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Common Skin Disorder: A Review

Ashwini Sakharam Chavan*, Dhanshri Bhagwan Chaudhari, Sonal Gokul Sandanshiv, Unnati Rajendra Chaudhari

Bachlor Of Pharmacy, Late Shri R K Kele College Of B Pharmacy Amalner Jalgaon, Maharashtra.

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***Corresponding Author**
Ashwini Sakharam Chavan

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A B S T R A C T

Skin disorders are related to the dysfunction of skin's components or layers defects of human skin. It has targeted all kinds of people regardless of age, gender, race, as well as social and economic status. Majority of the global population is affected by skin disorders to some extent this includes the three main categories namely dry skin, acne and hyperpigmentation. Because of the magnitude of the impact on the world population, this paper reviews skin disorders by looking three most common types which have become a great focus in many research works. The design of the review begins with profiling of literatures for as pan of 20years from 1999 to 2019 to accentuate the growing interest among research community in skin study. Skin anatomy is presented with focus on epidermis, dermis, skin turn over and the varying perspectives as well as the mechanical properties such as stress, strain, and absorption. On skin disorders, the number of literatures published for dry skin was found the highest and this is consistent with findings in other studies. Three skin disorders (dry skin, acne, and hyperpigmentation) have been critically reviewed by its physical evaluation and distinctive description. Etiologies of skin disorders are also reviewed and analyzed using relevant quality control tools

Keywords: Common skin disorders Skin anatomy Acne skin Dry skin Hyperpigmented skin.

1.0 INTRODUCTION

Tribology is a study that concerns with friction, wear and lubrication in many applications. "Tribo-" in Greek means rubbing and "-logy" means study. Hence, in layman term, Tribology is the study of rubbing of many interacting systems around us. Rubbing is a specific type of motion which is the heart of Mechanical Engineering study where people learn different faces off motion as observed in the behaviors of solid, fluid, semi-solid, and heat among others. Tribology is often defined as the science and technology of interacting surface sinrelative motion (Bhushan, 2013). Some of the key words of focus in grasping the concept of tribology is rubbing, interacting surfaces, and relative motion. When a system is in operation and rubbing of surfaces takes place, the system would response in certain ways and among the many concerns is the onset of friction and the subsequent wear and tear.

In a bigger perspective, any interacting surfaces in relative motion can be considered in tribology study and this makes tribology multidisciplinary, having a wider application horizon. It draws on various academic fields, including physics, chemistry, engineering, science of materials and biology. One field that has captured the interest of many researchers around the globe is Skin Tribology. There are many instances where interactions of skin in a defined system become a concern. The current interests and work of the authors on skin are described in three areas: (1) Fabrics-skin interactions and the issue of comforts, (2) Cosmetic effects on skin, and (3) Management of skin disorders using appropriate skincare products and cosmetics. In the context of skin tribology, wear and tear of skin manifests as aging and skin disorders while introduction of skin care and cosmetics offers solution in managing skin aging and disorders. Skin care products, while generally designed to improve skin health, can sometimes lead to skin disorders, especially if not chosen or used properly. Several factors can contribute to this: Allergic Reactions: Some people may be allergic to specific ingredients in skin care products, such as fragrances, preservatives (e.g., parabens), or certain active compounds like retinoids or acids (e.g., glycolic or salicylic acid). Skin Sensitivity: People with sensitive skin may experience irritation, redness, or rashes from products that contain harsh ingredients or chemicals. For instance, strong exfoliants or high-concentration vitamin C can cause reactions. Overuse or Misuse: Using a product too often, or in combination with

other potent products, can overwhelm the skin, leading to dryness, irritation, or even damage. For example, over-exfoliating can strip the skin of its natural oils and barrier, leading to sensitivity or breakouts. Symptoms of skin disorders can include: It chiness Dry skin or rashes Ulcers Peeling skin Cracked or dry skin Change in mole size or color Skin with discolored patches Pigmentation Skin loss Open lesions.

2.0 RESEARCH PROGRESS AND SKIN FACTS

Analysis of the current research progress on skin disorders provides a basis to gauge the importance of this topic and the interests of research community over time. Skin disorders are related to the dysfunction of skin's components or defects found in the layers of human skin. Regardless of age, gender and race, many people around the globe are affected by skin disorders which include not only the people who suffer but also those who manage. The research trend on skin disorders for 20 consecutive years (1999-2019) is given Figure 1, describing the number of related publications over the specified time period. The trend was produced on Science Direct Searched Engine using keywords "common human skin disorders" and only focused on published research articles. In Figure 1, it is convenient to segment the trend into three periods: (1) 1999-2002, (2) 2003 to 2010, (3) 2011 to 2019. The first period from 1999 to 2002 shows a declining trend in the total publications with a record of 746, 710, 663 and 582 for the respective years from 1999 to 2002. In the second period, there was asuddensurge in total publications in 2003 withv715 publications but this does not sustain when the number reduces to 675 in 2004. From 2003 to 2010, two dimples were observed, one in 2004 and the other in 2008 (676 publications). The rest of the years within this second period are relatively improving. In the third period from 2011 to 2019, there is an upward trend with steeper slope indicating a very active research output. A distinctive jump in publications is observed from 2018 (1120) to 2019 (1421) with a difference of 301 publications. The trend may suggest that there are more people seeking help from qualified practitioners such as dermatologists, aesthetic physicists, and beauticians to manage their skin disorders. It may also indicate a growing awareness among people to be more beauty conscious in their life styles as their economy strengthens. The break downs of the data in to respective main skin disorders are discussed in Section 4.0.

