
بسم الله الرحمن الرحیم

Nutrition in the life cycle

Nutrition in Pregnancy

1

Nutrition in Preconception

1

Readiness and Fertility

1

"fetus is the perfect parasite"

As fetal origins of disease

or *developmental origins of health and disease*

“Epigenetic effects”

1

- Although current public health recommendations promote mostly folate supplementation, there is some evidence that other nutrients also reduce the risk of congenital defects, such as vitamins B12, B6, and niacin, iron, and magnesium

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Dietary changes have been shown to decrease ovulatory disorders and improve fertility

1

Vitamin D deficiency in both men and women can be associated with infertility

for men it is associated with lower testosterone levels and lower sperm quality

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Infertility may also be due to extremes in body mass index (BMI) in either partner

Women with less than 17% body fat often do not menstruate

and those with less than 22% often do not ovulate.

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Women at risk include those with excessive exercise regimens, eating disorders, or both

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Calcium has been shown to be important in males for spermatogenesis, sperm motility, hyperactivation, and acrosome reactions.

1

Recommendations

Lower glycemic diet (including high-fat dairy products, but reducing *tmns-fats), obtaining iron from plant sources, consuming* a multivitamin daily, and being moderately physically active (Chavarro et al., 2007).

Recommendations for improved male fertility include

eating a higher fiber, lower glycemic index (including high-fat dairy products and monounsaturated fats, but reducing trans fats) and lower animal protein diet, in addition to obtaining iron from plant sources, consuming a multivitamin daily, and being moderately physically active
(Simon, 2014)

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Toxins:
environmental chemicals
tobacco and alcohol
Mercury
caffeine

No increased risk of miscarriage has been seen with caffeine consumption less than 200 mg/day, but data are conflicting for higher intakes

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- In men elevated BMI is associated with lower testosterone levels

- Obese women have a higher likelihood of prediabetes, undiagnosed diabetes preconceptually, or prolonged hyperglycemia; they also often have higher rates of fetal **congenital anomalies (**hypothyroidism, as well as hypertension)
- weight loss improves fertility for women, it has less effect on fertility in men

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1) PCOS
2)Hypothyroidism
3)oxidative stress

For women, vitamin D deficiency may be associated with insulin resistance and metabolic syndrome in polycystic ovary syndrome (PCOS)

Recent recommendations suggest that 5% to 10% weight loss is preferred to the use of metformin

evidence for a supplementation benefit appears weak and inconsistent

Examples of Nutrients Likely Important in the Periconceptual Period: Preconception Through Organogenesis

Brain and nervous system	Iron, zinc, iodine, LCPUFA, vitamins A, B_6, B_{12}, folic acid, copper, protein, selenium
Placental function and structure	Iron, LCPUFA, vitamins E, C, B_{12}, zinc, selenium, copper, omega-3 PUFA, folate
Inflammation and immune function	Vitamins A, D, zinc, fatty acids
Oxidative stress	Vitamins C, E, B_6, B_{12}, folic acid
Embryogenesis	Vitamins A, B_6, B_{12}, folic acid, zinc

- Fatty acids are found in all cell membranes; the fetal brain contains equal amounts of omega-6 (arachidonic acid) and omega-3 (docosahexaenoic acid [DHA]).
- DHA may be helpful regarding **birth weight** and **gestational length**, as well as **maternal depression**, but the results of supplementation trials have been mixed.
- There may be a slight benefit with supplementation on infant **visual** and **neural** development, as well as infant **immune function** and lowered risk of **food allergy.**

- Fetal DHA accretion is highest in the last half of pregnancy, reaching 30 to 45 mg/day in the last trimester.
- Transfer rates are highly variable and are lower among women with obesity, preeclampsia, hypertension, and diabetes (type 1, type 2, and GDM) (smoke).
- An average daily intake of 200 mg DHA during pregnancy and lactation currently is recommended.
- Intakes of up to 1 g/day of DHA or 2.7 g/day of total omega-3 PUFAs appear safe

- salmon, sardines, trout, herring, anchovies, and mackerel (not King mackerel).
- Caviar and brains (do not use where prion contamination is of concern) are also particularly high in DHA.
- flaxseeds and nuts, especially walnuts, but the conversion rate to DHA is usually very low.[ALA]
- Fortified eggs, but other fortified foods contain very little DHA. Foods labeled as fortified with omega-3s likely contain ALA.
- algal source of supplemental DHA

- In general, fish contain more DHA than EPA (although there is variability between species) and fish oil supplements contain more EPA than DHA. (cod liver oil)

2

Physiologic Changes of Pregnancy

2

- Blood volume???
- serum proteins, and water-soluble vitamins??
- Serum concentrations of fat-soluble vitamins and other lipid???

2

- Cardiac output and size
- Diastolic blood pressure
- Edema
- Dyspnea

2

- nausea and vomiting
- return of appetite that may be ravenous
- Cravings for and aversions to foods
- Increased progesterone concentrations
- Heartburn
- Gallstone
- Celiac disease

2

- GFR ??
- Renal tubular resorption??

The metabolism of macronutrients changes during pregnancy. This response varies between normal weight women and obese women

	غیر باردار	سه ماهه اول	سه ماهه دوم	سه ماهه سوم
ALb	4/1-5/3	3/1-5/1	2/6-4/5	2/3-4/2
Ch	<200	141-210	176-299	219-349
TG	<150	40-159	75-382	131-453
A	20-100	32-47	37-44	29-42
D	14-80	18-27	10-22	10-18
Ferritin	10-150	6-130	2-230	0-116
Hb	12-15/8	11/6-13/9	9/7-14/8	9/5-15
Zn	75-120	57-88	51-80	50-77

تشخیص آنمی مادر باردار

	آلبومین	هماتوکریت
سه ماهه اول	<11	<33%
سه ماهه دوم	<10/5	<32%
سه ماهه سوم	<11	<33%

0.5 - < 1.0 pack per day	+0.3 g/dl	+1.0 %
1.0 - < 2.0 packs per day	+0.5	+1.5
≥ 2.0 packs per day	+0.7	+2.0
All smokers	+0.3 g/dl	+1.0 %

