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Trip Report

**Experimental Biology 1998 Meeting
(FASEB)**

San Francisco, California

April 19-22, 1998

Sandra L. Huffman, Sc D

**Academy for Educational Development
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Breastfeeding and Related Complementary Feeding and Maternal Nutrition**

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List of Acronyms

ESSADI	Estimated safe average daily intake
FASEB	Federated Association of Societies of Experimental Biology
HPLC	High performance lipid chromatography
IIN	Instituto de Investigacion Nutricional
INN	Instituto Nacional de Nutricion, Mexico
JHU	Johns Hopkins University
LBW	Low Birth Weight
MI	Micronutrient Initiative
OMNI	Opportunities for Micronutrient Interventions
UC Davis	University of California at Davis
UNC	University of North Carolina
USDA	United States Department of Agriculture



BACKGROUND

The Experimental Biology meetings (formerly called FASEB) are held annually to provide a forum for scientists to present preliminary analyses of research that has not yet been published. It is also an opportunity to meet with colleagues and learn about on-going research. Abstracts are published for the papers presented at the meeting (those discussed below are provided in Annex 1). At times the results published in the abstracts were revised during the presentations. Note that there are only a few research studies related to breastfeeding, this is because there are few sources of funding for applied research in breastfeeding, which is costly because of the time, staff, and techniques needed to measure breastmilk output.

OUTCOMES

Research on breastfeeding

Grace Marquis (University of Alabama—Abstract 3132) studied the differences in colostrum of women who breastfed during pregnancy. Forty women were selected from obstetric patients in a Lima hospital and 10% were found to have breastfed during pregnancy. These mothers had similar maternal and obstetric characteristics of the other mothers, but were of slightly higher socioeconomic status. Of the 19 mothers who provided samples of colostrum, those (n=4) who had breastfed during pregnancy had lower levels of fat in their colostrum compared to those who had weaned before pregnancy.

Research on complementary feeding

Feasibility of increasing animal products in Guatemalan children's diets

H. Pachon (Emory—Abstract 1992) presented results of a longitudinal study of 302 Guatemalan children's (ages 0–24 months) dietary intakes based on weekly food recalls. Forty percent of children 6–11 months of age had received some animal products, but by 24 months, 20% had still not consumed any animal products other than breastmilk.

By 12 and 24 months of age, 45% and 74% had consumed eggs, and 30% and 62% had consumed beef. No differences in the proportion consuming animal products was observed by whether or not the mother was illiterate.

The authors suggest that encouraging the use of animal products among 6–12 month old children would be feasible in terms of availability.

Vitamin A status among infants fed different complementary foods (Ghana)

Anna Lartey (UC Davis—Abstract 3766) presented data illustrating the impact of providing four different types of local complementary foods on the vitamin A status of 216 Ghanaian breastfed infants 6–12 months of age. Children were divided randomly into four comparison groups, each group receiving one of the following: Koko (a local maize porridge) fortified with fish powder, weani-mix (a cereal-legume blend), fortified weani-mix, and weani-mix with fish powder. Children also consumed other foods provided by their families. Serum retinol was measured at 6 and 12 months of age.



Project foods provided between 55–99% of the non-breastmilk vitamin A intake. Breastfeeding episodes did not differ in the four groups. Plasma retinol increased in the fortified wean-mix group but decreased in all three other groups.

This study suggests that even fortifying an appropriate complementary food with fish powder is not enough to improve vitamin A status in breastfed Ghanaian infants. It provides additional support for the need for fortified complementary foods in vitamin A deficient areas.

Complementary foods and micronutrient status of low birth weight infants (4–6 mo)

Kay Dewey (UC Davis—Abstract 3767) reported on the results of a Honduran study of 119 low birth weight (LBW) infants (1500–2500 grams) who were randomly assigned to receive complementary foods between 4 and 6 months of age or to continue to be exclusively breastfed. More than 50% of all infants had low iron status at two months of age. Among iron deficient (hemoglobin < 100g/l) infants given iron drops, those exclusively breastfed had higher hemoglobin at 6 months (controlling for hemoglobin at 4 months) than those receiving supplemental foods. This is because the supplemental foods interfered with iron absorption from the iron drops.

Since provision of supplemental foods did not affect infant growth even in these LBW infants over those exclusively breastfed, these results suggest that LBW infants should continue to be exclusively breastfed, but all should be given iron drops since a high proportion are iron deficient.

Effect of increasing energy density and changing porridge thickness on caloric intake in Peru

V Bennett (UC Davis—Abstract 1256) reported on the effect of varying the thickness (viscosity) of complementary foods or varying the energy density on total caloric intakes in Peruvian children 8–17 months of age. Three diets were used over four consecutive days, with the child serving as its own control: (1) high caloric density and thick (high viscosity [HV]), (2) high density and low viscosity (LV), or (3) low caloric density and low viscosity. High density diets contained 1–1.2 kcal/gm and low density diets contained .6 kcal/gm. Outcome measures were total caloric intake and duration of meals.

Energy intake was highest in the high caloric density-HV diet compared to the other two diets. However, energy intakes were similar in the other two groups. Consumption time was similar in the two LV groups. Thus, promotion of diets that are high in energy density but thinner (such as with the use of amylase powder) can lead to increases in energy intake without causing increases in time for feeding. However, using a thick high density food will not be likely to enhance caloric intake over a thin, low density food.

Effect of energy density and changing porridge thickness on caloric intake in Guatemala

Dirk Schroeder (Emory—Abstract 4915) conducted a similar study in Guatemala as that described above, and also measured breastmilk intake. Children 6–14 months of age who received porridges with either high or low density or viscosity had reduced breastmilk energy intake (11%–17% reduction). The effect on total caloric intake was not reported.



Research on micronutrient supplements

Vitamin A supplementation of postpartum women in Bangladesh

Amry Rice (JHU—Abstract 3765) reported on a randomized controlled trial of postpartum Bangladesh women to assess the impact of providing 200,000 IU of retinol at 1–3 weeks postpartum compared to 1300 RE of betacarotene given daily. Pills were delivered weekly and compliance was 98% at three months, 96% at six months and 92% at nine months.

While maternal stores improved quicker in the vitamin A group, they fell after 6 and 9 months, while the betacarotene group had increased liver stores by 9 months.

Serum levels (measured by HPLC) were not different in the three groups of mothers. However at nine months postpartum, 50% of women produced breastmilk with low vitamin A, even among those who received daily betacarotene. Deficiency rates (< 20 g/l) in infants were quite high at 6 months (26%-retinol, 39%-betacarotene, and 35%-placebo). The proportion of infants with marginal liver stores was 83%, 86%, and 94% respectively.

These studies showed that both high dose vitamin A and daily betacarotene were inadequate in overcoming poor vitamin A status in these Bangladeshi mothers. Giving daily betacarotene to mothers for nine months postpartum may not help improve vitamin A status of mothers because most is passed through to the breastmilk. The implications of this study are that it is necessary to improve vitamin A status before lactation and preferably before pregnancy in order to build up the mother's stores in deficient populations.

Maternal iron status influences iron transfer to the fetus in Peru

Kim O'Brian (JHU—Abstract 4900) presented data from a randomized controlled trial in Peru that gave 1295 pregnant women (10–24 weeks) throughout gestation a supplement containing either 60 mg of iron (ferrous sulfate), 15 mg of zinc sulfate or both. Thirty-seven women were included in an isotope study of maternal iron, cord iron, and infants. The iron transfer to their infants was significantly influenced by the mother's iron status in the third trimester.

At the FASEB meeting last year, Laura Caulfield presented data on the effect of the zinc in the tablets on maternal and infant zinc status. Mothers receiving the supplement containing zinc had higher serum concentrations of zinc and higher urinary zinc than the other two groups, and their infants had higher cord zinc. Because maternal and neonatal zinc concentrations remained lower than values reported from well-nourished populations, the authors suggest that 15 mg of zinc in a supplement also containing iron may be insufficient for populations with low zinc status. They suggest the addition of at least 25 mg of zinc.

Daily multiple micronutrient supplementation of school children

D. Ash and Michael Latham (Cornell—Abstract 3768–69) reported on a randomized, double-masked trial of a multiple micronutrient fortified beverage provided to school children in Tanzania. The supplement was distributed in a sachet containing flavoring which was added to 200 ml of water by the teachers in the school, and was given to each child attending on the school day over a six month period.



The serving provided between 30–120% of the RDA for several nutrients (vitamin A-35%, vitamin C-120%, folic acid-35%, riboflavin-35%, niacin-35%, iron [ferrous glutamate]-30%, zinc-35%, iodine-30%)

While rates of anemia and low serum ferritin were similar at baseline (six months), the prevalence of low serum ferritin (< 20 mg/dl) was 11.3% in the fortified group and 19.7% in the unfortified group. The increment in height was significantly greater in the fortified group (3.4 cm vs 2.7 cm) compared to the unfortified group.

The investigators are now planning a similar trial among pregnant women.

Zinc and micronutrient supplements for children in China

An estimated 30% of Chinese children are zinc deficient. James Penland (USDA) reported on a 10-week supplementation study of children 6–9 years old from three poor regions of China to assess the benefits of zinc supplementation on cognitive and psychomotor function of rural Chinese children. Children were randomly assigned to receive a daily supplement for six days a week containing zinc alone (20 mg zinc sulfate), zinc plus micronutrients (50% of RDA or ESSADI [estimated safe average daily intake] for most vitamins and iron, folic acid at 25% of the RDA), or micronutrients alone.

Those who received zinc (with or without micronutrients) showed greater improvement in measures of attention, perception, and reasoning. Micronutrients with zinc resulted in greater improvement in psychomotor measures than zinc or micronutrients alone. These results will be compared to a similar study now being conducted among urban Chinese children.

Effects of zinc and iron intake on vitamin A status in Mexican children

E. Muñoz (INN—Abstract 3771) presented data for a study of 219 children ages 18–36 months of age in a rural community near Mexico City. At baseline, 73% of the children were anemic, 25% had low plasma zinc and 29% had low plasma retinol. Eighty-two percent of the children were deficient in at least two of these nutrients.

Children were randomly assigned to receive a beverage (for 5 days a week) containing zinc (20 mg zinc methionine), iron (20 mg of iron sulfate), zinc and iron, or a placebo.

After 12 months, both zinc and iron (alone or together) supplementation led to increases in plasma retinol. For vitamin A deficient children, the positive effect of zinc was greater than for non-vitamin A deficient children. For zinc deficient children, giving zinc was more effective in improving plasma retinol than giving only iron.

Effects of multiple micronutrient supplements in Mexican children

Jose Rosado (no abstract) reported on a randomized double-masked study among 318 rural Mexican children ages 5–17 months of age. Children in the intervention group received a beverage containing the RDA for vitamins D, E & K, thiamin, niacin, folic acid, biotin, I, Cu and Mn, 1.2 the RDA for vitamin A, and 1.5 the RDA for vitamin C, riboflavin, B₁₂, iron and zinc, and control children received a beverage with a similar taste that did not contain any micronutrients.



After 12 months, growth had increased in the intervention group by 9 cm over the control. The effect was greatest among the children in the lowest socioeconomic group within the study.

Now the Mexican government has developed a program to provide children in very low socioeconomic groups under age two with a fortified beverage also containing a whole dry milk (and maltodextrin and sugar)-based supplement containing micronutrients plus 250 kcal and 12 grams of protein. This supplement contains 15 mg zinc, 15 mg of iron, 100 ug iodine, 10 IU of vitamin E, 70 mg of vitamin C, and folic acid, and B₁₂. (It does not contain B₆.) This supplement is called NUTRISANO and is delivered in a foil wrapped packet.

The government is also providing a similar supplement to pregnant and lactating women, called NUTRIVIDA.

Research on improving micronutrient intake with improved diets

Increasing vitamin C intake to improve iron status in Mexico

Lindsey Allen (UC Davis—Abstract 3762) presented the results of an OMNI Research-funded project that attempted to improve iron status through increasing vitamin C consumption along with the typical Mexican diet of tortillas and beans. Thirty-six women were randomized to receive *agua de limon* (lemonade) containing 25 mg of ascorbic acid or lime flavored placebo drink twice a day with meals, for six days a week for eight months.

Women were selected who were iron deficient (serum ferritin less than <12 ug/L) but not anemic. There was no improvement in hemoglobin and the effect on serum ferritin was inconsistent (no effect at 2 and 8 months, and improvements at 4 and 6 months) controlling for initial serum ferritin.

This study is quite important since it is contrary to the current recommendation to increase vitamin C intake with meals. There is as yet no evidence that this will improve iron status in a field setting.

Increased dietary variety among children and improved school achievement

Michelle Mendez (UNC—Abstract 1250) used a cohort of children ages 10–12 years old in the Cebu (Philippines) Longitudinal study to assess the impact of increased energy and dietary diversity on achievement tests in school. Children in the lowest caloric intake group showed consistent increases in test scores as dietary diversity increased, while there was no effect seen among children receiving the highest caloric intakes.

