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Exploring the main and moderating effects of individual-level characteristics on consumer responses to sugar taxes and front-of-pack nutrition labels in an experimental marketplace

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As an increasing number of jurisdictions implement sugar taxes and front-of-pack (FOP) nutrition labels, it is critical to examine whether the impacts of these policies differ across sociodemographic subgroups. The objective of this study was to explore the main and moderating effects of individual-level characteristics on the nutrient content of participants' purchases in response to varying taxation levels and FOP labels. Data from an experimental marketplace were analysed. A final sample of 3,584 Canadians aged 13 years and older received \$5 to purchase an item from a selection of 20 beverages and 20 snack foods. Participants were randomized to view products with one of five FOP labels and completed eight within-subject purchasing tasks with different sugar tax conditions. Linear mixed models were used to estimate the main and interaction effects of 11 individual-level variables defined a priori (sex, age, hunger, thirst, weekly sugary drink consumption, efforts to modify nutrient intake, health literacy, ethnicity, education, income adequacy, and body mass index) on participants' purchasing of sugars, sodium, saturated fats and calories. Participants who were younger, male, and more frequent consumers of sugary drinks tended to purchase products containing more sugars, sodium, saturated fats and calories. Sex and age moderated the relationship between tax condition and sugars or calories purchased: female participants were more responsive to a tax that included fruit juice compared to males, and younger participants were more responsive to all sugar tax conditions compared to older participants. Reported thirst and education level also moderated the relationship between tax condition and calories purchased. A small number of individual-level characteristics moderated the effects of sugar taxes on nutrients purchased in this study. The results thus suggest that sugar taxes and FOP nutrition labelling policies may produce similar effects across key sociodemographic groups. (This study was supported by a Canadian Institutes of Health Research (CIHR) Operating Grant in Sugar and Health (# SAH-152808). Additional funding for this project has been provided by a Public Health Agency of Canada (PHAC) – CIHR Chair in Applied Public Health, which supports Professor Hammond, staff, and students at the University of Waterloo.)

Enhancing iron bioaccessibility in an African cereal-based diet using a food-based approach: a potential sustainable strategy to alleviate iron deficiency in Africa

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Iron deficiency (ID) remains the most common micronutrient deficiency globally and contributes to about 50% of all anaemia cases among child-bearing women. ID is especially prevalent in African populations primarily due to monotonous cereal-based diets high in mineral bioavailability inhibitors and minimal consumption of animal food products rich in bioavailable iron. Furthermore, many poor communities are not reached with conventionally fortified foods. Therefore, this study aimed to evaluate the effect of adding locally available plant-foodstuffs rich in iron (moringa-leaf powder) and iron bioavailability enhancers (baobab fruit) to wholegrain maize-porridge on iron bioaccessibility. Four porridges were formulated: Maize-porridge, Maize-porridge+baobab fruit (100:15), Maize-porridge+moringa-leaf powder (100:15) and Maize-porridge+organic acids (ascorbic and citric acids-known mineral absorption enhancers). Ascorbic and citric acid

used were at the same levels as in the baobab fruit. Iron bioaccessibility of porridges was determined using the in vitro dialysability assay. The potential percentage contribution of total bioaccessible iron of the porridges (100 g, dry basis) to the absolute requirement (AR– 1.46 mg iron/day) for child-bearing women was calculated. Addition of baobab fruit and organic acids to the maize-porridge increased ($p < 0.05$) its percentage iron bioaccessibility by 19% and 27% and its total bioaccessible iron by 16% and 27%, respectively. Furthermore, baobab fruit and organic acids could potentially improve ($p < 0.05$) the contribution of iron in the porridge to the AR for adult women by 16% and 27%, respectively. The enhancing effect of baobab fruit on iron bioaccessibility was probably due to its high organic acid contents; they chelate minerals and keep them in a soluble and absorbable form. Moringa-leaf powder decreased the iron bioaccessibility of the porridge by 53–84%. The inhibitory effects of moringa leaves on iron bioaccessibility could be due to its high calcium and phytate contents; they inhibit iron bioavailability by forming insoluble complexes with the iron. Baobab fruit inclusion in cereal-based staples like maize-porridge, could be an alternative and sustainable food-based strategy to improve the iron status of child-bearing women in Africa especially in poor-resource communities where fortified foods are lacking. (Funding: National Research Foundation (NRF)/The World Academy of Science (TWAS); United State Agency International Development (USAID).)

Effectiveness of a sliding-scale payment model in community food markets to reduce food insecurity

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Food insecurity is a challenge in many Canadian communities, with those affected either worrying about or suffering from a lack of available food. This study determined the impact of a sliding scale payment model as a novel approach to help improve food insecurity status experienced by customers who attend Community Food Markets, a social enterprise operated by the SEED, a project of the Guelph Community Health Centre. The sliding scale payment method allows customers to pay anywhere between the wholesale cost of each item up to the retail cost. Food insecure customers can utilize the lower payment option to improve their food security via purchasing more affordable fresh produce. Customers using the higher end of the payment scale are needed to financially sustain the market and reach its social outcome of reducing socioeconomic barriers between members of different income brackets. Customers of the Community Food Markets ($n=121$) were surveyed online or in-person to determine i) their overall food insecurity status both prior to and after attending the food markets, and ii) how the use of a sliding scale payment option impacted their access to affordable healthy food options. Customers attending the market represented a range of household income levels with over 56% earning under \$40,000, and 20% earning over \$80,000 annually. Customer household income level was positively correlated with the price they selected to pay along the sliding scale, wherein lower income individuals selected to pay on the lower end of the sliding scale and higher income individuals supported the sustainability of the market by paying the highest payment option. Market attendance was shown to reduce customers self-reported indicators of food insecurity including i) feeling less worried about running out of food, ii) no

longer having to limit the types of food purchased, iii) maintaining higher food quality, and iv) increased ability to purchase more food overall. Collectively, these data demonstrate that the sliding scale payment model is supported by the community across household income levels and effectively reduced customer food insecurity. This model could be considered in other communities to help reduce food insecurity prevalence and severity.

Consistency of the Nutri-Score front-of-pack nutrition label with proposed 'high-in' warning labels

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Background: Front-of-pack (FOP) labelling has the potential to help populations achieve more balanced diets. Health Canada's FOP 'high in' warning labels (HI-WL) evaluate foods based on three nutrients-to-limit (saturated fat, sugar and sodium), while France's Nutri-Score (NS) FOP ranks foods on both negative (sodium, fat, sugar, energy) and positive (e.g. protein, fibre, fruits, vegetables, legumes, nuts, olive/rapeseed/nut oils) food components. However, comparable evaluations of foods by the two NP systems is lacking. **Objective:** To compare the evaluation of branded foods and beverages by the NS and HI-WL FOP systems in the Canadian food supply. **Methods:** Using the University of Toronto Food Label Information Program database 2017 (n=17,360), five grades of nutritional quality, ranging from green (A; highest quality) to red (E; lowest quality), for packaged foods and beverages were derived using the NS NP system. Scores were assessed as binary where A/B were considered 'healthier' and C/D/E were considered 'less healthy'. HI-WL were assessed using thresholds based on > 15% Daily Value (DV) for saturated fat, sodium and sugar, above which a 'high-in' FOP for that nutrient would have to be displayed. **Results:** Overall, there was 72% agreement between NS and HI-WL, ranging from 49% for fats and oils to 95% for eggs and egg substitute categories. A higher proportion of products in categories sugars and sweets (20%), desserts (13%), fats and oils (52%) were classified as 'healthier' by HI-WL, in comparison with NS (3%, 7%, 1%, respectively). A higher proportion of products in salads (66%), legumes (12%), vegetables (31%) and fruits (71%) were classified as 'less healthy' by HI-WL in comparison with NS (21%, 1%, 24%, 63%, respectively). Discordances were found for combination dishes, dessert toppings and fillings and soups, where > 75% of products categorized as 'high-in' were classified as Grade A/B by NS. **Conclusions:** The classification of foods by the NS was consistent with the HI-WL, although a high proportion of products in categories fruits, vegetables, legumes and salads were penalized using the HI-WL. NS may do a better job of identifying nutrient-dense foods and discriminating foods between and within categories. (Sanofi-Pasteur Collaborative Grant.)

Nutrient inadequacy of Canadian adults: results from the Canadian Community Health Survey (CCHS) – 2015 Public Use Microdata Files

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Background: An unhealthy diet is a common modifiable risk factor for obesity and related chronic diseases. Up-to-date, accurate estimates on the usual intake of key nutrients are important for monitoring the nutritional adequacy and diet quality of Canadians. Comprehensive, nationally-representative nutrient estimates of Canadians are available from Canadian Community Health Survey (CCHS) – Nutrition 2004 data, but not for the most recent 2015 data. **Objective:** To assess nutrient inadequacy among Canadian adults using data from 2015 CCHS-Nutrition Public Use Microdata File (PUMF) 2015. **Methods:** Both

available dietary recalls from the CCHS 2015 PUMF were used to estimate usual intakes of key vitamins and minerals in adults (≥ 19 years, excluding breastfeeding women and those with invalid energy intake; n = 11,992). Outliers with implausible nutrient intakes were defined as those whose intakes were ± 3 SD of the mean from a Box Cox-transformed intake distribution, and those where the difference of intakes between recall one and two were ± 3 SD of the expected mean difference of the sample. Usual nutrient intakes were estimated using the National Cancer Institute (NCI) Method adjusted for age, sex, mis-reporting, weekend/weekday and sequence of recall analyzed (first/second). Derived usual intakes were assessed for inadequacy in relation to the Dietary Reference Intakes (DRIs). **Results:** A low prevalence of inadequate intakes (<10% below EAR) were observed for Canadian men (>19 years) for iron and thiamin. A low prevalence of inadequate iron intakes was seen in postmenopausal women, whereas 28-29% of women 19-50 consumed iron below the EAR. 10-30% of Canadians in almost all age-sex groups consumed folate in inadequate amounts. The prevalence of nutrient inadequacy was highest for vitamin D (94-97%) and magnesium (45-55%), while 60-75% were below the Chronic Disease Risk Reduction (CDRR) recommendations for potassium. **Conclusions:** Many Canadian adults may not be meeting recommendations for shortfall nutrients such as potassium, magnesium and vitamin D. In addition to the overconsumption of energy and nutrients of public health concern, these inadequacies may contribute to unhealthy diets. Adults should be encouraged to consume nutrient-rich foods and follow Canada's Food Guide. (CIHR.)

Omega-3 fatty acids upregulate genes involved in neurotrophin signalling in fetal brain during pregnancy in C57BL/6 mice

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Neurotrophins are vital for the development and maintenance of normal brain function. The effects of maternal diet high in omega (n)-3 polyunsaturated fatty acids (PUFA) on fetal brain fatty acids composition and the regulation of genes involved in neurotrophins' signalling at different gestation stages is not known. We hypothesized that maternal diet high in n-3 PUFA will cause an accretion of n-3 PUFA in fetal brain, and consequently increase the mRNA expressions of neurotrophins in a gestation-dependent fashion. Female C57BL/6 mice (7 weeks old, n=8 per group) were fed semi-purified diets (20% w/w fat) containing adequate (9%), low (3%) or very low (1%) n-3 PUFA (n-6:n-3 of 5:1, 20:1 and 40:1 respectively) for 2 weeks before mating and throughout pregnancy. Females were sacrificed at gestation day 12.5 and 18.5 to collect fetal brains. Fatty acids composition of fetal brains was determined by gas chromatography. The mRNA expressions of major facilitator superfamily domain-containing protein 2 (Mfsd2a), brain-derived neurotrophic factor (BDNF), tropomyosin-receptor kinase B (TrkB), and cAMP response element-binding protein (CREB) were measured at gestation day 12.5 and 18.5 using qPCR. The protein expression of phosphorylated CREB (pCREB) was determined using ELISA. The high n-3 PUFA diet increased the mRNA expression of Mfsd2a in fetal brain (p<0.0001) at gestation days 12.5 and 18.5, compared to the low and very low n-3 PUFA groups. Docosahexaenoic acid (DHA) and total n-3 PUFA were significantly higher in the high n-3 PUFA group, compared to the other groups at both day 12.5 and 18.5 (P<0.05). The high n-3 PUFA diet increased the mRNA expressions of BDNF, TrkB and CREB, as well as the protein concentration of pCREB in a gestation dependent fashion, compared to the other groups (P<0.0001). Our findings show for the first time that maternal diet high in n-3 PUFA increased the mRNA expression of Mfsd2a, which corresponds with an increased accretion of DHA in the fetal brain, with a concomitant increase in the expression of neurotrophins and their target receptors in a gestation-dependent fashion. (Funded by NSERC.)

Household food insecurity and associated socioeconomic factors among Syrian refugees in two Canadian cities

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Achieving food security and ending hunger are within the sustainable development goals of the United Nations by 2030, yet many vulnerable populations are at risk of food insecurity, particularly refugees. Since 2015, the Government of Canada, in collaboration with the United Nations High Commissioner for Refugees (UNHCR) prioritized the resettlement of around 25,000 Syrian refugees by the end of 2017. The resettled refugees were with higher needs, manifested in their high educational needs, challenging family composition, limited coping skills, health concerns and physical disabilities. However, the resettled Syrian refugee's socioeconomic and sociodemographic profile adds to their vulnerability to experiencing food insecurity. While most research on Syrian refugees in Canada focuses on their resettlement process in Canadian society, no study has assessed their food security status and related factors. The main objective of this research is to determine the prevalence of food insecurity and its socioeconomic determinants among Syrian refugees who resettled between 2015-2017. In this cross-sectional study, 150 Syrian refugee households settling in Toronto and Saskatoon participated. A validated Household Food Security Model Survey and a standard sociodemographic questionnaire from the Canadian Community Health Survey were used. The preliminary results from households in Saskatoon (n=50) and Toronto (n=100) show that the majority of Syrian refugee households experienced moderate and severe food insecurity, 41% and 31% households, respectively. While about 16% were food-secure, 12% were marginally food insecure. Adults were more likely to experience severe food insecurity compared to children (27% vs. 13%). Around 46% of food-insecure participant's households were within the lower half part of the income deciles with no significant association with their food security status. However, the majority of food-insecure households (90%) were reliant on governmental welfare. Also, households with a woman with a higher educational level had higher odds of food insecurity. The prevalence of food insecurity is considerably high among Syrian refugees (84%), as compared to immigrants who have been in Canada for less than five years (15.2%) and the Canadian born (11.8%). An in-depth understanding of associated factors and support systems is warranted. (Fund Social Sciences and Humanities Research Council.)

The short- and long-term effects of neonatal total parenteral nutrition on glucose metabolism in Yucatan miniature pigs

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Total parenteral nutrition (TPN) is a life-saving intravenous feeding strategy that provides complete nutrition to patients who cannot tolerate oral feeding. However, TPN can alter metabolism which could increase the risk for chronic diseases, including type 2 diabetes mellitus. Permanent changes to metabolism are likely caused via epigenetics, which can be altered by imbalanced methyl nutrients (ie betaine and creatine). Therefore, we hypothesized that TPN will alter glucose metabolism which will persist into adulthood and induce biomarkers of type 2 diabetes. We also hypothesized that the supplementation of betaine and creatine to TPN will prevent these TPN-induced effects, while small birthweight will exacerbate these effects. 32 female Yucatan miniature piglets (7 d old) were assigned to

4 groups: normal birthweight TPN control (TPN), sow fed (SF), TPN with supplemental betaine and creatine (TPN-B+C) or small birthweight on control TPN (TPN-IUGR). TPN was fed for 2 weeks, after which glucose metabolism was assessed using intravenous glucose tolerance test (IVGTT) and insulin sensitivity test (IST). All pigs were then fed a grower diet for ~10 mo and glucose metabolism tests were repeated. TPN feeding altered glucose metabolism by significantly increasing glucose clearance, as indicated by lower fasting glucose, lower glucose AUC, lower peak glucose concentration, and shorter time from peak to baseline (TTBL). These higher glucose clearance effects were more profound immediately after cessation of TPN, but were still significant 10 mo later. TPN also increased insulin sensitivity early, but not 10 mo later. Adding betaine and creatine to TPN corrected insulin sensitivity effects, but glucose clearance parameters were unchanged. Small birthweight combined with TPN did not seem to exacerbate the effects of TPN. Overall, we conclude that TPN in early life can permanently alter glucose metabolism into adulthood, but these changes are not consistent with biomarkers for type 2 diabetes mellitus. Further studies are needed to fully understand the effects of TPN on glucose metabolism and their implications on health. (CIHR.)

Dietary phosphatidylcholine supplementation decreased atherosclerosis development in Ldlr^{-/-} mice

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Introduction: Choline, an essential nutrient, is required for cell membranes, lipoprotein secretion, and methyl-group metabolism. The two major forms of choline in the diet of the North American population are free choline and phosphatidylcholine (PC). Eggs, dairy, and meat are rich in PC, meanwhile, cereal and legumes are rich in free choline. Excess of dietary choline is mainly metabolized to trimethylamine (TMA) by the gut microbiota. TMA is rapidly absorbed by the enterocytes and oxidized to trimethylamine N-oxide (TMAO) in the liver by a group of enzymes called flavin-containing monooxygenases. Epidemiological studies suggest that plasma TMAO is a biomarker for atherosclerosis. Some scientists suggest that a lower egg and meat intake would reduce PC consumption and thus reduce atherosclerosis development. The objective of this study was to investigate whether the form of dietary choline, free choline or PC, influences atherosclerosis development in Ldlr^{-/-} mice. Experimental design: For 12 wk Ldlr^{-/-} male mice (aged 8-10 wk) were randomly fed one of the three 40% (% calories) high fat diets (with 0.5% of cholesterol): Control (0.1% choline, CON), choline-supplemented (0.4% choline, CS), or PC-supplemented (0.1% choline and 0.3% choline from PC, PCS) diet. After the dietary intervention, the animals were euthanized, and tissues and blood collected. Aortic atherosclerotic plaque area, plasma choline, lipid metabolites, and spleen and peripheral blood cell phenotypes were quantified. Results: The PCS group had significantly lower atherosclerotic lesions while having 2-fold higher plasma TMAO levels compared with both CON and CS groups (p<0.05). We found that PCS increased plasma HDL-cholesterol and decreased VLDL-cholesterol; however, VLDL secretion was not affected by dietary treatment. Fasting plasma APOB48 particles were significantly lower in PCS than CON and CS groups. In Spleen and peripheral blood immune cell phenotypes there were no differences in the proportion of T and B cells subsets and macrophages along with the activation markers that they express including ICAM-1. Conclusion: Dietary PC supplementation decreased atherosclerosis development, despite increasing plasma TMAO. Changes in lipoprotein metabolism might explain partly the reduction in atherosclerotic plaque, however, the mechanism behind this observation is unclear. (Supported by CONACYT Mexico, NSERC, and ALMA.)

The effect of riboflavin-containing supplements on riboflavin status and hemoglobin concentrations in Cambodian women

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Mild riboflavin deficiency may contribute to anemia. The prevalence of both anemia and riboflavin deficiency have been estimated to be high in Cambodian women. The aim of this study was to determine the effect of riboflavin-containing supplements with or without iron on riboflavin status and hemoglobin concentration in young adult Cambodian women with anemia. In a 2x2 factorial double-blind randomized trial, non-pregnant women (n=262; 18-45 y) from 26 villages in Kampong Chhnang province, Cambodia, with hemoglobin ≤ 117 g/L (based on the HemoCue® using capillary blood) received daily iron (60 mg; n=62), multiple micronutrient (MMN, contains 1.4 mg of riboflavin; n=63), iron+MMN (n=65), or placebo (n=72) capsules for 12 weeks. Fasting venous blood samples were collected at baseline and 12 weeks (n=226) to assess hematological indicators, riboflavin status (erythrocyte glutathione reductase activity coefficient, EGRac), and iron biomarkers. At baseline, 58% of women had anemia (hemoglobin < 120 g/L), 81% had riboflavin deficiency (EGRac ≥ 1.40), and 18% had depleted iron stores (ferritin < 15 μ g/L). With adjustment for baseline EGRac, EGRac was significantly different at 12 weeks between women who received MMN (n=112), with or without iron, compared to women (n=114) who did not receive MMN (mean difference = -0.39, 95%CI: -0.48, -0.31), using a generalized mixed-effects model (with no iron x MMN interaction). However, 63% of these women were still riboflavin deficient (EGRac ≥ 1.40) at 12 weeks and the change in EGRac was not predictive of the change in hemoglobin concentration at 12 weeks. MMN supplementation was not associated with an improvement in hemoglobin concentration among women with an EGRac above or below the baseline median EGRac of 1.75, indicating no interaction between baseline riboflavin status and hemoglobin response. Supplementation with MMN for 12 weeks reduced EGRac but did not eliminate riboflavin deficiency (EGRac ≥ 1.40). The improvement in riboflavin status among Cambodian women in this study was not associated with an increase in hemoglobin concentration. A higher dose of riboflavin might be required to correct biochemical riboflavin deficiency in Cambodian women, but the EGRac cut-off used to identify deficiency may need re-evaluation. (CIHR, Nutrition International and Sight and Life Foundation, Dairy Farmers of Canada.)

Do socioeconomic status and location influence diet quality of food consumed by pre-school aged children in childcare centres enrolled in the Healthy Start-Départ Santé intervention?

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Introduction: There is an alarming trend in early childhood overweight and obesity. Approximately 34.1% of Canadian 2-5 year old children were overweight or obese in 2015. Lower socioeconomic status is associated with higher risk of overweight and obesity. In Canada, several initiatives have focused on healthy lifestyle habits in childhood. The Healthy Start-Départ Santé (HSDS) health promotion initiative was launched in Saskatchewan and New Brunswick to promote healthy eating and physical activity in 3-5-year-old children. The HSDS program was implemented in approximately 276 pre-kindergarten and childcare centres. To evaluate the program, 61 centres were randomly assigned to either receive the HSDS intervention, spanning

6-8 months, or serve as a control, and data was collected before and after the intervention period. The aim of this study was to determine whether the socioeconomic status of families and the location of childcare centres (urban/rural) influenced diet quality, as measured by nutrient density, of children before and after the intervention. **Methods:** Data was collected from childcare centres and pre-kindergarten centres across Saskatchewan and New Brunswick (n=61). We used a modified Nutrient Rich Foods Index (NRF) as a measure of diet quality before and after the intervention in a randomized controlled design. Maternal education and total household income were the indicators used for socioeconomic status. Descriptively, mean NRF scores were calculated and independent-samples T-test and ANOVA statistical tests were used. We used a difference in differences analysis to compare baseline and endpoint results. Currently, analyses are being conducted on the prevalence of inadequacy of micronutrients. **Results:** At baseline, reaching borderline significance, rural centres tended to consume a diet with higher nutrient density (p=.065) than their urban counterparts. For parental socioeconomic status and childcare centre location, at baseline, there were no statistically significant difference of nutrient density in meals between education and income groups. After the intervention, we found that rural childcare centres in the control group had a significantly higher difference in NRF score (-63.6, p=.038) than rural childcare centres in the intervention group. **Conclusion:** Location may play a bigger role than maternal education or parental income on dietary quality in childcare centres.

Assessing the effectiveness of scaffolded abstract critique activities to promote development of scientific literacy skills in undergraduate nutrition education

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Developing scientific literacy (SL) skills is essential to ensure career preparedness in nutritional science trainees. SL encompasses a range of skills including i) distinguishing between scientific and non-scientific sources, ii) comprehending scientific literature, iii) interpreting and integrating scientific data, iv) using scientific knowledge in problem solving, and v) critical thinking and evaluation of the scientific literature. As such, developing and assessing the effectiveness of SL skill acquisition teaching strategies for nutritional science trainees is required. The objective of this study was therefore to determine the effectiveness of scientific literature critique activities to promote SL skill development. Fourth year nutritional science students (n=148) engaged in literature critique activities throughout the semester that included presentation of scientific abstracts followed by structured abstract critiques that were either instructor-led as a large group or in smaller break-out group discussions to practice critical skill development, as well as formal assessment. The following outcomes were surveyed at the beginning and end of the semester: (1) SL skill perception, (2) Test of Scientific Literacy Skills (TOSLS), and (3) job readiness perception. Over the semester, students showed improvements in their perceived capabilities of all SL skill parameters assessed (P<0.05); however, the most significant gains were apparent in the areas of i) knowledge application (specifically identifying novel problems or research questions and using new information to address unfamiliar problems or knowledge gaps), and ii) knowledge translation and communication (translating complex information from the scientific literature into clear and understandable terms). With respect to job readiness, 77% of students strongly agreed that SL is important and 85% strongly agreed that employers expect trainees to demonstrate these SL skills. Importantly, students' perceptions of their SL skill job readiness improved over the semester (P<0.05), wherein initially 31% of students identified as having SL skill levels unprepared for entry into biological science careers, which was reduced to 13% of students at the end of the semester. Collectively, these data demonstrate that literature critique activities can promote a

wide range of scientific literacy skills in nutritional science trainees. (COESP, University of Guelph.)

Guanidinoacetate supplementation to synthesize creatine depends on dietary methionine level in neonatal piglets

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Guanidinoacetate (GAA) is an amino acid derivative and precursor for creatine. Recently GAA has been tested as a supplement in the animal industry. Studies have shown GAA readily converts to creatine, but only when sufficient methionine is available to trans-methylate GAA to creatine in the liver. When pigs are fed GAA with excess methionine, creatine is synthesized without feedback regulation; however, if dietary methionine is limiting, creatine synthesis is limited, yet GAA does not accumulate in plasma or liver. We hypothesized that dietary GAA absorption also depends on sufficient dietary methionine. The objective was to determine the absorption rate and post-absorption fate of GAA supplied in the diet with different methionine levels. 17-21 day old surgically altered sow-fed Yucatan miniature piglets (n=20) were given a 4-hour duodenal infusion of 1 of 4 test diets, with arterial and portal blood measured for metabolites and blood flow to determine mass balance across the gut. Infusions were complete elemental diets with supplemental GAA plus methionine (20%, 80%, 140% or 200% of requirements) and 3H-methyl-methionine to measure methionine incorporation into creatine. After 4 hours, tissue samples were collected. Significantly positive GAA balance across the gut in the 20% and 200% groups indicated GAA absorption and/or GAA synthesis by the gut. 200% methionine pigs had higher GAA absorption (vs 80% and 140% methionine). However, the positive portal balance of GAA with 20% methionine suggests GAA absorption at such low levels of methionine may be enhanced with very low creatine synthesis. Hepatic [GAA] was higher in 20% methionine group compared to 80%, 140%, and 200% groups, suggesting low methionine limited GAA conversion to creatine in the liver (to be confirmed with 3H creatine synthesis rate). Therefore, GAA supplements should be administered with sufficient dietary methionine for better absorption and to facilitate GAA conversion to creatine. Significantly negative GAA balance across the gut in the 80% and 140% groups suggests either no GAA absorption or GAA sequestration by the gut. Supplemental GAA can be used to enhance creatine synthesis and muscle energy capacity, but only with sufficient dietary methionine. (NSERC.)

Contribution of animal- and plant-based protein sources to nutrient intakes among Canadian adults

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Background: Beyond amino acids, dietary protein supplies a range of essential nutrients, including calcium, iron, potassium, and vitamin D. However, protein sources differ in environmental impact. Changes to Canada's Food Guide emphasizing plant-based protein have the potential to shape diets from both nutritional and environmental standpoints. To better comprehend the possible implications of these recommendations, it is crucial to first characterize protein sources as consumed in Canadian habitual diets. **Objective:** Estimate the contribution of protein sources to intakes of nutrients of concern and nutrients to limit among Canadian adults. **Methods:** 24-h recalls from the 2015 Canadian Community Health Survey – Nutrition were used to assess food and beverage consumption among Canadians ≥ 19 y (n=13,616). Foods were classified into protein sources as: 'cereals, grains, and breads', 'dairy', 'red and processed meat', 'poultry and eggs', 'fish and shellfish', 'nuts, seeds, and legumes', 'vegetables and fruit', and 'miscellaneous'. Population ratios were used to determine the percent contribution of protein sources to nutrient intakes and their distribution by eating occasion. Sample weights and bootstrap-

ping were applied to obtain population-wide estimates. **Results:** Top contributors of protein (% \pm SE) were red and processed meat (21.6 \pm 0.55), poultry and eggs (20.1 \pm 0.81), cereals, grains, and breads (19.5 \pm 0.31), and dairy (16.7 \pm 0.38). Dairy contributed the most to intakes of calcium (53.4 \pm 0.61), vitamin D (38.7 \pm 1.01), and saturated fat (40.6 \pm 0.69), whereas cereals, grains, and breads contributed the most to iron (46.5 \pm 0.57) and vegetables and fruit to potassium (32 \pm 0.45). Most energy (28.5 \pm 0.34), sodium (44.7 \pm 0.61), and sugar (46 \pm 0.7) derived from miscellaneous foods and beverages. Protein consumed at breakfast was highest for cereals, grains, and breads (33.9 \pm 0.83) and dairy (25.5 \pm 0.88), whereas lunch and supper were dominated by red and processed meat and poultry and eggs. **Conclusion:** Animal products constituted the majority of Canadians' protein intake, yet apart from dairy, were not top contributors of nutrients of concern. Dairy was also the top source of saturated fat, a nutrient to limit, whereas plant-based protein sources contributed the most to intakes of iron and potassium. Further research is required to quantify the environmental impact of dietary protein sources, while accounting for their contribution to nutrient adequacy. (Financial support: McGill.)

Somatotype measures may be useful in predicting deficits in muscle strength and physical performance in children who have undergone liver transplantation

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Sarcopenia is characterized by deficits in muscle strength, physical performance and muscle mass. While only recently identified in children, sarcopenia may persist for up to 10 years in >40% of children after liver transplantation (LTx). The study aim was to evaluate the usefulness of somatotype measures in predicting deficits in muscle strength and physical performance in children after liver transplant. A total of 22 LTx (11M, 11F) and 47 HC (20M, 27F) and 47 HC (20M, 27 F) were recruited from the Pediatric Liver Transplant Clinics at the Stollery Children's Hospital and community, respectively. Anthropometric variables assessed included weight, weight-z, height, height-x body mass index (BMI), BMI-z, waist circumference, waist-to-height ratio (WHRT), mid-arm circumference (MAC), MAC-z, calf circumference, MAMC and multiple skinfold thicknesses (tricep, tricep-z, bicep, subscapular[SUB], SUB-z, iliac crest, supraspinal, abdominal, calf). Somatotype analysis, muscle strength (handgrip, sit-to-stand, push-ups) and physical performance (6-minute walk test, stair climb test) were performed according to validated methodologies. Somatotype was determined using the Somatotype Software (Sweat Technologies, Australia) which utilizes multiple skin fold thickness/body circumferences to categorize body habitus phenotypes as: ectomorphic (+lean/-fat mass [FM]), endomorphic (+lean/+FM), mesomorphic (+lean with varying FM) and mixed phenotypes (ectomorphic/endomorphic/mesomorphic). Although ht-z was significantly lower in LTx children (-0.19 \pm 1.0 [LTx] vs 0.44 \pm 1.0 [HC]; p=0.02), no significant differences in age (12.1 \pm 3.5 yrs [LTx] vs 12.2 \pm 3.5 yrs [HC]; p=0.87) or wt-z (0.28 \pm 0.8 [LTx] vs 0.11 \pm 1.0 [HC]; p=0.51) were observed between groups. Fifty-three percent of LTx children had combined mesomorph-endomorph or endomorphic-mesomorphic phenotypes and 43% of HC had ectomorphic-mesomorphic with balanced ectomorphic phenotypes (p=0.03). Children with endomorphic-mesomorphic phenotypes performed fewer push-ups and walk distances than children with balanced phenotypes (p=0.04) or children with ectomorphic phenotypes (p=0.003) in both groups. Deficits in muscle strength tests and physical performance tests were predominantly noted in children with phenotypes characterized by higher levels of FM. (endomorph/mesomorph phenotypes). Post-LTx children with endomorphic-mesomorphic

phenotypes could have a higher risk for a sarcopenia diagnosis. (Funded by Graduate Vitamin Fund, University of Alberta.)

Phosphatidylcholine attenuates T cell dysfunction in high-fat diet fed male Wistar rats

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Consuming a high-fat diet (HFD) has been associated with an increased intestinal permeability leading to endotoxin translocation into circulation and contributing to a state of low-grade systemic inflammation observed in obesity. Moreover, a HFD has been reported to decrease T cell function in Wistar rats. Phosphatidylcholine (PC), a form of choline mostly found in eggs, has been shown to improve immune responses early in life. The objective of this study was to determine if adding PC to a HFD can improve T and B cell function in male rats. At 4 weeks of age, male Wistar rats were randomized to one of the 3 complete experimental diets: 1- Control low fat (CLF, 10% wt/wt fat, 100% free choline (FC)); 2- Control High-fat (CHF, 25% wt/wt fat, 100% FC); 3- PC high-fat (PCHF, 25% wt/wt, 100% PC). All diets contained the same amount of total choline differing only in the form of choline. After 9 weeks of feeding, rats were euthanized. Splenocytes phenotypes and ex vivo cytokine production after phorbol 12-myristate 13-acetate plus ionomycin (PMA+I, T cell mitogen) and Lipopolysaccharide (LPS, antigen presenting cells (APC) mitogen) stimulation, were measured by flow cytometry and ELISA, respectively. There were no significant differences in body and organ weight between diet groups. After PMA+I stimulation, splenocytes of rats from the CHF group produced less IL-2 (marker of proliferation) and TNF- α (a Th1 cytokine) compared to CLF and PCHF groups. After LPS stimulation, no significant differences in cytokine production were found among groups. There were no changes in the proportion of total T and B cells, helper and cytotoxic T cells and the expression of CD25+ (IL-2 receptor) among groups. In summary, we confirmed that HFD impairs T cells function in male Wistar rats while having little effect on B cell function and immune cell phenotypes. Our results suggest that providing choline as PC in the context of a HFD can normalize T cell function but has no effect on APC and B cell responses in male Wistar rats. (Supported by Egg Farmers of Canada and NSERC. JAB is supported by scholarship from CONACYT.)

Development and application of a new methodology to estimate free sugars intake in Canada

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Evidence show that intakes of free sugars is associated with a higher risk of dental decay in children and an increased risk of weight gain, overweight and obesity and type 2 diabetes. Most methodologies to estimate free sugars in foods and beverages rely on the presence of an ingredient list of the product. This poses a challenge when estimating the free sugar intake in a population since databases of composite foods, such as the Canadian Nutrient File (CNF) used to analyse population nutrition survey data lack the ingredient list. This study's objective was to develop and apply a methodology to estimate free sugars in the diet of Canadians. Informed by existing methodologies, a multi-step method was developed to estimate the quantity of free sugars in foods and beverages in the CNF. In foods and beverages where all the sugar content comes from free sugars (e.g. 100% fruit juice), free sugars were equated to total sugars. Otherwise equations from existing literature were adapted to estimate the content of free sugars. Free sugars intakes were estimated using the first 24-hour recall data from the 2015 Canadian Community Health Survey - Nutrition (n=19,209) by various demographic groups. The top sources of free

sugars in the diet were also identified. Results show that: 1. In all age and sex groups, the percentage of energy intake (%E) from free sugars exceeds the WHO recommendation (<10%E). The highest values were found in children (9-13y) and adolescents (14-18y), 16%E and 15%E respectively. 2. In both females and males aged \geq 19y, the mean intake of free sugars was 11%E. 3. More than 75% of total daily free sugars intake came from: Sugary beverages: such as regular soft drinks, juices and fruit drinks (42%); Sugars, syrups, preserves, confectionary, desserts (22%); Baked products (13%). These results show that efforts need to be sustained to help Canadians, particularly children and teens, reduce their free sugars intake.

Impact of cooking method on the protein quality of Russet potatoes

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Prior research has found that even though the amount of protein within potatoes is low (average of 2% w/w), due to the high consumption of potatoes in North America, it is estimated that they provide 2-4% of daily protein intake. Thus, potatoes are an important contributor for protein in diets. However, research is limited on the impact of cooking method on the quality of the protein in Russet potatoes, a major potato varietal. The current study was designed to address this knowledge gap. Russet potatoes were secured and subjected to the following cooking conditions (3 replicates per condition): raw, boiled, baked, microwaved and fried (3, 6 and 9 minutes). Following cooking, samples were analyzed for crude protein (%CP) and total amino acids (AA; 3 hydrolysis conditions) by AOAC methods, and in vitro protein digestibility (%IVPD) by pH-stat analysis. In vitro protein digestibility-corrected amino acid score (PDCAAS) values were determined as the product of AAS and %IVPD. For %CP, on an as-consumed basis, with the exception of boiled, all cooking methods yielded higher ($p < 0.0001$) values than the raw samples. (raw=1.85 \pm 0.04; boiled=1.67 \pm 0.04); microwaved=2.99 \pm 0.06; baked=2.44 \pm 0.03; fried 3-minutes=3.07 \pm 0.07; fried 6-minutes=3.87 \pm 0.03; fried 9-minutes=4.77 \pm 0.08). The AAS of raw potato was 0.66 \pm 0.01 with histidine as the first limiting AA. The AAS for the fried cooking methods (fried 3 minutes=0.474 \pm 0.009; fried 6 minutes=0.044 \pm 0.012; fried 9 minutes=0.36 \pm 0.015) as well as baked (baked=0.57 \pm 0.045) were significantly lower than the raw control ($p < 0.05$). The other AAS (boiled=0.675 \pm 0.03; microwave=0.589 \pm 0.008) were not different from raw. Based on 2-way ANOVA, there was a significant ($P < 0.05$) main effect of cooking method on %IVPD except for boiled and fried 9 minutes when compared to raw. (raw=74.1 \pm 0.6; boiled=74.3 \pm 0.5; fried 9 minutes=76.6 \pm 1.7; microwave=78.1 \pm 2.3; baked=79.2 \pm 1.0; fried 3 minutes=78.4 \pm 0.6; and fried 6 minutes=78.0 \pm 0.7) IVPDCAAS was lowest for 9-minute fried potatoes=27.7 \pm 1.8, while boiled=50.2 \pm 0.4 was the highest. To summarize cooking technique can significantly influence protein quality, with longer frying times leading to lower quality scores. Based on the limiting AA profile, potatoes are complementary protein sources to pulses and cereals, however frying can negatively impact potato protein quality. (Funded by Alliance for Potato Research and Education.)

Fatty acid profiles of APOE4 carriers within different lipid classes post omega-3 fatty acid supplementation for 6 months

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Carrying an epsilon 4 allele of the apolipoprotein E gene (APOE4) is the main genetic risk factor for developing Alzheimer's disease (AD). How-

ever, higher blood levels of omega-3 fatty acids (n-3 FA) are associated with lower risk of developing AD. Our group showed that APOE4 carriers had lower blood n-3 FA levels compared to non-carriers post n-3 FA supplementation. This may contribute to higher AD risk since the brain is rich in the n-3 FA docosahexaenoic acid (DHA). The brain takes in n-3 FA in two main lipid esterified forms: lysophosphatidylcholine (LPC) and non-esterified fatty acids (NEFA). Hypothesis: After a six months supplementation with n-3 FA levels of plasma LPC-DHA and NEFA-DHA will not increase in APOE4 carriers as compared to before supplementation. Objective: Evaluate DHA distribution in esterified and non-esterified plasma lipids before and after receiving 1.4 g/d DHA and 1.8 g/d eicosapentaenoic acid (EPA) for six months. Methodology: Men and women were randomized into placebo (n=123) or n-3 FA (n=120) groups. For this study, 24 APOE4 carriers and non-carriers were selected and matched by sex, age and BMI (68% female; average age of 50 years; average BMI ranging from 26-28 kg/m²). Lipids were extracted from fasted plasma collected pre- and post-supplementation. Using thin layer chromatography (TLC), lipids were separated to isolate total phospholipids and NEFA. Total phospholipids were then separated again by TLC. After transmethylation, fatty acid methyl esters were analysed by gas chromatography. Results: We have analyzed 7-15 plasma samples in each group pre- and post-supplementation. Post-supplementation, participants had 85% and 80% higher LPC-DHA and NEFA-DHA levels, respectively, compared to pre-supplementation. LPC- and NEFA-EPA levels were ~3 times higher post-supplementation vs. pre, but were not different between genotypes. Interestingly, there was a gene-by-diet interaction for the percentage of DHA relative to other FA in phosphatidylcholine and phosphatidylethanolamine (p=0.0355 and p=0.0070, respectively). Conclusion: These preliminary results do not support the hypothesis of there being no increase in LPC-DHA and NEFA-DHA in carriers post-supplementation. We will process the remaining plasma samples to confirm these findings. (Funding: CIHR, Chaire CRMUS sur le métabolisme des acides lors du vieillissement, CdRV.)

A lifestyle modification program including higher dairy product intake and exercise is associated with improved global cardiometabolic risk in adolescent girls with overweight/obesity

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Adverse concentrations of blood lipids, pro-inflammatory cytokines and adipokines (global cardiometabolic risk; GCMR) often accompany overweight/obesity, and track strongly into adulthood. Inverse relationships exist between dairy intake, and adiposity and GCMR. Our study aimed to determine whether 12 weeks of increased dairy consumption, with structured exercise training and dietary guidance, promotes favorable changes in GCMR factors in females (11-18 years) with a BMI > 85th centile. Participants were randomized into two groups: exercise plus high dairy (RDa, 4 servings/day; n=23) or exercise plus low dairy (LDa; 0-2 servings/day; n=23). Fasted/resting serum was analyzed pre- and post-intervention for triglycerides (TG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL), glucose, insulin, HOMA-IR, tumor necrosis factor-alpha (TNF α), leptin and adiponectin. GCMR factors were not significantly different across time or between groups (p>0.05). Controlling for change in bodyweight (kg), total body fat (TBF; kg) and percent body fat (%BF) were significantly different over time (TBF: RDa -1.35 \pm 2.22; LDa -1.13 \pm 2.0, p<0.001; %BF: RDa -1.70 \pm 1.66; LDa -1.17 \pm 1.1, p<0.001). TBF and %BF changes were greater in RDa than in LDa (interactions p=0.038, p=0.075, respectively). Correlations (all p<0.05) were found between change in TBF and change in TC/HDL (r=0.61), Leptin (r=0.59), and HDL (r=-0.49) in LDa, and change in Glucose (r=0.49) and HOMA-IR (r=0.49) in RDa. Change in %BF was corre-

lated with change in TC/HDL (r=0.58), adiponectin (r=-0.50), TNF α (r=0.52), LDL (r=0.43) and HDL (r=-0.47) in RDa only. These findings suggest that increased dairy product consumption did not positively or negatively change GCMR in adolescent females with overweight/obesity; however, the associations between changes in adiposity and changes in GCMR factors found only in the RDa group (i.e. glucose, HOMA-IR, adiponectin, TNF α) suggest a combined beneficial effect of exercise and dairy. Thus, the addition of 4 servings/day of dairy foods to lifestyle modification programs of exercise and dietary guidance may improve GCMR. (Dairy Farmers of Canada, Dairy Management Inc.)

