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A 15-year-old adolescent girl is brought in by her mother because she has not yet started to menstruate. She is tall for her age but otherwise of normal body habitus. She had a growth spurt that began when she was about age 12 years and began breast development at age 13 years. Physical examination finds Tanner stage III breast development and stages III to IV pubic hair. She shaves her underarms.

Introduction

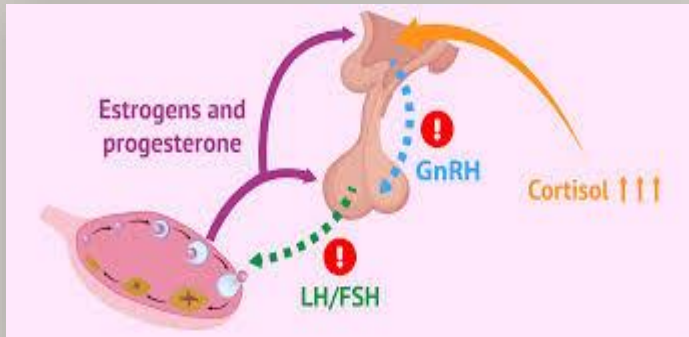
Puberty , an endocrine process involving :

Emotional transition

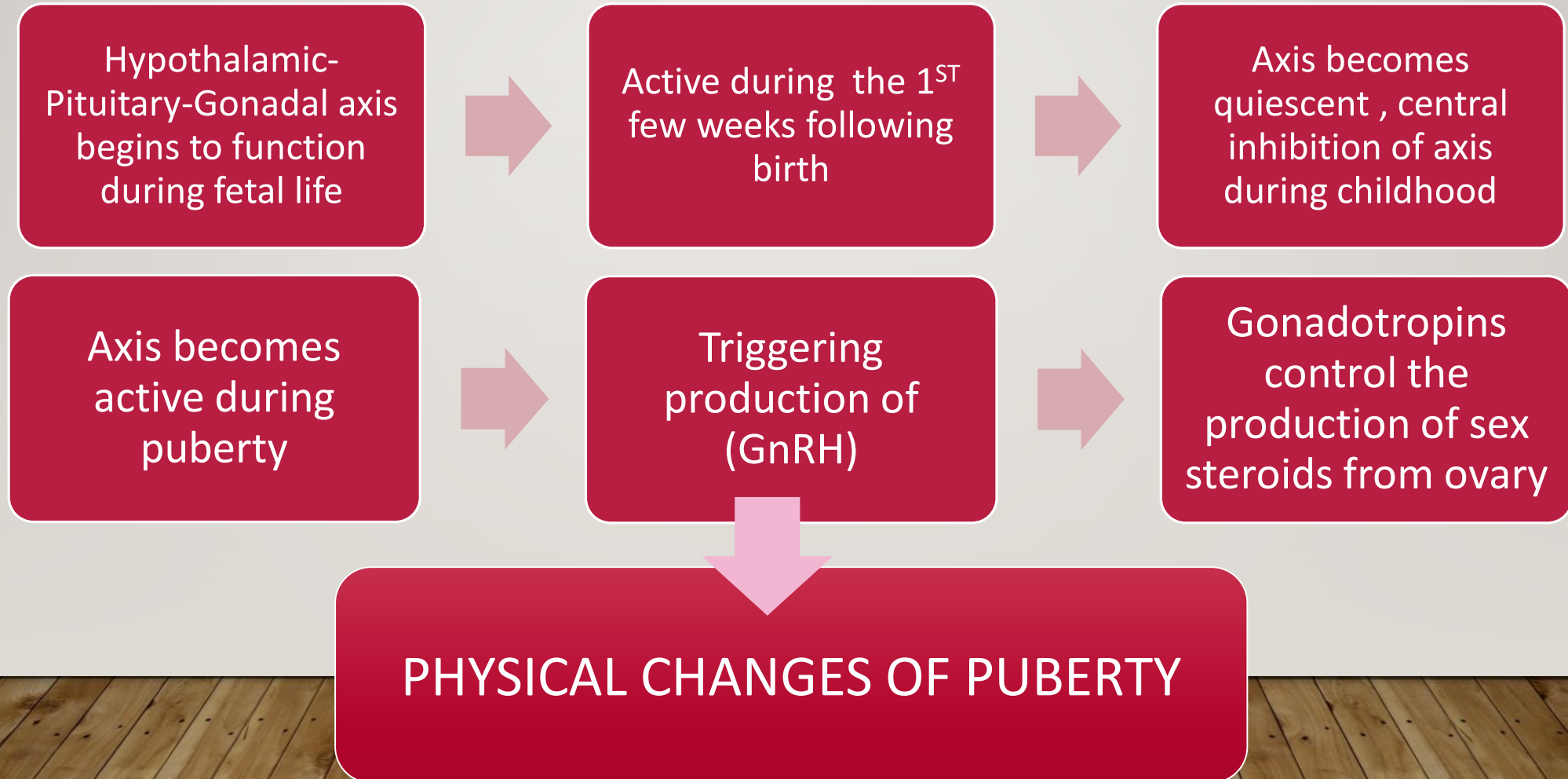
Physical transition

Sexual transition





Normal Pubertal Development



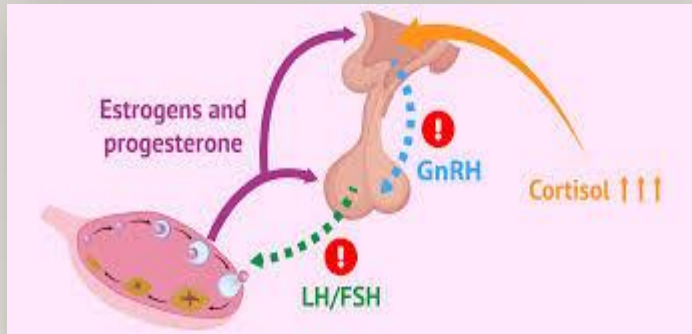
PHYSICAL CHANGES OF PUBERTY

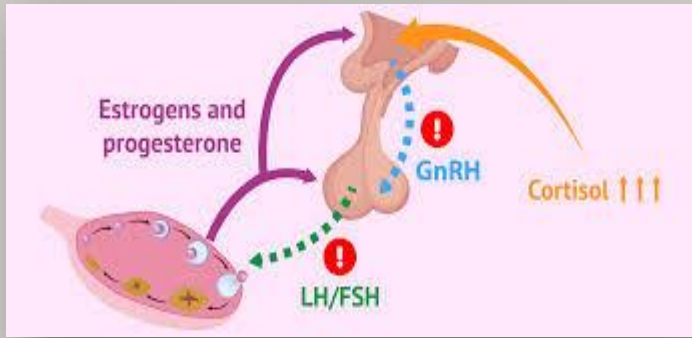
increased kisspeptin & neurokinin B secretion

pulsatile GnRH signaling from hypothalamus

increased pituitary secretion of LH&FSH

gonadal sex hormone production from ovaries





Normal Pubertal Development



Adrenarche

Gonadarche



Normal
Pubertal
Development

physical manifestation of adrenarche:

- development of pubic hair, axillary hair
 - apocrine odor
 - acne

Adrenarche

- At approximately 10 - 11 Y/O, an increase in the production of androgens in adrenal glands.
- Increase in production of dehydroepiandrosterone (cortical zona reticularis activity, adrenal pubertal maturation)
