Maternal Intake and Polyphenols


Daily vegetable intake during pregnancy negatively associated to islet autoimmunity in the offspring--the ABIS study.

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Abstract

OBJECTIVE: To investigate if maternal diet during pregnancy is associated with occurrence of islet autoimmunity (IA) in the offspring.

METHODS: Of 21 700 infants invited to the All Babies in South-east Sweden (ABIS) study, 16 004 screening questionnaires, including a 22-item food frequency questionnaire (FFQ) regarding the mothers' diet during pregnancy, were completed after delivery. Follow-up of the children (questionnaires and blood sampling) was performed at 1, 2.5 and 5 yr of age. IA was defined as being positive (above the 95th percentile for healthy children) in two or more measurements of autoantibodies [glutamic acid decarboxylase (GADA); tyrosine phosphatase (IA-2A), insulin autoantibodies (IAA)] analysed at the three time points or being diagnosed with type 1 diabetes during the 5-yr follow-up period. The 5 724 children in whom we carried out two to three possible blood samplings were included in the study. Logistic regression analysis was used to identify variables predicting IA.

RESULTS: Of 5 724 children, 191 (3.3%) were considered positive for IA. In a univariate analysis, less than daily consumption of vegetables (3-5 times/week) in the mothers' diet was associated with increased risk of IA (OR 1.71, 95% CI:1.24-2.35, p = 0.001) compared to daily consumption (p for trend = 0.004). The association was strengthened when adjusting for known IA-risk factors (p for trend <0.001).

CONCLUSIONS: Daily consumption of vegetables in the mothers' diet during pregnancy was associated with a decreased risk of IA in the offspring.

PMID: 19761530 [PubMed - in process]

Supplemental Content

A two generation reproductive toxicity study with curcumin, turmeric yellow, in Wistar rats.

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Abstract

The reproductive toxicity of curcumin, turmeric yellow, in Wistar rats was studied in order to generate additional relevant toxicity information for the use of curcumin in humans by oral administration. The two generation reproduction study was designed and conducted in accordance with OECD Guideline No. 416 [OECD, 1983. Guidelines for Testing of Chemicals, Guideline No. 416. Two Generation Reproduction Toxicity Study, adopted on 26th May 1983] and in compliance with Good Laboratory Practices (OECD, 1997 Principles of Good Laboratory Practice for the Testing of Chemicals. OECD, C(97)186/Final). The curcumin, mixed in the experimental diet at the concentrations of 1500, 3000 and 10,000 ppm was fed to three groups of rats, i.e., low, mid and high dose groups, and studied for two successive generations. A concurrent control group received experimental diet without the curcumin mixture. There were no treatment related adverse toxicological effects in the parental animals. No gross or microscopic changes were observed in any of the organs. None of the reproductive parameters were affected and there were no effects on the offspring other than a small reduction in pre-weaning body weight gain of the F2 pups at the highest dose level. It was concluded that the no observed adverse effect level (NOAEL) for reproductive toxicity of curcumin, fed in the diet for two successive generations to rats in this study was 10,000 ppm, which is equivalent to 847 and 959 mg/kg bodyweight (bw) per day for male rats and 1043 and 1076 for females for F0 and F1 generations, respectively. This study was the final toxicology study on curcumin reviewed by the Joint FAO/WHO Expert Committee on Food Additives (JECFA) at the 61st Meeting, 2003. The JECFA group considered that the small body weight reduction in the F2 pups of the highest dose group prevented this from being regarded as a no adverse effect level, and so allocated an ADI for curcumin of 0-3 mg/kg bw based on the intake of 250-320 mg/kg bw in the mid-dose group as the NOEL.

PMID: 16987575 [PubMed - indexed for MEDLINE]

Supplemental Content

Maternal Intake and Offspring: Vitamins

Maternal intake of vitamin D during pregnancy and risk of advanced beta cell autoimmunity and type 1 diabetes in offspring.


Tampere School of Public Health, University of Tampere, Tampere, Finland.

Comment in:

Abstract

AIMS/HYPOTHESIS: We evaluated the intake of vitamin D by pregnant Finnish women and examined associations between maternal intake of vitamin D and the development of advanced beta cell autoimmunity and type 1 diabetes in their offspring.

METHODS: The research was carried out within the Diabetes Prediction and Prevention study (DIPP), which is a population-based birth cohort of infants at genetic risk of type 1 diabetes. Mothers of 3,723 infants born between 1997 and 2002 completed a validated 181-item food frequency questionnaire, which included questions on dietary supplements. The offspring were observed at 3 to 12 month intervals for the appearance of autoantibodies associated with type 1 diabetes and for the development of clinical type 1 diabetes.