Complications and Nutritional Implications

Constipation and Hemorrhoids

Diabetes Mellitus

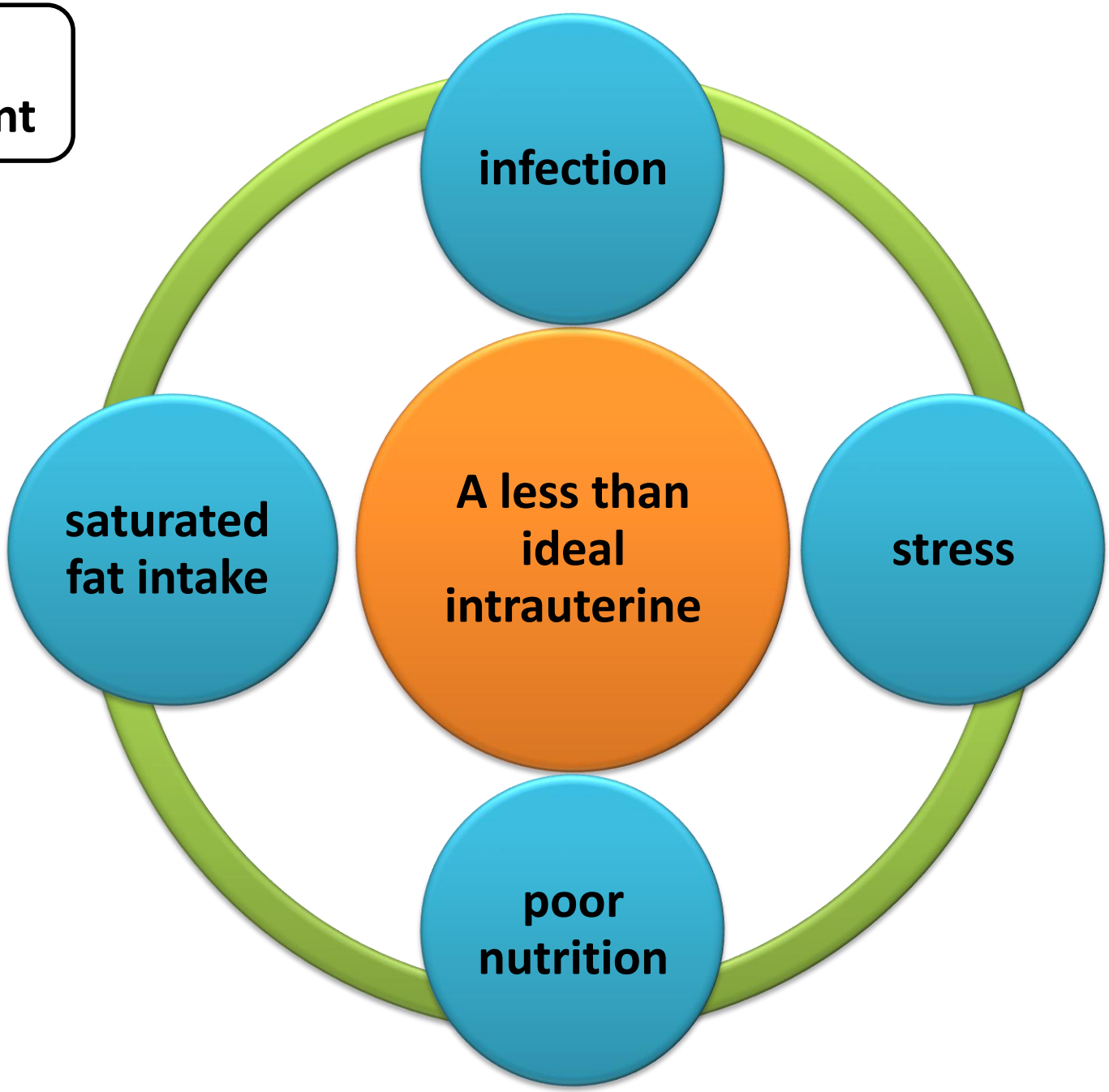
Edema and Leg Cramps

