group 6 – Fats and Oils

P069

Krill oil can inhibit proliferation of human osteosarcoma cell line

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Background
Osteosarcoma (OS) is a tumor of the bone and is a rare but aggressive form of cancer. Combination treatment for OS has not improved prognosis effectively thus a novel therapeutic agent must be explored. Omega-3 polyunsaturated fatty acids (n-3 PUFAs), mainly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are known to have many health benefits including inhibition of cancer progression. Krill oil is a natural product of Antarctic krill and is known for its ability to efficiently deliver EPA and DHA to cells than fish oil.

Objective
This preliminary study aims to determine the effects of krill oil on inhibiting proliferation of human OS cells in comparison to fish oil.

Design
The human 143B OS cell line was obtained from the American Tissue Culture Company. 2000 cells/100 µL of media were seeded into 96-well plates. Lipase was added to commercial krill, fish and olive oil samples to mimic the digestion of oils in the human gastrointestinal tract. The cells were treated with different oil solutions, doxorubicin (positive control) and PBS (vehicle control). Viability of the cells after 24, 48 and 72 hours was determined using a resazurin-based assay.

Outcomes
Krill oil containing 1.228 µM of EPA and 0.661 µM of DHA was added to the cells. It significantly inhibited proliferation of OS 143B cells more efficiently than fish oil after 24, 48 and 72 hours (P<0.05).This effect of krill oil also exhibited a time-dependent manner (% viability: 24 h - 77%; 48 h - 50% and 72 h - 44%). The percentage of viability of krill oil-treated cells was similar to that of 500 nM of doxorubicin. Fish oil (with matched EPA and DHA concentrations as in krill oil) did not show inhibition of proliferation at all three time-points compared to the control group.

Conclusion
Results suggest that krill oil can be used as a potential therapeutic agent towards OS treatment. The effects of krill oil also surpassed those of fish oil and inhibited proliferation in a time-dependent manner.

Source of funding

P070

Predicting change in adipokine levels following omega-3 supplementation in overweight and obesity: understanding inconsistencies in previously published data

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Background
Adipose tissue contributes to the regulation of energy homeostasis through the production of hormones including adiponectin and leptin. Literature suggests that circulating levels of these hormones are impacted by intake of specific fatty acids.

Objective
Results of studies pertaining to the effects of omega-3 fatty acids on adiponectin and leptin have been inconsistent. This study aims to identify potential compounding factors that may explain these differences.

Design
Forty non-diabetic adult subjects (body mass index (BMI) ≥ 25.0) were recruited. Anthropometric measures and fasting blood samples were taken at baseline and following 8 weeks of supplementation with 2g/day of omega-3. Blood samples were utilised to quantify adiponectin, leptin, markers of insulin sensitivity, liver function parameters and blood lipids.

Outcomes
Omega-3 derived changes in circulating adiponectin levels demonstrated no significant correlation to anthropometric measures, markers of insulin sensitivity or blood lipids (P≥0.05), however, significant inverse correlations were observed with alkaline phosphatise and corrected calcium levels (P<0.05). Omega-3 derived changes in leptin levels were positively correlated with BMI and inversely correlated with metabolites associated with potassium, bicarbonate, osmality, urea:creatinine, and estimated glomerular filtration rate (P<0.05).

Conclusion
With minimal contributing factors identified as impacting omega-3 derived changes in adiponectin levels, inconsistencies in results of previous studies may pertain primarily to the dose of omega-3 supplemented. Correlations between omega-3 derived changes in leptin and both BMI and renal function parameters provides significant insight into inconsistencies in the results of previously studies which have assessed the effects of omega-3 on this hormone.

Source of funding
Not applicable.

Poster Session 2: Thursday 5 December
Group 6 – Fats and Oils

P071

Effects of dietary supplementation with docosahexaenoic acid (DHA) on hippocampal gene expression in mice

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Background
Epidemiological studies have shown the beneficial effect of DHA (C22:6n-3), a long chain polyunsaturated fatty acid on cognitive function and synaptic integrity in neurodegenerative disease such as Alzheimer's disease (AD) and in ageing. While robust evidence exists on the beneficial effects of DHA on cognitive functions, the underlying molecular mechanisms remain unclear.

Objective
To investigate the effects of dietary supplementation with DHA on hippocampal gene expression in C57Bl/6 mice.