These results suggest that improving micronutrient status of children with low caloric intakes is especially important. Those who consume larger amounts of calories are also those more likely to have increased dietary diversity.

RECOMMENDATIONS & FOLLOW-UP

1. These notes will be sent out to colleagues via e-mail.
2. Luann Martin will include them as an attachment to reports sent to collaborating agencies and to field staff of LINKAGES.



ANNEX

Copies of Abstracts Cited

Abstract

Few studies to date have investigated the effects of usual diet on children's school achievement. Energy and nutrient deficiencies may impair achievement by adversely affecting brain function, attention and motivation, and school attendance. Using data from a cohort of more than 2,000 Filipino children aged 10-12y from the Cebu Longitudinal Health and Nutritional Study we assessed the relationship between variety in the usual diet, energy intakes and scores on Math and English achievement tests. Reports of foods children typically consumed at each meal were used to construct a dietary variety score based on representation of 7 food types [meats/fish, staples (primarily rice/corn), other starches, vegetables & fruits, beans & nuts, beverages, and sweets/salty snacks]. Energy intakes were estimated from 24 h recall data. Children were given a snack before test administration to reduce variability associated with acute dietary effects. In linear regression models, associations with variety but not energy intakes were significant after controlling for schooling, nutritional status, and socioeconomic status indicators. In addition, there was a significant energy/variety interaction; this interaction term was negative, indicating that children at lower energy intakes benefitted more strongly from greater variety. In models including the interaction term, both energy and variety had strong positive associations with test scores. Increasing energy intakes combined with improved dietary variety may help to improve school achievement.

Dietary variety and energy intakes are associated with Filipino children's school achievement

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Michelle A Mendez

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Introduction

Deficiencies of energy and key nutrients (notably iron and vitamin A) may affect children's intellectual abilities through a number of mechanisms, including suboptimal brain function because of reduced nutrient availability for key enzymes and neurotransmitters, poor attention, concentration and motivation to learn, and lower resistance to disease, which may in turn affect school attendance and thus achievement. The objective of this project was to assess whether greater variety in the usual diet—thought to reduce risk of nutrient deficiencies—was positively associated with school achievement in 11 year old Filipino children. A more specific goal was to assess whether the association between greater variety and achievement was especially strong among children with low-energy diets who may be more susceptible to adverse effects from nutrient deficiencies.

The hypotheses postulated were (i) high variety in children's usual diet would be positively associated with school achievement, independent of energy intakes, level of schooling and socioeconomic status (SES) (ii) low energy intakes would be negatively associated with school achievement, independent of dietary variety, schooling and SES and (iii) the positive association between school achievement and dietary variety would be greatest among children with low energy intakes.

Data and Methods

Data came from the 1994-95 round of the Cebu Longitudinal Health & Nutrition Study a follow-up study of a 1 year birth cohort from an and around metropolitan Cebu in the Philippines. The mean age of children was 11 years. English and Math achievement tests were administered to participants (N=2207) by the survey team. Usual dietary intakes were estimated based on mother's responses to a non-quantitative meal based questionnaire which asked about types of foods usually given to the child at each meal or snack. A single 24 hour recall of the child's diet on the previous day was used to estimate energy intakes based on Philippine official food consumption tables.

A dietary variety score was developed based on the number of the following food types included in child's usual diet:

- (1) meats or fish
- (2) staples (rice/corn)
- (3) other starches (roots/tubers)
- (4) vegetables and fruits
- (5) beans, nuts
- (6) beverages
- (7) sweet/salty snacks

One point was assigned for each food type reported for any meal or snack. Usual consumption patterns among children at each level of variety are shown in Table 1.

Table 1 Types of foods usually eaten by children in each food variety score group

	N number (food types (variety score))						
	2	3	4	5	6	7	
# children	23	234	645	990	356	50	
Number (%) usually eating each type of food (at any meal)							
Meats	5 24%	35% 210 48%	74 53%	56%	25 50%		
Fish	17 81%	219 94%	588 91%	796 88%	329 92%	47 94%	
Beans & nuts	0%	5 2%	69 11%	239 25%	3 56%	50 100%	
Rice/corn	21 100%	23 100%	645 100%	990 100%	356 100%	5 100%	
Bread/roll	0%	140 60%	83 75%	760 74%	309 87%	45 90%	
Noodles/past	0%	33 15%	135 21%	255 28%	354 100%	13 26%	
Roots/tubers	0%	2 9%	122 19%	208 23%	87 24%	1 2%	
Fruits	0%	3 1%	1 3%	50 6%	21 6%	8 16%	
Vegetables	0%	52 22%	248 38%	1 68%	5 100%	46 92%	
Biscuits/snack	0%	42 18%	121 19%	1 20%	83 24%	12 24%	
Milk/milk products	0%	1 0%	37 6%	1 3 11%	53 15%	13 26%	
Sweets/snack	0 0%	3 1%	27%	65 45%	158 44%	42 84%	
Salt/snack	0 0%	3 6%	90 14%	1 19%	32 37%	18 36%	

The food types listed are not mutually exclusive across variety score groups.

Data and Methods (continued)

Although mean energy intakes were higher among children with greater dietary variety as well as among children with higher SES, a number of analyses indicated that variety was not a surrogate for either SES or energy intakes (see, for example, Table 2).

Table 2 Spearman correlations for dietary & SES variables

Variable	Variety score	Energy intake quartile
Energy intake quartile	0.15	—
Variety score	—	0.15
Maternal education level	0.14	0.38
Log household income	0.10	0.32

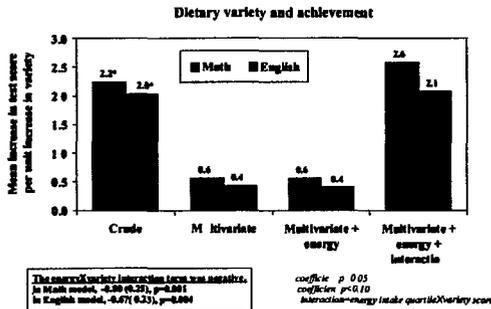
Linear regression was used to analyze the relationship between dietary variables and achievement test scores. Results are shown for a series of nested models: (i) crude (ii) multivariate-adjusted, (iii) multivariate models adjusted for both variety and energy and (iv) multivariate models which include both dietary variables and the energy/variety interaction term (see below).

$$\text{Test score} = \alpha + \beta(\text{variety score}) + \gamma(\text{energy intakes}) + \delta(\text{variety} \times \text{energy}) + \epsilon$$

Covariates included in multivariate models were highest grade level achieved to date, sex of child, mother's & father's education (years), log of household income (pesos), height-for-age z score, weight for height z score, total household assets score, environmental sanitation score, reading materials in home.

Results

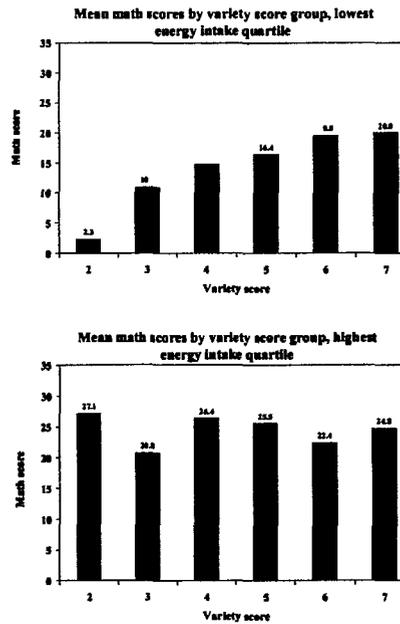
Fig 1 Mean test scores increased linearly with dietary variety, especially among children with low energy intakes.



Results (continued)

Supplementary analysis (i) Variable coding: For simplicity results are shown using a single ordinal variable to represent variety score. Models substituting dummy variables yielded similar results. Results for energy were also similar when modeled continuously or using dummy variables to represent intake quartiles. (ii) Influential groups: Supplementary models were run excluding the highest and lowest variety groups simultaneously and each variety group individually. These exclusions did not substantively change results. (iii) Community variability: To assess the potential confounding effect of differences in the quality of schooling across communities, analyses were repeated after adjusting for possibility of clustering within communities. Results were only slightly attenuated, and remained substantively the same.

Fig 2 Variety was associated with consistent increases in test scores among children with low energy intakes.



Results (continued)

Fig 3 The association between energy intakes & achievement test scores was weak after adjusting for SES but strong & significant after including the interaction with dietary variety.

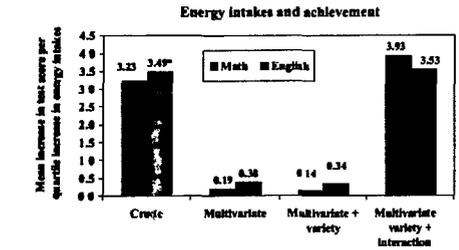
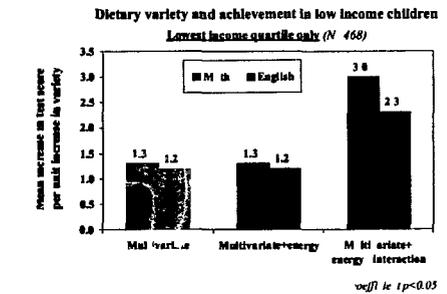


Fig 4 The "energy x dietary variety" interaction was significant even among very low income children.



Conclusions

Both greater variety in the usual diet and higher energy intakes were positively associated with school performance in 11 year-old Filipino children.

Greater dietary variety was most strongly associated with achievement among children with low energy intakes. The interaction between variety and energy intakes was significant even among low income children.

More research is needed to identify specific food components associated with greater dietary variety which appear to be most crucial for school performance in Filipino children. Further study is also necessary to determine whether the association between variety in the usual diet and achievement is causal and whether the association reflects cumulative (i.e. long term) effects, short term effects, or both.



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A PILOT STUDY OF INFANT FEEDING PRACTICES IN AL AIN UAE
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 University Al Ain UAE

Fifty five mothers from Al Ain United Arab Emirates (UAE) were interviewed to assess feeding practices of infants aged 0-12 months. Mothers were interviewed while waiting in children clinics at Twam hospital or at work places. Thirty five mothers (64%) were UAE citizen while the rest were of other Arab nationalities. A semi structured questionnaire was used to collect the data. Infants were reported exclusively breastfed for 4 months. First food reported to be offered was cereal (34%), milk formulas (21.5%), fruits (7%), yogurt (11%), vegetables (4.5%), water and sugar (4.5%). Reasons for introducing complementary food were to provide more nutrients for normal body growth (30%) being recommended by doctors or family (16%), training and teaching the infant (16%), mothers illness or insufficient milk (17%), child's illness (14%) and mothers work (8%). 49% of mothers believed that milk is the most nutritious infant food. 26% mentioned juices and 10% considered any kind of food as nutritious. 56% of mothers did not like feeding their infants sweets from fear of tooth decay or soft drinks (51%) and chips (69%) because they considered them non-nutritious. However, seven up was reported as helpful for treatment of diarrhea (22%) and home made potato chips as good food. Weaning before 2 month of age was reported by 25% of mothers due to insufficient milk (45%), mothers work (31%), mothers illness (9%) and refusal (8%) child illness (6%). Thus in this population cultural trend of 12-24 months of breastfeeding has been changed. Early introduction of food and early weaning (before 2 months) are commonly reported. More attention is needed to clarify the social and medical factors contributing to these changes and to promote breastfeeding in UAE.

1257

Associations between traditional food use, diet quality and anthropometry among adults in Yukon First Nations (Canada)
 O. Receveur and H. V. Kuhnlein, Centre for Indigenous Peoples Nutrition and Environment and School of Dietetics and Human Nutrition, McGill University, Ste Anne de Bellevue, PQ, H9X 3V9

Dietary records (24 hr recalls and food frequency questionnaires) were completed by adult Yukon Indigenous people in March-April (n=33) and October-November (n=129) 1999. Anthropometric data were collected in a subsample of 204 participants. Traditional food (food harvested from the local environment) was consumed on 5% of interview days and was associated with improved diet quality as measured by percent of energy derived from fat, saturated fat and sucrose. Prevalence of overweight (BMI > 2) was lower among men than women and increased with age. In the 20-40 age group, 22% of men and 27% of women were classified as overweight compared to 30% and 49% of men and women respectively in the 40-60 age group. The high prevalence of overweight in middle age women is of particular concern and appeared independent of total traditional food use as measured by daily intake (wet weight in g) weekly frequency of consumption of specific traditional food items or percent of energy derived from traditional food. (Supported by the Arctic Environmental Strategy, Canada)

1259

NUTRIENT INTAKES OF LACTO-VEGETARIAN, LACTO-OVO-VEGETARIANS AND OMNIVOROUS ASIAN INDIANS LIVING IN U.S.
 I. Sawhney and C.F. Tam, California State University at Los Angeles, CA 90032

The objective was to compare the macronutrient and micronutrient intake of lacto-vegetarian, lacto-ovo-vegetarian and omnivorous diets of 65 Asian Indians residing in U.S. A self designed questionnaire collected anthropometrics, social background and three day dietary intake. Mean age of subjects=29.7 years, mean BMI=23.46 kg/m² and mean length of stay in U.S.=5.6 years. Subjects diets averaged 65% energy from carbohydrates, 15% from protein and 20% energy from fat. Men consumed significantly higher levels of kilocalories, iron, sodium, chromium, phosphorus and cholesterol at P<0.05, P<0.041, P<0.037, P<0.018, P<0.010 and P<0.005 respectively. Women consumed significantly higher levels of calcium (P<0.005). Chromium consumption was more in lacto-ovo-vegetarians than omnivores at P<0.005. Lacto-vegetarians consumed less copper than lacto-ovo-vegetarians at P<0.04. Lacto-vegetarians consumed more sodium than lacto-ovo-vegetarians and omnivores at P<0.001 and P=0.000 respectively. Omnivorous consumed more iron than lacto-vegetarians at P<0.035. The dietary pattern could affect the micronutrient consumption in different groups whereas the higher energy consumption in men may contribute to the differences in consumption of micronutrients.