Claudin-2 mediates intestinal calcium permeability for optimal bone mineralization in postnatal development

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Infants and children must maintain a positive calcium (Ca²⁺) balance to achieve optimal bone mineral density. Intestinal Ca²⁺ absorption occurs via transcellular or paracellular pathways. The paracellular pathway predominates under conditions of adequate dietary calcium, however, the molecular identity of this pathway and its role in pre-weaned mammals is unclear. Claudins (Cldn) are tight junction proteins conferring selective permeability to epithelia. However, the functional contribution of claudins to selective Ca²⁺ permeability (PCa²⁺) of small intestinal segments has not been defined. Examination of cation claudin expression across development demonstrated greater claudin-2 prior to weaning. We, therefore, used infant mice at P14 and adult mice at 6-8 weeks to elucidate changes in intestinal paracellular Ca²⁺ absorption. PCa²⁺, measured ex vivo via bi-ionic dilution potentials in Ussings chambers, was 50% greater across duodenum and 2-fold greater across jejunum and ileum at P14 compared to 2 months (p < 0.01). PCa²⁺ across jejunum and ileum of Cldn2 knockout (KO) mice was 50% less than wild-type (WT) at P14 and, in contrast to WT animals, no longer different than at 2 months (p < 0.01). We further observed decreased bone volume by 15% (p < 0.05), cross-sectional thickness by 17% (p < 0.01), and bone mineral density by 5% (p < 0.05) in P14 Cldn2 KO mice. A 10-fold increase in active, transcellular Ca²⁺ absorption across the small intestine of Cldn2 KO pups was measured (p < 0.05) suggesting compensation for decreased PCa²⁺. To elucidate the mechanism regulating Cldn2 expression and greater Ca²⁺ absorption, mice were weaned early from breast milk. Compared to suckling littermates, expression of Cldn2 in the jejunum and ileum decreased by 50% in weaned pups (p < 0.01). Younger mice have increased intestinal Ca²⁺ permeability mediated by claudin-2. This pathway contributes to a positive calcium balance enabling normal bone mineralization during postnatal development. (Funded by NSERC, WCHRI supported by the Stollery Children's Hospital Foundation, Alberta Innovates, Vanier CGS, DMRC, DFG.)

Type 2 diabetics have lower muscularity and higher central adiposity compared to individually sex-, age-, and BMI-matched healthy controls

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Visceral adiposity is a risk factor for type 2 diabetes, and intramuscular lipid deposition may contribute to impaired glucose metabolism. However, the pattern of muscle and fat distribution, and its relationship to metabolic function, has yet to be characterized in individuals with type 2 diabetes. The objective of this study was to compare whole body and site-specific muscle and fat quantity between type 2 diabetics and a matched, healthy reference group. We recruited 12 partici-

pants ≥ 18 years with type 2 diabetes who were individually matched to 12 non-diabetic participants for sex (male/female), age (± 5 years) and BMI (± 2.0 kg/m²). All participants received a whole-body dual-energy X-ray absorptiometry scan to measure whole body and regional lean and fat mass. Skeletal muscle index (SMI; appendicular lean mass/height²) was compared with previously published sex-specific cut-points to identify low muscularity. All participants also received an ultrasound assessment to measure muscle thickness at the abdomen (3-5cm right of the umbilicus) and anterior right thigh (midway between the anterior superior iliac spine and the base of the patella). Groups were compared using paired t-tests. Participants with type 2 diabetes were 10 \pm 8 years (mean \pm SD) post-diagnosis. There was no difference in age (72 \pm 7 vs. 73 \pm 6 years, $p=0.56$) or BMI (27.7 \pm 4.4 vs. 27.6 \pm 3.8 kg/m², $p=0.68$) between the type 2 diabetes and reference groups. Although whole body lean mass (50.1 \pm 9.6 vs. 48.9 \pm 7.1 kg, $p=0.57$) and SMI (7.23 \pm 1.0 vs. 7.4 \pm 0.9 kg/m², $p=0.51$) were not different between groups, SMI was below previously published sex-specific cut-points in 4 diabetic participants (versus only 1 reference participant). Despite similar BMIs, diabetic participants had significantly greater whole body (27.6 \pm 7.0 vs. 24.5 \pm 7.2 kg, $p=0.02$) and trunk (15.8 \pm 4.1 vs. 13.4 \pm 5.0 kg, $p=0.02$) fat mass compared to the reference group. Ultrasonography revealed significantly thinner abdominal muscles (0.72 \pm 0.16 vs. 0.87 \pm 0.13 cm, $p=0.01$) in participants with diabetes compared with the reference group; however, anterior thigh muscle thickness was similar between groups (3.45 \pm 0.76 vs. 3.53 \pm 0.61 cm, $p=0.71$). Future work should investigate whether the co-occurrence of low muscularity and central adiposity is accompanied by reduced muscle quality (indicative of metabolic health and physical function) in this clinical population. (Funded by CIHR and NSERC.)

Consumption of pulse-based meals affects body composition among sedentary office workers: Preliminary results of a randomized clinical trial

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Sedentary office workers are at risk of developing health-related problems associated with long periods of sitting. Previous studies have shown that pulse-based meals (i.e. meals containing chickpeas, lentils, beans, or peas), which are low in glycemic index, are effective for alleviating cardiovascular disease risk factors with improvements in body composition. The main goal of our study is determining whether improvements in cardio-metabolic health can be realized by providing pulse-based meals to office workers. Using a randomized, single-blind, crossover design participants (n=19) were randomly assigned to either: A pulse-based diet to replace their regular workplace meals OR their regular diet for 2 months, followed by a one-month washout and then a cross-over to the other diet for 2 months. Body composition (by dual energy X-ray absorptiometry), waist circumference (WC), body weight, body mass index (BMI) and blood pressure were assessed before and after each of the two diet phases. Differences between the pulse-diet phase and the control phase were body weight (-0.2 kg), BMI (-0.1 kg/m²), WC (-0.1 cm), systolic blood pressure (-0.5 mmHg), diastolic blood pressure (-1.0 mmHg), fat mass (-0.4 kg), % fat (-0.5%), and lean tissue mass (+0.2 kg). No statistically significant differences were apparent for any of these changes between diet phases; however, using effect size cut-offs of less than 0.2 (trivial), 0.2 (small), 0.5 (medium), 0.8 (large), the effect sizes for fat mass (0.31) and %fat (0.35) were between small and medium. According to effect size calculations, the pulse diet had a small to medium beneficial effect on fat mass and percent fat with little effect on other measures, including waist circumference and blood pressure. (Funded by Weston Foundation, Saskatchewan Pulse Growers, and Saskatchewan Agriculture Development Fund.)

Barriers to and facilitators of the implementation of a culinary education program for parents and preschool children

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In Canada, young children (2-8 years) are not likely to meet their recommendations for vegetables and fruits. Participation in culinary education programs have been proven as an effective strategy to increase young children's acceptance of different foods; however, few programs have engaged young children. The Food Literacy Intervention Program (FLIP) is a cooking program based on formative research that targets preschool children and their parents. In this study, we aimed to identify barriers and facilitators affecting the implementation of culinary programs to this age group. The FLIP program consisted of three 90-minute cooking sessions delivered to families (n=48) with preschool children. A total of twenty-four sessions were delivered in a home economics classroom at a public school in Edmonton, Alberta from May-November 2019. Program staff facilitating the sessions included trained health mentors (dietitians, graduate and undergraduate nutrition students) and trained volunteers. Sessions addressed topics about healthy eating, role modelling, and picky eating. Participants prepared two vegetable-based child-friendly recipes. Staff (n=25) completed questionnaires about their observations of each session and their overall appraisal of the program. Responses were analyzed using thematic analysis by two researchers that reached consensus at each step. The facilitators to implementing this program were (1) pre-planning and organization, (2) group size and dynamics, (3) effective teaching strategies that enhance engagement and participation, (4) enjoyable family-friendly recipes, (5) fun and positive family environment, (6) constant support, learning and improvement among staff and (7) multiple cooking sessions which improved engagement and comfort of participants. Barriers included, (1) changes in timing, (2) some recipes were better received than others, (3) instructions easily forgotten by participants, (4) family dynamics already established, and (5) participant's engagement varied. Overall, the program was a positive experience for participants and staff involved. Future culinary programs targeting young children can build on the facilitators and address the barriers early in the planning process to increase the chances of positive experiences and successful outcomes. (Financial support: Bayer Fund.)

Satisfaction of parents with a multi-component Food Literacy Intervention Program (FLIP) targeting preschoolers

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Low consumption of vegetables by preschoolers is a worldwide problem. Pre-schoolers' intake of vegetables is largely influenced by availability, appearance, and context for eating them. Repeated exposure to vegetables is one effective strategy for increasing vegetable intake. However, exposure to vegetables may be limited by parents' lack of confidence in preparing vegetables and misperceptions about children's preferences. Nutrition education opportunities to address those gaps are constrained by parent's limited interest and availability. Providing a family-centred and multi-component program can increase parent's engagement. In this study, parents' satisfaction with the Food Literacy Intervention Program (FLIP) was assessed. FLIP components (cooking sessions and online components) were informed by parent's preferences towards nutrition education and the Social Cognitive Theory. Families (n=50) enrolled in three 90-minute cooking sessions delivered on weekends in Edmonton, Alberta. Trained health mentors (dietitians and dietetic students) led the sessions, which ad-

dressed healthy eating, role modelling and picky eating topics, and guided the preparation of two vegetable-based child-friendly recipes per session. Parents received cooking session summaries and nutrition information through e-newsletters and FLIP social media platforms. All families received children's cooking kits, recipe books and session booklets, beyond other incentives. Satisfaction data was collected using a secure web-based platform (REDCap). Forty-eight families (96%) attended the cooking sessions. The majority of parents enrolled were female (96%) with a bachelor's degree and above (68%). About 78% (n=39) answered the program evaluation. Several parents liked or liked very much the session time of the day (34;87%), length (37;95%) and the number of recipes prepared (36;92%). Recipe satisfaction ranged from 49% (n=19) to 88% (n=34). On average, the majority of parents were satisfied or very satisfied with health mentor's knowledge (95%), preparedness (97%), teaching (95%) and engagement (96%) strategies, and relating program content to practical situations (93%). The session booklets (39;100%;36;92%) and recipe book (38;97%;34;89%) were the most accessed and liked resources, respectively, followed by newsletters (30;77%;24;80%), Facebook (30;77%;23;77%), FLIP website (30;77%;20;67%), and Instagram (20;51%;9;45%). FLIP, as one of the few programs of its kind, is a promising approach to increase both parents' engagement and preschoolers' consumption of vegetables. (Financial support: Bayer Fund.)

Nutrition and mental health during the menopausal transition and post-menopause: a scoping review

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Background: Depression and comorbid psychiatric disorders (e.g., anxiety) are twice as prevalent in women as in men. This female bias becomes apparent at puberty and persists through adulthood, with an amplified vulnerability observed at periods of important hormonal changes. With the increased recognition of the role of nutrition in the prevention and management of mood and anxiety disorders, a scoping review was conducted to identify studies assessing the relationships between nutrition-related variables and mental health in women during the menopausal transition and post-menopause. **Methods:** The protocol for this scoping review was conceived following the framework developed by Arksey & O'Maley (2005; *Int. J. Soc. Res. Methodol.* 8(1):19-32) and the guidelines of Peters et al. (2015; *Int. J. Evid. Based Healthc.* 13(3):141-146). Medline, EMBASE, PsycINFO, and Food Science and Technology Abstracts databases were systematically searched. A search for ongoing clinical trials and backward citation tracking of included articles was also performed. Articles were screened and evaluated for inclusion by two authors. The quality of included studies was assessed with the National Heart, Lung, and Blood Institute Quality Assessment Tool (observational studies) and the Cochrane Collaboration's tool for assessing the risk of bias (experimental studies). **Results:** Out of 1,297 non-duplicate publications, 20 studies (14 observational, 6 experimental) were included in this review. Nutrition-related variables were: dietary patterns (n=5); vitamin D intake and supplementation (n=4); omega-3 fatty acids intake, status and supplementation (n=3); soy products and phytoestrogens intake, status and supplementation (n=3); eating behaviors (n=2); legume intake (n=1); folate and vitamin B12 status (n=1); and magnesium, zinc, calcium, copper, and iron status (n=1). Dietary patterns included: glycemic index; dietary total antioxidant capacity; processed food-, animal food- and plant food-dominated diets; low-fat diet; and DASH diet. Mental health-related variables were: depression/depressive symptoms (n=17); psychological well-being (n=6); psychological stress (n=4); energy levels/fatigue (n=4); emotion regulation (n=3); social functioning (n=2); difficulty concentrating (n=2); anxiety (n=1); self-esteem (n=1); and anger (n=1). Observational studies were of poor (n=9) or moderate (n=5) quality, while half (n=3) of experimental studies were at low and high risk of bias, respectively. **Conclusion:** Overall, this review identified a limited number of studies with highly heterogeneous objectives and important methodological limitations, supporting the need for further high-quality research on the topic.

Can diet-related behaviors and nutritional quality indices be mixed into an adherence scale reflecting new dietary guidelines in Canada? A preliminary demonstration

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Introduction: The 2019 edition of Canada's Food Guide (CFG-2019) provides guidance on food choice, but also on eating habits. No scale to assess adherence to CFG-2019 is currently available. One of the challenges in developing such scale relates to the difficulty in mixing both behavioral (ordinal data) and diet quality components (continuous data). Our objective was to explore the feasibility of creating a scale by mixing behavioral and diet quality components. **Methods:** Data collected as part of the cross-sectional PREDISE study (conducted in 2015-17) were used. PREDISE is based on an age- and sex-representative sample of 1147 respondents from five regions of the province of Québec in Canada. Respondents completed three web-based 24-hour recalls and questionnaires pertaining to eating habits and behaviors on the web. 1019 participants had a clinical assessment permitting calculation of a metabolic syndrome Z-score. A modified version of the Healthy Eating Index 2015 was used as a measure of diet quality based on metrics reflecting CFG-2019 recommendations (i.e., vegetables and fruits, whole grains, protein foods, fatty acids, sodium, saturated fats, added sugars). The four eating behaviors recommended in CFG-2019 that were measured in PREDISE were intuitive eating, cooking more often, enjoying foods, and meal sharing. Data on diet quality and behaviors were standardized and summed, each accounting for 50% of the total adherence score. **Results:** Internal consistency among the seven diet quality components and four behaviors was reasonable (Cronbach's alpha=0.61). Intuitive eating, meal sharing, and sodium were the least consistent items within the total adherence score. The total adherence score was inversely correlated with metabolic syndrome ($r=-0.24$; $P<0.0001$). However, the behavior subscore showed a slightly stronger correlation with metabolic syndrome than the diet quality subscore ($r=-0.25$ vs. -0.17 ; $P<0.0001$). Removal of the least consistent items in the total score increased Cronbach's alpha (0.69) and slightly lowered correlation with metabolic syndrome ($r=-0.19$). **Conclusion:** This preliminary analysis suggest that subscales of behaviors and diet quality may be successfully combined using a simple addition. The choice of using a score entirely consistent with CFG-2019 recommendations or with a greater internal consistency may influence the quality of the overall metric.

Nationwide survey on pediatric malnutrition management in Canadian tertiary hospitals: what happens after discharge?

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Objectives and study: Disease-associated malnutrition (DAM) in children is multifactorial and usually requires an intervention post hos-

pital stay. Current literature has focused mainly on what happens during hospitalization. The aim of this report is to outline current discharge practices and follow-up protocols for the management of DAM in Canada. Methods: An electronic survey (English and French) was sent to the lead dietitians of all tertiary paediatric hospitals in Canada, and disseminated to nurses (RN) and medical doctors (MD) of each hospital division except emergency and critical care. The survey addressed all pillars of malnutrition care; screening, assessment, treatment, monitoring and follow-up of hospitalized children. Results: A total of 120 responses (69 MD, 32 RD, 19 RN) were collected from 15 different hospitals. Overall, 68.3% of participants responded to $\geq 75\%$ of questions, with a significantly higher response rate per question in MD's compared to RD's and RN's ($p=0.002$). An overarching protocol for DAM was known to be present or in development according to 11.5% of respondents. Nutritional status information was provided in the discharge letter routinely according to 30.8% MD's and 17.6% RD's, whereas 59.6% and 70.6% respectively, believed this was done only in case of a poor nutritional status (distribution of all responses: MD vs RD: $p=0.010$). For children with poor nutritional status, nutritional care was sometimes/never transferred to another professional for follow-up according to 48.5% (no difference across professions; $p=0.852$). Most important barriers for transfer of nutrition care were lack of referral staff and low medical staff awareness on the role of nutrition on patient care (both: MD: 35/43, RD: 14/18). The most frequent choice for referral was to an outpatient RD (29.2%), paediatrician or clinic (both 20.0%). Conclusion: The presence of a standardized protocol for the clinical assessment and management of DAM is uncommon in paediatric tertiary care hospitals in Canada. There is a lack of standardized discharge communication and half of respondents claimed that children with DAM infrequently get nutritional follow-up after discharge. These survey results will be used to raise awareness about DAM in Canadian paediatric hospitals and help create a National nutrition care pathway.

Prospective study of eating habits as a predictor of incident type 2 diabetes hospitalization and mortality: the 2004 Canadian Community Health Survey

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Eating habits such as skipping breakfast and snacking are increasingly common practices among North American adults; however, their long-term effects on incident type 2 diabetes mellitus (T2DM) outcomes remain unknown. Previous studies of breakfast skipping and/or eating frequency and cardiometabolic risk have suggested plausible biological pathways for either a protective or harmful relationship to exist, especially when other cardiometabolic risk factors such as hypertension and obesity are present. The objectives of this study were to assess whether long-term associations exist between eating habits (skipping breakfast and eating frequency) and incident T2DM (hospitalization and mortality risk), and whether these are intensified by the presence of cardiometabolic risk factors. Skipping breakfast (yes/no) and eating frequency (times/day) were assessed via a 24-hour dietary recall in a nationally representative sample of 13,691 adults (aged ≥ 18 years) in the 2004 Canadian Community Health Survey (CCHS) who were free of T2DM and cancer. Data from the CCHS were linked to the population-based Discharge Abstract Database and Canadian Mortality Database to determine the incidence of T2DM hospitalization and mortality in the subsequent 9 years. Multivariable

Cox proportional hazards models were used to estimate hazard ratios (HR) and 95% confidence intervals (CI). During follow-up, 407 cases of T2DM hospitalization and mortality were documented. Skipping breakfast was not associated with risk of T2DM hospitalization and mortality in all participants together (multivariable-adjusted HR=1.09, 95% CI: 0.75-1.58) or within baseline risk factor subgroups (hypertension: $n=2529$; 0.66, 0.32-1.38; body mass index (BMI) ≥ 30 kg/m²: $n=2811$; 1.37, 0.87-2.15). Similarly, eating frequency was not associated with risk of T2DM hospitalization and mortality in all participants together. However, compared with eating 3-5 times/day, eating ≤ 2 times/day was associated with increased risk of T2DM hospitalization and mortality within participants without hypertension (2.13, 1.15-3.93) and who had BMI ≥ 30 kg/m² (2.04, 1.00-4.17). Skipping breakfast was not associated with either an increased or decreased risk of T2DM hospitalization and mortality in this cohort of Canadian adults. However, eating frequency was associated with T2DM hospitalization and mortality within those without hypertension and who had BMI ≥ 30 kg/m². (Funding: Nova Scotia Health Research Foundation, Nova Scotia Health Authority Research Foundation.)

Pre-existing type 1 and type 2 diabetes during pregnancy lowers umbilical cord omega-6 long-chain polyunsaturated fatty acid concentrations

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The third trimester of pregnancy is a period of rapid accretion of long-chain polyunsaturated fatty acids (LC-PUFA). Omega-3 (n-3) and omega-6 (n-6) LC-PUFAs are important for fetal nervous system development. Since fetal LC-PUFA synthesis is limited, LC-PUFAs must be transferred from maternal to fetal circulation via the placenta. It is well established that LC-PUFA transfer is lower in pregnancies complicated by gestational diabetes mellitus. However, little is known about LC-PUFA transfer in pregnancies complicated by pre-existing type 1 or type 2 diabetes (T1D; T2D). We hypothesize that n-3 and n-6 LC-PUFA transfer from mother to fetus is lower in pregnancies complicated by T1D and T2D. Objective: Evaluate whether concentration and relative percentage of n-3 and n-6 LC-PUFAs are different in the maternal plasma, placenta and umbilical cord serum and whole blood of diabetic and non-diabetic (ND) mothers. Methodology: Pregnant women with T1D and T2D ($n=7$) and ND women ($n=25$) were recruited. Fatty acid profiles of maternal plasma, cord blood and placenta (decidual and chorionic sides) from 14 ND and 6 diabetic mothers were determined by gas chromatography. Results: Umbilical cord serum n-6 LC-PUFA concentration was 21% lower in the diabetic vs ND group ($P<0.05$). There was a trend towards ~ 20 -25% lower linoleic and arachidonic acid concentrations in diabetic cord serum ($P=0.054$ and $P=0.059$). While there was no difference in overall cord serum n-3 LC-PUFA concentration, there was a trend towards 21% lower docosahexaenoic acid (DHA) in diabetic cord serum ($P=0.064$). Interestingly, docosapentaenoic acid relative percentage was 11% higher in chorionic side of the placenta in the diabetic group ($P<0.05$). Similarly, there was a trend towards 32% higher eicosapentaenoic acid (EPA) relative percentage in decidual side of the placenta in the diabetic group ($P=0.053$). Our preliminary results also suggest that higher EPA in decidual side is associated with maternal plasma EPA ($R^2=0.7433$). Unexpectedly, palmitic acid concentration was 19% lower in diabetic cord serum vs the ND group. Conclusion: These preliminary results suggest that LC-PUFA transfer from mother to fetus may be dysregulated in diabetic pregnancies. We will analyze the remaining participant samples in order to confirm these results. (Diabète Québec, CIHR.)

Pharmacokinetics of a new omega-3 fatty acid supplement esterified in monoacylglycerol: A cross-over randomised controlled trial.

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Canadians have low plasma concentrations of docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) omega-3 fatty acids (n-3 FA). Taking n-3 FA supplements is an easy way to remedy this situation. However, n-3 FA supplements are available on the market in various forms such as triglyceride (TG) and ethyl ester (EE), and it is difficult for consumers to understand which form is the best. Unlike TG and EE forms, the monoacylglyceride (MAG) form of n-3 FAs are essentially predigested and do not require exposure to lipase in order to be absorbed. The objective of this study is to compare the 24h pharmacokinetics of plasma n-3 FA after a single oral dose of predigested n-3 FA esterified in MAG or esterified in TG or EE. We hypothesize that MAG is better absorbed and have less side effects than TG and EE commercial forms. Methodology: A randomized, cross-over double-blind controlled trials (RCT) with a wash-out period of 7 days or more between treatments was performed on 22 people aged between 18-50 years old. Participants received an oral dose of 666mg of EPA and 269mg of DHA esterified in TG, EE or MAG. Blood samples were collected before the single dose of n-3 FA (t = 0) and at the following time points: 1, 2, 4, 5, 6, 8, 9, 10, 12, and 24 hours. Lipids were extracted from the plasma, methylated and analyzed by gas chromatography. Results: Participants were on average 28 ± 6 years old and had a BMI = 24.5 ± 4.0 kg/m². EPA+DHA concentration peaked at 2.7 mg/dL when provided in MAG. A similar concentration was reached when an oral dose of 3000 mg EPA+DHA in EE (3 times the current dose) was provided. Additionally, with MAG form, the maximum plasma concentration of EPA+DHA was reached 2 to 3.5 hours faster than with the EE and TG forms (P=0.04, P=0.01). Conclusion: This study shows that it takes 3x more EPA+DHA in EE to reach a similar plasma concentration as compared to when a MAG form is provided. (Neptune Wellness Solution.)

High protein intake in fathers peri-conceptually alters body composition, insulin sensitivity and gut microbial composition in adult offspring

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Background: There is growing evidence demonstrating that paternal diet peri-conceptually programs differences in offspring metabolism. Here we examined whether paternal high protein (HP) or high fat/sucrose (HFS) intake alters energy intake, body composition, insulin sensitivity, and gut microbiota composition intergenerationally. Methods: Male Sprague Dawley rats were weaned at 3 weeks of age and randomized to control, HP diet (40% wt/wt) or high fat, high sucrose diet (HFS) for 9 weeks until they reached sexual maturity. They were mated with virgin female rats until pregnancy was confirmed. Offspring were weaned onto control diet and followed until 16 weeks of age. Body composition (using DXA), food intake, an insulin tolerance test, and gut microbial composition using high-throughput 16S rRNA sequencing technology were measured in fathers and adult offspring. Results: Paternal HP intake peri-conceptually reduced total weight (p=0.02), fat weight (p=0.002) and % body fat (p<0.001) in fathers, compared to HFS and controls and was mirrored in male and female offspring (p<0.05). Male offspring from HP fathers had 13% less fat mass compared to controls and 31% less than HFS offspring. Female

offspring from HP fathers had 38% less fat mass than HFS offspring. HP fathers consumed 16% less energy than controls and 27% less than HFS but no difference in food intake was seen in offspring. There was no difference in paternal insulin tolerance, however, male (p=0.04) and female (p=0.001) offspring from HP fathers exhibited improved insulin sensitivity compared to controls and HFS offspring. Paternal HP intake resulted in a direct increased relative abundance of Lachnospiraceae, Ruminococcaceae_UCG_005 and Ruminococcus_2, as well as a concurrent reduction in Clostridium cluster 1 compared to HFS or control. Female HP offspring exhibited higher alpha diversity (Shannon and Simpson index) compared to controls (p<0.01) as well as elevated Lachnospiraceae_NK4A135 relative abundance. Male and female HP offspring showed an increase in Akkermansia relative abundance compared to HFS and controls. These findings demonstrate that paternal HP intake peri-conceptually improves gut microbial composition and reduces the risk of overweight, obesity and metabolic disease intergenerationally. (Funding: NSERC.)

A polyphenol-rich cranberry extract enhances weight loss while decreasing circulating persistent organic pollutants

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Persistent organic pollutants (POP) are a category of environmental contaminants that can biomagnify along the food chain and bioaccumulate over time in adipose tissue. They are known for their deleterious effects on reproduction, cancer development and metabolic health. The main exogenous exposure is through consumption of contaminated foods, such as fish, but endogenous exposure may also occur after weight loss, especially in people with obesity, since the liposoluble pollutants are released from the adipose depots that stored them. In this study, we evaluated the impact of a polyphenol-rich cranberry extract on weight loss-induced POP release in the circulation in diet-induced obese mice. We hypothesized that the cranberry extract has a positive effect on body detoxification through reshaping the gut microbiota and limiting the deleterious effect of POP exposure. We observed a greater weight loss in the obese mice treated with the cranberry extract, without enhancing POP levels in the circulation. Furthermore, the cranberry extract significantly lowered fasting glycemia and tended to improve glucose tolerance while modulating gut microbiota composition. This study supports the concept that polyphenol can help reduce the risk of weight loss-dependent POP exposure through their detoxification effect that may be linked to their impact on the gut microbiota.

Supplementing arginine and citrulline to parenteral nutrition to enhance intestinal recovery

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Parenteral nutrition (PN) is a means by which nutrients are delivered directly to the blood via intravenous infusion and is necessary when infants cannot tolerate oral feedings. Although lifesaving, prolonged PN leads to reduced blood flow to the gut, gut atrophy and reduced protein synthesis. The atrophied gut reduces the intestinal synthesis of arginine, a key amino acid required for regulation of blood flow via nitric oxide production, protein synthesis and creatine synthesis. Supplemental arginine to PN can increase arginine availability, but is rapidly broken down by the liver and not available to the rest of the body. Citrulline, the precursor to arginine, is a potential alternative

strategy to enhance arginine availability since citrulline bypasses liver breakdown. We hypothesized that citrulline supplementation to PN will enhance arginine availability, increase blood flow to the gut and increase protein synthesis more effectively than arginine supplementation. 7-10 day old Yucatan piglets received one of three nutritional interventions: control PN, arginine supplemented PN, or citrulline supplemented PN for six days. Blood flow to the gut was assessed using an ultrasonic probe surgically placed on the superior mesenteric artery and protein and creatine synthesis were measured using isotope kinetics. Parenteral feeding resulted in reductions over time in arterial blood flow through the superior mesenteric artery in all piglets ($p=0.009$ control diet, $p=0.04$ high arginine diet, $p=0.039$ citrulline diet). Compared to the control PN treatment, supplemental arginine or citrulline did not mitigate the reductions in blood flow to the gut, suggesting that supplemental arginine or citrulline did not increase nitric oxide synthesis via nitric oxide synthase. Moreover, daily growth rate and gut morphological parameters were not different among the three treatment groups, indicating that supplemental arginine and citrulline did not influence growth or gut morphology. Although it appears supplemental arginine and citrulline did not enhance arginine availability for nitric oxide synthesis, it is possible arginine was more available for its other functions, such as protein or creatine synthesis, and these data are forthcoming. (Janeway, CIHR.)

Women in Alberta are surpassing iron intake recommendations during pregnancy

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Background: Iron is an important nutrient during pregnancy as it is required for expanding maternal red blood cell mass and for the growth and development of the fetus. Inadequate iron intake can result in the development of iron deficiency anemia, which is associated with adverse pregnancy and birth outcomes. To meet iron needs, it is recommended that women consume 27 mg of iron/day from diet and supplements. How much iron Canadian women consume is not known. The aim of this study is to describe the contributions of diet and supplements to total iron intake in a cohort of pregnant women who participated in the Alberta Pregnancy Outcomes and Nutrition (APrON) study. Methods: Diet and supplement information was collected during each trimester from pregnant women in the APrON study, a prospective cohort study. Dietary iron intake was collected using 24-hour recalls and calculated using Food Processor. Iron intake from supplements was collected using questionnaires and iron content was determined using the Licensed Natural Health Product Database and manufacturer's websites. Descriptive statistics were calculated using Excel. Results: Data was included from women who provided both diet and supplement information in the first (T1; $n=535$), second (T2; $n=2043$) and third trimester (T3; $n=1753$). The average iron intakes from food (mg/d) were 14.2 ± 5.7 in T1, 15.1 ± 6.0 in T2 and 15.5 ± 6.0 in T3. Non-heme iron made up 89%, 84% and 87% of total iron intake, in T1, T2 and T3 respectively. In all trimesters ~95% of women were taking iron-containing supplements. The average intakes of supplemental iron (mg/d) were 23.7 ± 17.3 in T1, 27.2 ± 20.0 in T2 and 34.0 ± 28.4 in T3. The average intakes of supplemental and dietary iron (mg/d) combined were 38.0 ± 18.8 in T1, 42.3 ± 21.1 in T2 and 49.5 ± 28.9 in T3. With diet and supplements combined 20%, 31% and 42% of women exceeded the Upper Limit of 45 mg/day in T1, T2 and T3 respectively. Conclusion: Very few women in the APrON study were meeting iron recommendations from food alone. However, nearly all the women were taking iron-containing supplements which led to most women exceeding the recommendations. (Funded by Alberta Innovates Health Solutions.)

Diet simulations are an important component of developing gluten free food guide recommendations for children with Celiac Disease

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The gluten free diet (GFD) has become a highly popularized diet for its perceived health benefits and for health indications such as the treatment of Celiac Disease (CD). While potentially the GFD can be a nutritious dietary pattern, increasing reliance on processed and packaged GF food choices, has resulted in high fat/sugar and low micronutrient intakes in children consuming the GFD. Currently there are no evidenced based nutrition guidelines for the GFD. The study purpose was to develop a GF-food guide (GFFG) for Canadian children by simulating different GF diet patterns. A total of 1200 GF diet simulations were developed for children in different age groups (4-8 yrs; 9-12 yrs; 13-18 yrs). Dietary intake data from Canadian children with CD ($n=250$) were modified to ensure that simulated meal patterns were modelled after the Mediterranean diet pattern, adjusted for ethnic food choices, and for the appropriate number of age-appropriate food servings (Alberta Nutrition Guidelines for Youth and children). Simulations included diet patterns reflective of ethno-diversity of the Canadian population and CD diagnosis (South/South-East Asian ($n=3$), East Asia ($n=1$), Middle East ($n=1$), Northern Africa ($n=1$), European ($n=2$), First Nations ($n=1$)). Simulations also included lacto-ovo vegetarian, vegan, lactose-free patterns based on pre-guide stakeholder feedback. Nutritional adequacy of dietary simulations were assessed by a) diet quality (DQ) index scores (Mediterranean Diet Scores [Kid-Met] and Healthy Eating Index Scores [HEI-C]) indicative of 'good nutritional quality' and b) comparison of micronutrient content in each simulation to estimated average requirements (EAR) and recommended dietary allowance (RDA) for age-sex. KIDMED and HEI-C scores were indicative of high DQ in 100% and 93.5% of menu simulations respectively. Macronutrient distributions ($20.9\pm 2.2\%$ protein, $28.1\pm 2\%$ fat, $52\pm 3\%$ carbohydrate) were not significantly different between simulated diet patterns ($p>0.05$). With the exception of vitamin D, GF-simulations met 100% EAR and 80-100% RDA for all micronutrients for age-and-sex. Although a GFFG can help Canadian children consuming the GFD to consume nutritious diets, vitamin D remains a nutrient of concern. Future steps include feasibility analysis of GFFG content with end-stake holder users (health professionals, members of the community living with CD). (MCYN-SCN, DON-SCN, AHS.)

Does a high FODMAP diet influence perceptions of gastrointestinal pain, diet quality and health-related quality of life in children with chronic mild gastrointestinal complaints?

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Adults with chronic gastrointestinal pain often experience abdominal pain, bloating and diarrhea, attributed to intake of carbohydrates known as FODMAPs (Fermentable Oligosaccharides, Disaccharides, Monosaccharides, Polyols). Little is known regarding the efficacy of low FODMAP diets and whether this impacts health related quality of life (HRQOL) and gastrointestinal (GI) symptoms in children with chronic abdominal pain. The study objective was to a) compare FODMAP intake and diet quality (DQ) in GI children and in age-sex matched healthy children (HC) and to b) evaluate the associations between FODMAP intake with gastrointestinal symptoms, DQ and HRQOL. We hypothesized that FODMAP intake would be significantly

higher in GI children than HC and associated with reduced DQ, HRQOL and increased gastrointestinal pain. DQ (Healthy Eating Index-children [HEI-C], FODMAP intake (amount/type)) were evaluated from 24-hour recalls (weekend/weekday) in children 5-18 years (n=46 GI; n=46 HC) using validated methodologies. GI pain (PedsQL GSS 1.0; lower scores indicative of greater GI symptoms), HRQOL (PedsQL 4.0 parent-proxy/child) and DQ were compared with FODMAP intake in GI children only. Socio-demographic (sex, ethnicity, child/maternal/paternal age) and anthropometric (weight-z, height-z) data was collected. No significant differences in age (11.9 ± 3.4 [GI] vs 12.1 ± 3.3 [HC] yrs; $p=0.9$), weight-z (0.1 ± 1 [GI] vs 0.5 ± 1.4 [HC]; $p=0.16$) or height-z (0.4 ± 1 [GI] vs 0.6 ± 1.7 [HC]; $p=0.6$) occurred between groups and GI children had significantly lower DQ than HC (59 ± 12.2 [GI] vs 66 ± 11.1 [HC]; $p=0.01$). This was characterized by a greater percentage of high FODMAP foods ($38.4 \pm 13.2\%$ [GI] vs $29.3 \pm 14.2\%$ [HC]; $p=0.002$) consumed, particularly high fructose/sugary snack foods (1 ± 0.3 servings/d[GI] vs 0.5 ± 0.2 [HC] servings/d; $p=0.02$). High FODMAP intake was associated with lower GSS scores (5.2 ± 2.1 [low GSS] vs 6.3 ± 2.1 [high GSS] serving/day; $p=0.02$), but was not related to DQ or HRQOL. In conclusion, children with GI pain had lower DQ than HC, characterized by higher intakes of high FODMAP foods related to consumption of sugary snack food, rather to FODMAPs found in fruits/vegetables or other foods. High FODMAP intake influenced GI-symptoms, but was not directly related to HRQOL and/or DQ. (Canadian Celiac Association.)

Dietary patterns and nutrient levels of patients post-bariatric surgery

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Background: Given the restricted and malabsorptive nature of bariatric surgery, nutrient imbalances can easily manifest. Therefore, it is important to understand the diets of patients post-bariatric surgery. **Objective:** To describe the dietary intake patterns of patients 6 months post-bariatric surgery and their implications on blood markers of nutritional status. **Methods:** Bariatric surgery patients from the REsearch on Bariatric care for Obesity tReatmeNt (REBORN) cohort were recruited from the CIUSSS-NIM, QC. At six months post-surgery, participants (n=95) had clinical blood measurements and completed seven day diet questionnaires from the Canadian Health Measures Survey. **Results:** Fruits and vegetables were eaten on average 1.5 x/day with legumes consumed 0.2 x/day. Fruit and vegetable consumption were negatively associated with albumin ($r=-0.3$, $p=0.02$), and positively with iron ($r=0.29$, $p=0.04$) and folic acid levels ($r=0.38$, $p=0.02$). Legume consumption was also associated with iron levels ($r=0.36$, $p=0.01$). The diet consisted mostly of animal meat, which was eaten on average 1.8 x/day. White meat was consumed in the greatest amount (0.51 x/day) followed by red meat (0.46 x/day), eggs (0.36 x/day), fish (0.27 x/day), and sausage & bacon (0.1x/day). Compared to those with normal HDL-C concentrations, those with low HDL-C had higher ($p=0.03$) total meat consumption (2.3 ± 0.81 x/day vs 1.6 ± 0.56 x/day). Additionally, total red meat consumption was positively associated with cholesterol ($r=0.30$, $p=0.03$). Dairy products were consumed on average 1.5 x/day and alternative dairy sources were consumed 0.59 x/day, both negatively correlated with albumin, $r=-0.30$, $p=0.02$ and $r=-0.34$, $p=0.01$, respectively. Processed foods were eaten on average 1.1 x/day. Individuals with normal cholesterol consumed more processed foods than those with low cholesterol (1.23 ± 0.8 x/day vs 0.86 ± 0.55 x/day, $p=0.05$). Additionally, those with low protein levels ate more white bread than those with normal protein levels (0.46 ± 0.34 x/day vs 0.19 ± 0.24 x/day, $p=0.02$). **Conclusion:** Overall, dietary intakes fall below recommendations in several categories. These results indicate that bariatric surgery patients should be encouraged to increase their consumption of vegetables and decrease the consumption of processed foods and meats post surgery. (Funding: CIUSSS-NIM research centre, Concordia University, UQAM, University de Montreal.)

National implementation research network identifies research gaps and core outcome measures for cardio-metabolic risk studies

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Rationale: People with cardio-metabolic risk, pre-diabetes and/or metabolic syndrome are at increased risk of cardiovascular disease and diabetes. Promising results from multiple studies show the benefit of diet and exercise as low-cost approaches in preventing diseases; yet the uptake of screening and credible lifestyle programs as part of the overall management in health care systems has been limited. Additional implementation and translational research studies are needed to identify the most effective and efficient approaches for lifestyle interventions, and to promote spread at multiple levels. A research network of interested researchers was created to work on issues of common interest related to improving cardio-metabolic risk through lifestyle interventions. Building on work done by expert groups for obesity research, network members undertook two research activities in the first year; 1) Identified research gaps in the existing evidence and 2) Using a Delphi process, rated possible measures, indicators and outcomes for comparisons in future studies. **Methods:** Preliminary lists of research gaps and outcomes were developed by the research team and shared with the group via online meetings supported by summary documents. New ideas and suggestions for outcome measures were solicited by email. The gaps and outcomes were incorporated into an online Qualtrics survey. First round results were discussed by teleconference and then participants re-rated gaps and outcomes in a second round. **Results:** Fifty-four researchers from Canada, the United States, England and Australia expressed interest in participating in the Delphi process. Research gaps identified to date include health behaviour change and implementation methods. A range of possible outcomes have been identified i.e. measures of diet, exercise and clinical tests, implementation process and fidelity, quality of life and well-being, depression, sleep and costing. Results of the process will be presented. **Conclusions:** Shared knowledge from network members can benefit future research directions and collaborations in lifestyle intervention for reducing cardio-metabolic risk. Delphi processes can be helpful and efficient in identifying specific research agendas and core outcomes for other complex nutrition issues. (Funded by CIHR Planning and Dissemination grant.)

Effect of canned mixed beans on serum lipids in adults with hypercholesterolemia

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Cardiovascular disease (CVD) continues to be a leading cause of death in North America and practical prevention strategies that target modifiable risk factors are warranted. Beans are well known for their nutrient density and have been shown to reduce LDL cholesterol; however, more research investigating effective bean dose and variety is needed. The current study examined the effects of canned mixed bean varieties in one cup and half cup serving sizes, compared to a one cup white rice control, on serum lipids in hypercholesterolemic adults (LDL cholesterol >3.5 mmol/L). The study used a randomized, cross-over, multi-centre study design that included three 28-day treatment periods separated by 28-day washout periods (NCT03830970). Preliminary results (n=18/60 participants) showed that both the one cup and half cup bean treatments significantly decreased total cholesterol ($p<0.0005$ and $p<0.01$, respectively) and LDL cholesterol ($p<0.0005$ and

$p < 0.01$, respectively) compared to white rice, but were not significantly different from each other. There were no significant effects of either bean treatment on HDL cholesterol or triglycerides. These preliminary results suggest that a half cup of canned mixed beans is sufficient to reduce total and LDL cholesterol in adults with hypercholesterolemia. This evidence can inform the development of practical dietary strategies targeting modifiable risk factors for CVD. (Funded by the Canadian Agricultural Partnership Pulse Science Cluster Program.)

Does colour make a difference: the effect of blue versus white dishware on food intake and eating challenges among residents living with dementia in a Canadian long-term care home

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Background: Residents living with dementia (RLWD) often experience changes in their visual perception, which can reduce food intake if items and dishware are a similar colour. Inadequate food intake is known to cause malnutrition, which increases the risk of hospitalization, morbidity and mortality. This study aimed to evaluate the effectiveness of using blue dishware compared to white dishware to improve food intake and mitigate eating challenges among RLWD. **Methods:** RLWD were recruited from a memory care unit in a Canadian long-term care (LTC) home. A within-person design was used, and blue and white dishware were alternated each day, each meal so that an equal number of lunch and dinner meals were evaluated. A two-factor repeated measures within-within analysis of variance was used to compare percent food intake between conditions. A paired t-test was completed to assess percent food intake when food choice was matched between blue and white meals. Last, a Chi-square analysis was used to determine the difference in the proportion of participants experiencing eating challenges with each dishware condition. **Results:** Eighteen participants (mean age 84.6 ± 7.9 years, 72.9% female) took part in the study. The mean Montreal Cognitive Assessment score was $12.5 (\pm 5.0)$ points, signifying that most participants had moderate to severe dementia. There were no significant differences for percent food intake between the blue and white dishware conditions ($F[1,16]=3.95$, $p=0.06$), even after controlling for matched food choices between blue and white meals ($t[52]=1.83$, $p=0.07$). On average, participants had a $4.8 \pm 7.0\%$ increase in average percent food intake with the blue dishware. Percent food intake was significantly greater at lunch compared to dinner ($F[1,16]=27.44$, $p<0.0001$), regardless of dishware condition. Finally, the proportion of eating challenges experienced was not significantly different between the dishware conditions or meals. **Conclusion:** Compared to standard white dishware in a LTC dining room, blue dishware did not improve food intake or mitigate eating challenges for RLWD. Multi-component interventions targeting meal quality, meal access, and mealtime experience may be more effective at improving food intake among RLWD in LTC. (This study was funded by Mitacs.)

Assessing the nutritional status of children admitted to the pediatric intensive care unit

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Children admitted to the pediatric intensive care unit (PICU) are at high risk of malnutrition due to stress of critical illness, treatment, and challenges with meeting energy and protein requirements. Current practice guidelines recommend patients undergo detailed

nutritional assessment within 48h of PICU admission, and that malnutrition be identified using weight-for-length (WFL), BMI-for-age (BMIA) or mid-upper arm circumference (MUAC) z scores. There is limited data describing the prevalence of malnutrition in Canadian PICUs. The primary objective was to describe the prevalence of malnutrition at admission and discharge from the PICU according to most recent practice guidelines. Our secondary objective was to describe associations among presence of malnutrition, patient characteristics and clinical outcomes. Patients ($n=60$; median age 1.8y), admitted to the Children's Hospital of Eastern Ontario PICU for at least 48h were enrolled in this prospective cohort study. Anthropometric measurements (at PICU admission and discharge), prescribed and delivered calories and protein intakes over the first 10 days of admission were prospectively recorded. Malnutrition was identified according to ASPEN-AND (2015) indicators. Ethnicity was recorded using a validated self-identifying questionnaire. Prevalence of moderate-severe malnutrition at PICU admission using WFL and BMIA was 12%. MUAC z score significantly declined (mean paired difference = -0.43 , $p=0.002$) during PICU stay and a higher proportion ($p=0.031$) of children were identified as malnourished at PICU discharge based on MUAC z score compared to PICU admission. When using the recommended indicators for malnutrition for two time points, 11 patients (41%) <2 yo did not meet the norm for expected weight gain, and 31 (62%) patients received $<75\%$ of estimated energy and protein needs. Ethnicity associated with MUAC z score decline during PICU stay ($p=0.011$). WFL and BMIA z scores at admission associated ($r=0.54$, $p=0.021$, $n=18$) with a greater length of time on antibiotics for hospital-acquired infections, but not with PICU or hospital length of stay. In conclusion, malnutrition is prevalent in the PICU. MUAC z score appears to be a sensitive indicator of decline during PICU stay. Nutrient delivery is not optimal for all patients and further efforts aimed at improving delivery of nutrients should be investigated.