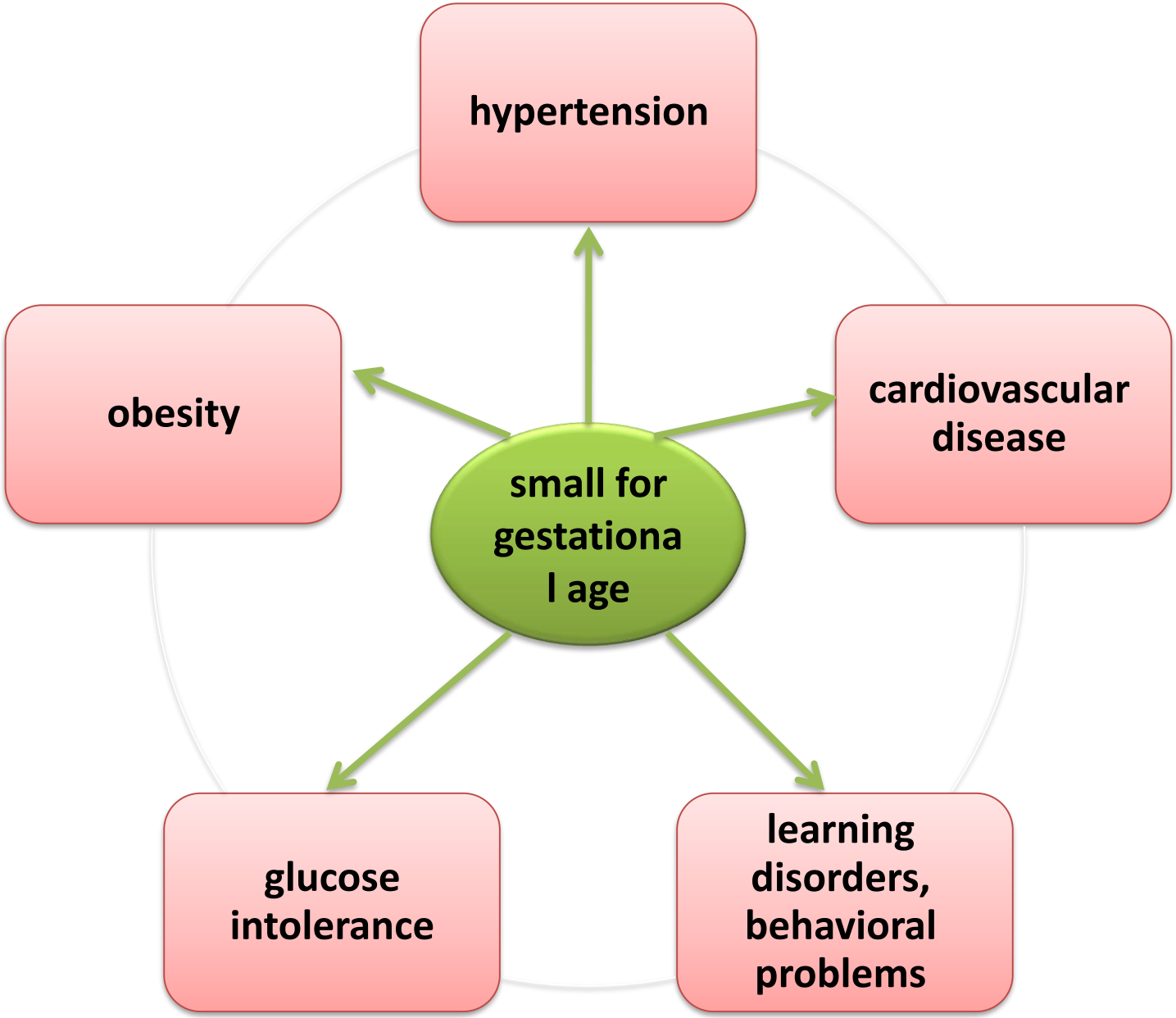
Heartburn

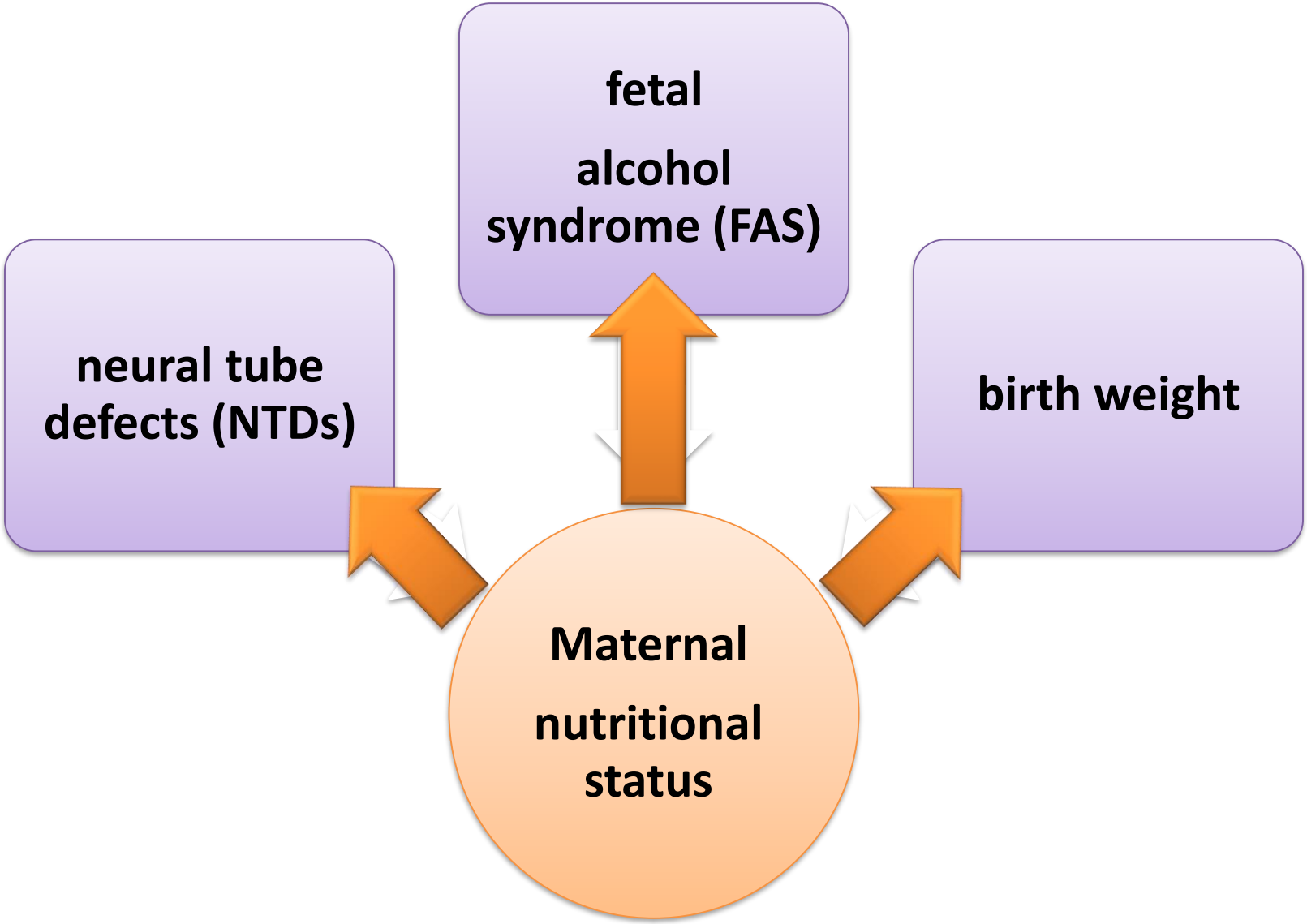
Nausea, Vomiting, and Hyperemesis Gravidarum