1256

THE EFFECT OF DIETARY VISCOSITY AND ENERGY DENSITY ON TOTAL DAILY ENERGY CONSUMPTION BY YOUNG CHILDREN RECOVERING FROM MALNUTRITION OR INFECTION
 V.A. Bennett, E. Morales, J. Gonzalez, G. Lopez de Romaña, J.M. Peerson, K.H. Brown, Prog in International Nutrition, UC Davis, CA 95616, Instituto de Investigación Nutricional, Lima, Peru, Hospital del Niño, Lima, Peru

To determine the effect of dietary viscosity and energy density on total daily energy consumption by non breast fed children 8-17 mo of age, we measured the amount of food consumed and the duration of meals during three different sub-studies. In each sub-study three dietary treatments were provided: high energy density/high viscosity (HD/HV), high energy density/low viscosity (HD/LV) and low energy density/low viscosity (LD/LV). In the different sub-studies the viscosity and energy density of the HD/HV diet were altered slightly to determine whether the impact of viscosity reduction varied in relation to the consistency of the HD/HV comparison diet. During all sub-studies each of the study diets was offered for four consecutive days in random sequence. Viscosity of the HV diets ranged from 79,000 to 568,000 mPa in the three sub-studies and energy density of the HD diets ranged from 1.0 to 2.2 kcal/g. The viscosity of the LV diets was 3,000 mPa and the energy density of the LD diets was 0.6 kcal/g. In each sub-study the mean amount consumed (g/kg BW/d) of the LD/LV diet was significantly greater than both the HD/HV and the HD/LV diets (P<0.0001) and the amount consumed of the HD/LV was significantly greater than the HD/HV diet (P<0.0001). Energy consumption (kcal/kg BW/d) with the HD/LV diet was significantly greater than the other two diets (P<0.0001) but the energy intakes from the HD/HV and LD/LV diets were similar. In the sub study that included the highest viscosity HD/HV diet, but not in the other sub studies it took significantly less time to consume the LD/LV diet (P<0.007) than the HD/HV diet, but consumption times were similar with the other two diets. We conclude that, at the range of viscosity and energy density tested, reducing the viscosity of HD/HV porridges resulted in increased energy consumption by young children.

1258

SEASONAL DIFFERENCES IN THE DIVERSITY OF DIETS OF BOYS AND GIRLS OF WEANING AGE IN RURAL MALI
 I. SILVA BARBEAU, C. CALDWELL and H. T. SISSOKO, OID and Dept of Horticulture, VPI&SU Blacksburg, VA 24061, DRSPR, Mali

The study was conducted in 3 villages in Mali. Food frequency data were obtained at the harvest, hot dry and the pre harvest periods. Eleven major food groups were formed. Repeated measures analysis of variance structure model designed to test the interactions among the villages, periods, sex and weaning status indicated that 1) the number of food sources consumed differed depending on period, village, sex and weaning status with the greatest variation occurring among villages, 2) children's consumption of number of veg and legume food sources did not vary by sex when this factor was considered independent of the weaning status but there were differences due to interactions of these factors. For the cereals, veg and legumes food groups, weaning status affected the no. of food sources for boys more than for girls. The diversity of girls' diets was identical regardless of weaning status. Boys had more cereal food sources and less veg and legume after weaning. There was a pattern of girls having slightly more diverse diets with interactions between sex and village reflecting that this pattern was more pronounced in the village with low est food diversity. Virginia Tech Title XII USAID/SECID/Mali FSR/E No AFR-0232-c-00-6031

1260

SALES OF FOOD AID AS SIGN OF DISTRESS, NOT EXCESS
 B.A. Reed and J.P. Habicht, Division of Nutritional Sciences, Cornell University, Ithaca, NY 14853

In 1996 the sale of food aid from refugee camps in Uvira, Zaire was seen as evidence of a glut of food and prompted a reduction in rations distributed. Using observation and open-ended interviews, qualitative data were collected on food preferences, acquisition and sales purchasing patterns of other necessities and resource levels. A questionnaire using this information was developed and administered to 1005 randomly selected households. The quantitative results confirmed the qualitative findings. Food aid was sold or exchanged by 72% of households, not because they had too much, but because they lacked resources to diversify their diet or cover other basic needs. Indicators of dietary quantity and quality were derived using household reports of the previous day's diet. At most 23% of households were consuming a diet minimally adequate in quantity and quality. Significant differences in the pattern of diet and sales of food aid were observed across resource levels. The poorest one-fifth of households whose diets were the worst were the most likely to sell food (RR=1.57, p<0.01). Purchases made using proceeds from food aid sales improved micronutrient intake, but at a great cost to energy intake. The magnitude of the problem of poor diets resulted from a failure to apply important relief policies. Key commodities were absent from the food basket; the staple and oil provided were not culturally acceptable and there was no facility for cereal milling. (Funded in part by UNHCR)

1992

THE FEASIBILITY OF INCREASED USE OF ANIMAL PRODUCTS IN THE DIETS OF YOUNG CHILDREN IN INDIGENOUS COMMUNITIES IN GUATEMALA H Pachon, D C Schroeder, R Flores and M Hughes Emory University Atlanta GA 30322 and El Instituto de Nutricion de Centro America y Panama (INCAP) Guatemala City Guatemala

Consumption of animal products particularly red meat during early childhood is associated with better linear growth in Latin America. However the promotion of animal products is sometimes discounted because such products are relatively expensive. The objective of this analysis was to determine the appropriateness of promoting the consumption of animal products as a nutritional intervention for young children in indigenous communities in rural Guatemala. Food consumption data from multiple weekly recalls administered during a prospective longitudinal study of 302 children between 0-24 months of age were used. By 12 months of age 43% of infants had consumed eggs 30% beef 18% chicken and 9% fish. By 24 months of age consumption increased to 44% for eggs 62% for beef 48% for chicken and 3% for fish suggesting that animal products are accessible to community families. Examination of socioeconomic characteristics of caregivers yielded no difference in animal product consumption for children of literate and illiterate caregivers. These results suggest that increasing the proportion of women who introduce animal products particularly eggs and beef earlier into the diets of their young children may be an acceptable and economically viable approach to improving linear growth in these communities. Funding: PAHO PO 1243(SP) NIH (R29 HD 33468)

1994

COMPLIANCE AND SIDE EFFECTS IN AN ANTENATAL IRON SUPPLEMENTATION TRIAL IN EKWENDENI MALAWI

Bobrow EA, Young MW, van der Haar E, (SPON: DG Schroeder) Rollins School of Public Health Emory Univ Atlanta, GA 30322 and Ekwendeni Hospital Malawi

A prospective trial of daily and weekly iron supplementation of pregnant women was conducted in rural Malawi April-September 1997. Women attending antenatal clinics were stratified into non-anemic (hemoglobin ≥ 110 g/L), mildly (100-109 g/L) and moderately anemic (70-99 g/L) groups. After stratification a total of 413 women were randomized to receive either a daily dose ($n=211$) of 60mg iron+0.25mg of folate or a weekly dose ($n=202$) of 120mg iron+0.50mg folate. During the study a subsample of women (daily $n=100$ weekly $n=96$) were interviewed concerning compliance and side effects experienced in the previous month. Compliance by pill count was significantly higher ($p<0.001$) in the weekly group with 2.6% of the total pills left over as compared to 35.5% in the daily group. Compliance according to interview also was higher ($p=0.04$) in the weekly than in the daily group with 96.8% versus 88.0% reporting consuming all pills. Although no overall difference ($p=0.847$) in compliance was found by fecal iron testing ($n=102$) more anemic women in the weekly group 70.9% had positive stools for iron compared to the daily group 53.3% ($p=0.04$). The percentage of women reporting side effects did not differ between groups: 28.0% and 30.2% in the daily and weekly groups respectively ($p=0.854$). No differences ($p=0.617$) were found in hemoglobin response (daily 2.17 ± 1.42 g/L weekly 1.05 ± 1.37 g/L) irrespective of anemia classification. Because weekly iron induced better compliance with a similar biological response and equal degree and variety of side effects from taking the supplement, it is concluded that weekly supplementation is preferable in pregnant women in rural Malawi.

1996

URINARY IODINE DURING PREGNANCY AND LACTATION IN NEPALI WOMEN Kerry J. Schulze, Lisa A. Gautschi, Michele L. Dreyfuss, Lee S. F. Wu, Keith P. West, Jr.

Johns Hopkins University School of Public Health, Center for Human Nutrition, Baltimore, MD 21205

The extent of iodine deficiency among women of reproductive age in the Gangetic plains of South Asia is not known. We determined urinary iodine (UI) as an indicator of iodine status in spot urine samples collected from women of the rural plains of Nepal during pregnancy (P) ($n=917$) and after ~3 months of lactation (L) ($n=651$). UI was measured by the Sandell-Kolthoff reaction after oxidation with ammonium persulfate. Intra-assay CV was <7% and inter-assay CV was 7% for 10 representative assays. During P median UI was 102.5 μ g/L and 49.4% of UI values were below 100 μ g/L, the cut-off for mild iodine deficiency. As gestational age increased, women became less likely to have UI values above the 75th percentile. During L median UI was 60.9 μ g/L with 66.4% of UI values below 100 μ g/L. UI in these women may reflect an increasing physiological demand for iodine across a reproductive event. During both P and L UI was strongly influenced by season and also varied by community of residence. Iodine deficiency appears to be an important public health problem among women of reproductive age in this region of South Asia. Supported by USAID Office of Health and Nutrition.

1993

PREDICTORS OF ANEMIA IN HONDURAN CHILDREN 1-5 YEARS OF AGE R. Albaladejo, L. Ramakrishnan, M. Hughes Emory University Department of International Health Atlanta GA 30322

Iron deficiency affects over 200 million people worldwide, particularly pregnant women and children <5 years of age in the developing world. Few countries however have good prevalence data on anemia, the major clinical manifestation of iron deficiency. The present study examined the prevalence of anemia (defined as <11 g/dl of hemoglobin) and predictors of anemia in a nationally representative sample of 1323 children 1-5 years of age from Honduras using data from the 1996 Honduran National Micronutrient Survey. The overall prevalence of anemia in children 1-5 years of age was 27%. The prevalence was 10.9% in children 12-36 months and 18% in children 36-60 months. Results using multivariate logistic regression methods showed that weight for age z score ($p=0.0007$), age in months ($p=0.0001$) and gender ($p=0.008$) were significant predictors of anemia. Younger children and/or those with a lower weight for age z score were at an increased risk of anemia. In addition girls were at a greater risk of anemia than boys. Contrary to expectations, the prevalence of anemia was not significantly associated with maternal education, having had an iron supplement in the previous six months or residence (urban vs rural). Although socioeconomic status was positively associated with anemia, this association was not statistically significant after accounting for weight for age. Using specificity/sensitivity analysis, the model based on age in months, sex and weight for age z score correctly predicted anemia in 50% of the time. These findings provide important targeting information for programs aimed at improving iron status in children.

1995

WEEKLY SUPPLEMENTATION OF WOMEN WITH VITAMIN A OR BETA-CAROTENE LOWERS MATERNAL MORTALITY IN NEPAL

KP West, Jr, J Katz, SK Khatri, SC LeClerq, EK Pradhan, SR Shrestha, PB Connor, S Dali, R Adhikari, RP Pokhrel, and A Sommer Center for Human Nutrition and Department of International Health Johns Hopkins University Baltimore MD 21205 USA and Nepal Netra Jyoti Sangh Kathmandu Nepal

Pregnant women in rural South Asia are at high risk of vitamin A (VA) deficiency, reflected by low serum retinol levels and frequent night blindness. In these cultures, maternal mortality can be 65-70x higher than in developed countries. We assessed the efficacy of dosing >44,000 women of reproductive age weekly with 7000 μ g retinol equivalents as preformed VA or beta-carotene (BC) vs a placebo control (PL) in reducing maternal mortality. Findings are based on >21,000 pregnancies. Pregnancy-related mortality among mothers through 12 weeks post partum was 739/463 and 369 deaths per 100,000 pregnancies yielding relative risks of 1.00, 0.63 (95% CI 0.39-1.01) and 0.50 (0.30-0.84) for the PL, VA, and BC groups, respectively. Combined VA/BC decreased pregnancy-related mortality by 43% (RR=0.57, 0.38-0.85). Weekly low-dose BC or VA supplementation can markedly reduce risk of pregnancy-related mortality in malnourished populations in rural South Asia. Supported by the Office of Health & Nutr, USAID, Washington DC & Task Force Sight & Life, Roche, Basel.

