Key Nutrients in Fetal Development

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Pregnancy! What an exciting yet mysterious word.

Pregnancy

- Achievement of successful pregnancy is three fold:
- Maternal health and well being during pregnancy itself.
- A healthy new born baby.
- Welfare of mother to nurture the new born adequately.

“NUTRIENTS INTRODUCED IN MATERNAL BIOLOGICAL SYSTEM HAS THE POTENTIAL TO INFLUENCE BOTH MATERNAL HEALTH DURING PREGNANCY AND FETAL HEALTH”

Role of Nutrition in Pregnancy

- Fetus carries his own blue print for development.
- Potential of blue print is realized if there is adequate supply of nutrients– energy, substrates and cofactor is sufficient to meet fetal demands.
- Hence a pattern of demands for energy and nutrients is placed on mother at each stage of pregnancy.
- Mother is solely dependent on her dietary needs to meet these demands.
- Hence maternal diet / supplementation becomes critical.

Renewed interest in nutrition during pregnancy

- Theory suggests that term infants who are small for their gestational age have an increased susceptibility to cardiovascular disease and Type II diabetes in adulthood as a consequence of physiologic adaptations to under nutrition during fetal life.

- The epidemiologic studies linking size at birth to disease in adulthood have highlighted the in formativeness of placental weight and thinness at birth, indicated by ponderal index, as markers of fetal growth in addition to weight for gestational age.

- Barker, D.J.P. eds. Fetal and Infant Origins of Adult Disease 1992 British Medical Journal Books London, UK

Traditional dietary concepts in pregnancy

- The general practice in most rural or tribal communities was to restrict dietary intake, especially during the final trimester of pregnancy because the general belief is that a large baby might cause a difficult delivery .
- Eating certain foods is discouraged.
- Concept of “hot” and “ cold” foods.

Nutritional considerations

- Nutritional status has to embrace the consideration of size and body composition.
- Quantity and quality of current intake.
- Her metabolic capacity and energy reserves.
- It should embrace the maternal needs and be sufficient to support the demands for successful and effective lactation .

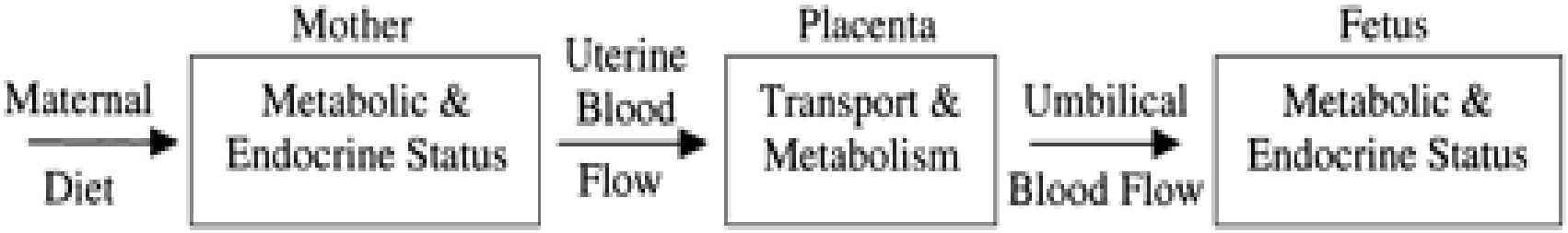
- Public health nutrition:4(2B),625-630

Effect of Diet on Neonate

- It is biologically plausible that nutritional effects on the fetus could vary with the time of pregnancy, because fetal development and nutrient needs are structured in time.
- Changes in nutritional needs have been identified even during the embryonic stage, with growth initially depending on simple molecules such as pyruvate, then being influenced more by amino acid concentrations.
- Animal experiments show that the consequences of nutritional interventions during pregnancy can depend on the timing .
- Nutritional conditions may be especially important in early pregnancy, when placental function is established because inadequate maternoplacental supply often underlies later manifestation of growth failure.

- Martin, P. M., Sutherland, A. E. & Van Winkle, L. J. (2003) Amino acid transport regulates blastocyst implantation. Biol. Reprod. 69:1101-1108.
- Harding, J. E. (2001) The nutritional basis of the fetal origins of adult disease. Int. J. Epidemiol. 30:15-23

Fetal Supply Line



International Journal of Epidemiology 2001;**30**:15-23

Maternal Vs Fetal Nutrition

- Common clinical causes of impaired fetal growth.
- Maternal hypertension associated with reduced uterine blood flow.
- Placental infarcts resulting in reduced placental transfer capacity, may severely limit fetal nutrient supply without a corresponding change in maternal nutrition.
- Much confusion and debate in the literature about the relevance of nutrition to human fetal growth has arisen from failure to make this distinction between maternal nutrition (relatively easy to measure but relatively less important) and fetal nutrition (very difficult to measure but very important).

Type of Nutrient and fetal birth weight

- There is an influence of different energy sources, for a given energy intake, on birth size.
- Godfrey and colleagues reported that the positive association between maternal protein intake in late pregnancy and placental weight reflected by the dairy intake, whereas birth weight was more closely related to meat protein intake.
- Rao et al. , in a study of pregnant Indian women, observed that the frequency of consumption of milk and green leafy vegetables was positively associated with birth dimensions of the baby.
- Chang et al. found that dairy product intake among pregnant African-American adolescents had a positive effect on fetal femur growth and attributed this to the calcium content of dairy foods.
- Differences between protein sources in relation to placental or fetal growth could reflect differences in the micronutrient content, but could also be due to differences in amino acid composition and metabolic consequences.
- In studies of animals, for example, the type of protein fed to rats was shown to influence body weight, visceral fat storage, and insulin sensitivity.

- Rao, S., Yajnik, C. S., Kanade, A., Fall, C.H.D., Margetts, B. M., Jackson, A. A., Shier, R., Joshi, S. & Rege, S., et al (2001) Intake of micronutrient-rich foods in rural Indian mothers is associated with the size of their babies at birth: Pune Maternal Nutrition Study. J. Nutr. 131:1217-1224
- 31. Chang, S.-C., O'Brien, K. O., Nathanson, M. S., Caulfield, L. E., Mancini, J. & Witter, F. R. (2003) Fetal femur length is influenced by maternal dairy intake in pregnant African American adolescents. Am. J. Clin. Nutr. 77:1248-1254.[Abstract/
- 32. Belobrajdic, D., McIntosh, G. & Owens, J. (2003) The effects of dietary protein on rat growth, body composition and insulin sensitivity. Asia Pac. J. Clin. Nutr. 12:S42.

Timing and balance of nutrients

- Balance of macro- and micro-nutrients reaching the fetus and the timing of any changes in their supply is likely to be important in determining the effects on fetal growth and later physiology.

- Randomized controlled trials of maternal dietary supplements show relatively little effect on birthweight overall, supplements with a relatively high proportion of calories provided as protein actually resulted in reduced mean birthweight.

- The mechanisms of this effect are not known. However, amino acids are transported across the placenta to the fetus by a number of amino acid transporters. Increasing availability of some amino acids may therefore result in competition for transporters and reduce the availability of other amino acids to the fetus, potentially limiting growth.

Timing and balance of nutrients

- Godfrey *et al.* have shown in a relatively well-nourished population that a combination of high carbohydrate in early pregnancy and low protein intake in late pregnancy was associated with reduced birthweight, low ponderal index and reduced placental weight.

- The proportions of protein and carbohydrate in women's diets during pregnancy have also been shown to influence placental size and the blood pressure of their adult offspring.

- Kudo Y, Boyd CAR. Transport of amino acids by the human placenta: predicted effects thereon of maternal hyperphenylalaninaemia. *J Inher Metab Dis* 1990;**13:**617–26.
- Godfrey K, Robinson S, Barker DJP, Osmond C, Cox V. Maternal nutrition in early and late pregnancy in relation to placental and fetal growth. *BMJ* 1996;**312:**410–14.
- Godfrey KM, Barker DJ, Robinson S, Osmond C. Maternal birthweight and diet in pregnancy in relation to the infant's thinness at birth. *Br J Obstet Gynaecol* 1997;**104:**663–67.
- Campbell DM, Hall MH, Barker DJ, Cross J, Shiell AW, Godfrey KM. Diet in pregnancy and the offspring's blood pressure 40 year later. *Br J Obstet Gynaecol* 1996;**103:**273–80

Markers of nutritional deficiency in fetal age

- Body proportions provide information about the timing of nutritional insults leading to the limitation of fetal growth.
- Thus a baby which is proportionately small in weight, length and head circumference at birth is presumed to have suffered from nutrient limitation in early pregnancy
- While a baby of similarly low birth weight who is relatively long and thin is presumed to have suffered nutrient limitation in late pregnancy.
- These two patterns are commonly referred to as **symmetrical and asymmetrical growth restriction**

- Barker DJP. Fetal origins of coronary heart disease. *BMJ* 1995;**311:** 171–74.
- Barker DJP, Martyn CN, Osmond C, Weild GA. Abnormal liver growth *in utero* and death from coronary heart disease. *BMJ* 1995;**310:**703–04.
- Dennison E, Fall C, Cooper C, Barker D. Prenatal factors influencing long-term outcome. *Horm Res* 1997;**48:**25–29

Nutritional needs during pregnancy

- Determination of nutrient needs during pregnancy is complicated because nutrient levels in tissues and fluids available for evaluation and interpretation are normally altered by hormone-induced changes in metabolism, shifts in plasma volume and changes in renal function and patterns of urinary excretion.
- Nutrient concentrations in blood and plasma are often decreased because of expanding plasma volume, although total circulating quantities can be greatly increased.
- Individual profiles vary widely, but in general, water-soluble nutrients and metabolites are present in lower concentrations in pregnant than in nonpregnant women whereas fat-soluble nutrients and metabolites are present in similar or higher concentrations.
- Homeostatic control mechanisms are not well understood and abnormal alterations are ill-defined.

- J. Nutr. 133:1997S-2002S, June 2003

Recommended weight gain

- In 1990, the Institute of Medicine (IOM) recommended Gestational Weight Gain ranges for women on the basis of body mass index (BMI; in kg/m2):

- 12.5–18 kg for those with a low BMI (<19.8),
- 11.5–16 kg for those with a normal BMI (19.8–26.0),
- 7.0–11.5 kg (overweight, BMI >26.0–29.0)
- 6 kg (obese, BMI >29.0) for those with a high BMI.

