

Abstract Book
Wageningen Nutritional Sciences Forum
March 4–6, 2009

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O2: Hughes *et al.* Energy restriction during childhood is associated with a lower risk of colorectal cancer later in life: An analysis from the Netherlands Cohort Study

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O5: Schouten *et al.* Changes in trunk fat mass are inversely associated with changes in arterial stiffness in a healthy population – a 6-year follow-up study –

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O1: Eating patterns contribute to large intrapair differences in body mass index and waist circumference among young adult twins

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Background: Inaccurate self-reports of food intake have made it difficult to establish consistent associations between eating patterns and obesity in large epidemiological studies.

Objectives: Our aim was to examine the association between eating behaviour and body mass index (BMI) and waist circumference (WC) in young adult twins using reports from both twins on their similarities and differences. We further examined whether physical activity and healthy dietary choices tend to cluster within respondents.

Subjects/Methods: A total of 713 monozygotic (MZ) and 698 same-sex dizygotic (DZ) twin pairs aged 22–28 years completed food frequency questionnaires and were asked to compare their own eating behaviour with their co-twin's behaviour by structured questionnaires. Twins with internally consistent answers were included in the analysis.

Results: MZ twins who ate more than their co-twins had 1.9 kg/m² higher BMI and 5.5 cm larger WC than their less eating twin siblings. Among DZ twins the differences were larger, 2.8 kg/m² and 7.5 cm, respectively. Increased BMI and WC within twin pairs was furthermore associated with choosing less healthy foods, eating more snacks, eating more fatty foods and eating more sweet and fatty delicacies. The physically active twin member consumed more fruits, cooked vegetables, breakfast cereals and rice or pasta and less fried foods and fried potatoes or french fries.

Conclusions: This study provides compelling evidence for the contribution of several eating patterns on BMI and WC independent of genetic predispositions. The use of comparative measures within twin pairs may improve the accuracy of self-reported eating behaviour.

O2: Energy restriction during childhood is associated with a lower risk of colorectal cancer later in life: An analysis from the Netherlands Cohort Study

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Energy restriction, especially during childhood, is thought to be protective against the development of colorectal cancer (CRC) later in life. We investigated this association in the Netherlands Cohort Study on diet and cancer (NLCS). Information on diet and risk factors was collected by a baseline questionnaire in 1986 when cohort members were 55–69 years of age (n = 120,852). Three indicators of exposure were assessed: place of residence during the Hunger Winter (1944–1945) and WW2 years (1940–1944), and father's employment status during the Economic Depression (1932–1940). Using the case-cohort approach, incident rate ratios (RR) and 95% confidence intervals were calculated for total colorectal, proximal colon, distal colon, rectal, and rectosigmoid cancers, separately for men and women, according to the three time periods of energy restriction. After 16.3 years of follow-up, 3202 cases and 4307 sub-cohort members were available for the analysis. Results from the multivariate analysis showed that men who lived in a Western city during the Hunger Winter, and therefore exposed to the highest degree of energy restriction, had a statistically significant lower risk of developing CRC (RR: 0.74, 95% CI: 0.61–0.92), as well as tumors of the proximal colon and rectum. In women, inverse associations were observed for tumors of the distal colon, rectum, and rectosigmoid. Generally, inverse associations were also observed between the other two exposure times and studied endpoints, though usually not statistically significant. Unique observational evidence from this 'natural experiment of history' suggests childhood energy restriction lowers CRC risk, thus providing more insight into the role of energy intake during early life in colorectal cancer development.

O3: Dietary glycemic index, glycemic load and subsequent weight and waist change in European men and women¹⁻⁴

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Background: Whether low glycemic index (GI) or glycemic load (GL) diets are beneficial in preventing obesity is unclear.

Objective: To investigate whether dietary GI and GL were associated with subsequent weight and waist change.

Design: In this population-based prospective cohort study, we used data of 89,432 European participants, aged 20–78 years (mean = 53 years) at baseline and followed for 1.9–12.5 years (mean = 6.5 years). All participants were free of self-reported cancer, cardiovascular diseases and diabetes at baseline. GI and GL were calculated based on dietary intake assessed by food frequency questionnaires and by using a GI table developed for this study. Multiple linear regression analyses were conducted and adjustment was made for baseline anthropometrics, demographic and lifestyle factors, follow-up duration, and other dietary factors.

Results: Mean GI and GL were 57 and 134 respectively. Associations of GI and GL with weight and waist change were heterogeneous across centers (*P* for heterogeneity < 0.01). Overall, for each 10-unit higher GI, weight increased by 34 g/year [95% confidence interval (CI): –47, 115] and waist increased by 0.19 cm/year [95% CI: 0.11, 0.27]. For each 50-unit higher GL, weight increased by 10 g/year [95% CI: –65, 85] and waist increased by 0.06 cm/year [95% CI: –0.01, 0.13].

Conclusions: Our findings do not support an effect of GI or GL on weight change. However, the small but positive association between GI, not GL, and subsequent waist gain supports a beneficial role of lower GI diets on preventing the development of abdominal obesity.

O4: Micronutrients and risk of breast cancer subtypes in postmenopausal women

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Introduction: Few studies on the association between micronutrients and breast cancer have examined the effect of the micronutrient source and almost none have focused on breast cancer subtypes. The aim of this study was to investigate associations between vitamin C, E, folate and beta-carotene from diet and supplements and incidence of overall breast cancer as well as subtypes defined by histology, oestrogen and progesterone receptor status.

Materials and methods: In a prospective cohort study of 25,413 postmenopausal women aged 50–65 years, information on diet,

supplements and lifestyle was collected through questionnaires at baseline (1993–97). During follow-up until April 2006, 981 cases were identified. Incidence rate ratios (IRR) of total breast cancers and breast cancer subtypes related to micronutrient intake were calculated using Cox Proportional Hazard analyses.

Results: We found no association between overall breast cancer and any subtype, with neither total nor supplemental intake of any micronutrient in the study. There was a non-significant tendency towards increased risk of overall breast cancer with higher dietary intake of vitamin C (IRR 1.08, 95% CI: (0.96–1.21) *pr* 100 mg increase), vitamin E (IRR 1.14; 95% CI: (0.89–1.46) *pr* 10 mg increase) and folate (IRR 1.05; (95% CI: 0.98–1.13) *pr* 100 µg increase). We found different effects of dietary micronutrients in sub-groups defined by histology and progesterone receptor status.

Conclusion: Dietary, but not supplemental, micronutrients were associated with postmenopausal breast cancer. Dietary micronutrients seem differently associated with breast cancer subtypes, suggesting that these should be considered separately in future studies on micronutrients and breast cancer.

O5: Changes in trunk fat mass are inversely associated with changes in arterial stiffness in a healthy population – a 6-year follow-up study –

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Introduction: Obesity, and in particular a centrally patterned fat distribution, has been shown to be related to arterial stiffness. How changes in body fat distribution impact on changes in arterial stiffness is unknown.

Methods: Data were derived from the Amsterdam Growth and Health Longitudinal Study on healthy, middle-aged subjects (*n* = 281, 147 women), in whom body composition by DEXA and arterial stiffness estimates by ultrasound imaging were measured at age 36 and repeated at age 42. Data were analysed with multiple linear regression analyses.

Results: After adjustment for sex and mean arterial pressure, changes in trunk fat (TF) were *adversely* associated with changes in carotid distensibility coefficient (*B*: −0.24, 95% CI: −0.47; −0.01). In contrast, changes in peripheral lean mass (PL) were *favourably* associated with changes in carotid Young's elastic modulus (*B* = −0.27, 95% CI: −0.49; −0.04). After additional adjustment for other body composition variables these associations became stronger. Further adjustment for biological risk factors (i.e. total/HDL cholesterol ratio, triglycerides, HbA_{1c}, heart rate) did not materially change any of the associations.

Conclusions: Changes in TF during adulthood have adverse effects on arterial stiffness, whereas changes in PL may counteract this.

O6: A saturated fatty acid rich diet can induce an 'obese gene expression profile' in adipose tissue of subjects at risk for metabolic syndrome

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Background: Changes in dietary fat composition could reduce the risk for developing metabolic syndrome but the underlying molecular mechanisms are largely unknown. The adipose tissue is an interesting tissue in this respect because of its role in lipid metabolism and inflammation.

Objective: To investigate the effect of saturated (SFA) and mono-unsaturated fatty acid (MUFA) rich diets on insulin sensitivity, serum lipids and gene expression profiles of adipose tissue of subjects at risk for metabolic syndrome.

Design: A controlled feeding trial of 8 weeks was performed with 20 abdominally overweight subjects. Subjects received a SFA-rich diet or a MUFA-rich diet. Blood and subcutaneous adipose tissue samples were obtained, insulin sensitivity was measured by hyperinsulinemic-euglycemic clamp and serum lipid levels were determined. Microarray analysis was performed on the adipose tissue samples.

Results: Consumption of a SFA-rich diet resulted in increased expression of genes involved in inflammation processes in adipose tissue, without a change in insulin sensitivity. The MUFA-rich diet led to a more anti-inflammatory gene expression profile, accompanied by a decrease in LDL cholesterol levels.

Conclusion: Consumption of a SFA-rich diet resulted in a pro-inflammatory 'obese like' gene expression profile while consumption of a MUFA-rich diet caused a more anti-inflammatory profile. This suggests that the type of fat may be important in the etiology of adipose tissue inflammation. Gene expression is affected without changes in insulin sensitivity. Adipose tissue expression changes of inflammation-related genes might be one of the first hallmarks in development of metabolic syndrome.

P1: No effect of salt intensity on ad libitum intake of tomato soup

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The aim of the present study was to investigate the effect of salt intensity on ad libitum intake of tomato soup. Secondly, the perceived saltiness before and after ad libitum intake of tomato soups with varying saltiness concentrations was assessed. Subjects (*n* = 48) ate in duplo ad libitum from an individually determined low intensity (LI) and high intensity (HI) salty tomato soups using a self-refilling bowl. Before and after ad libitum intake, LI and HI soups were sampled and judged on saltiness intensity and pleasantness. The results showed no difference in intake between the two soups (LI 375 ± 172 vs HI 388 ± 154 grams). After intake of the LI soup, saltiness intensity for the uneaten HI soup was perceived as more salty and the pleasantness of HI soup decreased significantly more than the pleasantness of the eaten LI soup (−22 ± 23 vs −9 ± 22 *P* < 0.05). After intake of the HI soup, the uneaten LI soup was perceived as less salty and the pleasantness of LI soup tended to be more decreased than the pleasantness of the eaten HI soup (−20 ± 24 vs −14 ± 21 *P* = 0.2). In conclusion, we did not find an effect of saltiness intensity on ad libitum intake in tomato soup. After ad libitum intake, people may obtain a new "reference point" of saltiness and find uneaten HI or LI respectively more salty or less salty. This could explain the higher decrease in pleasantness of the uneaten soup instead of the eaten soup.

P2: Effect of a high MUFA-diet and a Mediterranean type of diet on serum lipids and insulin sensitivity in adults with mild abdominal obesity

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Background: Diets high in monounsaturated fatty acids (MUFA) such as the Mediterranean diet may reduce the risk of cardiovascular diseases by improving insulin sensitivity and serum lipids. Besides high in MUFA, the Mediterranean diet also contains abundant plant foods, moderate wine and low amounts of meat and dairy products, which may also play a role.

Objective: To compare the effects of a MUFA-rich diet with a diet high in saturated fatty acids (SFA) and the additional effect of a Mediterranean diet on insulin sensitivity and serum lipids.