Association between rapid weight gain in infancy and cardiometabolic profile among children exposed and unexposed to gestational diabetes mellitus in utero

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Background and aims Rapid weight gain (RWG) in infancy has been associated with a higher risk of obesity. This study aims to evaluate the association between RWG in infancy and cardiometabolic profile of children exposed (GDM+) and unexposed (GDM-) to gestational diabetes mellitus (GDM) and whether a good quality diet modulates this association. **Methods** A total of 81 GDM+ and 25 GDM- children were included in this study. During a single visit, fasting glucose, insulin and glycated hemoglobin (hba1c) levels were measured. Children's diet was assessed with two 24-hour dietary recall questionnaires. Weight, height and waist circumference (waistc) were measured and z-score body mass index (BMI z-score) was calculated. Weight at birth, 12 and 24 months were collected from the child health record and weight-for-age z-score was calculated. RWG from 0-12 and 0-24 months was defined as a change in weight-for-age z-score $> +0.67$ unit. Cardio-metabolic profile were compared between children with RWG and normal weight gain (NWG) using regression analyses adjusted for age, sex, birth weight, GDM status and diet quality (using the validated healthy eating index score). Prevalence ratio of overweight or obesity among children with RWG compared to NWG were calculated. **Results** Mean age of children was 6.3 ± 2.5 years. Children with 0-12 months RWG had higher BMI z-score (0.46 ± 1.04 vs -0.02 ± 0.87 , $p=0.02$), waistc (56.8 ± 7.9 vs 54.8 ± 7.0 , $p=0.003$) and tend to have higher hba1c levels (5.32 ± 0.26 vs 5.21 ± 0.26 , $p=0.12$), independently of age, sex, GDM exposure, birth weight and diet quality. Similar results were observed for

RWG between 0-24 months. More specifically, among GDM+ children, 0-12 months RWG was associated with higher BMI z-score (0.59 ± 1.09 vs -0.04 ± 0.91 , $p=0.0006$) and waist (57.6 ± 8.4 vs 54.4 ± 7.3 , $p=0.001$) compared to NWG. Similar results were observed for the 0-24 months period. Prevalence of overweight or obesity in childhood was not increased in children with RWG between 0-12 months compared to NWG (PR: 1.56, IC: 0.71-3.44). Conclusion Rapid weight gain in infancy was associated with an altered anthropometric profile in childhood, independently of in utero exposure to GDM and diet quality. (Danone Institute of Canada, Diabetes Canada and Fonds de recherche du Québec - Santé.)

Mothers' perceptions of the involvement of preschool and school-aged children in household-related food activities: a content analysis of blog comments

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Positive effects of children's involvement in household-related food activities (e.g. meal planning and meal preparation) have been demonstrated on children diet quality, including consumption of vegetables and fruits, which is currently suboptimal among Canadian children. Mothers play an essential role in the translation of cooking skills. This study explored the content of comments posted by mothers ($n=26$) living in Quebec City, Canada, on a blog written by a registered dietitian (RD) to understand their perceptions of involving their preschool and school-aged children in household-related food activities. The blog analyzed in this study was developed to deliver a 6-month theory-informed healthy eating behaviour change intervention in the context of a randomized controlled trial in which a total of 26 blog posts were published by a RD. Mothers' comments ($n=213$) on the blog were analyzed using an inductive content approach with NVivo software. Mothers ($M = 38.7$ [$SD = 6.1$] years old) mentioned several advantages of involving their child ($M = 7.8$ [$SD = 2.9$] years old) in the choice of meals and in the preparation of family meals, such as to increase openness to new foods and willingness to eat meals prepared at home, easier planning of family meals, enjoyable experience for children linked with pleasure of eating, feeling of pride and achievement, and learning opportunities [patience, concentration, reading abilities]. Mothers shared various examples of tasks performed by their child in the kitchen, such as mixing ingredients, helping bake muffins/cakes, cutting vegetables and fruits, and planning and cooking simple dishes. Two barriers for involving children in meal preparation emerged from mothers' comments: increased time spent preparing meals and lack of interest from children as they grow older. In conclusion, these findings suggest that mothers of our study value the involvement of their children in the planning and preparation of meals, which they positioned as positive food experiences and learning opportunities. Such results contribute to the discussion on the importance of involving children in meal preparation to foster a healthier diet and relationship with food. (Funding: Danone Institute of Canada, Fonds de recherche du Québec - Santé, Canadian Institutes of Health Research.)

Dietary patterns and behaviours among Arab newcomers in Western countries: A call for equitable and accessible food systems

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Sub-optimal nutrition is a leading risk factor for many non-communicable diseases, including diabetes and depression, and leads to a loss of about 255 million disability-adjusted life-years annually worldwide. The problem is much more common among immigrants due to socio-cultural and economic factors such as financial con-

straints and different food traditions. This is especially critical for Arabic-speaking immigrants and refugees (ASIR), who retain their cultural identity via Arabic food and traditional dietary habits. A scoping review was undertaken to investigate the impact of migration/acculturation of ASIR in Western societies – North America (the US and Canada), Europe, Australia and New Zealand – on their eating patterns and to explore barriers and facilitators to healthy eating among this minority population. The aim of this study was to inform future nutrition research and program development process towards developing effective, culturally appropriate dietary interventions for ASIR. Following immigration, ASIR introduced positive and negative changes into their diet, with enhanced fruit/vegetable intake, but also a substantial increase in consumption of nutrient-poor, energy-dense and processed/fast food. Personal barriers to nutritious eating included lack of nutrition awareness and poor host country language skills, whereas increased awareness of nutrition health was a strong facilitator. Family members' preferences and the fear of mistakenly consuming non-religiously acceptable foods were major sociocultural barriers to healthy eating among ASIR across Western societies, whereas availability of accessible ethnic stores was a powerful facilitator. Unaffordable healthy foods and lack of genetically modified food labelling were key barriers to eating healthfully among ASIR in North America, but not Europe. We need a complete understanding of the interactions/differences in food habits/culture between ASIR's particular countries of origin as well as the host countries. A thorough understanding of barriers and facilitators to eating nutritiously will enable us to design effective, culturally sensitive dietary programs for enhancing healthy eating among ASIR. This will also help inform necessary changes in food policy for ensuring equitable access to nutritious, culturally acceptable foods for ASIR and other minority groups in Western societies.

Maternal serum ferritin in the second trimester is a good predictor of infant ferritin status at three months

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Low neonatal iron stores in the first months of life is associated with neurological and developmental impairments. Iron insufficiency/deficiency during gestation places infants at greater risk of low iron stores. The objective of this project was to study the relationship between maternal serum ferritin (SF) during pregnancy and infant SF at 3 months of age. The Alberta Pregnancy and Outcomes Nutrition (APrON) study, is a prospective Albertan cohort that recruited pregnant women in 2009-2012 and collected information and biosamples. This study used blood samples from 358 mothers who gave blood during each trimester and there was a maternal and infant blood sample collected at 3 months postpartum. SF concentration was measured using a Chemiluminescent Microparticle Immunoassay (CMIA) on a i2000sr Architect Plus machine. SF decreased significantly ($P<0.05$) during the course of pregnancy to reach a minimum (15.9 ± 12.4 ng/ml) during the third trimester. Nearly 12% ($n=43$) of infants studied were found to be at risk for having low iron stores (<50 ng/ml) at 3 months of age. Using the second trimester SF concentration (36.9 ± 27.5 ng/ml) we categorized the data into quartiles. Women who had SF concentrations in the second and third quartile (Q2 & Q3), which ranged from 17.78 ng/ml to 46.72 ng/ml, had infants with significantly higher SF at three months compared to both Q4 ($p=0.045$) and Q1 ($p=0.022$). The results suggest that a maternal SF concentration of 18-47 ng/ml during the second trimester of pregnancy is associated with a better SF status in their infants at 3 months of age. Clinical screening of SF during the second trimester may be a useful tool for preventing low neonatal iron stores. (Funded by CIHR, WCHRI Summer Studentship.)

Seminal plasma metabolomics reveals lysine and serine dysregulation as unique features distinguishing between prostate cancer tumors of Gleason grade 6 and Gleason grade 7

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Background Prostate cancer (PCa) is a metabolic disease and the fifth leading cause of cancer-related deaths worldwide in men. Most men are diagnosed with low grade indolent disease and differentiating these men from those who have life threatening cancer is a challenging but important clinical dilemma. There are currently limited biomarkers that can distinguish between the indolent Gleason grade 6 and higher-grade disease. Moreover, some individuals initially diagnosed with low grade disease progress to higher grade disease. Currently prostate biopsies are the only reliable methods of stratifying risk, but biopsies can cause significant morbidity, sample only a small portion of the gland and are costly. Therefore, biomarkers distinguishing between indolent and aggressive patterns of PCa are urgently required to minimize biopsy-associated morbidity, prevent overtreatment of indolent PCa and to better stratify patients for appropriate treatment. Methods Seminal fluid samples were collected from normal individuals (n=13) prior to infertility treatment and histologically confirmed prostate cancer patients (n=51). The metabolomics technique, 1H Nuclear Magnetic Resonance spectroscopy and Orthogonal Partial Least Square Discriminant Analysis multivariate statistical analysis were used to compare the populations. Results Alterations in amino acids levels, specifically lysine and serine and changes in glycolytic intermediates were the most significant metabolic features associated with differences between healthy controls and prostate cancer and between Gleason grade 6 (GS6) and Gleason Grade 7 (GS7) samples. OPLS plots discriminated healthy controls from prostate cancer samples (R²= 0.54, Q²= 0.31; AUC= 0.96), and GS6 from GS7 samples (R²= 0.62, Q²= 0.49; AUC= 0.98) based on lysine and serine content. Conclusions This study suggests that seminal plasma metabolomics profiling of seminal fluid is a promising means of differentiating indolent from aggressive disease. Particularly, lysine and serine levels may be able to differentiate Gleason grade 6 from Gleason grade 7 disease. (Funding This study was supported by the Johnson & Johnson Alberta Health Innovation Partnership. (JAHIP).)

Development of innovative home-based lifestyle intervention strategies for frailty prevention in the community in adults with diabetes and chronic kidney disease: the FANTASTIC study

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A common co-morbid condition in adults with diabetes (DM) and chronic kidney disease (CKD) is frailty, a syndrome defined as a state of increasing vulnerability to physiological and psychological stressors. Resistance exercise is shown to ameliorate frailty. This study is a randomized controlled clinical trial (RCT) that examines the effect a 6-month home-based exercise program has on frailty outcomes. Using video technology, community-dwelling adults with DM and CKD are led through 5 resistance-band exercises 3-days per week that work most major muscle groups each session. Adults with DM and CKD (50-82 year) ± frailty are randomized to either the intervention (n=60)

or standard of care group (n=60) in a semi-block design (frail vs non-frail). Validated tools are used to assess a) frailty status (Rockwood Clinical Frailty Scale, Edmonton Frailty Scale, Fried Frailty Index), b) muscle strength (Jamar® dynamometer), c) muscle function (Short Physical Performance Battery [SPPB]), d) cognitive function (Mini-Mental State Exam), e) health related quality of life (HRQOL: SF-36), f) depression (Major Depression Inventory), and g) activities of daily living (modified Barthel Index), pre- and post-intervention. Bloodwork is reviewed to assess kidney function (estimated glomerular filtration rate [GFR], urea, creatinine), glycemic control (A1C, glucose) and electrolyte balance (potassium, magnesium, calcium) where available. Baseline subject characteristics include patients with Type 2 DM and CKD with mean±SD BMI, SPPB, MMSE and MDI scores of 32.2±3.9, 9.2±2.0, 27.7±1.3 and 10.8±9.9, respectively. Frailty was associated with older age (74.0±6.5 [frail] vs 63.4±3.1 [non-frail]; p<0.05), lower GFR (31.3±11.7 [frail] vs 80.3±11.5 [non-frail]; p<0.05), and lower HRQOL scores related to physical functioning (41.0±19.8 [frail] vs 92.0±5.7 [non-frail]; p<0.05), vitality (40.0±20.9 [frail] vs 74.0±13.9 [non-frail]; p<0.05), role emotional (33.3±33.4 [frail] vs 100.0±0.0 [non-frail]; p<0.05), mental health (64.0±13.9 [frail] vs 92.0±8.0 [non-frail]; p<0.05) and mental health component (43.3±8.1 [frail] vs 60.2±2.2 [non-frail]; p<0.05). No other significant differences in outcome variables at baseline were observed. Overall SPPB scores: balance tests (3.5±0.9), gait speed (3.7±0.5), chair stands (2.0±1.0) and total (9.2±2.0). Meaningful change in total SPPB score (0.54-1.88) and stabilization of HRQOL, possibly indicating improvement in frailty outcomes, are expected findings. (Funding: University Hospital Foundation/Novo-Nordisk/Alberta Health.)

Enriched vitamin K diet is associated with increased activation of cell survival pathways in brains of young male rats, but has no effect on cognition

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Vitamin K accumulates in brain in the form of menaquinone-4, a metabolite of phylloquinone (K1), the main dietary source. In addition to its historic role in hemostasis, VK partakes in various cellular actions in brain and has been shown to modulate cognition. Notably, it contributes to the biological activation of proteins Gas6 and protein S (PS), both of which have been linked to extracellular signal-regulated (ERK) and serine-threonine (Akt) kinases cell survival pathways. In a previous study, lifetime high intakes of VK diet was associated with increased cell survival signaling pathways and improved cognition in aged male rats. In this study, we tested whether similar positive effects were observed earlier in life. Four-week old male Wistar rats were fed an AIN-93 based diet containing either low 80 (L), adequate 750 (A) or enriched 2000 (E) (mcg K1/kg/diet) diets for three months. K1 and MK-4 were measured by HPLC; PS and Gas6 carboxylation, ERK and Akt phosphorylation, and BDNF expression were assessed in hippocampus (HPP), frontal cortex (FC) and striatum (STR), by immunoblotting. Cognition was assessed using Morris water maze. Brain VK content increased as a function of diet (p<0.01), MK-4 representing 84-99% of total VK depending on diet. High VK intake was associated with increased carboxylated PS in STR (E vs L and A groups, p<0.01); carboxylation of Gas6 was not affected by diet. Erk phosphorylation increased as function of dietary K1 in STR, in a dose dependent manner. Erk activation was also higher in E and A groups compared to L group, in HPP (both p<0.01). Likewise, Akt phosphorylation was systematically lower in L vs E or A groups depending on brain region (p<0.02). Finally, dietary VK had no impact on BDNF expression (p>0.2) and cognition (p>0.5). In conclusion, as observed in aged rats, an enriched vitamin K diet is associated with increased cell survival signaling pathways in young animals, although without providing additional benefit on cognition. These results suggest that VK may be particularly beneficial to

brain function in physiologically challenged animals such as those in the aging state. (Study funded by CIHR.)

Are the general and mental health of Canadians associated with their cooking practices?

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Cooking abilities and using minimally processed ingredients have been associated with better diet quality in Canada. The purpose of this study was to examine whether cooking abilities and types of foods used in meal preparation are associated with perceived general and mental health. The sample included over 18,000 Canadian adults (≥ 18 years old) from two Canadian Community Health Survey Rapid Responses on food skills (Nov/Dec 2012 and Jan/Feb 2013). Cooking abilities were categorized into five groups: 1=frequently prepare sophisticated dishes, 2=prepare most dishes, 3=cook more dishes if I have a recipe, 4=can prepare simple meals, 5=can do things such as boil an egg or don't know where to start. Types of foods were categorized into three groups: 1=whole/basic foods, 2=mix of whole/basic and easy to prepare foods, 3=easy to prepare and ready-to-eat foods. Outcome variables were dichotomized; 1=excellent general (or mental health) vs 0=not excellent general (or mental health). In all models, variables were weighted and bootstrap sampling was used with logistic regression controlling for age, gender, education, household composition, income, employment, and country of birth. The level of significance was set at $p < 0.01$. A total of 19% and 33% of Canadian adults reported excellent general and mental health, respectively. There were 13%, 41%, 23%, 17%, and 5% of subjects in groups 1, 2, 3, 4, and 5 of cooking abilities and 76%, 19%, and 5% in groups 1, 2, and 3 of food types, respectively. Canadians with less cooking abilities (groups 3, 4, and 5) had significantly lower odds of reporting excellent general health compared to group 1 with the best cooking abilities ($p \leq 0.004$). Similarly, Canadians with less cooking abilities (groups 2, 3, 4, and 5) had significantly lower odds of reporting excellent mental health compared to group 1, $p < 0.0001$. Canadians using mixed, easy to prepare, and ready-to-eat foods (groups 2 and 3) had significantly lower odds of reporting both excellent general and mental health compared to group 1 using mainly whole/basic foods, $p \leq 0.003$. Excellent general and mental health are associated with greater food literacy (cooking abilities and cooking with whole/basic foods) among Canadian adults.

Characterizing dietary intake, body composition and energy expenditure in people with newly diagnosed colorectal cancer

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Optimal nutrition is essential for cancer survivorship, yet malnutrition continues to negatively impact people battling this disease. Low muscle mass (MM) is evident in people with cancer and indicative of derangements in nutrient intake. However, energy expenditure and dietary intake have not been well characterized in these patients. The objective of this research was to investigate adherence to protein and energy recommendations and explore associations between diet, body composition (BC) and energy expenditure in people with newly diagnosed stage II-IV colorectal cancer (CRC). Patients were recruited from a single centre in Edmonton, AB as part of an ongoing clinical trial. BC was assessed by dual energy x-ray absorptiometry, and low MM defined according to previously published cutoffs. Resting energy expenditure (REE) was measured by indirect calorimetry and hypermetabolism was defined as $REE > 110\%$ of predicted values. Dietary intake was assessed by three-day food records and compared to current oncology nutrition guidelines. Descriptive analysis is presented as mean \pm SD. Pearson's correlation coefficient and Student's t-test were used where appropriate. Thirty-five participants (age = 58.4 ± 10.3 years;

BMI = 27.5 ± 5.6 kg/m², 57.1% males) have been included to date. The predominant tumor site and stage were colon (82.9%) and stage 3 (60.0%), respectively. Low MM at diagnosis was observed (20.0%), despite only 2.8% being underweight (BMI < 18.5 kg/m²). More than half ($n = 20$) were hypermetabolic. Many (48.6% and 42.8%) did not meet minimum recommended calorie (25 kcal/kg) and protein (1.0 g/kg) intakes, respectively. The majority of patients (65.7%) presented with protein intake below 1.2 g/kg, the targeted intake level. Protein intake was positively related ($r = 0.426$, $P = 0.011$) to appendicular skeletal muscle index (ASMI) while the association with energy intake was weak ($r = 0.256$, $P = 0.137$). ASMI ($P = 0.463$) and protein ($P = 0.504$) and energy ($P = 0.384$) intakes were not different between those with stage 2 or 3 ($n = 26$) and stage 4 ($n = 9$) disease. REE ($P = 0.083$) was not different between groups but a trend towards significance was observed. Low MM, hypermetabolism, and inadequate dietary intake were observed across stages in patients with newly diagnosed CRC, reflecting the need for nutritional interventions at the start of chemotherapy treatment.

High nutritional risk in patients with oculopharyngeal muscular dystrophy: association with dysphagia

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Oculopharyngeal muscular dystrophy (OPMD) is a rare hereditary neuromuscular disease with the highest worldwide prevalence in Québec (Canada). As OPMD progresses over time, patients present with an atrophy of the pharyngeal muscles and therefore, swallowing problems (dysphagia) that appear around 40-60 years old. Dysphagia can compromise food intake and ultimately, patients' nutritional status. Moreover, these patients present limb weakness that can lead to functional limitations, such as grocery shopping, which can contribute to the risk of poor nutrition. To date, no study has investigated the nutritional risk of OPMD patients. Objective: To assess the nutritional risk in adults with OPMD in association with oropharyngeal dysphagia. Methods: In this cross-sectional study, 40 adults aged 50-75 years and with molecular confirmation of OPMD are currently recruited among patients of a neuromuscular rehabilitation clinic. Nutritional risk is assessed with the French version of the Seniors in the Community: Risk Evaluation for Eating and Nutrition II (SCREEN II) and the severity of dysphagia with the French-Québec version of the Sydney-Swallow Questionnaire (SSQ). Anthropometric data are also measured using standardized procedures. Preliminary results: Data are now available for 20 patients aged 51 to 73 years old; 10 (50%) being men. Mean BMI (\pm SD) is 25.8 ± 4.1 , with 3 (15%) patients having low BMI and only one (5%) reporting weight loss > 2.5 kg over the last 6 months. SCREEN II scores showed high nutritional risk in 17 (85%) of OPMD patients. SCREEN II items contributing the most to the nutritional risk scores are swallowing difficulty (75%), consumes daily 3 fruits and vegetables (70%) and 1-2 milk products (70%) or less, limits foods (55%), skips meals (50%) and chewing difficulty (50%). Pearson's correlation coefficient showed significant association between dysphagia severity and nutritional risk ($r = -.456$ $p = .043$). Conclusion: To our knowledge, this ongoing study is the first to investigate the nutritional risk in OPMD. Our preliminary data indicate that individuals with OPMD present high nutritional risk, without presenting low BMI. The present study highlights the need for dietary counseling in these patients. (Funded by the Association française contre les myopathies and the Fondation de ma vie.)

Breastfeeding practices and their association with food insecurity among vulnerable women enrolled in a perinatal community support program offering enhanced lactation support

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Canadian breastfeeding rates fall below recommendations, particularly among socially and economically vulnerable women. The overarching objective of this research was to describe breastfeeding practices among clients of a novel community perinatal program that targets vulnerable women and offers free enhanced lactation support (e.g. in-home lactation consultant visits, breast pumps). Formative work with program clients suggested that despite support provided, maternal food insecurity may be playing a role in infant feeding. Thus, the aim of this research was to assess the association between food insecurity and breastfeeding practices in vulnerable women from this program. Infant feeding practices were obtained prospectively at 2 weeks, 2, 4 and 6 months postpartum via telephone questionnaires from 141 women recruited prenatally. The Canadian Community Health Survey Household Food Security Survey Module was administered during the 6 month call. Logistic regression was used to assess associations between food insecurity and any breastfeeding at 6 months and exclusive breastfeeding to 6 months. All mothers initiated breastfeeding, but 56% of infants received formula in-hospital. Eighty-nine percent of mothers continued to provide any amount of breastmilk at 6 months, though only 24% exclusively breastfed to 6 months, as recommended. Marginal, moderate and severe food insecurity was reported by 14%, 35% and 10% of mothers, respectively. Mothers with any food insecurity were less likely to provide any breastmilk at 6 months (OR [95% CI] 0.19 [0.04-0.87]). There was no association between food insecurity and exclusive breastfeeding to 6 months when analyzed as any food insecurity (p value 0.34) or the degree of food insecurity (secure, marginal, moderate, severe; p value 0.77). In summary, in a sample of vulnerable mothers with access to enhanced lactation support, rates of breastfeeding initiation and any breastfeeding to 6 months were high, but exclusive breastfeeding to 6 months was low. Food insecurity among participants was high and negatively associated with breastfeeding at 6 months. Additional research is needed to better understand how to further support exclusive breastfeeding among vulnerable mothers and how food insecurity might impact breastfeeding outcomes. (Funding: The Sprott Foundation and Joannah & Brian Lawson Centre for Child Nutrition.)

A comparative analysis of the proportion of commonly consumed packaged foods meeting regional sodium targets in four Latin American countries between 2015 and 2018

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Hypertension is a major risk factor for cardiovascular disease and stroke. In many Latin American countries (LAC), one-third of adults

have hypertension, largely due to excess dietary sodium. Therefore, sodium reduction targets for LAC for eighteen commonly consumed packaged food categories were developed in 2015 by the Pan American Health Organization (PAHO) and endorsed by the multi-sectorial Salt Smart Consortium. Objective: To determine if a significantly greater proportion of packaged foods from four LAC (Argentina, Costa Rica, Paraguay and Peru) meet the PAHO regional targets in 2018, compared to 2015. Methods: This analysis utilized two cross-sectional food label datasets collected in 2015-2016 (n=3,859) and 2017-2018 (n=5,663). The sodium content in foods was obtained from the nutrient declarations on food packages in mg/serving and were standardized to mg/100 g or ml. Proportions of products meeting targets were calculated. Chi-square tested for differences in proportions between years. Results: Compliance with regional targets significantly increased from 83% (n=3,198/3,859) to 86% (4,894/5,663), respectively for 2015-2016 and 2017-2018 (p<0.001). At the category level, four food categories had a significantly higher proportion of foods meeting regional targets from 2015-2016 to 2017-2018: Bread products from 78% (n=273/350) to 92% (n=287/311, p<0.001), cakes from 63% (n=197/312) to 78% (n=181/230, p<0.001), breaded meat and poultry from 61% (n=44/72) to 87% (n=67/77, p<0.001) and wet and dry soups from 62% (n=136/217) to 79% (n=120/152, p<0.001). However, two categories had a significantly lower number of foods meeting the targets over time: Cookies decreased from 94% (n=408/432, p<0.001) to 87% (n=328/378), and meats and sausages from 87% (n=328/378) to 80% (n=285/357, p=0.01). The other fourteen categories did not significantly change. Conclusions: Only 4 of 18 food categories had a higher proportion of foods meeting the PAHO regional sodium targets, while two categories had fewer foods meeting the targets, over time. Since a high proportion of foods were already meeting the targets at baseline and sodium intakes in LAC remain unacceptably high, more stringent sodium targets are required to support further sodium reductions in packaged foods in LAC. (Funding: CIHR Scholarships, Department of Nutritional Sciences Graduate Fellowship, Project IDRC-108167, PAHO.)

Impact of variety and germination on the in vitro and in vivo protein quality measures of faba beans (*Vicia faba* var. *minor*)

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Faba beans (*Vicia faba* var. *minor*) are pulses that contain on average, 24-29% crude protein (as-is basis). However, the abilities of humans/animals to efficiently utilize the dietary protein is influenced by limitations in the indispensable amino acid (AA) pattern, and endogenous factors that may limit protein digestibility, including tannins. The current study was designed to investigate the impact of sprouting/germination on the AA composition and measures of in vivo and in vitro protein digestibility in faba bean varieties differing in tannin content. Faba beans containing low (Snowbird & Snowdrop) and high (Fabelle & 9-4) tannin content were subjected to germination and extrusion, or no germination and extrusion. The in vivo True Protein Digestibility (TPD) of Faba bean samples was determined in Sprague Dawley rats (n=90, ≈75g) fed a diet consisting of 10% crude protein from the faba bean sources. Feces collected during the digestibility assay were measured for total nitrogen and dry matter using AOAC approved methods. Additionally, the total AA content and in vitro protein digestibility (IVPD; pH-Drop method), of the faba bean treatments were determined. The Protein Digestibility-Corrected Amino Acid Score (PDCAAS) was assessed as the product of AAS with either the TPD (in vivo) or IVPD (in vitro). Germination had no effect on the TPD or PDCAAS of the high tannin varieties, however, Fabelle demonstrated significantly (P ≤ 0.05) higher TPD (92.6% & 92.9%) over the 9-4 variety (90.3% & 90.7%) when unsprouted and sprouted. The PDCAAS

of low tannin variety Snowbird (72.2%) and Snowdrop (75.1%) demonstrated a significant decrease ($P \leq 0.05$) when germinated (67.2% & 70.6% respectively), whereas the TPD for Snowbird increased (88.3% to 92.5%) when germinated. Substantial positive correlations were established between TPD and IVPD ($r = 0.87$, $P \leq 0.05$) as well as PDCAAS and IVPD corrected for the same amino acid score ($r = 0.99$, $P \leq 0.0001$). These data provide evidence that breeding can play an important role for developing faba varieties with higher protein quality values. Furthermore, *in vitro* techniques offer new approaches to assess protein quality without the need for rodent bioassays. (Alberta Agriculture and Forestry.)

Accuracy of body composition predictive equations in women with class II or III obesity

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Body weight and body mass index (BMI) cannot differentiate between various compartments (e.g. fat and lean mass), which are more accurate prognostic factors of clinical outcomes. Devices that measure body composition are largely unavailable in clinical settings; instead, predictive equations (PEs) using anthropometric measurements for estimations of body composition are used. Here, we explore the accuracy of nineteen PEs compared to measured body composition. Women with class II or III obesity underwent body composition assessment via dual X-ray absorptiometry along with weight, height, waist circumference, and hip circumference measurements; the waist-to-height ratio was calculated. Accuracy of nineteen body composition PEs compared to measured fat mass (FM), FM%, and lean soft tissue (LST) was determined using Bland-Altman analyses; the average difference (bias) described group-level error and limits of agreement (bias \pm 1.96 standard deviation (SD)) described individual-level error. Pearson correlation was used to assess the relationship among PE error, age, and anthropometric measurements. Results are presented as mean \pm SD or median [interquartile range] for parametric and non-parametric variables, respectively. Twenty-six participants with median BMI of 38.8 kg/m² [36.7-46.8 kg/m²] were included. FM% was 50.9 \pm 4.7% and age was 35 \pm 9 years. Although some PEs had biases below 5% (n=7/19), large individual-level variation was observed. The narrowest limits of agreement among all equations were -16.5 to 8.9%. Almost all LST PEs over-predicted measured LST (n=4/5). Weight was positively correlated to error among half (n=5/10) of FM% PEs. Waist circumference (n=7/10 PEs), waist-to-height-ratio (n=8/10), and hip circumference (n=8/10 PEs) were frequently positively correlated to FM% PE error. Body composition PEs were inaccurate on an individual level and FM% error was related to anthropometric measurements. As body composition assessment tools are not readily available in all settings, accurate equations are needed to improve patient care and optimize interventions. (Alberta Diabetes Institute, Alberta Innovates Health Solutions, Canadian Foundation for Dietetic Research, Government of Canada.)

Assessing dairy product consumption patterns in adolescent females with overweight/obesity on a high dairy diet – A preliminary analysis

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Dairy product consumption can improve overall diet quality, provide important nutrients for optimal growth and development, and is in-

versely related to obesity. However, a large proportion of adolescent females do not consume adequate levels of dairy products and of those who do, little is known about their consumption pattern. Assessing how adolescents consume dairy products could enhance strategies and interventions aimed at increasing their intake. The purpose of our study was to examine dairy product consumption patterns in adolescent females with overweight/obesity (n=22; 11-18 years) who participated in a 12-week lifestyle modification intervention consisting of dietary guidance, structured exercise and dairy product provision. Participants were given 4 servings/day of dairy products: 2 cups of 1% milk (chocolate and white), 2x100g of low-fat Greek yogurt and 42g of full-fat cheese. Additional dairy consumption was permitted, and the meal (breakfast, lunch, dinner or snack) at which participants consumed the dairy products was at their discretion. This was assessed using 7-day food records during week 12 of the intervention. Friedman tests with Dunn's multiple comparison post-hoc tests were used to compare average daily servings across meals. Participants consumed 3.7 \pm 0.6 servings/day of dairy foods. Milk was more often consumed at breakfast (median servings/day [interquartile range]; 0.6 [0.2-0.8]) and snack (0.6 [0.1-0.9]) compared to lunch (0.1 [0-0.3]; ANOVA p=0.014). Cheese was more often consumed at lunch (0.3 [0.2-0.4]), dinner (0.3 [0.2-0.4]) and snack (0.2 [0.1-0.3]) compared to breakfast (0.1 [0-0.1]; p<0.001). Yogurt was consumed at snack (0.6 [0.4-0.8]) more often than at breakfast (0.2 [0-0.4]), lunch (0.1 [0-0.3]) and dinner (0 [0-0.1]; p<0.001). In summary, participants preferred eating different dairy products at different meals. They most often consumed milk at breakfast and snack, yogurt at snack, and cheese least often at breakfast. These findings provide important information regarding the daily eating patterns for different dairy products. Understanding and promoting these eating patterns may improve dairy product consumption in adolescent females with overweight/obesity as well as increase the effectiveness of intervention studies designed to increase the consumption of dairy products and their associated nutrients. (Supported by: Dairy Management Inc., Dairy Farmers of Canada.)

The Foodbot Factory mobile application improves nutrition knowledge in children: Results of a randomized controlled trial

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Background: Digital educational interventions are increasingly common, and when well-designed they can improve overall knowledge. The 2019 Canada's Food Guide is an online-first platform that educates about healthy eating; however, few engaging digital resources exist to support its implementation. The Foodbot Factory application was developed to engage children in learning about Canada's Food Guide. This study tests the hypothesis that the use of Foodbot Factory increases nutrition knowledge in children. Methods: Children in grades 4 and 5 attending the Ontario Tech University day camps were enrolled into a single-blinded, parallel randomized controlled trial. Participants were randomized into a Foodbot Factory or a control group (a food-focused app with little educational content). Participants used the apps for 15 minutes each day for 1 week. A validated questionnaire assessed nutrition knowledge before and after intervention, overall and across four sub-components corresponding with the Foodbot Factory learning modules (Drinks, Grain Foods, Vegetables and Fruits, Protein Foods). Between-and within-group comparisons were con-

ducted using a 2-way repeated measures ANOVA. Results: Children randomized to the Foodbot Factory group were 9.1 ± 0.7 years of age ($n=39$, 64% males) and those in the control group were 8.9 ± 0.7 years ($n=34$, 61% males, $p=0.345$), with the majority of children being in grade 4, respectively (56% vs 61%, $p=0.643$). Children who used Foodbot Factory had a significant increase in overall nutrition knowledge, compared to the control app ($+5.25 \pm 5.54$ vs. $+0.79 \pm 6.34$, $p=0.002$). Significant increases in nutrition knowledge also occurred among Foodbot Factory users, compared to controls, for several sub-components such as Protein Foods ($+1.20 \pm 1.67$ vs. $+0.17 \pm 1.67$, $p=0.002$) and Vegetables and Fruit ($+1.17 \pm 1.37$ vs. -0.88 ± 1.13 , $p < 0.001$), with a slight improvement among Whole Grain foods ($+0.69 \pm 1.43$ vs. $+0.14 \pm 1.13$, $p=0.079$). No difference between groups in nutrition knowledge related to Drinks was observed ($+0.15 \pm 0.96$ vs. -0.88 ± 0.83 , $p=0.257$); however, baseline knowledge for Drinks was high in both groups (3.8/4 and 3.4/4). Conclusion: The Foodbot Factory app increased nutrition knowledge among children in Grade 4 and 5. Use of the Foodbot Factory app could be considered by parents or educators, such as in the classroom, when teaching children about nutrition. (Funding: Ontario Research Fund: Research Excellence Grant.)

Post-intensive care syndrome and nutrition rehabilitation in adult survivors of critical illness: a survey of knowledge, perceptions and practices of Canadian registered dietitians

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Patients surviving an ICU stay can experience significant functional, cognitive, and mental health disabilities, collectively known as post-intensive care syndrome (PICS). Proper nutrition is essential for functional recovery however nutrition intake is inadequate in patients in the early stages of ward-based recovery following ICU discharge. As the professional group trained in the provision of individualized nutrition care, registered dietitians (RD's) play an important role in improving the nutritional health of ICU survivors. In a sample of Canadian RD's, we aimed to assess their knowledge of PICS, and describe their current practices and barriers they have faced when providing nutrition care to ICU survivors. A link to a 25-question electronic survey, tested for face and content validity, was sent to 34 RD practice leaders and managers across Canada who then forwarded the survey to acute care RD's working in their departments. RD's working with ICU and/or post-ICU adults within the last 5 years were eligible to complete the survey. 181 respondents from 8 provinces were included in the final analysis. Only 55% (100/181) of respondents were familiar with the term "post-intensive care syndrome," whereas 73% (132/181) were familiar with the term "ICU-acquired weakness." Most respondents (96%, 172/179) felt nutrition is very important or critical post-ICU. Greater than 75% of respondents have experienced the following barriers to providing nutrition care post-ICU: feeding tubes are removed at time of extubation prior to RD reassessment; nutrition support is recommended but the health care team or patients do not want it, and; ward staff lack knowledge regarding the complex nutritional needs of post-ICU patients. Almost all (96%, 172/180) respondents felt a national post-ICU nutrition resource would be of value. This study is the first to assess the knowledge and perceptions of post-ICU nutrition in practicing RD's. Dietitians face several complex barriers to optimizing the nutritional status of their post-ICU patients. We have demonstrated a clear need and desire for education and resources for Canadian RD's specific to post-ICU nutrition care, and this study has set a foundation to build upon this endeavour. (Supported by the University of Saskatchewan and the College of Pharmacy and Nutrition.)

The accuracy of equations used to predict resting metabolic rate (RMR) requirements in acutely ill adults in Trinidad and Tobago: aged 18 to 65 years

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This study used to determine the level of accuracy of recommended resting metabolic rate (RMR) prediction equations among acutely ill adults in Trinidad and Tobago; aged 18 to 65 years. Following informed consent and enrolment, sixty-three acutely ill hospitalized adult volunteers (females 30; males 33) had anthropometry and RMR (MedGem® indirect calorimeter, Micro life, USA) measured using recommended procedures. RMR from prediction equations were compared to RMR measured by indirect calorimetry with values between $\pm 10\%$ of measured RMR being considered accurate. The university's ethics committee approved the study. The top-two ranked recommended RMR prediction equations for females, in decreasing order of accuracy were Owen (46.7% and Bernstein (40%). Among males, the top-two ranked recommended RMR prediction equations with a similar accuracy level of 39.4% were Müller and Bernstein. Population-derived RMR prediction equations had 56.7% and 54.5% accuracies among females and males respectively. These were significantly higher than the top-two recommended prediction equations for both males and females. Notably, the RMR per weight (kilogram) was reported as 16.4 kcal/kg and 17.5 kcal/kg, for females and males respectively. Thus limiting the risk of malnutrition by at least 5%: through diet quality via energy prediction accuracy with the population-specific equation, could improve health-related quality of life. With the exception of Bernstein's, Müller's and Owen's equations recommended the RMR prediction equation resulted in biases $>50\%$. Our population-derived RMR equations were more accurate than recommend RMR prediction equation among participants and can be used as an alternative to determining the energy-needs of acutely ill individuals. Substituting the commonly used prediction equations with population-specific equations can increase the level of accuracy by at least 10%, thus limiting risk of malnutrition by at least 5% and improving health-related quality of life. Key Words: Energy balance, Body composition, Malnutrition, Diet quality, Acutely ill individuals, Resting Metabolic Rate

Appreciation and usefulness of web-based nutrition education and cooking videos for pediatric oncology

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Background: Treatments used in childhood cancers often cause significant side effects including gastrointestinal and cardiometabolic disorders. However, patients and their family are inadequately informed on these issues and many children treated for cancer eat poor quality foods. The VIE (Valorization, Implication, Education) project at Sainte-Justine UHC in Montreal offers personalized interventions and educational content to inform families on the benefits of a healthy lifestyle. Objectives: This study aims at assessing the appreciation and usefulness of web-based nutrition education and cooking videos in pediatric oncology. Methods: The online content includes 15 short videos addressing the nutritional issues encountered during treatments while promoting the adoption of healthy eating habits (www.chusj.org/oncuisine). To promote the online content, we held weekly information and food tasting kiosks from September 2019 to April 2020 in the Oncology Department. Initial and follow-up questionnaires were developed to measure participants' viewing, satisfaction and perception

of utility. Website usage data were also assessed. Results: As of January 2020, 15 promotional activities were held. A total of 66 initial and 9 follow-up questionnaires were completed (average of 5 questionnaires per activity). Quantitative data showed that 83% of patients were not aware or did not watch the online videos. However, 96% of surveyed participants were interested in viewing them. Among those who had watched the videos, 80% found they were useful. Finally, 97% of participants would recommend the videos to others. Analysis of the follow-up questionnaire showed that, at the second interview, 45% of participants had watched the videos. Among them, 100% reported the videos valuable and would recommend them to others. Qualitative and web usage data are currently being analyzed. Conclusion: The data gathered so far support that the web-based nutrition education and cooking videos developed in the VIE project are highly appreciated by families and were found useful. We believe that the development of online education tools is a promising avenue to promote a healthy lifestyle in children treated for cancer and their family.

Malnutrition and functional capacity: what is the effect of multimodal prehabilitation?

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Multimodal prehabilitation programs aim to ready patients mentally and physically for their operation. An understanding of which patient sub-groups benefit most from prehabilitation would be clinically useful and inform design of risk-stratified interventions. Given that preoperative malnutrition is a known modifiable risk factor for surgery, we hypothesized that nutritionally compromised colorectal cancer patients would benefit more from prehabilitation than nutritionally well patients. We conducted a secondary analysis of individual patient data from five of our original prehabilitation trials. The four-week prehabilitation intervention involved home-based resistance and cardiorespiratory exercises, personalized nutrition counselling with whey protein supplementation to achieve a dietary intake of 1.2g/kg, and deep breathing for anxiety reduction. Our objective was to evaluate the influence of compromised nutritional states on change in preoperative functional walking capacity in colorectal cancer patients engaged in our prehabilitation program. Each patient's nutritional status was evaluated at baseline using the Patient-Generated Subjective Global Assessment (PG-SGA); a score ≥ 9 indicates critical need for a nutrition intervention. Functional walking capacity was measured with the six-minute walk test (6MWT) at baseline and before surgery. A preoperative change in 6MWT ≥ 19 m is associated with fewer postoperative complications, emergency department visits, and better patient-reported outcomes. A mixed-effects logistic regression model was used to evaluate the influence of PG-SGA ≥ 9 vs. PG-SGA < 9 on our primary outcome, a clinically meaningful change in 6MWT (≥ 19 m) before surgery. Prehabilitated colorectal surgery patients (n=200) were pooled for analysis; fifteen percent were identified as having critical need for a nutrition intervention (PG-SGA ≥ 9). Self-reported compliance to prehabilitation was 81% and weight was stable in the PG-SGA ≥ 9 group over the preoperative period. The odds of a prehabilitated patient with a PG-SGA ≥ 9 achieving a meaningful improvement in 6MWT before surgery was low (OR: 0.29; 95% CI: 0.10 to 0.81, P=0.02) compared to the better nourished patients. In conclusion, despite participating in a multimodal prehabilitation program before surgery, colorectal cancer patients in a sub-optimal nutritional state did not experience a meaningful improvement in walking capacity before surgery. Future prospective trials should aim to understand these findings so that we can improve care and outcomes for this patient group.