- The recommended ranges were derived from the observed weight gains of women delivering full-term, healthy infants without complications .

- Institute of Medicine, Food and Nutrition Board. Nutrition during pregnancy, weight gain and nutrient supplements. Washington, DC: National Academy Press, 1990

RECOMMENDED DAILY ALLOWANCES

FEMALE RDA (BY AGE)	15 - 18	19 -24	25 - 50	51+	PREGNANT
CALORIES	2200	2200	2200	1900	+300
PROTEIN	44	46	50	50	60
VITAMIN E	8	8	8	8	10
VITAMIN K	55	60	65	65	65
VITAMIN C	60	60	60	60	70
THIAMIN	1.1	1.1	1.1	1.0	1.5
RIBOFLAVIN	1.3	1.3	1.3	1.2	1.6
NIACIN	15	15	15	13	17
VITAMIN B6	1.5	1.6	1.6	1.6	2.2
FOLATE	180	180	180	180	400
VITAMIN B12	2.0	2.0	2.0	2.0	2.2
IRON	15	15	15	10	30
ZINC	12	12	12	12	15
SELENIUM	50	55	55	55	65

Energy needs in pregnancy

- Energy needs during pregnancy are currently estimated to be the sum of total energy expenditure of a non pregnant woman plus the median change in total energy expenditure of 8 kcal/gestational week plus the energy deposition during pregnancy of 180 kcal/d.
- Because total energy expenditure does not change greatly and weight gain is minimal in the first trimester.
- Additional energy intake is recommended only in the second and third trimesters.
- Approximately an additional 340 and 450 kcal are recommended during the second and third trimesters, respectively.

- Institute of Medicine (2002) DRI Dietary Reference Intakes for Energy, Carbohydrates, Fiber, Fat, Protein and Amino Acids (Macronutrients) 2002 National Academy Press Washington, DC .

Calories in pregnancy

- Total cost of pregnancy is335 MJ
- Increase energy intake appears to be modest and less than estimated energy needs.
- Traditionally caloric requirement in pregnancy have been estimated to be around additional 300 Kcal/day.
- This increased requirement must be adjusted for physical activity and pre pregnancy weight.
- Recommendations for energy intake in pregnant women must be population-specific because of differences in body size and lifestyles.
- The extent to which women change their habitual activity patterns during pregnancy will be determined by socioeconomic and cultural factors specific to the population

Carbohydrate recommendation in pregnancy

- High carbohydrate intake in early pregnancy suppresses placental growth, especially if combined with a low dairy protein intake in late pregnancy.
- Consumption of diets rich in sugar among low income, pregnant adolescents is associated with a twofold increased risk for delivering a SGA infant.
- No recommendation has been provided for sugar intake by the RDA (NRC 1989), but an intake below 10% of total energy intake is usually considered acceptable.
- Women with high sugar consumption took in relatively less total fat, protein, calcium and zinc .
- There is increasing evidence from animal studies that dietary sugar elevate insulin and increase insulin resistance and blood pressure (BP) .
- Eating primarily high-glycaemic carbohydrate results in feto-placental overgrowth and excessive maternal weight gain, while intake of low-glycaemic carbohydrate produces infants with birth weights between the 25th and the 50th percentile and normal maternal weight gain

- The Journal of Nutrition Vol. 127 No. 6 June 1997, pp. 1113-1117
- Proc Nutr Soc. 2002 Feb;61(1):45-50

Open Access Research

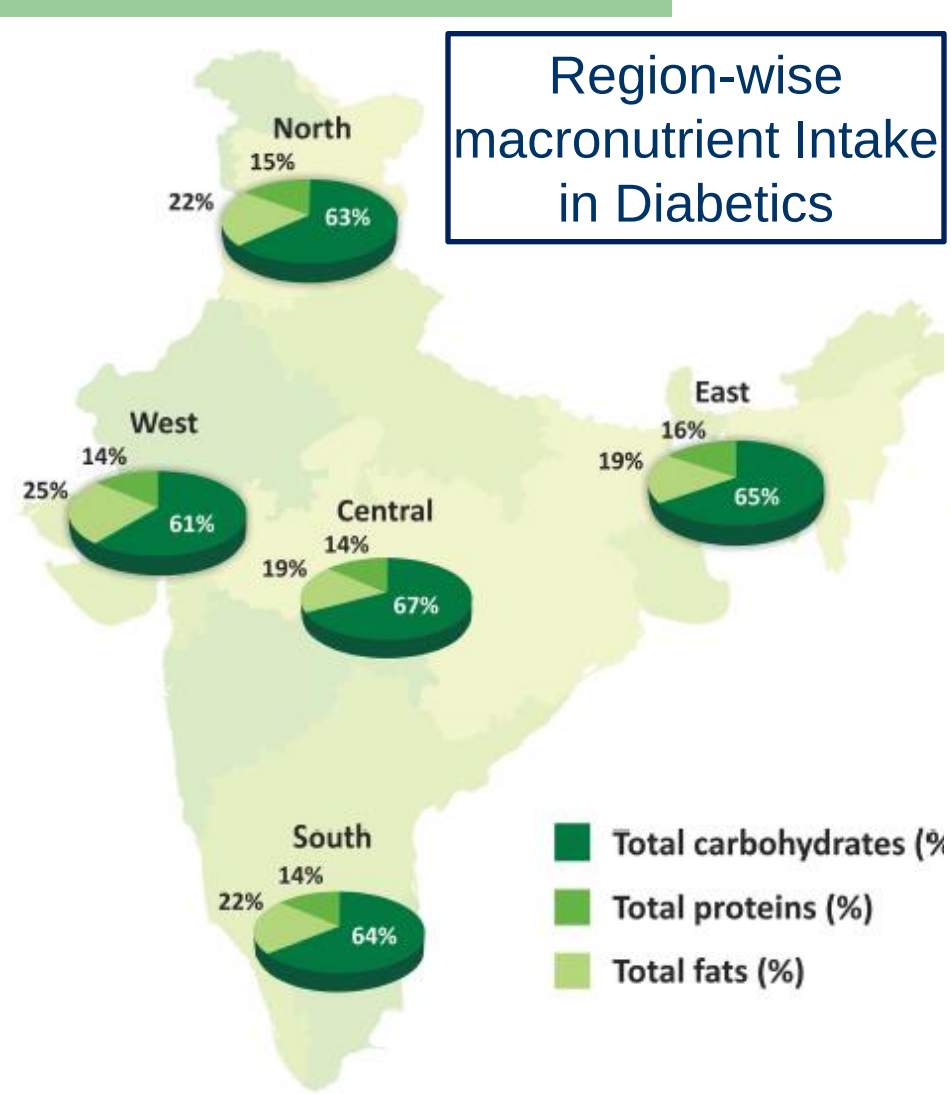
BMJ Open

Results from a dietary survey in an Indian T2DM population: a STARCH study

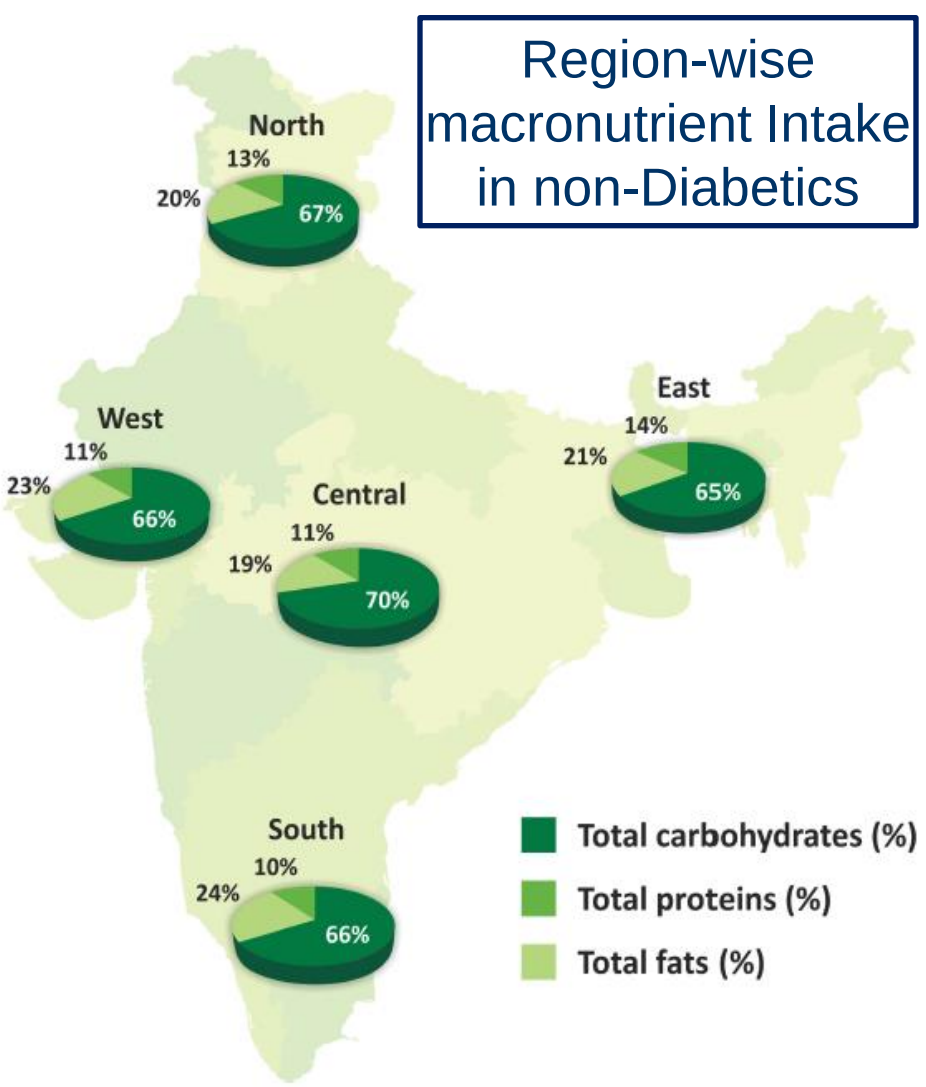
Shashank R Joshi, Anil Bhansali, Sarita Bajaj, Subodh S Banzal, Mala Dharmalingam, Shachin Gupta, Satinath Mukhopadhyay, Parag R Shah, Rakesh Sahay, Swapan Sarkar, PV Manjrekar, Rahul T Rathod, **Shilpa S Joshi**