Design: Randomized parallel controlled feeding trial, in 60 non-diabetics (40–65y) with mild abdominal obesity. After a two week run-in diet high in SFA (19 energy-%), participants were allocated to a high MUFA-diet (20 energy-%), a Mediterranean diet (MUFA 21 energy-%), or the high SFA-diet, for eight weeks.

Results: The MUFA-rich diet and the Mediterranean diet did not affect fasting insulin concentrations. The high MUFA-diet reduced total and LDL-cholesterol compared with the high SFA-diet, but not triglyceride concentrations. The Mediterranean diet increased HDL-cholesterol concentrations (+0.09 mmol/L, 95% CI 0.0, 0.18) and reduced the ratio of total cholesterol/HDL-cholesterol (−0.39, 95% CI −0.62, −0.16) compared with the high MUFA-diet.

Conclusions: Replacing a high SFA-diet with a high MUFA or a Mediterranean diet did not affect insulin sensitivity, but improved serum lipids. The Mediterranean diet was most effective, because it reduced total and LDL-cholesterol, and also increased HDL-cholesterol and reduced the total cholesterol/HDL-cholesterol ratio.

P3: Validity of the assessment of potassium and fish intake by a computerized two-day 24-h recall (EPIC-Soft) in five European countries – preliminary results from the European Food Consumption Validation (EFCOVAL)

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Aim: To evaluate whether countries can be ranked accurately according to their potassium and fish intake by two non-consecutive 24-h recalls as compared to biomarkers of dietary exposure.

Methods: Between May 2007 and May 2008, data was collected in five countries: Belgium, Czech Republic, France, the Netherlands and Norway. A total of 599 apparently healthy adults, between 45 to 65 years old and representing all educational levels were recruited. Two 24-h recalls were collected using EPIC-soft with at least one month in-between, taking into account weekday variations. Before the dietary interviews, one blood sample was taken. Two 24-h urines were collected during the same days as the 24-h recalls. Mean potassium and fish intake were compared to potassium recovery in urine and fatty acids in phospholipids (EPA + DHA), respectively.

Results: Underestimation of potassium intake was seen in both genders in all countries, except for Czech Republic, where overestimation was 6.3% in males and no bias was identified for females. Underestimation of intake varied from −3.2% to 17.1%. Ranking of potassium intake was reasonably good according to the biomarker; it was $r=0.76$ in males and $r=0.86$ in females. The ranking of the countries based on their average fish intake was similar to the ranking based on average EPA + DHA concentrations; it was $r=0.97$ in males and $r=0.96$ in females.

Conclusion: The preliminary results of the EFCOVAL validation study showed that the ability of two 24 h recalls appears to be good for ranking countries for fish intake and fairly good for potassium.

P4: Caregivers' capability of detecting malnutrition in elderly residents

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Objective: Malnutrition is a common problem among institutionalized elderly and frequently overlooked. This explorative study aims at

comparing the ability of qualified caregivers in a nursing home to detect malnutrition in elderly residents.

Subjects and methods: Of 28 elderly (9 male, 19 female) aged 70–98 years (mean age 84.4; SD 6.8) and living in a nursing home, the nutritional status was assessed. Using the Dutch Mini Nutritional Assessment (MNA) two caregivers screened all residents allowing to calculate the interobserver correlation. In addition, 10 caregivers were asked whether they considered their residents to suffer from malnutrition by classifying them into 3 categories: absence of malnutrition, at risk for malnutrition and malnourished.

Results: The interobserver correlation of the MNA performed by two caregivers was high ($r=0.872$) supporting the evidence of consistent classification with use of a validated instrument to assess malnutrition. The caregivers considered only 3.2% of the residents to be malnourished, whereas the MNA showed that 14.3% were malnourished (MNA < 17 points). Of those elderly having a BMI < 20 and MNA < 17, only 5% of the observations were classified as malnutrition. From a total of 21 elderly being classified as malnourished or at risk for malnutrition according to the MNA, hardly 15% received liquid supplementation on a daily basis.

Conclusions: Caregivers' recognition of malnutrition in their elderly residents is poor. Since prevalence of malnutrition in the elderly, especially when institutionalized, is high and has adverse effects on health outcomes, nursing homes should always implement screening of malnutrition into their policy.

P5: A very high intake of conjugated linoleic acid, a trans fat from milk and meat, does not affect blood pressure in normotensive humans

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Background: *Trans* fatty acids in the diet are produced either by industrial hydrogenation or by biohydrogenation in the rumens of cows and sheep. Industrial *trans* fatty acids increase the risk of coronary heart disease. The effects of *trans* fatty acids from milk and meat of ruminants are less clear. *Cis-9,trans-11* conjugated linoleic acid (CLA) is a *trans* fatty acid unique to ruminants. Our objective was to study the effect of diets high in *Cis-9,trans-11* CLA on blood pressure compared to oleic acid which was a secondary endpoint of the study.

Methods: Sixty-one healthy men ($n=25$) and women ($n=36$) were sequentially fed each of 3 diets for 3 weeks, in random order, for a total of 9 weeks. Diets were identical except for 7% of energy (18.9 g in a diet of 10 MJ/day) which was provided either by oleic acid, by industrial *trans* fatty acids, or by CLA. We measured blood pressure and heart rate on days 19 and 21 (period 1), days 40 and 42 (period 2) and days 61 and 63 (period 3).

Results: At baseline, mean blood pressure was 113.8 ± 14.4 mmHg systolic and 66.3 ± 9.6 mmHg diastolic. Blood pressure changed on average -0.1 mmHg systolic (95% confidence interval -1.49 ; 1.27 , $p=0.87$) and $+0.5$ mmHg diastolic (-0.73 ; 1.62 , $p=0.45$) during treatment with CLA relative to oleic acid.

Conclusion: High intakes of *cis-9,trans-11* CLA, mainly found in ruminant fat, do not affect blood pressure in normotensive healthy subjects.

P6: No difference in satiation between equally palatable meals with a sweet or savory taste

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Satiation is the process that brings a meal to an end. In terms of preventing over-consumption, it is of great importance to identify

features of foods that influence this process. Sensory properties have been shown to play a major role. The present study was undertaken to investigate the role of taste on satiation, independent of palatability, texture, energy density and macronutrient composition, by comparing meals with a distinct sweet and savory taste. A cross-over design was used, consisting of three test-conditions in which two tastes were compared. Sixty-four healthy, non-smoking, unrestrained subjects participated (18 males and 46 females), with a mean age of 22.3 years (SD 2.4) and a mean BMI of 21.6 kg/m² (SD 1.7). Rice was used as a test food, served in either a sweet or savory variant. The meals were similar in palatability, texture, energy density and macronutrient composition. *Ad libitum* intake, eating rate and processes of appetite and pleasantness during the meal were measured. Results showed no differences in *ad libitum* intake between the two meals. Subjects ate a mean of 314 g of the sweet rice and 333 g of the savory rice [t(64) = -1.18, n.s.]. In addition, the eating rate (sweet: 38 g/min; savory: 37 g/min [t(64) = 0.79, n.s.]) and the changes of appetite and pleasantness during the meals were equal. These data show that meals with a sweet or savory taste, similar in palatability, texture, energy density and macronutrient composition, do not differ in their influence on satiation in normal weight people.

P7: The effect of viscosity on learned satiation

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A higher viscosity of a food leads to a longer orosensory stimulation. This may facilitate the learned association between sensory signals and metabolic consequences. In the current study we investigated the effect of viscosity on learned satiation. In two intervention groups a low viscosity (LV) yogurt (n = 24) and a high viscosity (HV) yogurt (n = 22) was offered *ad libitum*. In a learning period of 4 weeks, subjects consumed *ad libitum* for breakfast a novel flavoured high energy density (HED) yogurt (150 kcal/100g) or low energy density (LED) yogurt (50 kcal/100g), with 10 exposures to each yogurt on alternate days. Preliminary analyses showed that at baseline subjects consumed more of the liquid product, regardless of energy density (liquid: 516 ± 214 g; semi-liquid: 457 ± 250; *p* < 0.05). In the HV intervention group a borderline significant interaction between exposure and energy density was observed (F(1, 369) = 3.61; *p* = 0.06); after 10 exposures, the LED yogurt resulted in a 46 ± 16 g higher intake compared with the HED yogurt. In the LV group, intake difference between the energy levels after 10 exposures was only 1.5 ± 15 g and no significant effect of energy density on *ad libitum* intake over the 10 exposures was observed (F(1, 401) = 1.04; *p* = 0.31). These results suggest that a higher viscosity facilitates learned satiation.

P8: Oral sensory stimulation with alcohol suppresses free fatty acids

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Background: Preingestive or cephalic phase responses, triggered by sensory stimulation of nutrients, influence the organism's digestive and endocrine responses and substrate mobilization.

Objective: To determine whether oral alcohol exposure provokes cephalic phase responses in normal-weight and overweight women.

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Design: In a semi-randomized, open label, crossover trial, eleven normal-weight (BMI 19–25 kg/m²) and eleven overweight (BMI 27–35 kg/m²) postmenopausal women sham-fed, after an overnight fast under three separate conditions four weeks apart, 41 g cake (750 kJ), 25 cL white wine (750 kJ; ~26 g alcohol) or 25 cL water. Venous blood was drawn prior to and for 30 min after two 3-minute episodes of modified sham feeding (MSF). Blood samples were analyzed for free fatty acid (FFA), triglyceride, glucose, pancreatic polypeptide (PP), insulin and alcohol concentrations.

Results: Incremental area under the curves (IAUC) of FFA concentrations differed significantly (*P* < 0.001) between the three treatments but not between BMI categories (*P* > 0.05). After sham feeding white wine, mean FFA concentrations dropped to a minimum of 77 ± 3% of baseline concentrations at *t* = 12 ± 2 min after baseline and returned to baseline at *t* = 30 min, whereas mean FFA concentrations after MSF with cake and water gradually increased. IAUC of triglycerides, glucose, PP and insulin concentrations did not differ between the three treatments (*P* > 0.05).

Conclusions: Oral sensory stimulation with alcohol elicits a cephalic phase response by decreasing free fatty acid concentrations. This effect is independent of BMI.

P9: Do European children prefer natural or flavoured juice?

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Taste is an important indicator for quality and composition of food and has large scale effects on the human body. Beef taste, e.g., activates the digestion process and prepares the human body to receive meat. In case of applied flavours there is nothing to assimilate: The digestion process is running idle, and this is a physiological deficiency. Usually, the consequence is more appetite and possibly overweight. The aim of the study presented was to ascertain whether children prefer natural or artificially flavoured food and if there are differences between European countries. Therefore 1381 children, aged from 6 through 9 years from 7 European countries were surveyed. The applied method was a forced choice paired with a preference test. Children had to choose their preferred juice from two samples. The first sample (A) was clear natural apple juice with addition of 0.53% saccharose. The second sample (B) was clear natural apple juice containing 0.52% saccharose and 0.05 % apple flavour. Preferences for flavoured juices were country-specific. Children from Italy, Estonia, Spain, and Hungary showed significant preferences (*α* < 0.05) for flavoured apple juice. Children from Belgium showed significant preference (*α* < 0.05) for the natural apple juice. German and Swedish children showed no significant preferences (*α* < 0.05) neither for natural nor for flavoured apple juice. Resulting preferences could be explained as 'learned preferences' depending on the default juice offer in the respective countries. In Italy, Estonia, Spain, and Hungary, most of the juices marketed - especially those for children - are flavoured, whereas juices in Sweden, Germany, and Belgium are predominantly natural juices without addition of flavour.