1997

NUTRITIONAL RICKETS IN BANGLADESH G. Combs Jr., C. Meisner, P. Fischer, J. Cimma, A. Rahman, N. Hassan, T. Kyaw Myint, J. Duxbury, R. Welch, A. Kabir, K. Talukder, B. Manaster, D. Staab, S. Haque, Cornell U

Ithaca, NY 14853, CIMMYT Dhaka, U. Utah, Salt Lake City, UT, Grenoble France, SARPV Dhaka, Dhaka, UNICEF Dhaka, USDA, Ithaca, NY, Inst. Mother Child Health, Dhaka, Mem. Christian Hosp. Chakaria, Bangladesh

Rickets has been identified in Chakaria, southeastern Bangladesh. Vitamin D therapy has not been beneficial. Rachitic children (9 m, 5 f, 36-98 mos) showed knock-knees (10), bowed legs (4) and sabre tibiae (3). Ten had active serum alkaline phosphatase >350 U/L, 7 of 12 had radiographic evidence of active rickets. Cases differed significantly from children seen by parents as 'unaffected' serum alkaline phosphatase (492 vs 206 U/L), serum P (4.3 vs 5.2 mg/dl), serum 25(OH)₂D₃ (20 vs 25 ng/ml), serum 1,25-(OH)₂D₃ (131 vs 73 pg/ml, $P<0.0005$) but not serum Ca (9.6 mg/dl). Only 2 of 10 children with active rickets had low 25(OH)₂D₃ levels (1 hypophosphatemic). Cases did not show elevated blood levels of known Ca antagonists (Al, Ba, Sr, Pb, Cd) nor were local water or foods high in these elements. Three 'unaffected' children had physical signs consistent with rickets (beaded ribs, 1 with widened wrists, 1 with knock-knees) without elevated alkaline phosphatase; such findings and elevated serum 1,25-(OH)₂D₃ among unaffected children suggest that subclinical Ca deficiency may be prevalent in this population. These results indicate Chakaria rickets to resemble the Ca-deficiency rickets described in Africa.

3128

FOLATE REQUIREMENTS DURING LACTATION ARE GREATER THAN PREVIOUSLY ESTIMATED A. D. Mackey, M.F. Picciano, H. S. Wright, D.C. Mitchell Dept of Nutrition The Pennsylvania State University University Park PA 16802

The current RDA for folate during lactation is 280 µg/d. This was based on the estimated folate need of non-reproducing women (180 µg/d) with an additional 100 µg/d to cover folate losses in milk. The increment assumes a dietary folate absorption of 50%, milk secretion rate of 800 mL/d, and human milk folate content of 50 µg/L. Recent data from our laboratory show that human milk folate content average value is 72% greater than that previously estimated. Thus the average incremental amount to cover losses in milk is 140 µg/d, not 100 µg/d. Data also exist to indicate that average folate needs of non-reproducing women is greater than previously estimated, 300 µg/d not 180 µg/d. Collectively these data suggest an average folate need of 440 µg/d during lactation. This estimate is supported by results from our study of 42 lactating women from 3 to 6 mo postpartum on self-selected diets plus 0 or 1 mg folate/d. Dietary folate intake was similar between groups (380 µg/d). Folate supplemented women exhibited higher values for Hb, Hct, and RBC folate and lower % reticulocytes at 6 mo than unsupplemented women. In unsupplemented women milk folate declined and plasma homocysteine increased. These data indicate that 380 µg folate/d are insufficient to prevent mobilization of maternal folate stores for milk folate secretion and are consistent with our estimated average need of 440 µg/d.

3130

LACK OF DIFFERENCE IN 4 MONTH POSTPARTUM WEIGHT GAIN BETWEEN BREAST FEEDING and BOTTLE FEEDING NEW MOTHERS I. FREELAND-GRAVES and L. WALKER Univ of Texas at Austin Austin TX 78712.

New mothers are encouraged to breast rather than bottle-feed because of the superior quality of human milk. An added benefit may be a more rapid return to prepregnancy weight due to increased energy needs for production of milk. Yet it is unclear whether this is true. To test this hypothesis an 8-page mail survey was conducted with 101 bottle-feeding and 106 breast-feeding women who were 4 months postpartum. Dietary behaviors were measured by the Food Habits Questionnaire, activity levels by the Wang et al. 1992 scale. Groups did not differ in most social/anthropometric characteristics: gestational weight gain (32 lb) prepregnancy body mass index (22 vs 23 for breast and bottle) or residual weight gain at 4 months postpartum (6 vs 5 lb). Differences were seen only with divisions into higher (> 77 lbs) and lower (< 77 lbs) postpartum weight gains. Bottle-feeding mothers with higher postpartum gains had less vigorous exercise patterns and higher fat intakes compared to those with lower weight gains. No such relationships were found with breast-feeding. Thus exercise and diet appear to be more influential in postpartum weight gains in those who bottle- rather than breast-feed.

3132

ARE THERE CHANGES IN THE COMPOSITION OF COLOSTRUM IN WOMEN WHO BREASTFEED THROUGHOUT PREGNANCY? G.S. Marquis, S. MARSANO, M.E. PENNY University of Alabama at Birmingham Birmingham AL 35294 Instituto de Investigacion Nutricional Lima Peru

Many women breastfeed throughout pregnancy (BFP) however the consequences of this practice on the subsequent lactation are unknown. To explore the effect of BFP on colostrum we conducted a pilot study with 40 early postpartum women in a Lima, Peru hospital. Mothers were over 18 y old had previously breastfed had a child who was 4 y old or younger and had an uncomplicated childbirth. Ten percent had BFP. We interviewed all women about their socio-demographic characteristics and breastfeeding beliefs. Only 19 mothers provided colostrum because of the difficulty in obtaining a sample or wish to not provide it. The colostrum fat content was significantly reduced in BFP women ($n=4$) as compared to those women who had weaned their children before becoming pregnant ($n=15$, Mann-Whitney U test statistic=65, $p=0.003$). BFP women did not differ with the other women in maternal or obstetric characteristics. They had slightly higher economic status and were all born in Lima. These results demonstrate that BFP is common in Lima and may affect the composition of colostrum. We have initiated a study to verify and amplify these findings (Supported by NIH MIRT Training Grant TW00077).

3129

EFFECT OF MATERNAL DIET ON MILK LACTOFERRIN LEVELS P.A. Ronayne de Ferrer, A. Baroni, C.B. Greco, M.E. Sambucetti, N. Lopez, J.M. Ceriani Cernadas (Spon. M.E. Rio) Dept Nutr & Food Sci Sch Pharm & Biochem Univ of Buenos Aires Junin 956 2do P 1113 Buenos Aires and Div Neonatology Dept Pediatrics Italian Hospital, Buenos Aires, Argentina

Maternal diet may affect milk composition but its effect is difficult to evaluate. The relationships between milk lactoferrin levels and protein or iron intakes are unclear. In a previous study we found modified casein to whey protein ratios according to varying maternal protein intakes. However variations of individual whey proteins were not assessed. In order to determine the effect of protein or iron intakes on milk lactoferrin content we analyzed 21 milk samples from middle-class lactating women for total protein and lactoferrin concentrations. Simultaneously dietary records were obtained in order to calculate protein and iron intakes. Lactoferrin values (expressed either as mg/dL or g/100 g protein) did not show any clear correlation with protein or iron intakes. These results are in agreement with some published data which failed to show an effect of different protein intakes on milk lactoferrin levels. Besides lactoferrin content seemed unaffected by maternal iron intake. More research is needed to assess which factors influence milk lactoferrin concentrations. Supported by the University of Buenos Aires (FA044).

3131

DURATION OF BREASTFEEDING IS PROLONGED FOR CHILDREN WITH LOW NUTRITIONAL STATUS PRIOR TO WEANING IN RURAL SENEGAL WEST AFRICA K.B. Simondon, F. Simondon (Spon. E.A. Frongillo) Nutrition Unit ORSTOM BP 304, 34032 Montpellier France

Nutritional status is negatively linked to duration of breastfeeding between 12 and 36 mo of age in many developing countries. This study tested the hypothesis that mothers prolong breastfeeding of malnourished children. From 1989-96 information was collected weekly on birth, weaning, death and migration in a study population of 28,000 in a rural area of Senegal. Weight and length at 9-10 mo of age were measured for 4,229 children born from 1989-90 as part of a vaccination trial (coverage 18%). The duration of breastfeeding was estimated by survival analysis (Kaplan-Meier and Cox proportional hazards analysis). The median duration was 23.0, 24.2, 23.4 and 22.7 mo for children with a length for age z score (LAZ) at 9-10 mo of < -2, -2 to -1, -1 to 0 and > 0 respectively (p for trend < 0.0001). Weight for length was also associated with duration of breastfeeding (p for trend < 0.0001). Relationships remained very significant after adjustment for mother's age, parity, height, occupation and education and the season of birth. Possible explanations for these findings are that mothers postpone weaning in case of either malnutrition or functional symptoms linked to malnutrition such as lack of physical independence, retarded development or frequent illnesses.

3133

SUCKLING BEHAVIOR AND ITS EFFECT ON LACTATIONAL AMENORRHEA FOR A NEW MEXICO POPULATION B. Taylor, S.J. Samuels and D.M. Taylor NM Highlands Univ Las Vegas NM and Univ Calif Davis CA

The hypothesis that the month-specific rate of return of ovarian cyclicity after childbirth is causally related to suckling pattern was tested for a regional population of New Mexican women. Forty-three participants used specially programed keys on a graphing calculator to enter automatically into memory both the start and stop of bouts of breast-feeding and the occasion of any missed data. These data were then processed to yield breast-feeding behavioral statistics for each 24-hour day: median suckling session length, session frequency, average session spacing, and the total daily session duration. We used survival analysis for time-dependent covariates and found significant behavioral predictors of the first postpartum menses.

Previously we followed a population of women recruited nationwide through the Couple to Couple League (CCL), an international provider of natural family planning instruction. In that study also several suckling session metrics were found to be significant predictors of the first postpartum menses. However the two groups seem to represent two substantially different populations as to their breast-feeding behavior: the NM women began feeding solid foods five weeks earlier than the women in the ecological breastfeeding CCL sample. The NM breastfeeding population tended to be similar to the CCL mothers in their patterns of breastfeeding performance in the first few weeks after childbirth. However long-term breastfeeding measures for the two groups diverged markedly. Decreased suckling session frequency and decreased total breastfeeding duration each day were found to signal a higher time-specific probability of recovering menstrual cyclicity. Simultaneously the risk of escaping from postpartum amenorrhea increased with increased average suckling session spacing. We conclude that an 'intermittent' pattern of short frequent sessions is more effective for the continuance of postpartum amenorrhea than a dosed pattern of scheduled long interval sessions. *This work was supported by NIH grant GM08066.*

3758

CHEMOKINE PRODUCTION BY CYTOKINE TREATED HUMAN ENDOTHELIAL CELLS AND ASTROCYTES IS ALTERED BY *CRYPTOCOCCUS NEOFORMANS* AND RESTORED BY INTERFERON- γ
Neelufar Mozaffarian, Arturo Casadevall, and Joan W. Berman, Albert Einstein College of Medicine, Bronx, NY 10461

Cryptococcus neoformans is a fungal pathogen which afflicts 10% of AIDS patients worldwide. This organism is acquired by inhalation and often leads to meningitis in the immunocompromised host. The inflammatory response to this infection is poor. Little is known regarding interaction of this fungus with cells of the blood-brain-barrier which regulate leukocyte migration. We studied the effect of *C. neoformans* on chemokine production by human endothelial cells and astrocytes treated with various cytokines with and without interferon- γ . We measured monocyte chemoattractant protein-1, interleukin-8, and interferon-inducible protein-10 (IP-10) at the messenger and protein levels by ribonuclease protection assay and ELISA respectively. We found that *C. neoformans* altered chemokine production in a cytokine-dependent fashion depending upon the cell type studied. In astrocytes, downregulation of IP-10 paralleled decreases in cytokine-induced nitric oxide suggesting one potential mechanism for chemokine regulation. In certain cases, interferon- γ could reverse the inhibitory effect of *C. neoformans* on chemokine production suggesting a block in physical interaction between the human cells and *C. neoformans*. In support of this we found that both endothelial cells and astrocytes were capable of internalizing *C. neoformans* and we are investigating interferon- γ modulation of phagocytosis. We hypothesize that *C. neoformans* may selectively alter chemokine expression by endothelial cells and astrocytes in vivo effectively reducing leukocyte emigration into areas of fungal invasion in the brain.

