

## **SKIN DEEP S.T.E.A.M: The Science and Politics of the Dark Tone**

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# **Ethnic skin types: Are there differences in skin structure and function?**

Prof. Donald B. Palmer BSc (Hons) MSc PhD FHEA

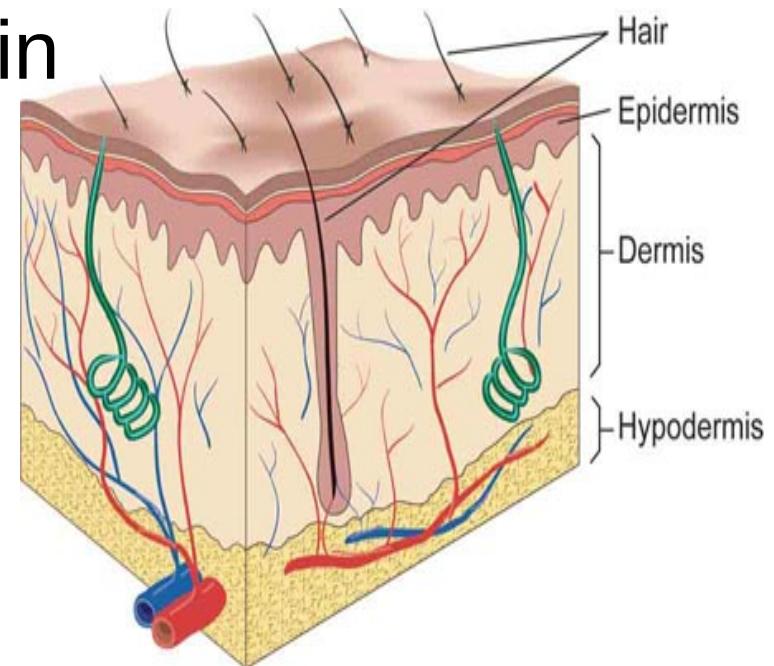
Associate Professor of Immunology

Royal Veterinary College, University of London

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# The function of skin

- One of the largest organs in the body in surface area and weight.
- The skin has three main functions:
  - protection
  - regulation
  - sensation



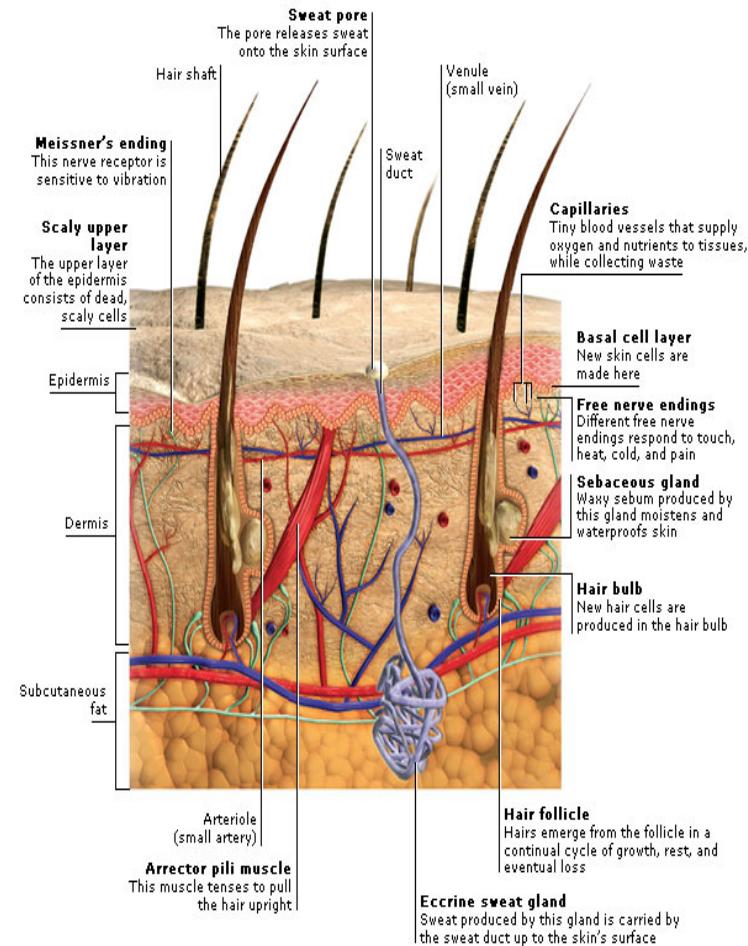
# Function of the skin

- **BARRIER:** Providing protection from: mechanical impacts and pressure, variations in temperature, micro-organisms, radiation and chemicals.
- **REGULATION:** The skin regulates several aspects of physiology, including: body temperature via sweat and hair, and changes in peripheral circulation and fluid balance via sweat. It also acts as a reservoir for the synthesis of Vitamin D.
- **SENSATION:** The skin contains an extensive network of nerve cells that detect and relay changes in the environment. There are separate receptors for heat, cold, touch, and pain

