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Pregnancy & Thyroid gland

- Physiological changes
- Iodine metabolism

Physiologic adaptation during pregnancy

Organ systems

- Cardiovascular system
- Pulmonary system
- Genital tract
- Urinary system
- Endocrine system
- Gastrointestinal Tract
- Skin

Endocrine System: Thyroid gland

The thyroid undergoes physiological changes during pregnancy:

- Moderate enlargement of the gland and increasing of vascularization.
- **HCG** causes thyroid stimulation since the first trimester, due to structural analogy with TSH.
- The thyrotropic activity of hCG causes also a decrease in serum TSH in the first trimester so that pregnant women have lower serum TSH concentrations than non-pregnant women.

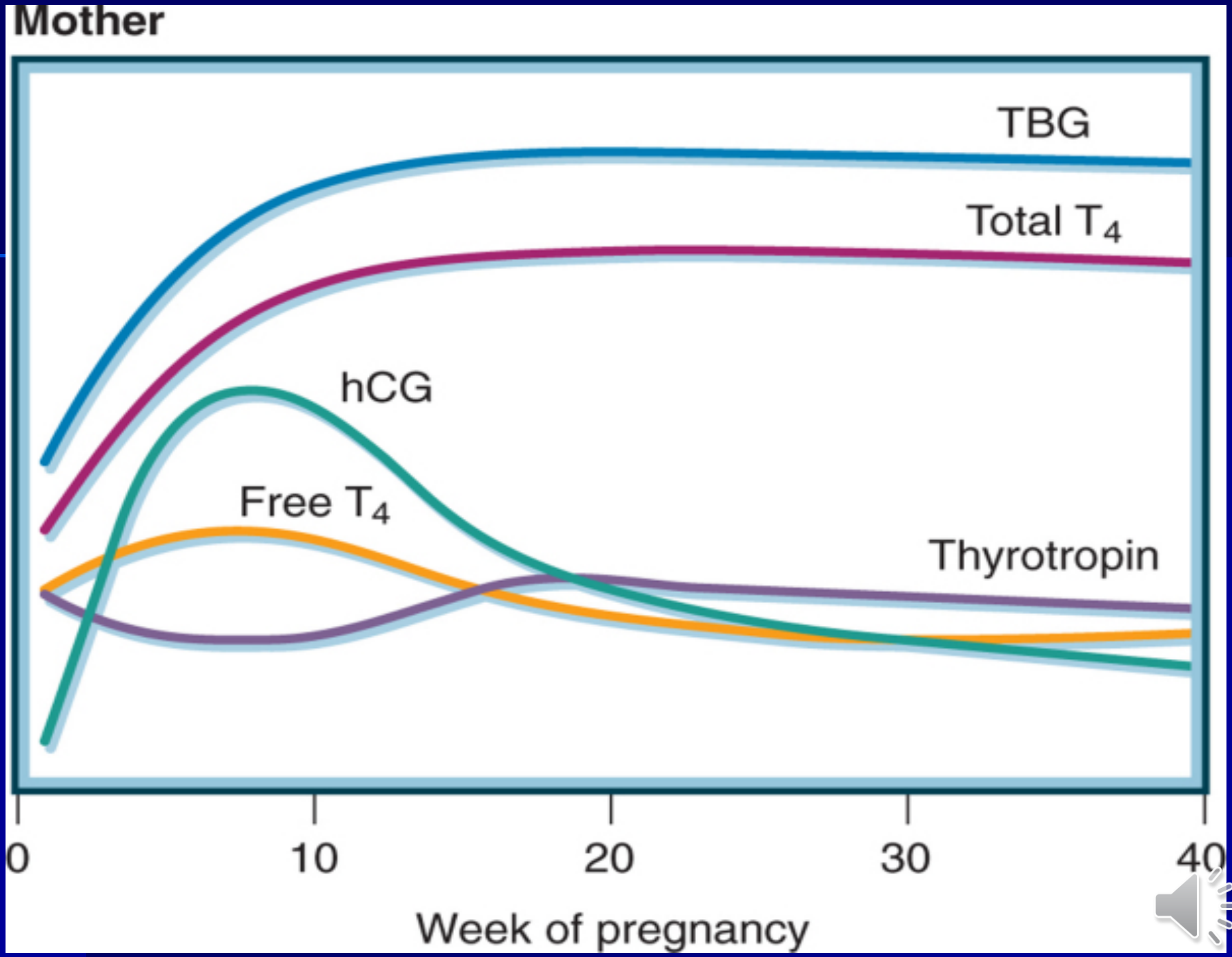
Physiologic adaptation during pregnancy

THYROID FUNCTION

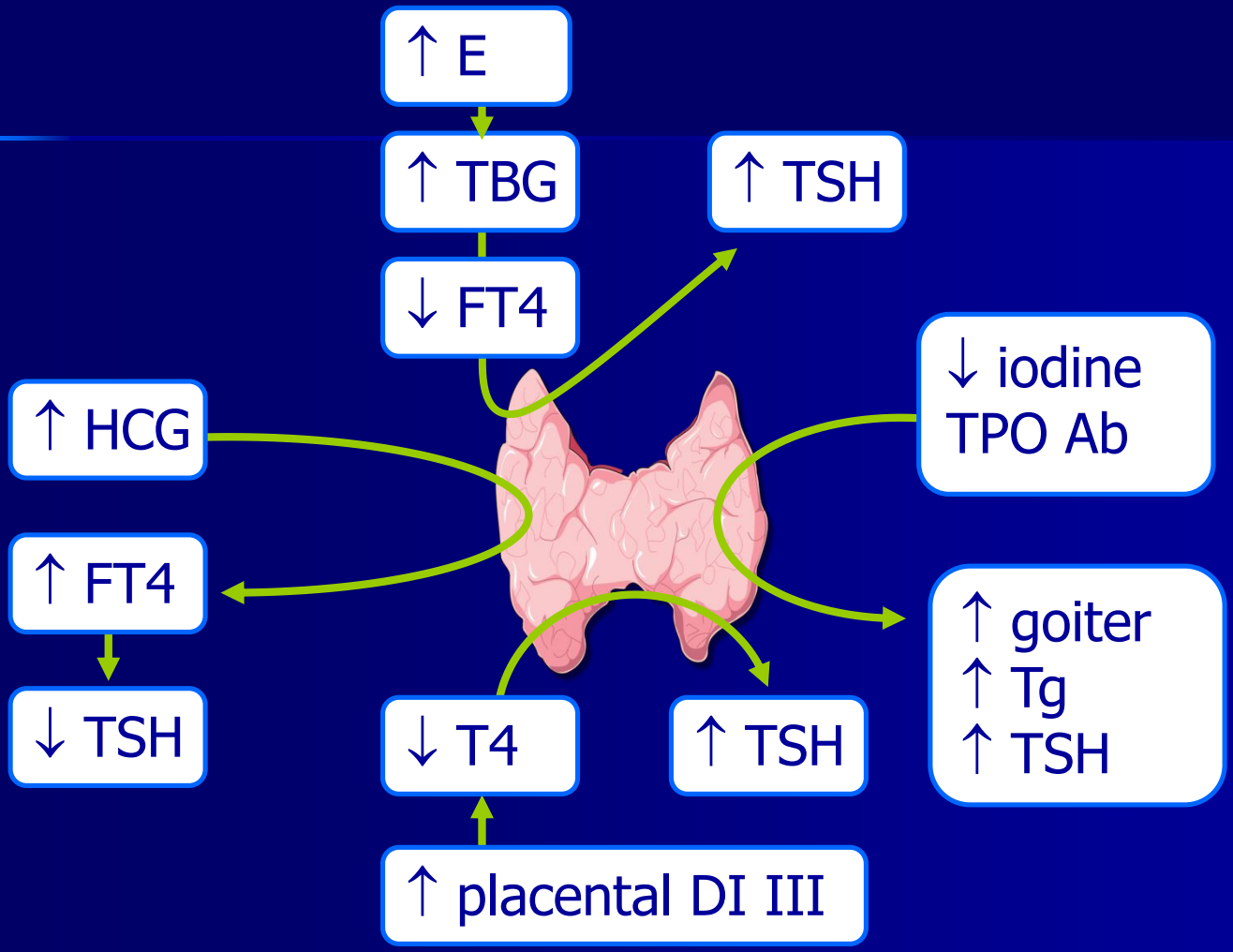
The production, circulation and disposal of thyroid hormones are all altered during pregnancy.