P10: Caloric restriction and exercise increase plasma ANGPTL4 levels in humans via elevated free fatty acids

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Elevated plasma triglycerides (TG) are increasingly recognized as a risk factor for atherosclerosis. ANGPTL4 is a target of hypolipidemic fibrate drugs and insulin-sensitizing thiazolidinediones. Recent studies in our group using transgenic mice over-expressing the mouse ANGPTL4

(mANGPTL4) gene in peripheral tissues showed that ANGPTL4 is an extremely powerful regulator of lipid metabolism. Recent work in human showed that variations in the ANGPTL4 gene are associated with alteration in plasma TG levels, indicating an important role of ANGPTL4 in governing lipid metabolism in humans. Here we report the development of an ELISA for quantitative measurement of ANGPTL4 in human plasma. Using this assay we found major variations in baseline plasma ANGPTL4 levels between individuals. Within an individual, plasma ANGPTL4 levels remain stable throughout the day but increase significantly in response to long term fasting, chronic caloric restriction, and endurance exercise. Intralipid injection as well as treatment with a β -adrenergic agonist, both of which lead to elevated plasma FFA levels, increased plasma ANGPTL4 levels compared to control treatment. Fatty acids markedly induced ANGPTL4 gene expression in rat hepatoma FAO cells, human primary myocytes, and mouse intestinal MSIE cells. In conclusion, our results show that plasma ANGPTL4 levels are increased by fasting, caloric restriction, and exercise, which is likely mediated by elevated plasma FFAs.

P11: Validation of a first FFQ developed using a computer system against independent biomarkers and three day food diaries

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Introduction: Food frequency questionnaires (FFQs) have to be updated regularly because of new research questions, changing food patterns, and a rapidly changing food market. Therefore, we developed a computer system that can quickly generate an FFQ tailored for a specific research question or population. We composed a first FFQ to assess energy, protein, fatty acids, carbohydrates and dietary fiber using this system. The aim of this study was to evaluate the principles of the computer-system by validating this first FFQ.

Participants: Healthy volunteers: 46 men and 64 women between 25 and 65 y.

Methods: Participants reported their intake first by a 3-day estimated food record and after 2–9 weeks by an FFQ. Intake of nutrients was computed using the Dutch food composition table of 2006. We collected one 24-hour urine sample to determine nitrogen, potassium, sucrose and fructose. Completeness of the samples was verified by recovery of three 80 mg doses of para-aminobenzoic acid (PABA-check). A non-fasting blood sample was drawn for determination of fatty acids in cholesteryl esters.

Expected results: A first FFQ, consisting of 118 food items, was generated with the computer system.

Results of nutrient intake and biomarkers, which have recently been processed, will be presented at the conference. Assessment of the intakes of energy, total fat, carbohydrates, and dietary fibre will be compared with reports by 3-d food records and those of protein and potassium with urinary nitrogen and potassium. Finally, the potential of sucrose and fructose from urine as biomarkers of monosaccharides plus disaccharides will be studied.

P12: Fish consumption and markers of colorectal cancer risk: a multi-centre randomized controlled trial

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Background and Aims: Diet is a major factor in the etiology of colorectal cancer, with high fish consumption possibly decreasing colorectal cancer risk, as is shown in several observational studies. To date, no intervention trials have examined the possible beneficial

effects of fish intake on colorectal cancer risk. Therefore, we investigated the effects of a six-month intervention with oil-rich or lean fish on apoptosis and mitosis within the colonic crypt in a multi-centre, randomized, controlled intervention trial.

Methods: Patients with colorectal adenomas, inactive ulcerative colitis, or no macroscopic signs of disease were recruited (n = 242) and randomly allocated to receive dietary advice plus either 300 g oil-rich fish (salmon) per week (n = 82), 300 g lean fish (cod) per week (n = 78), or only dietary advice (DA) (n = 82). Apoptosis and mitosis were measured in colonic biopsy samples collected pre- and post-intervention (n = 213).

Results: The total number of apoptotic cells per crypt did not increase in the salmon or cod group, -0.10 (95% CI -0.36 ; 0.16) and -0.06 (95% CI -0.32 ; 0.20) respectively compared with DA. The total number of mitotic cells per crypt decreased non-significantly with -0.87 (95% CI -2.41 ; 0.68) in the salmon group and with -1.04 (95% CI -2.62 ; 0.53) in the cod group compared with DA. Furthermore, the distribution of mitosis within the crypt was not significantly changed in either group.

Conclusion: Increasing fish consumption of either oil-rich or lean fish, with two portions per week over six months does not markedly change apoptotic and mitotic rates in the colonic mucosa.

P13: Self-reported energy intake by a food frequency questionnaire compared with energy needs to maintain body weight in 516 adults

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To assess how accurately participants report their energy intake by food frequency questionnaires (FFQ), we compared calculated energy intakes assessed by these questionnaires with actual energy requirements needed to maintain stable body weights from week 2 until the end of 11 controlled feeding trials, lasting 3 to 10 weeks.

The food frequency questionnaire was developed at Wageningen University. Volunteers (174 men and 342 women (BMI \pm SD, 22.8 ± 3.1 kg/m²)) agreeing to participate in controlled feeding trials filled out the FFQs just before the trial. Energy needs during the trials were calculated from the consumed foods and beverages using the Dutch food composition table.

The reported energy was on average $97.5 \pm 12.7\%$ for all participants, $94.7 \pm 16.3\%$ for men and $98.9 \pm 15.2\%$ for women of energy needs (difference for gender $p < 0.01$).

Of the participants 26.4% reported energy intake $< 90\%$ of the actual energy needs, 57.2% reported between 90 and 110% and 16.5% reported $> 110\%$. The correlation coefficient between the reported energy intakes and actual energy needs was 0.82 for all participants, 0.80 for men and 0.74 for women.

The BMI of participants who reported below 90% of energy needs was significantly higher than of the participants reporting between 90% and 100% and of those reporting above 110%.

We conclude that the food frequency questionnaire is an accurate method to estimate the level of energy intakes of these participants and to classify them according to their intake although the results are influenced by bodyweight.

P14: Investigations of resistant starch enriched products (pasta and bread)

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In our studies the properties of resistant starches of different origin and type have been investigated. According to the results of the *in vitro*

digestion tests and the measurement of heat sensitivity three resistant starches were selected (Hi-maize260, Hi-maize1043 and Fibersym70) for the application in pasta and bread products. Pastas from durum semolina and aestivum flour were produced with 10 and 20% resistant starch addition while in bread products a 20 % RS addition was used. Following the sensorial rating and *in vitro* digestibility, the product with the best properties was selected and investigated in human studies as well.

The GI measurement of the chosen pasta sample (pasta with 20% Hi-maize260) was carried out at the Maastricht University (the Netherlands) following the standard methodology (10 persons, bread as reference) and observing strict instructions.

Results have shown that the product containing resistant starch has had lower GI (62.11 ± 35.82) compared to the pasta without resistant starch (72.08 ± 29.95). The difference was not statistically significant; the remarkable variance however could be improved with the increased number of the volunteers.

Furthermore, it can be stated that the selected resistant starch (Hi-maize260) seems to be proper as a flour replacer in food applications and can lead to a reduced GI of the products. Additionally the pasta containing resistant starch may be an appropriate basis in the diet of overweight and obese individuals.

P15: Lactotripeptides do not lower ambulatory blood pressure in untreated whites: results from 2 controlled multicenter crossover studies

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Background: Dietary factors directly influence blood pressure (BP). The lactotripeptides (LTPs) IPP (isoleucine-proline-proline) and VPP (valine-proline-proline), formed by hydrolyzing dairy proteins, and potassium, a mineral mainly found in fruit, vegetables, and dairy products, are extensively studied for their BP-lowering effect. The efficacy of LTPs seems modest in whites compared with that in Asians.

Objective: The objective was to study the effects of enzymatically produced LTPs alone or in combination with potassium on ambulatory BP in whites.

Design: Two multicenter, placebo-controlled, randomized, crossover studies were conducted; each consisted of two 4-wk intervention periods separated by a 4-wk washout period. In study 1, 69 subjects received 200 g/d of a dairy drink with 5.8 mg IPP and 4.4 mg VPP or placebo. In study 2, 93 subjects received 100 g/d of a dairy drink with 2.7 mg IPP, 1.9 mg VPP, and 350 mg added potassium or placebo. The subjects were randomly assigned according to their daytime ambulatory BP.

Results: Mean 24-h systolic and diastolic BP (baseline values study 1: $137.1/81.6$ mm Hg; study 2: $139.2/80.9$ mm Hg) remained similar with no significant differences between treatments in either study ($P > 0.10$). Office BP decreased over the course of both studies (SBP > 5 mm Hg), but differences between interventions were not significant ($P > 0.10$). In both studies nighttime BP dipped during all treatments ($> / = 15\%$), statistically significantly more with placebo ($P < 0.05$). Sodium excretion increased significantly after consumption of LTPs and potassium compared with after placebo intervention ($P = 0.01$), but not after consumption of LTPs alone.

Conclusion: The data do not support a BP-lowering effect of LTPs in whites.

P16: Effect of a high intake of conjugated linoleic acid, an animal trans fatty acid, on lipoprotein levels in healthy human subjects

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Background: Trans fatty acids are produced either by industrial hydrogenation or by biohydrogenation in the rumens of cows and

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sheep. Industrial trans fatty acids lower HDL-cholesterol, raise LDL-cholesterol, and increase the risk of coronary heart disease. The effects of trans fatty acids from milk and meat of ruminant animals are less clear.

Objectives: We investigated the effect on blood lipids of cis-9, trans-11 conjugated linoleic acid (CLA), a trans fatty acid largely restricted to ruminant fats.

Methods: Sixty-one healthy women and men were sequentially fed each of three diets for three weeks, in random order, for a total of nine weeks. Diets were identical except for 7% of energy (approximately 20 g/day) which was provided either by oleic acid, by industrial trans fatty acids, or by CLA.

Results: Mean (\pm sd) serum LDL rose from 2.68 ± 0.62 mmol/L on oleic acid to 3.00 ± 0.66 mmol/L on industrial trans fatty acids ($p < 0.001$), and to 2.92 ± 0.70 mmol/L on CLA ($p < 0.001$). HDL-cholesterol fell by 0.05 ± 0.12 mmol/L on industrial trans fatty acids ($p = 0.001$) and by 0.06 ± 0.10 mmol/L on CLA ($p < 0.001$). The total to HDL cholesterol ratio rose by 11.6% on industrial trans fatty acids and by 10.0% on CLA.

Conclusion: High intakes of cis-9, trans-11 CLA raise the LDL to HDL and total to HDL cholesterol ratio in healthy volunteers. The effect of CLA may be somewhat less than that of industrial trans fatty acids.

P17: Effect of bite size and oral processing time on satiation (ad libitum food intake)

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Introduction: Food texture plays a role in food intake regulation. In previous studies we showed a clear effect of viscosity on satiation/ad libitum food intake (1). So far, the underlying mechanism responsible for differences in satiation responses between liquids and solids is not clear. In our first studies we found that the liquid product was consumed faster than the semi-solid product (1). In follow-up studies we found indications that bite size and oral processing time (OPT) could play a role (2). Therefore, our objective of the current study was to determine the effect of bite size and OPT on ad libitum food intake.

Methods: 22 healthy subjects participated in all 7 test conditions. Bite sizes were free, fixed to small bite sizes (approximately 5 gram) or large bite sizes (approximately 15 gram). OPT was free or fixed to 3 or 9 seconds. Subjects consumed chocolate custard through a tube connected to a peristaltic pump, to control bite sizes. Sound signals indicated OPT duration.