Design
Male C57Bl/6 mice were randomly divided into control and intervention (n=6 each) groups. One week after acclimatization all animals were raised on a semi-pure AIN93G diet. Intervention group received 50mg/kg/day of DHA daily for six weeks. Animals were sacrificed and hippocampi were processed for genome wide-expression analysis. Genes of interest was selected based on fold change and statistical criteria and were further analysed by RT-qPCR. Pathway analysis was conducted using Database for Annotation, Visualization and Integrated Discovery (DAVID).

Outcomes
DHA supplementation for six week exhibited significant decrease in interleukin 6 (*Il-6*), and significant increase in Wnt7a expression in the hippocampus of DHA supplemented as opposed to non-supplemented group. Wnts are peptides that are considered crucial for dendritic spine density, synaptic maturation and are required for long term potentiation.

Conclusion
Dietary enrichment with DHA modulates genes involved in inflammatory signals and promoting hippocampal neurogenesis. These findings advances our understanding on how dietary supplementation with these naturally occurring bioactive could potentially confer their beneficial properties particularly in hippocampus which is arguably the seat of cognition and memory formation.

Source of funding

P072

Is the omega-3 Index predictive of fatty liver in overweight men and women?

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Background
Non-alcoholic fatty liver disease (NAFLD) is an independent risk factor for cardiovascular disease, insulin resistance and type 2 diabetes. It has been suggested that habitual omega-3 intake can influence liver fat content, and supplementation has been shown to reduce liver fat. The omega-3 Index is a blood marker of long-term ($\geq$ 3 months) omega-3 intake that is obtained from lipid profiling of red blood cell membranes. There is growing evidence that a low omega-3 Index predicts cardiovascular disease, but its predictive value has not been tested in NAFLD.

Objective
To ascertain whether omega-3 Index can predict NAFLD in overweight/obese adults.

Design
Eighty overweight or obese adults (BMI $\geq$ 25 kg/m^2) undertook a proton magnetic resonance spectroscopy (^{1}H-MRS) scan to measure liver fat within seven days of giving a fasting blood sample. NAFLD was defined as liver fat $\geq$ 5.5%. Omega-3 Index was measured from lipid analysis of isolated red blood cells. Differences between groups were compared by Student's t-test.

Outcomes
Preliminary analysis (n = 75) identified 29 (39%) as having NAFLD. Liver fat was significantly higher in the NAFLD vs. the non-NAFLD group (mean ± SE :17.4 ± 2.3 vs. 2.6 ± 0.2 %, p<0.001). Significant differences were found between NAFLD and non-NAFLD respectively for: fasting triglycerides (1.8 ± 0.2 vs. 1.1 ± 0.1 mmol/L; p<0.001), HDL-C (1.2 ± 0.1 vs. 1.5 ± 0.1 mmol/L, p<0.001), TC:HDL-C ratio (5.2 ± 0.5 vs. 3.7 ± 0.1; p<0.01), insulin (76.8 ± 8.6 vs. 48.9 ± 3.9 pmol/L; p<0.01) and glucose (4.6 ± 0.1 vs. 4.1 ± 0.1 mmol/L, p<0.01); waist circumference (103.0 ± 1.8 vs. 97.4 ± 1.1 cm; p<0.05), and HbA1c (5.3 ± 0.1 vs. 5.1 ± 0.1 %, p<0.05). Omega-3 Index tended to be higher in NAFLD vs. non-NAFLD (9.0 ± 0.3 vs. 8.3 ± 0.3) but this did not reach significance (p=0.08).

Conclusion
These preliminary findings suggest that omega-3 Index may not predict the risk of fatty liver in overweight/obese adults. However, a combination of blood and anthropometric markers including sub-clinical components of the metabolic syndrome appears to predict those at risk of NAFLD.

Source of funding

Poster Session 2: Thursday 5 December
Group 6 – Fats and Oils
P073

Protective effects of furan fatty acid (FFA) supplementation in astrocytoma cell lines challenged with hydrogen peroxide

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Background
FFA in fish oil have antioxidant properties that potentially protect against oxidative damage in brain astrocytes.

Objective
To investigate the effects of FFA against oxidative-induced cell death and DNA damage in two genotypically distinct astrocytoma cell lines.