 - It can be converted to more potent androgens (testosterone / dihydrotestosterone)
- Adrenarche is independent of the hypothalamic-pituitary-gonadal axis
- Adrenarche , usually , begins prior to the first visible physical manifestation of gonadarche

The impact of adrenarche
on human puberty





Normal Pubertal Development

During pubertal transition, balance between inhibitory & stimulatory factors shifts to favor re-activation of axis, onset of pubertal changes, reproductive competence.

Gonadarche

- At approximately 7-8Y/O, an increase in the production & pulse of GnRH in hypothalamus
 - Increase in production & pulse of FSH & LH in pituitary
 - Production of estrogen & progesterone in ovaries
 - Folliculogenesis , Ovulation , Menses , Breast development , Cornification of vaginal mucosa , Uterine growth

Normal Pubertal Development

Process of sexual maturation requires approximately 4 years



Growth
acceleration

Breast
development
Thelarche

Pubic hair
development
Pubarche

Maximum
growth rate

Menarche

Ovulation



Normal Pubertal Development

- The initial event is accelerated growth .
- It may be subtle ; breast budding is easier to detect as the first event .
- While the majority of the time thelarche occurs before pubarche, in 20% of girls, pubarche will begin before thelarche .
- The sequence of breast development & pubic hair growth is quantified by the Tanner classification of sexual maturity .