There are skin facts that are important in understanding and appreciating skin better. Skin is the largest organ part of the human body as it covers the entire body with a surface area of 2m2, average thickness of 1.2 mm, average volume of 3.5 dm3 and it takes about 16% of the body weight (Agache and Humbert, 2004). The role of human skin can be varied into specific functions and functions exerted in conjunction with other organs. The specific functions of the skin include protection from harmful things, which may come from external physical, mechanical and chemical forces. In one aspect, skin acts as a chemical barrier by limiting the entry of foreign substances, preventing water and depletion of endogenous fluids. One amazing fact about skin is its self- healing property where skin is able to, overtime, maintain and repair itself except for appendages such as hair, nails, eccrine sweat glands, sebaceous glands and apocrine glands. Other skin functions exerted in conjunction with other organs are production of vitamin D, immune function, sensory function as well as regulation of body temperature. Skin is the first line of information and protection in the immunity cycle specially in delayed immunity (Agache and Humbert, 2004; Kolarsick and Goodwin, 2008; Nicol, 2005). Recent advances in skin science have greatly expanded our understanding of how the skin functions, how it ages, and how it interacts with the environment. Key areas of progress include the microbiome, personalized skincare, advanced treatments for skin diseases, and the development of technologies to prevent and reverse skin damage. This ongoing research holds great promise for improving skincare, enhancing skin health, and developing more effective treatments for skin conditions.

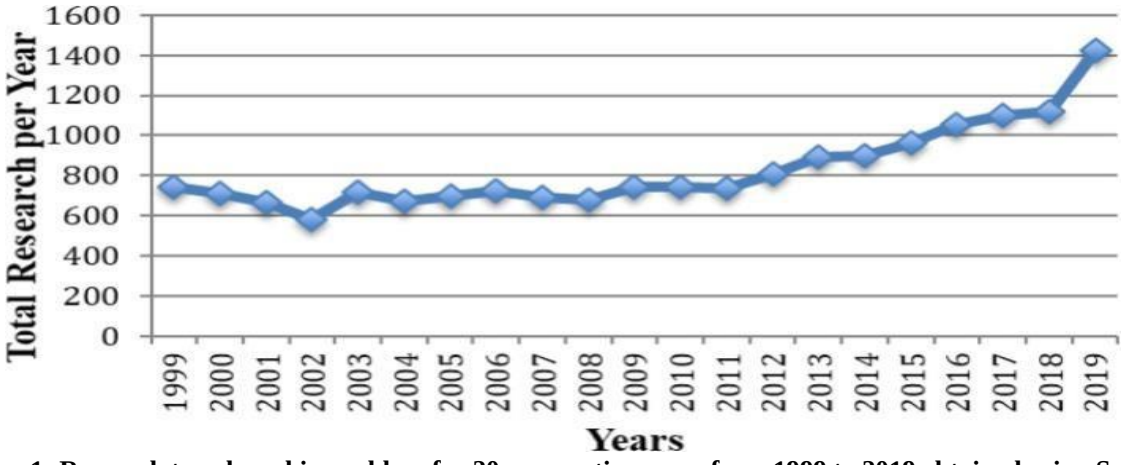

Figure 1: Research trend on skin problem for 20 consecutive years from 1999 to 2019 obtained using Science Direct Searched Engine based on a specific keyword

In its broader view, skin falls into two categories: glabrous skin and hair-bearing skin as shown in Figure 2(a) and (b) respectively ("Classifications of Skin," 2015). Glabrous skin or non hairy skin is typically found on the palms and soles, characterized by thick skin. Glabrous skin consists of stratified squamous epithelium to make skin wear and tear resistance while hair bearing skin has both sebaceous glands and hair follicles. Hair-bearing skin is the focus in this review paper as most skin disorders occurs in this area. One of the common skin disorders faced by many people is acne which is due to a blockage of hair follicles in the departed skin cells (Reddy & Jain, 2019).