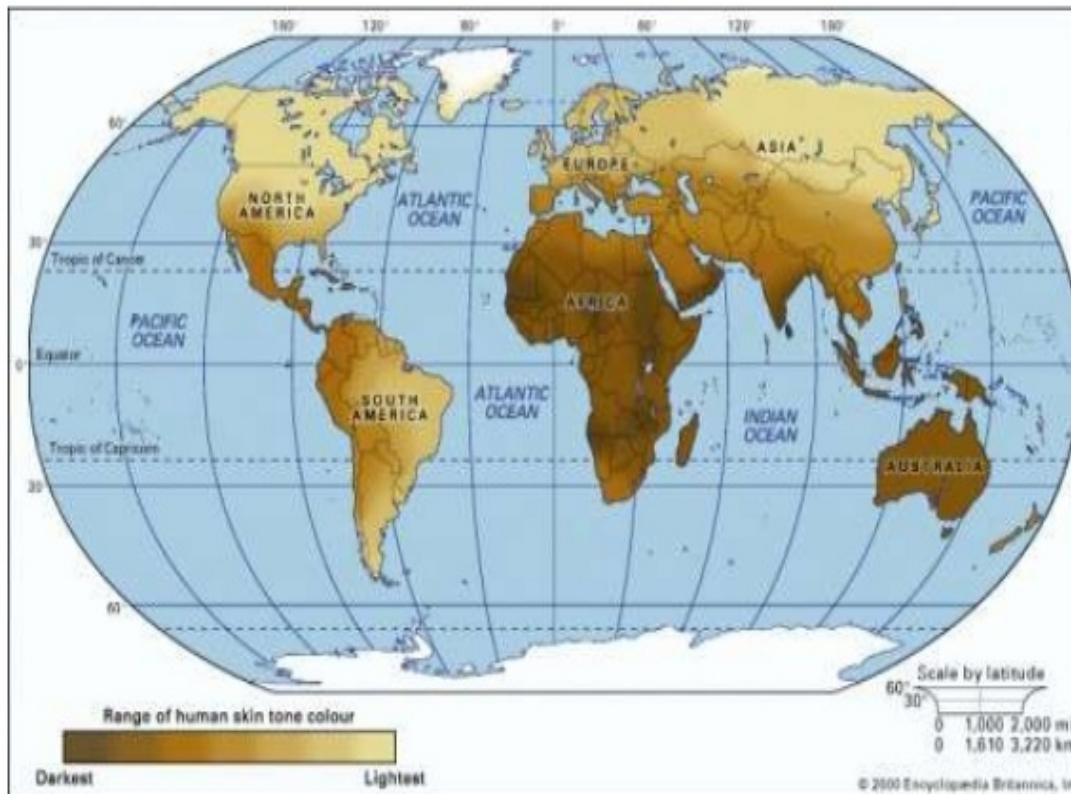
# The Structure of skin

The skin is made up of  
3 main layers:

- Epidermis
- Dermis
- Subcutaneous layer



# Distribution of skin colour



# What determines skin colour

- Pigmentation
- Four chromophores
  - Melanin
  - Haemoglobin
  - Oxyhaemoglobin
  - Carotenes

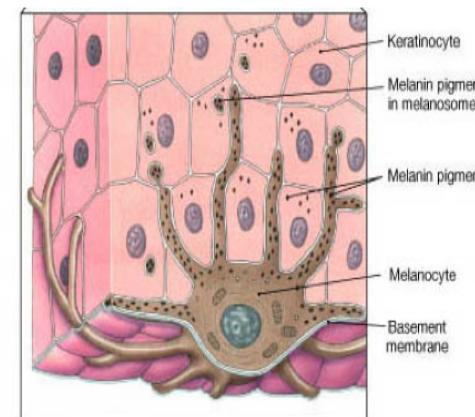


## Main article: [Fitzpatrick scale](#)

Type	Also called	Sunburning	Tanning behavior	Von Luschan's chromatic scale
I	Light, pale white	Often	Occasionally	1–5
II	White, fair	Usually	Sometimes	6–10
III	Medium, white to light brown	Rarely	Usually	11–15
IV	Olive, moderate brown	Rarely	Often	16–21
V	Brown, dark brown	Very rarely	Sometimes darkens	22–28
VI	Very dark brown to black	Extremely rarely	Naturally black-brown skin	29–36