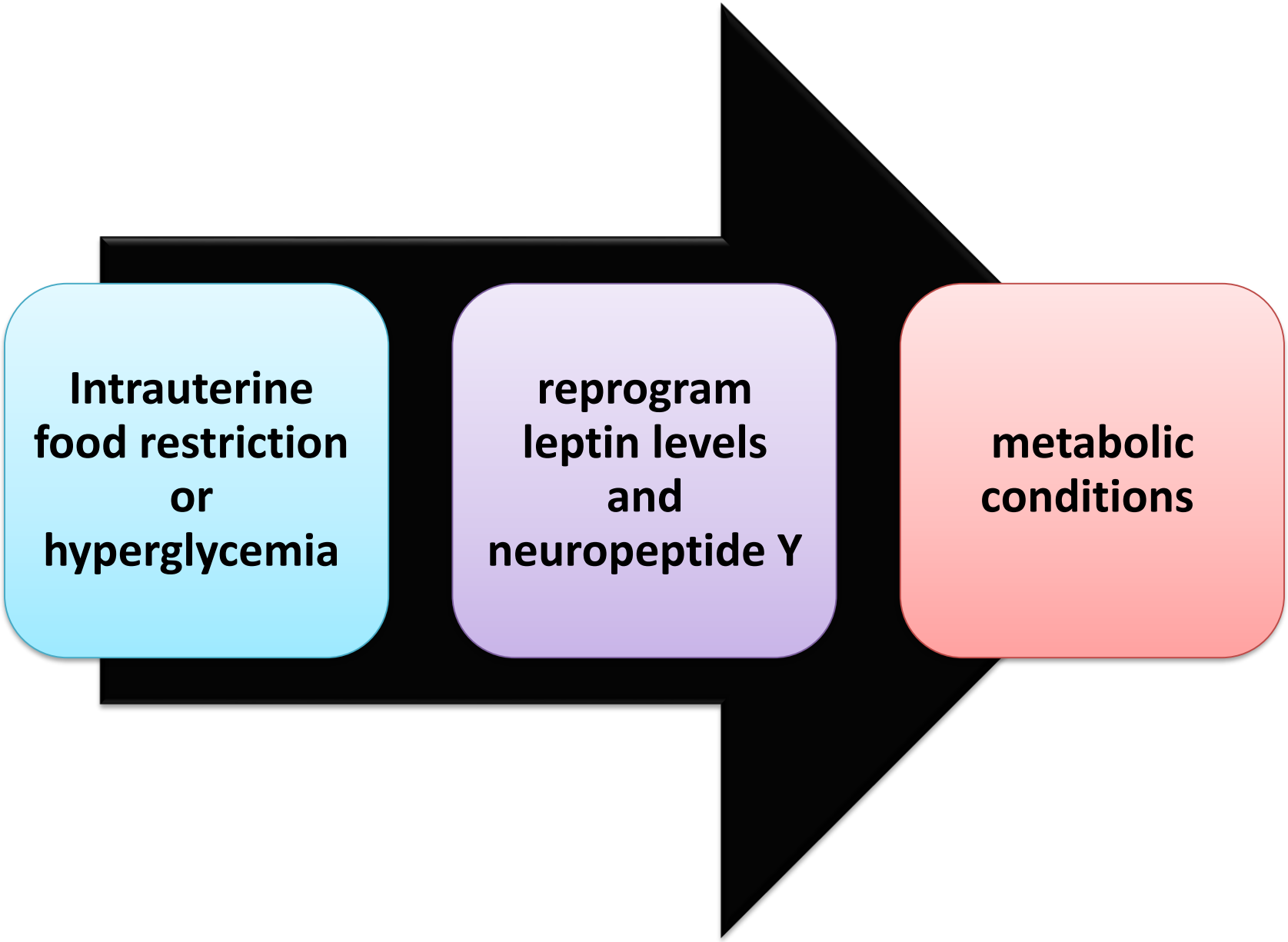
Pregnancy-Induced Hypertension

Uterine Environment



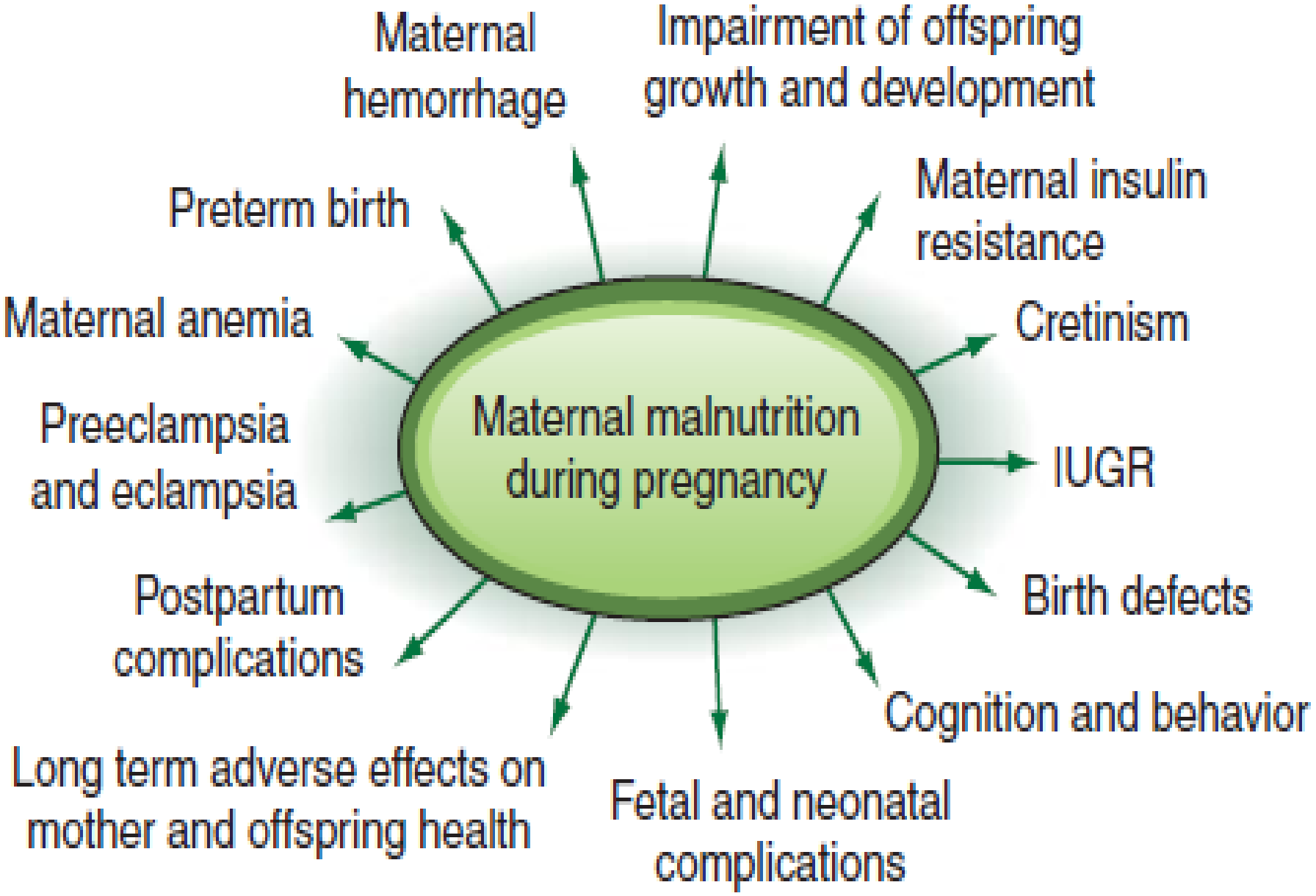

hypertension
obesity
cardiovascular disease
small for gestational age
glucose intolerance
learning disorders, behavioral problems