Results: Analyses showed a significant effect of bite size and OPT ($P < 0.05$). In the small bite size conditions, ad libitum intakes were 381 ± 197 (3sec OPT) and 313 ± 170 (9sec OPT) gram. In the large bite size conditions ad libitum intakes were much higher; 476 ± 176 (3sec OPT) and 432 ± 163 (9sec OPT) gram.

Conclusion: This study shows a clear effect of bite size on food intake. A larger bite size led to significant higher food.

P18: Induction of cardiac Angptl4 by dietary fatty acids is mediated by PPAR β / δ and protects against oxidative stress

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Little is known about the direct effects of dietary fatty acids on gene expression in the intact heart. In the present paper we show that oral

administration of synthetic triglycerides composed of one single fatty acid alters cardiac expression of numerous genes, many of which are involved in the oxidative stress response. The gene most significantly and consistently upregulated by dietary unsaturated fatty acids encoded Angptl4, a circulating inhibitor of lipoprotein lipase that was localized to the cardiomyocytes. Induction of Angptl4 was specifically abolished in PPAR β/δ -/- and not PPAR α -/- mice. Consistent with these data, fatty acids stimulated binding of PPAR β/δ but not PPAR α to the Angptl4 promoter. Upregulation of Angptl4 resulted in decreased cardiac uptake of plasma TG-derived fatty acids and decreased fatty acid-induced oxidative stress and lipid peroxidation. In contrast, Angptl4 deletion led to enhanced oxidative stress in the heart, both after an acute oral fat load and after prolonged high fat feeding. We conclude that stimulation of cardiac Angptl4 gene expression by dietary fatty acids and PPAR β/δ is part of a feedback mechanism aimed at protecting the heart against lipid overload and consequently fatty-acid induced oxidative stress.

P19: The effect of high-fat diet on plasma levels of ghrelin and leptin in rats

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Introduction: Ghrelin and leptin are key hormones involved in the regulation of appetite and energy homeostasis in humans and rats. Ghrelin stimulates food intake, decreases fat utilization and could cause obesity. In contrast, leptin inhibits food intake and augments energy expenditure. The effects of different nutritional factors on ghrelin and leptin secretion are not enough investigated in rats. Therefore, the aim of our study was to study the effect of a high-fat diet on plasma ghrelin and leptin levels and their effects on the adiposity. **Materials and methods:** Twenty male Wistar rats, body weight 220–260 g, were used in the study. Rats were randomized either on a standard chow diet (n = 10) or high-fat diet (a mixture of nuts) for *ad libitum* 11-week period. Body weight was measured once per week. At the end of the nutritional period, rats were sacrificed. Blood was collected for determination of lipids, and glucose by specific methods, as well as ghrelin and leptin by ELISA method (BioVendor). The weight of different organs was determined.

Results: Rats fed on a high-fat diet showed significant increase in total body weight compared to control group. The long-term intake of high-fat diet resulted in hyperleptinemia and hypoghrelinemia in experimental group. There was a significant positive correlation between plasma leptin levels and epididymal fat mass, liver and heart. In contrast, ghrelin levels showed inverse correlation with epididymal fat mass and liver.

Conclusion: Our data could elucidate the interactions between ghrelin and leptin and the mechanisms regulating the development of obesity.

P20: Dietary heme causes epithelial hyperproliferation, hyperplasia and disturbed surface-to-crypt signaling in mouse colon

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Background: Colorectal cancer risk is strongly associated with nutrition, especially with diets high in red meat. Red meat contains heme, which is known to induce cytotoxicity of gut contents and epithelial hyperproliferation. This hyperproliferation leads to epithelial hyperplasia and can eventually lead to colorectal cancer.

Aim: To identify molecules by microarray analysis that signal from surface epithelium to the proliferative colonic crypt to increase epithelial cell proliferation upon stress induced by heme.

Methods: C75Bl6/J mice (n = 9/group) received either a Westernized control diet (40 en% fat) or this diet supplemented with 0.5 μ mol/g heme for 14 days. Colons were excised and the middle part was used to quantify cell proliferation (KI67). Mucosa of the remaining parts was used for RNA isolation and microarray analysis. Furthermore, differences between surface and crypt gene expression were investigated by Laser Capture Microdissection (LCM) and microarray.

Results and conclusion: Epithelial hyperproliferation was observed in heme-fed mice compared to control mice. Fecal water of heme-fed mice was more cytotoxic than control fecal water. Microarray analysis of mucosa showed 3700 differentially expressed genes (q < 0.01). Gene expression analysis revealed human-relevant epithelial growth factors amphiregulin and epi-regulin, and arachidonic acid metabolites as important candidate signaling molecules. These could act as initiating signals from surface epithelium to the colonic crypt to induce hyperproliferation of epithelial cells in heme-fed mice. Furthermore, the observed downregulation of the Wnt antagonist Wnt Inhibitory Factor 1 (Wif1) may contribute to the heme-induced expansion of the crypt proliferative compartment.

P21: Genetic variants across regulatory pathways of lipid and glucose metabolism: interaction effects with BMI on glucose levels

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Background: Much of the genetic variation in glucose levels remains to be discovered. Especially, research on gene-environment interactions is scarce. Overweight is the main environmental risk factor for hyperglycemia. Transcriptional regulation is important for both weight maintenance and glucose control. We therefore analyzed 349 single nucleotide polymorphisms (snps), occurring in transcriptional pathways of glucose and lipid metabolism, and their interaction effects with body mass index (BMI) on glucose levels.

Methods: 349 SNPs were measured in 3244 participants of the Doetichem cohort. Non-fasting glucose levels and BMI were measured at baseline and after 6 years. SNP \times BMI interactions were analyzed by mixed models and adjusted for age, sex and time since last meal. False Discovery Ratio (FDR) < 0.2, was used to adjust for multiple testing.

Results: Two SNPs, rs8192678 (P-value = 0.0002; FDR = 0.07) and rs3755683 (P = 0.0012; FDR = 0.17), showed a significant interaction with BMI. These SNPs are both located in the PPARGC1A gene. In subjects with a BMI \leq 25 kg/m², rs8192678 (P = 0.02) and rs3755683 (P = 0.03) were significantly associated with glucose levels. No effect was observed in subjects with BMI > 25 kg/m².

Conclusion: Using a pathway based approach, we found a significant association between the PPARGC1A (rs8192678; rs3755683) \times BMI interaction and glucose levels. The association between glucose and PPARGC1A was only present in lean subjects.

This suggests that the effect of the PPARGC1A gene, which is involved both in fatty acid oxidation and glucose metabolism, is modified by BMI.

P22: Comparative global analysis of PPAR α -dependent gene regulation in humans vs. mouse hepatocytes

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Introduction: PPAR α is an important regulator of hepatic lipid metabolism in rodents. However, little information is available on the role of PPAR α in human liver. Here we set out to (1) characterize PPAR α -dependent gene regulation in primary human hepatocytes

using transcription profiling and (2) to identify the similarities and differences in gene regulation by PPAR α between mouse and human hepatocytes. To that end, human primary hepatocytes were isolated from 6 donors varying in age and sex. In parallel we isolated hepatocytes from 6 mice varying in age, sex, and strain. Hepatocytes were treated with PPAR α agonist Wy14643 for 6 and 24 hours and gene expression profiling was performed using Affymetrix GeneChips. At the level of individual genes, minor overlap was observed between the Wy14643-regulated geneset of mouse and human. However, more significant overlap was observed at the pathway level. Most of the genes commonly regulated in mouse and human were involved in some aspect of lipid metabolism and many represented known PPAR α target genes, including CPT1A, HMGCS2, FABP1, ADFP. Several genes were specifically induced by PPAR α in human (MBL2, ALAS1, TSKU) or mouse (Fbp2, Igals4, Cd36). Furthermore, several putative novel PPAR α targets were identified to be commonly regulated in mouse and human, including CREB3L3, KLF10, KLF11 and MAP3K8. In conclusion, we demonstrate that PPAR α regulates mostly divergent sets of genes in mouse and human hepatocytes, despite considerable overlap at the pathway level. The role of PPAR α as master regulator of hepatic lipid metabolism is well conserved between mouse and human.

P23: PPAR β/δ but not PPAR α serves as endogenous fat sensor in liver

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The metabolic response to fasting is governed by complex interplay between endocrine factors, energy substrates and metabolic enzymes, which is coordinated by the liver. Fasting is associated with enhanced adipose tissue lipolysis, thereby raising plasma free fatty acids (FFAs). Besides serving as a major energy substrate for liver, plasma FFAs may regulate hepatic gene expression. Here we utilize transgenic and knockout mice of the circulating factor Angptl4, which potently stimulates adipose tissue lipolysis and raises plasma FFAs, in combination with PPAR α -/- and PPAR β/δ -/- mice to examine the effect of plasma FFAs on hepatic gene regulation. Our results suggest that: 1) PPAR α activation in liver during fasting is not mediated by elevated plasma FFAs; 2) Dietary fatty acids, unlike plasma FFAs, are able to ligand-activate PPAR α in liver; 3) PPAR β/δ mediates induction by plasma FFAs of a specific set of genes, including *Lpin2* and *St3gal5*, during fasting; 4) PPAR α and PPAR β/δ play distinct roles in the adaptive response to fasting, illustrated by opposing effects on fasting plasma glucose and hepatic fatty acid oxidation and ketogenesis. Our data suggest that hepatic PPAR α and PPAR β/δ are activated by distinct pools of circulating lipids, representing a novel mechanism for functional differentiation between PPARs.

P24: The role of epoxidation and electrophile-responsive element (EpRE)-regulated gene transcription in the potentially beneficial and harmful effects of the coffee components cafestol and kahweol

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Cafestol and kahweol are two diterpenes present in unfiltered coffees such as French press, espresso and boiled coffees, that raise plasma

cholesterol. Several studies have been performed in order to elucidate the cholesterol raising mechanism behind these diterpenes. However no information is known about the metabolic fate of this compound. From the structure of cafestol we predicted that epoxidation in the furan moiety is a possible biotransformation route. The aim of the present study was to further investigate this potential mechanism and the role of bioactivation via epoxide formation for the specific coffee components cafestol and kahweol.

In our first experiment we used bile duct cannulated mice, which were dosed with cafestol via the portal vein. Bile was sampled and analyzed by LCMS. Secondly, a series of experiments were carried out using a hepa-1c1c7 cell line stably transfected with a luciferase reporter gene under control of an EpRE from the human NQO1 regulatory region to obtain a reporter cell line responsive to electrophiles. LCMS analysis revealed the identity of cafestol metabolites including epoxy-glutathione conjugates, glutathione conjugates and glucuronide conjugates. Our *in vitro* experiments show that cafestol and kahweol induce EpRE mediated gene induction after metabolic activation. Inhibition of certain CYP450 enzymes results in a significant decrease of EpRE mediated gene induction. Increasing intracellular GSH results in a significant decrease in EpRE mediated gene induction whereas decreasing intracellular GSH levels results in a significant 5-fold increase in EpRE mediated gene induction.

In conclusion, we provide evidence that cafestol induces EpRE, apparently via a bioactivation process that possibly involves epoxidation of the furan ring. The epoxides themselves appear subject to conjugation with glutathione. Further studies should further reveal the role of the epoxide(s) and the glutathione conjugates in the elevation of plasma cholesterol caused by the coffee components cafestol and kahweol.

P25: Hyperhomocysteinemia – Which body tissues contribute to plasma homocysteine entry and removal?