Physiologic adaptation during pregnancy

- Increase in thyroid-binding globulin
  - Secondary to an estrogenic stimulation of TBG synthesis and reduced hepatic clearance of TBG (prolongation of TBG half-life from 15 minutes to 3 days)
  - Begins early in the first trimester, plateaus during mid-gestation, and persists until shortly after delivery


Mother
TBG
Total T_4
hCG
Free T_4
Thyrotropin
0
10
20
30
40
Week of pregnancy

Factors For Thyroid Stimulation During Pregnancy



Delange: Int.J. Endocrinol. Metab. 2: 1, 2004

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Iodine metabolism

Iodine metabolism in pregnancy is marked by several characteristics:

- Synthesis of thyroid hormones is increased by up to 50% due to estrogen-induced increase in TBG concentration.
- Renal clearance of iodide increases owing to the ↑GFR.
- Iodide and iodothyronines are transported from maternal circulation to the fetus.
- Fetal thyroid hormone production increases during the second half of gestation and after delivery.
- Iodide is also transported into the breast milk.

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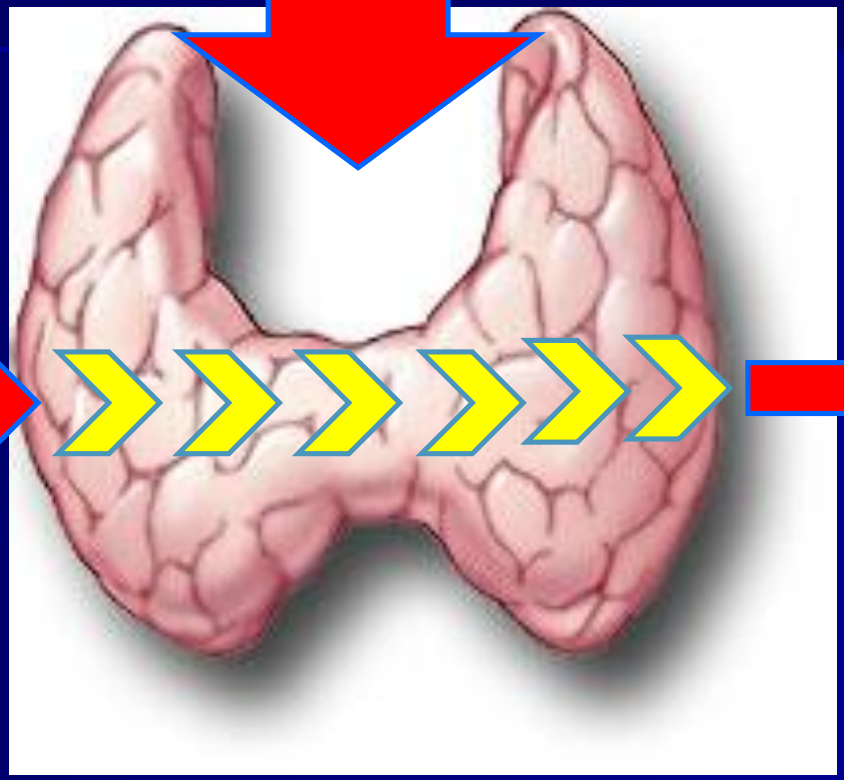
REDUCTION IN PLASMA IODIDE

Thyroid hormones synthesis

- Normal thyroid gland
- Normal H.P.T axis
- Adequate iodine

TSH



Iodine

T3

T4

Thyroid Hormone Synthesis

Thyroid Hormone

- Optimal mental & physical development
- Regulation of body metabolism
- Generation & utilization of body energy