RESULTS: Maternal mean daily intake of vitamin D was 5.1 microg from food and 1.3 microg from supplements. The maternal intake of vitamin D, either from food or from supplements, was not associated with the risk of advanced beta cell autoimmunity/type 1 diabetes in offspring (HR [95% CI] for intake of vitamin D from food 1.25 [0.80-1.95], for vitamin D intake from supplements 1.05 [0.95-1.16]), or with the risk of type 1 diabetes alone (HR [95% CI] for intake of vitamin D from food 0.84 [0.41-1.72], for vitamin D intake from supplements 1.09 [0.99-1.20]).

CONCLUSIONS/INTERPRETATION: Maternal intake of vitamin D either from food or supplements during pregnancy is not associated with advanced beta cell autoimmunity/type 1 diabetes or with type 1 diabetes alone in Finnish offspring carrying increased genetic susceptibility to type 1 diabetes.

PMID: 20369220 [PubMed - indexed for MEDLINE]

Supplemental Content

High maternal vitamin E intake by diet or supplements is associated with congenital heart defects in the offspring.

Smedts HP, de Vries JH, Rakhshandehroo M, Wildhagen MF, Verkleij-Hagoort AC, Steegers EA, Steegers-Theunissen RP.

Department of Obstetrics and Gynaecology, Division of Obstetrics and Prenatal Medicine, Erasmus MC, University Medical Centre, Rotterdam, The Netherlands.

Abstract

OBJECTIVE: To study associations between maternal dietary and supplement intake of antioxidants vitamin E, retinol and congenital heart defects (CHDs).

DESIGN: Case-control study.

SETTING: Erasmus MC, University Medical Center Rotterdam, the Netherlands.

POPULATION: Participants were 276 case mothers of a child with CHD and 324 control mothers with their children.

METHODS: Food frequency questionnaires covering the intake of the previous 4 weeks were filled out at 16 months after the index pregnancy. Data were compared between cases and controls using the Mann-Whitney U test. Risk estimates for the association between CHD and dietary intake of vitamin E and retinol were estimated in a multivariable logistic regression model.

MAIN OUTCOME MEASURES: Medians (5-95th percentile) and odds ratios with 95% CI.

RESULTS: Dietary vitamin E intake was higher in case mothers than in controls, 13.3 (8.1-20.4) and 12.6 (8.5-19.8) mg/day (P= 0.05). CHD risk increased with rising dietary vitamin E intakes (P-trend = 0.01). Periconception use of vitamin E supplements in addition to a high dietary vitamin E intake above 14.9 mg/day up to nine-fold increased CHD risk. Retinol intakes were not significantly different between the groups and not associated with CHD risk.

CONCLUSIONS: High maternal vitamin E by diet and supplements is associated with an increased risk of CHD offspring.

PMID: 19187374 [PubMed - indexed for MEDLINE]

Supplemental Content
Maternal serum vitamin B12, folate and homocysteine and the risk of neural tube defects in the offspring in a high-risk area of China.


Capital Institute of Pediatrics, Beijing, China.

Abstract

OBJECTIVE: To examine the association between the risk of neural tube defects (NTD) and maternal serum vitamin B12, folate and homocysteine in a high-risk area of China.

DESIGN: A case-control study was carried out in Luliang mountain area of Shanxi Province.

SUBJECTS/SETTING: A total of eighty-four NTD pregnancies and 110 matched controls were included in the study; their serum vitamin B12 and folate concentrations were measured by chemiluminescent immunoenzyme assay and total homocysteine concentrations by fluorescent polarisation immunoassay.

RESULTS: Serum vitamin B12 and folate concentrations were lower in NTD-affected pregnant women than in controls (P < 0.01). Serum total homocysteine was higher in the NTD group than in controls at less than 21 weeks of gestation (P < 0.01). Adjusted odds ratios revealed that women with lower vitamin B12 (adjusted OR=4.96; 95 % CI 1.94, 12.67) and folate (adjusted OR=3.23; 95 % CI 1.33, 7.85) concentrations had a higher risk of NTD compared to controls. Based on dietary analysis, less consumption of meat, egg or milk, fresh vegetables and fruit intake would increase the risk of NTD.

CONCLUSIONS: Lower serum concentrations of folate and vitamin B12 are related to the increased risk of NTD in high-risk populations. Both folate and vitamin B12 intake insufficiency could contribute to the increased risk of NTD. A dietary supplement, combining folate and vitamin B12, might be an effective measure to decrease the NTD incidence in these areas.