Design
Astrocytoma cell lines, U87MG and U118MG, were cultured for 9 days in FFA-supplemented media—0, 1, 10, 100 and 1000μg/mL—followed by an acute hydrogen peroxide (H_2O_2) challenge (100μM), and compared to unchallenged baseline controls. The cytokinesis-block micronucleus cytome (CBMN-cyt) assay was the primary outcome measure and used to measure DNA damage biomarkers such as micronuclei (chromosome loss and/or breakage), nucleoplasmic bridges (NPBs—DNA misrepair and/or telomere end fusions) and nuclear buds (gene amplification), cell proliferation and cytotoxicity (ie apoptosis and necrosis). A two-way ANOVA was used to determine statistical significance ($P<0.05$).

Outcomes
In the absence of a H_2O_2 challenge, FFA significantly reduced baseline necrosis frequency ($P=0.0039$) whilst increased baseline cellular proliferation ($P=0.0022$) in U87MG cells. In contrast, baseline cellular proliferation was significantly decreased ($P=0.0144$) while the frequency of NPBs significantly increased ($P=0.0034$) in U118MG cells. Preliminary experiments with a H_2O_2 dose response challenge also demonstrated that differences between cell lines U87MG and U118MG were significant for all CBMN-cyt biomarkers measured ($P<0.005$). U87MG was resistant, while U118MG was hypersensitive to H_2O_2. Supplementation with FFA however, did not achieve any significant interactions with H_2O_2 for U118MG, while significant interactions were found for a reduction in cellular proliferation ($P=0.0161$) and the necrotic cell death frequency ($P<0.0001$) in U87MG cells.

Conclusion
The effect of FFA on astrocytoma cells may differ depending on cell line sensitivity to H_2O_2, whereas cellular proliferation, necrosis and nucleoplasmic bridge frequencies may be affected mainly due to an interactive effect between FFA and H_2O_2. FFA exerted a protective effect against H_2O_2 in the U87MG cell line by significantly reducing cell death but may have influenced cellular kinetics by reducing the rate of cellular proliferation.

Source of funding

Poster Session 2: Thursday 5 December
Group 7 – Public Health

P074

Energy drink consumption patterns among secondary school students in New Zealand

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Background
Designed to enhance alertness or provide a short-term energy boost, energy drinks have become prominent in the daily routines of adolescent consumers.

Objective
To describe the energy drink consumption patterns in a sample of New Zealand secondary school students

Design
An online, self-completion survey was administered through the school computer labs. The "Fluid Intake Survey" consisted of four parts – demographics, type of fluid consumption, frequency of consumption and quantity of consumption. Participants were asked to identify which of twelve types drink they had ever consumed. Illustrations were used in the survey to clarify the fluid quantity. Participants then identified when and how much of each drink they usually consumed on a daily basis. Participants recorded their total fluid intake for a whole week. For the purpose of this study, energy drink consumption patterns will be reported.

Outcomes
New Zealand Food and Nutrition Guidelines suggest that energy drinks and energy shots are not recommended for children and young people due to large amounts of caffeine and psychoactive stimulants together with abundance of sugars in them. The results showed that many participants exceeded the health guidelines for consumption of energy drinks. A total number of 922 students participated in the survey, 63% indicated that they used energy drinks. Among the energy drink consumers, the average weekly consumption was 6.29 units. There was no statistically significant difference in consumption between genders or age groups. A statistically significant difference was observed between the four ethnic groups, with NZ Maori being the highest consumer of energy drinks (8.30 units/week), Pacific (7.17 units/week), NZ European (5.56 unit/week), NZ Asian (4.80/week) (p=0.007).

Conclusion
Enhanced education of the potential negative health implications of consuming energy drinks is recommended as well as the need for research in monitoring energy drink use in adolescents.

Source of funding

P075

Home availability of fruit and vegetables and obesogenic foods as an indicator of nutrient intake in 50 year olds from Canterbury, New Zealand

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Background
The home food environment is known to influence children's diet and selected health outcomes. However, similar research in adults is scarce. The home is arguably the most important food environment for New Zealand adults as the majority of food consumed is stored and prepared in the home.

Objective
To investigate relationships between home food availability and nutrient intake in 50 year olds from Canterbury, New Zealand.

Design
Two hundred and sixteen males and females (n=216) aged 50 participating in The Canterbury Health, Ageing, and Lifecourse Study completed a home food inventory (HFI) and a four-day estimated food diary. Regression analysis was used to investigate relationships between home availability of 'Fruit and Vegetables' and 'Obesogenic Foods' and intake of selected nutrients, adjusting for BMI and demographic factors.