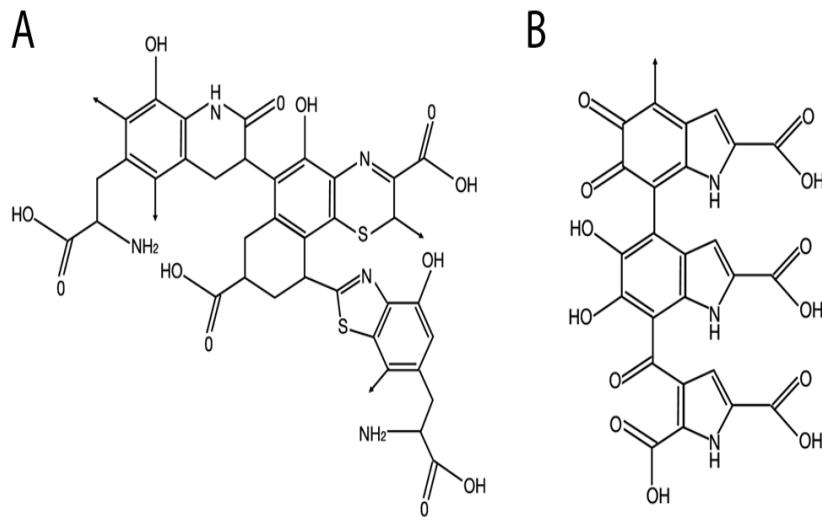
# What is melanin

- Natural skin pigment which protects the skin from UV damage-It functions like an antioxidant by quenching free radicals.
- **Eumelanin** – yellow to brown to very dark brown (almost black) color; seen in brown-black hair
- **Pheomelanin** – red-yellow color; seen in red hair
- Produced by melanocytes



# Chemistry of Melanins

The melanins are derivatives of the amino acid tyrosine. The enzyme tyrosinase acts to change the tyrosine into DOPA (3,4-dihydroxyphenylalanine), and then into dopaquinone. The dopaquinone can be converted to leucodopachrome and then follows one of two pathways to produce eumelanins (Figure B below). Alternatively, the dopaquinone can combine with the amino acid cysteine by two pathways to produce benzothiazines and phaeomelanins (Figure A below).

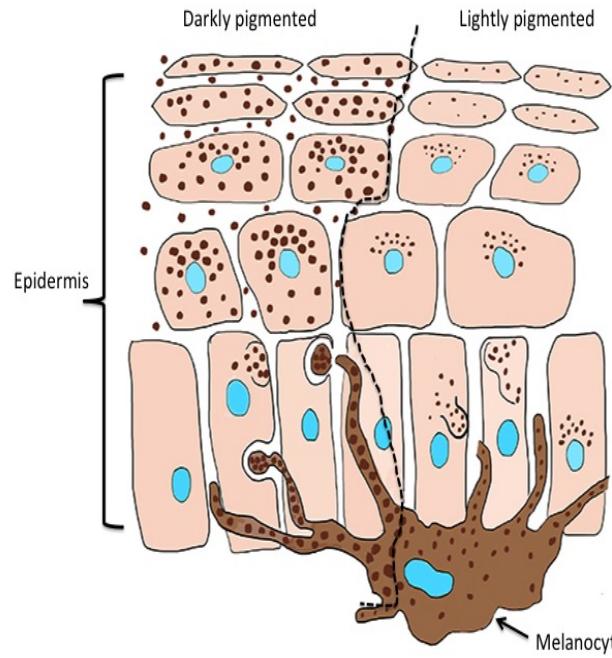


*Molecular structure of phaeomelanin (A) and eumelanin (B). [Diagram from <http://photoprotection.clinuvel.com/node/204>.]*