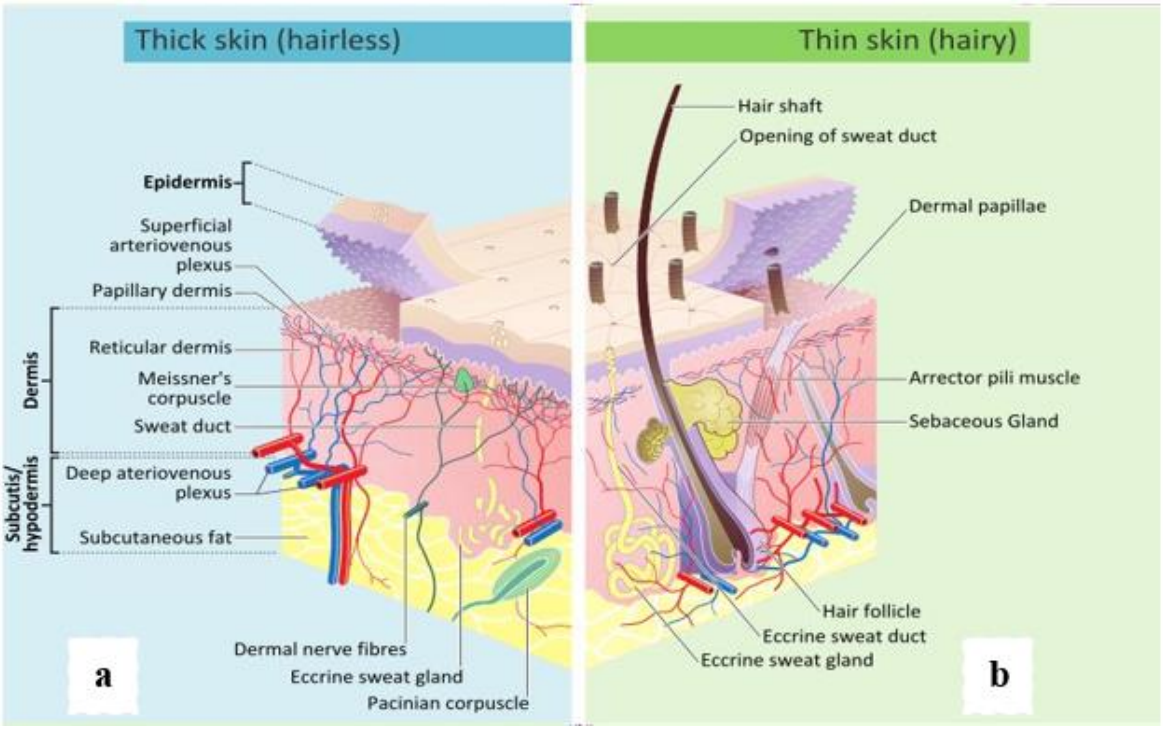

Figure 2: Thick layer (Hairless), Thin layer (Hairy) Human Skin

There is also a wide range of contradictory body sites which makes skin more intriguing to learn. For instance, the scalp with large hair follicles has only small vellus producing follicles although linked to large sebaceous glands and it is different from the forehead (Fu-Chan *et al*., 2005; Mcgrath*et al*., 2004). In the subsequent section, a discussion on Skin Anatomy is presented to highlight what constitutes human skins and how it works. Other main highlights are skin turnover time and skin components involved with the skin dysfunction.

3.0 SKIN ANATOMY

Skin has its own unique anatomy and that describes and determines its behavior and explains how it functions the way it does. Understanding skin anatomy also helps to put in context and clarify the commons kind is orders reviewed in later section of this paper. It serves as a protective shield against heat, light, injury, and infection. The skin also: Regulates body temperature Stores water and fat Is a sensory organ Prevents water loss Prevents entry of bacteria Acts as a barrier between the organism and its environment Helps to make vitamin D when exposed to the sun. It also helps to identify skin components which are dysfunctional and to plan for the right treatment. With the current interest of the authors, two of the three main layers of skin namely Epidermis and Dermis are subsequently discussed in the following subtopics.

Epidermis

Human skin consists of three layers as shown in Figure 2 and the outer most is called epidermis, giving the color skin that people see. Epidermis gives the first impression of a person and often the basis for categorizing people as fair or dark skin. Hence, the psychological effect of epidermis on people having skin disorders is tremendous. Epidermis is the thinnest layer of skin with approximately 0.01 cm thickness (Yusoff and Jaafar, 2012). What is epidermis? and How does it function to the benefits of human? Epidermis is made from specific constellation of cells known as keratinocytes, melanocyte, Langerhans cells and Merkel cells. Each type of cells has their own roles in supporting the overall function of epidermis. Approximately, 90-95% of epidermal cells are keratinocytes designed to synthesize keratin, the building blocks of the tough and fibrous protein in skin (Fu-Chan *et al*., 2005; Kanitakis, 2002). Keratinocytes proliferate in the basal layer of the epidermis and gradually change its morphology as they move upto the final layer of the skin giving protection from foreign substances from entering the body. The next type is melanocyte, a pigment synthesizing cell originating from the neural crest and are limited to the basal layer. Melanocyte is responsible for the production of

pigment melanin (giving rise to skin color), which then transferred to keratinocytes. There two forms of melanin: eumelanin and pheomelanin. Pale-skinned people tend to produce more pheomelanin and dark-skinned people produce more melanin. If melanocyte cells give rise to color, Langerhans cells on the other hand are designed for skin defense. Langerhans recognize and ingest the antigens found in epidermal tissue while Merkel cells are slow adapting oval shaped cells that combine with nerve endings to create sensory receptors for touch.

Layers of the skin: Stratum basale: Also known as the stratum germinativum, this layer contains stem cells that produce keratinocytes and melanocytes. Melanocytes produce melanin, the pigment that gives skin its color. Stratum spinosum: Also known as the prickle cell layer, this layer is made up of 8 to 10 cell layers. Stratum granulosum: One of the layers of the epidermis. Stratum lucidum: One of the layers of the epidermis. Stratum corneum: One of the layers of the epidermis.