PUBERTY & TANNER STAGING OSMOSIS.org

A

sparse, coarse, lightly pigmented hairs along the labia majora

B

enlargement of the breast and areola
progressively darker, coarser hair ,
spreads over the mons pubis

C

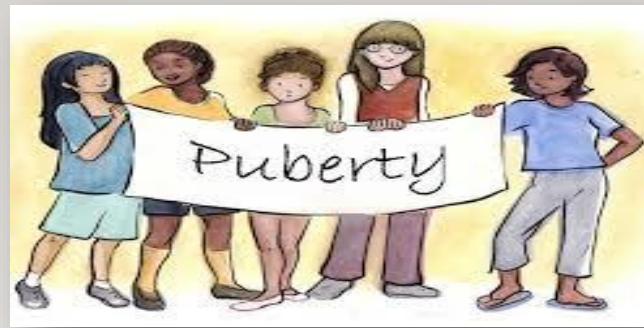
papilla forms a secondary mound above breast
pubic hair extends an inverse triangle

D

mature breast development due to
recession of areola to contour of breast

Spreading of hair to the medial aspects
of the thighs

E



-
- Breast development (thelarche) may be unilateral.
 - Increased estrogen secretion promotes uterine growth & causes physiologic leukorrhea
 - A thin, white, non-foul-smelling vaginal discharge
 - It begins 6 -12 months before menarche.
 - Menarche occurs, on average, 2 to 2.5 years after the onset of breast development
 - During the first-year post-menarche, menses are usually irregular & anovulatory



Normal Pubertal Development

- There is a strong relationship between **BODY FAT CONTENT** & the onset of puberty .
- Mild (BMI=30-34.99) to moderate (BMI =35-39.99) obesity results in earlier puberty, whereas thinness results in later puberty .
- The onset of puberty is also marked by significant **ETHNIC DIFFERENCES** .



Normal Pubertal Development

- The relation between **Puberty** & **race** :

(African American & Mexican American girls > girls of European descent > Asian American girls)

- The difference may result from :

- the differences in **BMI**
- genetic factors
- environmental factors
- socioeconomic conditions
- nutrition
- access to preventive health care
- chronic illness



Normal Pubertal Development

TABLE 38.1

ETHNICITY AND ONSET OF PUBERTY

Event	Mean Age (years)		
	Non-Hispanic Blacks	Mexican Americans	Non-Hispanic Whites
Thelarche	9.5	9.8	10.3
Pubarche	9.5	10.3	10.5
Menarche	12.2	12.5	12.5