PMID: 18547453 [PubMed - indexed for MEDLINE]
From nurture to Nature--the story of the Aberdeen asthma dietary hypothesis.

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Abstract

This article recounts the story of the dietary hypothesis for the rise in asthma and allergies from the first idea to publication of papers showing an association of maternal diet during pregnancy with rise of asthma in the offspring at 2 and 5 years. The nutrient most consistently associated with this endpoint is vitamin E, and it is suggested that reductions in the intake of this vitamin during pregnancy over past decades could explain up to a third of the excess cases of childhood asthma.

PMID: 18245805 [PubMed - indexed for MEDLINE]

Supplemental Content

Vitamin B12 and folate concentrations during pregnancy and insulin resistance in the offspring: the Pune Maternal Nutrition Study.

Yajnik CS, Deshpande SS, Jackson AA, Refsum H, Rao S, Fisher DJ, Bhat DS, Naik SS, Covaji KJ, Joglekar CV, Joshi N, Lubree HG, Deshpande VU, Rege SS, Fall CH.

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Comment in:

AIMS/HYPOTHESIS: Raised maternal plasma total homocysteine (tHcy) concentrations predict small size at birth, which is a risk factor for type 2 diabetes mellitus. We studied the association between maternal vitamin B12, folate and tHcy status during pregnancy, and offspring adiposity and insulin resistance at 6 years.

METHODS: In the Pune Maternal Nutrition Study we studied 700 consecutive eligible pregnant women in six villages. We measured maternal nutritional intake and circulating concentrations of folate, vitamin B12, tHcy and methylmalonic acid (MMA) at 18 and 28 weeks of gestation. These were correlated with offspring anthropometry, body composition (dual-energy X-ray absorptiometry scan) and insulin resistance (homeostatic model assessment of insulin resistance [HOMA-R]) at 6 years.

RESULTS: Two-thirds of mothers had low vitamin B12 (<150 pmol/l), 90% had high MMA (>0.26 micromol/l) and 30% had raised tHcy concentrations (>10 micromol/l); only one had a low erythrocyte folate concentration. Although short and thin (BMI), the 6-year-old children were relatively adipose compared with the UK standards (skinfold thicknesses). Higher maternal erythrocyte folate concentrations at 28 weeks predicted higher offspring adiposity and higher HOMA-R (both p < 0.01). Low maternal vitamin B12 (18 weeks; p = 0.03) predicted higher HOMA-R in the children. The offspring of mothers with a combination of high folate and low vitamin B12 concentrations were the most insulin resistant.

CONCLUSIONS/INTERPRETATION: Low maternal vitamin B12 and high folate status may contribute to the epidemic of adiposity and type 2 diabetes in India.

PMID: 17851649 [PubMed - indexed for MEDLINE] PMCID: PMC2100429 Free PMC Article

Supplemental Content


Association of low intake of milk and vitamin D during pregnancy with decreased birth weight.

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Comment in:

- CMAJ. 2007 May 8;176(10):1460; author reply 1460.

Abstract
BACKGROUND: Some pregnant women may be advised or choose to restrict milk consumption and may not take appropriate supplements. We hypothesized that maternal milk restriction during pregnancy, which can reduce intakes of protein, calcium, riboflavin and vitamin D, might represent a health risk by lowering infant birth weight.

METHODS: We screened women between the ages of 19 and 45 years who were attending prenatal programs in Calgary, Alberta (51 degrees N) for low milk consumption (< or = 250 mL/d). Using repeat dietary recalls, we compared these women and their offspring with women whose daily milk consumption exceeded 250 mL (1 cup). Birth weight, length and head circumference were obtained from birth records.

RESULTS: Women who consumed < or = 250 mL/d of milk (n = 72) gave birth to infants who weighed less than those born to women who consumed more (n = 207; 3410 g v. 3530 g, respectively; p = 0.07). Infant lengths and head circumferences were similar. Women who restricted milk intake had statistically significantly lower intakes of protein and vitamin D as well. In multivariate analyses controlled for previously established predictors of infant birth weight, milk consumption and vitamin D intake were both significant predictors of birth weight. Each additional cup of milk daily was associated with a 41 g increase in birth weight (95% confidence interval [CI] 14.0-75.1 g); each additional microgram of vitamin D, with an 11 g increase (95% CI 1.2-20.7 g). Neither protein, riboflavin nor calcium intake was found to predict birth weight.