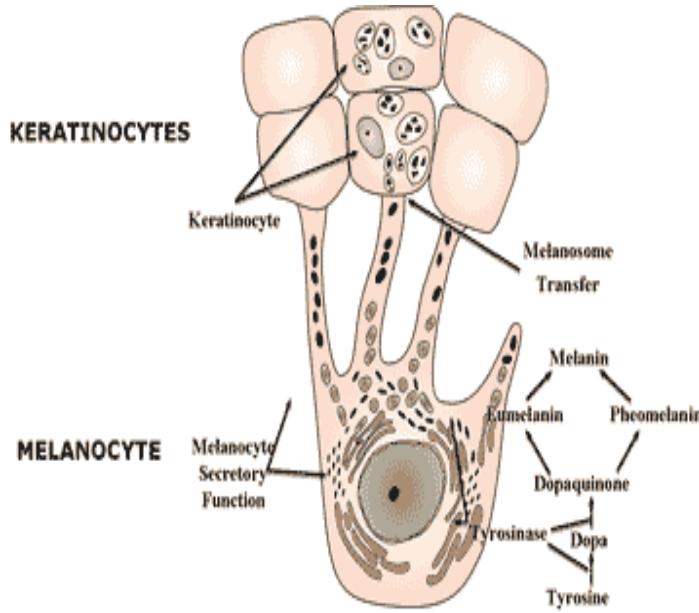
# Chemistry of Melanins

**Eumelanins** are insoluble, nitrogenous pigments produced by the oxidative polymerization of 5,6-dihydroxyindoles derived enzymatically from tyrosine via DOPA.

**Phaeomelanins** are sulfur-containing, alkali-soluble, pigments produced by oxidative polymerization of cysteinyldopas via 1,4-benzothiazine intermediates. Sepiomelanin is a form of eumelanin, present in the raw ink of cephalopods as a suspension of small, dark granules in a colourless plasma. The structure is a macromolecule or probably a mixture of polyacid polymers in which the predominant chemical unit is of the indole type. Allomelanins are produced from nitrogen-free precursors.



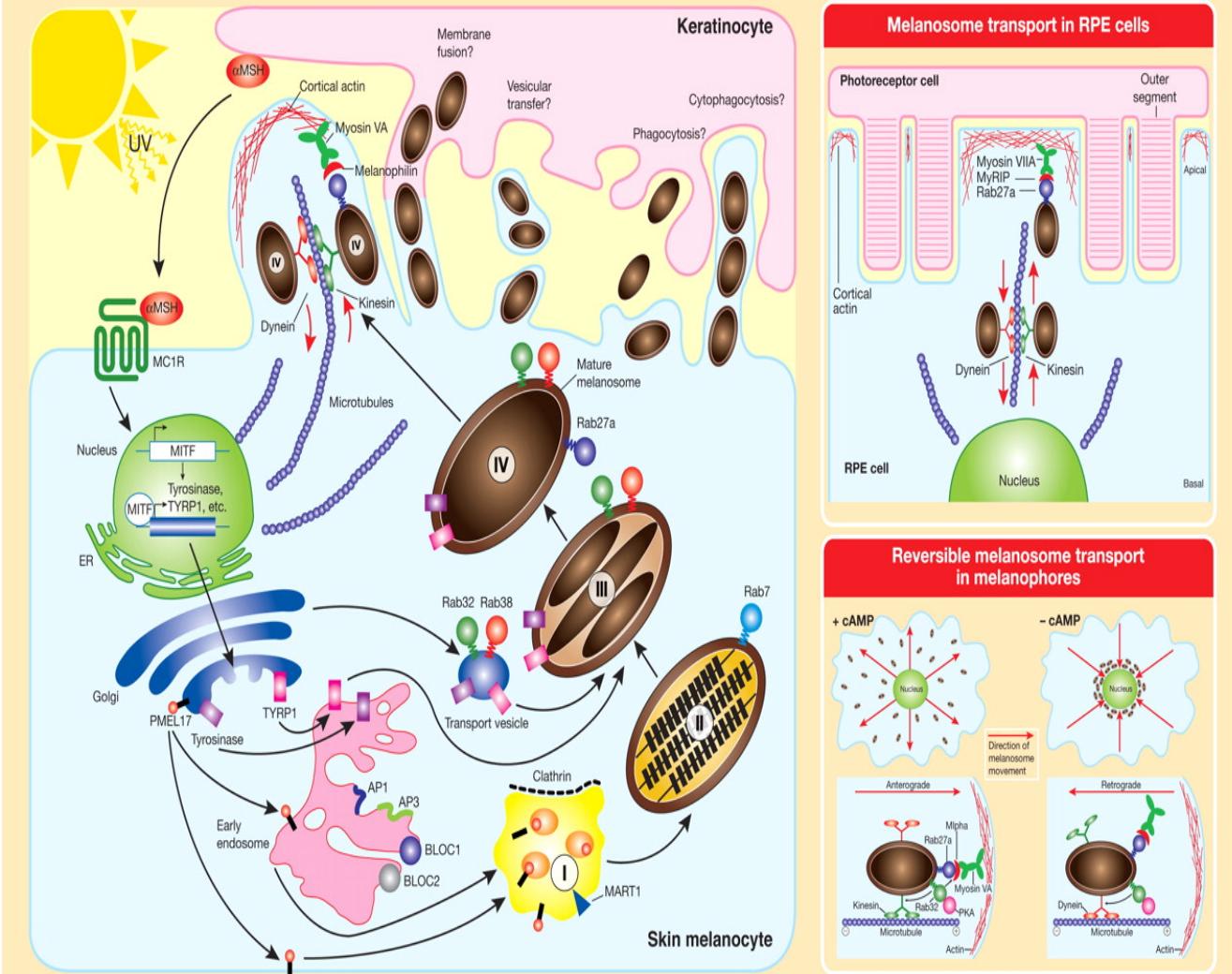
In human skin, melanocytes are localized at the dermal/epidermal border in a characteristic regularly dispersed pattern. Each melanocyte at the basal layer of the epidermis is functionally connected to underlying **fibroblasts** in the dermis and to **keratinocytes** in the overlying epidermis. Those three types of cells are highly interactive and communicate with each other via secreted factors and their receptors and via cell/cell contacts to regulate the function and phenotype of the skin.