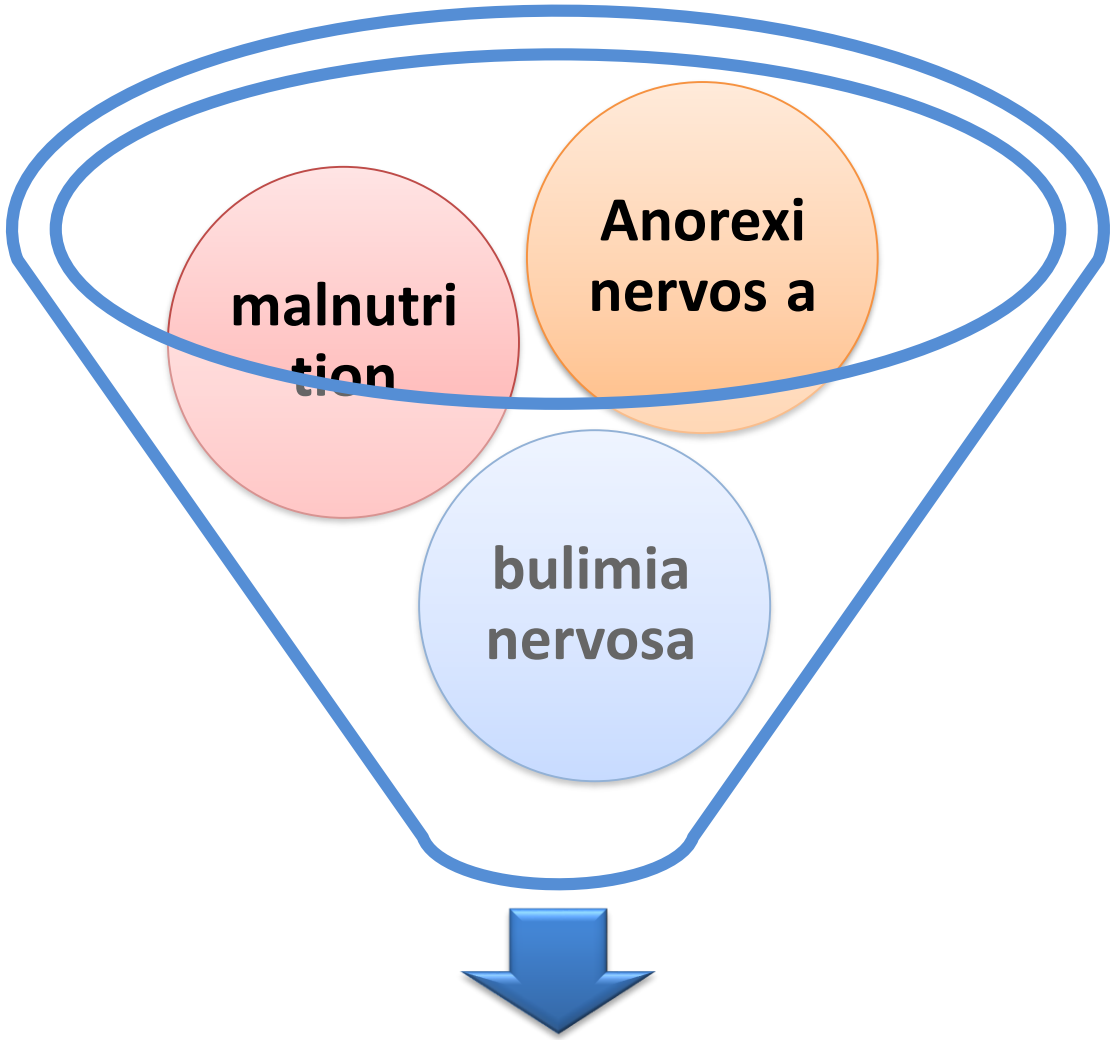

fetal
alcohol
syndrome (FAS)
neural tube
defects (NTDs)
birth weight
Maternal
nutritional
status


Intrauterine food restriction or hyperglycemia
reprogram leptin levels and neuropeptide Y
metabolic conditions

maternal starvation

- alterations in DNA
- hemorrhage at delivery
- Prolonged labor
- LBW
- spontaneous abortion
- Stillbirths
- neonatal deaths
- Congenital malformation


Maternal hemorrhage
Impairment of offspring growth and development
Preterm birth
Maternal insulin resistance
Maternal anemia
Cretinism
Maternal malnutrition during pregnancy
Preeclampsia and eclampsia
IUGR
Postpartum complications
Birth defects
Cognition and behavior
Long term adverse effects on mother and offspring health
Fetal and neonatal complications



amenorrhea, infertility, and reduced rates of pregnancy

Attention deficit disorder in some children may be related to suboptimal gestational iodine or low vitamin D transfer in a depleted mother

LBW and especially very low birth weight are major factors for perinatal mortality

Maternal obesity

=

higher incidence of stillbirths

Causes of Intrauterine Growth Restriction (IUGR)

Oxidative stress, metabolic stress, and inflammation may be important in increasing risk of preterm delivery

It appears that periconceptual malnutrition is more important than nutrition later in pregnancy

(obesity does not predict optimal nutrition)

prepregnant underweight, combined with low weight gain during pregnancy, has an additive effect on preterm and LBW risk

Even for those women of normal weight, low weight gain doubles the risk of preterm delivery; weight loss triples the risk

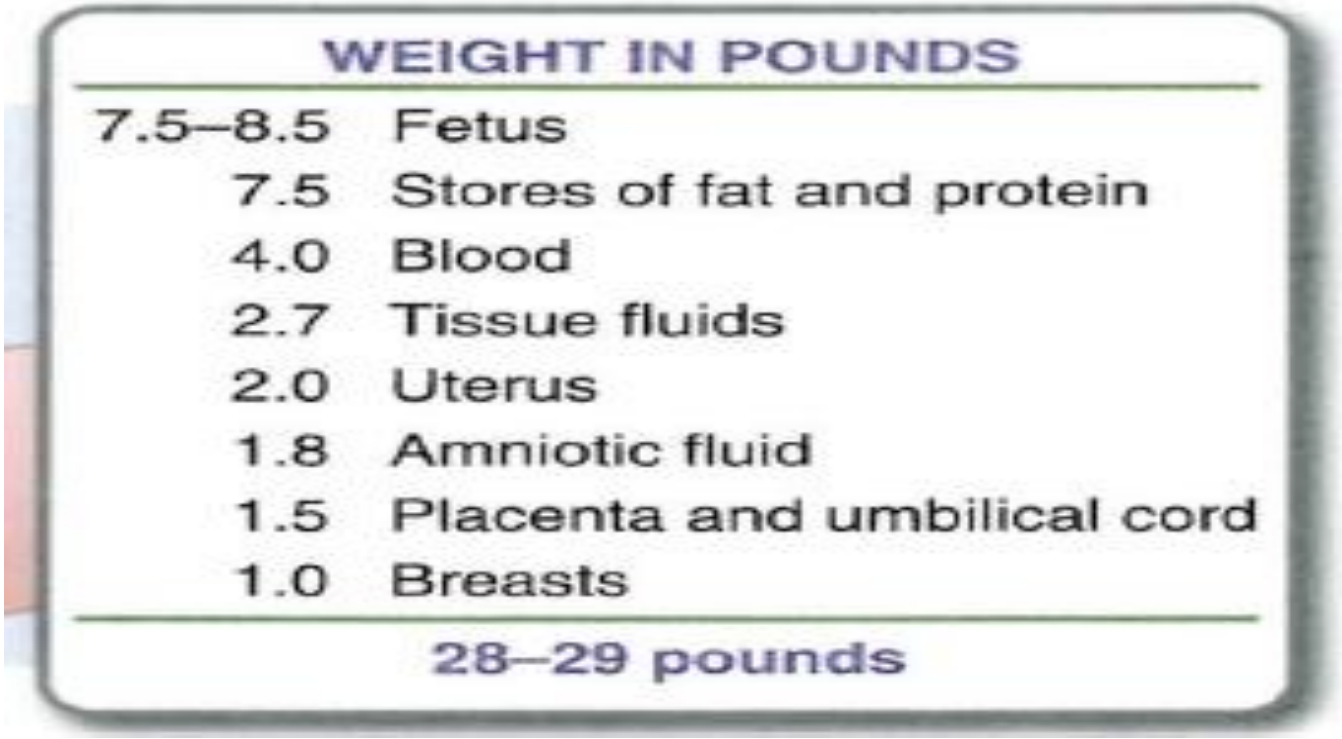
One study found nearly double the risk of preterm delivery if women consumed more than four servings of diet soda per day (Bloomfield, 2011), although that finding has been disputed

Licorice (glycyrrhiza glabra root) blocks the enzyme that inactivates cortisol, and the effect on preterm risk is doserelated.