Supported by the Dept. of Pathology, AECOM (N.M.), NIH R01 AI33774 (A.C.) and NIMH MH52974 and NS 11920 (J.W.B.)

3759

Chemokine induction of both glial and peripheral elements: implications for HIV encephalitis. C. M. McManus, K. Weidenheim, and J.W. Berman, Albert Einstein College of Medicine, Bronx, NY 10461

We are studying the role of chemokines and their receptors in the pathogenesis of HIV encephalitis, a major CNS complication of AIDS. Chemokines and their receptors maintain opposing roles in HIV infection: certain C-C chemokines compete with virus for binding to their receptors, a protective mechanism, where as chemokine receptors play a permissive role in HIV infection by functioning as coreceptors for entry of the virus into the cell. This study analyzes in vitro regulation of chemokines and their receptors in response to chemokines in major cells of HIV encephalitis: human microglia and peripheral blood monocytes. Chemokine receptors of any of the cells with MIP-1 α , MIP-1 β or MCP-1 suits in induction of these chemokines in a dose and time dependent manner as measured by RNase protection assay (RPA) and ELISA. C-C chemokine receptors were also analyzed by RPA demonstrating that astrocytes have no detectable levels of these receptors despite their ability to respond to chemokines suggesting that there are as yet unidentified receptor(s). Both microglia and PBMs constitutively express several C-C receptors and respond to chemokines by regulating their receptor expression. Brain sections of AIDS cases, encephalotogenic nonencephalotogenic and aged matched normals were analyzed by immunohistochemistry for expression of chemokines MIP-1 α , MIP-1 β and MCP-1 are expressed by glial elements as well as monocyte cells in encephalotogenic brains. There was minimal staining of all chemokines in nonencephalotogenic brains and controls. An understanding of how chemokines and their receptors are regulated in the CNS is crucial for determining treatment strategies for HIV encephalitis. (Supported by NIH NS 11920, NIMH MH52974 and NIA 5132 AG00194)

3760

EXPRESSION OF CHEMOKINES AND RECEPTORS BY HUMAN BRAIN MACROPHAGES AND NEURONS: RELEVANCE TO HIV ENCEPHALITIS. V.L. Sanders, J.C. Chosy, M.G. White, and C.L. Achim, Achim University of Pittsburgh School of Medicine, Pittsburgh, PA 15213

Objective: To determine the role that chemokines and receptors may play in monocyte recruitment across the blood brain barrier and in viral spread of HIV-1 within the brain parenchyma. **Methods:** Microglia were purified from human fetal brain tissue and macrophages were derived from human peripheral blood monocytes. Cell cultures infected with HIV-89.6 ADA or JR-FL were exposed to RANTES. HIV protein p24 levels were measured at 2, 4, and 7 days post infection by antigen capture assay and RT-PCR. In parallel, chemokine and receptor expression were detected by immunofluorescent laser confocal microscopy in post mortem brain tissues from HIV encephalitis (HIVE) patients and controls. **Results:** There were no differences in levels of infection between RANTES treated and non treated controls. In autopsy HIVE tissues, chemokines were detected on brain macrophages and astrocytes in and around microglial nodules in HIVE. The chemokine receptor CXCR4 was seen on brain macrophages, neurons and astrocytes. CCR3 was present on neurons and macrophages. CCR5 and CCR1 were detected on brain macrophages. **Conclusions:** Since RANTES did not inhibit infection in vitro, additional co-receptors may be present allowing for continued viral transmission. In vivo results support this conclusion: high levels of chemokines in microglial nodules are not sufficient to reduce viral expression. Chemokines and receptors were concentrated in areas of neuroglial reaction and inflammatory infiltrate supporting their involvement in macrophage recruitment. Presence of chemokine receptors on neurons suggest a direct role of these cytokines in neurodegeneration. (VJS supported by PHS AI 7487-3)

3761

RANTES BINDING BY CYTOMEGALOVIRUS INFECTED ENDOTHELIAL CELLS. J. Randolph Habecker, B.M. Rahill, D.D. Sedmak, The Ohio State Univ. Dept. of Path., Columbus, OH 43210

Cytomegalovirus (CMV) infected endothelial cells (EC) appear to be important sites for viral latency and persistence. CMV infected EC may use chemokines to attract and activate monocytes in order to facilitate infection of these cells and virus dissemination. The objectives of this study were to determine if RANTES binds to CMV infected EC and to investigate the nature of this binding. CMV infected EC specifically bound more ¹²⁵I labeled RANTES than noninfected EC. Northern blot experiments using RNA isolated from CMV infected EC at various times post infection revealed that these cells transcribe the US28 gene, a viral gene which codes for a promiscuous β chemokine receptor. At 12 hours through 96 hours postinfection, the expression of leukocyte chemokine receptors by CMV infected EC was investigated by RT-PCR. CCR1, CCR2, CCR3, CCR4, and CCR5 cDNAs were detected from control cells but none were detected from EC or CMV infected EC. Expression of the Duffy blood group antigen, shown to promiscuously bind chemokines, was not expressed by EC or CMV infected EC as determined by RT-PCR. These results are consistent with the hypothesis that it is the expression of the viral US28 gene product by CMV infected EC that result in RANTES chemokine binding.

INTERNATIONAL NUTRITION—MICRONUTRIENT INTERVENTIONS IMPACT AND EVALUATION II (3762-3763)

3762

COMMUNITY TRIAL OF THE EFFICACY OF LIME JUICE FOR IMPROVING IRON STATUS OF IRON DEFICIENT MEXICAN WOMEN. O.P. Garcia, M. Diaz, J.L. Rosado, L.H. Allen, Instituto Nacional de la Nutrición, Tlalpan, Mexico, D.F. and Program in International Nutrition, University of California, Davis, CA 95616

No previous community trials have investigated the benefit on iron status of increasing ascorbic acid (AA) consumption from local foods. Using iron isotopes we determined that iron absorption from rural Mexican meals (tortillas, beans and salsa) is doubled if 25 mg AA as *agua de limón* is consumed with each of 2 meals/d. In a community intervention trial, 36 non anemic iron deficient (serum ferritin <12 μ g/L) women, age 28 \pm 10, were randomly assigned to treatment (AA) or placebo groups. The AA group was provided 300 mL *agua de limón* containing 25 mg AA twice/day in their home 6 d/week for 8 months. The placebo group was similarly given a lime flavored beverage free of AA or citric acid. Beverages were consumed within \pm 1 hour of meals. Parasites, morbidity and serum AA were monitored. Serum ferritin (SF) at 0, 2, 4 and 6 mo was (mean \pm SD): placebo group 7.6 \pm 3.6, 8.3 \pm 0.9, 2.6 \pm 3 and 12.6 \pm 7.7 μ g/L. AA group 6.7 \pm 2.9, 10.0 \pm 2.1, 21.6 \pm 6.1 and 13.0 \pm 7.1 μ g/L. Hemoglobin was not affected by AA. Controlling for initial SF, ferritin was higher in the AA group after 4 months (P<0.05) and represents an increase in Fe absorption of 0.5 mg/d. Increasing dietary AA by 25 mg at 2 meals/d significantly improved Fe absorption and status. Funded by USAID/OWNI.

3763

ZINC SUPPLEMENTATION DURING PREGNANCY IN BANGLADESHI WOMEN HAD NO EFFECT ON BIRTH WEIGHT. S.J.M. Osendarp^{1,2}, A.H. Baqui¹, M.A. Wahed¹, S.E. Arfeen¹, J.M.A. Van Raaij² & G.J. Fuchs^{1,2}. ¹ICDDR,B Dhaka 1212, Bangladesh; ²Wageningen Agricultural University, The Netherlands; ³LSU School of Medicine, New Orleans, LA 70112, 2822

Although observational studies suggest a positive association between zinc status during pregnancy and pregnancy outcome, results of controlled supplementation trials have been mixed. We conducted a prospective double-blind intervention trial in a very poor urban Bangladesh community. 559 women were enrolled between 12-16 weeks gestation, stratified by parity and randomly assigned to two groups: 30 mg elemental zinc/day (n=269) or placebo (n=290). Supplementation continued until delivery and compliance with supplementation was 86%. Serum zinc and haemoglobin levels were estimated at baseline and at 7 months gestation, while anthropometrics and dietary intake of the women was assessed monthly and morbidity weekly. Newborns were measured by a physician within 72 hours after birth and birth weights and gestational ages were known for 410 singleton infants. The overall incidence of low birth weight was 42.9% (45.9% in zinc supplemented vs 40.3% in placebo supplemented, p=0.27). Incidence of prematurity by LMP was 21.2% (22.7% in zinc supplemented vs 19.9% in placebo supplemented group, p=0.52). Means and distributions of birth weight, length at birth and head circumference at birth were not significantly different between the two groups. We conclude that antenatal supplementation with daily 30 mg elemental zinc alone has no apparent impact on birth outcome in this population.

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3764

β CAROTENE TREATMENTS IMPROVE THE VITAMIN A STATUS OF THE MOTHER INFANT DYAD

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The Universidad Nacional Autonoma de Honduras Tegucigalpa, Honduras CA

We evaluated the effectiveness of two purified β carotene supplements and β carotene as palm oil to enhance the vitamin A status of vitamin A low mothers and infants in the marginal barrier of Tegucigalpa, Honduras. Short term supplementation of mother with water miscible β carotene increased β carotene in milk and serum of mothers 5 and 9 fold respectively and significantly increased serum retinol of their nursing infants. β carotene as palm oil resulted in 2 fold increases of β carotene in both milk and serum of mothers and statistically significant increases in serum retinol of vitamin A low infants. Purified β-carotene produced statistically significant changes in maternal serum: a 1.5 fold increase in milk β carotene and no change in infant serum retinol. We conclude that β carotene supplementation of mothers can improve the vitamin A status of both mother and infant and that dietary palm oil offers a practical source of vitamin A for the mother infant dyad.

Supported by grants from the International Life Sciences Institute (ILSI) and the Palm Oil Research Institute of Malaysia (PORIM)

3765

MATERNAL VITAMIN A OR β CAROTENE SUPPLEMENTATION IN LACTATING BANGLADESHI WOMEN EFFECTS ON MOTHERS AND INFANTS A.L. Rice, R.J. Stoltzfus, A. de Francisco, J. Chakraborty, C.L. Kjolhede, M.A. Wahed, Center for Human Nutrition Johns Hopkins University Baltimore MD 21205 and ICDDR B Dhaka, Bangladesh

The effects of maternal post partum vitamin A (VA) or β carotene (BC) supplementation on maternal and infant VA status were assessed during a community based trial in Matlab Bangladesh. At 13 wk post partum women were randomly assigned to receive either one 200 000 IU dose of VA followed by daily placebos (n=74) daily doses of 7.6 mg BC (n=73) or daily placebos (n=73) until 9 mo post partum. VA supplementation resulted in lower maternal MRDR ratios and higher milk VA at 3 mo but these improvements were not sustained. BC supplementation acted more slowly resulting in higher milk VA only at 9 mo. During the study > 50 % of all women produced milk with low VA ($\leq 1.05 \mu\text{mol/L}$ or $\leq 8 \mu\text{g/g}$ milk fat) irrespective of treatment group. The mean serum retinol concentration of 6 mo old infants was higher in the VA than the placebo group (0.84 ± 0.23 vs $0.77 \pm 0.21 \mu\text{mol/L}$, $P < 0.06$). Although the mean MRDR ratio was lower in both the VA and BC groups > 84 % of all infants had ratios indicative of low liver stores. We conclude that while both were beneficial neither intervention was sufficient to correct the underlying problem of subclinical VA deficiency in these women nor to bring their infants into adequate VA status. Funded by USAID Office of Health and Nutrition.