Joshi SR, et al. Results from a dietary survey in an Indian T2DM population: a STARCH study.BMJ Open 2014;4:e005138 doi:10.1136/bmjopen-2014-005138

Region-wise macronutrient Intake in Diabetics



Region-wise macronutrient Intake in non-Diabetics



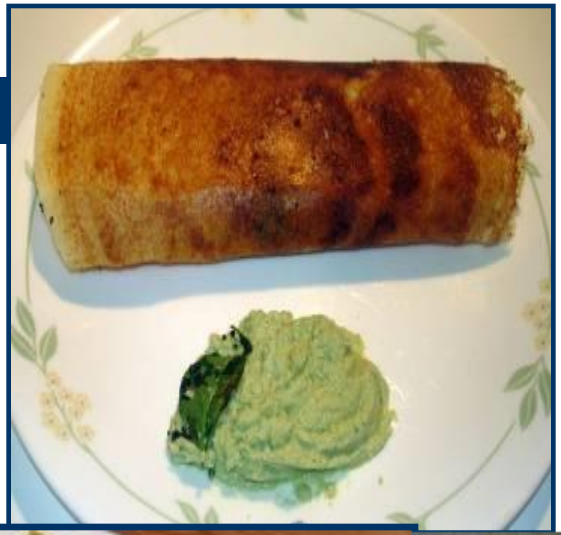
T2DM participants belonging to any part of India consume high carbohydrate in their diet if we compare with dietary recommendations

T2DM participants seem to be well aware of the importance of restricting the consumption of simple carbohydrate to <10%

Joshi SR, et al. Results from a dietary survey in an Indian T2DM population: a STARCH study.BMJ Open 2014;4:e005138 doi:10.1136/bmjopen-

Indian Food options …. All carbs!!!







Protein in pregnancy

- Balanced protein –energy supplementation resulted in a significant reduction in small for gestation age infants.
- Trials in which greater than 25% of energy came from protein was associated with an increased incidence of small for gestation age infants.
- Additional protein is needed during pregnancy to cover the estimated 21 g/d deposited in fetal, placental and maternal tissues during the second and third trimesters.
- Women of reproductive age select diets containing average protein intakes of 70 g/d , a value very close to the theoretical need of 71 g during pregnancy.

- Alaimo, K., McDowell, M. A., Briefel, R..R., Bischof, A. M., Caughman, C. R., Loria, C. M. & Johnson, C. L. (1994) Energy and macronutrient intakes of persons ages 2 months and over in the United States: NHANES III, phase 1, 1988–91. Adv. Data. 258:1-28.

Protein and pregnancy outcomes

- Roseboom et al. reported that among individuals who were in utero at the time of the Dutch famine in World War II, adult blood pressure was inversely related to the ratio of protein to carbohydrate in the mother's diet during the 3rd trimester of pregnancy.
- Campbell et al. located some 200 men and women born in Aberdeen between 1948 and 1954, whose mothers had completed a dietary survey during pregnancy. When the mother's intake of animal protein during pregnancy had been <50 g/d, there was a positive association between maternal carbohydrate intake and blood pressure of the offspring at age 40 y; when maternal intake of protein was >50 g/d, the association was inverse.
- Shiell et al. assessed the blood pressure of >500 individuals at age 30 y born to women who had lived in Motherwell, UK, and been encouraged to consume a pound of meat per day during pregnancy; elevated blood pressure was observed among individuals whose mothers had high intakes of meat and fish but low carbohydrate during late pregnancy.

- Roseboom, R. J., vander Meulen, J.H.P., van Montfrans, G. A., Ravelli, A.C.J., Osmond, C., Barker, D.J.P. & Bleker, O. P. (2001) Maternal nutrition during gestation and blood pressure in later life. J. Hypertens. 19:29-34.
- 36. Campbell, D. M., Hall, M. H., Barker, D.J.P., Cross, J., Shiell, A. W. & Godfrey, K. M. (1996) Diet in pregnancy and the offspring's blood pressure 40 years later. Br. J. Obstet. Gynaecol. 103:273-280.
- 37. Shiell, A. W., Campbell-Brown, M., Haselden, S., Robinson, S., Godfrey, K. M. & Barker, D.J.P. (2001) A high meat, low carbohydrate diet in pregnancy: relation to adult blood pressure in the offspring. Hypertension 38:1282-1288

Fat recommendation for pregnancy

- Dietary fat intake during pregnancy and lactation, as a proportion of energy intake, should be the same as for the general population.
- The n-3 LC PUFA, DHA should be deposited in adequate amounts in the brain and other tissue during fetal and early post natal life.
- Pregnant women should aim at achieving a dietary intake of n-3 PUFA that supplies a DHA intake of at least 200mg/day.
- Intakes of 1g/day DHA or 2.7g/dn-3 LC PUFA have been used in clinical trails without significant adverse effect.
- Women can meet this recommendation by consuming 2 portion of oily fish /sea fish per week.
- Dietary fish should be selected from large range of fishes available with out undue preference to large predatory fish which is more likely to be contaminated by methyl mercury.

- British journal of nutrition (2007),98,873-877

Iron

- Total iron cost of pregnancy is estimated at 1040 mg
- Of which 200 mg are retained by the woman when blood volume decreases after delivery and 840 mg are permanently lost.
- Iron is transferred to the fetus (300 mg) and used for the formation of the placenta (50–75 mg), expansion of red cell mass (450 mg) and blood loss during delivery (200 mg).
- Hemoglobin concentration declines during pregnancy along with serum iron, percentage saturation of transferrin and serum ferritin.
- Although these decreases reflect hemodilution to a large extent, transferrin levels actually increase from mean nonpregnant values of 3 mg/L to 5 mg/L in the last trimester of pregnancy, perhaps to facilitate iron transfer to the fetus.
- Enhanced intestinal iron absorption (two- to threefold) is an important physiological adjustment that assists pregnant women in meeting the requirement for absorbed iron, which is estimated to be 3 mg/d.
- Maternal anemia is associated with perinatal maternal and infant mortality and premature delivery.

Iron

- To preserve maternal stores and to prevent the development of iron deficiency, the recommended iron intake during pregnancy is increased by 9 mg to a total of 27 mg/d.
- This level cannot normally be obtained from foods, and supplementation is required to achieve recommended intakes.
- The routine use of iron supplements during pregnancy, however, is not universally endorsed.

- Institute of Medicine (2001) DRI Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc 2001 National Academy Press Washington, DC .

There are two types of iron found in food.

1. Heme iron is found in animal products such as red meat, fish and poultry.

2. Non-heme iron is found in plant products, such as grains, beans, legumes, nuts, vegetables and fruit.

Iron from animal products is better absorbed than iron from plant products. If lady doesnot eat any animal products, she will need to eat twice as much non-heme iron.

How to incorporate Fe rich foods

- Greens can be incorporated in the *dals* (lentils) or can be mixed with dough to make yummy *paratha* . Boiled pulses in form of chaat
- Add dried fruits such as apricots, prunes, raisins and dates to cream of wheat or enriched oatmeal.
- Garden Cress is added to soups, sandwiches and salads for its tangy flavor.
- If you are non-vegetarian, then options are more! Lean red meat is an excellent source of iron. Eggs are an excellent source of protein and iron, along with the fat soluble vitamin A that is essential for the immune system. Eggs can be easily included in your diet as breakfast or snack item



Nutrients	Food Groups	Foods	Nutrient content for 100 g edible portion
Iron	Green leafy vegetables	Amaranth, bengalgram leaves, cauliflower greens and radish leaves	18-40 mg

Dietary Guidelines For Indians,
National Institute of Nutrition

Nutrients	Food Groups	Foods	Nutrient content for 100 g edible portion
Vitamin C	Green leafy vegetables	Agathi, cabbage, coriander leaves, drumstic leaves, knol-khol greens	120-220 mg
	Other vegetables	Giant chillies *(capsicum)*	137 mg
		Green chillies	117 mg
	Fruits	Amla	600 mg
		Guava	212 mg

Dietary Guidelines For Indians,
National Institute of Nutrition

Iodine

- Maternal iodine deficiency leading to fetal hypothyroidism results in cretinism, characterized by severe mental retardation.
- Thyroid hormones are critical for normal brain development and maturation.
- Manifestation of other features of cretinism (deafmutism, short stature and spasticity) depends on the stage of pregnancy when hypothyroidism develops.
- When it develops late in pregnancy, the neurological damage is not as severe as when it exists early in pregnancy.
- Cretinism is prevented by correcting maternal iodine deficiency before or during the first 3 mo of pregnancy.
- The World Health Organization estimates that 20 million people worldwide have brain damage resulting from maternal iodine deficiency that could be prevented by iodine supplementation.
- The recommended iodine intake is 220 µg/d during pregnancy .

- Dunn, J. T. & Delange, F. (2001) Damaged reproduction: the most important consequence of iodine deficiency. J. Clin. Endocrinol. Metab. 86:2360-2363

Hytten, F. E. & Leitch, I. (1971) The physiology of human pregnancy 2nd ed. 1971 Blackwell Scientific Publications Oxford, United Kingdom

Hetzel, B. S. (1994) Iodine deficiency and fetal brain damage. N Engl J Med 331:1739-1744

Folate

- Maternal folate intake or status is associated with several negative pregnancy outcomes including low birth weight, abruptio placentae, risk for spontaneous abortions and neural tube defects.
- Folic acid supplementation prevents both the occurrence and recurrence of neural tube defects and significantly reduces the incidence of low birth weight .
- The recommended intake for folate during pregnancy is 600 µg/d.
- It will be important to evaluate the extent to which folic acid fortification increases intake of reproducing women, decreases neural tube defects and affects growth and development of the fetus.