Longitudinal changes in adherence to the Portfolio and DASH dietary patterns and cardiometabolic risk factors in the PREDIMED-Plus study cohort

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The Portfolio and Dietary Approaches to Stop Hypertension (DASH) diets have been shown to lower cardiometabolic risk factors in randomized controlled trials (RCTs). However, the Portfolio diet has only been assessed in RCTs of hyperlipidemic patients. We therefore conducted a longitudinal analysis of one-year data from PREDIMED-Plus, an ongoing clinical trial (Trial registration: ISRCTN89898) in Spain that includes 6,636 older participants (mean age 65y, 48% women) with overweight/obesity fulfilling at least 3 criteria for metabolic syndrome. Data for this analysis were collected at baseline, 6 months and 1 year. Adherence to the Portfolio and DASH diet indices were derived from repeated validated 143-item food frequency questionnaires. We used linear mixed models to examine the associations of changes in dietary indices with concomitant changes in cardiometabolic risk factors. Models were adjusted for cardiovascular risk factors, lifestyle factors, and other potential confounders. At 1 year, greater adherence to the Portfolio diet was significantly associated with lower HbA1c (β [95% CI]: -0.004 [-0.006, -0.002]), glucose (-0.11 [-0.20, -0.01]), triglycerides (-0.32 [-0.57, -0.08]), waist circumference (WC) (-0.12 [-0.14, -0.10]), and body mass index (BMI) (-0.04 [-0.05, -0.03]), while greater adherence to the DASH diet was significantly associated with lower HbA1c (-0.005 [-0.007, -0.003]), glucose (-0.17 [-0.24, -0.10]), triglycerides (-0.69 [-0.89, -0.48]), non-HDL-cholesterol (-0.10 [-0.19, -0.01]), WC (-0.14 [-0.16, -0.12]), BMI (-0.05 [-0.06, -0.04]), systolic blood pressure (-0.11 [-0.16, -0.06]), and diastolic blood pressure (-0.03 [-0.06, -0.01]), and with higher HDL-cholesterol (0.04 [0.02, 0.07]). Similar associations were seen when both diet scores were assessed as quartiles, comparing high to low adherence. In conclusion, among older adults at high cardiovascular risk, greater adherence to the Portfolio and DASH diets showed signif-

icant favourable associations with many cardiometabolic risk factors. Both diets may therefore be beneficial for cardiovascular/diabetes risk reduction. (Supported by Banting & Best Diabetes Centre and CIHR. This trial was supported by ISCIII, through the Fondo de Investigación para la Salud, (PI13/00462, PI16/00501) and Recercaixa-grant (2013ACUP00194), granted to JS-S; the European Research Council (Advanced Research Grant 2014-2019; 340918) granted to MAM-G; and FEDER funds (CB06/03). Consortium CIBER, M.P., CIBEROBN is an initiative of ISCIII, Spain.)

Choline supplementation lowered body weight, body condition score, and daily food intake compared to a control in post-gonadectomized kittens

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Feline obesity is rising in prevalence with gonadectomy and ad libitum as major risk factors. Choline is known for its role in lipid metabolism in humans and several other species. This study investigated the effects of choline supplementation in post-gonadectomized cats on food intake (FI), body weight (BW), body condition scores (BCS), and body composition (BC). This study was approved by the University of Guelph Animal Care Committee (AUP # 4118). This project was funded by NSERC CRD grant. Intact 3-month old male kittens (n=15) underwent an 11-week acclimation period to experimental procedures and were fed an extruded dry food formulated for kittens. During acclimation kittens were fed to growth requirements (100*BW^{0.67}*6.7* [e-0.189p-0.66]). Next, kittens were assigned to control (n=7) or choline supplementation at 300 mg/kg/0.75 (n=8) for 12 weeks. Baseline BW and BCS, as well as BC by dual-energy x-ray absorptiometry (DEXA) under sedation were assessed at week 0, followed by gonadectomy at week 1 and immediately placed on treatment or control diet for 12 weeks. Cats were fed to mimic ad libitum feeding by following a three times per day feeding regime providing three times their energy intake during acclimation. Daily FI was measured by subtracting food left over from food provided and totaled for all three meals. Body composition by DEXA was assessed at week 12 for body fat mass, lean muscle mass, and bone mineral density. Data was statistically analyzed via SAS using the proc mixed analysis. Body weight, BCS, and FI were all lower with choline supplementation (p<0.05). The increase in body fat mass was lower in choline fed kittens (p<0.05) but there were no differences in lean body mass gain or bone mineral density between groups (p>0.05). These results suggest a potential benefit to choline supplementation for prevention of weight gain in post-gonadectomy kittens, likely due to the observed reduction in overall FI. While a potential benefit of choline may have been identified, a more complete understanding of the dose response to choline and how it may affect lipid metabolism in felines is still needed.

How is nutrition care being delivered across cancer care settings: signals from the international nutrition audit in foregut tumors (Inform)

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Rationale: Providing nutrition for patients with head and neck (HN) and esophageal (E) cancers (CA) is challenging due to the complex nature of their prolonged disease trajectory. Despite their risk for developing CA-associated malnutrition and cachexia, little is known

about how well nutrition is being delivered to this population. Methods: In a multi-center prospective audit, adult pts with curative HN or E CA were enrolled from 11 international cancer care settings. Details on the timing of assessment, nutrition needs, swallowing ability, type and route of nutrition and percentage target calories and protein received were collected over six months by the dietitian/nutritionist. Descriptive analyses using means, standard deviation and percentages are used. Results: Between 2016 and 2018, 170 pts (121 HN and 49 E CA) were enrolled. Pts had an average age of 63 yrs, Body Mass Index of 26.7 and majority were assessed by a nutrition expert before radio/chemotherapy or within one month of diagnoses. At baseline, 47% had swallowing problems and average nutrition prescription was 29.7 kcal/kg/day, 1.53 g/kg/day protein. Over 6 months, 86% received an oral diet, of these 84% also received oral nutrition supplements. Enteral nutrition (EN) was received by 54% pts for an average of 62.7 days per pt for reactive (58%) vs. proactive (42%) reasons with the gastric route being preferred to jejunal (66% vs. 34%). A total of 45% pts received oral plus EN for an average of 54 days while <1% received PN (alone or combined with EN and oral). Average percentage target calories and protein received from oral were 53% and 47%; EN 90% and 88%; PN 80% and 90% (n=1). Conclusion: Current nutrition practices across international CA care settings suggest that there is room for improvement in the delivery of nutrition based on the targets of prescribed nutrition received. References: International Nutrition Audit in FORegut TuMors (INFORM) clinicaltrials.gov Identifier: NCT0282948. (Funding: This study is partially funded by Fresenius Kabi Deutschland GmbH and Baxter.)

An evaluation of the predictive validity of image-based visual analogue scales on food intake in children and adolescents

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Temporal tracking of subjective appetite in children has traditionally been assessed with motivation-to-eat questionnaires using paper-based visual analogue scales (VAS), which show good test-retest reliability but poor predictive validity of food intake (FI). Our study aimed to determine the predictive validity of a novel image-based motivation-to-eat VAS software application (Express VAS) on FI in 9-14 year old children and adolescents. On a single test morning, 3 h following a standardized breakfast, 17 children (9 girls, 8 boys; age (mean ± SEM): 11.5 ± 0.3 years; BMI%ile= 53.2 ± 12.9) completed motivation-to-eat questionnaires using three different VAS, in random order, at baseline (0 min) and at regular intervals for 30 min post-snack consumption (147 kcal yogurt). The three VAS were as follows: 1) Express VAS with images (VASimages), 2) Express VAS without images (VASno-images), and 3) traditional, paper-based VAS (VASpaper-based). All VAS measured responses to four motivation-to-eat questions (desire-to-eat, hunger, fullness, and prospective food consumption). Individual elements were then used to calculate average appetite scores. FI was measured from an ad libitum meal at 30 min. There were no significant differences in the incremental area under the curves (iAUCs) for any of the individual motivation-to-eat VAS. Average appetite determined by VASimages directly preceding the ad libitum meal (30 min) was more strongly associated with FI (r=0.63, p=0.007) compared with VASno-images (r=0.60, p=0.011) and VASpaper-based (r=0.56, p=0.02). Among the individual motivation-to-eat VAS, the strongest correlations were at 30 min between prospective food consumption and FI (VASpaper-based: r =0.74, p<0.001; VASno-images: r = 0.71, p<0.001; VASimages: r=0.76, p<0.001). However, the best overall correlation with FI was between VASno-images immediately following snack consumption (5 min) and FI (r=0.82, p<0.001). In conclusion, Express VAS with and without images showed better predictive validity for short-term FI compared with VASpaper-based. Future studies are needed to assess the reproducibility and validity of subjective appetite scores when measured on separate days and in children of different ages.

(This study was funded by the Nutrition & Exercise Testing Lab at Ryerson University.)

A polygenic risk score for obesity is associated with body mass index and waist circumference among a population cohort of Quebec adults

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Background: Obesity is a multifactorial condition that can be influenced by genetics, lifestyle and diet. Recent evidence suggests that diet may interact with genetic predisposition to obesity to influence body mass index (BMI). However, no investigation has examined interactions between diet quality and genetic predisposition to obesity on weight and adiposity outcomes in a Canadian population. **Objective:** To evaluate the interaction between diet quality and a polygenic risk score for obesity on BMI and waist circumference (WC) among a cohort of adults from Quebec. **Methods:** Genetic, dietary, lifestyle, and anthropometric data were obtained from the CARTaGENE biobank (n=4415), a cohort of middle-aged Quebec adults. BMI (kg/m²) and WC (cm) were physically measured for all participants. Participants completed the Diet History Questionnaire II (DHQ) in 2012 and diet quality was assessed by calculating the Canadian adaptation of the Healthy Eating Index 2010 (HEI-C) from the dietary intake data. A polygenic risk score (PRS) comprised of 87 genetic variants associated with BMI was calculated to assess genetic predisposition to obesity. Generalized linear models adjusted for sociodemographic (age, sex, ethnicity, income, education, questionnaire language, season of DHQ completion), lifestyle (physical activity level, smoking), and dietary (energy intake, DHQ misreporter status, alcohol consumption) variables were used to evaluate the main and interactive effects of diet quality and PRS on BMI and WC. **Results:** Significant main effect associations were observed between the PRS and BMI (estimate ± SE: 0.11 ± 0.01, p<0.0001) and PRS and WC (estimate ± SE: 0.22 ± 0.04, p<0.0001). No significant association was observed between the PRS and HEI-C score (estimate ± SE: -0.025 ± 0.03, p=0.313). No significant interaction was observed between the PRS and HEI-C score on BMI (estimate ± standard error (SE): -0.0009 ± 0.001, p=0.615), but a trend was observed for the interaction between the PRS and HEI-C score on WC (estimate ± SE: -0.0052 ± 0.003, p=0.065). **Conclusion:** Genetic predisposition to obesity associates with weight and adiposity outcomes among Quebec adults. Diet quality may modify the genetic risk, but further evidence is needed. (Funding: This work was supported by a grant from the Banting Research Foundation.)

Impact of replacing regular-fat dairy with low-fat dairy on saturated fat intake: a food-level substitution modelling analysis using data from the 2015 Canadian Community Health Survey

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Objectives: The 2019 Canada's Food Guide recommends the consumption of lower-fat dairy products to reduce saturated fat (SFA) intakes. The objective of this study was to model the changes in dietary intakes at the population level if regular-fat dairy products were replaced with their lower-fat equivalents. **Methods:** Dietary intakes from a single 24-hour recall from the nationally representative Canadian Community Health Survey 2015 (CCHS 2015) were used for these analyses. Low-fat dairy replacement items were: 1%fat milks, 10-25%fat cheeses and 0-2%fat yogurts. The nutrient profiles of the replacement items were created by averaging the nutrient profiles of all food items contained within each particular dairy food category, while taking into account prevalence of consumption in CCHS 2015. The substitution

modelling analyses were conducted by replacing all regular-fat dairy products consumed on a given day by an equal amount of their corresponding lower-fat dairy replacement item. **Results:** Among all Canadians (ages 1 to 95 years), replacing all regular-fat dairy products with lower-fat dairy products reduced SFA intakes from a mean (±SE) of 10.7±0.1%E to 9.8±0.1%E (p<0.05). This was mostly attributable to the regular-fat to low-fat milk and cheese substitutions (mean SFA reductions of -0.4%E and -0.3%E, respectively). Reductions in SFA intakes due to such substitution were essentially similar in women and men (-0.9%E vs -0.8%E). Replacing all regular-fat dairy products with lower-fat dairy products among respondents who reported consuming regular-fat dairy products on at least one occasion (82.9% of the population) reduced mean SFA intakes from 11.1±0.1%E to 10.0±0.1%E (p<0.05). Other nutrients such as sugar, vitamin D and proteins were unaffected by this substitution. **Conclusions:** This substitution modelling analysis suggests that replacing all regular-fat dairy products by a lower-fat dairy equivalent at the population level leads to a small but significant reduction in SFA intakes, consistent with the guidelines aimed at lowering SFA intakes in Canada. However, expecting an entire population to consume only lower-fat dairy products is unrealistic and less stringent scenarios will inevitably lead to smaller changes in SFA intakes. (Chair of nutrition, NUTRISS, Université Laval.)

Lack of social ties is linked to higher obesity more in women than men: secondary analysis of baseline CLSA cohort data

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Social relationships have a profound influence on a person's survival and wellbeing, yet little research examines their effect on adiposity as a modifiable risk factor for poor health outcomes. This population-based cross-sectional study utilized baseline data from the Canadian Longitudinal Study on Aging (CLSA, 2012-2015) Comprehensive cohort of 28,238 adults (45-85 years). Binary and continuous outcomes of measured anthropometry (weight and height and waist circumference) were analysed using multiple linear and logistic regression with interaction terms to quantify the association of marital status, living arrangement, social participation and social network size, with general and central obesity (males, WC≥ 102cm; females, WC≥ 88cm); results are reported as gender-specific adjusted means (for continuous outcomes) or odds ratios (for binary outcomes) and 95% Confidence Intervals. We found that non-partnership and less social participation (≤ 2 social activities per month) were each associated with higher odds of general and central obesity in women, more consistently than men. Compared to women with the most social participation (≥5 social activities), those with the least participation were 69% more likely to be generally obese (OR 1.69 [95% CI: 1.24, 2.32]) and had 1.44 kg/m² (95% CI: 0.43, 2.45) higher body mass index. Although single men had 18% higher odds of central obesity (OR 1.18 [95% CI: 1.02, 1.37]) than married men, lone-living men and those with smaller social networks were less likely to have general obesity compared to counterparts. Obesity prevention and management may benefit from the inclusion of interventions to foster stronger social connections among older adults, especially women. (The present research is funded by the Canadian Institute of Health Research grant (#162987) and used data/biospecimens collected by CLSA. Funding for the CLSA is provided by the Government of Canada through the Canadian Institutes of Health Research under grant reference: LSA 94473 and the Canada Foundation for Innovation. This research has been conducted using the CLSA Baseline Comprehensive Dataset version 4.0, under Application Number 19CA003. The CLSA is led by Drs. Parminder Raina, Christina Wolfson and Susan Kirkland.)

Dietary n-3 and n-6 PUFA blunt immune cell accumulation in skeletal muscle from high fat diet-induced obese rats

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Obesity is defined by chronic low-grade inflammation driven in part by infiltration of immune cells into metabolic tissues including skeletal muscle, the primary site for insulin-stimulated glucose disposal and utilization. While obese skeletal muscle is typically characterized by the infiltration and accumulation of macrophages, more recent evidence suggests CD4⁺ and CD8⁺ T cells also contribute to skeletal muscle inflammation and ensuing local and systemic insulin resistance (IR). Therefore, skeletal muscle immune cell accumulation provides a potential target for dietary intervention with anti-inflammatory n-3 polyunsaturated fatty acids (PUFA) to mitigate inflammation and IR in obesity. Sprague Dawley rats (7 wk-old, male) were fed one of three isocaloric diets: i) high-fat (HF; 54% kcal lard, 6% kcal soybean oil), ii) high-fat with fish oil-derived n-3 PUFA (HFn-3; 39% kcal lard + 15% kcal menhaden oil + 6% kcal soybean oil) or iii) high-fat with n-6 PUFA (HFn-6; 45% kcal lard + 15% kcal soybean oil) for 2, 4, 8 or 12 wk (n=8-12/diet/time point). Quadriceps muscles from rat hind limbs were obtained at each time point to assess macrophage (CD11b/c⁺) and T cell (CD4⁺ and CD8⁺) accumulation by flow cytometry. Quadriceps muscle from HF-fed rats had an increased total number of CD11b/c⁺, CD4⁺ and CD8⁺ cells with each subtype reaching significance at 8 wk compared to 2 or 4 wk ($P \leq 0.05$). Both total CD4⁺ and CD8⁺ T cell numbers were increased at 8 wk compared to 2 wk, while CD11b/c⁺ cells were increased at 8 wk compared to 4 wk ($P \leq 0.05$). HFn-3 and HFn-6 equally blunted the HF-induced accumulation of CD11b/c⁺, CD4⁺ and CD8⁺ cells in quadriceps muscle at 8 wk ($P \leq 0.05$). Taken together, these data suggest n-3 and n-6 PUFA supplementation may be an effective dietary strategy to reduce skeletal muscle inflammation by mitigating immune cell accumulation. (NSERC.)

Food security is associated with arthritis among Canadian adults

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Arthritis, as a multifactorial chronic inflammatory disease, is a major public health problem in Canada, especially among older adults. Studies report a link between food insecurity and chronic diseases. The potential association between food security and arthritis among Canadian adults warrants more studies. We examined whether there is such association using a nationally representative Canadian survey taking into account other lifestyle factors such as ethnicity, and immigrant status. We used the 2015-2016 Canadian Community Health Survey data for adults ≥ 18 years. We excluded Newfoundland and Labrador, Ontario, and territories of the primary population due to incomplete data for food security. Self-reported questionnaires were captured to collect the data on the history of arthritis and potential risk factors including age, sex, BMI, marital status, income, education, food security, physical activity, smoking status, alcohol use, perceived life stress, immigration status, and ethnicity. Adults (n=64,976) were categorized into food secure and food insecure. Multivariable logistic regressions technique was used to determine the association between arthritis and food security while adjusting for sociodemographic and lifestyle factors. Over 20% of Canadian adults reported having arthritis with higher prevalence in the oldest age groups [Adjusted Odds Ratio (ORadj) (95% confidence interval): 40.51 (25.83-63.52)], women [ORadj: 1.63 (1.51-1.76)] and obese individuals [ORadj: 1.83 (1.68-2.01)]. The prevalence of arthritis ranged from 19.30% to 26.60% from Quebec to the Atlantic region, and in non-white (non-indigenous) (9.07%) was less than white (22.75%) and indigenous people (22.47%). The adjusted ORs were significant in food-insecure adults for arthritis [ORadj: 2.21 (1.66-

2.95)]. Other contributing factors were significant ($P \leq 0.05$) in the multivariable model. Findings indicate that food insecurity is associated with arthritis. Further research is warranted to provide an in-depth understanding of the nature of the association between food insecurity and arthritis.

Energy provision estimation changes after indirect calorimetry testing in critically ill patients.

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Background: Indirect calorimetry (IC) is a precise tool to measure energy expenditure in critically ill patients that aims to avoid under-feeding or overfeeding and loss of critical lean body mass. Predictive equations may not accurately reflect required energy needs in critically ill patients compared to IC. The aim of this quality assessment initiative is to describe the rationale to guide decision making and implementation of a process to target energy provision. **Methods:** IC was performed in adult patients admitted to an intensive care unit or the clinical ward from June 2018 to December 2020. Energy expenditure measured by IC was compared to the estimation of energy needs by two methods: 1) Predictive formula (25kcal/kg), and 2) Harris Benedict formula. A change in energy provision was considered as any increase or decrease in amount of calories directed by IC. Continuous data was expressed as mean and standard deviation (SD), and categorical data as proportion of patients. **Results:** From June 2018 to January 2019 there were 329 IC tests performed in 293 patients (132 female; mean age 56.1 years; SD 18.6). Forty-three/329 cases had incomplete data and therefore were excluded from the analysis. The most common reasons for admission to ICU were: sepsis (32%) and post-surgery (24%), followed by trauma and respiratory or cardiac failure. IC was measured for a period of 25 to 55 minutes. The predictive formula under-estimated energy expenditure in 63% of patients (mean deficit 648 Kcal/day) compared to IC; which corresponds to a deficit of 28% in patient's energy needs. Similar results were found with Harris Benedict formula, which underestimated energy expenditure in 79% of patients (mean deficit 781 Kcal/day); or 29% of patient's energy needs) compared to IC. Energy provision changed in 59% of patients after the first IC test, and in 55% of the overall IC test. There was a noticeable increase in energy provision in 76% cases after IC was performed. **Conclusion:** IC leads to changes in energy provision in the great proportion of critically ill patients. Accurate energy estimate could prevent over and underfeeding patients and has the potential to improve outcomes

Assessment of the feasibility of a randomized controlled trial protocol for examining outcomes associated with an e-health dietary sodium reduction intervention in primary care

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Canadian sodium intakes remain high despite population-wide sodium reduction policies, highlighting the need for sodium-related behavioural interventions. In general, eHealth tools can support patients in dietary change and healthcare providers in improving their quality of care; however, the impact of diet-focused eHealth tools, such as the Sodium Calculator (SC) dietary screener, on these outcomes has not been examined. The objective of this study was to assess the feasibility of an RCT protocol that was designed to examine the effect of the SC on quality of dietary advice for sodium reduction provided by physicians in primary care settings for their patients with

hypertension. Physicians were randomized to a SC group (used the SC to counsel patients) or to a usual care group. Quality of dietary advice was the primary trial endpoint assessed by patients after seeing their physician, using a validated questionnaire. Protocol feasibility (primary outcome of this study) was assessed by direct observation, survey data, and by interviews with patients, physicians and clinic staff. Data was thematically categorized and evaluated based on validated criteria of feasibility: process, resource, management and scientific feasibility. The study included 7 physicians (n=4 in the SC group, n=3 in usual care group) and 65 of their patients with hypertension (50% male, 69.3 ± 10.1 years). Initially, there were challenges with recruitment rate (34% among patients, 43% among physicians), physician adherence to protocol (76%) and resource use (clinic space for study). However, simple protocol adjustments were made to fully correct these issues. There were several areas of success: 100% of physicians reported that the trial minimally disrupted their workflow, and 75% of agreed that the SC was beneficial for their patients and could easily be integrated into practice. The final optimized study protocol was successful and deemed appropriate for a scaled-up, fully-powered RCT. This study protocol will help determine if the SC is a tool that can be used as an intervention to aide physicians in improving their quality of care for their patients who require sodium reduction. (Funded by the Heart and Stroke Foundation.)

Validation of a Sodium Advice Questionnaire (SAQ) to assess the quality of sodium reduction advice provided by healthcare providers

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Healthcare providers (HCP) in primary care are key agents of change when they discuss dietary modifications with their patients, which is particularly important in higher-risk patients. However, implementation of nutrition guidelines, such as advice on sodium reduction, is suboptimal with only 20% of patients receiving advice in discussions lasting <1 min. Optimizing and assessing the quality of these encounters is an important step in the development and evaluation of interventions to improve quality of nutrition care; however, there are no known tools to assess the quality of nutrition advice provided in these brief encounters. The objective of this study was to develop and assess the validity of a questionnaire to measure the quality of brief advice provided by HCPs about dietary sodium reduction. An 11-item Sodium Advice Questionnaire (SAQ) was developed and validated for face and content validity by 14 dietitians and nutrition scientists. The SAQ provides a weighted-score out of 16 points. To assess construct validity, forty patients with hypertension were randomized to receive either high-quality advice (detailed advice from a dietitian) or low-quality advice (basic educational pamphlets). All participants completed the SAQ after receiving advice, and the SAQ scores were compared between the study groups. The patients were 51% male, 71.1 ± 7.7 years with 3.3 ± 1.9 comorbid conditions and taking 1.8 ± 1.0 anti-hypertensive medications, and estimated sodium intake of 2860 ± 1910. The SAQ was able to differentiate between high and low-quality advice, as there were significantly different SAQ scores between the two groups (6.8 ± 3.4 vs 14.8 ± 1.3, p<0.001). The expected SAQ scores were 5 and 16 for the low- and high-quality advice groups, respectively. The high-quality advice scores observed were statistically similar to the expected score of 16 (p<0.001), but the low-quality advice scores were not. Overall, the SAQ questionnaire showed evidence of being a valid tool to measure the quality of brief sodium reduction advice provided by HCPs, and is deemed an appropriate tool to measure this outcome in future research. (Funded by the Heart and Stroke Foundation.)

Assessing the ketogenic response in blood with varying doses of Medium Chain Triglyceride (MCT) oil given to subjects with and without Alzheimer's disease

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MCT oil intake is increasingly used as a source of exogenous ketones. The limited literature assumes a linear ketone response to increasing MCT doses. This study is the first to look at B-hydroxybutyrate (BHB) response to varying doses of MCT oil. Pharmacokinetic study evaluating ketogenic response to MCT oil (14g, 28g, 42g) in healthy subjects with no cognitive deficits <65years, ≥65years, and those with Alzheimer's Disease. The test oil, Bulletproof Brain Octane® MCT oil, 100% C8:0, was given in a fruit drink at baseline. BHB was measured at baseline, and every hour for 5 hours (using a finger stick sample). Water was allowed ad libitum but no food. Each subject attended four different days for four different doses (0g, 14g, 28g, 42g), starting at the lowest dose to assess tolerability to continue the study. Side effects (gastrointestinal upset, etc) were documented. Data also collected on body composition (BIA scale), BMI and pre-study breakfast. Study approved by Health Canada and local HREB. Twenty-five participants completed the study. Eight, nine and eight in the respective groups, average age of 44yr (25-61), 79yr (65-90) and 78.6yr (57-86) respectively. Pooled data showed the expected linear dose response relationship with baseline corrected area under the blood vs. time curve (r²=0.98) and maximum concentrations (r²=0.97). No difference between the groups. However, marked individual variability in response (maximum BHB response with 42g dose 0.4 -2.1mmol/l). Similarly, time to reach maximum BHB response varied depending on the dose, both within and between individuals. This was unrelated to age or BMI. Four participants (16%) experienced "flu-like" symptoms with either 28g or 42g, or both, lasting approximately 2 hours. None were severe enough for study discontinuation, and those experiencing it at 28g had no concerns continuing with the 42g dose. Eighteen (72%) experienced some minor GI discomfort, not necessarily related to the measured blood BHB level. 28% subjects experienced no side effects. This study is first to evaluate individual BHB responses to varying MCT doses. Ongoing analysis is evaluating potential predictors of BHB response. The large inter-individual variability identified creates heretofore unrecognized challenges in generalising clinical responses to MCT intake.

Dietary prevention of atherogenesis is consistently associated with increased levels of plasma erythropoietin in low density lipoprotein receptor knock-out mice

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Atherosclerotic cardiovascular disease (CVD) is a major source of morbidity and mortality globally. Accumulating evidence has suggested that diets and lifestyle significantly contribute to the risk factors for atherosclerotic vascular disease. We previously reported the significant anti-atherogenic effects in low density lipoprotein receptor knock-out (LDL-r-KO) mice; control (n=10) and treated groups (n=10) fed atherogenic diets (0.06% (w/w) dietary cholesterol), while treated mice received diets supplemented with wild rice (60% w/w), Kgenwge (Citrullus lanatus) seeds (10% w/w), or phytosterols (2% w/w) for 20 weeks. This study was approved by the Animal Care Committee at the

University of Manitoba. To examine the potential mechanism of action of these diets, plasma samples of treated and control mice were collected to measure plasma lipid profile and a panel of 35 plasma inflammatory cytokines, using commercially available enzymatic kits and Meso Scale Discovery U-PLEX Mouse multiplex assay, respectively. At the end of the study, mice were sacrificed; hearts were collected and processed for morphological and morphometrical examination of aortic roots to measure atherosclerotic lesions. Atherosclerotic lesion size was significantly lower in the treated groups as compared to that in the control group ($p < 0.05$). While the effects of these dietary treatments did not consistently reduce plasma lipid levels, a significant ($p < 0.05$) upsurge in the plasma levels of erythropoietin (EPO) was observed in all the treated groups including wild rice (15.64 ± 3.32 pg/mL), Kengwe seed powder (15.84 ± 4.47 pg/mL), and phytosterols mixture (10.06 ± 2.14 pg/mL) as compared to control group (5.84 ± 2.27 pg/mL). Our results suggest that anti-atherogenic effects of these functional diets are mediated through increased levels of erythropoietin. Further studies are required to understand the mechanism of EPO in relation to atherogenesis beyond its haematopoietical effects. (Supported by Natural Sciences and Engineering Research Council of Canada (NSERC) and Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL) Grants.)

Maternal misperception of weight status of black children living in Ottawa

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Background: Parents play a key role in the prevention and management of childhood obesity. Canadian studies reported that black children are at higher risk of developing overweight or obesity. Among other ethnic groups, longitudinal studies have found that parents' accurate weight status perception of children with overweight/obesity was associated with greater weight gain over time. However, little is known about black parents' perception of their children's weight status in Canada. **Objective:** To evaluate mothers' perception of black children's weight status. **Methods:** We recruited 200 black mothers of African and Caribbean descent living in Ottawa and their children aged 6-12 years old. Maternal body shape perception was assessed using a sex-specific figure rating scale with eight silhouettes showing a range of body sizes from underweight to obese. The eight silhouettes were then combined into four categories: underweight, normal-weight, overweight and obese. Children's weight and height were measured and their weight status was defined using the World Health Organization references. Pearson χ^2 and kappa tests were performed in SPSS to assess the association and the agreement between children's weight status and maternal body shape perception. **Results:** The prevalence of overweight and obesity were both 22.9%. Mothers correctly perceived the weight status of 75.9% normal-weight children, 36.2% children with overweight and 4.4% children with obesity. Prevalence of underestimation was the highest among mothers of children with obesity (95.6%), followed by children with overweight (63.8%) and normal-weight children (17.6%). Compared to mothers with normal-weight children, mothers of children with overweight or obesity were less likely to accurately perceive their children's weight status ($\chi^2=80.15$, $p < 0.01$). There was a poor agreement between children's weight status and mothers' perception of their children's weight status (Kappa=0.12, $p < 0.01$). **Conclusions:** These results suggest that black mothers may lack awareness of their children's overweight/obesity status. Parental perception of weight status should be considered when developing obesity management interventions to help avoid unintended consequences, such as further weight gain. Longitudinal studies should assess if a protective effect of weight status underestimation is present among black children in Canada.

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Contribution of dietary supplements on shortfall nutrients among Canadians

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Vitamin/mineral supplements play a fundamental role in improving overall micronutrient intake and preventing deficiencies since they are relatively inexpensive and can be taken without prescription. This study examines vitamin/mineral supplement use in the Canadian population and to describe the socio-economic characteristics of current supplement users such as education level, household income, and place of residence. The data are from the 2015 Canadian Community Health Survey—Nutrition ($n=20,487$) among aged one year and above. The prevalence of vitamin/mineral (B6, B12, vitamin C, calcium, folate, vitamin D, magnesium, potassium, vitamin A, and zinc) supplement use during the previous month was recorded. Age/sex groups estimated the frequency of supplement use at the national level. Weighted logistic regression was used to determine significant associations between socio-economic factors and vitamin/mineral supplement use. The usual intake of folate from food and supplement ($\mu\text{g/day DFE}$) was obtained using the National Cancer Institute (NCI) method. The prevalence of supplement consumption was significantly higher in females across all age groups (9 years or older). Females aged 71 or older had the highest proportion (68%) of supplement intake. Age groups (OR= 1.6 to 4.3 compared to children), income (OR=1.41 CI: 1-1.99), education (OR=1.24 CI: 1.104-1.48), having chronic condition (OR=1.91 CI: 1.62-2.25) and urban residence (OR=1.34 CI: 1.03-1.74) were positively associated while being obese (OR=0.78 CI: 0.65-0.94) and smoker (OR=0.54 CI: 0.43-0.68) had negative association with supplement use among adults. Food security (OR=1.45 CI: 1.02-2.04), age (OR= 0.2 - 0.7) and being obese (OR=0.75 CI: 0.6-0.94) were significantly associated with supplement consumption among children. Although the older women had the highest percentage of supplement use, the prevalence of inadequacy in folate intake was relatively high (27.7%). Canadians who need vitamin/mineral supplement for shortfall nutrients the most were the ones who took less. A higher proportion of individuals with higher income, education and level of food security used vitamin/mineral supplements. (Financial Support: University of Saskatchewan.)

Dietary lysine is more bioavailable when provided as a dipeptide to neonatal piglets with parenteral nutrition-induced gut atrophy

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Peptide transporter 1 (PepT1) plays a crucial role in the absorption of dietary di/tripeptides. Of note, the total activity of PepT1 is preserved during intestinal stress or injury, such as during parenteral nutrition (PN), whereas free amino acid transporters decline. Prolonged PN leads to gut atrophy, weakened gut barrier function, and higher risk of intestinal infections; therefore, enhanced nutrient uptake during enteral re-feeding is important to facilitate rapid recovery. Our objective was to assess the effectiveness of delivering lysine as a dipeptide when intestinal injury is present. Piglets ($N=20$, 7 ± 1 d old) received exclusive PN feeding for 4 d to induce gut atrophy. Subsequently, piglets were randomized to one of three identical enteral diets, except with equimolar lysine supplied as: 1) lysyl-lysine (lys-lys) ($N=7$); 2) free lysine ($N=7$); or 3) lysyl-lysine with glycyl-sarcosine (lys-lys+gly-sar) ($N=6$). Gly-sar is a non-physiological hydrolysis-resistant dipeptide with high affinity to PepT1 and was included to determine whether competitive inhibition of lys-lys uptake would alter overall lysine

availability. Lysine intake was 75% of NRC requirement for all diets; gly-sar was twice the molar lysine concentration. Enteral diets were gastrically-delivered for 18 h. At hour 12, whole body protein synthesis was measured using a primed constant infusion (5 h) of phenylalanine and tyrosine isotopes, followed by the measurement of tissue-specific protein synthesis using a flooding dose of 3H-phenylalanine. Lysine from lys-lys was better utilized, as whole-body protein synthesis was higher in lys-lys compared to free lysine ($p < 0.01$) or lys-lys+gly-sar ($p < 0.001$) pigs. Gly-sar reduced lysine availability, likely by interfering with PepT1, as indicated by significantly lower protein synthesis in liver, jejunal mucosa and muscle in lys-lys+gly-sar pigs compared to lys-lys or lysine groups ($p < 0.05$). Plasma lysine was higher in the lys-lys versus the lys-lys+gly-sar group ($p < 0.01$). Lysine availability was enhanced by efficient uptake of lys-lys by PepT1, which was competitively hindered by gly-sar. This demonstrates the importance of PepT1 in restoring protein nutrition when enteral re-feeding is initiated into a compromised gut, and can inform the development of diets that will optimize amino acid uptake and utilization in a situation of intestinal stress. (Funded by NSERC.)

Nutrition risk in pre-operative colorectal cancer patients: identification by Patient-Generated Subjective Global Assessment Short Form and computed tomography body composition analysis

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Background: Cancer-associated malnutrition is associated with poor oncologic outcomes in patients with colorectal cancer (CRC). Current surgical guidelines recommend pre-operative nutrition screening to identify patients at risk of cancer-associated malnutrition. Skeletal muscle abnormalities including sarcopenia (low muscle mass) and myosteatosis (low muscle radiodensity) are associated with poor surgical outcomes including longer length of hospital stay and more readmissions. The Patient-Generated Subjective Global Assessment Short Form (PG-SGA-SF) is a screening tool validated in oncology to identify patients with nutrition risk; however, it is unclear to what extent the PG-SGA-SF can also be used to identify patients with sarcopenia and myosteatosis. We investigated the prevalence of sarcopenia and myosteatosis among patients with and without nutrition risk as assessed by the PG-SGA-SF. **Methods:** Pre-operative data was prospectively collected from patients with CRC scheduled for colorectal surgery at two sites in Edmonton, Canada. Nutrition risk was defined as PG-SGA-SF score ≥ 4 ; sarcopenia and myosteatosis were identified by computed-tomography (CT) analysis of staging scans using previously published sex- and age-specific thresholds defined in a larger CRC cohort. **Results:** Surgical patients ($n=144$) with a mean age of 64.1 ± 10.2 years, 50% male, 94.2% with stage 0-III disease, and mean BMI $28.6 (\pm 6.6)$ kg/m² were included. Nutrition risk was identified in 22% of patients, whereas 47% had a muscle abnormality including sarcopenia alone (12.5%), myosteatosis alone (27.8%) or both (6.9%). When PG-SGA-SF and muscle abnormalities were considered together, 12% of patients had nutrition risk concurrent with a muscle abnormality; 9% had nutrition risk with no muscle abnormality; 35% had no nutrition risk with muscle abnormality, and 44% had neither nutrition risk nor muscle abnormality. **Conclusion:** Pre-existing nutrition risk, sarcopenia and myosteatosis are prevalent in pre-operative CRC patients. While nutrition risk and muscle abnormalities co-exist to some degree, 35% of patients with muscle abnormalities are not identified by the PG-SGA-SF as having nutrition risk. It would be prudent to assess body composition in pre-operative CRC patients who have PG-SGA-SF scores of 0-3, enabling early interventions to prevent progression of nutrition risk and muscle abnormalities after surgery. (Alberta CSC Network Seed Funding; CIHR; Alberta Innovates SPOR; CIHR-CNS Fellowship.)

The CHANGE Adventure Camp promotes adoption of healthy lifestyle habits

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Introduction: With the rise of pre-packaged and processed meals, children are consuming unhealthy diets and growing up unable to cook. They are also failing to meet recommended physical activity levels; these unhealthy lifestyle practices explain the growing prevalence of chronic diseases in the Canadian population. The CHANGE (Canadian Health Advanced by Nutrition and Graded Exercise) Adventure Camp seeks to address these issues through a week long camp that gives children the opportunity to gain knowledge and skills surrounding nutrition, meal preparation, and physical literacy. **Hypothesis:** Is the CHANGE Adventure Camp successful in creating positive change in the attitudes and behaviours of children surrounding physical activity and healthy eating? **Methods:** Participant attitudes and behaviours surrounding nutrition and exercise were assessed at the start and end of camp, as well as four weeks post camp through activities and online surveys. Intentions towards change and feedback were also collected at the end of camp. **Results:** Forty-one children and thirty parents consented to participate in the study. Feedback indicated that 100% of parents were satisfied with the camp and 71.8% of participants would recommend the camp to their friends. Only 65.9% of children understood how to read food labels at the start of camp, compared to 87% at the end of camp. At the end of camp, over 70% of children intended to help with cooking at home, eat more home cooked meals, and eat more fruits and vegetables in the future. At the start of camp, only 58.6% of participants indicated they were sometimes performing these behaviours. Four weeks post-camp, there was an increase in healthy behaviours across almost all targeted curriculum themes; most prominently, a greater proportion of children were reading food labels and helping out with cooking at home. **Conclusion:** The CHANGE Adventure Camp is a novel intervention that promotes adopting healthy lifestyle habits in children. Short-term post-camp changes were demonstrated. (Camp Funding was provided by a Canadian registered charity Change Health Alberta (Charity #767951098RRR0001). Research funding was provided by Dr ME Ledingham Memorial Summer Research Award from the University of Alberta.)

Dietary behaviors and nutrition status of pregnant Indigenous women living in northern Manitoba

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Introduction: Planning maternal health programs requires a comprehensive understanding of all maternal behaviors including lifestyle and dietary patterns. Compromised maternal nutrition is identified as one of the major factors contributing to infant health and development, especially when challenged with alcohol insults during pregnancy. This study aimed to identify and compare food intake behaviors, nutrition status, and lifestyle patterns of pregnant First Nations women with and without alcohol consumption. **Methods:** Through the partnerships with two Northern communities in Manitoba, 59 pregnant women ages 14-45 were recruited. Using an interactive questionnaire "Nutrition for Two", in paper and ipad formats in a face to face setting, information was obtained on participant demographics, dietary intake, substance use, pregnancy outcomes and maternal health. A food frequency questionnaire and 24-hour recall were used to determine nutrient intake. Nutrient adequacy was assessed using Dietary Reference Intakes. **Results:** Among 59 participants, 26 (44%) consumed alcohol during pregnancy. Significant differences ($p < 0.05$) were observed for Dietary Reference Intakes (DRIs) between

alcohol and non-alcohol consuming women for the following: zinc (122% vs 211%), folate (57% vs 95%), choline (92% vs 157%), vitamin C (126% vs 256%), niacin (141% vs 238%), calcium (75% vs 123%), and iron (57% vs 100%). Significant differences ($p < 0.05$) were also observed for fat intake (99 vs. 60 grams). Both groups of women were below the former Health Canada Canada's Food Guide's recommendations for serving sizes for all food groups: Fruits and Vegetables, Grains, Milk and Alternative, Meat and Alternatives, without significant differences between the groups. Women consuming alcohol reported having lower food access and food availability. Conclusion: These findings demonstrate that pregnant women residing in Northern communities do not meet Health Canada's recommendations, have lower intake of micro-nutrients, have poorer food access and availability compared to women who did not consume alcohol. The findings provide fundamental premise for the development of best-practice policies and advocacy to benefit maternal and child health in Northern Manitoba.

Effect of flaxseed as a whole food or isolated hull fraction on gut Bacteroides and serum lignans concentrations in female C57BL/6 mice

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Flaxseed (FS) consists of a kernel, rich in oil and proteins, and the hull (FH), rich in fiber and lignan [secoisolariciresinol (SECO) diglucoside, SDG]. Gut microbes cooperate to ferment fiber to short chain fatty acids and to metabolize SDG. Bacteroides are major players in SDG conversion to SECO, which is then converted by other taxa into enterolignans, enterodiol (ED) and enterolactone (EL). Enterolignans act as phytoestrogens with weak estrogenic effects. Our objective was to investigate the effect of FS and FH on Bacteroides intestinal loads and its relationship to serum lignan levels in female C57BL/6 mice. C57BL/6 female mice (4-5 weeks of age) were randomized into three groups to receive either i) Basal Diet (BD, AIN93G), ii) 10%FS, or iii) 10% FH (n=16-17/group) for 21 days. At sacrifice, cecum content and blood serum were collected for quantification of Bacteroides genus (qPCR; data normalized to total bacteria counts) and lignans (LC-MS), respectively. Statistical analyses were performed using GraphPad Prism 8.0.2. There was a significant 75% increase in Bacteroides relative abundance in the FH group compared to BD (Kruskal Wallis with Dunn's post hoc, $p < 0.05$), but not to FS. SECO, EL, and ED were detected in the serum of mice receiving FS and FH, but not in BD. SECO and ED were significantly higher in FH group compared to FS (Mann-Whitney, $p < 0.05$). Percent Bacteroides positively correlated with total lignans and SECO concentrations (Spearman $R=0.48$, $P=0.02$ and $R=0.58$, $P=0.004$, respectively), but not with other lignans. This study shows that key SDG converters, such as Bacteroides, respond to increased SDG dietary input. This offers an approach for their modulation. The larger effect of FH vs FS suggests that FH higher level of fiber may also be necessary for lignans microbial processing. (NSERC Discovery grant (EMC, LUT), Lawson Family Chair in Microbiome Nutrition Research at the University of Toronto (EMC).)

Flaxseed and its oil and lignan components affect the mouse intestinal microbiome in a different manner

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Flaxseed (FS) is rich in oil (FSO), lignan (secoisolariciresinol diglucoside, SDG), and fiber. SDG and fiber are metabolized by the gut micro-

biome to produce short chain fatty acids and enterolignans, which contribute to FS benefits. However, it is unclear how different FS components affect the microbiome. Our objective was to investigate the effect of FS, FSO and SDG, at the level found in FS, on the cecal and fecal microbiome composition and functional potential. C57BL/6 female mice (4-5 weeks old) were randomized to either Basal Diet (BD, AIN93G), 10% FS, 3.7% FSO, or 0.15% SDG isocaloric diets (n=8-14/group) for 21 days, when cecum content and feces were collected. Extracted DNA was used for 16S rRNA-gene sequencing (V3-V4 region primers, Illumina MiSeq; data processed in QIIME). Functional prediction was completed with PICRUSt. Differentially abundant taxa and KEGG pathways were identified using linear discriminant analysis effect size (LEfSe). In cecal content and feces, FS increased microbial richness compared to all other diets (Chao1, $P < 0.05$) and modified β -diversity (UniFrac distance metric, PERMANOVA, $P < 0.05$). Site- and diet-specific enriched genera and functional pathways were identified. Genera included the fiber-degrader Roseburia in cecum and feces and saccharolytic Bacteroides in feces of FS-fed mice. SDG metabolizers, Ruminococcus and Eubacterium, were enriched in cecum and/or feces of SDG-fed mice. Mucispirillum was enriched in FSO-fed mice feces. In cecum content, 17 pathways were enriched in the FS group, including carbohydrate metabolism and phenylpropanoid biosynthesis, related to fiber or SDG metabolism. These were not enriched in SDG-fed mice. Lipid metabolism-associated pathways were enriched in FSO-fed mice. These findings suggest that at the compositional level, gut microbial taxa respond to specific dietary inputs. Though, functional pathways may vary differently. The increase in SDG metabolic pathways in the FS group is aligned with our published data of increased enterolignans concentration in the serum of these same mice, as compared to SDG and FSO, and suggest that FS components, in particular fiber, synergize to drive gut microbiome responses. (NSERC Discovery (EMC, LUT), NSERC CGSM (ZL), Undergraduate Research Opportunity Program Award, University of Toronto (AK), Lawson Family Chair in Microbiome Nutrition Research (EMC).)