INTERPRETATION: Milk and vitamin D intakes during pregnancy are each associated with infant birth weight, independently of other risk factors.

PMID: 16636326 [PubMed - indexed for MEDLINE]PMCID: PMC1435952Free PMC Article

Supplemental Content


Low vitamin a intake affects milk iron level and iron transporters in rat mammary gland and liver.

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Abstract

Marginal vitamin A deficiency is common and can result in a secondary iron (Fe) deficiency. A positive correlation between maternal Fe status and milk Fe was observed in lactating
women supplemented with both vitamin A and Fe but not with Fe alone, suggesting effects of vitamin A on mammary gland Fe transport. We hypothesized that low vitamin A intake during lactation elicits differential effects on mammary gland and liver Fe transport and storage proteins, thus affecting milk Fe concentration but not maternal Fe status. We fed rats a control (CON, 4 RE/g) or a marginal vitamin A diet (AD, 0.4 RE/g) through midlactation. Effects on plasma, milk, liver and mammary gland Fe and vitamin A concentrations, and divalent metal transporter-1 (DMT1), ferroportin (FPN), ferritin (Ft), and transferrin receptor (TfR) expression were determined. Dams fed AD were not vitamin A or Fe deficient. Milk and liver vitamin A and Fe and mammary gland Fe concentrations were lower in rats fed AD compared with rats fed CON. Liver TfR expression was higher, whereas mammary gland TfR expression was lower in rats fed AD compared with rats fed CON. Liver Ft was unaffected, whereas mammary gland Ft was lower in rats fed AD compared with rats fed CON. Liver and mammary gland DMT1 and FPN protein levels were lower in rats fed AD compared with rats fed CON. Our results indicate that the mammary gland and liver respond differently to marginal vitamin A intake during lactation and that milk Fe is significantly decreased due to effects on mammary gland Fe transporters, putting the nursing offspring at risk for Fe deficiency.


**Supplemental Content**


**Micronutrient intake during pregnancy in relation to birth size.**


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**Abstract**

**BACKGROUND:** There exists very little information on possible effects on birth size of micronutrient intakes at levels that are usually encountered among pregnant women in developed countries.

**AIM OF THE STUDY:** To examine the relation of the intake of 20 micronutrients with birth weight, placental weight, birth length and head circumference of the offspring.

**METHODS:** In a cohort of 222 Caucasian women with singleton pregnancies in Boston, USA, diet during pregnancy was ascertained at the 27th gestational week through a validated semi-quantitative food frequency questionnaire, covering also intake of dietary supplements. Micronutrient intakes were correlated with birth size parameters after adjustment for confounding variables, including total energy intake.
RESULTS: Pantothenic acid, sodium and vitamin E were positively associated with all four birth size parameters. For pantothenic acid the association was statistically significant with respect to birth length, whereas for sodium with respect to head circumference and for vitamin E with respect to birth weight. In contrast, zinc was inversely associated with all four birth size parameters and the association was statistically significant with respect to head circumference.

CONCLUSIONS: In a moderately sized prospective study, we found evidence that pregnancy intake of pantothenic acid, vitamin E and sodium may be positively related with at least one of the studied birth size parameters, whereas an inverse association was found with respect to zinc intake. For the remaining 16 micronutrients, our findings indicate that they are not associated with birth size, at least within the range of intake encountered in this investigation. The results of this exploratory analysis need to be confirmed before pathophysiologic interpretations and generalizations are attempted.

PMID: 15309438 [PubMed - indexed for MEDLINE]


Maternal dietary B vitamin intake, other than folate, and the association with orofacial cleft in the offspring.

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Abstract

BACKGROUND: Periconceptional folic acid supplementation is suggested to prevent orofacial clefts (OFCs). Other B vitamins however may be beneficial as well.

AIM OF THE STUDY: To investigate the maternal periconceptional dietary intake of thiamine, riboflavin, niacin, pyridoxine and cobalamin in association with the occurrence of OFC.

METHODS: Two hundred and six mothers of a child with nonsyndromic OFC and 203 control mothers filled out a general questionnaire and a food frequency questionnaire around 14 months postpartum as a proxy for periconceptional intake. After exclusion of known pregnant and lactating mothers, those who reported to have altered their diet compared to the periconceptional period, and mothers with incidental folic acid supplement use
periconceptionally, data of 182 OFC mothers and 173 controls were analysed. After logarithmic transformation, geometric means (P5-P95) were calculated and compared between the groups. After subsequent adjustment for energy, quintiles of dietary B vitamin intake were created.