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Impaired transfer of methyl groups, as occurs during folate and choline deficiency, leads to plasma hyperhomocysteinemia and increases the risk for cardiovascular disease. Tissue sources of plasma homocysteine *in vivo* have not been quantified and it has not been elucidated whether hyperhomocysteinemia is due increased entry into or decreased removal from blood. These issues were addressed in rats offered diets with either adequate or inadequate folate and choline for 5 wk. A new model was used for measuring tissue metabolism based on isotopomer analysis after continuous intravenous infusion with [U-¹³C]methionine (mass + 5) plus [1-¹³C]homocysteine (mass + 1).

Folate and choline deficiency led to hyperhomocysteinemia. Decreased clearance from plasma did not contribute to the high plasma homocysteine as most tissues increased the fraction of intracellular homocysteine derived by importation from plasma by 33–106%. Methylation rates were highest in liver and pancreas, but the liver did not play a dominant role as the source of plasma homocysteine. Much of the homocysteine generated within the liver was (re)methylated and the enrichment of hepatic homocysteine derived from demethylation was less than that observed in plasma. In pancreas, the enrichment of mass + 4 homocysteine was highest and exceeded that of plasma. Enrichment of mass + 1 methionine was highest in the heart, indicating substantial import and methylation of plasma [1-¹³C]homocysteine.

In conclusion, plasma hyperhomocysteinemia results from increased entry rather than decreased removal. The pancreas, rather than liver, is a major exporter of homocysteine, whereas much intracellular homo-

cysteine is imported from plasma in tissues such as heart, which may affect cardiovascular function.

P26: Comparison of furan levels between different origin country coffee during manufacture roasting

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Furan is a five-member ring colorless cyclic ether with a low boiling point (approx. 32 °C). It appears in food after thermal food processing. Its existence in various type of thermal processed food has long been known. Since 2004 furan has been considered as a potentially hazardous chemical which has been classified as a possible human carcinogen by the International Agency for Research on Cancer (IARC). New coffee beverages consumer model open possibility of small coffee roasteries and coffee shops to propose new, unique product. This kind of preparing is more common to homemade than large scale production, so quality control is rather symbolic and depends only on client preferences. The aim of this study was determination furan level in different origin coffee beans prepared in small coffee roasteries. In our experiment we estimate average level of furan in five Arabica coffees originated from different countries: Brazil, Costa Rica, Columbia, Guatemala, and Ethiopia. We measure furan level in ground coffee beans as product ready for use and in 3 coffee samples furan levels during roasting were measured. Coffee beans from Brazil, Columbia and Guatemala had different roasting temperatures profile but all type of beans crack with characteristic noise. This moment was selected as typical marker of ongoing chemical changes and samples were collected in this particular moment for further furan analysis. Furan levels were also determined in coffee brew prepared and usually drunk as typical for Poland called "as Turkish coffee" and compared with furan levels in ground beans. Due to high volatility of furan solid phase micro extraction (SPME) was applied for sampling and further analysis by means gas chromatography – mass spectrometry (HS-SPME-GC/MS). Quantitative determination were made using internal standard furane-D4, isotope dilution and simultaneous scanning mode (mass range 38–200 m/z) and selected ion monitoring (SIM) of ions (m/z) 39 and 68 for furan and respectively 43 and 72 for furan D4. The average amounts of furan were different the lowest level was in roasted Costa Rica beans below 5 ppb and highest in Guatemala coffee 116 ppb. In Brazil beans furan average level in green beans is between 0.5–5 ppb but in roasted coffee furan level is 100 ppb.

P27: Nutritive values of fonio and fonio products

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Fonio (*Digitaria exilis*) is cultivated in a vast area in West Africa and is known to be used as staple food harvested 2 to 3 months before the main crops mature, providing nutrients in the hungry season. Fonio is consumed after a long and strong processing scheme which could affect iron and zinc content of fonio as the major part inside the grain is removed by cleaning, decortication and washing. The objective of the study is to determine the variation of nutrients contents especially iron, zinc, and phytate content of fonio varieties and fonio products, and the effects of processing on nutrients content of fonio. Twelve fonio varieties were collected from 34 farmers in 2 regions, contributing to approximately 70% of the total fonio production in Mali. Fonio paddy of each variety was cleaned, milled, washed and steam cooked according to standardized local procedures. Fonio products obtained from these processes were evaluated for iron, zinc and phytate content. The Fe concentration ranged from 1.7 to 54.9 mg/100 g dry matter in

paddy while 0.8 to 1.8 mg/100 g in the mid wet with an average values of 30.9 mg/100 g in paddy and 1.6 mg/100 g in mid wet. Values for Zn ranged from 2.4 to 3.6 in paddy while 1.9 to 2.5 mg/100 g in mid wet with an average of 3.1 mg/100 g in paddy and 2.2 mg/100 g in mid wet. The phytate concentration ranged from 410 to 700 mg/100 g in paddy and 30 to 210 mg/100 g in mid wet fonio with mean values of 519 mg/100 g in paddy and 130 in mid wet fonio. Molar ratio of phytate to iron of mid wet fonio and cooked fonio is above the critical value suggested that the absorption of iron from fonio might be poor. Molar ratios of phytate to zinc of fonio paddy, mid wet fonio and cooked fonio are less than the critical value suggested that iron bioavailability might be impaired. Cleaning, decortication and washing of fonio removes iron contamination from soils and other sources. Iron and zinc content of the fully processed fonio varieties which is around 2 mg per 100 g of dry matter is low. Phytate content of fonio predicts poor iron and zinc bioavailability and therefore a negative impact of the micronutrient status. Appropriate strategies such as food preparation methods could be suitable to improve the bioavailability of iron and zinc in fonio.

P28: Sucralose and glycation

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Glycation is called as the non-enzymatic glycosylation as a result of sugar bonding to the protein molecule. It involves the evolution of the molecule through a complex series of the reactions Amadori product, Schiff base, Millard reactions and lastly the molecule forms AGEs (Advanced Glycation End Product). Sucralose is the low-calorie sweetener made from table sugar (sucrose). Sucralose in reality it is about 600 times sweeter than sugar and can be used in place of sugar to eliminate or reduce calories in a wide variety of products, including beverages, baked goods, desserts, dairy products, canned fruits, syrups and condiments. The toxicity studies done on sucralose have clearly indicated as non-toxic compared to other sweeteners but till date no study on its effect on glycation has been done. We have studied the effect of glycation of sucralose on model protein such as insulin, *in-vitro* by measurement of fluorescence at Ex 370 nm/Em 400 nm. Sucralose shows increased fluorescence as compared to sucrose, this clearly indicates sucralose shows more glycation than the sucrose, which needs to be addressed, and its mechanism needs to be further investigated.

P29: How can local epidemiologic data be used in public health practice, an illustration

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Introduction: By collecting data on health and related topics the Community Health Service monitors the local health situation. How to benefit from these data in the development of health promotion activities is still a neglected research area. The aim of this study is therefore, to illustrate the possible use of epidemiologic data in public health practice, addressing loneliness in elderly people.

Methods: In 2005, a health monitor was performed among independently living elderly aged 65 years and over in order to identify the main local health problems (response 81%). In view of developing a logic model of change for the planning of interventions and evaluations, determinants of loneliness were assessed by reviewing literature, through interviews, and by in-depth analyses of the monitoring data using logistic regression.

Results: Loneliness was identified as a major health problem and therefore became a policy priority area in many municipalities. Quanti-

tative results showed that elderly with a good social network and who were engaged in society were more likely to have a good health. Elderly who were satisfied with their social contacts scored better on self-perceived health (OR 2.30; 95%-CI 2.01–2.65), physical functioning (OR 2.00; 95%-CI 1.71–2.35), and mental health (OR 4.29; 95%-CI 3.72–4.93). Results of the literature review and the interviews, also identified social network, social support, and social engagement as the main determinants of loneliness for inclusion in the logic model.

Discussion: Health monitors are a rich source of information and can be a powerful tool in public health practice. By supporting quantitative data with qualitative information a more complete picture of the health situation can be obtained as to better support the decision making process.

P30: Effectiveness of programmes aimed at increasing fruit and vegetable consumption in Europe

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Programmes aimed at increasing fruit and vegetable consumption are a part of the EU public health policy and respond to an inadequate (suboptimum) level of consumption of these products. Assessing the effectiveness of f&v campaigns is particularly difficult due to lack of precise intake measurements, slow results and lack of experience. Additionally, healthy foods are usually overreported and “bad” foods underreported. The measurable outcomes can be primary – change in consumed quantity of fruit and vegetable, and secondary – change in rates of non-communicable diseases.

The conducted analysis revealed the key factors that increase the effectiveness of studied programmes. First is the solid understanding of the underline causes of insufficient intake. Knowledge on the target group and the factors influencing consumer behaviour has a great impact on the outcomes of the campaign. Research conducted in Poland showed that most school children are aware of the health benefits of f&v and that young women (mothers) buy f&v mainly because of the needs of children. At the beginning of the intervention all sorts of communication tools to increase awareness of the program should be used. Clear vision and leadership, cultural adaption and patience are further needed. Other factors that play a particularly important role in the success of the long-term interventions include clear evidence of effectiveness for f&v programmes (pre and post intervention surveys). Publishing research is helpful in acquiring funds needed in order to continue the programme and in developing new efficient strategies in other environments and maximizing their health improving potential.

P31: Healthy or unhealthy, that is the question. Consumer perceptions of unhealthy eating; considerations and contradictions

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Consumer motives for food choice have been studied extensively, often showing the importance of health for consumers. Still, consumers make unhealthy choices in their dietary patterns resulting in ever rising rates of affluent diseases like obesity. Surprisingly, perceptions of unhealthy food behaviour have received limited research attention. This study takes an unhealthy approach to explore considerations and dilemmas that consumers face when choosing and consuming food. Six focus group discussions were carried out (N=35), of which 3 sessions with participants of normal weight (BMI=20,5–22,5) and 3 sessions with participants being overweight (BMI=26,5–34,0). Indirect techniques, particularly appropriate to unravel the underlying structure of observable parameters, were used to capture considerations and dilemmas. At first sight, respondents indicate ‘unhealthy’ and ‘healthy’ to be obvious opposites of each other; both the normal and overweight groups have contradictory colour associations with the two (red and greyish colours versus green and shiny colours, resp.). Also, respondents are very well able to categorise specific foods into healthy or unhealthy. However,

when eating is discussed in more detail confusion arises, for example about food products and treatments (e.g. “an apple is healthy but pesticides make it unhealthy”). It becomes even more complex when positioning foods in dietary patterns or lifestyles (e.g. “everything you eat extra, besides the main dishes, is unhealthy”), or when incorporating social and emotional aspects as well. Respondents report experiencing dilemmas in food behaviour, for example that dishes should be both home-made and convenient. In addition, clear benefits of unhealthy behaviour (e.g. indulging in fast-food) often appear connected to disadvantages (e.g. feeling guilty after eating fast-food). This study showed that healthy and unhealthy seem to be contradictory terms but that this relation is multi-layered, layers including nutrients, food products, dishes, dietary patterns, lifestyle, social and emotional aspects. These layers potentially conflict with each other.

P32: Determination of the quantity of maternal milk, and its zinc content, consumed by low birth-weight babies in Morocco

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Objective: To provide longitudinal data on breast milk consumption, using stable isotope techniques, at one and three months of life in low-birth weight (LBW) and normal birth weight (NBW) babies, and to determinate zinc in mother's milk.

Methodology: Sixteen paired mothers and babies were recruited of which 6 babies were LBW. After deuterium administration and saliva sampling during 14 days in the mother and her infant, the determination of the quantity of milk consumed by the babies was carried out by analyzing deuterium enrichment in saliva using the Fourier Transform Infrared Spectrophotometer (FTIR) milk volume was determined using special software ‘isotope.exe’. Anthropometric data were collected from the mothers and their babies. The statute of zinc in milk and was determined by an analytical method using ICP-SM.