- Bailey, L. B., Rampersaud, G. C. & Kauwell, G.P.A. (2003) Folic acid supplements and fortification affects the risk for neural tube defects, vascular disease and cancer: evolving science. J. Nutr. 133:1961S-1968S.
- de Onis, M., Villar, J. & Gulmezoglu, M. (1998) Nutritional interventions to prevent intrauterine growth retardation: evidence from randomized controlled trials. Eur. J. Clin. Nutr. 52:S83-S93.
- Cogswell, M. E., Kettel-Khan, L. & Ramakrishnan, U. (2003) Iron supplement use among women in the United States: science, policy and practice. J. Nutr. 133:1974S-1977S

Nutrients	Food Groups	Foods	Nutrient content for 100 g edible portion
Folic Acid	Green leafy vegetables	Amaranth, *ambat chukka*, mint and spinach	120 mg
	Pulses	Bengalgram, blackgram, greengram and redgram	120 mg
	Oilseeds	Gingelly and soyabean	180 mg

Dietary Guidelines For Indians,
National Institute of Nutrition

Excellent food sources of folate include:

- Asparagus
- Bran flakes
- Broccoli
- Chick peas
- Dried beans
- Lentils
- Spinach.
- **Very good food sources of folate include**:
- Cabbage
- Cauliflower
- Oranges
- Peas
- Wheat germ
- Wholegrain bread.
- **Good food sources of folate include:**
- Parsnips
- Potato
- Salmon
- Strawberries
- Tomato

Vitamin B_{12}

- Women in India have deficiency of Vitamin B12.
- Oral contraceptives are know to reduce serum B12 levels.
- Works with folic acid in cell growth and is essential to the normal development of the infant.
- Maternal B12 and folate concentrations predicts child's neurocognitive functions.
- Generally adequate amounts are obtained through animal products
  - Fish, eggs, milk, meats, etc.
- Vegans that do not have any animal products in their diet need supplementation

FOLATE AND B12

- These micronutrients regulate C1 metabolism.
- Folate and B12 are methyl donors in diet and methylation of DNA is major mechanism of regulation of gene expression.
- Imbalances in B12 and folate nutrition results in disturances in 1c metabolism and result in epidemic of adiposity and type 2 diabetes in India.
- Maternal folate conc were directly related to adiposity in child at 6 years of age.
- Low B12 status in mother predicted insulin resistance in the baby.
- Most insulin resistant children were born to mothers with low B12 and highest folate status.

Calcium

- The most exciting challenge of nutritional therapy is prevention of pregnancy induced hypertension, who treatment after manifestation is poor.
- Overwhelming evidence exist for role of calcium and vit D for prevention of PIH
- Supplementation with1 g calcium is associated with halving the risk of pre-eclampsia.
- 24% reduction in risk ratio of preterm births overall and by 55% in women at high risk of pre eclampsia.

- Hofmeyr et al calcium supplementation during pregnancy for preventing hypertensive disorders and related problems. The cochrane library 2011.

Nutrients	Food Groups	Foods	Nutrient content for 100 g edible portion
Calcium	Cereals and Legumes	Ragi, bengalgram (whole), horsegram (whole), rajmah and soyabean	200-340 mg
	Green leafy vegetables	Amaranth, cauliflower greens, curry leaves, knol-khol leaves	500-800 mg
		Agathi	1130 mg
		Colocasia leaves	1540 mg
	Nuts and Oilseeds	Coconut dry, almond, mustard seeds and sunflower seeds	130-490 mg
		Gingelly seeds	1450 mg
		Cumin seeds	1080 mg
	Fish	Bacha, katla, mrigal, pran and rohu	320-650 mg
	Milk and Milk Products	Buffalo's milk, cow's milk, goat's milk, curds (cow's)	120-210 mg
		Cheese, *khoa*, skimmed milk powder and whole-milk powder	790-1370 mg

Vitamin D / 25-hydroxycholecalciferol

- The biologically active form of the vitamin, 1,25-dihydroxycholecalciferol, circulates in bound and free forms and both are elevated in pregnancy.
- All forms of vitamin D are transported across the placenta to the fetus.
- Vitamin D deficiency during pregnancy is associated with several disorders of calcium metabolism in both the mother and her infant, including neonatal hypocalcemia and tetany, infant hypoplasia of tooth enamel and maternal osteomalacia.
- Supplementation of 10 µg (400 IU)/d in affected women lowered the incidence of neonatal hypocalcemia and tetany and maternal osteomalacia whereas higher amounts (25 µg/d) increased weight and length gains in infants postnatally.
- The prevalence of vitamin D deficiency is high in pregnant Asian women in England and in pregnant women in other European countries .
- Food sources of vitamin D are few and no increase in vitamin D intake during pregnancy is recommended.

- . Paulson, S. K. & DeLuca, H. F. (1986) Vitamin D metabolism during pregnancy. Bone 7:331-336.
- . Specter, B. L. (1994) Do North American women need supplemental vitamin D during pregnancy or lactation?. Am. J. Clin. Nutr. 59:484S-490S.
- . Brooke, O. G., Butters, F. & Wood, C. (1981) Intrauterine vitamin D nutrition and postnatal growth in Asian infants. Br. Med. 283:1024

Indian Maternal nutrition

- Relationship of maternal nutrition with birth size is influenced by many biological as well as socio-economic factors.
- In India, poor fetal growth has been attributed to widespread maternal under-nutrition .
- Recent study on the rural undernourished Indian women, strong associations of birth size were not observed with maternal consumption of macronutrients but only with consumption of micronutrient rich foods such as green leafy vegetables (GLV) and fruits.

- Gopalan C: Low birthweight: Significance and implications nutrition in children. In Sachdev HPS, Chaudhury P (eds): "Developing Country Concerns." New Delhi: Imprint,1994 .
- Rao S, Yajnik CS, Kanade AN, Fall CH, Margetts BM, Jackson AA, Shier R, Joshi S, Rege S, Lubree H, Desai B: Intake of micronutrient-rich foods in rural Indian mothers and size of their babies at birth: Pune Maternal Nutrition Study.J Nutr131 :1217 –1224,2001

Diets of Indian Pregnant women

- Mean energy and protein intakes at 18th wk gestation were inadequate and were low as compared to RDA for Indian pregnant women.
- The intakes were low mainly due to high prevalence of nausea (50.8%) reported within first 3–4 months.
- However, intakes improved considerably by 28th wk of gestation meeting the nutrient requirements.
- Their diets were rich in fats (31% of total energy) but were low in carbohydrates (58% of total energy).
- Milk, fried snacks, sweets and bakery products were major contributors (20 %) to dietary fat intakes.
- Apart from cereals and pulses, milk and non-vegetarian items contributed about 13 % to protein intakes.
- The activity pattern remained similar throughout the pregnancy.

- Kanade,Rao etal Maternal Nutrition and birthsize among urban affulent and rural women in India . AJCN,no 1,137-145(2008)

Diet weight correlations

- Simple product moment correlations showed that birth weight of babies was not related to maternal energy intakes, nor to physical activity at 18 and 28 wk gestation.
- Protein intake (28th wk) and fat intake (18th wk); absolute as well as percent of total energy; were related to birth weight ($p < 0.05$).
- Additionally, fat intakes were correlated with triceps skin fold thickness ($p < 0.01$).
- In contrast, percent calories from carbohydrates (18th wk) were inversely correlated with birth weight and triceps ($p < 0.001$).
- These associations remained significant even after adjustment for maternal size (pre-pregnant weight / height / body mass index).

- Kanade,Rao etal Maternal Nutrition and birthsize among urban affulent and rural women in India . AJCN,no 1,137-145(2008)

Effect of Fruit consumption in Indian mothers

- Fruit consumption in urban affluent women was relatively high.
- Commonly consumed fruits were apple (55%), banana (49%), sapota (38%), mango (24%) and orange/sweet lemon (32%) etc.
- It was observed that the frequency of consumption of fruits at 18th wk was related to birth length ($p < 0.05$) after adjusting for gestation, sex and parity .
- The association remained significant even after adjusting for prepregnant weight (height or BMI).
- The relative risk of delivering short (lower tertile of length) babies was 2.8 times higher in mothers who ate fruits less than once a day than in mothers who had higher consumption of fruits (more than once a day).
- Fruits are rich sources of micronutrients especially vitamins and antioxidants and its association at 18th wk when energy intakes are low assumes significance.

- Kanade,Rao etal Maternal Nutrition and birthsize among urban affulent and rural women in India . AJCN,no 1,137-145(2008)

- .

Effect of dairy consumption in Indian Women

- Milk was consumed consciously during pregnancy by majority of women. In fact, 40% women used to drink it thrice a day. Consumption of milk at 28th wk was associated ($p < 0.05$) with triceps skin fold .
- The odds ratio delivering thin (lower tertile of triceps skinfold) babies was 0.36 in mothers who took milk thrice a day compared with 1.0 in mothers who took it less than twice a day.
- Associations of bone outcomes in the children with estimated maternal calcium intakes were weak, compared with those with milk and milk product intakes.

- The Journal of Clinical Endocrinology & Metabolism Vol. 91, No. 8 2994-3001

Effect of Green Leafy Vegetables (GLV) in Indian Mothers

- The frequency of consumption of GLV at 28 wk was strongly related to all birth measurements.
- These relationships remained significant after adjustment for prepregnancy weight (or height and BMI), energy intakes, physical activity score, weight gain during pregnancy and socioeconomic status .
- An increase in frequency of consumption was associated with an increase in birth weight of 19 g after adjustments for all of these factors.
- The trend with birth weight was stronger among the lightest mothers, those with a prepregnancy weight below the lowest tertile (40 kg).
- *Journal of Nutrition.* 2001;131:1217-1224.)

Urban – rural Indian pregnant women

- Urban affluent mothers had a good pre-pregnant nutritional status .
- Weight gain (18th wk or 28th wk of gestation) was not associated with birth weight or length but pre-pregnant nutritional status was strongly related with birth weight in rural as well as urban mothers indicating importance of good pre-pregnant nutritional status.
- Rural babies had significantly low birth weight, skin fold thickness at triceps and ponderal index in comparison to urban babies, but had comparable mean values for length, head circumference and mid-arm circumference.
- Preservation of head circumference in rural babies in spite of chronic undernutrition of their mothers renders some support to the observations of brain sparing.
- In addition, preservation of length in rural babies highlighting similar importance for skeletal growth in the event of maternal undernutrition.