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VITAMIN A STATUS OF GHANAIAN BREAST FED INFANTS 6-12 MONTHS FED IMPROVED COMPLEMENTARY FOODS A. Lartey, A. Manu, Brown, K.H., J.M. Pearson and K.G. Dewey, Dept of Nutr Prog in International Nutr Univ of Calif Davis CA, 95616 Dept of Nutr & Food Sci Univ of Ghana Legon

Porridges made from Weanmix (cereal legume blend) and koko (fermented maize dough) are common complementary foods fed to infants in Ghana. To evaluate the effect of feeding improved locally formulated complementary foods on nutritional status 216 breast fed infants were randomly assigned to receive one of 4 foods from 6 to 12 mo. Weanmix (w) Weanmix fortified with vitamins and minerals (wm) Weanmix plus fish powder (wf) and Koko plus fish powder (kf). Dietary intakes of project food and other foods were assessed by 12 hour weighed food records at 6, 7, 8, 10 and 12 mo. Breast feeding episodes were monitored during dietary data collection. Blood samples were drawn at 6 and 12 mo for plasma retinol determination. Breast feeding frequency was not significantly different among the 4 groups at any time point. Project foods contributed 55-99 % of the total non-breastmilk vitamin A intake. Vitamin A intake from foods was significantly higher in group wm at 7, 8, 10 and 12 mo compared with the other 3 groups. At 12 mo 61% 73% of the infants in groups w, wf and kf had low intakes (<42 μg RE/d from non breast milk foods). Plasma retinol levels increased in group wm between 6 and 12 mo but decreased in the other 3 groups ($w = -0.08 \pm 0.3^*$, $wm = 0.17 \pm 0.4^*$, $wf = 0.01 \pm 0.3$, $kf = -0.02 \pm 0.3 \mu\text{mol/L}$, $p < 0.05$). At 12 months the percentage of infants with low plasma retinol (<0.7 μmol/L) was $w = 27.0\%$, $wm = 10.4\%$, $wf = 34.3\%$ and $kf = 28.1\%$ ($p < 0.05$). The results suggest that in this population breast fed infants fed complementary food fortified with vitamin A have better vitamin A status than those fed non fortified foods. Funding provided by Nestle Foundation and Rockefeller Foundation.

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EFFECTS OF AGE OF INTRODUCTION OF COMPLEMENTARY FOODS ON MICRONUTRIENT STATUS OF TERM LOW BIRTHWEIGHT BREASTFED INFANTS IN HONDURAS K.G. Dewey, R.J. Cohen, L. Landa Rivera, K.H. Brown, Prog Internat Nutr & Dept Nutr Univ Calif, Davis CA 95616 8669 & San Pedro Sula, Honduras

To evaluate the optimal timing of introducing complementary foods to full term low birthweight (1500-2500 g) infants 119 infants exclusively breastfed for 4 mo were randomly assigned to continue exclusive breastfeeding until 6 mo (EBF) or receive iron fortified foods (rice cereal, chicken, fruits & vegetables in jars) in addition to breast milk from 4 to 6 mo (SF). Data on dietary intake, growth and morbidity were collected from 4 to 6 mo. Blood samples were collected at 2, 4 and 6 mo and analyzed for hemoglobin (Hb), hematocrit (Hct), plasma ferritin, % transferrin saturation, vitamin A, vitamin B₁₂, folate, zinc, C reactive protein and erythrocyte folate. Infants with Hb < 100 g/L at 2 mo (48%) or 4 mo (21%) were given medicinal iron drops for 2 mo; the proportion given iron drops did not differ between EBF and SF groups at either age. There were no significant differences in weight or length gain 4-6 mo between the EBF and SF groups. There was no significant impact of complementary foods on indices of vitamin A, B₁₂, folate or zinc status. Among infants not given iron drops 4-6 mo (n=87) Hb and Hct levels declined in the EBF group but increased slightly in the SF group from 4 to 6 mo ($p < 0.01$) and the decline in ferritin was less in the SF group ($p < 0.01$). Among infants given iron drops 4-6 mo (n=23) Hb increased more in the EBF than the SF group ($p = 0.08$, $p = 0.04$ when controlling for Hb at 4 mo). These results support the recommendation that low birthweight breastfed infants should receive an additional source of iron prior to 6 mo because half of the infants already had low Hb at 2 mo. Iron drops are recommended before the age when complementary foods would normally be introduced. Among infants given iron drops the data indicate that complementary foods interfere with iron utilization. Complementary foods given from 4 to 6 mo did not influence growth or any of the other indices of micronutrient status. Therefore exclusive breastfeeding to about 6 mo with iron supplementation can be recommended for term low birthweight infants.

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TRIAL OF A MICRONUTRIENT DIETARY SUPPLEMENT TO CONTROL VITAMIN A, IRON AND IODINE DEFICIENCIES IN TANZANIA D.M. Ash, S.R. Tatala, E.A. Fronigillo Jr., G.D. Ndossi, H. Mehancho and M.C. Latham, Cornell Univ Ithaca, NY 14853 TFNC Tanzania and Procter & Gamble Company Cincinnati, OH 45253

The three main strategies used to control micronutrient deficiencies are food diversification, fortification, and consumption of medicinal supplements through the health care system. In Tanzania, a fourth strategy is currently being evaluated. A micronutrient fortified beverage supplement that provides nutrients in physiological doses, not megadoses, has been developed to control several deficiencies at the same time. The efficacy of the supplement was evaluated in a randomized, double-blind, placebo-controlled trial among 830 primary schoolchildren in Mpwapwa District, Dodoma Region. The supplement was packaged in individual serving sachets containing 25 gm net of a powder that when added to 200 ml of water produces a very palatable orange flavored drink. The serving provides between 30 and 120 % of the RDA for vitamin A, iron, iodine, zinc, vitamin E, ascorbic acid, and several B vitamins. The children drank one serving every attended school day for a 6 month intervention period. At baseline 44 % of the children were anemic (Hb < 12.0 g/dL) and 4 children with Bitot's spots were excluded from the study and treated. Participation in the study was excellent with a 91 % retention rate. The mean incremental change in Hb for those with an initial Hb < 11 g/dL was 1.3 g/dL and 0.14 g/dL in the fortified and non fortified group respectively. At baseline 21.4 % of the fortified group and 20.6 % of the non fortified group had serum retinol levels < 20 mg/dL. After 6 month intervention, serum retinol levels < 20 mg/dL were nearly twice as prevalent in the non fortified group than the fortified group (19.7% vs 11.3%, respectively $p < 0.001$). The supplement was highly acceptable and compliance was high. In this population where iron and vitamin A deficiency are prevalent, the beverage supplement was effective in improving nutritional status. Children who had lower hemoglobin and vitamin A status benefited more from the micronutrient fortified beverage. (Supported by MI Canada and UNICEF)

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IMPACT OF A MICRONUTRIENT DIETARY SUPPLEMENT ON GROWTH OF SCHOOL CHILDREN IN TANZANIA M.C. Latham, D.M. Ash, S.R. Tatala, G.D. Ndossi, H. Mehancho and E.A. Fronigillo Jr., Cornell Univ Ithaca, NY 14853 TFNC Tanzania and Procter & Gamble Company Cincinnati, OH 45253

There is increasing evidence that in deficient populations providing micronutrients may improve the growth of undernourished children. This has been shown with iron and zinc and may be due to the fact that this improves appetite and food intake. In Tanzania an investigation has been undertaken to evaluate the impact of a micronutrient dietary supplement on iron, vitamin A and iodine status of school age children. This was a randomized, double-blind, placebo-controlled trial. Reported here is an evaluation of the impact of this supplement on nutritional status using anthropometry. The subjects were 830 primary school children in Mpwapwa District. The supplement consists of 25 gm of a white powder in a sachet which is mixed with 200 ml water to produce an orange-flavored beverage. One serving provides 30 to 120 % of RDA for 10 micronutrients including 3 minerals (iron, zinc and iodine) and 7 vitamins (A, C, folate, niacin, thiamin, riboflavin and pyridoxine). The children consumed one serving every school day attended over a period of 180 days. Children at the baseline found to have intestinal parasites received a dose of albendazole. As reported elsewhere biochemical determinations showed that both iron and vitamin A status were poor in large numbers of children at the onset of the study. There was no significant difference in weight for age and height for age in the fortified and non fortified group at the baseline. In multivariate analyses treatment group was the strongest explanatory variable for incremental change in height and weight. The mean change in weight for the fortified group was 1.8 kg vs 1.0 kg in the non-fortified group ($p < 0.001$). The mean change in height for the fortified group was 3.4 cm vs 2.7 cm in the non fortified group ($p < 0.001$). The supplement was very popular with children. School staff were pleased with the program. We conclude that this dietary supplement using physiological not medicinal doses of micronutrients can improve growth of schoolchildren and reduce malnutrition as well as improve iron and vitamin A status. (Supported by MI UNICEF and SmithKline Beecham UK)

3770

ZINC AND MICRONUTRIENTS AFFECT COGNITIVE AND PSYCHOMOTOR FUNCTION OF RURAL CHINESE CHILDREN J.G. Penland, H.H. Sandstead, N.W. Alcock, H.H. Dayal, Chen Xue Cun, Li Jue Sheng, Yang Jia Jiu and Zhao Fajl USDA ARS Grand Forks Human Nutrition Research Center Grand Forks ND University of Texas Medical Branch Galveston TX Chinese Academy of Preventative Medicine Beijing Qingdao Medical College Qingdao 3rd Military Medical University Chongqing Second Military Medical University Shanghai

A supplement containing 20 mg/d zinc (Zn) Zn plus micronutrients (Zn+M 50% RDA or mean ESSADI excluding Zn Ca Mg P folate at 25% RDA) or micronutrients alone (M) was provided in a double blind fashion for 10 weeks to 54 children (aged 6-9 years) from poor rural regions in the provinces of Chongqing Qingdao and Shanghai in the Peoples Republic of China Cognitive and psychomotor function were assessed at baseline and 10 weeks by measuring performance on a battery of computer administered tasks designed specifically to emphasize attention perception memory and concept formation (reasoning) and the motor and spatial skills necessary for successful performance Plasma lead was also measured and included as a covariate in the analysis of treatment effects Compared to either M or Zn alone Zn+M resulted in greater improvement in finger tapping (manual dexterity) object search (perception) and performance on an oddity task (reasoning) Compared to M alone Zn alone resulted in greater improvement in memory for both objects and complex shapes There were no treatment effects on continuous performance (attention) Results will be compared to those from an earlier study with children living in nearby urban areas These findings indicate that cognitive and psychomotor function may be suboptimal in the estimated 30% of Chinese children who are zinc deficient

Additional support Thrasher Research Fund and General Nutrition Products

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THE EFFECT OF ZINC AND/OR IRON SUPPLEMENTATION ON THE NUTRITIONAL STATUS AND METABOLISM OF VITAMIN A OF MEXICAN PRESCHOOLERS FROM A RURAL AREA Munoz E, Rosado JL, Allen LH, Lopez P, Furr HC Instituto Nacional de la Nutricion Mexico DF University of California Davis CA University of Connecticut Storrs CT

Some studies suggest that there is a metabolic interaction between zinc and vitamin A and only few studies suggest iron and vitamin A interaction The objective of this double blind placebo controlled study was to assess the effect of iron and/or iron supplementation on the nutritional status and metabolism of vitamin A Subjects were 219 preschoolers (18-36 mo) with a history of anaemia (25% low plasma zinc (4.5%) and plasma retinol (29.4% with low and deficient values) They were randomly assigned and supplemented for 12 mo with 20 mg/d of either zinc iron and zinc plus iron or placebo After six months of supplementation plasma retinol level increased significantly in the zinc (2.38 ± 1.44) iron (1.81 ± 1.04) and zinc plus iron groups (2.44 ± 1.63) compared with placebo (1.26 ± 2.1 ug/dl) (p<0.05) Plasma retinol binding protein (RBP) increased significantly only in the iron group (4.0 ± 1.7) compared with placebo (2.00 ± 1.04 mg/L p<0.05) and also did plasma prealbumin (PA) (2.79 ± 0.9 vs 2.33 ± 0.3 mg/dl p<0.05) Plasma zinc and iron improved significantly (p=0.0001) There was a significant correlation between the changes of retinol RBP and PA and a nearly significant association between the changes of Hb/RBP and Hb/ferritin We concluded that both zinc and iron supplementation improved vitamin A nutritional status This study suggests a metabolic interaction between iron supplementation and vitamin A status

NUTS IN A HEALTHFUL DIET II (3772-3775)

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EFFECTS OF A WALNUT DIET ON THE FATTY ACID (FA) COMPOSITION AND OXIDIZABILITY OF LOW DENSITY LIPOPROTEINS (LDL) E. Ros, D. Zambon, S. Munoz, A. Asensio, M. Merlos, J.C. Laguna, J. Sabate Lipid Clinic Nutr & Diet Serv Hospital Clinic Barcelona Sch of Med D Pharmacol Barcelona Sch of Pharm Spain and D Nutrition Loma Linda Univ CA USA

Walnuts are considered as part of a healthy diet However they are rich in polyunsaturated FA (PUFA) and thus may increase LDL oxidizability In the Barcelona Walnut Trial 49 hypercholesterolemic subjects consumed two isocaloric diets a monounsaturated FA (MUFA)-rich olive oil diet and a PUFA rich diet containing ~50 g walnuts/day LDL were isolated and their lipid and FA composition were analyzed Further conjugated diene (CD) kinetics and TBARS lysine residues and vitamin E levels in LDL and TBARS and vitamin C levels in total plasma were measured after a Cu²⁺ induced oxidative challenge After the walnut diet LDL cholesterol was reduced by 9% and the overall content of PUFA in LDL increased by 15% while that of MUFA decreased by 12% The LDL triglyceride and cholesteryl ester fractions were enriched with PUFA qualitatively more (40% and 30% respectively) than LDL phospholipids (10%) resulting in a reduction of the FA unsaturation of the surface relative to the core of LDL particles The levels of oxidation related analytes were similar after the two diets in both total plasma and LDL with the exception of CD V_{max} which was 27% higher after the walnut diet compared with the MUFA diet due to increased substrate availability In conclusion a walnut diet increases the PUFA content of core LDL lipid without reducing the overall resistance of the particles to oxidation