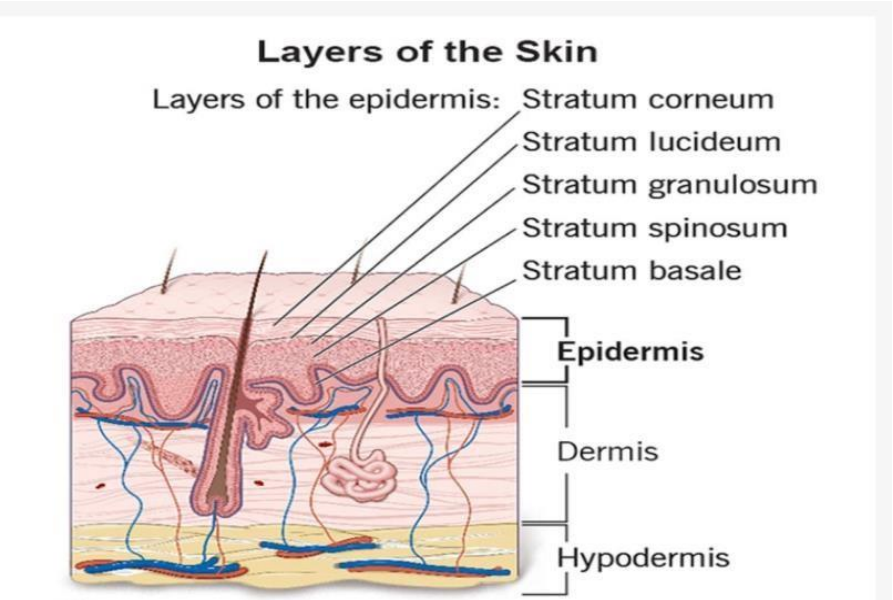

Figure 3: An anatomy of human skin layers. The outer layer of skin, epidermis is made up from keratinocytes, melanocyte, Langerhans cells and Merkel cells while dermis made up of the fibrillar structural protein or known as collagen. The outermost layer of the skin is the thinnest layers among the layers with 0.01cm, the thickness of dermis layer and hypodermis layer are 0.19cm and 0.60cm respectively (Yusoff and Jaafar, 2012)

The epidermis is further divided into five different layers as shown in Figure 4: Stratum corneum, Stratum lucidum, Stratum granulosum, Stratum spinosum and Stratum basale. The epidermis is constantly renewing its layer tissues, in which the basal cells go through the proliferation cycles to balance loss of the cells from the outer surface of the stratum corneum (skin peeling or desquamation). The actual nature of this cycle maybe different from one person to another and hence is important to be considered in optimizing the use of skin products in the long run. The keratinocytes start to differentiate while leaving the basal layer and they undergoa number of changes in structure and composition during the transition through stratum spinosum and stratum granulosum. During the keratinocytes maturation, the keratinocytes synthesize and expresss ever different structures of lipids and proteins. The last cycle of keratinocyte. differentiation has changed their structure and transformed into corneocytes that is the outer most skin layer that people see and touch (Haake *et al.*, 2001; Yusoff and Jaafar, 2012).

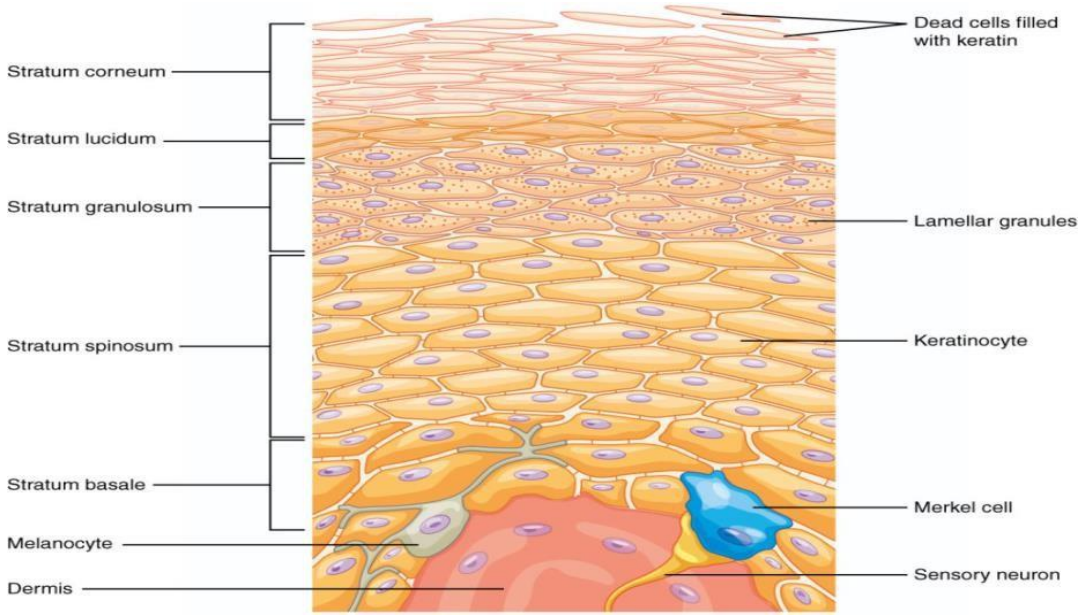

Figure 4: The epidermis of thick skin has five layers: stratum basale, stratum spinosum, stratum granulosum, stratum lucidum, and stratum corneum