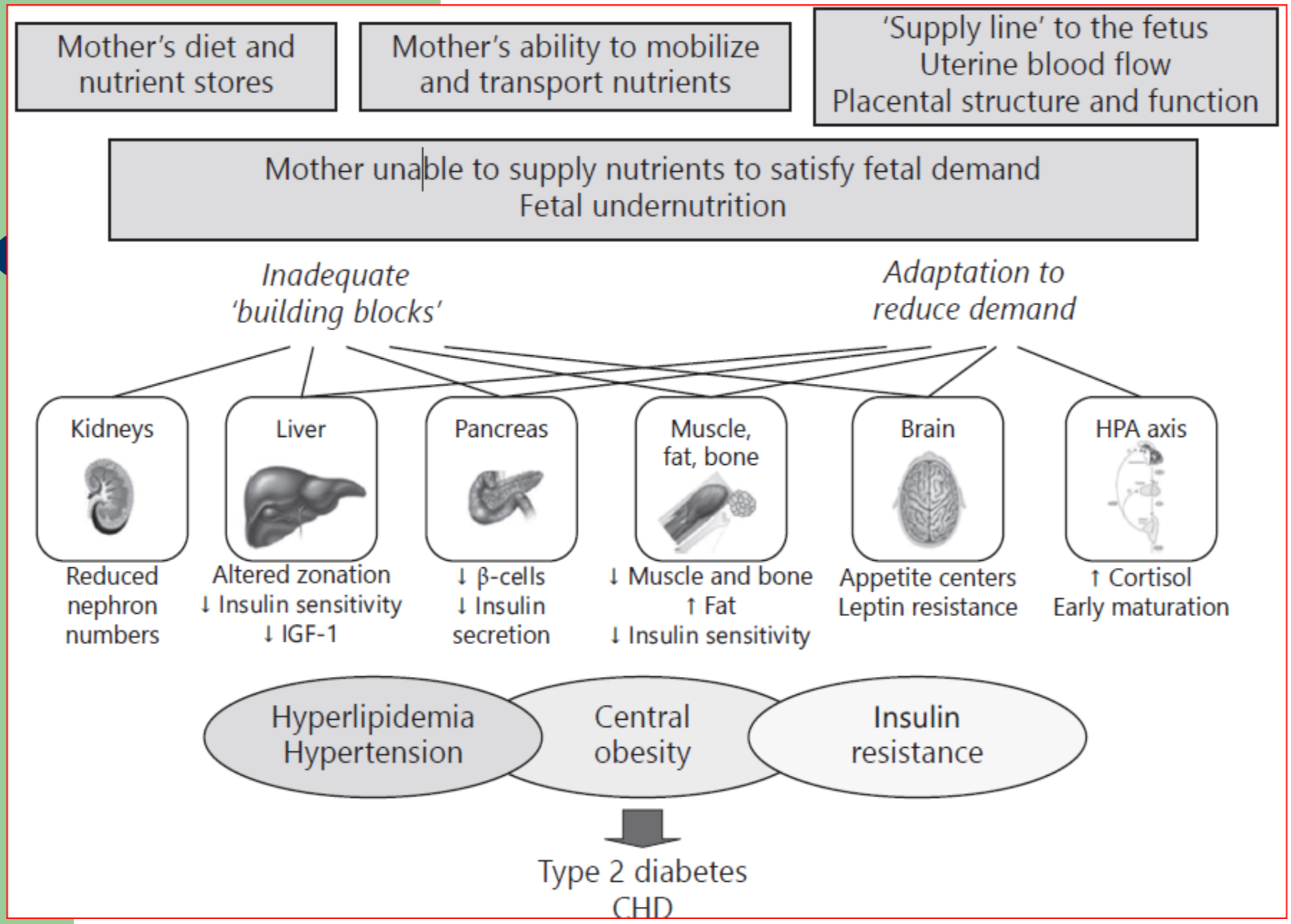
- Vijayalaxmi P, Kuputhai U, Meenakshi Devi N: Nutritional profile of selected expectant mothers and the cost of pregnancy.Ind J Nutr Diet25 :247 –253,1988 .
- Devi SB, Singh KJ, Devi YL, Singh WG: Maternal and neonatal anthropometric and haematological parameters in Manipuri population.Ind Pediatr26 :673 –677,1989 .
- Piers LS, Diggavi S, Thangam S, Raaij JMA, Shetty P, Hautvast JGAJ: Changes in energy expenditure, anthropometry and energy intake during the course of pregnancy and lactation in well-nourished Indian women.Am J Clin Nutr61 :501 –513,1995 .

Food or pharmacology is the best means of providing micronutrients?

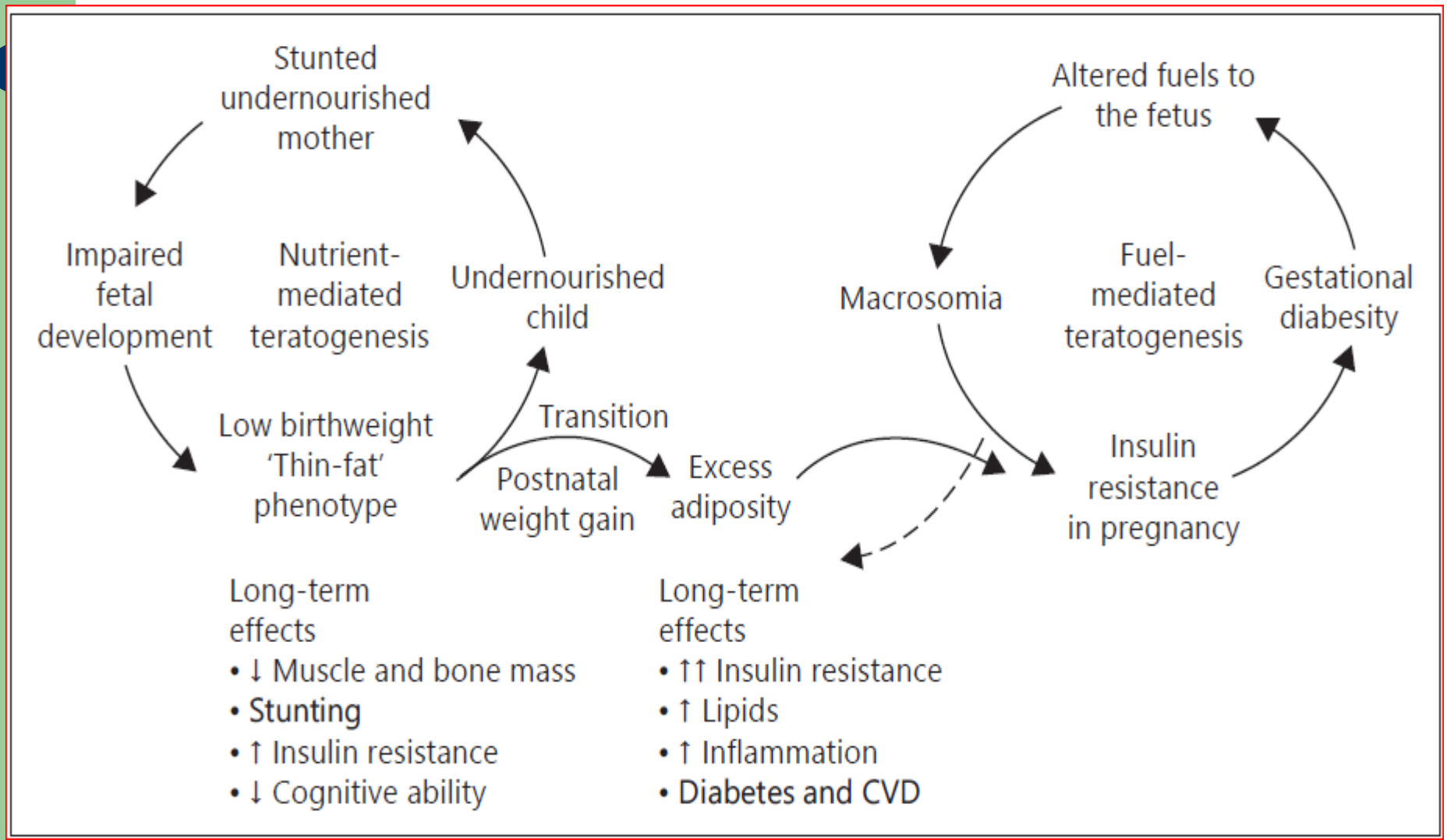
- There is some evidence that supplementation with folate in pregnancy leads to improved fetal growth.
- An evaluation of India's long-standing anemia prophylaxis program, with routine iron and folate supplementation to women in the third trimester of pregnancy for the past two decades, demonstrates no significant impact on birth weight.
- It may be that the micronutrient-rich foods provide a more effective combination of nutrients than do conventional supplements that contain only one or two micronutrients or macronutrients.
- Thus, food-based interventions may be more beneficial .
- *Journal of Nutrition.* 2001;131:1217-1224

Effect of Antenatal nutrition on fetus

- Metabolic programming is the phenomenon whereby an altered nutritional experience (overlapping with the critical window of organogenesis during early periods in life) by permanently modifying metabolic processes in the organism predisposes it for the onset of diseases later in life.


Mother's diet and nutrient stores
Mother's ability to mobilize and transport nutrients
'Supply line' to the fetus
Uterine blood flow
Placental structure and function
Mother unable to supply nutrients to satisfy fetal demand
Fetal undernutrition
Inadequate 'building blocks'
Adaptation to reduce demand
Kidneys
Liver
Pancreas
Muscle, fat, bone
Brain
HPA axis
Reduced nephron numbers
Altered zonation
↓ Insulin sensitivity
↓ IGF-1
↓ β-cells
↓ Insulin secretion
↓ Muscle and bone
↑ Fat
↓ Insulin sensitivity
Appetite centers
Leptin resistance
↑ Cortisol
Early maturation
Hyperlipidemia
Hypertension
Central obesity
Insulin resistance
Type 2 diabetes
CHD

Intergenerational effects of fetal nutrition on diabetes risk.