Outcomes
Females with a high 'Obesogenic Foods' score were significantly more likely to have high SAFA (OR 5.8, CI:1.67, 19.6) and high sugar intake (OR 3.1, CI:1.23, 7.58). Males with a high 'Obesogenic Foods' score were less likely to have high folate (OR 0.14, CI:0,05, 0,40) and fibre intake. (OR 0.21, CI:0.07, 0.60). Men and women with a higher 'Fruit and Vegetables' were more likely to have high vitamin C intake (OR 5.6 and 4.5 respectively).

Conclusion
HFI scores are associated with selected nutrient intakes, particularly in women; suggesting that they are useful for identifying those with less favourable nutrient intake. Future research should investigate whether these HFI scores can predict health outcomes.

Source of funding

Poster Session 2: Thursday 5 December
Group 7 – Public Health

P076

Relationship between post-resettlement food insecurity, social support and vegetable intake among resettled refugees in Australia

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Background

Food insecurity is a global public health issue associated with unhealthy diets making the food insecure susceptible to diet-related diseases. Resettled refugees living in industrialised countries are at a higher risk of food insecurity than the native population. However the associations between the resettled refugees' food insecurity, social support and vegetable intake are relatively unknown.

Objective

To assess the interaction of food insecurity, social support and vegetable intake among resettled African refugees.

Design

This was a cross-sectional study where food preparers from 71 households of African refugees residing in South East Queensland (SEQ) were recruited through purposive sampling. Food insecurity, social support, vegetable intake and demographic information were collected. Chi square and logistic regression tests were used to determine associations and predictors of food insecurity.

Outcomes

Thirteen (18%) of the participants experienced food insecurity. The proportion of households with adult food insecurity was 25% while 10% had child food insecurity. Participants who had low education levels and no social support were 4.7 (95%CI 1.0-28.7; P<0.05) and 4.4 (95%CI: 1.0-18.8; P<0.05) times more likely to be food insecure, respectively than those with high education levels and social support. Although not statistically significant, individuals from households with adult food insecurity had a lower vegetable intake while those from households with child food insecurity had a higher vegetable intake.

Conclusion

Food insecurity is more prevalent among post resettlement African refugees compared to the general Australian population and is associated with social support and education. Strategies to enhance education and social support networks for resettled African refugees may work towards alleviating food insecurity among this group.

Source of funding

P077

Association of nut consumption with nutrient intakes and cardio-metabolic risk factors: results from the 2008/09 New Zealand Adult Nutrition Survey

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Background

Only a limited number of studies have examined the association of nut consumption with nutrient intake and cardio-metabolic risk factors. No studies have investigated these outcomes in the southern hemisphere where dietary patterns may differ.

Objective

The purpose of this study was to examine the association of nut consumption with nutrient intakes and risk factors for chronic disease among adult New Zealanders.

Design

Anthropometric measurements, blood pressure, and 24-hr diet recalls were taken from participants in the 2008/09 New Zealand Adult Nutrition Survey (n=4721). Blood samples were analysed for total and HDL cholesterol, HbA1c, C-reactive protein and folate.

Outcomes

After adjustment for potential confounders, compared to non-consumers, whole nut consumers had higher intakes of energy and percent energy from total fat, monounsaturated fat, and polyunsaturated fat, whereas percent of energy from saturated fat and carbohydrate were lower (all p<0.002), and after adjustment for energy intake, whole nut consumers had higher intakes of vitamin E, folate, copper, iron, magnesium, potassium and phosphorous while cholesterol intakes were significantly lower (all p≤0.049). Whole nut consumers also had lower body weight, BMI and waist circumference (all p≤0.033). However there were no statistically significant differences in blood pressure (both p≥0.237). The only differences in blood indices were higher concentrations of whole blood and serum folate among whole nut consumers compared to non-consumers (all p≤0.046).

Conclusion

Nut consumption was associated with improved diet quality and blood folate concentrations, and lower BMI and waist circumference, which collectively could reduce the risk of chronic disease.

Source of funding

Poster Session 2: Thursday 5 December
Group 7 – Public Health

P078

Using new technology to assess individual dietary intake at remote communities

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Background
In order to investigate the relationship between diet and diseases is important to assess dietary intake. The use of new technologies has been shown to improve dietary assessment.