Iodine

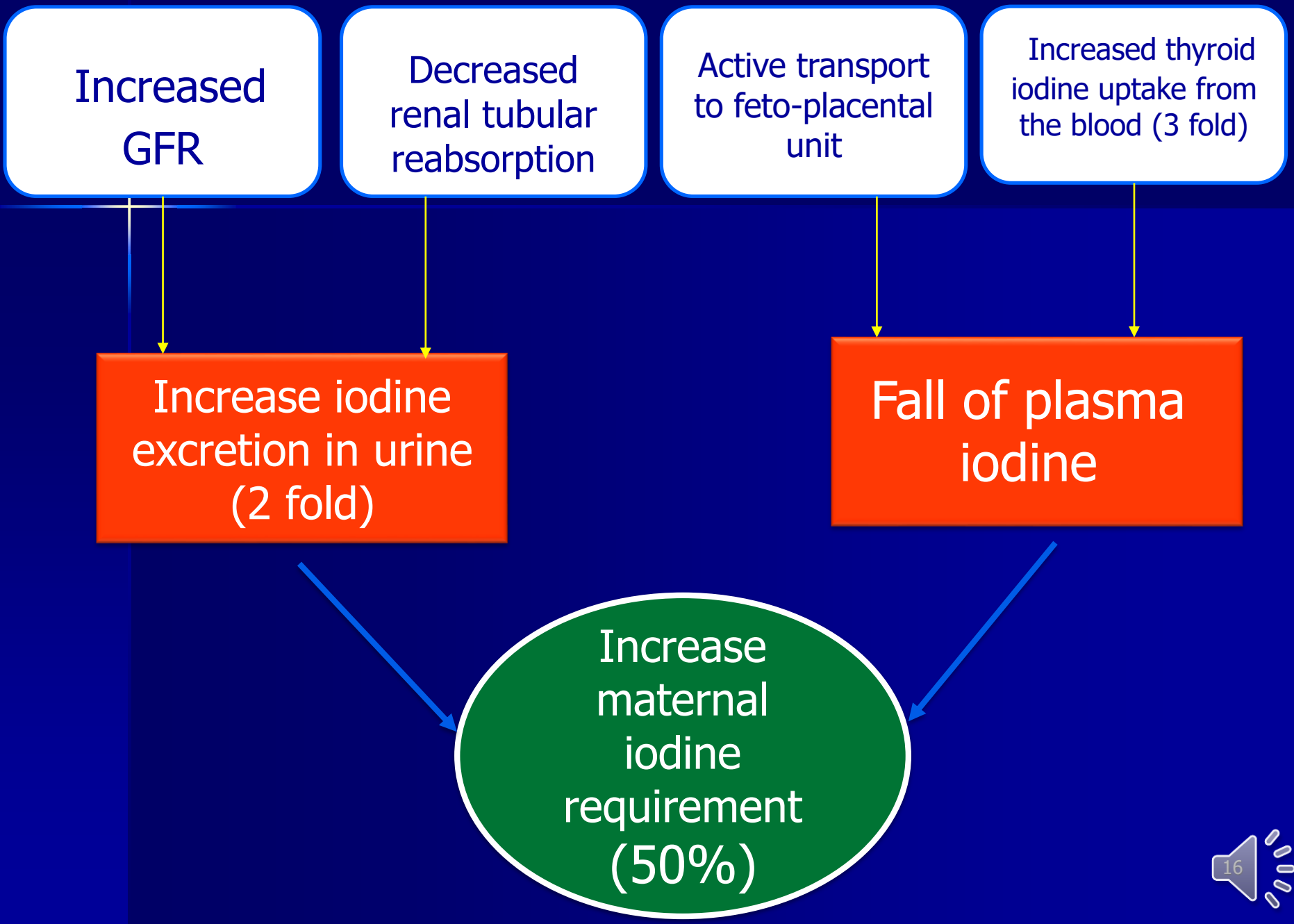
- Iodine is a chemical and essential trace element for the human.
- Total quantity present in body is 15-20 mg , mostly in thyroid gland(60%).
- Iodine contributes 65% of T_4 and 59% of T_3 molecular weight.

How Much Do We Need?