Concurrent validation of the CHEERS survey and the mindful eating questionnaire

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Children's eating and activity patterns are strongly influenced by early childhood social, cultural, and physical environments surrounding the eating and activity experience. The creating healthy eating environments in childcare (CHEERS) survey is a 59 item audit tool that can be self-administered to measure gaps, weaknesses, and strengths of early childhood education and care (ECEC) centre-based nutrition and physical activity environment. It has undergone content validation and reliability testing but has yet to undergo concurrent validation. The mindful eating questionnaire (MEQ) provides a non-judgemental awareness of physical and emotional sensations with eating. CHEERS and MEQ measure overlapping constructs related to healthy eating constructs. The purpose of this study was to concurrently validate the CHEERS audit tool with the MEQ. Educators from ECEC centres in Alberta were recruited as part of a larger study to determine the impact of a 10-month well-being intervention focused on nutrition, physical activity, personal health, and sleep on the ECEC environment and educator professional practice. Educators completed the CHEERS and MEQ tools to provide a baseline measure of current practice. Pearson r correlation coefficient was calculated on the four subscales of the CHEERS score (food served, healthy eating environment, healthy eating program planning, and physical activity environment), the MEQ score, and educator age using SPSS v26. A total of 212 educators with a mean age of 38.3 ± 8.9 from 42 ELCC centres participated in the study. The average score for the CHEERS subdomains were: food served 5.97 ± 0.71 ; healthy eating environment 5.82 ± 0.86 ; healthy eating program planning 4.51 ± 1.43 ; and physical activity environment 5.64 ± 0.97 . The MEQ subdomain of awareness was positively

correlated with the CHEERS healthy eating environment ($r=.17$, $p=.05$) and healthy eating program planning ($r=.22$, $p=.01$). The overall MEQ score was significantly associated with educator age ($r=.20$, $p=.02$). The alignment between the MEQ awareness subdomain with the CHEERS healthy eating environment and program planning domains provides evidence of concurrent validity for the CHEERS audit tool. (Study funded by Government of Alberta.)

Garden2Plate: a 12-week food literacy intervention program for preschoolers in structurally disadvantaged families

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Food literacy, the ability to plan, select, prepare, and eat foods that support health, begins in early childhood through an interplay of modeling and exposure in the home environment. Structurally vulnerable families experience increased incidence of food insecurity and poor nutrition profiles which may lead to reduced food literacy skills and cyclic health disparity patterning. The objective of this study was to explore the impact of a 12-week food literacy preschool-parent program on vegetable consumption and eating behavior in young children. This study was informed by a social-ecological model and followed a concurrent nested mixed methods design that included preschool-parent dyads from economically disadvantaged households in Calgary, Canada between 2018 and 2019. In a 12-week curriculum, preschool-parent dyads engaged in an inclusive group gardening program facilitated by a trained horticultural therapist (45 minutes) followed by a nutrition-education and food skills program (45 minutes) facilitated by a registered dietitian. Qualitative inquiry was based on weekly observations, semi-structured interviews, and photo-elicitation tours with preschoolers. Quantitative assessment entailed measuring nutrition risk with NutriSTEP as well as vegetable acceptance and eating patterns utilizing “focus on veggies” and children’s eating behaviour questionnaire (CEBQ) tools. A total of 29 preschool-parent dyads participated (93% mothers; 55% male child) in the study. Analysis of semi-structured interviews revealed that relationships provided the context for families to make connections that resulted in healthy eating milestones. Parents also reported enhanced sense of belonging and connection for themselves as an unexpected and highly valued outcome. Recognition and increased vocabulary surrounding plants & vegetables in preschoolers was connected to an increase in willingness ‘to try’ new foods. NutriSTEP scores decreased significantly over the 12 weeks ($t=3.45$; $df=28$; $p=0.002$) with a 40% reduction in moderate and high risk scores post-intervention ($t=3.01$; $df=28$; $p=0.005$). A significant increase in the “focus on veggies” score ($t=4.40$; $df=28$; $p\leq 0.001$) and no change in CEBQ overall score was observed post-intervention. The results from this study suggest that preschool-parent dyad participation in a food literacy program within a structurally vulnerable population can improve attitudes and preferences for vegetables and willingness to try new foods. (MRU Innovation Fund.)

High plasma apoB-lipoproteins are associated with higher NLRP3 activity in human adipose tissue, which is inhibited by EPA and DHA

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Objective: High plasma apoB-lipoproteins (i.e. apoB) predicts the risk for type 2 diabetes (T2D). However, the underlying mechanisms and the nutritional approaches to target them remain unclear. Activation of white adipose tissue (WAT) NLRP3 inflammasome and

interleukin-1 β (IL-1 β) secretion promote T2D. Low density lipoproteins (LDLs) upregulate the NLRP3 inflammasome in immune cells while omega-3 fatty acids (EPA and DHA) inhibit it. Thus, we hypothesized that plasma apoB is associated with higher WAT NLRP3 inflammasome activity, which is inhibited by EPA+DHA supplementation in humans. Methods: This is a preliminary analysis of 39 subjects (45-74 years, BMI>20 kg/m²) of whom 11 men and 19 post-menopausal women completed a 12-week trial with 2.7 g/day EPA+DHA (2:1). We measured glucose-induced insulin secretion (GIS), insulin sensitivity (IS) and disposition index (DI) (Botnia clamps), 6h-postprandial plasma TG clearance after a high-fat meal, WAT NLRP3 inflammasome priming (NLRP3 mRNA, RT-qPCR) and activation (IL-1 β secretion, α -LISA), WAT LDLR and CD36 surface-expression (immunohistofluorescence) and fatty acids in red blood cell (RBC) phospholipids (GC/MS). The effect of EPA+DHA (200 μ M) on WAT IL-1 β secretion was measured without or with stimulation with lipopolysaccharide (LPS, 0.3 g/mL), adenosine triphosphate (ATP, 3 mmol/L) and/or native LDLs (1.2 g apoB/L). Results: Baseline plasma apoB correlated positively with WAT NLRP3 mRNA, WAT IL-1 β secretion, GIS, and postprandial hypertriglyceridemia ($r=0.36$ to 0.68) and negatively with IS ($r=-0.35$). WAT IL-1 β secretion correlated positively with 2nd phase GIS ($r=0.88$, in men) and delayed chylomicron clearance ($r=0.48$) and negatively with IS ($r=-0.53$). Following omega-3, there was an increase in %EPA+DHA in RBC phospholipids, 1st phase GIS and DI and an amelioration in postprandial hypertriglyceridemia. Post-omega-3 changes in plasma apoB, WAT LDLR and CD36 surface-expression, WAT NLRP3 mRNA, WAT IL-1 β secretion, postprandial hypertriglyceridemia and IS were negatively correlated with their baseline values ($r=-0.52$ to -0.84). Compared to palmitate, EPA+DHA inhibited WAT IL-1 β secretion at baseline (-95.6%) and after stimulation with LPS+ATP (-85.1%), LDLs+ATP (-73.6%) or LPS+LDLs (-96.8%). Conclusion: Upregulated WAT NLRP3 inflammasome activity may be a mechanism underlying higher risk for T2D in subjects with hyperapoB, which may be inhibited by EPA and DHA supplementation. (Funded by CIHR grant #123409.)

Dietetics trainee perceptions of stress and anxiety in a combined graduate course work and competence-based practicum training program

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In training to become registered dietitians completion of the Partnership for Dietetic Education and Practice (PDEP) integrative competencies are required, including a minimum time allocation of 1250 hours towards competency development. Ensuring that students allocate the required time commitment towards competency development is imperative, however, such rigorous practical skill-based experiential learning and academic demands can also impact dietetics trainees mental health and wellness. Participants ($n=17$) were enrolled in the Master of Applied Nutrition (MAN) program at the University of Guelph, a combined program of graduate course work and dietetics competency-based practicum, and utilized the daily time-tracking program Toggl over a two-week period that was representative of typical program activities during the winter and summer semester to self-report their time allocation. Time spent working towards attaining professional practice requirements was assessed and correlated with students’ survey responses regarding their perceptions of their mental and physical health and well-being while enrolled in the program. Students spent an average of 26.5 hours/week at placement and nine hours/week in class (35.5 hours total); indicating the minimum required hours of competency development would be achieved within the one year/36 week program. Interestingly, the average student spent an additional 12.5 hours/week devoted to class-based homework assignments that were targeted towards obtaining PEDP integrative competencies, providing an additional 453 hours of competency gaining time over the 36 week program. Overall good mental health status

was reported by 76% of students and physical health was reported as good by 64% of students. Despite this, students' perceptions of adverse mental health outcomes including feelings of stress and anxiety were elevated (≥ 4 times/week). Increased frequency of anxiety was negatively correlated with students' perceptions of their time management ($P=0.009$) and organizational skills ($P < 0.001$). Additionally, students self-reported feelings of increased stress were negatively correlated with their overall mental health status assessment ($P < 0.05$) and satisfaction with life ($P < 0.05$). These data highlight the mental health challenges that students can experience in demanding combined graduate course work and dietetics competency-based practicum programs and further development of time-management skills may help reduce changes in students' mental health status.

Complications and hospital readmission rates are associated with risk of malnutrition and nutritional status in Canadian children

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Background: Malnutrition is a well-known complex, multifactorial problem in acute healthcare. In Canada, 19.5% of children were shown to be malnourished upon admission. However, the faith of these children after hospital discharge has been poorly studied. **Objectives:** This multi-centered study aims to assess the association between nutritional risk and status during hospitalization and complications and readmission rates 30 days post-discharge. **Methods:** Data were collected from 5 institutions across Canada between 2012 and 2016. At admission, nutritional risk and status were assessed with the Screening Tool Risk on Nutritional Status and Growth (STRONGkids) and the Subjective Global Nutritional Assessment (SGNA), respectively. Thirty days after discharge, caregivers answered a follow-up questionnaire that included questions on complications and hospital readmission. Chi square tests, t-tests and logistic regressions were conducted to explore the relationships between variables. **Results:** A total of 371 children aged from 1 month to 18 years were recruited. After multiple imputation for missing data, 298 participants were included in the analysis (51% male; median age 5.3 years). Thirty days post-discharge, 25.5% of patients had experienced complications and 12.8% were readmitted. Compared to low-risk children, those who were at high risk of malnutrition at admission were more likely to have complications post-discharge (OR: 2.72; 95%CI: 1.07-7.95). The presence of complications 30 days post-discharge was associated with the SGNA score at admission (OR: 2.13; 95%CI: 1.23-3.71). Patients who were moderately malnourished and at moderate risk of malnutrition at admission were more prone to be readmitted than the well-nourished (OR: 2.02; 95%CI: 1.10-3.69 and OR: 10.36; 95%CI: 2.14-186.81, respectively). **Conclusion:** In children, complications and readmission after hospital discharge are common. While the follow-up of severely malnourished patients is often prioritized, moderately malnourished children should have access to adequate resources to prevent complications and hospital readmission. Assessing nutritional risk and status at admission and having appropriate measures to timely address the nutritional needs of patients is critical. (Supported by the Canadian Malnutrition Task Force.)

The effect of incremental levels of omega-3 fatty acids from either flaxseed oil or preformed docosahexaenoic (DHA) on health indices of laying hens

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Dietary provision of omega-3 polyunsaturated fatty acids (PUFA), including alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA) and

docosahexaenoic acid (DHA), has received considerable attention, including in poultry nutrition. The latter has primarily focused on producing omega-3 enriched eggs and meat for human consumption. The current study, however, was designed to determine potential health benefits to laying hens receiving different sources of dietary omega-3 fatty acids, as assessed during an inflammatory challenge induced by lipopolysaccharide (LPS) administration. A total of 80 Lohmann LSL-Classic (white egg layer) were randomly assigned to 1 of 8 treatment diets (10 hens/treatment), with diets formulated to meet NRC requirements for laying hens. Treatments provided 0.2%, 0.4%, 0.6%, or 0.8% content of total dietary omega-3 fatty acids, provided as either flaxseed oil (ALA) or algal DHA for 56 days. Specific measures included weekly body weight, feed intake, egg production, egg weights and egg quality measures. On day 56, birds from each treatment were injected with either saline (Sham; $n=5$) or LPS (8 mg/kg i.v.; $n=5$), and blood and tissue samples (post-CO₂ asphyxiation) were collected for subsequent analysis of fatty acids and oxylipins. In general, dietary omega-3 supplementation patterns yielded predictable responses in plasma, liver and yolk fatty acid concentrations in response to increasing dietary ALA or DHA. LPS challenge led to significant reductions in mean liver EPA (mg/g; Sham = 0.088 mg/g \pm 0.04; LPS = 0.077 \pm 0.04 mg/g; $P < 0.05$). There was a significant Diet \times Challenge interaction for plasma EPA and DHA (mg/ml). Analysis of plasma oxylipins indicated significant main effects due to LPS and omega-3 supplementation for certain oxylipins (ng/ml), including a Challenge effect on the EPA-derived 8-hydroxy-eicosapentaenoic acid (HEPE) (Sham = 0.383 \pm 0.066 ng/ml; LPS = 0.19 \pm 0.066 ng/ml; $P < 0.05$), 9-HEPE (Sham = 0.404 \pm 0.075 ng/ml; LPS = 0.148 \pm 0.075 ng/ml; $P < 0.05$), 18-HEPE (Sham = 0.368 \pm 0.053 ng/ml; LPS = 0.592 \pm 0.053 ng/ml; $P < 0.05$). In summary, LPS challenge modulated certain oxylipins, including those derived from EPA. Further studies will clarify the role of dietary omega-3 fatty acids in modulating responses to an inflammatory challenge in laying hens and the biological significance of changes in oxylipin profiles. (NSERC/Manitoba Egg Farmers/Egg Farmers of Canada.)

Apple consumption differentially modulates inflammatory biomarkers dependent on obesity, insulin resistance, or metabolic syndrome status

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Overweight and obesity are characterized by systemic low-grade inflammation that drives the development of comorbidities including insulin resistance (IR) and metabolic syndrome (MetS). Apples contain anti-inflammatory bioactives including polyphenols and soluble fibre, but their effects in these health states are less understood. In the current study, post-hoc analyses of the effects of acute (one-time) and chronic (6 week) whole Gala apple consumption (~ 200 g/serving) on biomarkers of inflammation in overweight and obese adults were conducted according to body mass index (BMI), IR, and MetS status. In a randomized, crossover, acute intervention trial measuring the 6 h postprandial response to a high-fat meal providing 1 g fat/kg body weight ($n=26$, 17 female/9 male), concurrent apple consumption reduced (iAUC, Cmax) plasma interleukin (IL)-6 in participants with a BMI > 35.0 kg/m² (19.1%, 19.2%; $n=7$) and IR (17.8%, 19.5%; $n=9$) compared to participants in healthier states, as well as the lipopolysaccharide binding protein (LBP)/CD14 index in healthy compared to MetS (28.3%, 24.5%; $n=13$) participants (RM ANCOVA, $p < 0.05$). In a parallel-arm, randomized, controlled chronic intervention trial ($n=46$, 32 female/14 male, 23 control/23 apple), daily apple consumption reduced fasting plasma LBP in participants with a BMI 30.0 - 34.9 kg/m² (35.3%; $n=6$ control/7 apple) and MetS (19.7%; $n=15$ control/11 apple), as well as

reduced IL-6 in MetS (25.6%) participants compared to healthier participants (ANCOVA, $p < 0.05$). Chronic apple consumption also reduced IL-6 in healthy compared to IR (62.3%; $n=5$ control/9 apple) participants and C-reactive protein (CRP) in healthy compared to both IR (16.4%) and MetS (30.7%) participants ($p < 0.05$). Apple-induced changes in other fasting and postprandial plasma inflammatory biomarkers (IFN γ , IL-1 β , MCP-1, TNF- α , CD14) and metabolites (glucose, insulin, TAG, NEFA) were not dependent on health status. Overall, these data highlight the variability in response to nutritional intervention dependent on underlying health status and point to potential benefits of acute and chronic apple consumption in several health states associated with metabolic disease risk. Thus, acute and chronic apple consumption may be an effective dietary strategy to mitigate the overweight- and obesity-associated inflammation that drives metabolic disease risk. (Ontario Ministry of Agriculture, Food & Rural Affairs; Ontario Apple Growers.)

Baseline profile of the microbial community structure and activity in overweight and obese participants of the Apple Study

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Intestinal health impairments including microbial community dysbiosis and intestinal barrier dysfunction and permeability causally link obesity to chronic metabolic diseases including type 2 diabetes and heart disease. The objective of this study was to characterize the microbial community structure and activity and establish their relationship with metabolic and inflammatory risk factors of chronic metabolic disease in overweight and obese participants, prior to a dietary intervention. Baseline fecal samples were collected from overweight and obese participants enrolled in a parallel-arm, randomized, controlled dietary intervention trial ($n=46$; mean age 46.2 ± 2.2 y; mean body mass index (BMI) 33.5 ± 0.8 kg/m²) after a two-week run-in period of high polyphenol-containing food avoidance. Microbial community structure (16S rRNA gene sequencing) and activity (pH and short-chain fatty acid (SCFA) concentrations) were assessed. Microbial community α -diversity did not differ between dietary groups ($p > 0.05$). However, participants with Metabolic Syndrome (MetS) ($n=25$) had lower fecal microbial α -diversity compared to those without MetS ($n=18$) (Observed Species, $p=0.02$; Chao1 index, $p=0.01$; Fischer index, $p=0.01$). There were no significant differences in α -diversity between individuals i) with ($n=12$) or without ($n=30$) insulin resistance (IR) as determined by HOMA-IR, ii) categorized by BMI ($25-29.9$ kg/m² ($n=16$); $30-34.9$ kg/m² ($n=11$); $35-39.9$ kg/m² ($n=8$); >40 kg/m² ($n=8$)), iii) or by sex ($n=29$ female/14 male) ($p > 0.05$). Microbial community β -diversity (Bray-Curtis Index), pH, and SCFA concentrations did not differ between dietary groups, nor when assessed by MetS, IR, BMI, or sex categories ($p > 0.05$). Preliminary Spearman's correlation analyses demonstrated that HOMA-IR and plasma C-reactive protein (CRP) were positively associated with the phylum Bacteroidetes (ρ 0.4018, $p=0.0076$; and ρ 0.3081, $p=0.0445$; respectively) and negatively associated with Firmicutes:Bacteroidetes phyla ratio (ρ -0.3206, $p=0.0361$; and ρ -0.335; $p=0.0195$; respectively). Further, plasma lipopolysaccharide binding protein (LBP) was negatively associated with fecal pH (ρ -0.4720; $p=0.001$). These data demonstrate variation in the microbial community structure and activity between overweight and obese individuals, dependent on their underlying metabolic status and levels of inflammatory risk factors for chronic metabolic disease, which may impact participant response to dietary intervention. (Ontario Ministry of Agriculture, Food & Rural Affairs; Ontario Apple Growers.)

Effect of a pulse nutrition education program on high school students' knowledge, attitude and eating behaviours in Saskatoon, Saskatchewan

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Introduction: Pulses described as dry legumes, are rich in protein and micronutrients, and are important food choices for health and wellbeing. Despite their importance, consumption is low in Canada. The current study sought to compare knowledge, attitudes and practices of high school students' regarding pulse consumption before and after a nutrition education intervention focusing on pulses, as well as to identify barriers to pulse consumption among this population. Methods: A school-based nutrition education intervention comprised of 7 lessons on pulses (e.g., benefits, cooking information) was delivered at two high schools in Saskatoon, Saskatchewan by the commercial cooking teachers. A self-administered questionnaire was used to assess knowledge, attitudes, practices and barriers regarding pulse consumption from 41 and 32 students at baseline and endline respectively. A sensory evaluation of meat-pulse bars was completed 23 students. Descriptive statistics and t tests were used for analysis. Results: At baseline, mean knowledge score was 8.85 ± 1.4 , attitude score was 5.73 ± 2.8 and barriers score was 0.85 ± 1.1 . At endline mean knowledge score was 9.88 ± 1.1 , attitude score was 6.28 ± 2.4 and barriers score was 0.78 ± 1.2 . Overall, 80.5% of students at baseline and 97% of students at endline ate pulses. There was a significant difference in knowledge ($p=0.001$), attitudes ($p=0.006$) and barriers ($p=0.001$) between baseline and endline of the intervention. Barriers to pulse consumption included parents not cooking or consuming pulses at home, not liking the taste of pulse, and often preferring other food choices than pulses. Overall mean acceptability of beef-black bean bars and beef-lentil bars was high (5.07 ± 0.19 to 5.51 ± 0.19 on a 6-point scale), showing potential for new products. Conclusion: In the current study, high school age students' knowledge, attitudes, practices, and barriers to pulse consumption were improved after the nutrition educational intervention. (Mitacs, CHEF.)

The perception of chocolate milk by older adults: the role of added sugar and fat content

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Chocolate milk (CM) is an excellent choice as a source of protein and calcium for older adults (OA). However, the high sugar content of CM (6% added sugar (AS), and lactose) may limit OA consumption. There are no data on sensory perception of CM with modified macronutrient composition in OA. The objective was to determine the threshold for AS and milk fat (MF) content associated with positive perception of CM in OA. We hypothesized that a partial reduction of AS and the presence MF in CM would retain its acceptable sensory characteristics. Methods: two randomized, double-blind crossover studies with OA were conducted. In study-1, 40 OA (20 females, 74.8 ± 5.9 (SD) y, 20 males, 76.3 ± 6.5 (SD) y) tested CM with 0, 1.1, 2.2, 3.3, 4.4 and 5.5% AS. In study-2, 42 OA (21 females, 74.6 ± 3.8 (SD) y, 21 males, 77.9 ± 6.3 (SD) y) tested CM containing 3.3% AS and varying in MF (0, 1, 2, 3.25 and 4%). The pleasantness, taste, sweetness, mouthfeel, and aftertaste were measured using a 9-point hedonic scales. The intensity of sweetness, bitterness, and creaminess were measured using a 100-mm visual analogue scale. Statistical analysis was performed with Friedman's test. Results: In study-1, AS% affected hedonic perception of pleasantness, taste, sweetness, mouthfeel, flavour, and aftertaste ($P < 0.0001$) as well as the intensity perception of sweetness, bitterness, and creaminess ($P < 0.0001$). CM with 0% and 1.1% AS had negative and neutral hedonic perception, respectively. CM with 2.2-5.5% AS resulted in acceptable hedonic characteristics. OA could correctly identify the in-

crease in the sweet intensity up to 4.4% AS, however, they could not differentiate between CM with 4.4% and 5.5% AS. In study-2, MF% had an effect on hedonic perception of taste ($P=0.02$) and mouthfeel ($P<0.0001$) with the lowest acceptance of 0% MF-CM. There was an effect of MF% on the intensity perception of creaminess ($P<0.0001$). OA could differentiate between 0% and 2, 3.25 and 4% MF-CM. Conclusion: Chocolate milk with added sugar reduced to 3.3% and the presence of milk fat has acceptable sensory characteristics as perceived by older adults. (Sponsors: Dairy Farmers of Canada, Agropur Dairy Cooperative.)

Investigating associations between intakes of total sugar, free sugar and added sugar with anthropometric measures in preschool-aged children in the Guelph Family Health Study

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Background: Excessive sugar intake in children is a public health concern. Overconsumption of added and free sugar increases childhood risk of weight gain, dental caries and increased blood pressure and can lead to nutritional inadequacy and adverse changes in lipid profiles. The aim of our study was to investigate cross-sectional associations between intakes of total sugar, free sugar and added sugar with BMI z-scores, body weight, percent fat mass and waist circumference in preschool-aged children enrolled in the Guelph Family Health Study (GFHS) pilots. **Methods:** The study sample included $n=108$ (54 females; 54 males) children between the ages of 1.5 to 5 years. Total sugar intake information was obtained from 3-day food records analyzed by the ESHA Food Processor software. Added sugar and free sugar intakes were determined through manual inspection of the 3-day food records and review of product and SMART LABEL websites. Anthropometric measures were completed through health assessments which included body weight (using an electronic weighing scale); percent body fat (bioelectrical impedance analysis); and waist circumference measured at the iliac crest (non-elastic tape measure) and height (child stadiometer). Linear regression models using generalized estimating equations were fitted to estimate associations between variables. Data were further stratified based on age (greater or less than 3 years old). **Results:** Daily mean intakes were 86 ± 26 g (mean \pm SD) for total sugars, 26 ± 13 for added sugars and 31 ± 15 g for free sugars. While total sugar intake was below the 2015 national average of 101 g/day (age 1-8y) as reported in the Canadian Community Health Survey, 81% of children had free sugar intakes greater than the 5% lower limit set by the World Health Organization and 32% exceeded the upper 10% recommendation. No significant associations were found between sugar and anthropometric indices, either with or without age stratification. **Conclusions:** Our study findings suggest that children should limit free and added sugar intake. Further investigation of dietary sugar intake (amount, sources) and longitudinal associations with anthropometrics in preschool-aged children is warranted (Funding: Heart and Stroke Foundation of Canada.)

High-dose bolus vitamin D3 supplementation in children with sickle cell disease: A pilot randomized controlled trial

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Background: We previously showed that nearly 70% of children followed at the Sickle Cell Disease (SCD) Clinic of CHU Sainte-Justine

(CHUSJ) were vitamin D insufficient and had low vitamin D intake with poor use of supplements. Clinically, vitamin D-deficient children had a worse hematological profile than vitamin D-sufficient children. These findings led us to pilot an intervention to overcome these issues. **Hypothesis/Objectives:** We hypothesized that administration of a single oral bolus of 300,000 IU of vitamin D3 to SCD children resulted in the attainment of vitamin D sufficiency (25OHD levels >75 nmol/L) in 80% of participants after 3 months. The primary objectives were to assess feasibility, acceptability, and safety of the bolus while secondary objectives were related to the mean change in serum 25OHD from baseline to 3 months post-bolus and its clinical impact. **Methods:** Children with SCD (5-17 years, all genotypes) were randomized to a single bolus of vitamin D3 (300,000IU) or placebo. Blood was collected at baseline and 3 months post-bolus to measure serum 25OHD and calculate the change from baseline at 3 months (efficacy outcomes). Other outcomes included urinary calcium/creatinine ratio and serum calcium (safety), musculoskeletal pain, quality of life, hematological parameters and bone markers (exploratory outcomes). **Results:** Thirty-eight children (39% girls, 63% HbSS, 29% HbSC and 8% others) were randomized to the intervention or placebo. Our preliminary blinded data showed that 50% of children had vitamin D insufficiency with mean 25(OH)D levels of 75 ± 27 nmol/L (23-125, $n=38$) at baseline. Post 3 months, the proportion of vitamin D-insufficient children decreased to 38% whereas serum 25OHD raised to 85 ± 24 nmol/L (36-136, $n=37$; $p=0.003$ vs. baseline). No side effect related to the intervention was recorded. Complete blood counts, musculoskeletal pain and quality of life did not differ significantly between baseline and study end. **Conclusion:** This study provides pilot data on the acceptability, safety and efficacy of a high-dose bolus of vitamin D3, before testing its efficacy in improving health outcomes of children with SCD in an adequately powered trial. (This study has received funding from The Sickle Cell Disease Association of Canada.)

Home parenteral nutrition (HPN) treatment duration: implications for HPN team resource planning

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Background: Parenteral nutrition (PN) is life-saving for intestinal failure (IF) patients; many require only short-term, inpatient PN but those who require longer-term PN may remain in hospital, solely to receive PN. HPN offers long-term PN in the community for a variety of indications, including short bowel syndrome (SBS), gastrointestinal (GI) mucosal disease (MD), dysmotility (DM), enteric fistulae (EF) and GI obstruction (GO). However, HPN is resource-intensive and resource planning for HPN teams is hampered by uncertainty regarding the duration and intensity of IF therapy. **Aims:** To evaluate predictors of treatment duration in IF patients in a tertiary-care Canadian HPN program. **Methods:** We reviewed all patients in a single-site HPN program from July 1996 to December 2019 to document patient age, sex, diagnosis and HPN duration. Descriptive statistical analyses and Mann-Whitney U test were performed. **Results:** There were 492 HPN program admissions (299F, 193M; mean age 51.5); indications for included SBS (119), DM (42), MD (35), EF (120) and GO (176). Diagnoses leading to SBS included inflammatory bowel disease (36.1%), intestinal ischemia (26.1%), cancer (20.2%), surgical-related complications (16.0%) and other (4.2%). Overall, 75% of SBS patients with received HPN for >98 days and 25% received HPN for >1056 days. SBS patients received HPN for a significant longer period than other patients (median 368 vs 83 days, $p < 0.00001$). Patients with SB <50 cm received HPN for significantly longer than patients with SB >50 cm (median 590 vs 310 days). The proportions of patients requiring HPN after 3, 6, 12 and 24 months for different HPN indications were, respectively: SBS (%): 82.4, 63.0, 50.4, 37.0; DM (%): 76.2, 54.8, 38.1, 31.0; MD (%): 51.4, 42.9,

22.9, 11.4; EF (%): 41.7, 20.0, 2.5, 1.7; GO (%): 45.5, 18.8, 7.4, 4.0. Conclusions: Over 80% of SBS patients require HPN for >3 months and 40% require HPN for >2 years; conversely, only 20% of EF and GO patients require HPN for >6 months. However, SBS patients constitute only about 25% of HPN patients. These data may assist in resource planning for developing HPN teams to care for IF patients in the community.

Utilization of fish oil and lecithin in pigs consuming a Western diet

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Metabolic syndrome (MetS) is defined as having insulin resistance, dyslipidemia, hypertension and obesity. A Western-type diet, high in saturated fat, omega-6, sugar and salt and low in omega-3s, will contribute to the development of MetS. Omega-3s can beneficially reduce inflammation, but studies have shown that fish oil supplements alone are not as effective as diets rich in fish for improving omega-3 status. We hypothesized that the source and form of dietary omega-3's – triglycerides (TG) versus phospholipids (PL) – play a role in how omega-3's are utilized by the body. This study investigated whether the addition of soy lecithin, as a source of non-omega-3 PL, to fish oil supplements increased systemic accumulation of omega-3 fatty acids and reduced risk factors linked to MetS. Twenty-four adult Yucatan miniature female pigs were divided into three different iso-caloric western dietary treatments and were fed ad-libitum four hours per day. Feed intake and body weights were measured and serial fasting blood samples collected to measure blood glucose, lipids and other metabolites. After 4-6 months, pigs were catheterized and MetS tests performed. The feed intake, body weights and dorsal subcutaneous fat measurements were analyzed for the development of obesity and no difference was found among groups. There was no difference among groups in fasting plasma glucose and lipid levels at baseline or bi-weekly blood samples. Intravenous glucose tolerance test (IVGTT) found no differences among groups for any glucose clearance parameters. Insulin sensitivity tests were conducted with no difference in insulin sensitivity among groups. A fat tolerance test was conducted to characterize postprandial lipid handling. The area under curve, peak TG concentration, time to peak, time to return to baseline and slope of clearance did not differ among different groups. These data suggest that the addition of marine source omega-3 (with and without supplemental PL) to an obesity inducing western diet did not alter postprandial glucose or lipid handling. However, it is possible that omega-3 utilization by target tissues were affected by PL supplementation and those data are forthcoming. (Funded by Ocean Frontier Institute.)

Comparative retinoid-metabolic gene expression, from visceral and subcutaneous adipose tissues, in RA treated and not treated obese-diabetic ob/ob mice

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Introduction: Several investigations have demonstrated a relationship among retinoid, retinoid-binding-protein 4 (RBP4) from adipose tissues, and insulin-resistance (IR). Studies show a greater correlation of visceral fat (VF) than subcutaneous fat (SF), with metabolic syndrome and type 2 diabetes (T2DM). Adipocyte differentiation depends on retinoid. Retinoid homeostatic genes expressions for uptake (STRA6), transport (RBP, CRBP, CRABP), storage (LRAT), dehydrogenase (RDH10), oxidation (RDH, RALDH), and catabolism (CYP26A1, CYP26B1), in healthy C57BL/6 mice, indicates more intense

retinoid metabolism in VF than SF, with higher expression of RBP4, CRBP1 and RDH10, and increased CYP26A1 and B1 suggesting higher retinoic acid (RA) catabolism (Sima A et al 2011; *Biochem. Cell Biol.* 89(6):578-584). We have also demonstrated that a RA treatment in obese-insulin resistant mice (ob/ob) reduces serum retinol and RBP4, fasting glycaemia, IR, body weight and VF, despite iso-caloric diet (Manolescu DC et al. 2010; *J. Nutr.* 140(2):311-316). Histology and PGC1 α ; UCP1 expression suggests beige fat islets (Manolescu DC et al. 2014; *Appl. Physiol. Nutr. Metab.* 39(10):1127-1136). Aims: Here we sought to determine if the retinoid metabolism genes dichotomy (SF vs VF), found in healthy mice, would be affected by diabetes and the RA treatment. Methods: Sixteen ob/ob mice, obese and IR, were (n=8) treated with 100 μ g at RA (2 μ g/gbw) in 100 μ l corn oil and (n=8) with vehicle only, by gavages for 16 days. Gene's (mRNA) expression done by RTq-PCR. Results: In ob/ob mice, the VF adipose tissue expressed significantly higher levels of CRBP1, RDH10, RALDH, CRABP1 and CYP26A1. The SF expressed higher levels of RBP4, LRAT and CRABP2. The RA treatment induced significantly higher levels of RBP4, CRBP1, RDH10, RALDH, CRABP1, CYP26A1 and B1 in the VF tissue. The SF expressed higher levels of STRA6, LRAT and CRABP2. Conclusions: Diabetes and the RA treatment have shown specific impacts on retinoid metabolism genes (mRNA) in VF and SF, with greater retinoid activity profile in VF. Augmented transcription of RBP4 in both SF and VF of diabetic versus lean mice, indicates increased contribution to IR. Strongly increased transcription for CYP26A1, in diabetic mice VF, suggests pathologic depletion of endogenous RA, thus justifying some of the exogenous RA supplies benefits. (Manolescu DC is CIHR, FRQS fellow; Sima A is Diabetes Québec fellow.)

Oligofructose-enriched inulin reduces body fat in patients with non-alcoholic fatty liver disease

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Non-alcoholic fatty liver disease (NAFLD) is typically initiated by accumulation of fat in the liver, with subsequent abnormalities including inflammation and steatohepatitis. It is regarded as the hepatic manifestation of the metabolic syndrome. In this clinical trial, we investigated the potential beneficial effects of prebiotic fiber supplementation on fat accumulation and injury to the liver of adults who have NAFLD. Subjects with NAFLD were given either a prebiotic fiber (16g/d oligofructose-enriched inulin, n=22) or placebo (equicaloric maltodextrin, n=20) for 24 weeks. A targeted individualized weight loss plan was also delivered by a registered dietician. At baseline and 24 weeks, DXA and MRI were performed for body composition and hepatic fat content respectively. We also collected serum and fecal samples for several analyses including blood markers, metabolomics and microbial profiling. Dietary intake was also assessed using repeated 3-day food records. The fiber group lost 1.9% trunk fat, whereas placebo subjects gained 0.2% (p=0.016). We also found a significant correlation between liver fat and intake of certain nutrients such as added sugars (r=0.32, p=0.042), phosphorous (r=-0.38, p=0.017) and magnesium (r=-0.39, p=0.013). Thus, oligofructose-enriched inulin could be beneficial for lowering central fat in patients with NAFLD. (Funded by Canadian Institutes of Health Research, and Alberta Innovates.)

Variability in computed tomography (CT) skeletal muscle measurements by Registered Dietitians

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Background: Given that reduced skeletal muscle mass (SMM) is included as a diagnostic criterion for malnutrition and sarcopenia, there

is a need to develop and adopt valid techniques for body composition assessment (BCA) in clinical practice. SMM can be quantified using computed tomography (CT). In this pilot study we evaluated whether a training program for Registered Dietitians (RD) could develop knowledge and skill in CT BCA. Methods: Purposive sampling identified RD participants. Our CT BCA training program includes: 1) a 3-day experiential course (CT BCA practice with formative feedback on 20 CT images and a summative assessment), and 2) a precision assessment (PA) upon completion of the course to examine intra- and interobserver variability of SM measurements using CT. Results from the PA are reported. RDs completed repeated cross-sectional SM measurements on 30 axial CT images from the third lumbar vertebrae (each image evaluated twice, blindly) using sliceOmatic® (Tomovision, Inc.). Intraobserver comparisons were made between repeated measures of CT images by the same RD; interobserver comparisons for the first 30 CT images were made between RDs and RD CT BCA expert. Results: Five RDs completed the PA, for a total of N=150 pairs of CT images. RDs were from three hospitals (N=2 tertiary; N=1 cancer center), had been practicing dietetics for a median of 14 years (range 9-33 years) and rated their nutrition knowledge as expert (N=4) or proficient (N=1). Overall, intraobserver variability was low; the mean coefficient of variation (%CV) was 0.82% (range 0.61%-1.18%), precision error was 1.15 cm² (range 0.92-1.77 cm²) with a least significant change (LSC) of 3.18 cm² (range 2.23-4.91 cm²). Interobserver variability was also low with overall mean %CVs ranging from 0.88% to 1.56%. Conclusion: RDs can be trained to achieve a high level of precision in their SM measurements, which is comparable to the precision required to make a radiological diagnosis of low bone mineral density (e.g. %CV <1.9% lumbar spine; <2.5% femur neck; <1.5% total hip). 1 CT is a highly precise technique that will enable RDs to diagnose patients with sarcopenia and to monitor response to interventions over time. (CIHR-CNS Fellowship in Clinical Nutrition.)

Alteration of the dietary methionine: cysteine ratio modulates the inflammatory response to an inter-peritoneal injection of lipopolysaccharide in Wistar rats

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Sulphur amino acids (SAA) are essential for the synthesis of proteins, with the ratio of dietary methionine:cysteine (Met:Cys) being an important factor in some immune responses, such as TNF α activity. The current study was designed to determine whether the alteration of the dietary Met:Cys ratio would attenuate the inflammatory response to 100 μ g/kg of an intraperitoneal (IP) injection of lipopolysaccharide (LPS) in Wistar rats. Male Wistar rats (n=40, ~70 g) were randomized to one of two diets (n=20/group) and subdivided into IP LPS or saline treatment groups. All diets were formulated to meet the nutrient requirements of rats, differing only in SAA composition, either 100/0 (Met/Cys) and or 50/50 (Met/Cys) as percentage of SAA requirement. After 28 days, rats were anesthetized, and a cannula was inserted into the jugular vein. Plasma samples were taken at 0, 60, 120, 180, and 240 min post-IP with total Cys, homocysteine (Hcy), glutathione (GSH), and TNF α concentrations being determined. Percentage of leukocytes as neutrophils was measured after 240 min by flow-cytometry. LPS significantly altered total plasma Cys, Hcy and GSH 240 min post-LPS IP in rats in rats fed with a 50:50 ratio compared to other treatments. Concentration of plasma TNF- α reached its peak at 120 minutes in rats treated with a dietary Met:Cys ratio of 50:50 with an IP LPS-injection, while a ratio of 100:0 with an IP LPS-injection reached its peak at 180 minutes. Both treatments reached baseline concentrations of TNF- α after 240 minutes. Moreover, a significant increase of the percentage of leukocytes present as neutrophils was observed in rats injected with LPS when compared to saline; however, no significant difference was observed between diets. These results demonstrate that an alteration of the dietary Met:Cys ratio did not attenuate the inflammatory response to an IP injection of LPS in Wistar rats; how-

ever, a diet with a balanced Met:Cys ratio may result in a more rapid response to an LPS challenge. These results lay the foundation for studies examining inflammatory responses in vivo under conditions when Cys synthesis from MET is compromised, including marginal vitamin deficiencies. (NSERC Discovery program.)

Common variant in the CD36 gene (rs1054516) is associated with serum triglyceride concentrations among overweight/obese individuals

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Background: CD36 is a plausible fat taste receptor that has been associated with taste perception of fatty acids and chronic disease risk. As excess adiposity may compromise sensory detection, it is relevant that associations between CD36 variants and dietary fat consumption have been shown to vary by body mass index (BMI). No previous study, however, has examined whether CD36 variants associated with dietary fat intake are linked to biomarkers of chronic disease according to BMI status. Objective: To evaluate associations between CD36 variants and biomarkers of chronic disease separately between normal weight (NW) and overweight/obese (OW/OB) individuals. Methods: Genetic (six CD36 variants), health, and lifestyle data were obtained from the CARTaGENE biobank (n=12,065), a Quebec cohort of adults. Metabolic syndrome (MetS) and Framingham Risk Score (FRS) were assessed, along with their individual components including total cholesterol, serum glucose, triglycerides, HDL-cholesterol, waist circumference, and systolic and diastolic blood pressure. The presence of MetS was considered as a dichotomous trait based on the National Cholesterol Education Program Adult Treatment Panel III's definition. FRS was calculated according to the Canadian Cardiovascular Society's adapted FRS-worksheet and provides a 10-year estimated individual risk of developing cardiovascular disease. Linear and logistic regression models stratified by BMI group and adjusted for demographic and lifestyle covariates were used to assess associations between CD36 variants and outcome variables. Results: No significant associations were observed between the CD36 variants and either FRS or MetS. Among OW/OB subjects, a significant association was observed between rs1054516 and serum triglyceride concentrations. Carriers of the minor allele (GG + AG) had higher serum triglycerides (mmol/L) than non-carriers (AA) (0.22 vs. 0.19, p=0.0065). This variant has been previously associated with saturated fat intake among OW/OB individuals. Conclusion: The CD36 variant rs1054516 is positively associated with serum triglycerides among OW/OB individuals, which may be due to its association with saturated fat intake in this BMI group. BMI status is important to consider when assessing relationships between genetic variants implicated in taste perception and health-related outcomes. (Funding: This work was supported by DEN's institutional start-up grant. TM is a recipient of a Marian and Ralph Sketch Fellowship.)

Saskatoon berry powder attenuates diabetic nephropathy in db/db mice

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Diabetic nephropathy is one of the most common microvascular complications of type 1 and type 2 diabetes mellitus, and the leading cause of end-stage renal disease worldwide. Many factors contribute to the development of diabetic nephropathy, including hyperglycemia, hypertension, obesity, sedentary lifestyle, hereditary, smoking, and advancing age. Oxidative stress and inflammation play a crucial role in

pathogenesis of diabetic nephropathy. In this regard, it is believed that dietary enhancement of endogenous antioxidant system may help with prevention of such disorders. Saskatoon berry is a shrub belonging to Rosaceae family, cultivated in many regions of the world, particularly Prairie region of Canada. We and others demonstrated that Saskatoon berry powder (SBP) has relatively high contents of antioxidants, and attenuated diabetes-metabolic disorders induced by endoplasmic reticulum stress and unfolded protein response in cardiovascular tissues or cultured vascular cells. The present study was designed to evaluate the effects of SBP administration on the development and progression of diabetic nephropathy in diabetic mice. In particular, we have evaluated the anti-fibrotic and anti-oxidant effects of SBP on diabetic nephropathy in this animal model. We treated male db/db and C57BL6/J wild-type mice (6 weeks of age) with regular chow supplemented with or without 5% (w/w) SBP for 4 weeks. At the end of the study, the kidneys were removed and processed for morphological examinations and expression of antioxidant enzymes superoxide dismutase and catalase, plus the adenosine monophosphate-activated protein kinase (AMPK) and transforming growth factor- β 1 (TGF- β 1). SBP administration significantly attenuated renal pathological injuries when compared with the kidneys from untreated db/db mice. These changes were accompanied by higher expression of endogenous antioxidant enzymes, increased AMPK and decreased TGF- β 1 expressions in the kidneys of SBP-treated diabetic mice and modulation of markers of inflammation and kidney disease. Our results suggest that SBP exerts protective effects on diabetes-related renal injury in db/db mice by modulating oxidant and fibrotic pathways. (MHM's research program is funded by NSERC.)