Skin Turnover Time

Skin turnover time is the interest of the authors in anticipation of its influence on the management of treatment for skin disorders. It is commonly stated that the normal skin epidermis requires 27-28 days to renew its layers but other clinical studies on the cycle period for skin turnover reported differently as summarized in Table 1 (Epstein & Maibach, 1965; Grove & Kligman, 1983; Halprin, 1972; Pinkus, 1952). In skin turnover, there are two types of time measurement that can be considered namely the transit time and renew time. Transit time represents the time required for a basal cell to reach the granular layer while renewal time is an average time for all basal cells to reach stratum corneum layer. Transit time and can be equal to renew time if all cells move at the same rate but this does not normally happen in human epidermis. Healthy skin turnover helps keep the skin smooth, fresh, and free of clogged pores. Slow turnover can result in dryness, dull skin, or even breakouts due to dead skin cells accumulating. Exfoliation can help encourage faster skin turnover by removing dead cells, allowing new skin to surface. However, over-exfoliating can damage the skin and cause irritation.

Table 1: Turnover time suggested in different studies

Publication	Skin turnover time
Pinkus, 1952	Turnover time of 26.7 days, when mitotic duration of 1h
Epstein & Maibach, 1965	Average renewal time of human epidermal cells (basal, prickle and granular layers)-13 to 18 days
Halprin, 1972	Malpighian layers (inner most layer of epidermis) transit time-14 days Total epidermal turnover time for normal skin-52 to 75 days
Grove &Kligma, 1983	Stratum Corneum transit time for young adults- 20 days Stratum Corneum trans it time for older adults-more than 30 days

The stratum corneum is the outermost layer of the epidermis. Sometimes referred to as the horny layer of the skin, the stratum corneum is composed mainly of lipids (fats) and keratin, the protein comprising human hair and nails, as well as structures such as horns, hooves, and claws of animals. As such, the stratum corneum primarily functions as a barrier between the deeper layers of skin and the outside environment, preventing toxins and bacteria from entering the body. It also helps to keep moisture from evaporating into the atmosphere, which keeps the skin hydrated. **1) Protection**: It acts as a barrier to protect the underlying tissues from physical damage, pathogens, and harmful environmental factors like UV radiation, toxins, and chemicals. **2) Water proofing**: The cells in the stratum corneum are filled with keratin, a tough protein that helps to prevent water loss and maintain hydration in the skin. **3) Prevention of Infection**: By forming a tough, dense layer, the stratum corneum prevents microorganisms from penetrating the deeper layers of the skin, reducing the risk of infections. **4) Desquamation**: This layer is constantly being shed and replaced with new cells from the layers below. This process is important for maintaining skin health and removing damaged cells. Overall, the stratum corneum is vital for maintaining the skin's integrity and preventing dehydration and infections.

Dermis

Dermis is the middle layer of human skin sandwiched between epidermis and hypodermis. Dermis lies on the subcutaneous tissue in hypodermis that houses lipocytes which are small lobes of fat cells. There are two main layers in dermis called papillary region, adjacent to epidermis, and reticular dermis, next to hypodermis. The main constituents in dermis are collagen, elastic fibers, and extra fibrillar matrix. The supporting matrix is the basis of the dermis where protein and polysaccharides are bonded together to produce macromolecules, responsible for retaining water capacity of skin. The collagen forms the major constituent and has great tensile strength of the dermis while elastin makes up only a small section of the bulk (Mcgrath*et al*., n.d.). In a nutshell, dermis plays important roles in providing mechanical support and nourishment to human skin.

The importance of collagen and elastin was studied by Daly in 1982 where skin elastic behaviour and the structure of collagen and elastin fiber networks of the dermis were tested using tensile test method on human skin specimens (Daly, 1982). From the study, it was concluded that human skin samples (taken from the abdomen area) had exhibited elastic behavior. Initially, there was a large extension recorded even with a lower stress applied. Beyond the initial extension, when the skin sample had become stiffer, the change was comparatively small even with much larger applied stress. It was believed that the observed behavior was in response to the high stiffness of the collagen as the fibers becoming oriented and straightened out due to the applied stress. The Young's modulus E for the skin sample was also computed and the values obtained were two orders of magnitude less compared to soft rubber or elastin were obtained. Functions of the Dermis: **1) Support and Strength**: The dermis provides structure to the skin, supporting the epidermis and allowing the skin to remain intact under physical stress. **2) Elasticity**: The elastin fibers in the dermis allow the skin to stretch and return to its original shape, contributing to flexibility and resilience. **3) Temperature Regulation**: The dermis helps regulate body temperature through sweat glands (via perspiration) and blood vessel dilation/constriction, which controls heat dissipation and retention. **4) Nutrient Supply**: The dermis' blood vessels supply oxygen and nutrients to the epidermis, which has no blood supply of its own. **5) Sensation**: The nerve endings in the dermis allow the skin to detect sensations like pressure, pain, temperature, and vibration, providing vital sensory feedback from the environment. **6) Protection**: The dermis plays a role in protecting the body from harmful microorganisms and other environmental factors by supporting the epidermis' outer barrier function.