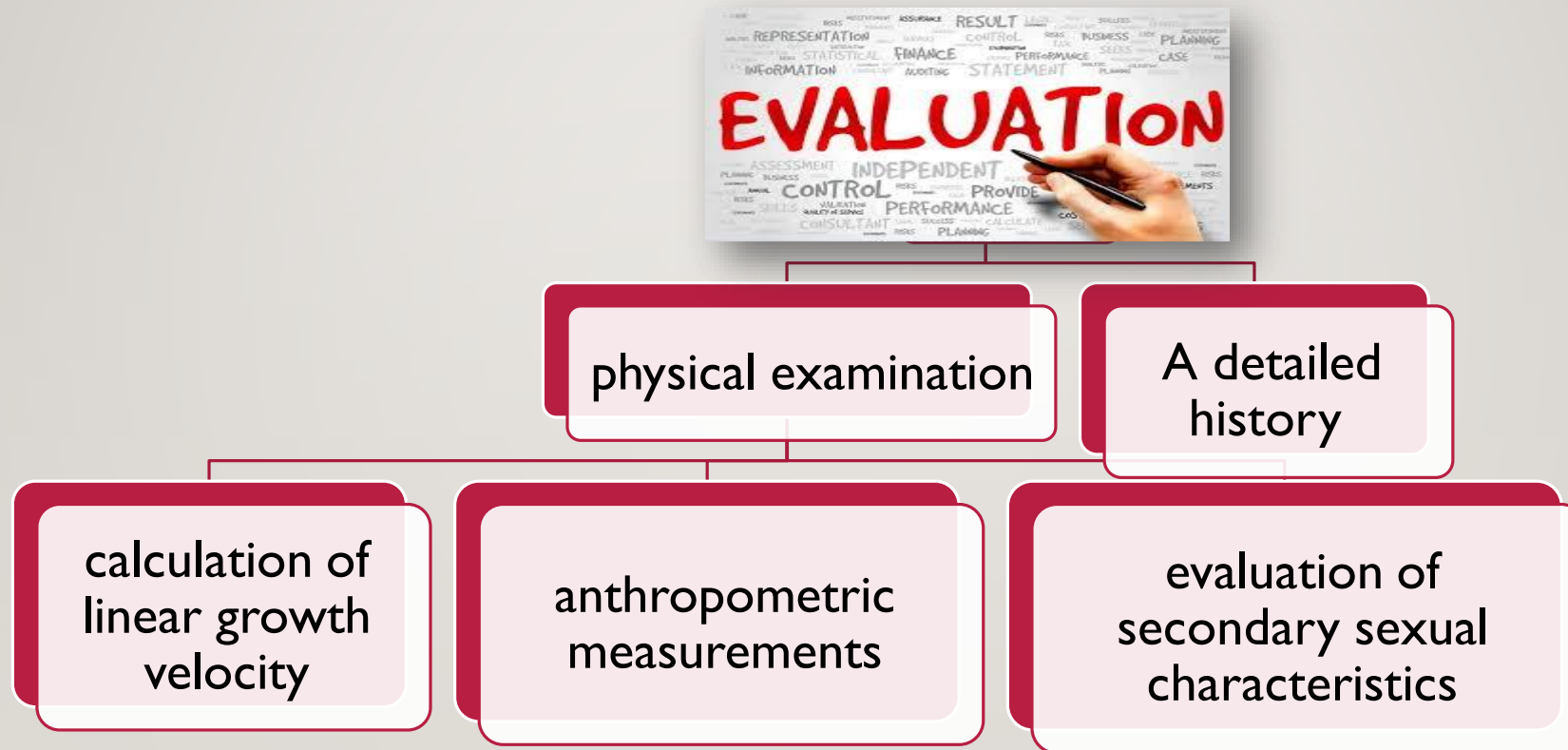
Sources: Data from McDowell MA, Brody DJ, Hughes JP. Has age at menarche changed? Results from the National Health and Nutrition Examination Survey (NHANES) 1999–2004. *J Adolesc Health*. 2007;40(4):227-231; Goldman MB, Troisi R, Rexrode KM. *Women and Health*. 2nd ed. Academic Press; 2013; Finer LB, Philbin JM. Trends in ages at key reproductive transitions in the United States, 1951–2010. *Women's Health Issues*. 2014;24(3):e271-e279.



- Precocious puberty
(development of puberty prior to age 8)
- Primary amenorrhea
(no menstruation by 15 years)
- Delayed puberty
(absence of breast development by age 13 years)
(absence of menarche by age 15)
(lack of menses after 3 years since breast development)
- Incomplete sexual maturation

The presence of any of these disorders requires:

- 1 investigation of the hypothalamic-pituitary-gonadal axis
- 2 Investigation of the reproductive outflow tract.

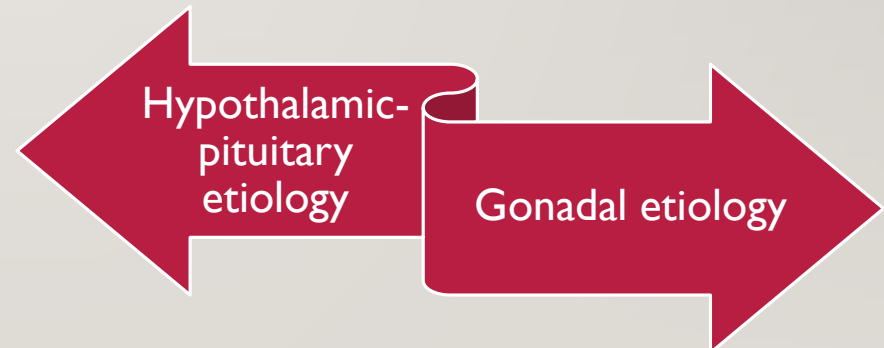




Laboratory studies :



Distinguish between :



Thanks for your attention