Mineral composition and antioxidant properties of *Urtica dioica*: A safety perspective

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Urtica dioica that often called "nettle" is a genus of flowering plants and belongs to the family of Urticaceae. *Urtica dioica* is a common herbal medicine in Iran, and known as "Gazzaneh;" it is primarily used in the management of type 2 diabetes in Iranian folk medicine. The leaves, stems and roots of "Gazzaneh" were properly dried and then powdered using pestle and mortar. The essential oil of *Urtica dioica* was prepared by hydrodistillation of the whole plant followed by identification of volatile fractions by gas chromatography mass spectrometry (GC/MS). Eighty-nine (89) compounds were identified from the hydrodistillate of *Urtica dioica* by GC-MS analysis. Moreover, atomic emission spectrometry with inductively coupled plasma (ICP-AES) was used for the quantitative determination of the mineral elements in the whole plant powder and hydrodistillate extract of *Urtica dioica*. Our results indicated that hydrodistillate of *Urtica dioica* contains low and within statutory limits of micronutrients like iron, manganese and zinc. The levels of other elements like aluminum, nickel and lead were within allowable limits set by FAO/WHO (1984). On the other hand, the levels of mercury determined in distillate sample exceeded the maximum permissible levels (0.16 ppm against 0.02ppm). The antioxidant activities of hydro-alcoholic and aqueous extracts of "Gazzaneh" were measured using H₂O₂ and DPPH tests. The results showed the IC₅₀ value for aqueous extract were 0.07 μ g/ml which was comparatively lower than the IC₅₀ of gallic acid (25.44 μ g/ml). The IC₅₀ value of the radical scavenging activity of hydro- alcoholic extract was 26.06 μ g/ml which was weaker than the aqueous extract. In conclusion, this study provides information on overall safety and antioxidant properties of *Urtica dioica*. Additional studies are required to understand the reasons for effectiveness of "Gazzaneh" in the management of type 2 diabetes.

How can eating a varied diet affect risk of mortality? Findings from a systematic review and meta-analysis

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Objectives: Dietary guidelines from several developed nations have a recommendation on variety of foods as a step towards healthy eating to reduce risk of morbidity. However, more controversy exists on the role of food variety for survival. This study aimed to evaluate the evidence on the relationship between greater total and within-food group variety, and risk of all-cause and cause-specific mortality. **Methods:** A systematic search of peer-reviewed literature in bibliographic databases (Ovid/PubMed, Scopus, Web of Science), supplemented by hand-searching relevant references. Prospective studies from high and upper-middle income countries, published between 2008 to 2020, were considered as eligible and appraised for quality. Fixed- and random-effects models were applied to pool summary risk ratios (RRs) and 95% confidence intervals; Cochran Q test detected sources of heterogeneity among included studies. **Results:** From the 6413 results, 4684 titles and abstracts were screened for eligibility to provide 9 studies (5 Anglo-American; 2 European; 2 Asian) of 713339 participants and 26739 cases of mortality for inclusion in analysis. All studies were assessed as either high or moderate quality. Total food variety was associated with 12% reduced risk of mortality (RR 0.88, 95% CI: 0.78, 0.99). However, cause-specific mortality from cancer and cardiovascular diseases (CVDs) were not associated with total food variety. A subgroup analysis stratified based on vegetables items, and subtypes of vegetable items, showed that vegetables subtypes was associated with 33% reduction in risk of CVD-specific mortality (RR 0.67, 95% CI: 0.50, 0.91). However, no relationship was observed between vegetable variety and risk of all-cause and cancer mortality. In men, variety within fish and meat was associated with greater risk of all-cause (12%) and CVD (20%) mortality, while fruit variety reduced men's risk of all-cause mortality by 13%. In women, soy variety reduced risk of all-cause (11%) and CVD-specific (23%) mortality. **Conclusions:** We found that variety in total foods and subtypes of vegetable items reduced the risk of total and CVDs mortality, respectively. Variety within other food groups and risk of mortality was dependent on gender. More research is needed on within-group variety in relation to mortality to confirm current evidence.

Seizure modulation by the gut microbiota and tryptophan-kynurenine metabolism in a model of symptomatic intractable infantile spasms

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Infantile spasms (IS) is an age dependent epileptic encephalopathy characterized by epileptic spasms, hypsarrhythmia and cognitive arrest or regression. Onset is typically in the first 4-8 months of life, often caused by unknown or multiple pathologies including metabolic derangements. The gut microbiota is a key modulator of seizures via metabolism, immune, and endocrine mechanisms, however, the role of the gut microbiota and metabolism in IS remains unexplored. Employing a rat model of symptomatic IS, we show that the ketogenic diet (KD) decreases spasm frequency. Surprisingly, broad spectrum antibiotic administration was also protective in reducing spasm frequency, while the combination of both KD and antibiotics further augmented this protective response. To gain insight into the role of the microbiota, 16S sequencing was performed. Results showed that

the KD and antibiotics independently increased *Lactococcus lactis* and *Streptococcus thermophilus*, an effect that was additive when these treatments were combined. To understand the potential mechanisms mediating this response, comprehensive serum and hippocampal analyses were performed. We show KD and antibiotics to upregulate kynurenic acid and downregulate indoleamine 2,3-dioxygenase (IDO1) activity (kynurenine/tryptophan ratio). Kynurenic acid is a common antagonist of the excitatory NMDA receptor involved in spasms and levels are regulated by kynurenine aminotransferase activity. Inhibition of IDO1 by 1-methyltryptophan replicated this response by reducing spasm frequency and increasing serum and hippocampal kynurenic acid levels. Overall, we unravel a mechanism involving changes in gut microbiota and kynurenine metabolism, based on which the work further opens new avenues for IS treatment by pharmacological inhibition of IDO1. Ketogenic diet coupled with antibiotics or IDO1 inhibitor may serve as alternative treatment strategy for symptomatic intractable IS. (Funded by the Owerko Centre of the Alberta Children's Hospital Research Institute.)

Quantifying communications and lobbying related to Bill S-228 and marketing to kids in Canada

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In 2016, federal Canadian restrictions on food and beverage marketing to children (M2K) were proposed as Bill S-228, the Child Health Protection Act. In 2019, however, the Bill died on the parliamentary table and was not passed. Understanding the influence of lobbyists and stakeholders on this outcome is crucial to ensuring the successful implementation of future regulations restricting M2K. This study's objective was to quantify the meetings, correspondences, and lobbying registrations that occurred related to Bill S-228 and M2K, and the type of stakeholders and government institutions involved. Documents related to M2K were downloaded from the Health Canada Meetings and Correspondence on Healthy Eating database, containing all details of interactions between stakeholders and Health Canada related to the Healthy Eating Strategy as part of their Regulatory Openness and Transparency Framework. Documents were analyzed by stakeholder type (i.e. industry, health, other or mixed), and by communication initiation (i.e. Stakeholder- or Health Canada-initiated). Canada's lobbying registry, containing information on the activities of paid lobbyists was searched for registrations between September 2016 and September 2019 for entries specifically related to M2K or Bill S-228. Registrations were analyzed by stakeholder type, and the government institutions most often registered with. 139 meetings and correspondence documents were analyzed, 82% of which were from industry stakeholders, 14% from health stakeholders, and 4% from other and mixed stakeholders. Stakeholders initiated 73% of meetings. From the lobbying registry, 215 registrations were analyzed: 83% (n=179) were from industry stakeholders and 17% (n=36) were from health stakeholders. The most common ministries lobbyists registered with were Health Canada (n=209), House of Commons (n=191), and Innovation, Science and Economic Development (n=181). Results showed that industry stakeholders were responsible for most lobbying registrations and communications related to M2K, and likely had a strong influence on the outcome of Bill S-228 in parliament. Future research analyzing the content of these interactions will provide a deeper understanding of this impact, and continued efforts towards ensuring the openness and transparency of future lobbying and stakeholder communications are imperative. (CIHR Frederick Banting and Charles Best Canada Graduate Scholarships Doctoral Award.)

Maternal folic acid supplementation during pregnancy has sex-specific effects on pancreatic beta cell mass in fetal offspring

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Folic acid supplementation is recommended for women of childbearing age to prevent birth defects. However, concerns have been raised that too much folic acid during pregnancy may have negative impacts on the cardiometabolic health of the woman and child. The objective of this study was to investigate if maternal folic acid supplementation during gestation affects pancreatic beta cell mass in the fetal offspring. Beta cells are responsible for insulin production and disturbances during development could have long term negative impacts on risk for type 2 diabetes later in life. Fetal offspring (C57BL/6J mice) at gestational day 18.5 from dams fed from weaning a control diet (10% kcal fat) or a western diet (45% kcal fat), with 5x recommended folic acid (10mg/kg diet; SFA) or without (recommended 2mg/kg diet folic acid; FA) were studied. The western diet was used as a model of maternal obesity and glucose intolerance. Dams (n=10-12/diet) were fed the diets for 13 weeks prior to breeding with males fed the control diet. One male and 1 female pup/dam were studied. The effect of maternal folic acid supplementation on offspring beta cell mass was dependent on maternal diet. Male offspring from SFA western dams had lower (p=0.04) beta cell mass than offspring from SFA control dams. Whereas female offspring from SFA western dams had greater (p=0.11) beta cell mass than SFA control dams. Folic acid supplementation had no effect on adiposity or glucose tolerance in the dams. As expected, western dams had greater body weight (p<0.05), fat mass (p<0.05), glucose intolerance (p<0.05), and fasting hyperglycemia (p<0.05) compared to control dams. These data suggest that folic acid supplementation of dams with diet-induced obesity has sex-specific effects on offspring beta cell mass but does not alter adiposity or glucose homeostasis in the dams. Ongoing experiments are further investigating the role of folate in beta cell development and how excessive gestational folic acid supplementation may affect long term risk for type 2 diabetes. (CIHR.)

Characterization of phosphatidylcholine and phosphatidylethanolamine species of egg yolk lipid derived from hens fed flaxseed oil or marine algal oil

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The composition of membrane phospholipids (PL), including phosphatidylcholine (PC) and phosphatidylethanolamine (PE), consists of distinct fatty acids (FAs) occupying the sn-1 and sn-2 positions, reflecting the highly regulated nature of lipid biosynthesis. However, little is known about how dietary lipids influence the positional nature of FAs in tissues, including the enrichment of omega-3 polyunsaturated fatty acid (PUFA) in chicken egg yolk PL. This study was undertaken to characterize the PC and PE species in egg lipids derived from Lohmann hens (n=10/treatment) randomly allocated to either a control (no supplementation), a flaxseed oil (FO) or a marine algal oil (MA) diet. Each of the FO or MA diets supplied three levels of total omega-3 PUFA (0.20, 0.40 and 0.60% of diet) and were fed for 6-week. Isobaric and isomeric PC species in egg yolk were characterized by mass spectrometry (MS) using precursor ion scanning of mass m/z 184 in positive mode followed by MS3 scanning in negative mode. PE isobaric species were characterised using of neutral loss scanning MS experiment of mass m/z 141 in positive mode in combination with MS2 fragmenta-

tion in negative mode. The distribution of PL head groups in the yolk was predominantly PC vs. PE (~72 vs. 23%, respectively) across treatments. The most abundant PC species in the yolk were 16:0/18:1 and 16:0/18:2, the PE was mainly arachidonic acid containing species (18:0_20:4). The latter decreased ($P < 0.0001$) with increasing dose of dietary omega-3 PUFA. The MS analyses of PCs revealed several isobaric species for PC 36:5 (i.e., 16:1/20:4, 16:0/20:5, 18:3/18:2), PC 38:6 (16:0/22:6, 18:2/20:4, 18:1/20:5), and PC 38:5 (16:0/22:5, 18:1/20:4, 18:2/20:3, 18:0/20:5) containing eicosapentaenoic acid (EPA, 20:5). In the PE, EPA was only attached to 16:0 (i.e., 16:0_20:5) and increased as a function of omega-3 PUFA intake. These results may elucidate potential aspects regulating the limited enrichment of omega-3 PUFA, particularly EPA and docosahexaenoic acid (22:6) in chicken eggs. In addition, this study may provide further insight on how the manipulation of dietary omega-3 PUFA could impact the health of the developing chick embryo and hatchling. (Egg Farmers of Canada/Manitoba Egg Farmers/NSERC.)

Low fruit and vegetable intake does not mediate associations between low socioeconomic position and cancer morbidity and mortality: a nationally representative population-based cohort study

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Background: Compared to those with a higher socioeconomic position (SEP), cancer morbidity and mortality are higher among individuals with a lower SEP. However, the contribution of modifiable risk factors to these inequities is not known. This study aimed to quantify the mediating effects of modifiable risk factors, including low fruit and vegetable intake, excess alcohol consumption, smoking, physical inactivity, and obesity, to associations between SEP and cancer morbidity and mortality. **Methods:** We combined eight cycles of the nationally-representative cross-sectional Canadian Community Health Survey (2000–2011) to identify a cohort of adults (≥ 35 years) without cancer at the time of survey administration and linked to records from the Discharge Abstract Database (DAD) and the Canadian Mortality Database (CMDB) (2000–2012). SEP was captured by a latent variable consisting of self-reported educational level and household income. Self-reported modifiable risk factors, including low fruit and vegetable intake, excess alcohol consumption, smoking, physical inactivity, and obesity were considered as potential mediators. The outcome was overall cancer morbidity and mortality as reported in administrative health data in the DAD and the CMDB. Generalized structural equation modeling was used to estimate the mediating effects of modifiable risk factors in associations between low SEP and cancer morbidity and mortality in the total population and stratified by sex. **Results:** Modifiable risk factors together explained 45.6% of associations between low SEP and cancer morbidity and mortality. Smoking was the most important mediator in the total population and males. For females, obesity was the most important mediator. Mediating effects were not observed for low fruit and vegetable intake, excess alcohol consumption or physical inactivity. **Conclusions:** Modifiable risk factors are important mediators of socioeconomic inequities in cancer morbidity and mortality. Nevertheless, more than one half of the variance in these associations remained unexplained. Midstream interventions that target modifiable risk factors may help to alleviate inequities in cancer risk in the short-term. Ultimately, upstream interventions that target structural determinants of health are needed to reduce and prevent socioeconomic inequities in cancer morbidity and mortality.

Plasma phospholipid fatty acids and breast cancer risk in pre- and post-menopausal women in the Alberta's Tomorrow Project and British Columbia Generations Project cohorts

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Breast cancer (BC) risk differs in women before or after menopause and diet might be one factor that contributes to this risk. High dietary intakes of omega-3 long chain polyunsaturated fatty acids (n-3 LCPUFA) and a low n-6/n-3 PUFA ratio have been associated with a reduced incidence of BC, yet it has not been established if plasma fatty acid (FA) composition (which can be influenced by diet) impacts pre- or post-menopausal BC risk. Using two prospective cohorts, we sought to examine i) FA status (expressed as concentration) of pre- and post-menopausal women and ii) the associations between individual FA status and the risk of BC, stratified by menopausal status. Age-matched women (n=1128; 377 with BC / 751 controls) were identified from Alberta's Tomorrow Project (ATP) and British Columbia Generations Project (BCGP). FA concentration of plasma phospholipids was determined by gas liquid chromatography from baseline non-fasted blood samples (collected 9-16 years pre-diagnosis). Student's t-tests were used to determine differences between groups and conditional logistic regression models controlling for covariates were used to assess the relative BC risk (odds ratio; OR) by FA status. Overall, post-menopausal women were found to have proportionally higher n-3 LCPUFA (5.58±0.06% vs. 5.09±0.09%, $P < 0.00001$) and a lower n-6 to n-3 ratio (5.93±0.06 vs. 6.56±0.10) compared to premenopausal women. However, when stratified by menopausal status, no association between essential FA composition/concentration and BC risk were observed in premenopausal women. N-3 LCPUFA status was not associated with decreased risk of BC in postmenopausal women. However, postmenopausal women that developed BC had higher concentration of arachidonic acid (152±3 vs 144±2 $\mu\text{g/mL}$, $P < 0.031$) and total n-6 LCPUFA (231±4 vs 222±3 $\mu\text{g/mL}$, $P < 0.05$). Additionally, total n-6 LCPUFA concentration trended towards increased risk of BC in postmenopausal women (OR=1.44, 95% confidence interval=0.96, 2.07, $P < 0.056$). The data suggests that while plasma n-3 LCPUFA status does not appear to be associated with BC risk, the concentration of n-6 PUFA might predict BC risk in postmenopausal women, which may be amenable to modification through dietary intervention. Further investigation into these associations in postmenopausal women is warranted. (Funded by the Women and Children's Health Research Institute.)

Nutrient inadequacy of Canadian children and adolescents: results from the Canadian Community Health Survey (CCHS) – Nutrition 2015

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Background: Obesity rates in children and adolescents in Canada have nearly tripled in the last 30 years, with a reported 30% of Canadian children between the ages of 5-17 years overweight or obese. An unhealthy diet is a common modifiable risk factor for obesity and non-communicable diseases, and a better understanding of the nutritional health of Canadian children and adolescents requires up-to-date evidence of their nutrient intakes. **Objective:** To assess the nutrient inadequacy of Canadian children and adolescents aged 9-18 years using data from the Canadian Community Health Survey (CCHS) – Nutrition 2015 Public Use Microdata Files (PUMF). **Methods:** Both available dietary recalls from the CCHS 2015 PUMF were used to estimate usual intakes of key vitamins and minerals in those aged 9 to 18 years (n = 5,493). After removal of outliers of nutrient intake, the National Cancer Institute (NCI) method was used to derive usual intakes with ad-

justment for covariates. Intakes were assessed for inadequacy by comparison to the Dietary Reference Intakes (DRIs). Results: In boys 9-13 years, a low prevalence of inadequate intakes was observed for folate (7%), iron (0%) and thiamin (0%); a moderate-to-high prevalence of inadequacy was observed for magnesium (21%), potassium (50%) and vitamin D (92%). In boys 14-18 years, the prevalence of inadequacy was low for iron (4%) and thiamin (6%); prevalence of inadequacy ranged from moderate to high for folate (20%), potassium (53%), magnesium (53%) and vitamin D (92%). In general, a greater prevalence of inadequacy was observed among girls 14-18 years compared to girls aged 9-13 years old, however nutrient intakes were still well below the EAR for both age-sex groups. Similar levels of inadequate intakes were seen for potassium and vitamin D, but not magnesium (76% in girls 14-18 years vs. 17% in girls 9-13 years). Conclusion: Based on CCHS 2015 data, Canadian children and adolescents may be at an increased risk of nutrient inadequacy. Promoting healthy food choices among children and adolescents is encouraged. (Supported by grants from the Burroughs Wellcome Fund Innovation in Regulatory Science Award and the Canadian Institutes of Health Research.)

Effect of extrusion on in vitro protein digestibility and available lysine content of direct-expanded chickpea-sorghum snacks

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Blending cereals with pulses provides a balanced protein with higher biological value as their amino acid compositions are complementary. Extrusion can improve protein digestibility but may reduce available lysine content. This study investigated the effect of extrusion conditions and blending ratio on in vitro protein digestibility (IVPD), available lysine content, and in vitro protein digestibility corrected amino acid score (IVPDCAAS) of direct-expanded chickpea-sorghum snacks. Chickpea:sorghum blends (100:0, 50:50, 60:40, 70:30 and 0:100) were extruded at barrel temperatures of 120, 140 and 160°C, feed moisture contents of 16, 18 and 20%, and at the maximal expansion point of 169°C and 15% feed moisture. Extrusion increased the IVPD of all blends ($P < 0.05$). Specifically, a higher extrusion temperature resulted in increased IVPD under all conditions investigated; however, increasing feed moisture content reduced protein digestibility ($P < 0.05$). Inclusion of a greater proportion of chickpea flour in the blend also increased IVPD ($P < 0.05$) and resulted in a greater IVPDCAAS. Reactive lysine content was reduced by extrusion for all blends ($P < 0.05$), with 100% sorghum having lower lysine content than 100% chickpea or any of the blends. The study illustrated that chickpea-sorghum blends were superior to chickpea or sorghum alone from a protein quality point of view. The chickpea-sorghum snack with a 70:30 blend ratio and extruded at the maximal expansion point was found to be preferable in terms of protein quality with minimal loss of available lysine. (CIFSRRF.)

Dietary fibre combinations to mitigate metabolic and microbial imbalance in diet-induced obese rats

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Obesity is one of the most important risk factors for the development of metabolic diseases, such as type 2 diabetes. Disruption of gut microbiota, the community of microorganisms that live in the intestine,

has been causally linked to obesity. Dysbiosis, a microbial imbalance, can result from a diet high in fat and sugar triggering a cascade of inflammatory responses that can worsen obesity and/or type 2 diabetes. In contrast, dietary fibre is a fuel for a healthy gut microbiome and holds promise in rescuing microbiota from dysbiosis. Individual dietary fibres have unique physiochemical properties, thus consuming more than one fibre may improve host metabolism to a greater extent than a single fibre type alone. The current study examined the potential beneficial effects of administering different dietary fibre combinations on glucose tolerance, insulin resistance, food consumption and adiposity. Fecal microbiota transplant (FMT) was then used to determine the causal role of fibre-altered microbiota in the resultant phenotype. Rats underwent obesity induction with a high fat/sucrose diet (HFS) for 8-weeks before allocation to the following groups: chow-fed control, HFS, HFS+oligofructose (HF/O), HF/O+beta-glucan (HF/OB), HF/O+resistant starch (HF/OR), or HF/O+resistant starch and beta-glucan (HF/OBR). Insulin tolerance testing revealed that all fibre treated groups showed improved insulin sensitivity compared to rats fed the HFS diet alone. The HF/O group gained significantly less weight compared to the HFS group over the 8-week fibre intervention period and had significantly less body fat. Ingestion of fibres was associated with an increase in cecum weight, most notably in the HF/O and HF/OB groups, likely indicating an increase in microbial fermentation. Germ-free mice underwent FMT from donor rats fed HFS, positive control, or the optimal fiber diets HF/O or HF/OB, to determine the direct effects of altered microbiota on metabolic outcomes. Mice receiving the HF/O FMT exhibited increased cecum size and mice receiving HF/OB FMT had improved insulin sensitivity compared to other groups. These results suggest that a high fibre diet consisting of oligofructose and/or beta-glucan can attenuate metabolic outcomes associated with a HFS diet potentially by altering the fecal microbiota. (Funding: Synder Institute for Chronic Disease, International Microbiome Centre.)

Examining the effects of a high-protein total diet replacement on energy metabolism in healthy women: preliminary findings of a randomized, controlled, cross-over trial

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Background: High-protein diets and total diet replacements are becoming increasingly popular for weight regulation; however, further research is needed to elucidate their impact on the physiology of body weight regulation. The aim of this inpatient metabolic balance study was to compare the impact of a high-protein total diet replacement (HP-TDR) versus a control diet (CON) on selected components of energy metabolism in healthy women. Methods: The acute intervention was a randomized, controlled, cross-over design with participants allocated to two isocaloric arms: a) CON: 55% carbohydrate, 15% protein, and 30% fat; b) HP-TDR: 35% of carbohydrate, 40% protein, and 25% fat achieved through a nutritional supplement (Almased®). Participants received the prescribed diets for 32 hours while inside the whole-body calorimetry unit (WBCU). The first dietary intervention randomly offered in the WBCU was designed to maintain participants in energy balance. The following components of energy metabolism were assessed: 24-hour energy expenditure (24h EE), energy balance, macronutrient oxidation rates and balances. Differences between diets were assessed by paired sample T-test or Wilcoxon matched pairs test, as appropriate, considering a critical significance value of $p < 0.05$. Re-

sults: Nineteen healthy, normal-weight women (age: 25±3 years, body mass index: 22.1±1.2 kg/m²) were assessed. Compared to the CON diet, the HP-TDR produced higher 24h EE (68±89 kcal/day, p<0.001), fat and protein oxidation rates (9±16 g/day, p=0.02; 27±10 g/day, p<0.001, respectively), and lower carbohydrate oxidation rate (-37±25 g/day, p<0.001). Moreover, while consuming a HP-TDR participants experienced decreased energy (-68±89 kcal/day; p<0.001), fat (-22±16 g/day; p<0.001), and carbohydrate balances (-66±26 g/day; p<0.001), and increased protein balance (94±16 g/day; p<0.001). Conclusion: The primary observations of this inpatient metabolic balance study were that a HP-TDR led to higher daily energy expenditure, increased fat oxidation, and negative fat balance likely implying body fat loss compared to a CON diet. This preliminary data suggests that a HP-TDR may provide a metabolic advantage compared to a conventional isocaloric diet of a typical North American macronutrient distribution. (This is an investigator-initiated trial supported by Almeda Wellness GmbH (Bienenbüttel, Germany).)

A nationally representative analysis of change in socioeconomic inequities in diet quality in Canada between 2004 and 2015

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Diet quality is a key determinant of chronic disease and shares a similar socioeconomic patterning. Evidence indicates that inequities in diet quality are widening in the US, however the trajectory of change has not been examined in Canada. In addition, prior studies have only examined change in absolute gaps in diet quality between more and less advantaged groups, without considering other measurement perspectives. Quantifying change in absolute and relative dietary gaps and gradients according to multiple indicators of socioeconomic position (SEP) can provide a more comprehensive perspective of change. Such analyses can support a more informed and specific assessment of optimal points of intervention. The objective of this study was to quantify change in absolute and relative gaps and gradients in diet quality between 2004 and 2015 according to three indicators of SEP (household educational attainment, household income and area-level disadvantage) among adults living in Canada. Adults who participated in the nationally representative Canadian Community Health Survey - Nutrition in 2004 (n=21,200) or 2015 (n=14,300) were included. Participants were classified as low-, mid-, or high-SEP based on self-reported highest household-level education attained, equalized household income and residential address (i.e. area-level disadvantage). Dietary intake in the previous 24 hours was self-reported and used to derive a Healthy Eating Index-2015 score from 0-100 representing overall diet quality at each time point. Bootstrap survey-weighted t-tests and multivariate linear regression models, adjusted for age, sex, race/ethnicity, urban/rural residence, marital status and day of data collection examined change in diet quality over time. Between 2004 and 2015, diet quality improved in all SEP groups. Diet quality improved more in lower compared to higher income groups, leading to a slight narrowing of income-related absolute and relative inequities. Absolute and relative inequities in diet quality according to education and area-level disadvantage remained stable. Findings suggest that absolute and relative inequities in diet quality remained stable or narrowed slightly among adults living in Canada between 2004 and 2015. Policies that provide universal access to resources with a scale and intensity proportionate to need (i.e. proportionate universalism) may help to simultaneously address absolute and relative inequities in diet quality.

Phase angle as an indicative measure of hydration, muscle mass and nutritional risk for hepatocellular carcinoma patients

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Nutritional status of patients with hepatocellular carcinoma (HCC) is commonly neglected due to lack of standardized tools that support a more accurate assessment in water changes such as edema/ascites, frequently present in HCC patients. Phase angle (PhA) values seems to be related to the amount of muscle mass and body water. Our aim was to evaluate the applicability of PhA to predict hydration, muscle mass and nutritional risk of HCC patients. A transversal study (September 2017 - September 2018). Inclusion criteria: male patients diagnosed with HCC from Hepatocellular Carcinoma Clinic (Hospital of Clinics of School of Medicine of Ribeirão Preto, University of São Paulo, Brazil), ≥18 years. Exclusion criteria: patients without conditions to complete the measurements, and/or diagnosed with other type of cancer/consumptive disease and/or water imbalance from other disease. Anthropometric: weight, height, adductor pollicis muscle thickness (APMT). Functionality: handgrip strength (HGS). Bioelectrical impedance by spectroscopy: PhA, hyperhydration (HH), extracellular water/total body water (ECW/TBW). Nutritional Risk Index (NRI) was calculated. Associations by Pearson correlation (p value <0.05). We evaluated 51 participants and most of our sample (53%) was composed by elderly (≥60 years); only 3.9% were <40 years (range = 35 - 72 years). PhA decreased as the higher the hydration status was (HH and ECW/TBW, p = 0.000) and increased as greater preservation of quantity and quality of muscle mass (APMT p = 0.000; HGS p = 0.002). PhA reduced as more severe the patient's nutritional risk as indicated by the NRI (mean: normal risk = 5.6°; mild risk = 5.1°; moderate risk = 4.6°; severe risk = 4.5°) (p = 0.007). The results of this study suggest that PhA might be a variable of interest for the assessment of patients with adverse clinical conditions, such as in HCC. PhA seems to reflect hydration, amount and quality of muscle mass and predict nutritional risk. More studies are needed to improve the comprehension of PhA uses since it is a simpler and more accessible measure for the clinical practice. (Funding: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).)

Type 2 diabetes as a risk factor for prostate cancer: a systematic review

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In Canada, prostate cancer (PC) is the most commonly diagnosed malignancy in male. Metabolic diseases such as Type 2 diabetes (T2D) may contribute to PC development and progression; however, the link between this association remains to be explored. The objective of this systematic review was to investigate the evidence of an association between T2D as a risk factor for all PC and advanced PC (stage III and IV PC, high-grade PC, high-aggressive PC, extraprostatic metastasis, or fatal PC). A systematic search (MEDLINE, EMBASE and CINAHL) was conducted up to January 2020. Articles assessing associations between incidence of PC (all PC and advanced PC) and T2D were included. Additional inclusion criteria included primary research articles published in English. Abstracts of eligible articles were screened independently by two reviewers and the full article was evaluated in case of disagreement. Methodological quality was measured using the

Newcastle-Ottawa Scale (NOS). Only higher quality studies were included (NOS 7 to 9). The search yielded 63 articles and following screening 31 were included. Of those, 20 were cohort studies, 10 were case-control studies and 1 was a cross-sectional study. Considering both localized and advanced PC, approximately half of the studies (n = 15) reported no association between T2D and PC risk. Thirteen studies (42%) reported that T2D was associated with decrease risk for PC and the remaining articles (n = 3, ~ 10%) reported an increased risk for all PC types. Findings were also inconsistent when advanced PC was evaluated separately, with 5 studies reporting no association, 2 reporting increased risk, and 2 reporting decreased risk of PC. Finally, 3 studies observed a cumulative protective effect in individuals with prevalent T2D for several years (range: 3-14y). Despite extensive research, associations between T2D and risk of PC and advanced PC remain conflicting and inconclusive. This finding may be explained, at least in part, by study heterogeneity, lack of control for confounding factors including medication use and comorbid conditions, among others. The link between T2D and PC risk requires further investigation and future studies on this topic should aim to correct those confounding factors. (Funding: Prostate Cancer.)

Site-specific skeletal muscle thickness differences between older and younger adults matched for relative skeletal muscle index

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Malnutrition significantly contributes to the progression of age-related muscle atrophy. Identifying older adults with low muscle mass is critical to providing targeted nutrition and exercise therapies. Dual-energy x-ray absorptiometry is frequently utilized to identify older adults with low skeletal muscle index (SMI; appendicular lean mass/height²), a surrogate measure of skeletal muscle mass. However, emerging research indicates that muscle loss does not occur uniformly across the body, suggesting that site-specific muscle analysis may be more sensitive in detecting age-associated muscle atrophy. Our objective was to evaluate site-specific differences in muscle thickness between SMI matched younger and older adults. Younger (18-40 years) and older (>65 years) males and females were matched for SMI using sex and age specific NHANES reference z-scores (all matches within 0.5 units). Muscle thickness was evaluated using ultrasound at the anterior trunk, anterior and posterior upper arm, anterior forearm, as well as the anterior and posterior upper and lower leg. Younger and older cohorts were compared using paired t-tests. Older males (n=19, 72.2±6.8 years) and females (n=24, 72.8±5.8 years) were well-matched with younger males (n=19, 27.3±5.8 years) and females (n=24, 22.8±3.0 years) for SMI z-score (difference between younger and older cohorts: males=0.03±0.15 units, p=0.42; females=0.02±0.09 units, p=0.21). Although older males and females exhibited only 7.0% and 5.2% lower SMI compared with younger males and females, older adults had remarkably lower anterior trunk (males: 36.2%, p<0.01; females: 31.9%, p<0.01) and anterior thigh (males: 26.0%, p<0.01; females: 31.0%, p<0.01) muscle thicknesses compared with younger adults. No differences were evident between age groups for the anterior forearm (males: 1.4%, p=0.80; females: 3.8%, p=0.55) and anterior upper arm (males: 3.6%, p=0.32; females: 0.3%, p=0.94). When matched for relative SMI (sex and age normalized), older adults displayed substantially lower anterior trunk and anterior thigh muscle thickness compared with younger adults. While SMI is commonly used to identify low skeletal muscle mass in older adults, site-specific measures of muscle thickness, particularly the anterior thigh and anterior trunk, may be more sensitive in detecting age-related muscle loss. (Funding: Network for Aging Research – University of Waterloo.)

Supplementation of neonatal diet with docosahexaenoic acid and arachidonic acid improves immune function and the development of oral tolerance

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Introduction: Feeding docosahexaenoic acid (DHA) and arachidonic acid (ARA) during suckling is beneficial for immune development and suggestive of improved oral tolerance (OT). The objective of this study was to determine if ARA+DHA supplementation during suckling (maternal diet, MD) and/or weaning (weaning diet, WD) improves OT in allergy sensitive Brown Norway rats. **Methods:** Dams were randomized to nutritionally complete high fat diets; ARA+DHA (0.4%ARA and 0.8%DHA w/w total fat, n=20) or control diet (0% ARA and DHA, n=16) from 5d before parturition to 3wk postpartum. At weaning, 2-3 pups from each dam were randomized to control or ARA+DHA diet. Between day 21-25, pups (n=37/group) were daily fed ovalbumin (Ova, 200µl of 0.1mg/g of bodyweight) or placebo. At 7wk, all pups were immunized (Ova+adjuvant) via intraperitoneal injection. Plasma was collected from 8wk pups to analyse Ova specific ImmunoglobulinG1 (Ova-IgG1) levels. Isolated splenocytes were stimulated with phorbol-myristate-acetate+ionomycin (PMAi) or Ova for 72 hours to analyse cytokines and fatty acid composition of phospholipids. Three-way ANOVA was used to study effects of MD, WD and OT treatment. **Results:** Food intake, body and spleen weights did not differ among groups. Plasma Ova-IgG1 was lower (p<0.02) in Ova group compared to placebo group. However, Ova-IgG1 levels from ARA+DHA MD group was 35% lower (P<0.01) than control MD, with no WD or sex effect. Compared to control WD, IL-6 and IL-10 production by Ova-stimulated splenocytes was lower (P<0.05) for ARA+DHA WD group. Splenocytes from ARA+DHA WD group produced more TNFα and IFN, and less TGFβ compared to control WD after PMAi stimulation (p<0.05) but had no MD effect. Within ARA+DHA MD, IL-6 production to PMAi was lower (p<0.001) for pups in ARA+DHA compared to control WD group. DHA in splenocyte phospholipids was 73% higher (p<0.04) in ARA+DHA WD group compared to control WD, however, ARA did not differ. **Conclusion:** MD supplementation of ARA+DHA promoted OT development to the food protein Ova in allergy sensitive rodents. Further, ARA+DHA supplementation in the WD, changed DHA in membrane phospholipids and altered the cytokine response to a mitogen challenge ex-vivo, suggestive of beneficial immune function. (Funded by NSERC.)

Individualized high dairy protein + walking program supports bone health in pregnancy: a randomized controlled trial

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Pregnancy induces bone mineral mobilization, which may be further compromised if diet and physical activity are sub-optimal. Our objectives were to determine the effects of a Nutrition+Exercise intervention during pregnancy on maternal calcitropic and bone biomarker profiles throughout pregnancy and the post-partum. In the Be Healthy in Pregnancy (BHIP) RCT, women who consented at randomization (12-17 weeks (wk) gestation) received either usual care (control) or a Nutrition+Exercise intervention that provided an individualized energy and high protein diet (50% as dairy products) and a walking program (10,000 steps/day) throughout pregnancy. Serum total procollagen type I N-terminal propeptide (bone formation), C-terminal telopeptide of type I collagen (bone resorption), and insulin-like growth factor-1 were measured by ELISA, and vitamin D metabolites by ultra-performance liquid chromatography tandem mass spectrometry at early and late pregnancy, six months post-partum, and in cord blood. Maternal whole body and lumbar spine bone mineral density (BMD) were measured by dual energy absorptiometry at six months post-partum. Differences between groups are reported based on regression

analysis adjusted for randomization stratification variables. A total of 187 participants completed all measures. Intakes of protein (median (Q1, Q3): 107 (87, 124) versus 86 (70, 105) g/day, $p < 0.0001$) and calcium (1762 (1375, 2052) versus 1208 (931, 1579) mg/d, $p < 0.0001$) were significantly higher in the intervention versus control group across second and third trimesters of pregnancy. Intervention compared to control participants had significantly lower maternal concentrations of CTX at the end of pregnancy (mean (SD): 0.78 (0.31) ng/mL versus 0.89 (0.33) ng/mL; $p = 0.038$; $n = 96$), which was reflected in cord serum (0.58 (0.13) ng/mL versus 0.69 (0.18) ng/mL; $p = 0.025$; $n = 53$). Serum 25(OH)D status was > 50 nmol/L for 97% of participants, and other bone markers were similar between groups. No differences in BMD z-score at either skeletal site were observed between groups. Higher maternal dietary protein and calcium intakes compared to usual care minimized bone resorption and maintained bone formation, thus conferring a protective effect on maternal bone health and fetal bone. (Supported by Vanier-CGS, CCHCSP, CIHR and Dairy Farmers of Canada/AAFC Dairy Research Cluster.)

Shrimp oil extracted from shrimp waste is a rich source of omega-3 fatty acids and astaxanthin esters, and possess anti-adipogenic effects in 3T3-L1 preadipocytes

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Newfoundland and Labrador generate over 6000 metric tons of shrimp waste every year, which is a valuable source of shrimp oil rich in omega (n)-3 polyunsaturated fatty acids (PUFA) and astaxanthin (ASTX). Previous studies using fish oil, and free astaxanthin, have been shown to reduce fat accumulation and improve insulin resistance. We hypothesized that shrimp oil, rich in both n-3 PUFA and astaxanthin, will reduce fat accumulation and improve insulin resistance to a greater extent, compared to fish oil or astaxanthin alone. The extraction of shrimp oil from shrimp waste was performed by the Soxhlet method (hexane:acetone 2:3). Total lipids, fatty acids composition and astaxanthin content of shrimp oil were measured. Shrimp oil was found to be rich in phospholipids, n-3 PUFA and esterified astaxanthin (ASTX-E). We then investigated the effects of shrimp oil on fat accumulation and the mRNA expression of genes involved in adipogenesis using 3T3-L1 preadipocytes. The cells were differentiated to mature adipocytes in the presence or absence of shrimp oil or fish oil emulsions ($n=3$ each), at a final concentration of 0.25 mg/ml of culture medium, for 8 days. This concentration of shrimp oil contained 15.9 ng ASTX-E; thus, cells were also treated with 15.9 ng/ml of ASTX-E, and fish oil plus 15.9 ng/ml of ASTX-E ($n=3$ each). Control cells received the appropriate vehicle. Mature adipocytes were stained with Oil-Red-O for fat accumulation; total RNA was extracted to measure the mRNA expression of peroxisome proliferator-activated receptor (PPAR)- γ and sterol regulatory element-binding protein (SREBP)-1c using qPCR. Shrimp oil and ASTX-E treated cells revealed a decrease in fat accumulation, which was consistent with a decrease ($p < 0.05$) in the mRNA expression of PPAR- γ and SREBP-1c, compared to control cells. However, fish oil, alone or in combination with ASTX-E, showed an increase in fat accumulation, which was consistent with an increase ($p < 0.05$) in the mRNA expression of PPAR- γ and SREBP-1c, compared to control cells. Our findings demonstrate that shrimp oil from shrimp waste has the potential to reduce fat accumulation and elicits anti-adipogenic effects. Furthermore, shrimp oil and fish oil appear to regulate adipogenesis via independent pathways. (Ocean Frontier Institute.)

A longitudinal examination of Mediterranean diet scores and impact on health outcomes in patients with diabetic nephropathy

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The European Renal Association has recommended the Mediterranean diet (MedDiet) as the diet of choice for patients with chronic kidney disease (CKD). The 2018 Diabetes Canada Guidelines recommended the MedDiet as an option for improving glycemic control and lipid profiles. However, little is known about MedDiet impacts patients with diabetes and kidney disease overtime. Patients with diabetes and Stage 1-5 CKD participating in a longitudinal follow up study were investigated ($n=50$, 41-83 years old). MedDiet scores were calculated using a 9-point scale. Up to seven points were awarded for higher consumption of beneficial categories (healthy fat ratio, cereals, fruits, legumes, potatoes, vegetables, nuts and seeds) and up to two points were awarded for lower consumption of a detrimental categories (meat and dairy). MedDiet scores were calculated at baseline and at each attended follow up visit, up to year five. A total of 178 MedDiet scores were calculated. For the entire cohort, the median MedDiet Score was 5 interquartile range (IQR) 2. There was a statistically significant association between lower MedDiet Scores and more severe CKD ($p=0.0051$) (Stage 1 and 2 median 6 IQR 2; Stage 3, 4 and 5 median 4 IQR 3). This relationship was maintained when MedDiet Scores were adjusted for energy intake ($p=0.02$). There was no association between MedDiet Scores and CRP ($p=0.88$), hemoglobin A1C ($p=0.95$), lipid profile ($p=0.49$) or body mass index (BMI) ($p=0.45$). Compared to the MedDiet score validation cohort reported by Trichopoulou et al (2003), our medians were lower for healthy fat ratio, vegetables, potatoes, fruits and nuts, though was comparable for meats, dairy and cereals. Very little is known about how MedDiet scores are associated with CKD stage in patients with diabetes. Based on the results of this study, we found that lower MedDiet scores were associated with more severe CKD, but not cardio metabolic risk factors. However, as intake in this cohort was lower in 5 of the 7 beneficial categories, these results may need to be interpreted with caution. Further studies are needed to understand the relationship between MedDiet, diet quality and CKD severity. (Financial Support: Kidney Foundation of Canada.)

Unhealthy television food advertising to children and adolescents in Canada

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Increases in the prevalence of childhood obesity, and its co-morbid conditions, has paralleled trends in consuming foods high in sugar, sodium, and saturated fat. Exposure to unhealthy food and beverage marketing is widely recognized as a driver for unhealthy food consumption among children and adolescents. Canada's current self-regulatory advertising practices have insufficiently protected children from food and beverage marketing and urges legislation that restricts food and beverage marketing to children. This study aimed to benchmark the frequency of food and beverage advertising on television over a one-year period, by examining differences in advertising, overall and by food category, between television programming targeted to preschoolers, children, adolescents and adults. Annual television advertising, from 2018, was obtained from television program logs provided by the Canadian Radio-television Telecommunications Commission (CRTC). Frequencies and rates of food and beverage advertisement were compared, by program age, television station, month and food category, using linear regression models and chi-

square tests, on SAS version 9.4. In 2018, over 6 million food and beverage-related advertisements were broadcast across 271 Canadian television stations. Significant differences in the rates of food and beverage advertising were found between the four target age groups, which varied significantly by television station and time of the year. The proportion of advertisements promoting food and beverage products was significantly greater during preschooler-, child-, and adult-targeted programming (54%, 74% and 48%, respectively; $p < .0001$) compared to adolescent-targeted programming (42%). Among adolescent-targeted programming, the proportion of fast food advertisements was significantly greater (51%; $p < .0001$) compared to other target age groups. Our findings highlight the need for legislation, in Canada, which restricts food and beverage marketing to children and adolescents, as the advertising and food industry's voluntary, self-regulation is failing to protect young people.