Objective
Aim to test the feasibility and practicability of assessing dietary intake using new technologies at individual level.

Design
This cross-sectional study was conducted in a remote community. All people aged 18y or older with interest in nutrition were invited to participate in the study. Flyers were delivered to Health centres, food stores, shire, Community Development Employment Program, aged care and local employment services. Three community workers helped with the recruitment by inviting people at their houses. Participants were trained on dietary data intake methodology including practice in collecting dietary intake from a child using 4-day dietary records and taking pictures of, or video recording, all foods given to the child. Two research team members visited participants' house daily sometimes twice a day to support data collection. Nutritional analysis was performed using Foodworks.

Outcomes
Eleven people completed the training and eight collected dietary intake, five over four days and three during one day. A total of 113 photos and 48 movies were taken. The number of photos and videos taken by mothers over 4 days ranged from three to 62 and from one to 16, respectively according to the participant. The average of pictures and videos taken by participants was 14 and 8, respectively. In total, 88 meals were recalled and 40% of the meals had the image recorded. The percentage of meals recorded by participant decreased from 51% in the first day to 26% in the fourth day. Around AU$2000,00 per participant was spent. Estimates of individual usual dietary intake were acceptable when compared to the energy expenditure average.

Conclusion
Estimates of individual usual dietary intake and use of new technology was well accepted by participants, particularly for one day, but very expensive. The findings from this study provide insights into the development of an appropriate approach for measuring individual dietary intake in remote communities.

Source of funding
This work was supported in part by the Menzies Small grant.

P079

Balanced protein energy supplementation for undernourished pregnant women in low-income countries and child physical growth: a systematic review

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Background
The effect of balanced protein energy supplementation in undernourished pregnant women is unclear. While systematic reviews to date have included studies from high, middle and low-income countries, country-specific sociopolitical factors are confounders.

Objective
Assess the effect of balanced protein energy supplementation in undernourished pregnant women from low-income countries on child growth.

Design
A systematic review of articles published in English (1970 to 2013) was conducted using articles retrieved via MEDLINE, Scopus, the Cochrane Register, and hand searching. Only experimental research analysing effects of balanced protein energy supplementation in undernourished pregnant women from low-income countries with physical growth as the primary outcome were included. Two reviewers independently assessed full text articles against inclusion criteria. Validity of eligible studies was ascertained using the Quality Assessment Tool for Quantitative Studies developed by the Effective Public Health Practice Project (EPHPP QAT). PROSPERO registration number: CRD42013005115

Outcomes
Seven studies met inclusion criteria (n=2367). All studies reported on birthweight, five studies reported on birth length and birth head circumference and two studies reported on longer-term growth. Standardised mean differences were calculated using random-effects model. Balanced protein energy supplementation significantly improved birth weight (7 RCTs, n= 2367; P=0.021, 95% CI, 0.03-0.38). No significant benefit was observed on birth length or birth head circumference. Impact of intervention could not be determined for longer- term physical growth as only two studies reported on longer-term growth.

Conclusion
Balanced protein energy supplementation targeting undernourished pregnant women in low-income countries has a positive effect on birth weight. Additional research is required in developing countries to identify impacts on longer-term infant growth.

Source of funding
Not applicable.

Poster Session 2: Thursday 5 December
Group 7 – Public Health

P080

Food security among students at the University of Wollongong

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Background

Food insecurity occurs whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain. There has been limited research into food security among University students, although one previous study in Queensland reported the prevalence of food insecurity with hunger up to 25%.

Objective

To investigate the level of food security amongst students attending the University of Wollongong (UOW). A secondary aim was to investigate factors influencing access to and preparation of foods suitable to meet cultural and religious needs.

Design

An online survey was distributed via UOW student clubs and associations. Food security was measured using both a single item question taken from the Australian National Nutrition Survey (NNS) and multi item questions, based on the United States Department of Agriculture (USDA) Community Food Security Assessment Toolkit. Students were also asked about purchasing behaviours and cultural requirements of food.