The melanin produced by the action of tyrosinase is “packaged” within the melanocyte into unique vesicles called melanosomes. These organelles are then transferred from the melanocyte to surrounding keratinocytes in the skin. As keratinocytes move from the lower part of the epidermis up to the surface, they can carry the ingested melanosomes with them, and the result is a deposition of the melanin-filled melanosomes near the skin’s surface. This is what gives the skin its brownish tint. The image on the right shows a melanocyte and the production of melanosomes.

# Melanosomes at a Glance

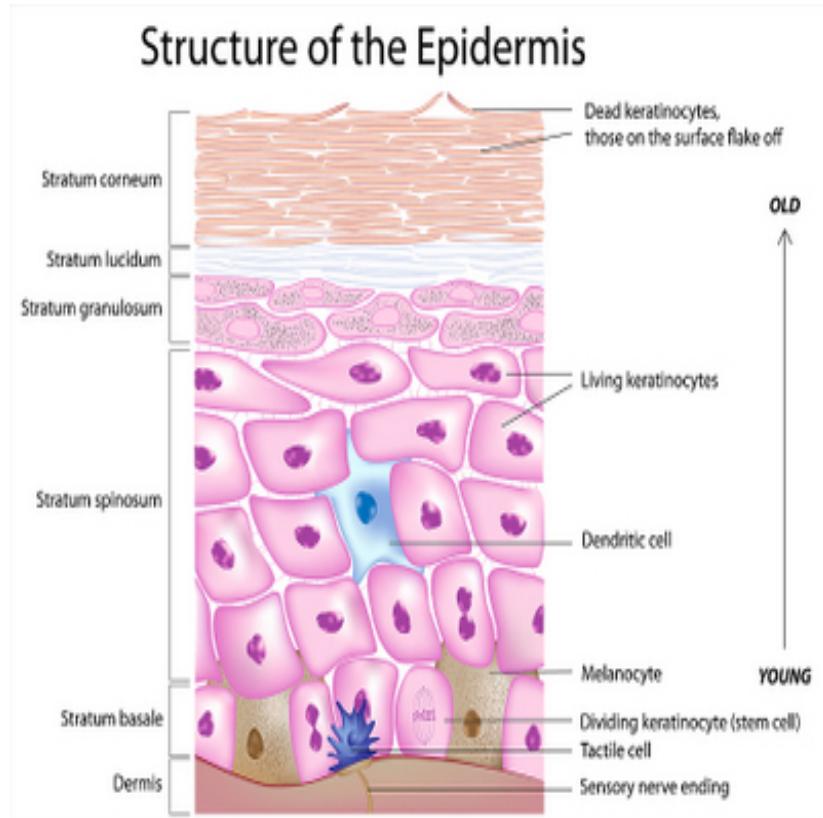
Christina Wasmeier, Alistair N. Hume, Giulia Bolasco and Miguel C. Seabra