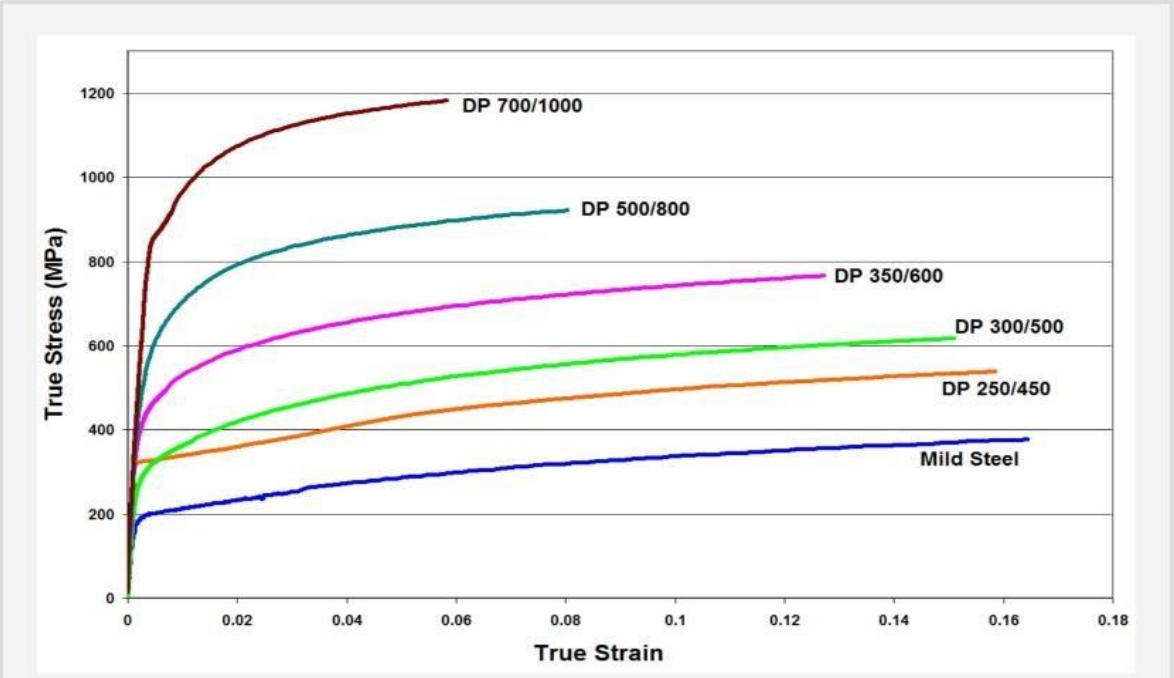

Figure 5: True stress-strain curves for a series of DP steel grades. S-5, V-1 Sheet thicknesses: DP 250/450 and DP 500/800 = 1.0mm. All other steels were 1.8-2.0mm

4.0 COMMON SKIN DISORDERS

With prior knowledge of skin anatomy presented in Section 3, discussion of skin disorders in this section makes more sense. Skin disorders are related to the dysfunction of skin components or the layer's defect of human skin which can manifest as irritation and itchiness in some cases. Specific defects in enzymes, structural proteins or lipid metabolism have been identified as the root cause of skin disorders form the cases. There are also stratum corneum defects which may lead to protein or lipid abnormalities of barrier function defect, which in turn may lead to an increasing trans epidermal water loss (Murphrey and Zito, 2019; Rawlings and Harding, 2004). This unwanted condition eventually affects the integrity of skin.

On an outward perspective, skin diseases can be categorized into three: Dry Skin (Eczema, Xerosis, Atopic Dermatitis and Psoriasis), Hyperpigmentation (Post-Inflammatory, Vitiligo and Melasma) and Acne. In are center epidemiological study of skin diseases conducted in Himatnagar, Shah and Sheth (2019) found important statistics of skin diseases suffered among patients they studied. Based on Figure 6, the top three skin diseases are Eczema, Xerosis, and Acne with a specific percentage of 32%, 21%, and 16% respectively. The three combined makes up almost two third (79%) of the total percentage. The next group is made of Atopic Dermatitis (10%) and Post-Inflammatory (9%). The third group, having 5% or less, consists of Melasma (5%) and Vitiligo (4%) and Psoriasis (3%).

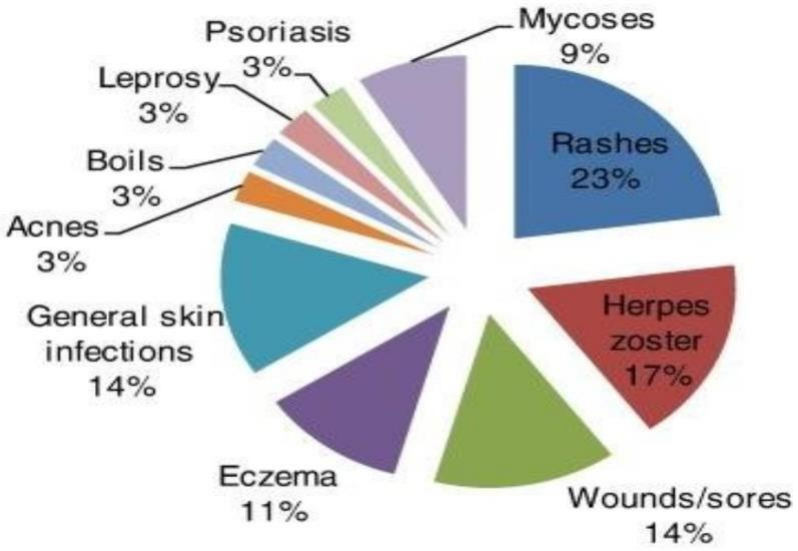

Figure 6: Frequency of affected people of different skin diseases Common skin problems