Epigenetics

- The term epigenetics refers to heritable changes in gene expression that are driven by extracellular stimuli and mechanisms that act on DNA but without changing the DNA sequence.
- The main epigenetic mechanisms are DNA methylation, histone modification, and microRNAs.
- Maternal suboptimal nutrition leads to a range of physiological and cellular adaptive responses in key organ systems, therefore there must be a retained memory of the perturbed environment in early life.
- There is growing evidence that this cellular memory may be mediated by changes in the epigenome.

- Daniella E. Duque-Guimaraes and Susan E. Ozanne, Nutritional programming of insulin resistance:

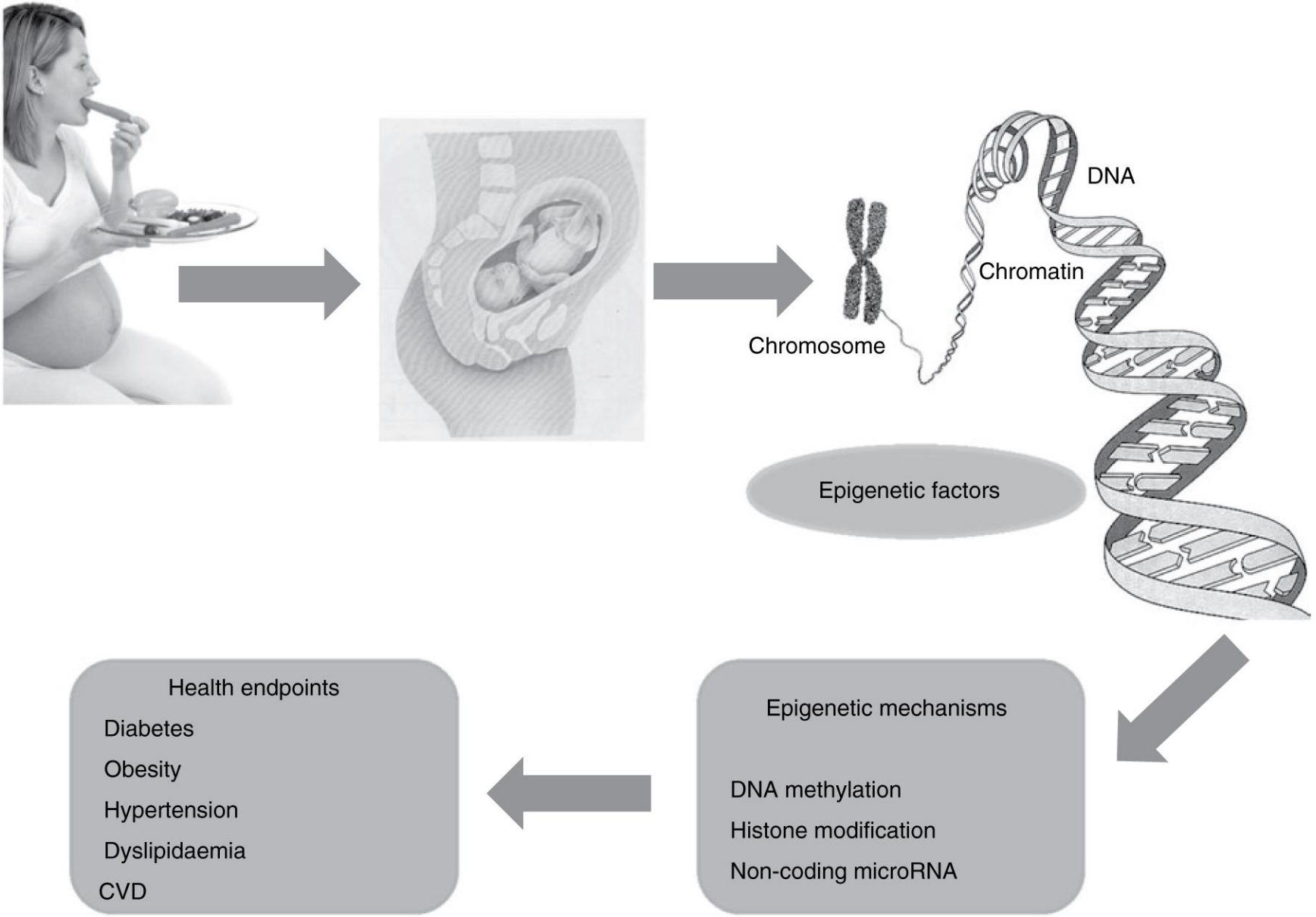


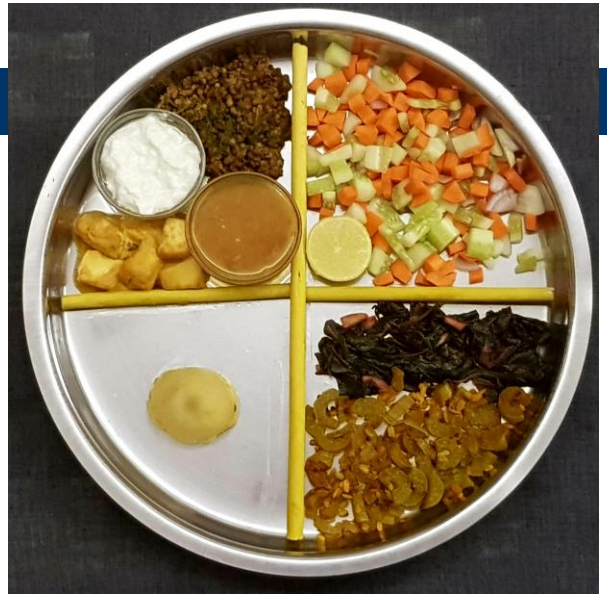
Fig. 1. The potential role of maternal diet on the development of the metabolic syndrome. Different epigenetic mechanisms may be involved in the long-lasting effects elicited by dietary factors in the development of the main components of the metabolic syndrome: diabetes, obesity, hypertension, dyslipidaemia and CVD.

Table 1. Epigenetic roles of main nutritional factors and type of diets

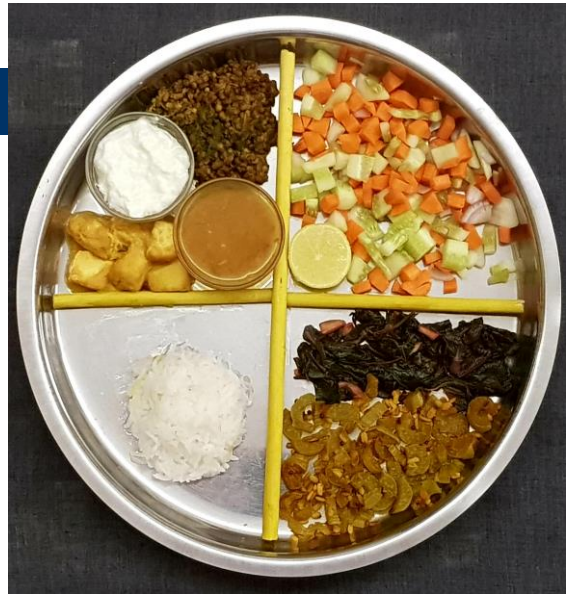
Nutritional factors (natural source) and diet	Epigenetic mechanisms	Main physiological and clinical effects	References
Butyrate (fermentation of dietary fibre)	Histone modifications	Cancer prevention and therapy; anti-inflammatory	Wiedmeier *et al.*[55]
Betaine (grain products and vegetables such as spinach and beets) Choline (red meat, poultry, milk, eggs)	DNA methylation	Fetal brain development and function	Sinclair *et al.*[10], Zeisel[11], Mehedint *et al.*[12], Kanai & Hirohashi[13]
Curcumin (turmeric)	MicroRNAs	Cancer prevention and therapy	Salerno *et al.*[22], Sun *et al.*[23]
Diallyl disulfide (garlic)	Histone modifications	Cancer prevention	Ficz *et al.*[15], Delage & Dashwood[16]
High-cholesterol diet	MicroRNAs	Obesity	Pogribny *et al.*[26]
High-fat diet	DNA methylation	Obesity; metabolic syndrome	Buckley *et al.*[45], Khan *et al.*[46,47]
Dietary methyl deficiency	MicroRNAs	Non-alcoholic steatohepatitis; liver cancer	Weiss *et al.*[25]
Dietary protein restriction	DNA methylation; histone modifications	Impaired glucose metabolism; type 2 diabetes	Armitage *et al.*[31,32], Cianfarani *et al.*[40]
Folic acid (leafy vegetables, nuts, sunflower, seeds)	DNA methylation	Embryonic development	Steegers-Theunissen *et al.*[9]
Genistein (soya)	MicroRNAs	Cancer prevention and therapy	Iorio *et al.*[21]
Retinoic acid (carrots, spinach, eggs)	Histone modifications; microRNAs	Cancer prevention and therapy	Yang *et al.*[24]
Sulforaphane (broccoli)	Histone modifications	Cancer prevention	Ficz *et al.*[15], Delage & Dashwood[16]

Strategy to improve eating habits

A



B



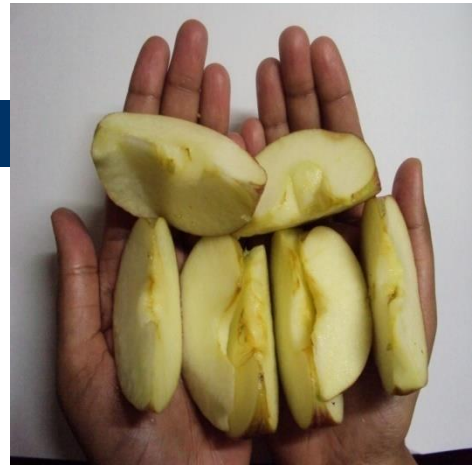
C

carbohydrate options
A- 1 roti
B- 30 gm rice (raw)
C- ½ potato

Order of Eating

Making Right Choice: Both 125 Kcal

Including healthy options…..More fresh foods



Food Perception in terms of calories

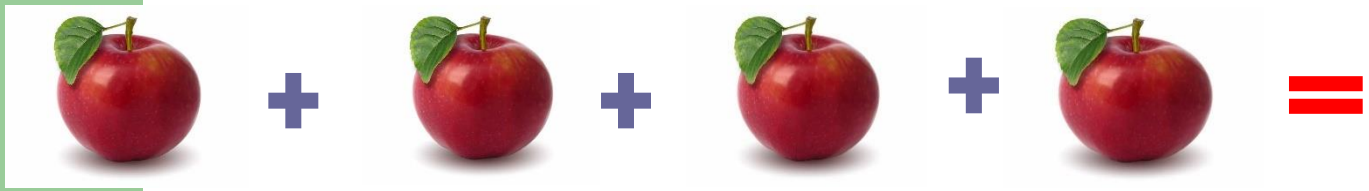
Wheat Chapatti (Heavy , High calorie)