RESULTS: The periconceptional intake of thiamine, niacin and pyridoxine was significantly lower in mothers of an OFC child. A trend towards risk reduction for OFC with increasing dietary intake was demonstrated for thiamine (p = 0.04) and pyridoxine (p = 0.03). Risk reductions were only demonstrated in women using folic acid supplements periconceptionally. Supplement users tended to consume a diet richer in B vitamins.

CONCLUSIONS: Periconceptional intake of thiamine, niacin and pyridoxine seems to contribute to the prevention of OFC.

PMID: 14991264 [PubMed - indexed for MEDLINE]

**Supplemental Content**


**High multivitamin intake by Wistar rats during pregnancy results in increased food intake and components of the metabolic syndrome in male offspring.**


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**Abstract**

The effect of high multivitamin intake during pregnancy on the metabolic phenotype of rat offspring was investigated. Pregnant Wistar rats (n=10 per group) were fed the AIN-93G diet with the recommended vitamin (RV) content or a 10-fold increase [high vitamin (HV) content]. In experiment 1, male and female offspring were followed for 12 wk after weaning; in experiment 2, only males were followed for 28 wk. Body weight (BW) was measured weekly. Every 4 wk, after an overnight fast, food intake over 1 h was measured 30 min after a gavage of glucose or water. An oral glucose tolerance test was performed every 3-5 wk. Postweaning fasting glucose, insulin, ghrelin, glucagon-like peptide-1, and systolic blood pressure were measured. No difference in BW at birth or litter size was observed. Food intake was greater in males born to HV dams (P<0.05), and at 28 wk after weaning, BW was 8% higher (P<0.05) and fat pad mass was 27% higher (P<0.05). Food intake reduction after the glucose preload was nearly twofold less in males born to HV dams at 12 wk after weaning.
Fasting glucose, insulin, and ghrelin were 11%, 62%, and 41% higher in males from HV dams at 14 wk after weaning (P<0.05). Blood glucose response was 46% higher at 23 wk after weaning (P<0.01), and systolic blood pressure was 16% higher at 28 wk after weaning (P<0.05). In conclusion, high multivitamin intake during pregnancy programmed the male offspring for the development of the components of metabolic syndrome in adulthood, possibly by its effects on central mechanisms of food intake control.

PMID: 18525008 [PubMed - indexed for MEDLINE]

Supplemental Content

Maternal Intake and Offspring: Genistein

Early soy exposure via maternal diet regulates rat mammary epithelial differentiation by paracrine signaling from stromal adipocytes.

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Arkansas Children's Nutrition Center, University of Arkansas for Medical Sciences, Little Rock, AR 72202, USA.

Abstract

Diet-mediated changes in transcriptional programs that promote the early differentiation of the mammary gland may lead to reduced breast cancer risk. The disparity in adult breast cancer incidence between Asian women and Western counterparts is attributed partly to high soy food intake. Here, we conducted genome-wide profiling of mammary tissues of weanling rats exposed to soy protein isolate (SPI) or control casein (CAS) via maternal diet to evaluate the contribution of early exposure on mammary gene expression. Of the identified 18 up- and 39 downregulated genes with SPI relative to CAS, a subset was associated with lipid metabolic pathways, consistent with reduced mammary adipocyte size and suggesting stromal adipocyte-specific genomic changes. Female offspring of rats fed SPI tended to have fewer terminal end buds (P = 0.06) and had significantly lower body weight and abdominal fat mass. To demonstrate the functional consequence of SPI-mediated adipocyte metabolic changes on neighboring mammary epithelium, the expression of in vivo regulated genes in 3T3-L1 adipocytes treated with soy isoflavone genistein and effects of the resultant conditioned medium (CM) on the differentiation of HC11 mammary epithelial cells were evaluated by quantitative RT-PCR and/or Western immunoblots. In differentiated 3T3-L1, genistein decreased fatty acid synthase and stearoyl-CoA desaturase and increased hydroxysteroid 11-beta dehydrogenase 1 expression. CM from genistein-treated adipocytes had higher adiponectin levels and augmented prolactin-induced, glucocorticoid-regulated
beta-casein levels. These findings suggest that soy-associated components, by targeting mammary adipocytes, alter paracrine signaling to enhance mammary epithelial differentiation, with important implications for the prevention of breast cancer associated with obesity and obesity-related diseases.