Results: Maternal Body mass Index in mothers of NBW babies was $26,23 \pm 6,21 \text{ Kg/m}^2$ after 3 months of the childbirth, compared to mothers of LBW babies; $25,27 \pm 2,46 \text{ Kg/m}^2$. The body weight gain of babies with NBW was $2250 \pm 346,4 \text{ g}$ and $1925 \pm 287,23 \text{ g}$ in LBW babies after 3 months. Based on head circumference values and according to WHO standards, LBW babies show a delay in growth at birth and even after 3 months. The average quantity of the mother's milk consumed by NBW and LBW babies was $425,18 \pm 278,65 \text{ g/day}$ and $357,46 \pm 244,86 \text{ g/day}$ respectively. The zinc is slightly weaker in the mother's milk.

Conclusion: The isotopic technique based on the enrichment of saliva by deuterium, is an accurate method for estimating breast milk intake in babies.

P33: Differences and similarities in European recommendations on a subset of micronutrients of concern for elderly people in Europe

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Most European countries possess national recommendations on micronutrient intakes for elderly people reflecting the level of intake that would cover the requirements of practically all healthy persons in a specific population. They are used for assessing adequacy of dietary intakes and planning desirable dietary intakes.

For elderly people vitamin D, calcium, vitamin B12, folate, iron and zinc are micronutrients of concern as inadequate intakes or status are prevalent in Europe and associations with severe health problems have been demonstrated. However, recommendations on these micronutrients show a largely heterogeneity in Europe.

Until now a standard approach for deriving micronutrient recommendations throughout Europe has been lacking. Countries/organisations use their own methodologies often involving small and select committees of experts. Furthermore, cultural and regional factors may affect the weighing of evidence and decision-making. This results in diversity

between micronutrient recommendations in Europe causing confusion for policy-makers, health professionals, industry, and consumers. When comparing the methodological approaches used differences in the type/concept of the micronutrient recommendations (RDA/AI), publication dates as a proxy for available evidence, criteria for adequacy, the evidence base and assumptions made, may all contribute to the variation between publications on recommendations.

In the scope of the EURRECA-network of excellence funded by the European Commission micronutrient requirements will be derived by reviewing the evidence on relations between intake, status and health of elderly in Europe. The results will guide EURRECA in harmonizing approaches for setting nutrient recommendations.

P34: Impact of the national flour fortification program on the prevalence of anaemia and iron deficiency among women of childbearing age in Morocco

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Background: The prevalence of anaemia among Moroccan women at childbearing age was 32.6% in 2000 (national survey). A National programme of flour fortification with elemental electrolytic iron, folic acid and vitamins B groups was launched in 2005 to reduce anaemia among women.

Objective: This study was undertaken with these objectives: monitoring the flour fortification program, establishing a baseline data for monitoring program in future and to explore the impact of consumption of iron fortified flour on iron status among women at childbearing age in Morocco.

Method: A cross-sectional survey was conducted among 1842 women at childbearing age (14–49.9 years) in May–June 2006, in fifteen Moroccan provinces. Blood haemoglobin, C-reactive protein and ferritin levels were measured in a sub-sample of the population (n=265). Haemoglobin was measured by HemoCue method and serum ferritin was determined with ELISA method. Anaemia was considered if haemoglobin < 12.0 g/dl and iron deficiency by low reserve (ferritin < 15 µg/l).

Result: The prevalence of anaemia and iron deficiency among women at childbearing age was 31.5% and 28.2% respectively.

Conclusion: the prevalence of anaemia and iron deficiency remain high among women at childbearing age. It is early to draw up a sound conclusion from this study given that the flour fortification has just begun and only 50% of the national production of flour is fortified. The monitoring program will be continued and the data of this study will be used as a reference to evaluate the entire programme.

P35: 'No new born feeds on breast milk only': Infant feeding perceptions among men and women in Eastern Uganda

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Background: HIV-1 positive mothers are recommended to choose between 'Exclusive breastfeeding' (EBF) or 'Exclusive formula feeding' (EFF). Acceptability, Feasibility, Affordability, Sustainability and Safety (AFASS) are WHO's *a priori* criteria for EFF. EBF for the first half of infancy is associated with huge health benefits for children in areas where infant mortality is high. But, even if EBF has been recommended for decades, few mothers are practicing it. We set out to understand men's and women's infant feeding perceptions and to which degree EBF and EFF were AFASS.

Methods: Eight focus groups with 81 informants provided information for inductive content analysis. Four groups were held by men among men, and four groups by women among women in Mbale District,

Eastern Uganda. The study was part of formative studies from 2003–2005 for the ongoing study PROMISE EBF (<http://clinicaltrials.gov/>, Id no: NCT00397150).

Results: Both men and women regarded EBF as "not enough" or even "harmful". At the same time, not breastfeeding a newborn was seen as dangerous and as unacceptable except in cases of maternal illness. A mother's commitment to breastfeed came out strongly. Men argued that not-breastfeeding could entail sanctions by kin or in court. Most women had attended antenatal teaching, but expressed a desire to understand more while the men expressed dissatisfaction with being left out from health education.

Conclusion: Neither EBF or EFF were acceptable infant feeding practices. Increased culture-sensitive infant feeding promotion is needed. Programs might benefit from an "urge to learn" attitude among both parents in Eastern Uganda.

P36: Identification of factors predicting fonio (*Digitaria exilis*) consumption among urban Malian women in reproductive age

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Fonio is a West African traditional cereal which promises potentialities for improving the household food security in Mali due to its capacity to mature earlier than the other cereals and its reported good nutritional and cooking properties. However, very few studies have reported on the factors that could influence its consumption, especially in urban area. Our study seeks to identify factors determining intention to consume fonio among women. We performed a cross-sectional questionnaire survey in Bamako, the capital city of Mali, based on the Theory of Planned Behaviour and Health Belief Model, and with a sample of 108 women (15–49 year-old). The study showed that intention was significantly correlated with fonio consumption ($r_s = 0.78$, $P = 0.000$). Attitudes towards behaviour (standardized $\beta = 0.32$, $P = 0.016$) was the best predictor for intention to consume fonio, after adjustment for age, education and interviewers' effect. Health behaviour identity was significantly correlated with attitudes towards behaviour ($r_s = 0.67$, $P = 0.000$) and perceived barriers ($r_s = 0.33$, $P = 0.000$). Health value (standardized $\beta = 0.23$, $P = 0.010$) contributed significantly to the prediction of health behaviour identity. Perceived barriers was a significant interaction term in the relation between intention and behaviour (standardized $\beta = -0.72$, $P = 0.037$). A comprehensive program for fonio promotion should stimulate a positive attitude towards fonio consumption, influence men, family and neighbours' opinion and overcome some barriers like the difficult processing and the low know-how of women about fonio cooking.

P37: Dietary diversity and nutrient adequacy of women of reproductive age in Mali

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Micronutrient deficiencies are of major public health concern among women in Mali, but the nutrient density of the diet is often insufficient to meet their nutrient requirements. A positive correlation has been found between dietary diversity and nutrient adequacy for children but this relationship has not been sufficiently validated for different age groups. We

determined the dietary diversity and its correlation with nutrient adequacy among 108 women aged 15–49 years in Bamako (Mali), recruited using a three-stage cluster sampling method. Anthropometry, blood sample collection and food intake measurement using a 24h-recall were performed. Nutritional status, anemia, iron deficiency and zinc deficiency prevalence, dietary diversity scores (DDS) and probabilities of adequacy (PA) for 11 micronutrients were derived. Overall, 17% of the women suffered from chronic energy deficiency, while 29% were overweight. The prevalence of anemia was 32% of which 15% of iron deficiency anemia, while 34% of the women were zinc deficient. The DDS varied from 6 to 8 for 82% of the women. Energy intake through fat (31%) exceeded the recommended limit of 30%. The PA was below 0.20 for B12 and folate, ranged 0.20–0.49 for riboflavin, calcium, and niacin, and was 0.50 or above for iron, vitamin A thiamine, B6, zinc and vitamin C. DDS and PA were positively correlated even when adjusting for energy intake, especially for thiamin, B6, folate, and vitamins C and A. Dietary diversity is a good indicator of nutrient adequacy among women of reproductive age in Mali.

P38: The impact of a community food initiative in changing the 'food culture' of a community: a focus on mothers with young children in Skelmersdale, England

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The link between a nutritionally-poor diet and the development of chronic disease is well established. The incidence of such disease is of particular concern amongst population groups in areas of high socio-economic deprivation⁽¹⁾. Community-based initiatives (CBI) have been gaining in popularity as a method to direct health promotion efforts at low-income populations⁽²⁾.

The present research aimed to examine the role and outcomes of a CBI in relation to processes of behavioural change and to broader socio-economic influences. This objective was examined from both client- and non-client-based perspectives using mothers with young children as the focus.

The research took a phenomenological approach using ethnographic data-recording techniques. This combined stance was taken in order to reflect both nutritional and social (community development) outcomes of the intervention. Incorporating non-clients allows the evaluation to account for the key influences, enablers and barriers for participants and, importantly for public health research, to determine how much of any change is socially driven.

Analysis of findings for clients indicates the importance of individual capacity (self-efficacy) and problem-solving capabilities for engaging in healthy eating patterns, resulting from addressing a number of common barriers in this population. The comparison with non-clients has brought to light the complex and contending influences involved in food choice, and has enabled an understanding of a hierarchy of influences for mothers of young children.

The research has enabled an understanding of the role and impact of the intervention on the wider processes of change (successful and unsuccessful) involved in any given community setting.

P39: Dietary sources of nutrients among preschoolers: a basis for dietary recommendations

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Objective: to identify major food sources of nutrients among preschoolers in Flanders (Belgium) as a basis for dietary recommendations.

Methods: Three-day estimated diet records were collected from a representative sample of Flemish preschoolers 2.5–6.5 years old (n 696). For 23 dietary constituents, the contribution of each of 58 food groups was computed by summing the amount provided by the food group for all individuals divided by the total intake of the respective nutrient for all individuals.

Results: Bread (12%), sweet snacks (12%), milk (6%), sugared milk drinks (9%), and meat products (6%) were the top five energy contributors. Sweet snacks were among the top contributors to almost all micronutrients because of high consumptions of fortified biscuits. Sweet biscuits are also main contributors to saturated fatty acid intakes (16%). Although fruit juices (mainly industrial) are main contributors to total vitamin C intakes (42%), they are also major contributors to simple carbohydrates (14%). Butter/margarine are the main source of vitamin D and polyunsaturated fatty acid intakes.

From the major food sources and the gaps in nutrient and food intakes among Flemish preschoolers, some recommendations to pursue the designated nutritional goals could be drawn: the intake of sweet snacks and sugar rich drinks should be discouraged, while the consumption of fruits, vegetables, water, bread and margarine on bread should be encouraged.

Conclusion: Flemish preschoolers should change their dietary habits to increase compliance with dietary recommendations and a variety of foods should be recommended above the consumption of fortified foods.

P40: The use of food photographs as a portion estimation aid for dietary assessment surveys in a rural West-African setting

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Background: In industrialised countries food photographs are often used in dietary assessment survey as a portion size estimation aid. We performed a validation study of a self-developed food photograph album in a rural setting in West-Africa.

Methods: A food photograph album was developed containing four coloured photos per dish. In two rural villages, portion sizes of eight frequently consumed dishes were weighed and offered for consumption to 137 women. The day after the presented portion sizes were estimated using food photographs.