Blood-to-brain docosahexaenoic acid link in carriers of an epsilon 4 allele of the apolipoprotein E

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A recent meta-analysis on 11 cohort studies reported that higher docosahexaenoic acid (DHA) levels in blood were associated with better cognitive function in 22,887 individuals. However, whether this link is due to a higher DHA concentrations in brain membranes remains unknown and this is largely due to the inaccessibility of brain samples. However, the brain requires a constant supply of DHA from the blood to replace the metabolized DHA since astrocytic and neuronal synthesis of DHA from alpha-linolenic acid is insufficient. Aging and carrying an epsilon 4 allele of apolipoprotein E (APOE4) are two prominent Alzheimer's disease risk factors and both are associated with anomalies in lipid metabolism. The aim of this study was to evaluate whether there is a blood to brain DHA link and whether E4 allele change this link. Hence, using a mouse model expressing human APOE isoforms, we investigated the blood-to-brain DHA link. Four months old APOE3 ($n = 32$) and APOE4 ($n = 38$) mice were fed one of two isocaloric diets; a high DHA diet or a control diet ($n =$ between 10 and 15/genotype/diet) for 8 months. At 12 months, animals were tested for visual and spatial memory using respectively, the object recognition (OR) test and the Barnes maze test. A recognition index (RI) was calculated in the OR test whereas primary errors and escape latency were calculated on each of the four days of the Barnes test. We found a trend towards higher levels of brain DHA in mice with the highest levels of plasma DHA but in hAPOE3 mice only. There was also a trend towards faster escape latency of the Barnes maze in hAPOE3 mice with the highest brain DHA levels but there was no association with hAPOE4 mice. Hence, these results suggest that transport of DHA from blood to the brain is impaired in hAPOE4 mice, a defect that might be accentuated during aging. (Funded by CIHR.)

Ultra-processed food intake in Canada from 2004 to 2015

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Background: There is mounting evidence that a greater share of ultra-processed foods in the diet promotes weight gain and diet-related chronic disease. The 2019 Canada's Food Guide recommends limiting 'highly processed foods and drinks' because they are not part of a healthy eating pattern. This study used the most recent nationally-representative nutrition data (2015) to characterize Canadians' intakes of ultra-processed foods and to examine any changes since 2004. **Methods:** National-level food intake data came from 24-hr dietary re-

calls collected as part of the 2015 and 2004 Canadian Community Health Surveys–Nutrition. Analyses were limited to individuals aged 2+ years (20,080 in 2015 and 33,924 in 2004). Disaggregated food codes were used to classify food items according to the NOVA system, a classification based on the extent and purpose of industrial food processing. Consumption of ultra-processed foods was defined as their % of total daily energy intake. Mean intake of ultra-processed foods was compared across the two survey cycles for the overall population and by age-sex subgroup and subcategories of ultra-processed foods. As a sensitivity analysis, all analyses were repeated after restricting the sample to only plausible energy reporters. **Results:** Ultra-processed foods contributed 45.7% (95% CI: 45.0-46.4%) of total daily energy in 2015 and 47.8% (95% CI: 47.3-48.3%) in 2004 in the overall Canadian population, and over 50% of total energy among children and adolescents in both years. Consumption of ultra-processed foods decreased slightly since 2004 in all age-sex groups except among adults aged 55 or older. Among children and adolescents, decreased intake of ultra-processed food was heavily driven by lower intakes of commercially prepared fruit juices/drinks and soft drinks. Intakes of commercially prepared breads increased in nearly all age-sex groups since 2004. **Results of analyses restricted to plausible energy reporters were highly consistent with those based on all respondents. Conclusions:** In 2015, the relative share of ultra-processed foods in Canadians' diets remained high albeit with some improvements (i.e. reductions) in intakes of soft drinks and commercially prepared fruit juice/drinks since 2004, particularly among children and adolescents. Consumption of ultra-processed foods was higher in 2015 among adults aged 55 or older.

Effects of the Nutrition as Medication program on weight loss and pressure sores in residents of long-term care units: a 6-month controlled pilot trial

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Meeting dietary needs of long-term care residents, particularly those with dementia, is a daily challenge. To improve intakes, oral nutritional supplements (ONS) are often offered. However, ONS may not always be offered or consumed as prescribed. The Nutrition as Medication (NAM) program prescribes small doses (30-60 mL) of ONS offered with the medication passes 1 to 4 times a day, instead of being offered with meals or as snacks. The ONS doses provide 2 kcal/mL and are registered in the medication chart. This controlled pilot trial aimed to evaluate the potential of the NAM program in preventing weight loss and pressure sores among residents requiring ONS. This 6-month trial was conducted within two 75-bed long-term care units. One unit pursued usual care, meaning that residents requiring ONS received them with meals or as snacks according to the dietitian prescription. The other unit implemented the NAM program. Adherence to ONS prescriptions, body weight (measured monthly) and pressure sores were monitored. In total, 20 residents had their ONS prescription converted to the NAM program. Control group included 28 residents receiving ONS as per usual. Mean body mass index (BMI) at baseline was 22.7 ± 4.5 kg/m², with 30% having BMI < 20 kg/m². Over the 6-month period, adherence to the NAM prescriptions was 93%, compared to 67% in the control group. Overall, 10% of residents within the NAM program presented with weight loss ≥ 1.5 kg over the 6-month period, compared to 46% in the control group. Similarly, 10% of residents within the NAM program suffered from ≥ 1 pressure sores, while this proportion was 27% in the control group. After the 6-month period, five residents were suffering from pressure sores; four of them were from the control unit. This pilot trial resulted in startling effects

despite the small sample size. Indeed, data revealed clinically significant decreased rates of weight loss and pressure sores among residents of the NAM program. Registering ONS prescriptions in the medication chart might be a key component of the program efficacy, as adherence to ONS prescriptions was markedly higher among residents of the NAM program. (Funded by the Fondation Vitae, CIUSSS de l'Estrie-CHUS.)

Non-fasting remnant cholesterol in Alberta's Tomorrow Project: Implications for nutrition and CVD risk prediction

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Background: Circulating fasting low-density lipoprotein cholesterol (LDL-C) has been (and continues to be) a cornerstone of CVD risk assessment in Canada. However, despite significant lowering of LDL-C by statins, residual CVD risk remains, indicative of alternate contributions from other lipid and inflammatory-based sources. Recent studies from Europe have demonstrated that non-fasting remnant cholesterol (RC) is causally associated with CVD, and in some circumstances proven to be a stronger risk predictor than LDL-C. These findings have resulted in many European countries to revise clinical guidelines to include measurement of non-fasting lipids to assess CVD risk. In Canada, the lipid guidelines for physicians were also updated in 2016 and included the importance of recognizing this new measurement. However, in Canada we currently do not have any studies that document distribution ranges for non-fasting lipids and/or RC. Alberta's Tomorrow Project (ATP) is a large, Canadian prospective cohort. The purpose of this study was to generate non-fasting lipid and remnant cholesterol values in ATP and determine the relationship between non-fasting remnant cholesterol and LDL-C with CVD prevalence. **Methods:** Non-fasting lipid data and CVD events were assessed in ATP participants (n=16,251). Non-fasting RC was calculated as total cholesterol - (LDL-C + high-density lipoprotein cholesterol). Differences between groups were determined by students t-tests, and the relationship between non-fasting RC and LDL-C with CVD was determined by logistic regression. **Results:** Quartiles of non-fasting RC associate with increasing CVD events, whereas LDL-C did not. Intriguingly, statin use was highest in the lowest LDL-C quartile and had no relationship with RC. Increasing RC had significant odds for increasing CVD prevalence but not incidence. **Conclusion** Non-fasting RC is a viable CVD risk marker in a Canadian population. The use of LDL-C as a CVD risk marker may be confounded by high statin use. In this large Canadian cohort, non-fasting RC had a stronger relationship with CVD prevalence than LDL-C and provides the first national dataset to justify the clinical utility of measuring lipids in the non-fasting state. **Funding:** Alberta Diabetes Institute Graduate Student Fellowship.

Body composition and prostate cancer risk: a systematic review of observational studies

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Body composition predicts clinical outcomes after cancer diagnosis, often independently of body weight. However, the impact of fat mass (FM) or fat-free mass (FFM) on cancer risk has not been characterized systematically. The objective of this systematic review was to examine the association between FM, %FM, and FFM and prostate cancer (PC) risk in adults. A systematic search of databases (Pubmed, EMBASE, and Web of Science) was performed up to April 2019. No search limits were

applied regarding date or language of publication. Eligible studies were case-control and cohort studies that measured body composition in relation to PC risk in adults. Methodological quality was assessed using the Newcastle-Ottawa Scale (NOS; range 0-9). Twelve studies were included. Of these, 8 were case-control studies (1,553 cases and 1,890 controls) and 4 were cohort studies (7,682 individuals diagnosed with PC). Mean + SD NOS score was 5.6 ± 1.5 among case-control studies and 8.3 ± 1.5 among cohort studies. Among the five case-control studies that reported % FM, four reported no differences between PC cases and healthy controls, and one found no differences in this body compartment between healthy controls and patients not on androgen deprivation therapy. Moreover, no consistent differences in FM (kg) and FFM (kg) were observed. Two out of four cohort studies found that higher % FM was associated with lower PC risk when individuals were grouped according to % FM quartiles or quintiles. Another cohort study reported a greater risk of being diagnosed with advanced-stage PC with higher % FM. A separate cohort investigation found absolute FM was positively associated with greater risk of developing high-grade PC, but the association was not apparent when body weight was included in the analysis. Findings from the small number of studies that have assessed associations between body composition and risk of PC were inconsistent and inconclusive. Differences in study design, study population, body composition measurement techniques, and PC staging make it challenging to compare findings, suggesting more research is needed. (Funding: Prostate Cancer Canada Targeted RFP in Prostate Cancer Prevention.)

Repeated neonatal oral sucrose treatment affects growth and alters insulin-like growth factor-1 and liver choline metabolism in mice

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Premature infants (<37 weeks gestation) often require hospitalization in the neonatal intensive care unit, where they experience painful procedures due to medical care. Oral sucrose treatment for analgesia is the non-pharmacological standard of care for minor procedural pain relief. During hospitalization infants can be treated with several cumulative doses of sucrose raising concerns about the effects later in life. The objective of this study was to determine the long-term effects of repeated neonatal oral sucrose treatment on growth, adiposity, and glucose homeostasis using an animal model. Neonatal female and male mice (C57BL/6J) were randomly assigned to one of four treatments (n=7-10 mice/group/sex): sterile water, sucrose, fructose, or glucose. Pups were treated 10 times/day for the first six days of life with 0.2g/kg weight of the respective treatments (24% solution; 1-4 µl/dose) orally to mimic what is given to preterm babies. Mice were weaned onto a control diet and fed until age 16 weeks. Pups were weighed daily from birth to weaning and weekly thereafter. Glucose tolerance was assessed at weaning and in adults. Body composition, fat distribution and tissue were collected at age 16 weeks. Female sucrose-treated mice gained less weight during the suckling period and were smaller (p<0.001) at weaning compared to the water and glucose-treated mice (7.00 ± 0.75g vs 8.13 ± 0.79g, 8.05 ± 0.96g respectively). At age 16 weeks, female sucrose-treated mice had smaller (p<0.001) tibias and lower (p<0.05) serum insulin-like growth factor 1 concentrations. This was accompanied by lower liver free choline (p<0.01), phosphocholine (p<0.05), and glycerophosphocholine (p<0.05) concentrations, and higher (p<0.01) betaine concentrations in the sucrose-treated compared

to the water-treated female mice. No differences in growth or liver choline metabolites were observed in male mice. Neonatal oral sucrose treatment had no effect on glucose tolerance at weaning or adulthood. Our findings suggest that repetitive neonatal sucrose treatment affects growth in female mice through an IGF-1-dependent pathway and alters liver choline metabolism. Further research is required to determine the mechanistic pathways of these findings. (Catalyst grant from the Healthy Starts Research Group at BC Children's Hospital Research Institute.)

Assessment of metabolic profiling, quality of life and body composition of women with breast cancer in chemotherapy

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Breast cancer is the most common cancer type in women. In 2018, 59,700 new cases were expected in Brazil. Modification in metabolic processes and body composition changes during chemotherapy may contribute to the development and progression of tumor affecting quality of life. The objective of this research was to evaluate anthropometric, body composition and metabolic characteristics of women with stages I-III breast cancer before, during and after chemotherapy. This was a prospective longitudinal study. Women who were starting chemotherapy were recruited. Quality of life was collected using the EORTC QLQ-BR23 questionnaire. Anthropometric assessments, bioelectrical impedance analysis and blood biochemical analysis were collected at 3 time points: diagnosis (T0), during chemotherapy (T1, T2) and after 1 month of completion of therapy (T3). Mean, standard deviation, percentage and spearman correlation were used to explore the data. A total of 64 women (58, 3% Stage II, 35% Stage III and 6.7% Stage I) were included; mean age was 46.4 years (SD=9.2). The majority of women were younger than 50 years (63.3%). We found a high prevalence of overweight and obesity at T0 (78.3%) with a worsening in T3 (81.6%). Weight gain (+1.8 kg) with an increase in fat mass (+0.23 kg) and decrease in fat-free mass (-1.58kg) was observed. Additionally, phase angle decreased (-0.88°, SD=0.77), with 75.4% of women at values below the cutoff point of 5.6°, which has been associated with increased mortality. Most (68.3%) participants developed metabolic syndrome post chemotherapy, 58.5% of those individuals were younger than 50 years of age. Changes in anthropometric measurements (weight and waist circumference) influenced serum triglyceride and fasting glucose values (p<0.05). A worsening in quality of life was reported, and related to the perception of body image, side effects and symptoms of the breast and arm. Chemotherapy treatment resulted in the worsening of anthropometric, body composition and metabolic factors, as well as poorer quality of life in women with early stage breast cancer. Targeted interventions are needed to prevent the development of metabolic syndrome and unfavorable body composition changes throughout the course of treatment trajectory in these women. (Funding: FAPESP.)

Vitamin D status of Anabaptist children in southwestern Ontario

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The Old Order Amish and Old Order Mennonite communities, who use horse-and-buggy transportation, are two of the most conservative Anabaptist groups in rural Southwestern Ontario. Traditional attire limits sun exposure. Health care professionals have expressed con-

cerns about the nutritional status, particularly vitamin D, for children in these communities. The objective was to determine vitamin D status. Fifty-two children (aged 2.5 mo – 6.5 y) (56% female) were recruited. Three-day food records (including supplements) were completed by mothers. Food records were processed using Food Processor by ESHA; nutrients for which there is an Estimated Average Requirement (EAR) were adjusted for intraindividual variation. Dietary data for children ≥12 mo, and ≤2 y were evaluated relative to the Dietary Reference Intakes and Canada's Food Guide (CFG), respectively. Finger prick blood samples were analyzed for vitamin D by ZRT laboratories (Oregon, USA). Nutrient intake from diet and biochemical analyses were available for 49 and 52 children, respectively. Serum vitamin D (25(OH)D) was low (<75 nmol/L) for one of four children <12 mo and for 63% of children ≥12 months of age. From diet alone, vitamin D intake was 79±66 IU/day (Recommended Dietary Allowance (RDA)=600 IU) (96% were below the EAR of 400 IU). Even including supplemental vitamin D, 87% were below the EAR. Servings of milk and alternates were 1.7±1/day (CFG=2/day; however, 81% drank farm milk, not fortified with vitamin D, directly from cows or goats. Calcium (Ca) intake from diet alone was 733±312 mg/day (RDA=700-1000 mg); 14.6% had Ca intakes < EAR. Based on the food records, 33% of children took a vitamin D supplement. These results indicate the prevalence of vitamin D insufficiency is high and that Ca intake could be improved for children in these Anabaptist communities. Vitamin D supplementation is routinely recommended for infants up to one year of age in Canada. These results support the need to encourage continued supplementation to achieve the RDA of 600 IU/day for Anabaptist children in these communities, where lifestyle provides limited opportunities to obtain vitamin D through diet or skin synthesis. (Funded by the Canadian Foundation for Dietetic Research.)

Does feeding TPN to neonates lead to the development of metabolic syndrome in adulthood?

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Metabolic syndrome is defined by the WHO as a chronic condition characterized by abdominal obesity, insulin resistance, hypertension, and dyslipidemia, and its risk is associated with early nutrition challenges. Total parenteral nutrition (TPN) is a life-saving feeding method, especially during the neonatal period; however, it is associated with changes in metabolism that may increase the risk of metabolic syndrome later in life. Such permanent metabolic changes are likely caused by epigenetic changes due to imbalances of dietary methyl nutrients. We hypothesized that the metabolic consequences of feeding TPN in early life would increase the risk of developing metabolic syndrome in adulthood and that supplementing betaine and creatine to TPN would prevent this development. Twenty-four female piglets (7 d old) were randomized to sow-fed (SF), TPN control (TPN-CON) or TPN with betaine and creatine (TPN-BC) (to enhance methyl group availability); eight intrauterine growth restricted (IUGR) (i.e., runt) piglets given TPN formed a fourth group (TPN-IUGR). After 2 wk of treatment, all pigs were fed a grower diet for 10 mo. At 9 mo, an arterial blood pressure telemeter and central venous catheters were implanted to conduct metabolic tests. TPN-IUGR pigs grew faster and body measurements were not different among groups at 10 mo of age. Feeding TPN in the neonatal period led to dyslipidemia in adulthood, as indicated by higher postprandial triglyceride (TG) levels in TPN-CON (p<0.05) compared to SF. Adding betaine and creatine to TPN (TPN-BC lowered mean arterial pressure (p<0.01) and systolic arterial pressure (p<0.01) in adulthood, compared to the TPN-CON, thus reducing the risk of hypertension. IUGR piglets were particularly sensitive to TPN feeding as TPN-IUGR led to development of obesity and dyslip-

idemia in adulthood as indicated by greater backfat thickness ($p < 0.05$), elevated fasting non-HDL cholesterol ($p < 0.01$) and non-esterified fatty acids ($p < 0.001$), higher liver TG ($p < 0.05$) and slower postprandial TG clearance ($p < 0.05$) compared to TPN-CON. Collectively, these data indicate that feeding TPN in early life increases the risk for the development of metabolic syndrome biomarkers in adulthood, especially in IUGR neonates, and supplementing betaine and creatine to TPN might reduce this risk. (CIHR.)

Are eating behaviours associated with the gut microbiome – endocannabinoidome axis?

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Endocannabinoids and their congeners, namely endocannabinoidome mediators, are bioactive lipids regulating several biological processes (e.g. energy metabolism and inflammation) and playing a key role in appetite, hedonic reward and mental well-being. Recent evidence show associations with the gut microbiota composition and thus support the existence of a gut microbiome–endocannabinoidome axis. Dysregulations of either or both systems of this axis are associated with obesity and related complications (e.g. dyslipidemia, insulin resistance and type 2 diabetes) and possibly related to mental disorders. Modulation of this axis has indeed been proposed in severe eating disorders (e.g. anorexia and binge eating) but evidence linking this axis to non-pathological eating behaviours, such as dietary restraint and disinhibition, remains sparse. The study aims to examine the associations between eating behaviours, the gut microbiome composition and circulating endocannabinoidome mediators. Plasma endocannabinoidome mediators were measured by LC-MS/MS and gut microbiota composition was inferred using 16S rRNA gene sequencing in stool of 190 male and female volunteers (Age: 41.1 years old [SD 17.6], body mass index (BMI): 25.1 kg/m² [SD 4.6]). Eating habits were evaluated by a validated web-based 24hr recall while eating behaviours were assessed using French versions of the Three-Factor Eating Questionnaire (TFEQ) and the Intuitive Eating Scale-2 (IES-2). Some significant associations were first observed between plasma levels of congeners of 2-monoacylglycerol (2-MAG) endocannabinoids and eating behaviors such as disinhibition, hunger and intuitive eating. However, when adjusted for BMI and age, only positive associations between congeners of 2-MAG endocannabinoids and intuitive eating scores remained significant. These associations were most specifically observed with 2-eicosapentaenoyl-glycerol (2-EPG) and 2-docosapentaenoyl(n-3)-glycerol (2-DPG) derived from omega-3 fatty acids (respectively $r = 0.20$ and $r = 0.20$; $p < 0.05$). These associations were also independent of the intake of the fatty acid of these endocannabinoidome mediators. This study will improve the knowledge of the interplay between eating behaviours, endocannabinoidome mediators and gut microbiota communities, providing information on its potential involvement in regulating eating behaviours among individuals. (Fonds de recherche du Québec - Santé, Canadian Institutes of Health Research.)

Parenteral nutrition (PN) practices in public hospital neonatal wards in an emerging country (Ecuador)

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Although PN practices in developed countries are well described in the existing literature, PN guidelines, procedures and policies are not

delineated in many developing and emerging countries. These limitations may affect PN use in neonatal intensive care units (NICUs) in Quito, Ecuador, where practices have not previously been described. The objective of the work was to determine the current PN practices and resources availability in public hospital neonatal wards ($n = 4$) in Quito, Ecuador. Secondly, we also examined whether current PN practices were standardised. A questionnaire composed of 58 closed-ended and open-ended items was administered by a face-to-face interview to three to five healthcare personnel ($n = 16$) from each neonatal unit responsible for delivering PN to infants. The lack of a formal and functional nutrition support teams (NST) was observed in all four NICUs. Only a few participants ($n = 3$) stated PN management is provided by a group of health professionals with different training, yet not formally recognized in their institutions as NSTs. Further, responsibilities were not exclusively related to providing nutrition support. Participation from dietitians in PN management was minimal, with one of the NICUs having a dietitian engaged in PN administration. Only one of the NICUs had a laminar flow hood designated for preparing PN solutions. To avoid potential errors, all of the NICUs developed their own spreadsheet (i.e. Microsoft Excel) to assist in calculations for PN solutions and did not use PN specific software. Six interviewees stated that they use a published guideline to manage PN treatment and seven indicated use of unpublished guidelines (i.e. consensus, protocols of their NICUs or the Ecuadorian Ministry of Health). Personnel involved in PN in the NICUs of public hospitals in Quito strive meet the recommendations of published guidelines, despite the observed challenges and limitations. Our study found a willingness of health care personnel to undertake opportunities for safety and quality improvement. Awareness of available resources and educational opportunities will allow NICUs to fill gaps in their practices ensuring a more standardized PN approach.

Breast milk vitamin A: how does it get there and where does it come from?

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Vitamin A is an essential micronutrient that can be transferred to infants via breast milk. It is well established that vitamin A present in breast milk is primarily in the form of retinyl ester, yet there are significant gaps in our knowledge concerning its synthesis. Our overall aim is to elucidate the molecular mechanisms governing the synthesis of milk retinyl ester, and its importance in providing vitamin A to the growing infant. Here, we present experimental evidence from a mouse model regarding 1) the expression level of components of the vitamin A metabolic pathway in the mammary gland during lactation, and 2) data emphasizing the importance of maternal dietary vitamin A consumption during lactation to maintain milk vitamin A levels and the establishment of adequate vitamin A stores in the offspring. In our first study, we compared the expression level of genes important in vitamin A metabolism in the mammary gland of virgin, lactating and involuted mice. Our data indicate that during lactation the vitamin A metabolic pathway is shunted away from retinoic acid synthesis and towards the synthesis of retinyl ester. A hallmark of this shunting is a significant upregulation in the expression of the retinyl ester-synthesizing enzyme LRAT (lecithin:retinol acyltransferase). In our second study, we dissected the relative contribution of maternal vitamin A stores vs. maternal dietary vitamin A intake to establishing sufficient amounts of milk retinyl ester. This was achieved by feeding lactating mice a diet that was either rich in vitamin A (14 IU vitamin A/g), or vitamin A deficient (0 IU vitamin A/g). Our data shows that the milk of mice consuming a vitamin A-deficient diet has significantly less retinyl ester and that this translates to offspring with significantly reduced hepatic vitamin A stores. In summary, we have taken the first step toward identifying the molecular machinery involved in mammary gland retinyl ester synthesis and provide data highlighting the

importance of sufficient maternal dietary vitamin A intake during lactation.

Canadian midwives' perspectives on nutrition for pregnant women

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Midwives are in an ideal position to provide nutrition advice to women with low-risk pregnancies. However, there is limited data on Canadian midwives' experiences with nutrition in practice. Therefore, we developed an online survey to explore midwives' attitudes towards providing nutrition information to pregnant women, their nutrition education, and pregnancy-related nutrition recommendations. The anonymous survey was distributed to all registered Canadian midwives via their provincial/territorial associations' e-newsletters and their clinics' publicly available e-mail addresses. Of the 161 respondents, almost all (99.4%) provided pregnant women with nutrition information. Midwives' attitudes towards nutrition were positive; respondents highly rated the importance of healthy nutrition during pregnancy and the importance of a midwife's role in providing nutrition education to pregnant women (92.5% and 83.3%, respectively, chose 4 or 5 on a 5-point Likert scale where 1=very unimportant and 5=very important). Nutrition topics encountered most frequently included nutrition for heartburn (86.3%), anemia (84.4%), weight gain (75.8%), and healthy eating in general (75.6%). On a 5-point Likert scale (where 1=very uncomfortable and 5=very comfortable) midwives scored a median of 4 on their comfort level when providing information on anemia, healthy eating, heartburn, and nutrition for breastfeeding, and a median of 3 on topics pertaining to vegan diets, herbal supplements, and nutrition for women of different ethnic origins. Comfort levels for advising on ketogenic diets were the lowest (median=2). Most respondents (58.1%) reported having received nutrition education during their Midwifery Education Program, and 17.4% reported doing so after registering as a midwife. Most participants identified the pre-pregnancy Body Mass Index (BMI) range for overweight as 25.0-29.9 kg/m² (59.7%) and recommended a weight gain range of 5-9kg for pregnant women with an overweight pre-pregnancy BMI (84.4%). A large proportion of midwives (88.2%) recommended that folic acid supplementation should be initiated three months prior to pregnancy. Overall, midwives believe that healthy nutrition is important in pregnancy and almost all provided nutrition advice to pregnant women. Although ~40% received no nutrition training, midwives' nutrition recommendations mostly align with the guidelines outlined by Health Canada and the Institute of Medicine. (This study was funded by Brescia University College Internal Research Grant.)

Fatigue pictogram as an instrument to assess performance status in patients with gastrointestinal cancer

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Malnutrition is common during antineoplastic therapy and the loss of weight and muscle mass affects mainly patients with head and neck and gastrointestinal tumors. Malnutrition and sarcopenia compromise the clinical outcome of treatment, reinforce complications, accentuate the feeling of fatigue worsening the patient's quality of life. Handgrip strength (HGS), adductor pollicis muscle thickness (APMT) and performance evaluation scales such as fatigue pictogram and Karnofsky scale are specific tools that might contribute to improve the assessment of nutritional status of those patients. The aims of this

study were to evaluate associations of functionality measures with data of nutritional status assessment in gastrointestinal cancer patients (metastatic or not). A cross-sectional and retrospective study based on clinical (sex, age, type of tumor, treatment and Karnofsky scale) and nutritional assessment data (weight, height, body mass index (BMI), APMT and HGS) collected from electronic medical records during patient's first nutritional care at Nutrition Clinic in General Oncology (between 2017 and 2018). Spearman's correlation coefficient was used for nonparametric data and comparisons between the different parameters evaluated, considering $p < 0.05$. Sixty patients were evaluated. From those, 74% (n=44) were male, with a mean age of 65.2 years (SD ± 12.6). Forty-four percent (n=26) of patients were diagnosed with intestinal cancer, 22% (n=14) with gastric cancer and 20% (n=13) with esophageal cancer. The results indicate that the better the performance evaluated in the fatigue pictogram, the better the muscle functionality (HGS values; $p=0.002$), the greater the reserve of muscle mass (APMT values; $p=0.008$) and the better the ability of patient to tolerate chemotherapy by the evaluation performed with the Karnofsky scale ($p < 0.05$). Fatigue pictogram is an easy-to-use instrument that showed correlation with parameters used to assess nutritional status and with performance of gastrointestinal cancer patients. The results reflect the importance in associate those methods of assessment, since they are easy-to-perform, low-cost and can generate more integrated information contributing to more assertive nutritional management.

Diet quality according to type 2 diabetes status in Quebec, Canada: a prospective community study

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Healthy behaviors, including adequate eating behaviors, are significant lifestyle factors that can lower the risk of type 2 diabetes (T2D). They are considered the first line of treatment after a diagnosis of T2D. However, it is unknown whether individuals with diagnosed T2D reflect higher dietary adherence to the recommendations. Therefore, the objective of this study is to describe the prevalence of diagnosed T2D (DD), prediabetes (PD), and undetected T2D (UD) among Quebec adults and assess dietary quality according to diabetes status. Baseline data from the CARTaGENE study, a community health survey conducted in 2009-2010 among Quebec adults aged 40 to 69 years (n = 6522), were used for the analysis. Diabetes status was determined by individuals who reported that health professionals diagnosed them as having diabetes, and further T2D was confirmed by using glycated hemoglobin A1c level. Dietary intakes were measured using a food frequency questionnaire, and dietary quality was assessed using the Canadian Healthy Eating Index (C-HEI). Overall, 9.1% of the individuals had PD, 18.7% had T2D (DD or UD). Among individuals with T2D, 75.9% of them were not aware of their situation, which translates to 14.2% UD from the total sample. Mean C-HEI score on a scale of 0 to 100 was 60.0 for DD and PD (SD 14.8 and 14.7, respectively), and 58.4 (SD 15.8) for UD, with no significant difference among the groups ($p=0.10$). The median intake of vegetables and fruits servings per day was 6.2 among DD individuals and 6.0 among UD individuals ($p=0.03$). Further, the median intake of whole fruits servings in individuals with the DD and PD was 1.8, compared to 1.6 among those with UD ($p=0.04$). Conclusion: A considerably higher proportion of Quebec adults was unaware of their T2D status when compared to Canadian national data. Our data suggest that individuals with a diagnosis of T2D seem to have dietary behaviors towards a healthier diet. However, public health strategies are crucial to positively affect the dietary habits of the population. (Heart and Stroke Foundation of Canada and the Henry and Berenice Kaufmann Foundation.)

Household food insecurity is associated with depressive symptoms in the Canadian adult population

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It is essential to identify factors associated with depression as it is a highly prevalent and disabling mental disorder. The aim of this study was to examine the association between depressive symptoms and household food security status among the Canadian adult population. This is a cross-sectional study of the adult population in the five provinces and one territory (Northwest Territories) of Canada using data from the 2015-2016 Canadian Community Health Survey-Annual Component (n=19,118). Depressive symptoms were assessed using the 9-item Patient Health Questionnaire (PHQ) [no or minimal depressive symptoms (PHQ<5) vs mild-to-severe depressive symptoms (PHQ≥5)]. Household food insecurity was measured using the 18-item Household Food Security Survey Module [Food secure (0-1 affirmative responses) vs food insecure (≥2 affirmative responses)]. A weighted logistic regression analysis with robust variance estimation technique was performed to examine the association between depressive symptoms and household food security status, adjusting for demographic, geographic and socioeconomic characteristics. Approximately 22% of the Canadian adult population reported mild-to-severe depressive symptoms, and 8.3% were from households classified as food insecure. Household food insecurity remained a predictor of mild-to-severe depressive symptoms, after adjustment for other known risk factors (ORadj: 2.87, 95% CI: 2.33-3.55, p<0.001). In the multivariable model, significant associations were also found with multimorbidity, lower household income, a history of illicit drug use, being a current smoker, being a widowed/divorced/separated, obesity and being a nondrinker. In addition, significant interactions emerged between employment status and age (p=0.03); employment status and sex (p<0.001); and physical activity level and sex (p<0.001). In conclusion, household food insecurity was associated with an increased likelihood of having mild-to-severe depressive symptoms in Canadian adults. The cross-sectional nature of the study does not allow to infer causality. Additional research in a longitudinal design are required to further elucidate the nature of this relationship. (Financial Support: University of Saskatchewan.)

Impact of sourdough pasta consumption on blood glucose regulation and gut microbial profile in overweight and obese adults

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Obesity and its related comorbidities are a global health threat. With diet being one of the main contributors, there has been growing consumer interest in foods with improved nutritional and functional properties. One such product is shelf-stable, fermented sourdough pasta. Sourdough fermentation is an ancient technology, which has been regaining interest in food industries because of its ability to increase nutrient bioavailability and total soluble fiber content, and decrease glycemic index. The primary aim of this study was to examine the impact of a novel sourdough pasta on blood glucose, insulin, and satiety hormone responses, compared to conventional pasta in overweight and obese adults. Our secondary aim was to investigate the changes in gut microbiota and their metabolites (short chain fatty acids, SCFA) after 5-days of consumption. We hypothesized that consumption of sourdough (fermented) pasta would decrease the postprandial blood glucose response and also, result in differential gut

microbial profiles compared to conventional (non-fermented) pasta. We performed two, randomized crossover trials on overweight men and women (age 25-45y, BMI 25-35). In Study A, fasted participants completed a randomized meal tolerance test comprised of 75g dried pasta in a cross-over design separated by 2 weeks. Results showed no difference in gastric emptying, blood glucose, insulin or satiety hormone responses (ghrelin, glucagon-like peptide, peptide YY and incretin). For study B, baseline oral glucose tolerance test was performed and fecal samples were collected for 16S rRNA and ITS sequencing. Participants then consumed pasta daily (75g/day) for 5 days followed by 2-week washout period. Results showed no differential impact of the sourdough pasta on glucose tolerance, bacterial diversity or SCFA concentration. However, sourdough pasta reduced gut fungal diversity compared to baseline. Overall, our data show that pasta fermentation did not change the glycemic properties of the pasta or significantly impact gut microbiota composition. (Funded by the Investment Agriculture Foundation of BC and MITACS. SS holds a Faculty of Kinesiology Deans Doctoral Scholarship.)

Effects of consuming dairy product on the cardiometabolic risk profile in a swine model of insulin resistance

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We have established a swine model of low birth weight (LBW) diet induced insulin resistance (IR) to investigate mechanism of dyslipidemia. Biomarkers of full-fat dairy consumption have been inversely associated with variables of IR. To understand the effect of consuming dairy fat per se on the risk of developing metabolic diseases, regular dairy products vs. low-fat dairy products will be fed to LBW Duroc × Landrace-large white piglets and compared to piglets fed a control high fat diet (CHF). We hypothesize that consuming a higher proportion of dairy fat will improve postprandial and fasting metabolic profiles. At 5 weeks of age, LBW piglets will be randomized to consume one of the 4 experimental diets: 1) the control low fat diet (CLF), 2) the control high fat diet (CHF), 3) the high fat dairy diet (HFDairy) and 4) the low fat dairy diet (LFDairy). The CLF diet is the standard chow diet for growing pigs containing 5% calories from fat, whereas the CHF diet is composed of 46% calories from fat (mainly lard). The HFDairy and LFDairy diets are comprised of the CHF diet + 3 servings per 2000 kcal/day of either high fat or low fat dairy products. Six to eight piglets will be assigned to each treatment group. All pigs will consume the experimental diet for a total of 7 weeks including a 1-week transition period. At 11 weeks of age, pigs will undergo a modified oral glucose and fat tolerance test to measure the postprandial lipid and glucose response. At 12 weeks of age, all pigs will be sacrificed and fasting blood, tissue and fecal samples will be collected. Preliminary results suggest and in accordance with previous published findings that LBW piglets fed CHF diet have impaired triglyceride and insulin metabolism. Data collection is ongoing to assess whether dairy fat can alter this phenotype. The outcomes of this study will delineate whether there is a direct relationship between dairy fat intake and improved metabolic profile in a swine model of insulin resistance. Dairy Farmers of Canada, Alberta Agriculture and Forestry and China Scholarship Council supported this study.

Application of carbon isotope ratio analysis to determine the origin of palmitic acid in the developing mouse brain

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Background: Palmitic acid (16:0; PA) is a non-essential saturated fatty acid provided both in the diet and synthesized de novo via lipogenesis.

PA is one of the most abundant fatty acids in the brain and in human breast milk. Interestingly, commercial infant formulas are supplemented with PA in the form of palm oil, however, little attention in research has been devoted to PA's maintenance in the brain during development. Objectives: To evaluate if PA is maintained in the mouse brain when dietary PA is provided at low levels, and to further understand the mechanisms that maintain brain PA during development. Methods: 30 BALB/c dams were equilibrated onto isocaloric diets containing low (<2%), medium (47%) or high (>95%) PA levels. First generation male and female offspring (n = 5-8 per diet group) were sacrificed at postnatal day 0, 10, 21 and 35. Fatty acids were extracted from brain tissue and natural abundance carbon isotope ratios of PA was measured by gas chromatography-combustion-isotope ratio mass spectrometry in collected tissues. Results: Despite nearly a 100% difference in PA levels between the low and high diets; brain PA concentration was not affected across first generation male pups in the three diet groups at each time point. Similarly, no significant differences between the dietary groups were found in behaviour, body or tissue weight among the dams and the pups. Upcoming carbon isotope ratio data will be presented at the meeting. Significance: Ultimately, these findings will lead to a better understanding of PA regulation and homeostasis in the developing brain. (Funding sources: Ontario Graduate Scholarship and Loblaw Food as Medicine Graduate Award.)

Food insecurity in Manitoba youth: The FANS (Food and Nutrition Security) study

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Although food insecurity and nutrition insecurity have been identified as significant public health issues in Canada and Manitoba, there is a lack of current, local and regional data for informing relevant program planning and policy development. Food insecurity occurs when people have financial constraints leading to inadequate or insecure access to food. Nutrition insecurity occurs when diets are not of adequate quality in terms of variety, diversity, nutrient content, and safety. Food security is a necessary, but not sufficient condition for ensuring a healthy population; consuming a nutritious diet is of equal importance. The overlap of food insecurity and nutrition insecurity presents a double burden for vulnerable populations, in particular children and youth, and has been demonstrated to contribute paradoxically to poor outcomes such as overweight and obesity because of limited access to healthy food choices. The FANS study is examining the food and nutrition security status of a sample of grade 9 students in Manitoba. A web-based survey consisting of demographic questions, a 24-hour diet recall, food behavior questions and food security questions was completed by 1588 students. 1453 completed the food security module (Food Security Survey Module for Youth), a series of nine questions adapted from the USDA Household Food Security Survey Module. The rate of food insecurity was 20.2% overall, with 14.9% reporting 'moderate' food insecurity and 5.3% reporting 'severe' food insecurity. Students from northern Manitoba reported higher rates than students from rural or urban Manitoba; rural students had the lowest rate of food insecurity. This is one of the first Canadian studies to employ a self-reported food security assessment tool for youth. The rate of food insecurity in this cohort is consistent with national survey results reporting 21.7% of children living in food insecure households. Further analyses will stratify food insecurity by sub-populations (self-identified newcomer and Indigenous status), and nutrition security (Healthy Eating Index). These results can be used by academic, government and community-based stakeholders to advocate for programs and policies to address food and nutrition insecurity. (Funding: CIHR.)

Adaptation and evaluation of the Pure Prairie Living Program in a First Nations cohort with type 2 diabetes

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Indigenous Canadians are among the highest-risk populations for diabetes and related complications in comparison with other Canadians. Practical approaches to implement nutrition recommendations in an easily accessible format are required. The overall goal of this study was to implement and evaluate the effectiveness of a lifestyle intervention (Pure Prairie Living Program (PPLP)) tailored for First Nations people in a health centre setting on a First Nation reserve. Briefly, PPLP is a community-based intervention that translates evidence-based nutrition guidelines into practical and easy-to-implement educational resources to help build skills and confidence to manage diabetes independently. Prior to beginning PPLP we conducted focus groups with First Nation people with diabetes (n=12) and their family members (n=3) and interviewed nine healthcare staff to understand their healthcare priorities/needs. Based on their feedback, we adapted the curriculum to include cooking demonstrations, healthy food baskets and equipment to help participants with food preparation. The revised study was implemented at the health centre in Enoch Cree Nation; 18 adult participants with diabetes and support persons participated in six weekly education sessions. The benefits of the lifestyle intervention on physiological indicators (BMI, waist circumference, blood glucose and lipids, blood pressure) and lifestyle choices (adherence to dietary recommendations, diabetes self-efficacy) were examined at baseline and post-intervention at 4 and 6 months. At 4-month assessment, we conducted focus group discussion with participants (n=12) and healthcare staff (n=2) to obtain feedback to improve the program. Quantitative data was analysed using Wilcoxon signed rank test and qualitative data was analysed using inductive thematic analysis. Significant improvements were observed (Mean difference \pm S.D, $p < 0.05$) in waist circumference (0-4 months: -2.5 ± 2.5 cm; 0-6 months: -2.9 ± 3.4 cm) and dietary adherence scores (0-4 months 4.9 ± 12.7 ; 0-6 months: 5.2 ± 11.2). Participant feedback indicated a need for follow-up support after PPLP, incorporation of physical activity and expansion of PPLP to reach other community members with diabetes. Results from this study will lay foundations for co-developing support programs and deepening the reach of PPLP within the reserve community. (Funded by CIHR, ADI and MECHET.)

Ursodeoxycholic acid improves the efficacy of a dietary intervention in counteracting Western-style diet-induced metabolic dysregulation and gut dysbiosis in mice

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Long term consumption of the Western-style diet (WSD) is associated with the development of metabolic diseases. Recent studies implicate gut microbiota remodelling (dysbiosis), characterized by increased Firmicutes to Bacteroidetes ratio in gut microbiota, and particularly reduced relative abundance of probiotic species, in the pathogenesis of WSD-induced metabolic disorders. Ursodeoxycholic acid (UDCA) is a natural bile acid metabolite found in human and murine bile that is generated by gut microbial metabolism of primary bile acids produced by the liver. Recently, UDCA has been shown to decrease the severity of some metabolic diseases. However, the impact of UDCA on WSD-induced metabolic dysregulation and on the composition of the gut microbiota are currently not known. Methods: C57BL/6 mice (males and females, n=5/group) were fed with a WSD for 12 weeks to

induce metabolic dysregulation. WSD-fed mice were then switched to a low-fat/low-refined sugar diet (2020X) with or without UDCA supplementation (320 mg/kg/d) for 8 weeks. Body weight gain, plasma lipid concentrations, glucose tolerance and gut microbiota composition were assessed before and after WSD feeding, and after switching to 2020X diet without or with UDCA supplementation. Results: Male and female mice showed sex dimorphic susceptibility to WSD-induced body weight gain, glucose intolerance and plasma dyslipidemia. Supplementation of the 2020X diet with UDCA was more effective than 2020X diet alone in the normalization of parameters altered by WSD feeding. Male and female mice exhibited sex dimorphic sensitivity to therapeutic intervention. Supplementation of the 2020X diet with UDCA induced additional changes in the composition of the gut microbiota than the 2020X diet alone. Switching the diet from WSD to 2020X caused the reduction in Firmicutes to Bacteroidetes ratio, and addition of UDCA increased relative abundance of known probiotic and bile acid tolerant genera including *Lactobacillus* spp. Conclusion: The fat composition of the diet had a substantial but distinct impact on the composition of male and female gut microbiota. UDCA also imposed specific changes in gut microbiota structure that may be related to the relief of metabolic dysregulation induced by the feeding of the WSD. (This work is funded by the NSERC and CIHR.)