**Supplemental Content**


**Reproductive safety studies with genistein in rats.**


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**Abstract**

Genistein is a phytoestrogen that occurs naturally in the diet and is found in a wide variety of plant-derived foods especially in soybeans and soy-based foods. There is widespread interest in genistein and related phytoestrogens as chemopreventive agents for a variety of human diseases and cancers based on epidemiologic evidence of reduced cancer rates in populations with a high intake of soy. Soy, and hence its constituents, such as genistein, have been consumed at high levels in several Asian populations for many centuries without any apparent adverse effects and to the contrary, many health benefits have been associated with the ingestion of soy based foods. Concern has been raised, however, of potential adverse effects due to the estrogenic and other activities of the isoflavones and thus a comprehensive series of safety studies was performed with genistein. To assess the teratogenic and fetal toxic potential of genistein, several studies were conducted. Genistein was tested in an in vitro rat whole embryo culture assay (WEC), which is a preliminary screen, for fetotoxic and teratogenic potential, over a concentration range of from 1 to 100 microg/mL. Treatment related anomalies were observed at concentrations of >or= 10 microg and at 100 microg/mL, all embryos were malformed. Two in vivo embryo fetal developmental safety studies were conducted with genistein by oral administration (gavage and dietary admix) in which there was no evidence for a teratogenic effect. In an oral (gavage) embryonic and fetal development pilot study, genistein was administered to rats at dose levels of 0, 20, 150 and 1000 mg/kg/day from days 6-20 of gestation to females that were allowed to litter and rear their offspring up to day 7 of lactation. A slight maternal toxicity at 1000 mg/kg/day was observed as indicated by decreased body weight and food consumption and at this dose, adverse effects in the pups were observed including increased pup mortality, poor general condition, reduced pup body weights, and reduced pup milk uptake. At the high dose of 1000 mg/kg, no external malformations were noted, however some minor visceral and skeletal variations were observed. At the low dose of 20 mg/kg/day, an increased mortality, reduced milk uptake, a
decreased % male sex ratio, and decreased body weights during lactation were observed. Due to lack of effects at the mid dose and the small number of animals, a relationship to treatment was considered unlikely. In an oral (dietary admix) Prenatal developmental safety study, genistein was administered to rats at dose levels of 0, 5, 50, 100 and 500 mg/kg/day from day 5-21 of gestation. At 500 mg/kg, maternal body weight and food consumption were markedly reduced. The incidence of resorptions was markedly increased with a corresponding decrease in the number of live fetuses per dam. Fetal body weights were also reduced. No treatment-related teratogenic effects were noted during external, visceral and skeletal examination of fetuses or in body weight normalized anogenital distance. On the basis of these studies, it is concluded that genistein has no teratogenic potential in vivo at very high doses of up to 1000 mg/kg/day by oral gavage in the embryo-fetal toxicity pilot study or up to 500 mg/kg/day by dietary admix in the Prenatal developmental study even though these doses were maternally toxic and fetal-toxic. In vitro, genistein had teratogenic potential at high concentrations in the WEC screening assay, however this was not predictive of the in vivo findings. On the basis of the definitive Prenatal development study, the NOAEL for maternal toxicity and adverse effects on embryonic development was considered to be 100 mg/kg/day when administered orally by dietary admix.

PMID: 17433519 [PubMed - indexed for MEDLINE]

Supplemental Content

Maternal Intake and Offspring: Amino Acids and Minerals


Folic acid supplementation during the juvenile-pubertal period in rats modifies the phenotype and epigenotype induced by prenatal nutrition.

Burdge GC, Lillycrop KA, Phillips ES, Slater-Jefferies JL, Jackson AA, Hanson MA.

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Abstract

Prenatal nutritional constraint is associated with increased risk of metabolic dysregulation in adulthood contingent on adult diet. In rats, folic acid supplementation of a protein-restricted (PR) diet during pregnancy prevents altered phenotype and epigenotype in the offspring induced by the PR diet. We hypothesized that increasing folic acid intake during the juvenile-pubertal (JP) period would reverse the effects of a maternal PR diet on the offspring. Rats were fed a control (C) or PR diet during pregnancy and AIN93G during lactation. Offspring
were weaned on d 28 onto diets containing 1 mg [adequate folate (AF)] or 5 mg [folic acid-supplemented (FS)] folic acid/kg feed. After 28 d, all offspring were fed a high-fat (18% wt:wt) diet and killed on d 84. As expected, offspring of PR dams fed the AF diet had increased fasting plasma triglyceride (TAG) and beta-hydroxybutyrate (betaHB) concentrations. The FS diet induced increased weight gain, a lower plasma betaHB concentration, and increased hepatic and plasma TAG concentration compared with AF offspring irrespective of maternal diet. PPARalpha and glucocorticoid receptor promoter methylation increased in liver and insulin receptor promoter methylation decreased in liver and adipose tissue in FS compared with AF offspring, with reciprocal changes in mRNA expression irrespective of maternal diet. These findings show that increased folic acid intake during the JP period did not simply reverse the phenotype induced by the maternal diet. This may represent a period of plasticity when specific nutrient intakes may alter the phenotype of the offspring through epigenetic changes in specific genes.