Wheat Khakara (light , Low calorie)

Advertisement

- Certain food products are marketed as healthy and low calorie

= **50 kcal**



=

200 Kcal

Some Basic Precautions……

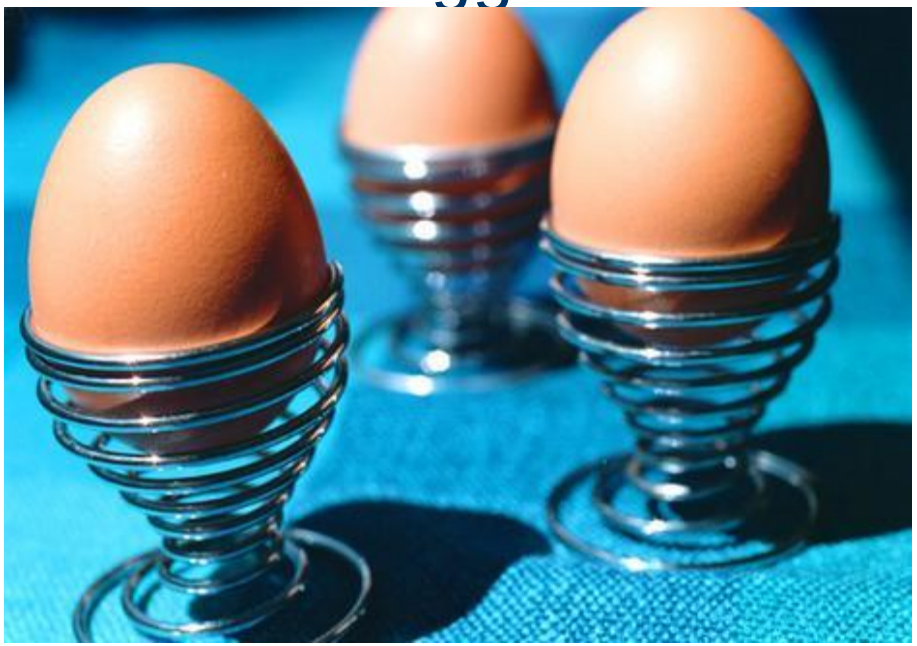
Listeria infection

- **The bacteria *Listeria monocytogenes* can contaminate some foods. Healthy people may experience no ill-effects at all, but the risks are substantial for pregnant women. The greatest danger is to the unborn baby, with increased risk of miscarriage, stillbirth or premature labor. A listeria infection is easily treated with antibiotics, but prevention is best.**

  Some foods are more prone to contamination than others. Exclude these foods from your diet if you are pregnant: Soft cheeses, such as brie, camembert and ricotta – these are safe if served cooked and hot
- **Precooked or pre-prepared cold foods that will not be reheated – for example, pre-prepared salads, pate, quiches and delicatessen meats like ham and salami**
- **Raw seafood such as oysters and sashimi or smoked seafood such as salmon (canned varieties are safe)**
- **Unpasteurized foods**
- **Soft-serve ice-cream.**
- **The organism that causes listeria is destroyed by heat, so properly cooked foods are not a risk.**

Salmonella

- Salmonella is a cause of food poisoning that can trigger miscarriage. The most likely sources of salmonella are raw eggs and meat



Good food hygiene

- Good food hygiene is the best way to reduce the risk of salmonella and listeria infections.
- **Suggestions include:**
- Always wash hands before and after preparing food.
- Keep your kitchen surfaces clean.
- Do not let uncooked food contaminate cooked food.
- Wash fruit, vegetables and salad before eating.
- Cook food thoroughly.
- Keep pets away from kitchen surfaces.
- Wear rubber gloves when handling pet litter trays or gardening.
- Store food at correct temperatures.

Mercury in fish

- It is suggested that pregnant women eat 2–3 serves of fish every week for good health. Caution should be exercised when choosing the type of fish you will eat.

  There are a few types of fish that need to be limited because they contain high levels of mercury, which is dangerous for the developing foetus.

  Pregnant women should: Limit to one serve (150g) per fortnight

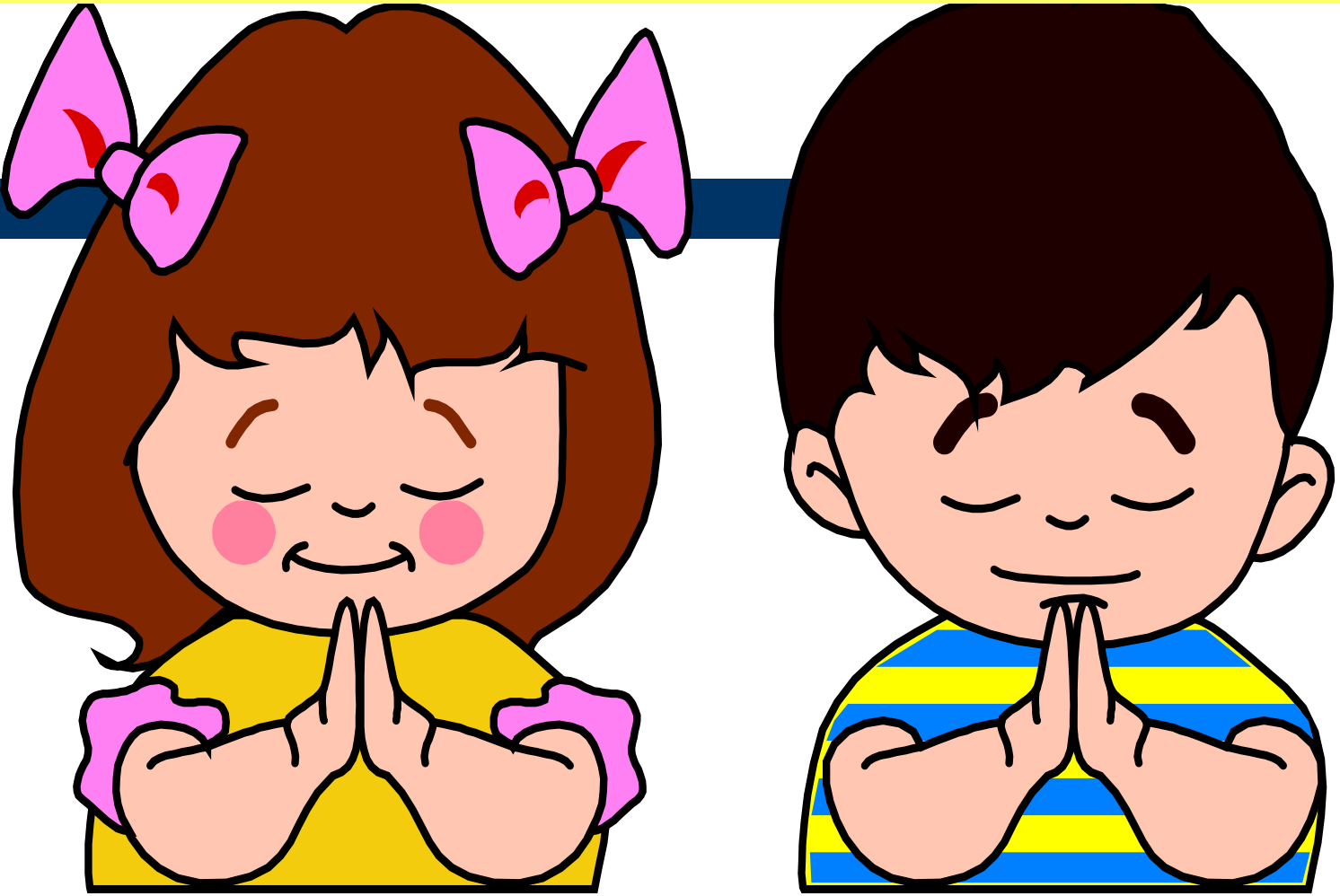
The Three Bs: Beans, Broccoli and Berries

- The best diet for pregnancy includes beans, broccoli and berries and here's why.
- Beans like chickpeas, lentils, and soybeans are packed with nutrients like iron, fiber, protein, calcium, and zinc.
- Beans are a vegetarian pregnant woman's best friend.
- Berries supply a good dose of Vitamin C, potassium, fiber, and folate.
- You can eat them in place of unhealthy, fat-laden desserts and pastries in order to satisfy that persistent sweet tooth.
- Broccoli is a versatile vegetable that contains a wide range of nutrients including folate, lutein, fiber, and calcium.

Food Additives and Ingredients

- Use of sweeteners that are Generally Recognized as Safe (GRAS) is acceptable
- Pregnant women could takein moderate of sweetners.
- Aspartame intake within Food and Drug Administration guidelines is safe during pregnancy
- Women with PKU should avoid aspartame
- Moderate consumption of cured meats and other foods rich in nitrosamines
- MSG consumption not thought to pose a health risk to mother or child

BE CAREFUL, BE COMPETENT
COUNSEL BEFORE CONCEPTION



FOR OUR MOTHERS, and FOR US

THANKYOU

What are Dietary Supplements?

- A product (other than tobacco) intended to supplement the diet or that contains one or more of the following : vitamin, mineral, herb or a plant derived substance (garlic) amino acid, concentrate ,metabolic , constituent or extract.
- A product intended for ingestion in pill, capsule, tablets or liquid form.
- A product not represented for use as a conventional food or as the sole item of a meal or diet.