Age group	Daily requirement	Tolerable upper level
Preschool children	90 μg/day	200
Schoolchildren(6-12 y)	120 μg/day	300-450
Adult (>12 y)	150 μg/day	600-1100
Pregnant & Lactating women	250-300 μg/day	600-1100

Pregnancy

Relative Iodine Deficiency


Increased GFR
Decreased renal tubular reabsorption
Active transport to feto-placental unit
Increased thyroid iodine uptake from the blood (3 fold)
Increase iodine excretion in urine (2 fold)
Fall of plasma iodine
Increase maternal iodine requirement (50%)

Iodine Requirement (µg/day)

During pregnancy	µg /day
Basal	150
40-50 % increased T4 requirements	50 - 100
Transfer of T4 and I from mother to fetus	50
Increased renal clearance of I	?
Total	**250 - 300**
During lactation	
Basal	150
0.5-1.1 L milk/day x 150-180 µgI/L	75 - 200
Total	**225 - 350**

Recommended Dietary Allowance for Iodine in Pregnant Women(μg/day)

World Health Organization	**200-300**
US Institute of Medicine	**220**
Endocrine Society	**250**

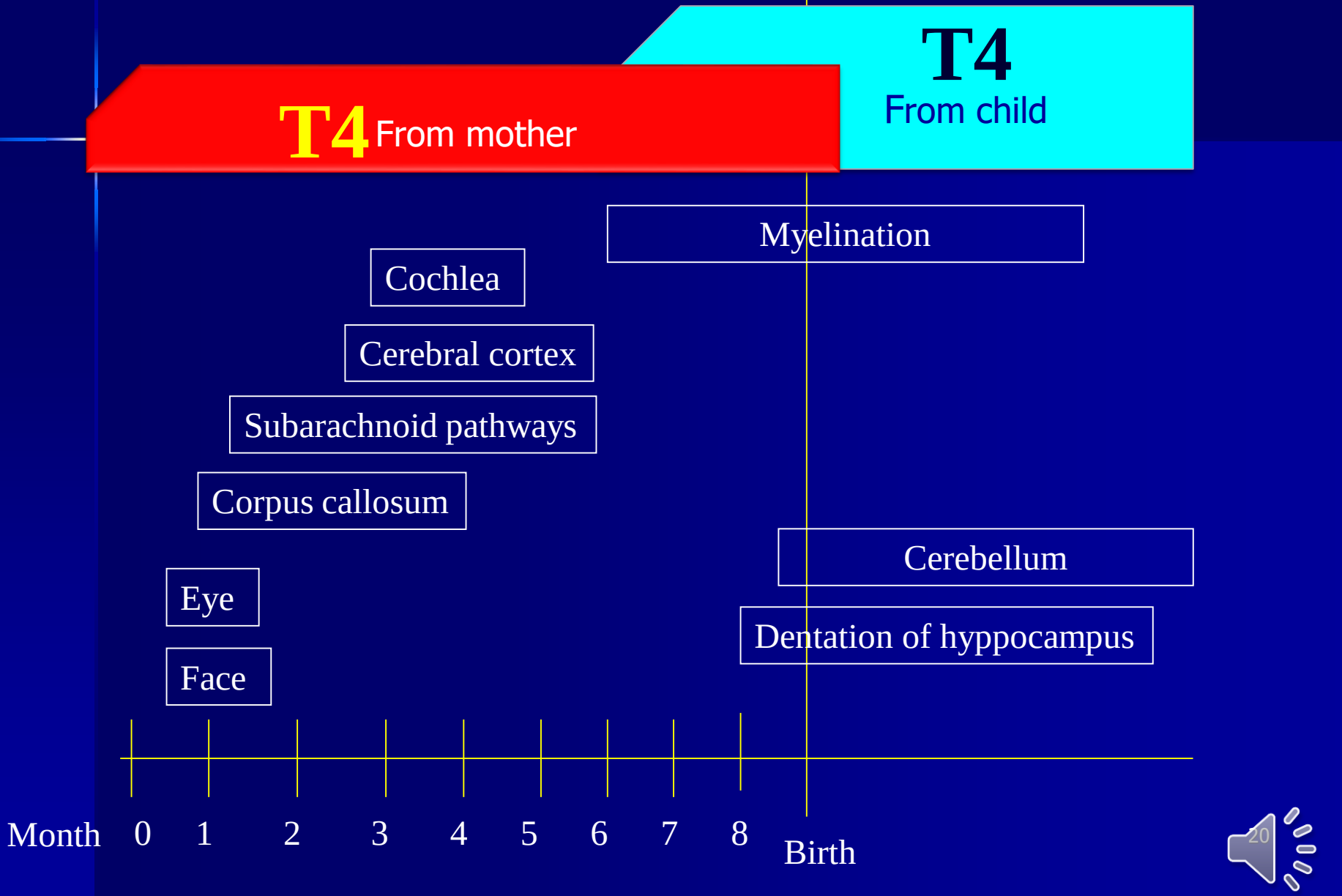
Pregnancy & Breastfeeding

Mothers are the sole source of iodine for their babies

The Fetal Thyroid

- Begins concentrating iodine at 10-12 weeks
- Controlled by pituitary TSH by approximately 20 weeks
- Maternal T4 essential for first 24 weeks of gestation
- Foetal T4 starts at 24 weeks

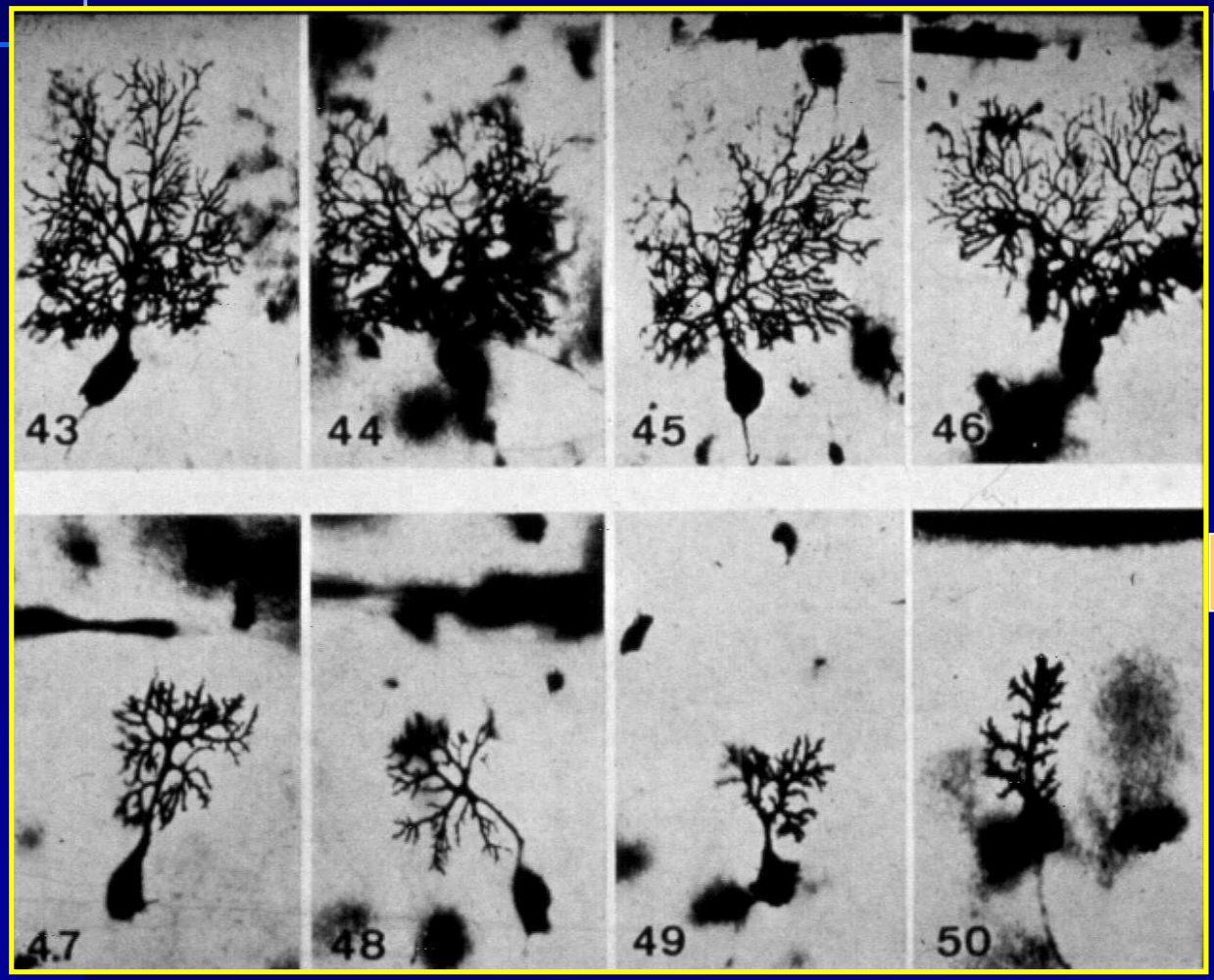
Developing brain needs normal level of circulating T4