Results: In 55% of a total of 1028 estimations, the correct photo was selected. On a group level, mean differences between served and estimated portion sizes varied between –8.4% to 6.3%. For each food, proportions of underestimating and overestimating participants were balanced, except for 2 dishes. Subjects who attended school were almost twice as likely to choose the correct photo. Portion size ability appeared to be influenced by the size of the portion offered.

Conclusion: Food photographs can be a useful portion size estimation aid in rural settings of West-African countries on a group level.

P41: Impact of vitamin A fortified oil on vitamin A status of Moroccan preschool-age children

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Background: In Morocco, 40% of children are vitamin A deficient (VAD). Vitamin A oil fortification is used to reduce VAD among children.

Objective: To assess the impact of consumption of vitamin A-fortified oil on vitamin A status of preschool-age children (36–60 month).

Methods: A longitudinal evaluation of serum retinol levels of preschool-aged children was performed. Two consecutive surveys were executed in 237 children in May–June 2006 and in 386 children in December–January 2008. Those surveys were conducted in fifteen Moroccan provinces.

Results: The prevalence of vitamin A deficiency in May–Jun 2006 was 28.4%. In December–January, this prevalence was 22.7% ($p=0.135$).

Conclusions: The reduction in the vitamin A deficiency prevalence is still not significant. It is recommended to continue promoting fortified oil consumption and monitoring plasma retinol of children.

P42: Application of LQAS in assessing program coverage and behaviours for an integrated child nutrition project: SAFANS Lesotho

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In recent years there has been an increase in the number of vulnerable households in Lesotho, due almost exclusively to the combined impact of HIV/AIDS, food insecurity and chronic poverty. At the centre of these causative factors are the high rates of malnutrition observed among children under the age of five. The most recent national nutrition survey (2007) reported chronic malnutrition at 41% (unacceptable by WHO standards). Therefore, SAFANS Lesotho project was initiated to focus on reducing chronic malnutrition amongst underfive children in the three World Vision Area Development Programmes sites.

A baseline survey was then commissioned to profile the situation, coverage and knowledge of key components of the project: nutrition, food security, health and agricultural services and practices. LQAS (Lot Quality Assurance Sampling) methodology was employed for sampling, collecting and analysing data. This method is useful for planning, monitoring and evaluating community health programs by local managers in catchment areas.

A total of 285 households with children under the age of five were surveyed in this study to establish base level indicators. Moderate chronic stunting and underweight were the most prominent types of malnutrition in all the supervision areas. Stunting 43% ($-2SD$) while underweight 10% ($-2SD$) respectively. Dietary diversity is minimal as most households consume staple maize porridge with green leafy vegetables.

In conclusion chronic malnutrition remains the most pressing health and development concern in the 3 ADP hence the need to implement a well coordinated and structured project that encourages positive behaviours and community empowerment towards addressing malnutrition.

P43: Methodological challenges in right to food studies at household level

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Introduction: Right to adequate food is a human right enshrined in the United Nations Universal Declaration of 1948 of freedom from hunger and the International covenant of Economic, Social and cultural Rights. Most studies in right to food arena have been at the national level and special vulnerable groups. Studies focus being on the operationalization and implementation of the right to food at state level. Limited studies have been conducted at the household level.

Objective: The study aimed at developing a tool which could be used to measure realization of the right to food and also be an indicator of household food security.

Methodology: Right to adequate food tool was developed from the rights obligatory parameters used at state level and modified in the context of the household level. The tool consists of a leikert scale of a five point rating. A household right to food index (HRTFI) was then computed and categorized to measure low or no violation, moderate violation and violation of right to food. The tool was used among farming and pastoral communities. The household right to food index

was then used to measure food security at household level. Qualitative data was collected through focus group discussions.

Results: Computed realization of right to food by respect and fulfilment showed significant difference ($p=0.01$) among the farming community for food diversity and household food security compared to the pastoral community. Challenges included religion and cultural barriers to data collection as well as community perceptions of the right to food.

P44: Iron status and associated factors in rural school going children (5–8 years) of Haryana state, India

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Background: Iron deficiency prevents forty to sixty percent of children in developing countries from growing to their full mental potential. Research Question: To determine iron status and anemia in rural school children and their associated factors. Settings: Rural school children (5–8 years), Haryana, India. Study Design: Cross-sectional. Sampling design: Stratified multi-stage random sampling. Optimum sample size: 230 children. Methodology: Blood analysis: Hemoglobin, serum ferritin and CRP concentration were analysed in venous blood sample. Dietary consumption: 24-h recall on two non-consecutive days was used. Micro-nutrient adequacy was calculated in children diet. Four algorithms were chosen to estimate non-heme iron bioavailability. Statistical analysis: ANOVA was done to determine differences in biochemical indices between normal and iron deficient children. Spearman's correlation coefficients were calculated for comparing the outcomes of algorithms. Results: 217 children completed study. Out of them, 58% children were anemic, 49% were iron deficient and 40% were iron deficient anemic. Diets of this population were cereal based (mainly whole wheat flour), did not include MFP and were high in tea consumption. Mean dietary intake of energy, protein, iron, zinc, and vitamin-A were significantly higher in normal children than iron deficient children. Though intake for vit-C was also higher in normal children than iron deficient but difference was not significant. Probability of adequacy (PA) for vitamin C and iron in their diets were low (27% and 25%, respectively). Daily average non-heme iron bioavailability as calculated by different algorithms was found low 3.1 to 4.6%. Conclusion: Results showed that iron deficient children had low iron and vit-C intake in their diet. Source of iron in their diet was non-heme. Bioavailability of consumed iron was between 3.1–4.6%. They have to focus on iron and vitamin-c rich diet.

P45: Anthropometric features of pupils provided with meals under the nepad school feeding programme

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Introduction: School Health and Nutrition Programmes are implemented to improve the nutritional status of children in deprived areas of the world.

Study design and methodology: A cross sectional design was employed. A total of 400 pupils were sampled randomly from three public schools in the greater Accra Region. A semi-structured questionnaire was used to solicit socio-economic information. Standard procedures were used in obtaining anthropometric data while 24-hour recall dietary data was collected for a sub-sample. Statistical significance was tested using Chi-square and Analysis of Variance.

Results: About 60% Of pupils belong to households with sizes ≥ 6 . Height ($p=0.02$); body weight ($p=0.04$) and triceps skinfold measurements were statistically different among pupils from various schools ($p<0.001$). Body mass index also showed statistical significance association with sex of pupils ($p<0.001$). Only children aged 7–10 years met their EAR for

protein, carbohydrate and energy. About 28.0% of pupils were suffering from various degrees of malnutrition. Selected vitamin and mineral intakes were above 50.0% for all age groups and sexes.

Conclusions: Most of the pupils are from large households that is why only 7–10 year-olds met half of their basic nutritional requirements. Females were also heavier, taller and have relatively more subcutaneous fat than males of comparable age.

P46: Fortification of lysine for improving protein quality in multiple-fortified quick cooking rice

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Previous studies in Thailand indicated that rice-based complementary foods of breast-fed infants normally provided inadequate iron and calcium. Quick-cooking rice fortified with different nutrients was therefore developed. The idea of lysine fortification was based on the fact that lysine is a limiting amino acid in rice. The objective of this study was to determine the feasibility of producing quick-cooking rice (MFQCR) fortified with adequate levels of vitamins, minerals and lysine together with an assessment of lysine intake among Thai infants.

Lysine together with iron, calcium, zinc, thiamin and folate was fortified into broken rice to meet the requirements for infants aged 6–24 mo. Lysine loss and changes in physical and sensory qualities were determined during a shelf-life study under accelerated condition. To assess the lysine intake among infants, 24 hour-recall data from Thai National Food Consumption Survey (2006) among infants aged 6–24 mo in Central Thailand was used.

It was considered feasible to produce lysine-fortified MFQCR, and using it did not affect the intake of infants. The lysine requirement was most fulfilled in infant aged 12–24 mo being fed with 3 meals. Food consumption data showed that the daily lysine intake was certainly adequate, and no difference between infants from low- and high-income households was found. Lysine fortification in MFQCR might not be beneficial to infants in Central Thailand; however, it is still considered more required in countries where the populations consume cereal-based diet, and have no access to good quality protein e.g. Cambodia, Indonesia and North Korea.

P47: Early predictors of total and HDL cholesterol levels in 8-year-old children

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Background: Elevated childhood cholesterol levels may be associated with cardiovascular diseases in adulthood. Evidence exists that cholesterol levels may be influenced by factors early in life, such as breastfeeding and birth weight. This study aims to identify these early predictors.

Methods: Anthropometric measures and blood samples were collected during a medical examination in 787 8-year-old children participating in the PIAMA study. Total and HDL cholesterol were determined in serum. Linear and logistic regression were performed to estimate regression coefficients and odds ratios for the associations with breastfeeding, birth weight, and maternal overweight before pregnancy. Logistic regression with outcome measure having serum levels in the highest tertile of the distribution.

Results: Only slight differences existed in mean total and HDL cholesterol and total:HDL ratio between the categories for birth weight, breastfeeding, and overweight of the mother. Girls with a higher birth

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weight tended to have lower HDL cholesterol levels ($\beta = -0.00007$, $p = 0.02$). Other regression coefficients for total and HDL cholesterol were non-significant. Odds ratios tended to be in opposite direction for boys and girls. Only girls with birth weight <2500g tended to have a lower risk for a high total:HDL ratio, but the number of children in this subcategory was very small.

Conclusion: Evidence for a relation between breastfeeding, birth weight and serum cholesterol levels could not be demonstrated in the present study. Therefore we were not able to confirm results from previous studies. Perhaps the possible influence of breastfeeding and birth weight only becomes apparent after a considerable period, e.g. in adolescence or even adulthood.

P48: N-3 polyunsaturated fatty acids from fish and cardiovascular disease

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Background: N-3 polyunsaturated fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are associated with a reduced risk of fatal coronary heart disease (CHD) and cardiovascular disease (CVD). We examined these associations in a general Dutch population.

Design: Between 1993–1997, participants filled out questionnaires on diet and lifestyle. We included 20,148 subjects, 20–59y, with no history of myocardial infarction or stroke. Hazard Ratios (HRs) were calculated with Cox proportional-hazard models, adjusted for age, gender, BMI, family history of CVD, supplement use, cholesterol lowering or anti-hypertensive drugs, education level, smoking, and intake of alcohol, energy, fruit, vegetables, and saturated fat. Endpoints were classified by the International Classification of Diseases. Results: Median intakes in quartiles of EPA + DHA were 39, 84, 150, and 233 mg/day. During 8–13y of follow-up, 607 patients died of which 155 of CVD and 82 of CHD. The adjusted HR for fatal CHD was lower in the highest quartile of EPA + DHA (0.53; 95% CI: 0.28–0.99) as compared with the lowest quartile. For fatal CVD, this was not found (Q4: 0.85; 95% CI: 0.54–1.33). The number of incident cases was 1157 for CVD and 752 for CHD. HRs for incident CVD across quartiles of EPA + DHA intake compared with the lowest quartile were: 1.01 (0.85–1.20), 1.07 (0.90–1.27), 0.97 (0.82–1.15). For incident CHD HRs were: 0.90 (0.72–1.11), 1.06 (0.86–1.30), and 0.97 (0.79–1.19). Conclusion: Dietary EPA + DHA is associated with fatal CHD, even in a population with a low fish intake. We found no associations of EPA + DHA with non-fatal CHD and with fatal and non-fatal CVD.

P49: Intake of fatty fish and n-3 fatty acids intake in relation to cognitive performance and 6 year cognitive change in aging men: the Veterans Affairs Normative Aging Study

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Background: High intake of fish and marine n-3 polyunsaturated fatty acids (PUFAs) may protect against age-related cognitive decline. However, results are inconsistent and limited data exist regarding changes in multiple cognitive functions over a longer period of time.