Outcomes

A total of 337 students from ten faculties completed the survey; average age 30 years (18 to 68 years). The prevalence of food insecurity among UOW students using the single-item measure was 19.6% (n=62). Food insecurity using the more sensitive multi item measure identified three in five students (60.8%, n=198) experienced some level of food insecurity. More than thirty seven percent of the students reported a severe level of food insecurity. The prevalence of food insecurity was higher among international students (70% vs 52% domestic students, p=0.001), coursework students (71% vs 50% research students, p <0.001), students without a car, (68.2% vs 56% with a car, p=0.029), unemployed students (68.6% vs 49.2% employed student, p=0.001) and students who were renting (69.3% vs 37.3% in other accommodation, p<0.0001).

Conclusion

University students are at significant risk of food insecurity and there is a need to provide better support services to them. Information from across the sector should be obtained to determine the extent of food insecurity amongst university students in Australia.

Source of funding

Not applicable.

P081

Assessing the effectiveness of interventions by a non-government organisation in the Philippines

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Background

A feeding program addressing food insecurity in Tacloban city, Philippines, consisted of a six-month supplementary feeding program, parental education activities and community kitchen. It was evaluated using quantitative and qualitative methods.

Objective

To investigate the effectiveness of a NGO intervention in addressing food insecurity and health impacts on children.

Design

The impact on food insecurity and health status of participating children and households were assessed using anthropometric parameters (weight and height) and parent-report of food insecurity (Radimer-Cornell questionnaire). A total of 87 children (mean ±SD age: 3.8 ±1.5 years at baseline were assessed at the beginning of the program, end of the 6 month program and up to 18 months after the program ceased.

Outcomes

Preliminary results show a positive trend in the z-score weight for age of the participating children during feeding programs (+0.1 z-score); there was no significant increase in the z-score height for age of the participating children. The number of children under 25th percentile for weight has increased from 85% to 88.5% and for height from 81.6% to 90.8% after the program ceased. All the participating families were food insecure post feeding program with 61% of them severely food insecure, 35.5% moderately food insecure and 3.5% mildly food insecure.

Conclusion

There was no significant improvement in the weight and height of children after the 6 month feeding program ceased. Despite an increase in food availability during feeding program all the participating families remained food insecure.

Source of funding

Not applicable.

Poster Session 2: Thursday 5 December
Group 8 – Nutrition Methods

P082

The development of a tool to assess the healthiness of Australian food environment

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Background
Food environments contribute to individuals' ability to purchase and consume a healthy diet. Measures of neighbourhood food environments are useful for understanding how environmental factors, such as food availability, accessibility and promotion, impact on health and obesity; and for identifying opportunities for modifying these environments for effective health promotion.

Objective
This study is designed to develop a research tool to classify neighbourhood food environments ranging from 'less' to 'more' health promoting.

Design
Classification of food outlets was based on a definition of each food outlet resulting in 26 categories or "food outlet types" based on work of Winkler (2008) and Innes-Hughes (2011). A ranking of the relative 'healthiness' of food outlet types was then devised, based on available literature linking the availability of food outlets in neighbourhoods to health and nutrition outcomes. The classification tool was piloted in 20 suburbs in the Illawarra region of NSW using GIS mapping. An algorithm was developed to score each suburb by classifying the food outlets as 'Healthy', 'Intermediate' and 'Unhealthy' and adding the scores of total food outlets of each suburb. This score was then correlated with the SEIFA scores (2011) of the suburbs.

Outcomes
The most commonly found food outlets across the suburbs were 'take-aways' and 'restaurants'. The preliminary algorithm was developed on the literature showed that the healthiest food outlets were Major and Minor supermarkets and Fruiter/Grocer shops whereas the least 'healthy' food outlets were convenience stores, service stations, bakeries/cake shops, take-aways (local or franchise), pizzerias, liquor shops and pubs. Preliminary analysis shows SEIFA of suburbs correlated with one of four scoring models of the suburbs' food environment. Delphi survey of nutrition experts will establish an agreed "order of healthiness".

Conclusion
Further development of the tool using a Delphi survey of experts will confirm the degree of agreement of the 'healthiness' index and can inform future interventions and policy towards improving the healthiness of food environments by identifying at-risk suburbs.

Source of funding
Not applicable

P083

Design and validation of a Simple Dietary Questionnaire with Australian adolescents

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Background
Assessment of food intake in adolescents with dietary tools that are valid and simple to complete are needed to monitor the dietary consumption patterns of this age group, and for researching links between diet and health.

Objective
This study aimed to develop and examine the reproducibility and validity of a Simple Dietary Questionnaire (SDQ) to obtain food group level data in Australian adolescents.