The profile of research focus on three main categories of skin disorders has been produced using Science Direct Searched Engine (Figure 7) in order understand not only the direction of interests among research but also to appreciate the weight of the problems specific to the skin categories. This trend is based on keywords search namely common skin disorders of dry skin, acne skin and hyperpigmented skin. In Figure 7, the graph correlates the total number of research papers on each of the category over a period from 1999 to 2019.Based on Figure 6, the trend of publications related to Acne and Hyperpigmented has remained almost the same over the period. However, in the case of dry skin, the trend is distinctive and overall, it is by far the most researched about compared to the other two. Ona closer look, there has been a pronounce increment in the number of publications after 2011 which is signified by the slope of the trend. Noticeably, in 2019 there is a tremendous increase for dry skin with 884 publications as compared to 716 papers in 2018. Overall, from 1999, there has been a big gap between the number of publications for dry skin as compared to those of acne skin and hyperpigmented skin. This trend can be explained by the profiling of the prevalence chart of Figure 5 where majority of the population suffered from dry skin problem.

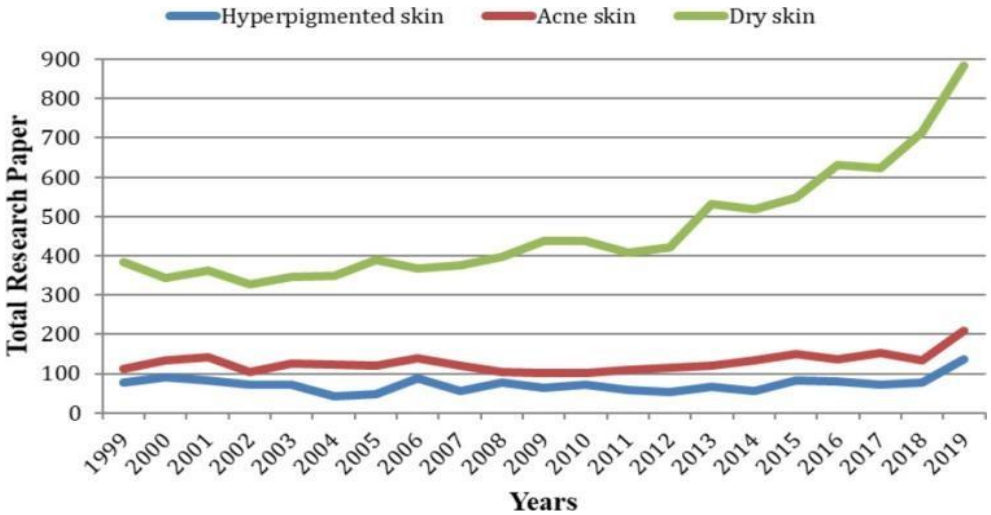

Figure 7: Research trends of dry skin, acne skin and hyperpigmented skin for 20 years from 1999 to 2019 based on Science Direct Searched Engine using specific keywords

There are important factors that lead to human skin disorder such as environment, weather, hormones and genes. All the factors may differ on individual basis. For an instance, atopic dermatitis patience might have a historical family of a topic while some of psoriasis patience are affected because of the faulty in the immune system that makes skin cells turn over rapidly.

However, this aspect of skin disorder is not addressed in this paper. Instead, the subsequent discussions detail out important aspects of three categories of skin disorder plotted in Figure 6.

Dry Skin

Dry skin can be recognized by the physical characteristics such as being rough and finely scaled (Uehara and Miyauchi, 1984). Dry skin is a condition often associated with a lack of natural oils or sebum. Some studies have suggested that microorganisms and chemicals exposure, low humidity and low environmental temperature are the factors that influence the patients to experience dry skin condition (Ashida *et al*., 2001; Uehara and Miyauchi, 1984).

To treat dry skin, you can try: Using luke warm water instead of hot water Avoiding harsh soaps, detergents, and perfumes Using a humidifier to add moisture to the air Wearing fabrics that are kind to your skin, like cotton Using detergents without dyes or perfumes Applying a clean, cool, damp cloth to the affected area if it's itchy. These are some of the important factors to consider in adopting an effective management of skin disorders tailored to specific individual needs.