**Abbreviations:** αMSH, α-melanocyte-stimulating hormone; AP, adaptor protein; BLOC, biogenesis of lysosome-related organelles complex; cAMP, cyclic adenosine 3',5'-monophosphate; MART, melanoma antigen recognised by T cells; MC1R, melanocortin 1 receptor; MITF, microphthalmia-associated transcription factor; MyoVA, melanophilin (zebrafish); RPE, retinal pigment epithelium; TYRP1, tyrosinase-related protein 1.

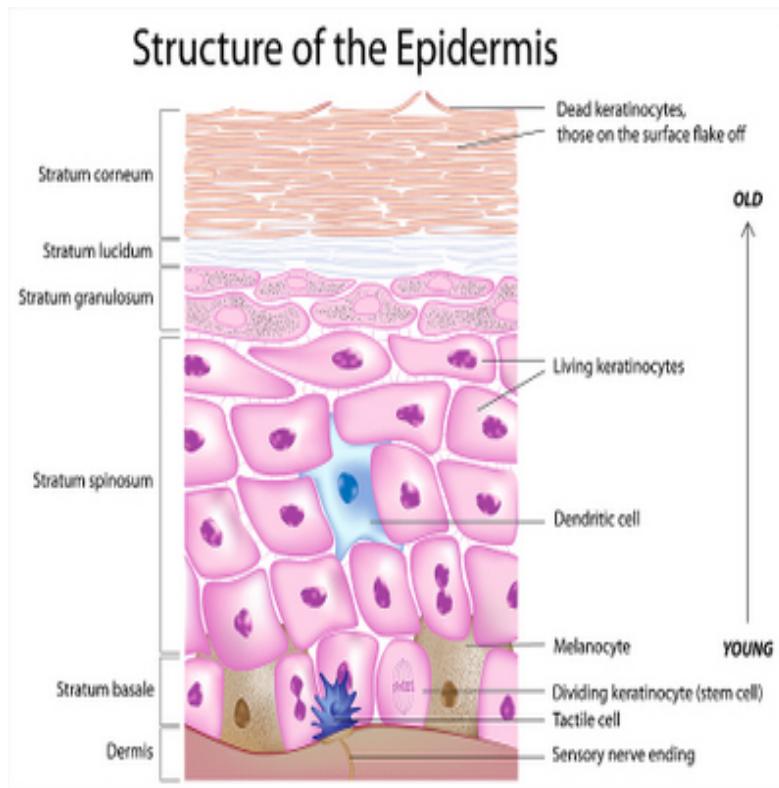
© Journal of Cell Science 2008 (121), pp. 3995-3999

# Racial differences in stratum corneum



- Thicker in black skin
- Increase cohesiveness
- Higher Lipid content in black skin
- Lower water content in black skin Increased bacterial content on black skin
- No difference in pH

# Racial differences in the Epidermis



- In the epidermis of white skin, hyperpigmentation or tanning is always followed by a drop in glutathione reductase and reduced glutathione.
- Black skin have larger melanosomes than white skin.
- Black skin has a higher electrical resistance than white skin, which suggests greater cohesion and thickness.
- Black skin has more and larger fibroblasts than white skin. The fibroblasts in black skin are also more multi-nucleated. This can lead to more abnormal scarring and keloid formation.
- Black skin also has larger mast cell granules than white skin, which may also play a part in keloid formation.