Similar results , psychological stress

The role of paternal nutrition in preterm risk is unexplored

Pregnancy Weight Gain Recommendations



WEIGHT IN POUNDS	
7.5–8.5	Fetus
7.5	Stores of fat and protein
4.0	Blood
2.7	Tissue fluids
2.0	Uterus
1.8	Amniotic fluid
1.5	Placenta and umbilical cord
1.0	Breasts
28–29 pounds	

Distribution of weight gain during pregnancy

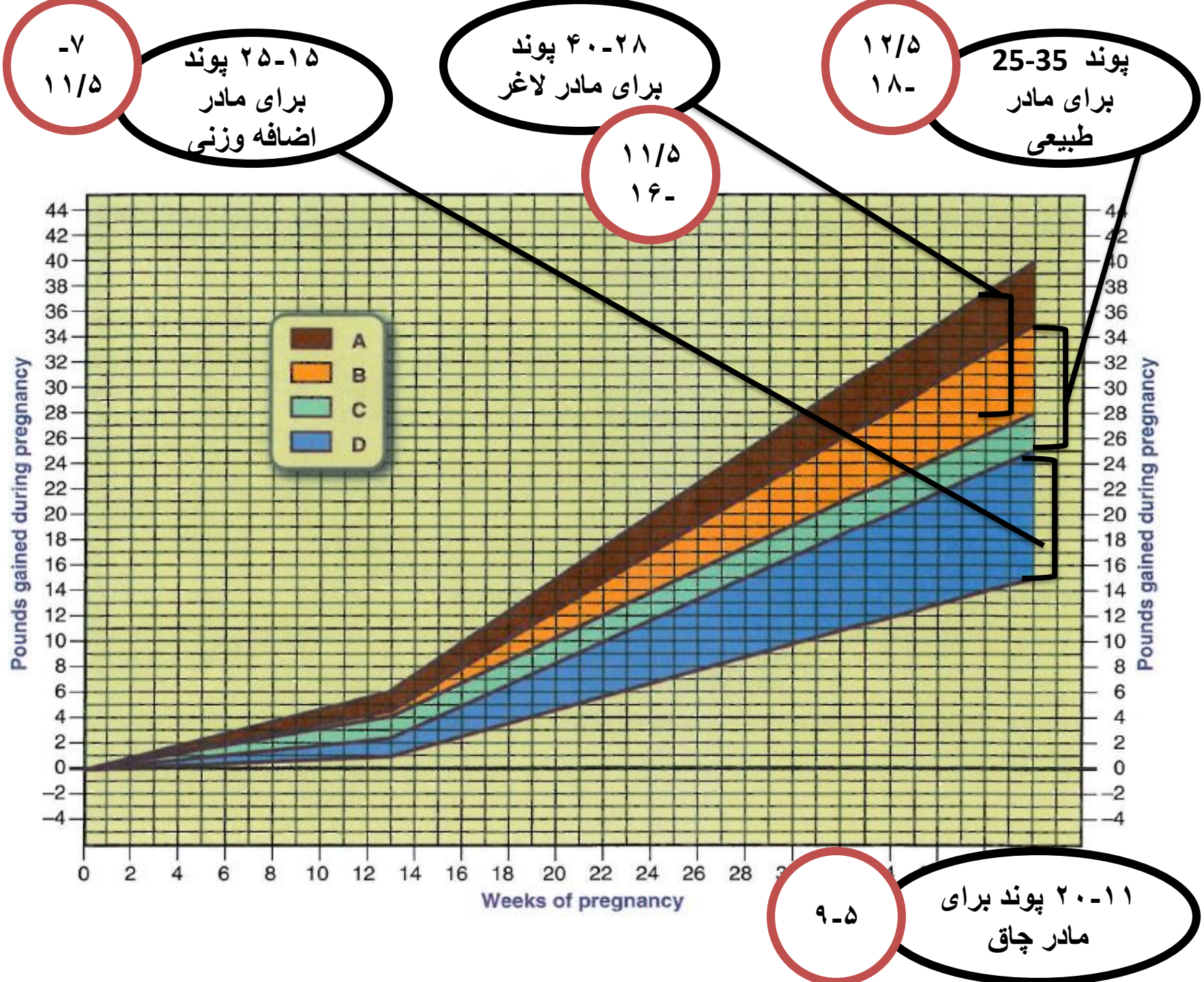

۷-
۱۱/۵
۱۵-۲۵ پوند
برای مادر
اضافه وزنی
۲۸-۴۰ پوند
برای مادر لاغر
۱۱/۵
۱۶-
۱۲/۵
۱۸-
پوند 25-35
برای مادر
طبیعی
A
B
C
D
Pounds gained during pregnancy
Weeks of pregnancy
۹-۵
۱۱-۲۰ پوند برای
مادر چاق

TABLE 15-11 U.S. Institute of Medicine (IOM) Prenatal Weight Gain Goals

Prepregnant Weight Category	Total Singleton Weight Gain	Rates of Gain in 2nd and 3rd Trimesters for Singletons* Mean/week (Range)	Total Twins Weight Gain (Provisional guidelines)
Underweight	28-40 lb	1 lb (1-1.3)	Insufficient information available for guideline
BMI < 18.5	[12.5-18 kg]	[0.51 kg (0.44-0.58)]	
Normal weight	25-35 lb	1 lb (0.8-1)	37-54 lb
BMI 18.5-24.9	[11.5-16 kg]	[0.42 kg (0.35-0.50)]	[17-25 kg]
Overweight	15-25 lb	0.6 lb (0.5-0.7)	31-50 lb
BMI 25.0-29.9	[7-11.5 kg]	[0.28 kg (0.23-0.33)]	[14-23 kg]
Obese	11-20 lb	0.5 lb (0.4-0.6)	25-42 lb
BMI ≥ 30.0	[5-9 kg]	[0.22 kg (0.17-0.27)]	[11-19 kg]

Nutrient Requirements During Pregnancy

- **Energy**
- Metabolism increases by an average of 15%
- increases 340 kcal/day during the second trimester and by 452 kcal/day in the third trimester

- **Exercise**
- recommends at least 30 minutes of moderate
- discuss with her health practitioner

- **Protein**
- 0.8 g/kg in the first half of pregnancy
- in the second half to 1.1 gm/kg/day
- For each additional fetus, at least another 25 g/day of protein is recommended
- 20% - 30% to 35%
- WHO; 0.83 g/kg/day +0.7 g/day, 1 9.6 g/day, 31.2 g/day (23% of calories)
- prepregnant value + 6 g/day

- **Carbohydrates**
- Maintain appropriate blood glucose and prevent ketosis
- 14 g/day/1000 kcal

- **Lipids**
- there is no DRI
- (DHA) is 200 mg/day and can be met by one to two portions of fish per week
- W6 =13g/d , W3=1/4g/d

- **Folic Acid**
- Low folate levels =miscarriages, LBW, and preterm birth, congenital malformations, NTDs, orofacial clefts and congenital heart defects
- (CDC) recommends: 400 mcg/day preconceptually
- Women who have had a previous NTD : 400 mcg/day , 4000 mcg/day (4 mg/day) from 1 month before to 3 months after conception
- Red blood cell folate levels exceeding 906 nmol/L (400 ng/ml) have been associated with the fewest NTDs

- Smoke, alcohol, drugs, malabsorption syndromes, genetic differences (MTHFR 677 C to T = 11% -22%) (increased folate intake , added riboflavin)
- 6 to 12 cups of raw spinach or 2 cups cooked = one bowl of fortified breakfast cereal

- **adverse effects :**
- masking of vitamin B12 deficiency, tumor promotion, epigenetic hypermethylation, interference with antifolate treatments, and an increase in miscarriages and multiple births.
- 500 mcg/day = offspring adiposity and insulin resistance at age 6

- adequate folic acid in the second trimester may decrease inflammation, and folate status is associated inversely with the severity of bacterial vaginosis, a documented risk factor for preterm delivery.