Design
Participants completed the 25-item SDQ online on two occasions followed by two 24-hour food recalls by telephone, on a week day and a weekend day, using triple pass methodology. Food groups were vegetables, fruit, sweetened cereals, white bread/pasta, white rice, wholegrains, takeaway food, high sugar/energy snacks, nuts, sweetened drinks, eggs, legumes, fish, meat/chicken, flavoured dairy, plain dairy and water. Reproducibility was established by correlating questions regarding frequency of consumption of foods and drinks from the repeated SDQs, and concurrent validity by correlating average daily food group consumption data from the repeated SDQs with average food group level consumption data calculated from the repeated 24 hour dietary recalls. Extended questions examined food diversity in selected groups of food and drinks.

Outcomes
66 adolescents aged 13-18 completed two SDQs and of those 61 completed the 24-hour recalls. The SDQ took, on average, 9 minutes to complete. Test-retest reliability coefficients for the SDQ were strong (r=0.543-0.88, p<.001). Significant validity coefficients ranged from r=0.26 (p=0.046) to r=0.57 (p<.001). The validity coefficient for plain dairy was non-significant, and for water was in the opposite direction. Scores showing diversity of foods consumed correlated significantly with frequency of consumption (r=0.26-0.81 for the SDQ and r=0.29-0.48 for the 24-hour recall).

Conclusion
For key food groups such as fruit, vegetables and non-core foods and sweetened drinks the SDQ is a simple, inexpensive, valid method of measuring dietary intake of adolescents with minimal participant burden. We provide a useful tool for identifying food group intake of adolescents that can be used to evaluate links between food intake and health status, and to evaluate health intervention programs to improve dietary patterns of this age group.

Source of funding
Not applicable.

Poster Session 2: Thursday 5 December
Group 8 – Nutrition Methods

P084

A healthy dietary habits score is an indicator of diet quality in New Zealand adolescents

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Background

Adoption of optimal dietary habits during adolescence is associated with better dietary status and may have a protective effect on chronic diseases later in life. The association between healthy dietary habits and diet quality has not been assessed using a diet index in New Zealand (NZ) adolescents.

Objective

This study aims to examine whether reporting more healthful dietary habits is associated with a better diet quality in a representative sample of NZ adolescents aged 15 to 18 yrs.

Design

A 17-item Healthy Dietary Habits Score for Adolescents (HDHS-A) was developed based on a Dietary Habits Questionnaire. Using data from the 2008/09 NZ Adult Nutrition Survey, adolescents aged 15 to 18 yrs (n = 694) who completed a single 24-hour diet recall and dietary habits questions were included in this secondary analysis. The associations between HDHS-A and nutrient intakes estimated by the 24-hour diet recalls were examined using post-hoc trend analyses.

Outcomes

Increasing thirds of HDHS-A were associated with a higher intake of protein, dietary fibre, polyunsaturated fat and lactose ($P<0.01$), and a lower intake of sucrose ($P<0.05$). Significant positive associations were also found between HDHS-A and most micronutrients ($P<0.01$).

Conclusion

More healthful dietary habits, as indicated by a higher HDHS-A, were associated with a more favourable nutrient profile. A healthy dietary habits score may serve as an indicator of diet quality in NZ adolescents.

Source of funding

P085

Validity and reliability of bioelectrical impedance analysis and dual-energy X-ray absorptiometry to estimate body fat percentage against air displacement plethysmography

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Background

Body fat percentage (BF%) is most accurately predicted using air displacement plethysmography (ADP) (gold standard method). Dual-energy X-ray absorptiometry (DXA) and bioelectrical impedance analysis (BIA) also predict BF% and have distinct advantages for use in the clinical or research setting. No study to date has compared all three methods simultaneously in a normal adult population with a range of ages (19-72yr), gender and BF% (5-54%).

Objective

The aim was to assess the validity and reliability of BIA and DXA against ADP in estimating BF% in healthy adults.

Design

BF% of 166 adults (19-71y) was measured twice within 5 days using ADP, DXA and BIA. Agreement between measurements was analysed using *t*-tests, effect size, linear regression models and method of triads. Reliability was assessed by comparing and correlating repeat measurements (*t*-test and Pearson correlation coefficients, respectively).