**Supplemental Content**

**Zinc intake during pregnancy increases the proliferation at ventricular zone of the newborn brain.**

Azman MS, Wan Saudi WS, Ilhami M, Mutalib MS, Rahman MT.

Department of Biomedical Science, Faculty of Science, International Islamic University Malaysia (IIUM), Kuantan, Malaysia.

Abstract

Neurogenesis involves cell proliferation, cell cycle arrest, differentiation, migration and the natural developmental death of the neural precursors. These processes are highly co-ordinated and governed by cell-cycle genes and neural transcription factors. Zn plays a crucial role as a functional and structural component of enzymes and transcription factors and components of the intracellular signaling pathway associated with the regulation of cell proliferation. The influence of additional Zn intake during pregnancy on the neuronal proliferation at ventricular zone of the developing fetus has been studied. Pups delivered by the group of mice provided with drinking water with 4.0 mM Zn supplement throughout pregnancy contained an increased number of proliferating neurons in the ventricular zone at P0 compared to those delivered by the mice provided with drinking water without any Zn supplement. This finding provides direct evidence to support the notion that maternal Zn levels influence the development of the nervous system of the offspring.

PMID: 19178786 [PubMed - indexed for MEDLINE]
Importance of methyl donors during reproduction.

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Abstract

Evidence is growing that optimal dietary intake of folate and choline (both involved in one-carbon transfer or methylation) is important for successful completion of fetal development. Significant portions of the population are eating diets low in one or both of these nutrients. Folates are important for normal neural tube closure in early gestation, and the efficacy of diet fortification with folic acid in reducing the incidence of neural tube defects is a major success story for public health nutrition. Similarly, maternal dietary choline is important for normal neural tube closure in the fetus and, later in gestation, for neurogenesis in the fetal hippocampus, with effects on memory that persist in adult offspring; higher choline intake is associated with enhanced memory performance. Although both folates and choline have many potentially independent mechanisms whereby they could influence fetal development, these 2 nutrients also have a common mechanism for action: altered methylation and related epigenetic effects on gene expression.

PMID: 19116320 [PubMed - indexed for MEDLINE]PMCID: PMC2628952Free PMC Article

Maternal calcium intake during pregnancy and blood pressure in the offspring at age 3 years: a follow-up analysis of the Project Viva cohort.
Abstract

A previous analysis of the Project Viva cohort (eastern Massachusetts, 1999-2002 recruitment) found an association between higher second-trimester supplemental maternal calcium intake and lower systolic blood pressure in offspring at 6 months. The authors analyzed 5,527 systolic blood pressure measurements from 1,173 mother-child pairs from this same cohort when the children were aged 3 years. They estimated the change in offspring blood pressure for a 500-mg difference in maternal total, dietary-only, and supplemental-only calcium intake during the first 2 trimesters of pregnancy. Mean daily total calcium intake was 1,311 mg (standard deviation, 421) in the first trimester and 1,440 mg (standard deviation, 386) in the second trimester. Mean systolic blood pressure of the offspring at age 3 years was 92.1 mm Hg (standard deviation, 10.3). None of the maternal calcium intake measures during the first and second trimesters was associated with systolic blood pressure in the offspring. For example, for each 500-mg increment in maternal total elemental calcium intake in the second trimester, child's 3-year systolic blood pressure was 0.1 mm Hg lower (95% confidence interval: -0.9, 0.6). Maternal calcium intake during pregnancy was not associated with offspring blood pressure at the age of 3 years.

PMID: 18945693 [PubMed - indexed for MEDLINE] PMCID: PMC2727186 Free PMC Article

Supplemental Content


Effect of maternal calcium intake during pregnancy on children's blood pressure: a systematic review of the literature.

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Abstract

BACKGROUND: Calcium supplementation during pregnancy has been shown to reduce the incidence of hypertension in the mother, but the effects on the offspring are uncertain. Assessing the impact on the offspring is very important given the now large body of evidence
indicating that blood pressure levels in childhood and young adulthood can be influenced by factors operating during fetal life. We conducted a systematic review of the literature to summarize the evidence supporting an association between maternal dietary calcium intake during pregnancy and blood pressure in the offspring.