- negative effect of maternal exposure to bisphenol A is effectively neutralized by maternal supplementation with folic acid, betaine, and choline

- 50% to 70% (not 100%) of NTDs could be prevented with the periconceptual use of 400 mcg folic acid/day

- Optimal levels of other methyl donors (B2, B6, B12, and choline) may also lower the risk of NTDs and improve birth weight

- **Vitamin B6**
- Regarding nausea and vomiting, standard doses of 25 mg three times per day have questionable efficacy but do not appear to be dangerous.

- ***Vitamin B12***
- Role in :growth and development, immune function
- Deficiency: vegetarians, especially vegans, Crohn's disease, gastric bypass, metformin.
- Deficiency : related to depression in adults ,NTDs , fetal growth

- **Choline**
- fetal brain development, NTDs ,orofacial clefts
- important in placental functioning and may affect maternal and fetal responses to stress.
- a small study using 750 mg during pregnancy did not identify adverse effects
- milk, meat, eggs, fish

- ***Vitamin C***
- increases during pregnancy
- higher for those who smoke, abuse alcohol or drugs, or regularly take aspirin
- Low plasma levels = preterm
- Supplementation with vitamin C is not recommended

- ***Vitamin A***
- Low level = IUGR, maternal and neonatal mortality
- among women positive HIV; improved vitamin A status is associated with improved birth weight possibly by improving immunity
- Excess, is teratogenic
- Supplementation is limited to 5000 IU/day
- up to 10,000 IU/day
- Isotretinoin
- liver

- **Vitamin D**
- not increase during pregnancy (600 IU/day ,15 mcg/day)
- Salmon, mushroom, 5 to 15 minutes 2 to 3 times/ week
- in pregnancy conversion of 25(OH)D to 1,25(OH)2D increased (three times nonpregnant) (not associated with hypercalciuria or hypercalcemia) (increasing vitamin D-binding protein levels)

- role in:

  preeclampsia, preterm delivery, gestational diabetes, bacterial vaginosis, cesarean delivery, development of the infant's immune function and development of allergy, type 1 diabetes

- serum levels of 25(OH)D= 20 ng/ml (50 nmol/L) for bone health
- Other experts suggest at least 32 ng/ml (80 nmol/L) but growth restriction at > 70 nmol/L and child eczema at > 75 nmol/L also have been reported
- Supplementation = insufficient evidence
- 1000 to 2000 IU/day=Safe
- High Does not appear to be teratogenic

- **Vitamin E**
- requirements do not increase
- Deficiency = miscarriage, preterm birth, preeclampsia, and IUGR
- Supplementation =proinflammatory

- **Vitamin K**
- not increase
- hyperemesis gravidarum, Crohn’s disease, or gastric bypass

- ***Calcium***
- Hormonal factors
- Maternal absorption of calcium: doubles
- 30 g accumulated (25 g in the fetal skeleton)
- low calcium intake ~ IUGR and preeclampsia
- blood clotting, intracellular proteolysis, nitric oxide synthesis, regulating uterine contractions

- The requirement ~ does not increase
- One-third cup of dried skim milk is equivalent to 1 cup of fluid milk
- higher in protein or fat: less calcium
- Soy milks are fortified :? , (31%,59%)
- calcium carbonate ?
- vegetable sources ?
- excess antacid ingestion

Food	Calcium Content	Fractional Absorption	Estimated Absorbed Calcium	Amount Needed to Equal 1 c Milk
Milk	300 mg/c	32.1%	96.3 mg	1.0 cup
Beans, pinto	44.7 mg/0.5 c*	26.7	11.9	4.05 cups, cooked*
Beans, red	40.5 mg/0.5 c	24.4	9.9	4.85 cups
Beans, white	113 mg/0.5 c	21.8	24.7	1.95 cups
Bok choy	79 mg/0.5 c	53.8	42.5	1.15 cups
Broccoli	35 mg/0.5 c	61.3	21.5	2.25 cups
Cheddar cheese	303 mg/1.5 oz	32.1	97.2	1.5 oz
Chinese mustard greens	212 mg/0.5 c	40.2	85.3	0.55 cup
Chinese spinach	347 mg/0.5 c	8.36	29.0	1.65 cups
Kale	61 mg/0.5 c	49.3	30.1	1.6 cups
Spinach	115 mg/0.5 c	5.1	5.9	8.15 cups
Sweet potatoes	44 mg/0.5 c	22.2	9.8	4.9 cups
Tofu with calcium	258 mg/0.5 c	31.0	80.0	0.6 cup
Yogurt	300 mg/c	32.1	96.3	1.0 cup

- ***Copper***
- intake ~ marginal
- Deficiency ~ Menkes, increased zinc or iron, drugs, bypass surgery
- Deficiency » embryo development, teratogenic (decreased activity of cuproenzymes, increased oxidative stress, altered iron metabolism, abnormal protein crosslinking, decreased angiogenesis, and altered cell signaling)
- Recommended: Cu + Zn,Fe

- ***Fluoride***
- requirements do not increase
- 32 teeth are developing during gestation
- Transported across the placenta?

- ***Iodine***
- requirements increase
- Thyroxine, metabolism of macronutrients, fetal neuronal myelination, gene expression
- **deficiency** » miscarriage, congenital anomalies, fetal goiter, and stillbirth, prematurity, poor fetal growth, decreased IQ, cretinism.
- urinary iodine

- ***Iron***
- **RDA** ~ doubles
- **IDA** » IUGR, preterm delivery, increased fetal and neonatal mortality, and if severe (hemoglobin ,9 g/dl), with complications during delivery, increased fetal cortisol production ,oxidativedamage to fetal erythrocytes, fetal brain development and the regulationof brain function,

- **Neonatal iron deficiency** ~ mother (HTN, DM, smoking, ID) prematurity,
- » Neurobehavioral, learning, memory , genomic changes

- requirement for pregnancy is 1190 mg, but with the cessation of menses, the average net deficit is 580 mg.
- + 17 mg/day
- Normal absorption is 1 to 2 mg/day from a normal diet, and 3 to 5 mg/day if the diet contains high-iron foods

- first trimester serum ferritin < 20 mcg/L, supplementation may be necessary.
- HB , HTC values decrease in the second trimester # growth restricted infant, preterm delivery, and stillbirth (increase again in the third trimester).

- iron therapy » increase of 1 g hemoglobin or 3% in hematocrit by 4 weeks.
- Enteric-coated ~ not recommended
- Parenteral iron?
- CDC and WHO recommend early iron supplementation to lower the risk of LBW.
- overtreatment of IDA ~ preterm delivery, IUGR, and GDM

- 36 mg /kg body weight~ lethal
- Meat, liver, Vegetable.

- ***Magnesium***
- fetus accumulates 1 g of Mg during gestation
- deficiency » fetal growth, teratogenesis,SIDS
- treat women with preeclampsia
- Optimal levels ~ prevent leg cramps

- ***Phosphorus***
- Important in ATP
- low phosphorus levels, indicative of "refeeding syndrome," have been found in women experiencing severe vomiting or other situations resulting starvation.