Outcomes

BIA showed excellent relative agreement to the true value ($\rho = 0.97$ [0.96, 0.98]) and to ADP ($R^2 = 0.88$), but absolute agreement was biased and the limits of agreement wide (-4.25 to 8.37%). BIA underestimated body fat with 2%, across all BF% values, not differing between men and women. DXA showed excellent relative agreement to the true value ($\rho = 0.97$ [0.96, 0.98]) and with ADP ($R^2 = 0.92$), and good absolute agreement despite wide limits of agreement (-6.13 to 6.91%). DXA overestimated extreme low BF% (all men) and underestimated high BF% (all women). ADP, BIA and DXA showed excellent reliability with repeat measurements differing by less than 0.2% with very small 95% CIs. On average, BF% measured by ADP can be predicted from BIA measurements by adding 2%.

Conclusion

DXA compares well to ADP except at extreme BF% levels.

Source of funding

Not applicable.

Poster Session 2: Thursday 5 December
Group 8 – Nutrition Methods

P086

A short FFQ developed for use in New Zealand adults: reliability and validity for nutrient intakes

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Background
There are currently no validated short multi-nutrient FFQs available to assess multiple nutrient intake in New Zealand (NZ) adults.

Objective
To evaluate the reliability and relative validity of a 57 item semi-quantitative FFQ for assessing the habitual intake of nutrients in New Zealand adults over the past 12 months.

Design
Participants were 132 males and females aged 30-59 years. FFQ reliability was assessed using intra-class correlations. Relative validity was assessed by comparing nutrient intakes derived from the FFQ v. those from an 8 d diet record (8dWDR) collected over 12 months and selected blood biomarkers, using Spearman correlations. Supplementary cross-classification and Bland-Altman analyses were performed to assess validity of the FFQ v. the 8dWDR.

Outcomes
Reliability coefficients ranged from 0·57 for Zn to 0·74 for vitamin C, The highest validity coefficients for energy-adjusted data were observed for alcohol (0·74), cholesterol (0·64) and carbohydrate (0·63), and the lowest for niacin equivalents (0·29) and thiamin (0·30). For all energy-adjusted nutrients mean percentage correct classification was 73.9% and gross misclassification was 6.6%. Results of Bland-Altman analyses showed wide limits of agreement for all micronutrients but high agreement was observed for most macronutrients (96% for protein, 100% for total fat). When compared with biomarkers, energy-adjusted correlation were 0·30 for beta-carotene and 0·38 for vitamin C.

Conclusion
The FFQ provides highly repeatable measurements and good validity in ranking individuals' intake, suggesting that it will be a useful tool to assess nutrient intake of NZ adults in future research.

Source of funding
University of Otago Research Grant and Department of Human Nutrition PBRF grant

P087

Validation of fruit and vegetable intakes assessed by food frequency questionnaire using plasma carotenoids in adults.

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Background
High quality dietary validation studies use objective plasma biomarkers as independent measures of fruit and vegetable intake.

Objective
To validate self-reported adult fruit and vegetable intakes, using the Australian Eating Survey (AES) food frequency questionnaire (FFQ), against a range of plasma carotenoids. A secondary goal was to examine plasma carotenoid concentrations by weight status

Design
Dietary intakes were assessed using the AES, a semi-quantitative 120 item FFQ. Dietary carotenoids were derived using the US Department of Agriculture National Cancer Institute food composition database. Fasting plasma carotenoids (α- and β carotene, lutein/zeaxanthin, lycopene and cryptoxanthin) were assessed using high performance liquid chromatography (HPLC) in a sample of 38 adult volunteers (n=25, 66% female).

Outcomes
Significant correlations were found between the FFQ carotenoids and plasma carotenoids for α-carotene (r=0.52, P<0.001), β-carotene (r=0.47, P<0.01), and lycopene (r=0.26, 0.04). Statistically significant negative correlations were found between plasma carotenoids (except lycopene) and weight metrics (BMI, waist circumference and fat mass).

Conclusion
Results indicate that the AES FFQ is a valid measure of fruit and vegetable intake based on significant positive correlations between plasma and FFQ carotenoids of α-carotene, β-carotene and cryptoxanthin, which are abundant in fruit and vegetables. The significant negative relationship between plasma carotenoids and body weight suggests that individuals with higher BMI may have lower antioxidant capacities.

Source of funding
Meat and Livestock Australia grant.

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