Objective: To assess the association between fatty fish as well as marine n-3 PUFA (EPA-DHA) intake with cognitive performance and cognitive change over 6 years in 1025 elderly men.

Design: Participants were from the US Veterans Affairs Normative Aging Study (NAS). Cognitive function was assessed with a battery of cognitive tests focusing on the factors memory/language, speed and

visuospatial/attention. Dietary intakes were assessed with a food frequency questionnaire. General linear models were used to assess cross-sectional associations and mixed models were used to assess the associations over time. Models were adjusted for age, education (model 1) and also for BMI, smoking, diabetes, and intake of alcohol, saturated fat, vitamin C and vitamin E (model 2).

Results: Mean age of the participating men was 68 years at baseline. Median fish consumption ranged from 0.7 to 4.2 portions per week over the quartiles. Cross-sectional analyses showed no association between fatty fish or EPA-DHA intake and cognitive performance. Also over 6 years of follow-up we did not observe any significant associations between fatty fish or EPA-DHA intake and cognitive change.

Conclusions: In this population of elderly men, higher intake of fatty fish or EPA-DHA was neither associated with cognitive performance nor with 6-year cognitive change.

P50: Fruit and Vegetable Intake and Risk of Acute Coronary Syndrome

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Background: Prospective epidemiological studies have found that high fruit and vegetable intake lowers the risk of coronary heart disease. However, many of these studies did not examine the effects of specific fruits and vegetables but looked rather at overall fruit or vegetable intake or even of fruits and vegetables combined.

Objective: To examine the potential association between fruit and vegetable consumption, in particular the sub-groupings citrus fruits, apples and cabbages, and the risk of acute coronary syndrome (ACS) in a prospective Danish cohort study.

Methods: During a median follow-up of 7.7 years, 1075 incident ACS cases were identified among 53,388 men and women aged 50-64 years at baseline. Cases were identified in the National Patient Registry and verified by review of medical records. Baseline intake of fruits and vegetables was estimated based on a validated food frequency questionnaire, and associations between exposures and ACS incidence rate ratios (IRR) were based on a Cox proportional hazards model.

Results: Overall, fruit consumption tended to be associated with decreased risks of ACS for both men and women. For men, we found an inverse association for apple intake per 25 g/d [IRR (95% CI): 0.97 (0.94-0.99)]. This association was also seen among women, albeit borderline significantly. However, an increased risk in association with fruit juice intake was seen among women per 25 g/d [IRR (95% CI): 1.04 (1.00-1.09)]. No mentionable associations were seen for vegetables.

Conclusion: Our results provide some support for a protective effect of fresh fruit intake, particularly apples, on ACS risk.

P51: Alcohol and pancreatic cancer risk in the Netherlands Cohort Study

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To examine prospectively the relation between alcohol and pancreatic cancer risk, the authors analyzed data from the Netherlands Cohort Study. Participants were 120,852 individuals who completed a baseline questionnaire in 1986. A case-cohort approach was used for data processing and analyses. After 13.3 years of follow-up, 350 pancreatic cancer cases (185 men and 165 women; 67% microscopically confirmed) were available for analysis. Incidence rate ratios (RRs) and their 95% confidence intervals (CI) were estimated using Cox proportional hazards models. Compared to abstaining, the highest category of alcohol

consumption (30 g/day of ethanol) was positively associated with pancreatic cancer risk (multivariable-adjusted RR=1.57, 95% confidence interval (CI): 1.03, 2.39; $P_{\text{trend}}=0.12$, for all pancreatic cancer cases and multivariable-adjusted RR=1.54, 95% CI: 0.94, 2.54; $P_{\text{trend}}=0.22$, for microscopically confirmed pancreatic cancer cases). In the subgroup of stable alcohol users, a similarly increased pancreatic cancer risk was found. This increased cancer risk was limited to the first part of follow-up and was not observed during later follow-up. No associations were observed between consumption of specific alcoholic beverages and risk of pancreatic cancer. The associations were not modified by gender, folate intake or smoking. Overall, the author's findings suggest an increased pancreatic cancer risk for high ethanol intake (30 g/day). However, this increased pancreatic cancer risk was observed only during the first part of follow-up and not during later follow-up.

P52: Fresh and processed fruit and vegetable intake and risk of cardiovascular and all-cause mortality in a Dutch population-based follow-up study

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Introduction: Fruit and vegetable intake lowers CVD and all-cause mortality risk. Whether fresh and processed fruits and vegetables have similar health effects remains unclear.

Objective: We examined the association of total, fresh and processed fruit and vegetables with CVD and all-cause mortality in a population-based follow-up study in the Netherlands.

Design and methods: 20,148 men and women were examined between 1993-1997, 20-65y and free of CVD. Food intake was assessed by a validated 178-item food frequency questionnaire. Processed fruits and vegetables are juices or cooked. Cause of death was obtained from national registries up to 2007, 678 participants died, 155 of CVD. Cox proportional hazard model was used, adjustments were made for age, gender, energy and alcohol intake, smoking, socioeconomic status, supplement use, anti-hypertensive or cholesterol-lowering drugs, family history of MI and fiber, fish, saturated fatty acids and fruit or vegetables intake.

Results: 50 g increase of fruit intake was inversely associated with all-cause mortality, HR 0.97 (95% CI: 0.94-0.99). HRs for fresh and processed fruit intake with all-cause mortality were 0.96 (0.93-0.99) and 0.98 (0.94-1.03), respectively. A lower risk of all-cause mortality was observed for 50 g increase of vegetable intake; 0.92 (0.85-1.00). HRs for fresh and processed vegetable intake with all-cause mortality were 1.01 (0.88-1.17) and 0.89 (0.81-0.98), respectively. These trends in association were also observed for CVD mortality, but less strong and borderline significant.

Conclusion: Fruit and vegetables are inversely associated with all-cause mortality in healthy Dutch men and women. For vegetables, this relationship was attributable to processed, cooked vegetables.

P53: Dietary protein intake and incidence of type 2 diabetes in the EPIC-NL study

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Background: Dietary recommendations and research efforts are mainly focussed on relative dietary fat and carbohydrate content

in relation to chronic diseases. Meanwhile, high protein diets may contribute to disturbance of glucose metabolism with type 2 diabetes (T2DM) as a result, but little evidence from prospective studies is available yet. We examined the association between dietary total, vegetable, and animal protein intake and incidence of T2DM.

Methods: A prospective cohort study was conducted with 40,072 Dutch adults, aged 20-70 years at baseline. Dietary protein intake was measured with a validated food frequency questionnaire. T2DM cases were mainly self reported, and verified against GP records.

Results: During a mean follow-up of 10.1 (1.9) years, 919 incident T2DM cases were documented. Diabetes risk increased with increasing total protein (HR (95% CI) highest vs. lowest quartile: 2.16 (1.78–2.61)) and animal protein (2.18 (1.81–2.64)) intake. Adjustments for confounders not substantially change these results. Further adjustment for waist and BMI attenuated the associations (total protein: 1.23 (0.94–1.59), animal protein: 1.15 (0.89–1.49)). When separating these associations for normal weight and overweight/obese subjects, T2DM risk significantly increased in normal weight subjects (2.19 (1.26–3.80)), while no association was found in overweight/obese subjects ($p_{\text{interaction}} < 0.05$). We found no relation between vegetable protein intake and T2DM.

Conclusions: High protein diets, mainly from animal source, may increase T2DM risk in normal weight, but not in overweight/obese persons. These results underline the importance of accounting for protein content of diet in dietary recommendations to prevent T2DM. More research in this area is warranted.

P54: Serum cholesteryl fatty acid fractions and glucose tolerance status in population based cross-sectional study: The CoDAM study

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Introduction: Some studies suggested that fatty acid (FA) patterns in blood that are characterized by low fractions of saturated FA and high fractions of linoleic acid could reduce the development of insulin resistance and related disorders. We evaluated the association between serum cholesteryl FA fractions, glucose tolerance status, and HOMA-IR, a measure of insulin resistance, among high-risk participants of the CoDAM study.

Methods: Serum FA fractions were determined and expressed as % of total FA. Desaturase activity was estimated as product/precursor ratio. Adjusted means were obtained to investigate difference in serum FA fractions across participants with normal glucose tolerance (n = 279), impaired glucose metabolism (n = 115), and type 2 diabetes (n = 137). Linear regression was used to examine the associations between serum FA fractions and HOMA-IR (n = 524).

Results: The proportions of total saturated FA, as well as the individual fractions C16:0 and C18:0, were higher in diabetic participants than in those with a normal glucose tolerance status (total saturated FA: 13.3%

vs. 12.8%, $p = 0.01$, respectively). The fractions of total mono-unsaturated FA, poly-unsaturated FA, and trans-FA were not significantly different. Furthermore, diabetic participants had a lower $\delta 5$ -desaturase activity than normal glucose tolerant participants (7.7% vs. 8.4%, $p = 0.01$, respectively). HOMA-IR was positively related with total saturated FA fractions and inversely related with $\delta 5$ -desaturase activity ($\beta = 0.051$ (95% CI 0.004, 0.10); $\beta = -0.048$ (95% CI -0.08, -0.02), respectively).

Conclusion: A higher fraction of total saturated FA and low activity of $\Delta 5$ -desaturase were associated with type 2 diabetes and HOMA-IR. This might be important in the prevention of type 2 diabetes.

P55: The effect of food groupings on the association of dietary diversity and nutrient adequacy of women in Kenya

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Most parts of Africa are characterised by poor infrastructure, high illiteracy and clear seasonal differences, resulting in varying food availability. These present challenges in assessment of adequate nutrient intakes from diets. The conventional food consumption survey methods are tedious, time consuming and expensive. There is therefore need for simple methods measurements of dietary diversity scores, if found reliable. Studies demonstrate a significant association between dietary diversity score and micronutrient adequacy, however due to methodological shortcomings, dietary diversity scores need further validation. It is against this background that a study was designed to determine the effectiveness of using different food groups on the association between dietary diversity and nutrient adequacy in the diet of women of child bearing age in Kenya.

A cross-sectional food consumption survey among 75 women of child bearing age (15–49 years) was carried out in Mbooni sub-location of Makueni district during the short rains of October to December 2007. A previously tested 24hr-recall questionnaire was administered on 3 non-consecutive days, to assess dietary diversity scores based on categorisation of foods into 6, 13 and 21 food groups for vitamin A, vitamin C, iron and zinc and mean probability of nutrient adequacy (MPA) were calculated. Descriptive analysis and partial rank correlation were performed using Statistical package for social sciences (SPSS).

Results of the study demonstrated that the diets in the study area were predominantly starchy and starch contributed 55% of total energy intake. The mean daily energy intake was 1702 ± 570.9 Kcal, below average requirement of 2100 Kcal. Dietary diversity scores based on 6 and 13 food groups were significantly associated with the mean probability of adequate nutrient intake ($r = 0.44$ and $r = 0.43$; $p < 0.01$) and probability of adequate intakes of vitamin A ($r = 0.34$; $p < 0.01$) and zinc ($r = 0.38$; $p < 0.001$). However, based on 21 food groups the dietary diversity score was only significantly associated with vitamin A ($r = 0.30$; $p < 0.01$) after adjusting for energy intake and age.

The study concludes that food group diversity scores are promising as simple tools to assess the nutrient adequacy for contemporary dietary studies. Dietary diversity score based on categorisation into 6 food groups is recommended as the best and most simple indicator for nutrient adequacy for women of reproductive age living in rural Kenya.