- ***Selenium***
- Antioxidant
- Low selenium ~ miscarriages, preeclampsia, IUGR
- DRI increases

- ***Zinc***
- Requirements rise
- Zinc is part of 100 enzymes related to the metabolism of macronutrients
- Deficiency » teratogenic, congenital malformations, anencephaly , oral clefts, acrodermatitis enteropathica miscarriage, fetal growth restriction, hypertension, preeclampsia, preterm delivery, intrapartum hemorrhage.
- High levels of iron supplementation may inhibit zinc absorption

Overweight and obese women

increased risk for:

intrauterine fetal demise (IUFD) or miscarriage

gestational diabetes mellitus (GDM)

pregnancy-induced hypertension (PIR)

cesarean section

in women who are obese

increased risk for:

Preterm (< 32 weeks)

Cardiac defect

NTD (Folate, BI2, iron, magnesium and niacin, choline)

Macrosomia(birthweight > 4000 g)

hypertensive disorders

weight loss include improved

plasma lipids, glucose, and uric acid, which may also reduce

pregnancy risk factors.

Postbariatric Surgery?

Adolescent Pregnancy?

Multiple Births?

Infants of multiple-birth pregnancies have a greater risk of:

Premature

IUGR

LBW

maternal physiological adaptations?

Calories	Underweight: 4000 kcal Normal: 3000-3500 kcal Overweight: 3250 kcal Obese: 2700-3000 kcal	Estimated needs are 40-45 kcal/kg. Monitor weight gain and modify calories to meet target weight goals.
Protein	Underweight: 200 g Normal: 175 g Overweight: 163 g Obese: 150 g	Target 20% of calories from protein. Choose concentrated sources as space becomes limiting.
Carbohydrate	Underweight: 400 g Normal: 350 g Overweight: 325 g Obese: 300 g	Encourage low glycemic choices.
Fat	Underweight: 178 g Normal: 156 g Overweight: 144 g Obese: 133 g	Encourage healthy fats.

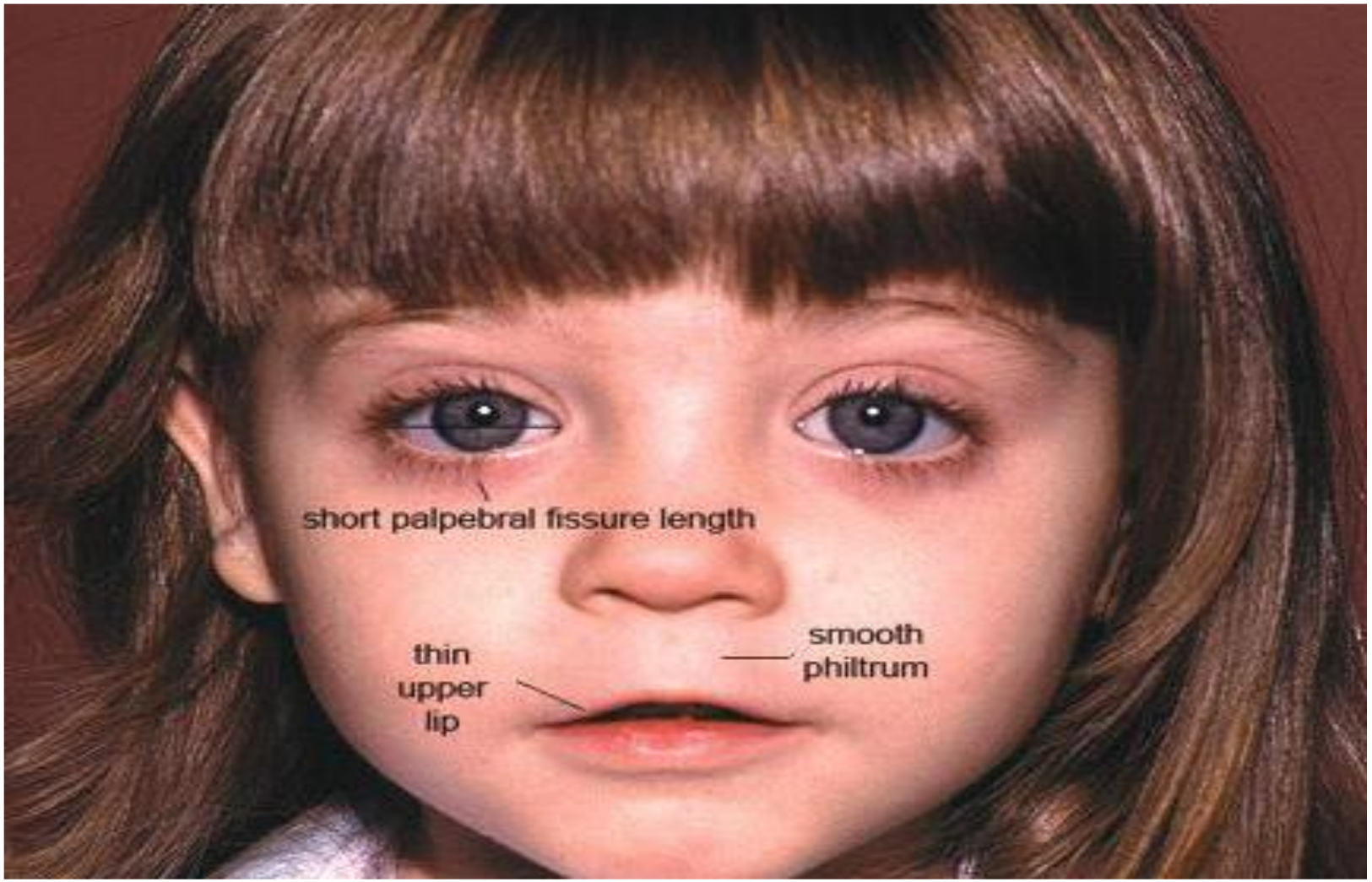
Vitamin D	1000 IU/day	Assessment of maternal levels should be considered in first and early third trimesters to allow alterations in the supplemental dose, especially important if the mother is on bed rest.
Vitamin C	500-1000 mg/day	This is half of the UL of 1800-2000 mg/day. See more recent cautions.
Vitamin E	400 mg/day	This is half of the UL of 800-1000 mg/day. See more recent cautions.

Zinc	15 mg/day (T1); 30mg/day (T2-3)	Diet alone may not be enough. Supplementation may be required.
Iron	30 mg/day as part of 1 multivitamin/day (T1), 2 multivitamins/day (T2 and T3)	Twin gestation requirement is likely double that of singletons. Higher intakes may be needed for treatment of anemia.
Folic acid	1000 mcg/day	
Calcium	1500 mg/day (T1); 2500 mg (T2-3)	UL: 2500 mg/day, consider limiting if there is a history of kidney stones.
Magnesium	400 mg/day (T1); 800 mg/day (T2-3)	
DHA + EPA	300-500 mg/day	

Complications and Nutritional Implications

- Constipation and Hemorrhoids
- Cravings, Aversions, and Pica
- Diabetes Mellitus
- Edema and Leg Cramps
- Hypertension
- Nausea and Vomiting, Hyperemesis Gravidarum, and Ptyalism

Alcohol


short palpebral fissure length
thin
upper
lip
smooth
philtrum


موفق باشید