Supported in part by the California Walnut Commission FIS 94/0077 and Fundacio Privada Catalana de Nutricio i Lipids

3774

INCREASED UPTAKE OF HUMAN LOW DENSITY LIPOPROTEINS (LDL) BY HEPG2 HEPATOMA CELLS AFTER A WALNUT DIET J.C. Laguna, S. Munoz, M. Merlos, D. Zambon, C. Rodriguez, E. Ros, J. Sabate D Pharmacol Barcelona Sch of Pharm Lipid Clinic Nutr & Diet Serv Hospital Clinic Barcelona Sch of Med Spain and D Nutr Loma Linda Univ CA USA

In the Barcelona Walnut Trial we have shown that plasma LDL cholesterol (LDL-C) levels decrease in hypercholesterolemic patients when they are shifted from a monounsaturated fatty acid (MUFA)-rich olive oil diet to an isocaloric polyunsaturated fatty acid (PUFA)-rich diet containing ~50 g walnuts per day To test the hypothesis that changes in LDL composition could alter LDL uptake by liver cells lipoproteins were ultracentrifugally isolated in 11 patients during the two diets LDL lipid and fatty acid composition were analyzed the particles were marked with the diiodoacetyl indocarbocyanine fluorescent probe and their uptake by human HepG2 cells (2.8x10⁵ cells/well cultured in DMEM plus 0.5% fatty acid free BSA) was measured After the walnut diet, LDL C levels were reduced by 8% and the rate of LDL uptake increased by 44% (p<0.05) the fatty acid composition of LDL lipid was strongly modified major changes taking place in LDL triglycerides the percent molar concentration of 18:1 n:9 decreased by 16% (p<0.01) while those of 18:2 n:6 and 18:3 n:3 increased by 44% and 145% respectively (p<0.01) In conclusion changes in LDL fatty acid composition induced by a walnut diet could be responsible for increased LDL catabolism and explain the observed reduction of plasma LDL-C levels

Supported in part by the Walnut Commission of California, grant SAF97 0215 (Spanish Health Ministry) and Fundacio Privada Catalana de Nutricio i Lipids

3773

EFFECTS OF DIETS HIGH IN PEANUTS PEANUT BUTTER (P/PB) AND PEANUT OIL (PO) ON THE SUSCEPTIBILITY OF LDL TO OXIDATIVE MODIFICATION R.L. Morgan, T.D. Etherton, T.A. Pearson, and P.M. Kris Etherton Graduate Program in Nutrition The Pennsylvania State University Univ Park PA 16802 Univ Rochester School of Med Rochester NY 14620

Oxidation of LDL is thought to be a causative factor in the development of CHD Some studies show LDL enriched in PUFA to be more susceptible to oxidation than LDL enriched in MUFA but studies using P/PB or PO as a PUFA source have not yet been performed Since recent studies suggest a protective effect of frequent nut consumption against CHD we used a randomized double blind five period crossover design (n=22) to study the effects of the following diets on LDL ox average American (35% fat 15% SFA) low fat (25% fat 7% SFA) P/PB (35% fat 7% SFA) PO (35% fat 7% SFA) and olive oil (35% fat 6% SFA) LDL ox was measured spectrophotometrically by the formation of conjugated dienes at a wavelength of 234 nm There was no difference in lag time or maximum diene production among diet groups The lower rate of oxidation (nmol dienes/min/mg LDL protein) for the olive oil (OO) diet (20.5 ± 1.3 lmean ± SE) versus the PO diet (24.7 ± 1.2 p<0.08) and the P/PB diet (24.7 ± 1.2 p<0.09) was likely due to a lower LDL PUFA content Further studies are needed to determine whether P/PB and PO have unique antioxidants that protect against the initiation of LDL oxidation (i.e. lag time) (This work was funded by The Peanut Institute)

3775

Weight reduction A Comparison of a high unsaturated fat diet with nuts vs a low fat diet F.M. Sacks, K. McManus Brigham and Women's Hospital Boston MA 02115

Obesity is becoming increasingly prevalent in the USA despite the emphasis in public health guidelines on reducing fat intake Weight loss studies that use a low fat diet although sometimes successful in the short term have not shown success in sustaining weight loss Long term adherence with a low fat diet may be impeded by reduced satiety palatability and variety We are conducting an 18 month trial of the effectiveness of two calorie controlled dietary approaches one low in fat (20% of total energy) and the other moderate in fat (30%) mainly from unsaturated fatty acids Nuts are intended to be a major source of the unsaturated fat in the moderate fat diet A total of 101 persons (10 men 91 women) with mean age 42 years have been randomized to the diets Mean BMI at baseline was 33.6 kg/M² and % body fat was 38% Enrollment concluded in 9/97 and the program is scheduled to end in 2/99 Interim results will be presented on weight loss adherence body composition and cardiovascular disease risk factors after an average 7 months in the trial (Funded by the International Nut Council the Peanut Institute and the International Olive Oil Council)

4898

IRON STATUS OF THE ELDERLY FRAMINGHAM HEART STUDY COHORT AN IRON REPLETE POPULATION WITH A HIGH PREVALENCE OF ELEVATED IRON STORES R J Wood D J Fleming P F Jacques P W F Wilson JM USDA HVRCa Tufts Univ sitv Boston MA 02111 The Framingham Heart Study \HLBI Framingham MA 01701

We evaluated the Fe status of 140 free-living elderly (61-93y) Americans from the original Framingham Heart Study cohort. Using a multivariate model of assessment (serum ferritin(SF) transferrin saturation(Tsat) mean cell volume(MCV)) the prevalence of Fe deficiency(ID) (at least 2 abnormal values) was 70% while the prevalence of Fe deficiency anemia (ID + ab normal hemoglobin) was 10% whether subjects whose SF levels might be pathologically elevated due to infection inflammation liver disease or genetic hemochromatosis were included or not. While the population mean values for all Fe indices were normal men(M) had significantly higher average levels than women(W) of SF (M geometric mean=112µg/L 95%CI=100-125 W geometric mean=14µg/L 95%CI=68-81) serum iron Tsat Hb and hematocrit. Three percent of subjects had depleted Fe stores (SF<12µg/L) while 95 individuals (12.8%) had high Fe stores (SF>300µg/L for M >200 for W) 14% of men 12% of women. Mean±SD total Fe heme and nonheme Fe intakes assessed by food frequency questionnaire were 18±16 2mg 0.90±0.53mg 12.4±7.6mg with no significant difference in average values between men and women. Sixteen percent of subjects (n=120) used Fe in supplemental form. Mean±SD intake of users= 27.9±22.7mg. Ninety one percent (n=671) of the population had total Fe intakes ≥2/3 RDA (≥6.6mg/d). We conclude that a free-living elderly white US population is an Fe-replete group the most likely liability in Fe nutrition being elevated storage Fe rather than Fe deficiency.

4900

MATERNAL IRON STATUS INFLUENCES IRON TRANSFER TO THE FETUS K O O'Brien, N Zavaleta, LE Caulfield, Dong Xiao Yang, SA Abrams Johns Hopkins School of Hygiene and Public Health, Baltimore MD USA, Instituto de Investigacion Nutricional, Lima, Peru, and USDA/ARS CNRC Baylor College of Medicine Houston, TX, USA

Iron transfer to the fetus may be influenced by maternal iron status. This possibility was examined during the third trimester of pregnancy (33 ± 1 wk gestation) in 37 women living in a peri-urban settlement area of Lima, Peru. Three groups of pregnant women were recruited. Group 1 received no prenatal supplementation. Group 2 received prenatal supplements containing 60 mg of Fe (as ferrous sulfate) and 250 µg of folate and Group 3 received 60 mg of Fe 250 µg of folate and 15 mg of Zn (as Zn sulfate) from week 10-24 of pregnancy throughout gestation. On the day of the isotope study fasted women consumed an oral dose of ⁵⁷Fe (10 mg, as ferrous sulfate) in a flavored sugar drink that did not contain ascorbic acid. Immediately following the PO dose an i.v. dose of ⁵⁸Fe (0.6 mg) was administered. Cord blood was collected and analyzed for iron isotopes using TIMS. Serum transferrin receptors (sTfR) were measured in maternal blood on the day of isotope dosing. The average percent enrichment (% Enrich.) of the PO and i.v. tracer in the cord blood and maternal sTfR levels are detailed below (mean ± SD). Means within columns with different superscripts significantly differ from one another (p<0.05).

Group	n	Maternal Hb (g/dl)	Cord Blood Hb (g/dl)	Cord ⁵⁷ Fe / Enrich	Cord ⁵⁸ Fe / Enrich	Maternal sTfR (nmol/L)
1	12	10.8 ± 1.0	15.0 ± 1.8	4.29 ± 0.92 ^a	13.21 ± 2.13	23.7 ± 10.3
2	14	11.2 ± 1.3	15.6 ± 1.4 ^{ab}	2.72 ± 1.42 ^b	11.64 ± 4.28	15.8 ± 4.5 ^b
3	11	11.2 ± 1.1	16.3 ± 1.4 ^b	2.36 ± 1.41 ^b	12.58 ± 3.70	19.2 ± 9.4 ^{ab}

Significantly more oral tracer was found in infants born to mothers who did not receive prenatal Fe and cord blood ⁵⁷Fe tracer enrichment was significantly related to maternal sTfR ($y = 1.739 + 0.74X$ $r^2 = 0.191$ $p < 0.01$). Iron transfer to the fetus was significantly influenced by maternal iron status. (Supported by the Nestle Foundation)

4902

A HIGH LEVEL OF HUMAN LACTOFERRIN IN THE MILK OF TRANSGENIC MICE FUNCTIONS AS AN IRON SCAVENGER FOR SUCKLING NEONATES P. Zhang, A. Lewis, V. Sawicki, L. Hanson, J.H. Nuijens, and M. C. Neville Univ of Colorado Sch of Med Denver CO 80262 and Pharming BV Leiden, Netherlands

Lactoferrin (Lf) is present in human milk in high concentration. As an iron binding protein, its role in iron absorption by infants remains controversial. In this study transgenic mice over-expressing human Lf in their milk at levels comparable to human colostrum (about 12 mg/ml) and mature milk (about 2 mg/ml) were used as an *in vivo* model to test the hypothesis that Lf in milk increases iron absorption by neonates. The iron level in milk was manipulated by feeding lactating dams either commercial laboratory chow with an iron level of 300 mg/kg diet or one of the three special diets containing 5, 15 or 50 mg Fe/kg diet, respectively. Results indicated that, when the iron level in milk was normal the hemoglobin (Hb) concentration in the blood of 10-day-old non-transgenic pups suckling transgenic milk with high levels of human Lf was significantly lower than pups suckling either transgenic milk with low levels of human Lf or control milk without human Lf. In the situation of low iron concentration in milk, there was a tendency for pups nursed by transgenic dams on 5 and 15 mg Fe/kg to have higher Hb concentration. However these groups of pups were significantly smaller than controls. When this factor was taken into account by calculating the total body Hb per pup the iron status of pups suckling transgenic milk tended to be poorer than controls. These data provide no evidence to support the hypothesis that Lf in milk promotes iron absorption and suggest that the protein can act as an iron scavenger decreasing iron absorption by suckling neonates. Supported by NIH grant HB33186

4899

IRON STATUS IN PREGNANT WOMEN IS NOT IMPROVED BY WEEKLY OR TWICE WEEKLY IRON SUPPLEMENTATION Pena-Rosas JP, Nesheim MC, Crompton DWT, Sanjurjo D, Layrisse M, and Frongillo E, Cornell University Ithaca NY 14853 and Instituto Venezolano de Investigaciones Cientificas Caracas Venezuela. Weekly or twice weekly iron supplementation during pregnancy could be better accepted than a daily regimen if such regimens prove effective and produce less side effects. This study assessed the effectiveness of weekly and twice weekly iron supplementation in iron status of 96 pregnant women from Trujillo lowlands Venezuela women at 10-30 weeks of gestation were allocated to receive 120 mg of ferrous sulphate and 0.5 mg of folate once a week (Group W) or 60 mg of iron as ferrous sulphate and 0.25 mg of folate twice a week (Group TW). Hemoglobin, serum ferritin, serum iron and total iron binding capacity were measured at baseline and at the end of the supplementation. At baseline 79% and 75% of the women were anemic in W and TW groups and at the end of the study the prevalence was 87% and 73% respectively. In both groups iron stores measured by serum ferritin decreased at the end of the supplementation period and among anemic women the prevalence of iron deficiency increased with either treatment. The overall prevalence of side effects was similar in both regimens but some specific side effects were higher in the W group. Based on these results iron supplementation programs for anemic pregnant women on a weekly or twice weekly basis cannot be expected to alleviate anemia.