# Other differences



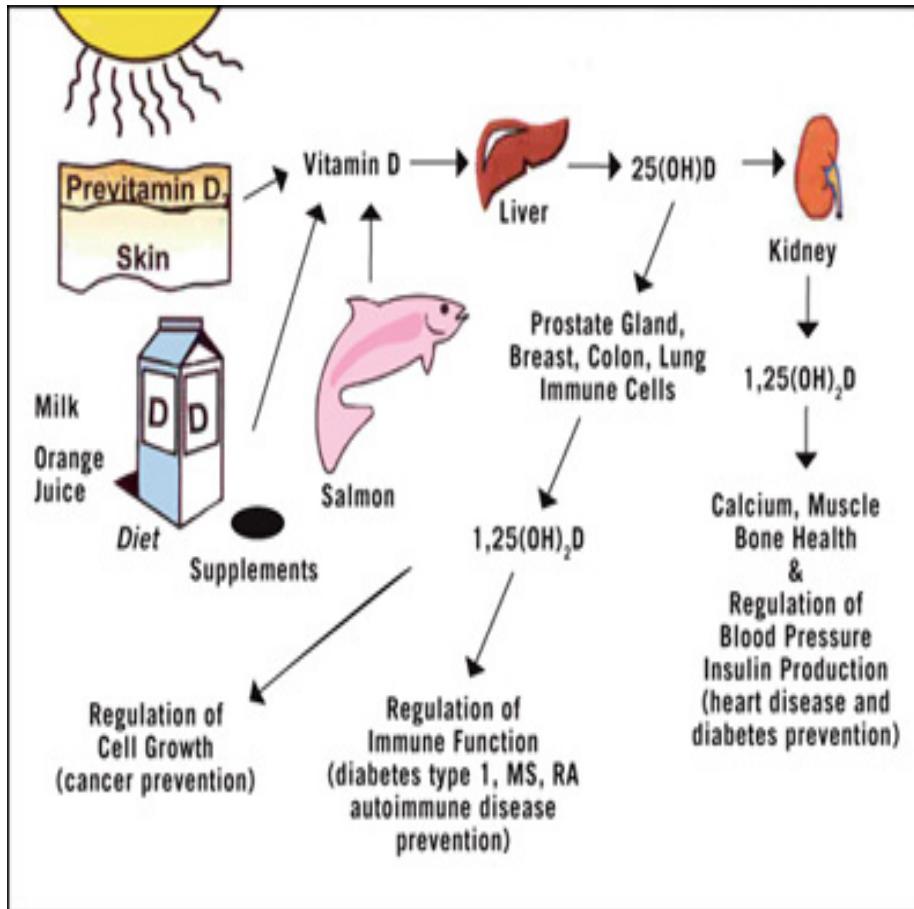
- Black skin and Asian skin have **thicker and more compact dermis** than white skin. This is also why blacks and Asians have fewer facial wrinkles than whites.
- Black skin less prone to photoaging.
- Black skin and Asian skin have **thicker and more compact dermis** than white skin. This is also why blacks and Asians have fewer facial wrinkles than whites.
- Black skin has more casual lipids and **more moisture** in the stratum corneum than white skin.

# Other differences



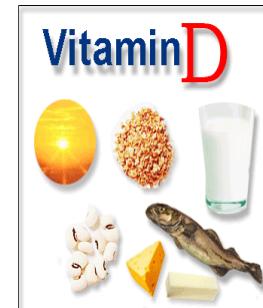
- Black skin **sheds its outer layers more** (increased desquamation) than white skin
- Black skin has **50% lower ceramides** than white or Hispanic skin. Asians have the highest skin ceramide levels.
- Black and Indian skin has **two times more alkali-insoluble melanin** (darker DHI-enriched eumelanin) than white skin, hispanic skin and Chinese skin.

# Vitamin D



# Vitamin D Deficiency

- Vitamin D deficiency has been linked to bone fragility in children and adults, and to an increased risk of chronic diseases.
- The main sources of vitamin D are the diet and cutaneous synthesis, the latter being the most important one, since foods are relatively poor in vitamin D.



# Causes of Vitamin D Deficiency

- **Your exposure to sunlight is limited.** Because the body makes vitamin D when your skin is exposed to sunlight, you may be at risk of deficiency if you are homebound, live in northern latitudes, wear long robes or head coverings for religious reasons, or have an occupation that prevents sun exposure.
- **You don't consume the recommended levels of the vitamin over time.** This is likely if you follow a strict vegan diet, because most of the natural sources are animal-based, including fish and fish oils, egg yolks, cheese, fortified milk, and beef liver.
- **You have dark skin.** The pigment melanin reduces the skin's ability to make vitamin D in response to sunlight exposure. Some studies show that older adults with darker skin are at high risk of vitamin D deficiency.

# Summary

- Skin pigmentation dictates many of the changes in skin associated with ageing
- Differences in stratum corneum biology are apparent in different skin types.
- Black skin has a greater pore size.
- More studies are required.





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