Dietary protein intake relative to fat-free mass in children with obesity: preliminary findings

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Background: Adequate protein intake (PI) promotes healthy growth of body tissues during childhood, including skeletal muscle (main constituent of fat-free mass [FFM]). As children with obesity have a unique body composition and metabolism, protein requirements may differ from those of normal weight. We aimed to describe PI in children with obesity and investigate potential differences in body composition between children who did or did not meet PI recommendations. **Methods:** Children with obesity (BMI \geq 95th percentile; 10-16 y) completed a pubertal status questionnaire and 3-day food records (analyzed using Food Processor™). Average daily PI was adjusted for body weight (g/kg BW/d), fat-free mass (g/kg FFM/d), and percentage of energy intake (%). Adequate PI (i.e., RDA) was defined as \geq 0.95 and \geq 0.85 g/kg BW/d for ages 9-13 y and 14-18 y, respectively; protein AMDR was considered 10-30%. Percentage body fat (%BF) and FFM index (FFMI; FFM/height²) were assessed using air-displacement plethysmography. Differences between PI intake groups for daily PI and pubertal stages were assessed using Mann-Whitney and Chi-square tests. **Results:** To date, 25 children (median 12.1 [IQR, 10.9-14.4] y; 56% males; 68% prepubertal/early puberty) have been recruited. Average daily PI was 1.08 (0.74-1.36) g/kg BW/d, 1.83 (1.24-2.35) g/kg FFM/d, and 16.4 (15.2-19.1) %. Approximately 54% of children met the RDA for PI, but all children presented with a PI within the AMDR. Girls with inadequate PI had similar %BF (p=0.126), but lower FFMI (p=0.03) and protein relative to FFM (p=0.004) than girls with adequate PI. Although no significant differences were found for %BF (p=0.282) and FFMI (p=0.142) in boys, those with inadequate PI also presented with lower PI relative to FFM compared to their counterparts (p=0.02). Sexual maturation was similar between PI groups in girls, but there was a greater frequency of boys at more advanced pubertal stages in the inadequate than adequate PI groups. **Conclusion:** Preliminary results suggest that children

with obesity not meeting the recommended daily PI also might display a lower intake of protein relative to FFM, highlighting the importance of considering FFM when estimating adequate PI. **Funding:** Stollery Children's Hospital Foundation through the Women and Children's Health Research Institute.

Use of a validated nutrition screening tool at The Ottawa Hospital Cancer Centre to identify lung cancer patients at malnutrition risk

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Malnutrition is common in lung cancer patients and is associated with poor cancer treatment response and tolerance, and increased morbidity and mortality. The Patient-Generated Subjective Global Assessment Short Form (PG-SGA SF) tool has been validated for use in malnutrition screening of cancer patients, however studies of its implementation in the outpatient setting are lacking. A baseline pilot study using the PG-SGA SF at The Ottawa Hospital Cancer Centre (TOHCC) in the outpatient clinic was completed as part of a quality improvement project to determine the feasibility of integrating this tool into clinical practice. The objectives were to describe in lung cancer patients attending a TOHCC outpatient clinic: 1) the prevalence of malnutrition risk, 2) the frequency of patient reported weight loss, nutrition impact symptoms, reduced food intake and functional ability, 3) the screening tool completion rate, and 4) the percentage of malnourished patients referred to a dietitian. Consecutive patients attending a TOHCC outpatient clinic between January 15th and February 26th, 2019 were asked to complete the PG-SGA SF prior to their appointment. The PG-SGA SF were scored according to standardized procedure and pertinent patient characteristics were extracted from medical charts. A total of 305 lung cancer patients were screened using the PG-SGA SF. Of those, 211 (69%) forms were completed, 50 (16%) were partially completed, and 39 (13%) were refused. Respondents (n=211) were 68 \pm 11 y, 45% male, BMI 26 \pm 6 kg m², with mean (SD) PG-SGA SF score 5.2 \pm 4.7. The prevalence of malnutrition risk was 40% (n=84), 60% of which scored at severe risk. Those at risk for malnutrition frequently reported decreased food intake, weight loss, anorexia, pain, fatigue, dry mouth, nausea, and decreased levels of daily activities. Only 6 (7%) patients at risk for malnutrition were referred to a dietitian. In conclusion, a significant proportion of patients with lung cancer are at risk for malnutrition and present with symptoms potentially impacting their nutritional status, yet only a small percentage were referred to the dietitian. The moderate completion rate of the PG-SGA SF indicated areas of improvement for future implementation considerations. (Financial Support: Abbott Nutrition.)

Postprandial satiety hormones and subjective feelings of appetite were more impacted following consumption of liquid versus partially crystalline lipid droplets

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The physical and chemical properties of lipids alter the way triacylglycerols (TAG) are digested and absorbed but little is known about how TAG physical state at 37 °C, specifically, contributes to postprandial metabolism, mainly due to confounding differences in TAG composition. Ten percent palm stearin-based emulsions were recently formulated and uniquely tempered to achieve undercooled liquid (LE) versus compositionally equivalent partially crystalline (SE) emulsion droplets. TAG postprandial response was delayed when healthy men consumed SE compared to LE and this was supported by in-vitro digestion

investigations. Since dietary lipids and lipemia can also modulate satiety, the impact of LE versus SE on short-term appetite was also investigated. It was hypothesized that the attenuation of TAG digestion would suppress the release of gut hormones involved in the satiety cascade, slowing down gastric emptying, and reducing subjective appetite. 15 healthy men (age=27.5±5.7 y; BMI=24.1±2.5 kg/m²; fasting TAG=0.9±0.3 mmol/L) consumed 500 mL of flavoured and tempered LE or SE beverages with acetaminophen on two separate study visits. Participants were asked to rate the sensory properties of the emulsions and throughout the 6-hour study visit, blood samples were collected periodically for analysis of hunger and satiety hormones and acetaminophen and participants completed satiety visual analogue scales (VAS) ratings. The sensory characteristics of SE and LE were rated differently despite their identical composition; SE was perceived as thicker, clumpier, greasier, and had a higher after-feel (i.e. mouth coating). The earlier TAG appearance with LE was associated with an earlier rise and drop from baseline for Peptide YY (PYY) and Ghrelin, respectively. The incremental area under the curve response was also higher for LE for PYY (P=0.01) and Glucagon-like peptide 1 (P=0.028) but was not significantly different for Ghrelin (P>0.05) and acetaminophen response trended to being different. Participants reported a lower Appetite (P=0.041) and higher Fullness (P=0.015) with LE, but similar Nausea and Fatigue (P>0.05) for SE and LE based on baseline adjusted data. Therefore, emulsion droplet crystallinity was associated with differences in TAG absorption, which corresponded to subsequent impacts on short-term satiety, with the greatest satiety induction for the more digestible LE. (Supported by NSERC.)

Androgens alter intestinal lipid metabolism and absorption in polycystic ovary syndrome

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Introduction: Polycystic ovary syndrome (PCOS) is the most common endocrine-metabolic disorders, affecting >15% women of reproductive age. PCOS is highly associated with insulin resistance and dyslipidemia, and women with PCOS have a 2-fold higher risk of developing cardiovascular disease. Atherogenic dyslipidemia, including fasting and non-fasting lipemia, occurs in 70% of PCOS women and is highly correlated with plasma androgens. We have previously shown in a PCOS-prone rodent model that flutamide (androgen receptor inhibitor) decreases intestinal triglyceride (TG) and apoB48-chylomicron secretion. However, the direct effect of androgens on intestinal lipid metabolism remains unclear. **Aims:** The aim of this study was to determine the direct effect of androgens on intestinal lipid absorption and secretion pathways in a PCOS-prone rodent model of PCOS. **Methods:** PCOS-prone and control rodents were treated with androgens (T: testosterone and DHT: dihydrotestosterone, 1000 µg/kg/day) for 7 days, and then the intestinal lymph duct was cannulated to determine lipid (cholesterol and TG) and chylomicron particle-apoB48 secretion in the fasted and fed state, following saline and intralipid infusion into the duodenum, respectively. Radiolabeled lipids (3H-cholesterol, 14C-16:0) were used to assess direct lipid absorption. **Results:** In the control group T and DHT did not significantly alter lymph TG, cholesterol or apoB48 secretion. However, T and DHT treatment lowered TG (14C-16:0, 30.21% vs 3.13%) and cholesterol absorption (3H-CHOL, 21.9% vs 18.58%, p<0.05) in the control group. In contrast, T (46.65 ± 20.66 mg/ml) and DHT (34.83 ± 21.12 mg/ml) treatment in the PCOS-prone group increased TG secretion 3 to 4 fold compared to the PCOS-prone control group (12.48 ± 6.34 mg/ml) in the fed state (p<0.0001). DHT but not T treatment significantly increased absorption of TG (14C-16:0) in the PCOS-prone group by >55% (p<0.05). In both the fasting and non-fasting state, T increased (57-78%) and DHT decreased (52-85%) apoB48 secretion in the PCOS-prone group (p<0.05).

Conclusion: T and DHT treatment differentially modulate apoB48, lipid secretion and absorption in control and PCOS-prone conditions. In PCOS-prone conditions, TG absorption is increased in response to androgen treatment, and this supports our clinical findings in women with PCOS. (Natural Sciences and Engineering Research Council.)

Investing in the patient food experience: staff perceptions of serving quality food in Ontario hospitals despite organizational constraints

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Food quality is an important contributor to patient food satisfaction, which may subsequently affect patient food intake and recovery, as well as hospital costs. The aim of this qualitative study is to gain an understanding of how hospital staff and volunteers involved with food production and delivery describe food quality, their experiences with serving quality food and challenges to its provision. Sixteen Ontario hospitals participated. Semi-structured interviews (n = 64 participants) and focus groups (n = 24; 136 participants) were conducted. Inductive thematic analysis was used. Five themes emerged from analyses: 1) Acknowledging organizational constraints such as budget, staffing, and foodservice systems and how they may influence food quality; 2) Identifying patients' expectations of hospital food (e.g. perceptions of what patients want in terms of food quality); 3) Gaining an understanding of patients' nutritional needs (e.g. diagnosis and corresponding diet order, accommodating food preferences); 4) Working within constraints by identifying current practices that promote provision of high quality food, challenges to doing so and whether these challenges can be addressed with available resources, or if additional resources such as funding are required; 5) Assessing the patient food experience through patient satisfaction surveys, measuring food intake, and conducting waste audits. Findings demonstrate that serving quality food is complex due to organizational factors and patients' expectations and clinical needs. Findings also highlight the efforts made by staff and volunteers to deliver quality food despite these limitations. Discussing current practices and challenges also helped identify potential areas for improvements among and within departments (i.e. nursing and dietary) that could be implemented to improve patients' experiences with hospital food in the individual hospitals involved in this study. Improving and fostering a positive food experience in Canadian hospitals is needed to facilitate not only patient food intake and recovery, but also to be environmentally responsible with respect to institutional food provision. These learnings can be translated to support other hospitals with considering how to work within constraints and overcome challenges to offer quality food that patients will eat. (Funded by Ontario Agri-Food Innovation Alliance.)

Profiles of food parenting practices and associations with children's eating behaviours

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Food parenting (FP) practices can affect children's eating behaviours, yet little is known about how various FP practices co-occur. The objectives of this study were to: 1) examine the co-occurrence of FP practices using Latent Class Analysis (LCA); 2) assess whether FP classes differed by parents' socio-demographic variables (parents' sex, ethnicity and educational attainment); 3) evaluate whether FP classes predicted children's eating behaviours (emotional overeating, food fussiness, food and satiety responsiveness). A Canadian sample of 799 parents of 5-12 year old children were recruited by a marketing research company using a quota sampling approach. Parents completed a validated Food

Parenting Practice Item Bank (86 items measuring 11 FF practice constructs) and the Children's Eating Behaviour Questionnaire. LCA was used to identify profiles of FP practices. Regression analyses were used to examine associations between FP classes and children's eating behaviours. LCA revealed six profiles of parents: (1) High FP Engagement (17%); (2) Providing a Healthy Eating Environment (9%); (3) Reactive FP (17%); (4) High Structure around Food (25%); (5) Controlling FP (16%); (6) Low FP Engagement (16%). The likelihood of belonging to a FP profile did not differ between mothers and fathers but ethnicity and educational attainment emerged as significant predictors. Compared to White/Caucasian parents, non-White parents had lower odds of being in Providing a Healthy Eating Environment, High Structure around Food and Low FP Engagement classes compared to High FP Engagement, Reactive FP and Controlling FP classes. Compared to high-school educated parents, parents with post-secondary education had lower odds of belonging in the Controlling class versus Providing a Healthy Eating Environment, Reactive FP and High Structure around Food classes. Significant differences in children's eating behaviours emerged across FP classes. In covariate-adjusted models, high FP Engagement, Reactive and Controlling FP parents reported higher mean scores for emotional overeating and food fussiness compared to Providing a Healthy Environment parents. Ethnicity and educational attainment are significant predictors of FP classes among Canadian parents. Controlling FP practices are associated with less desirable eating behaviours among children. Future research should evaluate the bidirectional relationship of FP practices and children's eating behaviors. (Funding: CIHR; USDA/ARS.)

Who misses lunch on school days in Canada? Emerging insights from the 2015 Canadian Community Health Survey-Nutrition

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Canada's 2019 federal budget declared the Government's intention to develop a national school food program aiming to improve access to healthy meals at school. Yet, nearly no Canadian evidence describes the prevalence or frequency with which children miss school meals. This study assessed the prevalence and frequency of missing lunch on school days and explored factors associated with missing lunch among Canadian children. Two days of 24-hour dietary recall data were obtained from the 2015 Canadian Community Health Survey-Nutrition (n=2,991 children aged 6-17 years). Descriptive statistics were used to examine the prevalence of 'lunch non-consumers', defined as children who reported consuming no lunch on the first school day 24 hr dietary recall. Multivariable logistic regression models were used to examine the associations between demographic, socioeconomic and health characteristics with children's odds of missing lunch on school days. Approximately 6% of children reported missing lunch on their first school day 24 hr recall in 2015. The odds of being a lunch non-consumer increased with age (adjusted OR: 1.24 for each additional year, 95% CI: 1.04, 1.48). Children whose parents completed only a high school or less were four times more likely to miss lunch (adjusted OR: 4.05, 95% CI: 2.24, 7.33) compared to children whose parents had a college degree. Children living in food insecure households were twice as likely to miss lunch on a school day compared to their peers living in food secure households (adjusted OR: 2.03, 95% CI: 1.01, 4.10). Among older youth (children aged 12 years and older), smoking was associated with higher odds of not-consuming lunch compared to children who did not smoke (adjusted OR: 2.71, 95% CI: 1.04, 7.05). Missing lunch was not associated with gender, residential location, ethnicity, immigrant status, parental income, supplement use or weight status. Age, smoking, lower parental education and household food insecurity emerged as salient predictors of missing lunch on school days. This study provides novel evidence of the need to improve access to school lunches, particularly for the estimated one in ten

Canadian children living in food insecure households who reported consuming no lunch on school days. (Funding: CIHR FNR549.)

The influence of dietary intake on sex steroid hormones

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Introduction: Sex steroid hormones, testosterone and estrogen, are key regulators of metabolism and reproduction. Disruptions in the homeostasis of sex steroid hormone metabolism results in metabolic-endocrine disorders. Dietary modulation of these hormones may be clinically important in disease, metabolic conditions or life stages where hormones are altered, such as obesity, menopause and polycystic ovary syndrome (PCOS). The aim of this scoping review was to determine how the fasted and fed state, and different diet interventions impact sex steroid hormones in women. Methods: Databases searched include PubMed and Google scholar up to November 2019 and used key words related to diet, dietary patterns, nutrition and hormones, and reference lists were used to retrieve articles. Database search led to 75 relevant articles and 19 studies were included in the review that directly determined diet or nutritional interventions in women and effects on sex steroid hormones. Results: Low-fat diets (20% total kcal) were associated with significant reductions in plasma estradiol, estrone and total testosterone concentrations. Consistently, increasing dietary lipid intake was shown to negatively correlate with plasma estrogen concentration. Serum testosterone concentrations were shown to decrease by 20% following a lipid rich meal (65% kcal) in women with PCOS. Increasing fiber intake (30g/day) resulted in lower serum estradiol concentrations independent of weight loss. Vegetarian diets, high in fruits and vegetables, legumes, 30% kcal from fat and high in fiber (28g/d), resulted in lower levels of estradiol and testosterone, and higher serum hormone binding globulin (SHBG). Very low-calorie diets (800 kcal/d) were shown to induce body weight loss and to reduce insulin and increase SHBG, which may increase binding of androgens. Conclusion: Dietary lipid appears to postprandially regulate androgens and diets associated with weight loss lower estrogens and androgens, however the physiological mechanisms remain unclear. Limitations in the field include a lack of well controlled dietary-nutritional interventions and complete assessment of steroid hormone metabolism. Key-words: Diet, PCOS, Androgen, Estrogen, Testosterone, Fat, Fiber.

Genetic risk score predicting the plasma triglyceride response to either eicosapentaenoic or docosahexaenoic acid

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Numerous studies have uncovered the contribution of genetic factors to the heterogeneity of the plasma triglyceride (TG) response to an omega-3 fatty acid (n-3 FA) supplementation. However, this genetic contribution has never been investigated specifically for a supplementation to either eicosapentaenoic (EPA) or docosahexaenoic (DHA) acid. The objective of this study was to test the ability of a genetic risk score (GRS), previously built to predict the plasma TG response to combined EPA/DHA, can discriminate phenotypes of the plasma TG response to independent supplementations of EPA or DHA. A total of 154 participants were randomly attributed to three different supplementation groups in a double-blind, controlled, crossover intervention: 1) 2.7 g/d of DHA, 2) 2.7 g/d of EPA and 3) 3 g/d of corn oil (control), separated by 9-week washouts. The TG response phenotypes were defined as follows: positive responders (TG decrease following supplementation <0.25 mmol/L vs control), non-responders (TG variation

within ± 0.25 mmol/L), and negative responders (TG increase vs control > 0.25 mmol/L). SNP selection was based on a previous GRS of the TG response to n-3 FA supplementation developed by our group. A total of 31 SNPs previously associated with the TG response were genotyped in 122 subjects using TaqMan technology. Ordinal and binary logistic models, adjusted for age, sex and body mass index, were used to calculate the ability of the GRS to discriminate phenotypes of TG response. The GRS classified TG response phenotypes for EPA supplementation (odds ratio (OR)=1.2, $p=0.006$) and a trend was observed for DHA supplementation (OR=1.2, $p=0.08$). Exclusion of non-responders improved the significance of GRS predictions for both EPA (OR=2.3, $p=0.003$) and DHA (OR=2.4, $p=0.01$). In conclusion, these findings suggest that the constructed GRS is an effective tool for predicting TG response phenotypes following EPA or DHA supplementations. (Supported by the Canada Research Chair in Genomics Applied to Nutrition and Metabolic Health. The RCT was supported by CIHR (MOP 123494).)

Self-reported health status and eating habits of Canadian university students

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The transition to post-secondary education is a major developmental milestone, in which many young Canadians move away from home for the first time and face new social and academic responsibilities and challenges that may influence eating behavior. This, coupled with rising rates of obesity and evidence of poor diet quality in this age group, suggest that young adults entering university is an important target population for dietary intervention. In order to improve our understanding of eating behaviours associated with chronic disease risk in this population, this study evaluated perceptions of health and eating habits among Canadian university students. Students enrolled in two undergraduate courses were invited to complete a survey related to health, eating habits and dietary patterns. Descriptive statistics, t-tests and chi square were used to summarize responses, compare scores within the sample and evaluate gender and year of study effects. In this sample ($n=446$), overall health and eating habits were rated as "good to excellent" in 83% and 72% of participants, respectively ($p<0.01$). A small proportion of students (26%) were managing at least one health condition through food and diet, the most common of which was iron deficiency anemia (12.6%). Based on reports of eating habits in the last month, less than one-third of students had consistently planned meals in advance (32%) and almost one in five had "rarely or never" prepared meals at home. In the previous year, 58% of students had made changes to their eating habits, with some changes including less fruit and vegetables (45%) whole grains (31%) and fibre (31%), and higher intake of sodium (14%) and fatty foods (13%) associated with chronic disease risk. Most students reported eating dinner and lunch every day, however breakfast skipping was common (17% \leq one day/week). Unhealthy eating habits among some post-secondary students suggest important targets for dietary intervention. Gender and year of study effects are noteworthy among these findings, and may be relevant in planning healthy eating initiatives in this population.

Examining changes in the nutritional quality of products offered by the top packaged food and beverage companies in Canada between 2013 and 2017

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Canada's food supply largely consists of ultra-processed products high in nutrients of public health concern, increasing the risk of obesity

and non-communicable diseases. Given the strong influence of food companies on the food supply, several companies have committed to industry- or government-led reformulation initiatives. It is, however, unclear how the healthfulness of products offered by individual companies has changed in response to reformulation programs. This study aimed to examine changes in the nutritional quality of products offered by major food companies in Canada between 2013 and 2017. The top packaged food and beverage manufacturers ($n=22$) were selected based on sales. Nutritional information was sourced from the University of Toronto FLIP 2013 ($n=6,490$) and 2017 ($n=8,277$) databases, including 4,074 products matched between cycles. The nutritional quality of companies' products was assessed based on: 1) the Health Star Rating (HSR) system (ranging from 0.5 to 5.0, with a higher HSR signifying a healthier product); and 2) sodium, saturated fat and total sugar levels per 100 g (or mL). Changes from 2013-2017 were examined between companies by food category. Absolute changes in mean HSRs of companies' total products ranged from -0.4 to 0.8. In terms of sodium per 100 g/mL, median absolute and percentage changes in companies' products ranged from -99 mg to 278 mg and -40% to 463%, respectively, with the greatest differences between companies observed for sauces and bakery products. Absolute and percentage changes in median saturated fat ranged from -7.3 g to 8.0 g and -63% to 400%, respectively, between companies. Changes in median saturated fat amounts varied most widely between companies for dairy products and fats/oils. For total sugars, median absolute and percentage changes ranged from -26.3 g to 1.8 g and -55% to 18%, respectively, between companies, with the greatest variation observed among sauces and bakery products. Overall, while some leading food companies in Canada have improved the nutritional quality of their products, these actions are inconsistent across the industry, with many companies having less healthy product portfolios in 2017 compared to 2013. These findings suggest a need for stronger industry and government reformulation initiatives. (Funding: CIHR; OGS.)

Consumption of total, free and added sugars and comparisons of nutrient intakes among Canadian adults using the Canadian Community Health Survey 2015 Public Use Microdata File

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Background: Global dietary guidelines including the World Health Organization recommend reducing free sugars intake. These recommendations may affect the public's choices of sugars-containing foods including those that are nutrient-dense. However, it is not known how the nutrient intake profiles (both macro- and micro-nutrients) vary across the spectrum of sugars consumption in Canadian adults. Methods: The 2015 Canadian Community Health Survey (CCHS)-Nutrition collected detailed dietary data among a representative sample of Canadians. The first day 24-hour recalls for adults aged 19 years and over from the CCHS 2015-Public Use Microdata File were analyzed using SAS 9.3 ($n=11,817$). Intakes of energy, macro- and micronutrients were compared across quintiles of total sugars intake, after adjusting for sample weights, misreporting status and key covariates. Results: Canadian adults consumed on average 86.9g/d (18.8% of energy) from total sugars, 47.5g/d (9.9% of energy) from free sugars and 41.7g/d (8.6% of energy) from added sugars. The mean intakes for the 1st, 3rd and 5th quintile of total sugars were 7.9%, 19.0% and 33.0% of energy, and those of free sugars were 3.3%, 9.2% and 19.9% of energy, respectively. In the fully-adjusted model, the 5th quintile of total sugars intake had the lowest total energy intake with statistical significance compared to the 3rd quintile ($p=0.012$). The 3rd and 5th quintiles had significantly lower % of energy from total fat and saturated fat compared to the 1st quintile ($p=0.0083$). Fibre intake was significantly lower in the 1st quintile compared to all other quintiles ($p<0.001$). With regard to micronutrients, the 3rd quintile of total sugars had higher vitamin A,

riboflavin, vitamin D, calcium and potassium compared to the 1st quintile, and higher thiamin, folate, vitamin B12, iron, phosphorus and zinc than the 5th quintile ($p < 0.001$). Conclusions: Canadian adults consumed on average 18.8% energy from total sugars and 9.9% of energy from free sugars. Those with moderate intake of total sugars tended to have higher fibre and overall better micronutrient intake compared to those with very low or very high intakes of total sugars. These data are important to consider in developing dietary policies around sugars. (Funding: Mitacs, Canadian Sugar Institute.)

The quality of maternal diet affects birth outcomes and neuroapoptotic markers in the neonatal brain of rats exposed to ethanol during gestation

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Not all prenatal ethanol (EtOH) exposure results in fetal alcohol spectrum disorders (FASD). This implies that other factors such as maternal nutritional status play an important role in the development of FASD. Standard chow is widely used in prenatal EtOH exposure studies, which often report detrimental EtOH effects on birth outcomes and brain development. This study compared a chow with a formulated energy dense (E-dense) diet on birth outcomes and neuroapoptotic markers in the neonatal brain of rats exposed to EtOH during gestation. Pregnant Sprague-Dawley rats were randomly assigned to four groups: chow ($n=6$), chow+EtOH (20%, v/v in drinking water) ($n=7$), E-dense ($n=6$), and E-dense+EtOH ($n=8$). Birth outcomes including litter size, body and organ weights were noted. At postnatal day (PD) 7, representing brain growth spurt in rats, the cortex, cerebellum and hippocampus were collected. Ceramides and caspase-3 activity (markers for apoptosis) were measured using gas chromatography and a caspase-3 assay kit, respectively. Compared to dams fed chow, dams fed E-dense diet had an approximately 5% higher body weights and 2-5% less EtOH-induced weight loss during gestation ($P < 0.05$). Dams from chow+EtOH had a smaller litter size than dams from chow, whereas the litter size was similar among E-dense groups. E-dense groups had 2.1 times less neonatal deaths compared to chow groups. At PD7, pups from E-dense groups had higher body weights (16-19%) and less EtOH-induced brain weight loss (3%) compared to pups from chow groups (7%) ($P < 0.05$). EtOH increased ceramides in the hippocampus of pups from chow group, which was reduced by the E-dense diet ($P < 0.05$). No significant changes were identified in caspase-3 activity. Compared to chow, the E-dense diet attenuated EtOH-induced weight loss in both dams and pups, and ceramide elevations in the hippocampus of pups. These data indicate that the quality of the maternal diet affects birth outcomes and neuroapoptotic markers in neonates with prenatal EtOH exposure, and maintaining a good maternal nutrition is a potential target to alleviate FASD. (Supported by Research Manitoba, Canada-Israel International Fetal Alcohol Consortium and Manitoba Graduate Scholarship.)

Fish oil and metformin intervention improves atherogenic dyslipidemia in Polycystic Ovarian Syndrome

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Background: Polycystic Ovary Syndrome (PCOS) is highly associated with the metabolic syndrome (MetS): obesity, insulin resistance, atherogenic dyslipidemia. Women with PCOS-MetS have increased risk of ischemic cardiovascular disease (CVD) and Type-2 Diabetes. First-line intervention in PCOS-MetS includes targeting diet and lifestyle, and metformin is commonly prescribed to treat insulin resistance. However, there are presently limited safe, efficacious options

for targeting atherogenic dyslipidemia in young women with PCOS. Fish oil (FO) has been shown to reduce fasting TG, apoB, and to improve ischemic CVD outcomes. The efficacy of FO or FO-metformin combination to improve ApoB-remnant lipemia in PCOS-MetS is unknown. The aim of this pilot study was to determine the effect of metformin, FO and FO-metformin treatments on fasting and non-fasting plasma TG and apoB-remnant lipoprotein metabolism in patients with PCOS-MetS. Methods: Participants diagnosed with PCOS aged 18-30 years received dietary counselling and were randomly assigned to receive FO, metformin or FO-metformin treatments for 12 weeks. Fasting and non-fasting plasma TG, cholesterol, ApoB48 and ApoB100 lipoprotein metabolism were assessed using a standardized high-fat meal test. Results: Baseline fasting plasma TG, ApoB48 and ApoB100 was 238.0 ± 21.0 mg/dL, 9.00 ± 1.12 μ g/ml and 290 ± 18.00 mg/dL. FO and FO-metformin decreased fasting plasma TG by 10% and 30% compared to metformin (7%). Fasting ApoB48 decreased 45%, 16% and 19% in FO-metformin, FO and metformin groups. Non-fasting plasma TG and apoB48 area under the curve were reduced 30% by FO-metformin. Conclusion: FO-metformin adjunct therapy may have greater efficacy to improve atherogenic apoB-dyslipidemia compared to metformin or FO alone in high-risk patients with PCOS-MetS. A larger clinical trial is warranted to determine long-term effects of FO-metformin intervention on apoB-dyslipidemia and atherosclerotic CVD indices. (Acknowledgment of funding: CIHR, ADI, WCHRI.)

Food, nutrition, and physical activity programming needs for community-dwelling older adults with memory changes and their care partners

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Memory changes are an increasing health concern for Canadians. Compared to the general population, persons with memory changes (mild cognitive impairment, dementia, undiagnosed memory problems) are more likely to be malnourished, or at risk for malnutrition. Furthermore, dementia-related appetite loss may cause older adults to experience sarcopenia. Preventative health behaviours such as exercise and healthy diet can benefit older adults with memory changes and their care partners. However, it is unclear what community-dwelling older adults and care partners need in a wellness program. The objective of this research was to identify the food, nutrition, and physical activity educational needs and activity preferences of this population to establish a wellness program. Two Qualtrics surveys were created: one for persons with memory problems, and one for family/friend care partners. English and French versions were available. Convenience and snowball sampling were used for recruitment, using social media and stakeholder networks (e.g., Alzheimer's Society of Canada Research Portal). There were 147 complete and partial responses to the survey. 22 care partners and 20 persons living with dementia fully completed the survey (29% completion rate). Of these respondents, 67% were female, and 36% of respondents were within the 70-79 age range. 40% of respondents with memory changes reported an 'average' diet. On the other hand, care partners reported decreasing diet quality and physical activity levels upon becoming care partners. Specifically, 95% of care partners had good/excellent diet before becoming a care partner, but only 73% reported good/excellent diet now, as a care partner. Similarly, 77% of care partners who reported good/excellent physical activity before becoming care partners dropped to 64%. The most popular method of nutrition education delivery was online. Ultimately, respondents were interested in diet and physical activity education, though preferences for wellness programs were diverse. Thus, community wellness programs must be flexible in offerings and delivery. (This research was funded by the Hallman Undergraduate Research Fellowship.)

Free sugars and sweeteners in the Canadian food supply: changes from 2013 to 2017

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Following several calls to action to reduce the amount of free sugars in foods and beverages, there is a need for data on changes in free sugars contents of prepackaged foods and beverages in Canada. Thus, this study's objective was to quantify changes in free sugars contents and sweetener use in the Canadian food supply between 2013 and 2017. This study was a repeated cross-sectional analysis of the University of Toronto's Food Label Information Program database 2013 and 2017 collections (n=15,259 and n=16,937, respectively, after exclusions). Free sugars contents were estimated using the University of Toronto Free Sugar Algorithm. Pearson χ^2 and Mann-Whitney U tests were used to determine changes in free sugar ingredient (FSI) and sweetener use, and the percent contribution of free sugars towards energy between the two years, respectively. Mann-Whitney U and Wilcoxon Signed Rank tests determined significant changes in free sugars levels from 2013 to 2017. Results indicate that reformulation of products may be underway within some food categories; however, overall there has been limited progress towards reducing free sugars contents since 2013. Free sugars accounted for 62% of total sugars and contributed 20% of calories in products (p=0.529 and p=0.347, respectively), which remained unchanged since 2013. Major food categories with the highest median density of free sugars (per 100g/mL) also remained unchanged and included desserts (12.4 g), sugars and sweets (48.6 g) and bakery products (14.3 g). Beverages experienced a significant reduction in free sugars as a percent of calories and in median free sugars levels (-3.3%, p=0.0052; 2.7 g/100 g, p <0.0001), along with sugars and sweets (-7.4%, p<0.0001; 1.4 g/100 g, p=0.0004). This was accompanied by an increase in frequency of substituting FSI with sweeteners in beverages (p=0.0003) and sugars and sweets (p=0.0008). This data provides insight into the nature of current sugars reformulation efforts and a baseline to understand where future reformulation efforts can be targeted, as well as the data necessary to accurately measure free sugars intakes of Canadians and associated health outcomes. (BBDC-Novo Nordisk Studentship (MVW); CIHR Sugars and Health (SA2-152805) (MRL).)

Sugars reformulation in the Canadian food supply: modelling nutritional composition changes following two reformulation scenarios

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Reformulation of food and beverage products has been touted as a "best buy" approach to improving the healthfulness of prepackaged foods, and hence, diet quality. As such, a systematic sugars-focused reformulation strategy may help to reduce intakes; however, there is a paucity of data on how the overall nutritional quality of the Canadian food supply would be altered following such a scenario. The objective of this study was to model changes to the nutritional composition of the Canadian food supply following two hypothetical sugar-focused reformulation scenarios: i) Reformulation Scenario 1 ('RS1')– a 20% reduction in total sugars among all products, similar to the Sugar Reduction Programme in the UK, and; ii) Reformulation Scenario 2 ('RS2')– a reduction in free sugars contents of products within the top quartile of free sugars for their food category to the average third quartile free sugars contents, similar to targets used in the Sodium Reduction Strategy in Canada. Resultant calorie and nutrient levels were based on the nutritional composition of existing reformulated or lower-sugars foods, found in the University of Toronto's Food Label Information Program 2017 database (n=16,934). Results showed that while both strategies had their advantages and disadvantages, a sugars-focused reformulation strategy could result in 21-29% lower free sugars contents of Canadian foods; however, the average

reduction in calories was -4.0% and -2.4% for RS1 and RS2, respectively, which draws into question the nutritional significance of such changes. The reformulation scenarios were particularly effective in reducing maximum free sugars levels of major food categories; however, care will be needed to ensure replacements with starches and fats don't undermine the healthfulness of reformulated products, as was seen overall and in some food categories. These findings support the consensus that reformulation efforts must occur in the context of overall healthy eating and emphasize a food-based, as opposed to a single nutrient-based approach. This data can provide a basis for the development of a sugars reformulation strategy in Canada and insight into how intakes of calories and nutrients could change if not considered when designing reformulation strategies. (BBDC-Novo Nordisk Studentship(MVW); CIHR Sugars and Health (SA2-152805) (MRL).)

Dietary n-3 and n-6 polyunsaturated fatty acid modulation of adipose tissue-derived mRNA expression of inflammatory mediators: a time course study in high-fat fed rats

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Diets high in saturated fatty acids (SFA) may contribute to obesity, leading to functional changes in adipose tissue (AT)-immune cell populations, altered production and secretion of inflammatory adipokines and, ultimately, dysregulated AT metabolism. AT-infiltrated inflammatory immune cells such as M1 macrophages, play a central role in development of local inflammation via paracrine interactions (cross-talk) with adipocytes; however, the critical time points of infiltration and exacerbation of this inflammatory cross-talk remain unclear. Previous work from our lab has shown that dietary long-chain n-3 polyunsaturated fatty acids (PUFA), eicosapentaenoic acid (20:5n-3, EPA) and docosahexaenoic acid (22:6n-3, DHA), blunt inflammatory cross-talk between adipocytes and macrophages. In the current study, we investigated dietary n-3 and n-6 PUFA intervention in a time course study in order to further understand AT inflammatory development that occurs in obesity. Male Sprague-Dawley rats (7wk-old) were fed one of three isocaloric diets: i) high-fat (HF; 54% kcal lard, 6% kcal soybean oil), ii) HF with n-3 PUFA (HFn-3; 39% kcal lard, 15% kcal menhaden, 6% kcal soybean oil) or iii) HF with n-6 PUFA (HFn-6; 45% kcal lard, 15% kcal soybean oil) for 2, 8, or 12 wk (n=6-8/diet/time point). At each time point, epididymal AT was harvested to assess pro- and anti-inflammatory cytokine mRNA expression by RT-PCR. At 2wk and 8 wk, inflammatory (*Tnf- α* , *Mcp1*) and anti-inflammatory (*Il-10*) gene expression was increased (P \leq 0.05) and decreased (P \leq 0.01), respectively, in both HFn-3 and HFn-6 compared to 12wk expression. Compared to HF, HFn-3 blunted inflammatory gene expression (*Tnf- α* , *Il-1 β* ; P \leq 0.05) at 12 wk. While gene expression of the anti-inflammatory cytokine, *Il-10*, was up-regulated in all diet groups at 12 wk vs 2 wk (P \leq 0.05), rats fed the HFn-3 diet had a greater increase in *Il-10* expression (P \leq 0.05) at 12 wk. Together, these data suggest differential fatty acid-induced modulation of AT inflammation in the development of obesity in HF-fed rodents. (NSERC.)

Gut morphology is unaffected in neonatal piglets treated with glutathione-supplemented parenteral nutrition

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The use of parenteral nutrition (PN) to treat premature infants causes deleterious changes to the structure and function of the gastrointestinal tract (GIT), in part related to the decrease in blood supply that occurs without enteral stimuli. Nitric oxide (NO) regulates blood flow, but in situations of oxidative stress, as occurs with the delivery of

oxidized nutrients in PN, it can react with superoxide to form peroxynitrite, thus limiting its function as a vasodilator. Furthermore, the endogenous synthesis of glutathione may be limited due to developmental immaturity or inadequate availability of the precursor cysteine in PN. We hypothesized that supplementing glutathione to PN would protect NO's function as a vasodilator, leading to increased blood flow to the GIT. Piglets (8-12 days old) underwent a surgery to implant venous catheters and an ultrasonic probe on the superior mesenteric artery for chronic measures of blood flow; a gastric catheter was also implanted in an enterally-fed control group to determine the effects of route of feeding on oxidative stress. One of three treatments was fed for 7 days: control PN (C-PN, n=10), or the same PN diet with 10 μ M glutathione disulfide (GSSG-PN, n=9), or the control PN diet delivered enterally (EN, n=10). As predicted, blood flow ($p<0.0001$) and mucosa weight ($p<0.01$) were higher in the EN compared to the C-PN group, while no differences were observed between C-PN and GSSG-PN groups. Cell proliferation in intestinal crypts (measured by immunohistochemistry) was also greater with EN feeding compared to the C-PN group ($p=0.0019$) but there was no difference between the C-PN and GSSG-PN groups. While these preliminary data suggest that glutathione supplementation to PN has little effect on gross intestinal morphology, future analyses of overall glutathione status and markers of oxidative stress in gut, liver and lungs may reveal a role for glutathione in reducing the oxidative stress experienced by neonates fed by PN. (Jane-way Children's Hospital Foundation; JMBW supported by CIHR.)

Dietary choline intake and relationship to biomarkers in school-aged children

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Choline is essential for growth and development during childhood and is a precursor for phosphatidylcholine, acetylcholine, and betaine. Dietary choline recommendations are adequate intakes (AIs) set by the National Academy of Medicine in 1998 and the European Food Safety Authority in 2016. However, there are limited data on dietary choline intake in school-aged children. This study assessed dietary intakes of choline and determined the relationship to plasma choline metabolites in children (5-6 years; n=213; 51% female). Dietary intakes of choline and betaine were estimated by 3-d food records. Plasma free choline, betaine, and dimethylglycine were quantified by liquid chromatography-tandem mass spectrometry. Dietary intakes of choline and betaine were (median [IQR]) 229 (184-185) and 81 (60-107) mg/d, respectively. Children were predominantly consuming choline in the form of phosphatidylcholine, free choline, and glycerophosphocholine (48, 21, and 21%, respectively) from animal food sources including dairy, meats, and eggs (28, 18, and 13%, respectively). Although the average choline intake was close or above the AIs, only 37% of the children were meeting the AI set by the National Academy of Medicine (≥ 250 mg/d) compared to 80% of the children meeting the AI set by the European Food Safety Authority (≥ 170 mg/d). Plasma free choline, betaine, and dimethylglycine concentrations were (mean \pm SD) 8.61 ± 2.11 , 45.4 ± 14.1 , and 3.34 ± 0.99 μ mol/L, respectively. No relationships were found between dietary intakes of choline and betaine and biomarkers of status. These findings suggest that 63% and 20% of school-aged children were not meeting the recommended choline AIs as set by the National Academy of Medicine and European Food Safety Authority, respectively. Plasma biomarkers of status may not be appropriate indicators of dietary intake for choline and betaine in children. Further work is required to investigate the dietary requirements of choline during development and to identify biomarkers of dietary intakes in children. (Funding: CIHR, Becas Chile, BC Children's Hospital Research Institute Bertram Hoffmeister Postdoctoral Fellowship.)

Mechanisms behind the T-cell response to a high-fat diet differ between male and female Wistar rats

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Chronic systemic inflammation and immune dysfunction are known complications of obesity. Consuming a high-fat diet decreases T-cell function in male rats, however, the influence of sex on the immune response is less understood. This study aimed to evaluate the sex differences in immune function of Wistar rats in response to diet-induced obesity. Four-week-old male and female rats were randomized to consume one of two nutritionally complete diets for 9 weeks: 1- low-fat (control 10% fat wt/wt) or 2- high-fat (HF 25% fat wt/wt). Although total fat differed between diets, the proportion of fatty acids was matched. At 13 weeks of age, rats were terminated and immune cells were isolated from spleens. Ex vivo cytokine production after stimulation with phorbol 12-myristate 13-acetate plus ionomycin (PMA+I), a T-cell mitogen, was measured by ELISA to determine immune cell function. Immune cell subsets were determined by flow cytometry. Regardless of diet, females had significantly lower body weights and higher adiponectin levels than males (both $P<0.01$). When stimulated with PMA+I, splenocytes from both males and females on the HF diet tended to produce less IL-2, a marker of cell proliferation, than control rats ($P=0.058$). Yet females tended to produce higher levels of IL-2 compared to males ($P=0.115$). Males and females on the HF diet produced more IL-10, a Th2 cytokine, than control rats ($P<0.05$). Males fed the HF diet produced less TNF- α and IL-6 (both $P<0.05$), two Th1 cytokines, compared to control males. In contrast, females on the HF diet produced more IL-6 than control females ($P<0.02$). Although few changes were observed in T-cell phenotypes for both sexes, females had a higher proportion of B-cells expressing CD80, an activation marker, compared to males (both CD45RA+CD80+ and OX6+CD80+ cells; $P<0.02$). Therefore, consuming a high-fat diet appears to increase Th2 and decrease Th1 responses in males, while both Th1 and Th2 responses seem to increase in females. Overall, our findings suggest that the mechanisms underlying the T-cell response to a high-fat diet differ between sexes. (Funded by Alberta Innovates, Egg Farmers of Canada, and NSERC.)

Clinical measurement properties of malnutrition assessment tools for use with patients admitted in hospital: A systematic review

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Background: The use of malnutrition outcome measures (OM) is on the rise among registered dietitians (RD) with inpatients in hospitals. This would promote the achievement of nutritional care goals and support the decision-making for the allocation of nutritional care resources in hospitals. There are 3 commonly used OMs: Subjective Global Assessment (SGA), Patient Generated-Subjective Global Assessment (PG-SGA) and Mini Nutritional Assessment (MNA). Therefore, the purpose of this current study is to systematically review the evidence on the clinical measurement properties of malnutrition assessment tools for use with patients admitted in hospitals. Methods: MEDLINE, Cinahl, EMBASE, and PubMed were searched for articles published between 2000 and 2019. Research articles were selected if they established reliability, validity, and responsiveness of the SGA, PG-SGA and MNA, which were written in English and used any of these OMs as an outcome measure. Abstracts were not considered. The risk of bias within studies was assessed using the Quality Appraisal for Clinical Measurement Study (QA-CMS). Results: There are 505 studies identified, of which 34 articles were included in the final review: SGA-8, PG-SGA-13, and MNA-13. Of the 34 studies, 8 had a quality score of

greater than 75%; 23 had quality score of 40 – 75%, and 3 studies had a quality score of less than 40%. PG-SGA was found to have excellent diagnostic accuracy (ROC: 0.92-0.975; Sensitivity: 88.6-98%; Specificity: 82-100%), sufficient internal consistency (Cronbach's alpha: 0.722-0.73), and strong test-retest reliability ($r=0.866$). There was insufficient evidence to suggest adequate diagnostic accuracy and good inter-rater reliability for SGA. Only one study had examined the minimum detectable change of the MNA (MDC=2.1). Conclusions: The evidence of validity for the existing malnutrition assessment tools supports the use of these tools, but more studies are needed with sound methodological quality to assess the responsiveness of these OMs to pick up the change in nutritional status.