Importance of iodine in brain development

- 50,000 brain cells produced/second in developing fetal brain
- One million billion connections between these brain cells: Determine IQ

The network of connections are less dense in Iodine Deficient Brain



Iodine Sufficient Brain

Iodine Deficient Brain

What happens if pregnant women don’t get enough iodine?

Iodine Deficiency In Pregnancy

Severe Iodine Deficiency is Associated with Adverse Obstetric Outcomes

Fetus

- Congenital anomalies
- Decreased intelligence
- Neurological cretinism spasticity, deaf mutism, mental deficiency

Neonate

- Neonatal goiter
- Neonatal hypothyroidism
- Endemic mental retardation
- Increased susceptibility of the thyroid gland to nuclear radiation

Pregnant Women

- Prematurity
- spontaneous abortion
- Still birth
- Increased infant mortality

Iodine Deficiency In Pregnancy

Results from observational studies, have indicated that even mild to moderate iodine deficiency (ID) in pregnancy might negatively affect child neurodevelopment.

Evidences:

Bath SC, et al. Effect of inadequate iodine status in UK pregnant women on cognitive outcomes in their children: results from the Avon Longitudinal Study of Parents and Children (ALSPAC). *Lancet 2013 382:331–337*

- Children of women with UIC < 150 µg/L were more likely to have scores in the lowest quartile for verbal IQ , reading accuracy and reading comprehension than were those of mothers with UIC > 150 µg/L.

Evidences:

Hynes KL. et al. Mild iodine deficiency during pregnancy is associated with reduced educational outcomes in the offspring: 9-year follow-up of the gestational iodine cohort.

J Clin Endocrinol Metab. 2013; 98(5):1954-62.

Hynes KL, et al. Reduced educational outcomes persist into adolescence following mild iodine deficiency in utero, despite adequacy in childhood: 15-Year follow-up of the Gestational Iodine Cohort investigating auditory processing speed and working memory.

Nutrients 2017

Evidences:

Abel MH, et al. Suboptimal maternal iodine intake is associated with impaired child neurodevelopment at 3 years of age in the Norwegian Mother and Child Cohort Study.
J Nutr 2017;147:1314–1324

Abel MH, et al. Maternal iodine intake and offspring attention-deficit/hyperactivity disorder: Results from a large prospective cohort study.
Nutrients 2017

Evidences:

The **INMA** Mother and Child Cohort Study
(Infancia Medio Ambiente)

- A prospective cohort study in four Spanish regions(iodine-sufficient or mildly iodine-deficient) with recruitment of pregnant women and follow-up of their children up to 4–5 years.
- Cognitive and motor function was assessed in 1803 children.
- They found an association between low maternal urinary iodine and lower cognitive scores in childhood.

Mario Murcia, et al. J Epidemiol Community Health 2018;**72**:216–222

Conclusion

Thyroid hormones and iodine are required to increase basal metabolic rate and to regulate protein synthesis, long bone growth and neuronal maturation.

Fetal development highly relies on thyroid and iodine metabolism and can be compromised if they malfunction.

Neurological impairment is a negative outcome of fetal hypothyroidism due to ID.


در پناه حق باشید