Mechanisms of how supplementation with micronutrients can affect pregnancy

Possible mechanisms for beneficial effects include a generalized

- Improvement in the immune function of women, with a reduced incidence of infections and subsequent reduced incidence of preterm birth;
- Improved energy metabolism and anabolic processes in the mother, with a reduced incidence of fetal intrauterine growth restriction;
- Improved ability to respond to stress;
- Expansion of plasma volume secondary to fluid retention, with subsequent improvements in fetal growth;
- Improved hemoglobin levels;
- Increased absorption of iron related to intake of vitamin C and riboflavin, with subsequent improvement in hemoglobin levels

- Gopalan C. Multiple micronutrient supplementation in pregnancy. *Nutr Rev* 2002; 60:S2–6
- Keen CL, Clegg MS, Hanna LA, et al. The plausibility of micronutrient deficiencies being a significant contributing factor to the occurrence of pregnancy complications. *J Nutr* 2003;133(Suppl 2):1597S–605S.
- Susser M. Maternal weight gain, infant birth weight, and diet: causal sequences. *Am J Clin Nutr* 1991;53:1384–96.

Potential disadvantages

- Adverse interactions of micronutrients when supplied in combination;
- Enhanced or reduced absorption of one nutrient by other nutrients (e.g., interaction between iron and vitamin C, and iron and zinc);
- Deleterious effects on the fetus and the mother from overdose of any one component (e.g., vitamin A overdose);
- Cost

- Ladipo OA. Nutrition in pregnancy: mineral and vitamin supplements. *Am J Clin Nutr* 2000;72(Suppl):280S–90S.
- Haider BA, Bhutta ZA. Multiple-micronutrient supplementation for women during pregnancy [review]. *Cochrane Database Syst Rev* 2006;(4):CD004905

Role of multi micronutrient supplementation

- On the basis of a systematic review performed in 2005, the World Health Organization currently recommends iron–folic acid supplementation for all pregnant women.
- The review reported that multi micronutrient supplementation during pregnancy were more efficacious than 2 or fewer micronutrients in reducing the rates of low birth weight and small-for-gestational-age births.
- However, when multi micronutrients were compared with iron–folic acid supplementation, no evidence of a difference was noted.

- Haider BA, Bhutta ZA. Multiple-micronutrient supplementation for women during pregnancy [review]. *Cochrane Database Syst Rev* 2006;(4):CD004905.
- *Composition of a multi-micronutrient supplement to be used in pilot programmes among pregnant women in developing countries*. New York (NY): UNICEF; 1999.
- Lumbiganon P. Multiple-micronutrient supplementation for women during pregnancy [commentary]. Geneva (Switzerland): Reproductive Health Library, World Health Organization; 2007

Dietary supplements in Pre-eclampsia and the hypertensive disorders of pregnancy

- Two further forms of supplementation have been evaluated : sources of prostaglandin precursors such as fish oil, and calcium.
- Observational studies suggested the possibility of a prophylactic effect of fish oil and prompted more rigorous randomized trials. Other sources of fatty acids, such as oil of evening primrose, have also been evaluated in randomized trials.
- The hypothesis that dietary calcium might be related to the risk of pre-eclampsia was also derived from observational studies. There are now 11 trials (6894 women) in the systematic review. Women in these trials received at least 1 g calcium/day.
- Overall, there is a 30% reduction in the risk of pre-eclampsia.

- *British Medical Bulletin* 67:161-176 (2003)

Gestational Diabetes Mellitus

- Normal weight women are recommended 30Kcal/Kg/day of there pregnant weight.
- Women with BMI >30 are recommended 25Kcal/kg/day of their present body weight.
- Carbohydrates should be given around 40-45% of calories.
- Limiting carbohydrates in breakfast to 33% is important as insulin resistance is greatest in morning.
- Carbohydrates should be distributed through out the day.
- Important to give 3 main meals and 3 mid meals to maintain glycemia.

Common myths in maternal nutrition

Garden cress seeds:

These seeds have been shown to have estrogenic properties in animals and have shown to cause abortions.

Methi seeds

It should not be used during pregnancy because it can cause premature labor

Common Myths in Maternal Diet

Papaya in Pregnancy

Large amount of ripe fruit /small amount of raw fruit are known to decrease level of progesterone and inducing abortions.

Unripe papaya latex acts like prostaglandin and oxytocin, which induces labor. PG and Oxytoxic effects of this phenomenon is a well known traditional remedy

Pineapple in Pregnancy:

The mechanism by which pineapple contributes to inducing labor might be the proteolytic action of ***bromelain***. Bromelain might help to soften the connective tissue of the cervix and, thus, bring on labor. Because bromelain is destroyed in the production process of canned pineapple, one should consume only canned / cooked pineapple flesh.

Vitamin A

- Placental transport of vitamin A between mother and fetus is substantial, and recommended intakes are increased by 10%.
- Low maternal vitamin A status is inconsistently associated with intrauterine growth retardation in communities at risk for vitamin A deficiency.
- Dietary supplementation with vitamin A or ß-carotene is reported to reduce maternal mortality by 40% but to not affect fetal loss or infant mortality rates.

- West, K. P., Jr, Katz, J., Khatry, S. K., LeClerq, S. C., Pradhan, E. K., Shrestha, S. R., Connor, P. B., Dali, S. M., Christian, P., Pokhrel, R. P. & Sommer, A. (1999) Double blind, cluster randomised trial of low dose supplementation with vitamin A or beta carotene on mortality related to pregnancy in Nepal. The NNIPS-2 Study Group. BMJ 318:570-575
- Katz, J., West, K. P., Jr, Khatry, S. K., Pradhan, E. K., LeClerq, S. C., Christian, P., Wu, L. S., Adhikari, R. K., Shrestha, S. R. & Sommer, A. (2002) Maternal low-dose vitamin A or beta-carotene supplementation has no effect on fetal loss and early infant mortality: a randomized cluster trial in Nepal. Am. J. Clin. Nutr. 71:1570-1576.
- Rothman, K. J., Moore, L. L., Singer, M. R., Nguyen, U. S., Mannino, S. & Milunsky, A. (1995) Teratogenicity of high vitamin A intake. N. Engl. J. Med. 23:1369-1373.

Weight Gain In Pregnancy: Historical perspective

- During the first half of the century, American obstetricians restricted weight gain during pregnancy to prevent toxemia, difficult births, and maternal obesity.
- *Williams' Obstetrics*, a prestigious American textbook, stated in 1966 that "Excessive weight gain in pregnancy is highly undesirable for several reasons; it is essential to curtail the increment in gain to 25 lb (12.5 kg) at most or preferably 15 lb (6.8 kg).
- This policy of severe weight restriction was challenged in the 1960s, when experts began to recognize that the relatively high rates of infant mortality, disability, and mental retardation seen in the United States were a function of low birth weight .
- In 1970, a review of the scientific evidence by the National Academy of Sciences concluded that the usual practice of restricting maternal weight gain was associated with increased risk of low birth weight.
- The National Academy of Sciences Committee on Maternal Nutrition concluded that a weight-reduction program that distorts normal prenatal gain should not be followed during pregnancy and increased the formal recommendation for pregnancy weight gain to 9–11.4 kg

Role of Placenta

- The placenta has multiple roles as an important component of the fetal supply line.
- The most obvious placental influence on fetal nutrition is via its capacity to transport nutrients from the maternal to the fetal circulation.
- This transfer capacity is influenced by such factors as placental surface area and availability of specific nutrient transporters on the membranes.
- The placenta will also influence fetal nutrition via its role in the metabolism of key nutrients.
- If uterine glucose supply falls, the placenta consumes an increasing amount of glucose from the fetal circulation to maintain its own metabolic demands.
- Hence the placenta competes directly with the fetus for available nutrients. Similarly the fetus has been shown to export amino acids back to the placenta when supply is limited.
- This may underlie clinical observations of fetal wasting.
- The placenta will influence fetal nutrition because it produces hormones which in turn may influence fetal and maternal nutritional supply.
- Both placental lactogen and growth hormone are produced by the placenta in large amounts. They contribute to maternal insulin resistance, increasing the availability of glucose and other nutrients in the maternal circulation for transfer to the fetus.

- Owens JA, Owens PC, Robinson JS. Experimental fetal growth retardation: metabolic and endocrine aspects. In: Gluckman PD, Johnston BM, Nathanielsz PW (eds). *Research in Perinatal Medicine (VIII) Advances in Fetal Physiology: Reviews in Honor of GC Liggins*. Ithaca, NY: Perinatology Press, 1989, pp.263–86

Malnutrition in pregnancy

Requirements for nutrients increase in pregnancy :

- Deficiencies exist because of losses or malabsorption associated with diseases
- Inadequate knowledge about adequate prenatal nutrition
- Dietary taboos associated with pregnancy.

- AJCN VOL72 , No1,280-290 s

Why is supplementation necessary?

- Plasma concentrations of many vitamins and minerals show a slow, steady decrease with the advance of gestation, which may be due to hemodilution
- Other vitamins and minerals can be unaffected or increased because of pregnancy-induced changes in levels of carrier molecules.
- Available data on vitamin and mineral metabolism and requirements during pregnancy are fragmentary at best, and it is exceedingly difficult to determine consequences of seemingly deficient or excessive intakes in human populations.
- However, animal data show convincingly that maternal vitamin and mineral deficiencies can cause fetal growth retardation and congenital anomalies.

- AJCN VOL72 , No1,280-290 s

Supplementation with micronutrients : benefits

- Significantly reduced risk of low-birth-weight infants among women given multimicronutrient supplementation during pregnancy compared with women given placebo or iron–folic acid supplementation.
- The birth weight of infants was 54 g higher on average among those whose mothers were given micronutrients than among those whose mothers received iron–folic acid supplementation.
- The practice in most developed countries of giving multivitamins along with iron and folic acid to pregnant women needs to be adopt in developing countries.

- Fawzi WW, Msamanga GI, Urassa W, et al. Vitamins and perinatal outcomes among HIV-negative women in Tanzania. *N Engl J Med* 2007;356:1423–31

Data on use of supplements in Pregnancy

- Nutrient requirement increase during periods of growth and development such as pregnancy and lactation to support fetal growth and infant development.
- There exist recommendation concerning a need for limited nutrient supplementation during pregnancy and lactation.
- Data however suggest that supplementation depends upon demographic, sociologic and economic factors.
- Recommended intakes for 14 of 21 essential nutrients increase during pregnancy.
- These nutrients comprise of 7 vitamins, 5 minerals and choline.

- International life science institute,2006:529-63