4901

RECOMBINANT HUMAN ERYTHROPOIETIN (EPO) AND PARENTERAL IRON SUPPLEMENTATION IN ANEMIA OF PREMATURITY C. Wu, J. Widness, K. Lombard and R. E. Serfass Iowa State Univ Ames, IA 50011 and Univ of Iowa, Iowa City IA 52242

Three groups of 9-10 very low birth weight infants who met selection criteria were fed mother's milk and a nutritional supplement by gavage tube or bottle for 21 days. All received oral iron (9 mg/kg) as a polymaltose complex daily between feedings with ascorbic acid added. The CONTROL group received only the above. Starting on day 3 the +EPO group received EPO (900 U/kg) subcutaneously at 3-day intervals. In addition to EPO the EPO+FE group received iron sucrose (2 mg Fe/kg) daily in isotonic sodium chloride as an intravenous (i.v.) infusion over 1-2 hours. On day 7 all infants received oral ⁵⁷Fe-polymaltose and i.v. ⁵⁸Fe-sucrose. Means for the following did not differ significantly between groups: erythrocyte incorporation of oral and i.v. labels, absorption of oral label and retention of i.v. label. Hematology data (erythrocyte distribution width, reticulocyte counts, % hypochromia, transferrin receptor serum iron, transferrin, and ferritin) at various times confirmed that EPO stimulates erythrocyte formation. Serum ferritin decreased with time in the CONTROL and +EPO groups and increased in the EPO+FE group. At the end of the study means for serum transferrin differed significantly (+EPO > CONTROL > EPO+FE) as did means for reticulocyte counts (EPO+FE > +EPO > CONTROL). Intravenous iron improved these measures of iron metabolism. Supported by March of Dimes grant 96-1055

4903

CEREAL MEAT AND COW MILK TO PREVENT IRON DEPLETION (ID) IN INFANTS FROM LOW INCOME HOUSEHOLDS G S Yeung and S H Zlotkin Dept Of Nutr Sci, Pediatr Res Inst and Div of GI/Nutr Hosp for Sick Children Univ of Toronto Toronto Canada M5R 1L9

Iron deficiency anaemia (IDA) depresses mental and motor development in affected infants. In Canada, the prevalence of ID and IDA is as high as 45% and 25% respectively in low income families. Low income families also tend to introduce cow milk to infants at an earlier age. This research tested the efficacy of ingesting adequate amounts of two iron rich foods infant cereal and meat to prevent ID in cow milk fed infants in the second 6 months of life from low income households. The incidence of ID and/or IDA was compared between a control group receiving no specific dietary intervention and a treatment group receiving cow milk cereal and meat. A higher proportion of treatment infants (13.8%) compared to control infants (6.8%) developed ID or IDA. However when those not consuming adequate amounts of meat and/or cereal were excluded only 4.2% of the treatment infants developed ID or IDA. We concluded that cow milk when combined with iron rich foods such as meat and iron fortified cereal from the age of 6 months is efficacious in preventing iron deficiency but is not likely an effective intervention. Supported by the Dairy Farmers of Ontario, Min. of Agriculture Food and Rural Affairs Ontario, Nestle Canada Inc, H J Heinz Company of Canada and Proctor & Gamble Inc.

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IMPACT OF ENERGY DENSE COMPLEMENTARY FOODS OF VARYING VISCOSITIES ON BREASTFEEDING FREQUENCY & BREASTMILK INTAKE IN A TRADITIONAL GUATEMALAN COMMUNITY DC Schroeder F B in B Torun Emory U Atlanta GA 30322 & INCAP Guatemala City Guatemala

Increasing energy (E) density & manipulating the viscosity of complementary foods are common approaches to improving infant feeding in developing countries. Little is known, however, about the impact of these approaches on breastfeeding (BF) frequency and intakes. The impact of 3 E dense rice porridges was assessed in a rural Guatemalan community. Control porridge (CF) 1.5 kcal/100 g, amylose containing porridge (A) 1.5 kcal/100 g, viscosity but more solids & E (HE) 10.1 kcal/100 g, amylose containing porridge with lower viscosity (LV) 8.1 kcal/100 g. Children 6-14 m randomly received in a cross over design either HE & CF (n=24) or LV & CF (n=24) in addition to other foods & breastmilk (BM). Porridges were delivered on 10 consecutive d & intake was estimated by differential weighing. BF freq & BM intakes were measured through repeat in home test weighing during 17 daytime hrs. Before the study infants breastfed 6.2±1.8 times & consumed 358.7±94.5 ml (220.6±38.1 kcal) of BM per 12 hr day. When consuming experimental porridges average BF freq declined significantly by 1.1-1.5 times per day (p<0.001) no significant differences were observed among the 3 porridges. Total BM (and energy from BM) intakes decreased 11.1% with the use of improved foods (p<0.001) no significant differences among porridges were observed. Results suggest that introduction of E dense complementary foods has a significant negative impact on BM intake regardless of the viscosity of these foods. *Funding: the Charles A & Anne Morrow Lindbergh Fund Emory U Research Committee NIH (R29 HD 33468)*

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PRENATAL CARE UTILIZATION MATERNAL PRENATAL DIETARY INTAKES AND ANTHROPOMETRIC MEASUREMENTS AND PREGNANCY OUTCOME IN URBAN AFRICAN AMERICAN WOMEN A A Johnson C S Welch C H Edwards E M Knight O J Cole L J Ovmade O E Westnev L S Westnev and H Larvea Howard University Washington DC 20059

Prenatal care utilization has often been found to be related to pregnancy outcome but little information is available on its relationship to maternal nutritional status. The relationships of prenatal care utilization to maternal nutritional measures and pregnancy outcome were investigated in the current study. The sample comprised 203 nulliparous pregnant African American women with full term singleton deliveries. Data collected included monthly quantitative 24 hour food recalls, maternal prepregnancy weight, height and weight gain, and infant birth weight. Weeks of gestation on entry into prenatal care (WPC) and number of prenatal visits (NPV) were used to calculate the Kotelchuck Adequacy of Prenatal Care Utilization Index (KI). The KI was not significantly related to maternal prenatal dietary intakes, anthropometric measurements or infant birth weight (P>0.05). WPC was positively related to intakes of vitamins A and C (r=0.19 and 0.21 respectively) but negatively related to intake of calcium (r=0.20) (P<0.05). NPV was positively related to intake of calcium (r=0.18) (P<0.05). Maternal anthropometric measurements were more predictive of infant birth weight than KI. Supported by Grant J PO1 HD17104 to ENG NICHD NH

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MATERNAL HEIGHT AND BIRTHWEIGHT IN A MULTI ETHNIC COHORT K. Pickett, B. Abrams, S. Selvin, School of Public Health Univ of Cal Berkeley CA 94720

Objective: To determine whether maternal height has a differential association with birthweight in white, black, Hispanic and Asian mothers.
Methods: The analytic sample included 4624 white, 1085 Hispanic, 2135 Asian and 1026 black women with singleton births uncomplicated by maternal diabetes, hypertension or congenital anomalies delivered at the University of California, San Francisco between 1980 and 1990. Multiple linear regression analysis was used to assess the relationship between maternal height, modeled with linear and quadratic terms, and birthweight.
Results: On average Asian and Hispanic women were shorter than white and black women. After adjustment for prepregnancy weight, gestation net weight gain, parity, smoking and infant sex, maternal height was positively and statistically significantly associated with birthweight in black and Asian women but not Hispanic women. In white women the significant association between height and birthweight was modified by gestational age at birth, prepregnancy weight, parity and maternal smoking. None of these interactions were observed in the other race-ethnic groups.
Conclusions: These results confirm that shorter women deliver smaller infants. However, this finding was not applicable to the Hispanic group. Furthermore, the height birthweight relationship appears to be more complex among white women. Other studies should investigate possible mechanisms for these findings.
Supported by grant HD27347-05 from the National Institute of Child Health and Human Development.

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ZINC STATUS OF LACTATING WOMEN PARTICIPATING IN AN EXERCISE AND WEIGHT LOSS PROGRAM KL Moreno CA Lovelady ML Taylor Department of Food, Nutrition and FSM University of North Carolina, Greensboro NC 27402-6170

The purpose of this 10 week study was to determine if overweight (BMI=25-30) exclusively breastfeeding women may lose 0.5 1kg/wk without affecting infant growth or maternal nutritional status. Subjects were randomly assigned to a weight loss group (WLG n=3) or control group (CG n=4) and provided with a supplement containing only vitamins. Measurements taken at 4, 9 and 14 wks postpartum included maternal zinc status, body composition, weighed three-day diet records and infant vitamin status. Plasma zinc was determined by atomic absorption spectrophotometry and 5 nucleotides activity by spectrophotometry. The WLG exercised 4 d/wk for 45 min and restricted energy intake by 500 kcal/d less than estimated needs. The WLG lost more weight and body fat than the CG (4.9±0.8 vs 1.2±0.9kg, p=0.03 and 6.9±1.5 vs 1.7±1.3%, p=0.04 respectively). No difference between groups was seen in infant growth or weight gain (6.6±0.4 vs 7.4±1.1cm and 1548±107 vs 1968±375g, respectively). Other results are

	Energy (kcal/d)	Dietary Zinc (mg/d)	Plasma Zinc (µg/L)	5 NT (u/L)
WL Base	2090±393	8.0±1.9	92.7±2.7	3.7±0.7
C Base	2483±282	11.2±2.6	90.6±6.3	5.2±0.3
WL Mid	1287±233*	8.3±2.7	113.5±15.7	3.0±0.6*
C Mid	2228±163	10.8±1.5	101.6±11.8	5.2±0.5
WL End	1654±228	11.3±3.6	99.9±3.3	3.2±0.7
C End	2331±315	11.4±1.1	103.6±10.5	4.9±0.4

p<0.05
This preliminary data suggests that weight loss does not affect infant growth or maternal zinc status
Supported by NIH R15 HD34222-01

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THE IMPACT OF SELF CONCEPT NUTRITION ATTITUDE & KNOWLEDGE AND DIETARY SELF EFFICACY ON ATTITUDE TOWARD WEIGHT GAIN AND ENERGY INTAKE IN PREGNANT ADOLESCENTS T Kurzion M C Mitchell P Moran Dept of Human Nutrition & Food Management The Ohio State University

Adolescent childbearing is associated with adverse maternal and neonatal outcomes. Maternal weight gain is a predictor of infant birth weight. Little is known on the impact of self concept, nutrition attitude & knowledge (NAK) on gestational weight gain. This study examined the relationships among body image (BI), self esteem, NAK, weight gain attitude (WGA), dietary self efficacy, caloric intake and body composition in 31 pregnant adolescents (16+ 14 yo). These variables were assessed using a Likert type questionnaire. Circumferences and fat folds were used to assess body composition and a food frequency questionnaire for dietary intake. BI score (24.9+ 5.6) was significantly positively correlated with WGA (r=0.72 p<0.05) and energy intake (r=0.33 p<0.01). Mean NAK score (46.0+ 4.7) was significantly positively correlated with WGA (r=0.564 p<0.001) and with dietary self efficacy (r=0.577 p<0.001). Mean self esteem score (40.4+ 6.0) was significantly correlated with all the above variables. This study indicates that in pregnant adolescent BI satisfaction and self esteem are positively correlated with attitude toward weight gain and energy intake. Higher scores on NAK scales were associated with more positive attitude toward gestational weight gain and dietary self efficacy. Negative BI and self esteem and low NAK may lead to poor attitude toward weight gain and compromised gestational weight gain and pregnancy outcome in pregnant adolescents. A model to explain the relationship among the above variables in pregnant adolescents is proposed.

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MATERNAL TRIMESTER WEIGHT GAIN AND BIRTHWEIGHT DIFFERENCES BY RACE-ETHNICITY? B. Abrams, S. Selvin, K. Pickett, School of Public Health Univ of CA Berkeley CA 94720

Objective: To compare the relationship between maternal weight gain pattern and birthweight in four race-ethnic groups.
Methods: Uncomplicated, singleton births delivered at the University of California, San Francisco between 1980 and 1990 were eligible. Complete data were available for 3207 white, 714 Hispanic, 1189 Asian and 607 black women. All recorded weight gain measurements were used to estimate maternal trimester gain. We assessed the relationship between trimester gain and fetal birth using multiple linear regression analysis adjusting for six covariates. Findings are statistically significant (p<0.05) unless noted.
Results: Total maternal weight gain was positively and similarly associated with birthweight for all groups. For whites, second trimester gain was more strongly associated with birthweight than for the first and third. Among Hispanics, the second trimester was also most strongly related to birthweight, the first trimester coefficient was half the magnitude and the coefficient for the third trimester was not significant. For the Asian and black groups, weight gain in all three trimesters was associated with birthweight, but the association did not vary significantly by trimester.
Conclusion: In this cohort, specific patterns of maternal weight gain in particular weight gain during the second trimester are related to fetal birth weight in some race-ethnic groups but not others.
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