METHODS: A systematic review was performed to identify randomized, quasi-randomized and cohort studies reporting the relationship between offspring blood pressure or incidence of hypertension and levels of maternal dietary calcium intake during pregnancy, either from supplements (i.e. pills) or food. MEDLINE, EMBASE and the Cochrane Library Registry were searched for relevant trials.

RESULTS: Two randomized trial and three observational studies were identified and included in this review. In 4 of the 5 studies, loss to follow-up was a serious concern. There was heterogeneity between the studies, particularly those conducted on children below 12 month of age. Results were more consistent among the studies including older children (1 to 9 years) where a higher maternal calcium intake was associated with a reduction of -1.92 mm Hg (95% CI -3.14 to -0.71) in offspring systolic blood pressure. One large randomized trial found a clinically and statistically significant reduction in the incidence of hypertension in 7-year-old children (RR = 0.59, 95% CI 0.39 to 0.90).

CONCLUSION: There is evidence in the literature to support an association between maternal calcium intake during pregnancy and offspring blood pressure. However, more research is needed to confirm these findings given the small sample sizes and the methodological problems in many of the studies conducted so far. More studies on populations with calcium deficit are also needed. If confirmed, these findings could have important public health implications. Calcium supplementation during pregnancy is simple and inexpensive and may be a way to reduce the risk of hypertension and its sequels in the next generation.

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**Supplemental Content**


**Periconceptional dietary intake of choline and betaine and neural tube defects in offspring.**

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Periconceptional intake of folic acid prevents some neural tube defects (NTDs). Other nutrients may also contribute to NTD etiologies; a likely candidate is choline. Similar to folic acid, choline is involved in one-carbon metabolism for methylation of homocysteine to methionine. The authors investigated whether maternal periconceptional dietary intakes of choline and its metabolite betaine influence NTD risk. Data were derived from a case-control study of fetuses and infants with NTDs among 1989-1991 California births. In-person interviews were conducted with mothers of 424 NTD cases and with mothers of 440 nonmalformed controls. A standard 100-item food frequency questionnaire was used to assess nutrient intake. Dietary intakes of choline were associated with reduced NTD risks. Controlling for intake of supplemental folic acid, dietary folate, dietary methionine, and other covariates did not substantially influence risk estimates for choline. NTD risk estimates were lowest for women whose diets were rich in choline, betaine, and methionine. That is, for women whose intake was above the 75th percentile compared with below the 25th percentile for all three nutrients, the odds ratio was 0.17 (95% confidence interval: 0.04, 0.76). Study findings for dietary components other than folic acid offer additional clues about the complex etiologies of NTDs.


**Supplemental Content**


**Low maternal dietary intakes of iron, magnesium, and niacin are associated with spina bifida in the offspring.**

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**Abstract**

Evidence about the preventive effects of nutrients other than folate on the occurrence of spina bifida is scarce. Therefore, the aim of this work was to investigate the role of maternal nutritional intake and the risk of spina bifida in the offspring. In 106 cases and 181 controls, the mothers' nutrient intakes were obtained by an FFQ approximately 24 mo after conception of the index pregnancy. Energy-adjusted mean nutrient intakes were compared, and odds ratios (OR) and 95% CI were calculated. Although mean nutrient intakes were comparable to the Dutch food consumption survey data, fat, cholesterol, iron, and folate intakes were below the 1998 Dutch Recommended Daily Allowances. Case mothers had significantly lower intakes of plant proteins (7%), polysaccharides (4%), fiber (7%), iron (6%), magnesium (6%),
and niacin (4%) than control mothers. Mono- and disaccharide intakes were significantly higher (6%) in the case mothers than in control mothers. The adjusted OR (95% CI) in the lowest quartiles for plant proteins was 5.4 (2.3-12.4), for fiber 3.1 (1.5-6.8), for iron 3.5 (1.4-8.3), for magnesium 1.9 (0.9-4.1), and for niacin 2.5 (1.2-5.2). Mono- and disaccharide and polysaccharide intakes in the highest quartile had ORs (95% CI) of 2.9 (1.4-6.3) and 0.5 (0.3-1.0), respectively. The nutritional intake of Dutch women from food groups containing iron and folate seems to be compromised. Low preconceptional intakes of plant proteins, iron, magnesium, and niacin are associated with a 2- to 5-fold increased risk of spina bifida.

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