Dry skin is found among children and adults and if it goes untreated, it can develop into abnormalities and eventually progress into skin diseases. Extremely dry skin refers to any skin condition that exceeds its normal dry state. Dryness is often associated with the observed impaired barrier function in atopic skin, psoriasis, ichthyosis, and contact dermatitis (Lodén, 2003). Dermatitis and eczema are frequently used terms to describe a polymorphic pattern of inflammation caused by dryness, atopic dermatitis, psoriasis and ichthyosis in the acute phase while xerosis and contact dermatitis is in the chronic stage. In a study conducted at Germany home care, the finding shows that more than half of the participants were affected by dry skin (Lichterfeld-Kottner *et al*., 2018). In other study of atopic dermatitis among adult population in the USA, it was found that 60.1% of the participants had a mild disease while 28.9% and 11% of the participants suffered from moderate and severe disease respectively (Fuxench*et al*., 2018). In addition, a questionnaire conducted by Larsen *et al*., in North Europe found that girls out numbered boy sin a topic dermatitis with a ratio of 1.3:1.0 (Larsen *et al*., 1996). The prevalence of ichthyosis vulgaris is estimated about 1 in 300 persons (Rabinowitz, 2015) while the prevalence of xerosis in elderly was 55.6% (Paul *et al*., 2011).

Morphology of Dry Skin

Dryness is frequently linked to damaged skin barrier function. The impaired barrier function triggers cytokine generation and secretion, which can lead to skin inflammation, increased proliferation of keratinocytes and epidermal hyperplasia (Lodén, 2003; Proksch *et al.*, 1991). When this barrier function is impaired, the skin became dry, itchy, scaly and skin surface becomes rough compared to anormal skin as shown in Figure 8(a) and Figure 8(b). Skin surface of dry skin disorders can differ depends on its severity. Uehara and Miyauchi observed the skin surface between two types of patients; atopic dermatitis alone and atopic dermatitis with ichthyosis vulgaris. It is shown in Figure 9(a) and Figure 9(b) the severity of patient with a topic dermatitis alone and the patient who suffer from both atopic dermatitis and ichthyosis vulgaris. It can be seen that patient with atopic dermatitis and ichthyosis vulgaris tend to have more rough skin surface and scaly than the patient with only atopic dermatitis disorders.

Figure 8: The skin surface of normal and dry skin subjects. (a) Normal skin surface, no obvious wrinkles and smooth skin surface; (b) Dry skin surface with visible wrinkles and rough skin surface (Sato *et al*., 2000)

Figure 9: Skin surface of dry skin patient. (a) with atopic dermatitis alone; (b) with atopic dermatitis and ichthyosis vulgaris (Uehara & Miyauchi, 1984)

The rate of substance penetration into skin to remain soft and smooth is related to the thickness of the stratum corneum of dry skin. It has been observed that dry skin has thicker stratum corneum layer compared to the normal skin and the tortuous lipid pathway around the corneocytes tend to have a longer penetration distance than the actual stratum corneum layer thickness (Potts and Francoeur, 1991). Leveque *et al*., revealed that skin conductance and skin extensibility decreased with the severity of skin dryness may cause the stratum corneum to become thicker or drier (Leveque *et al*., 1987). A study by Saint-Leger *et al*., shows that xerosis does not change the total amount of stratum corneum but an increased proportion of free fatty acid sand decreased amounts of neutral lipid are related to the level of severity of dryness (Saint- Leger *et al*., 1989). Xerosis is often associate with less stretchable stratum corneum due to as light increase in epidermopoiesis.

Trans epidermal Water Loss (TEWL) is the amount of water that evaporates through skin to the environment. An experiment conducted by Leveque *et al*., showed that it is normal for TEWL to occur in dry skin due to the thickening of skin's outer layer (hyperkeratosis) as a way for stratum corneum to compensate for a barrier function defect, suggesting an epidermis failure to produce a normal thickness competent barrier (Leveque *et al*., 1987). An increase in TEWL indicates a disturbance in the structure of the stratum corneum and less stretchable with increasing dryness. The size of exfoliated corneocytes also decreases as the dryness increases.

Is Dry Skin Dehydrated?

Dry skin is commonly associated with dehydrated skin. Generally, dry skin and dehydrated skin are different; No, dry skin is not the same as dehydrated skin: dry skin is more to skin type characterized by the lacking of natural oils or sebum while dehydrated skin is a condition signified by lacking of water stated that dehydration is the result of a fluid imbalance and insufficient volume of circulation, either too little fluid consumption or too much fluid loss (Shimizu *et al*., 2012 (Andrew *et al.*, 1992).

To treat dehydrated skin, you can: Stay hydrated, apply water-based products, and Use hydrating serums and mists.

To treat dry skin, you can use oil-based products. You can also choose a moisturizer rich in emollients and occlusives.

An experiment on physical signs of dehydration in elderly people conducted by Shimizu *et al*., in 2012 found that dry mouth and fever were the most frequently Dehydration can be caused by not drinking enough water, sweating too much, or other factors. to treat dehydrated skin, you can: Stay hydrated, apply water-based products, and Use hydrating serums and mists.

To treat dry skin, you can use oil-based products. You can also choose a moisturizer rich in emollients and occlusives.

Although dry skin and dehydrated skin are different, there are related on some grounds. In some cases, observed, A temporary condition that occurs when the skin doesn't have enough water in the to player. Dehydration can be caused by not drinking enough water, sweating too much, or other factors.

Patients with dehydrated skin can be treated through diet and lifestyle by consuming more water to improve hydration. For patients with dry skin, they need to improve skin moisture through appropriate treatments such as frequent applications of suitable moisturizers. For patients with both dry and dehydrated skin, they can be treated by combining treatments for specific cases of dehydration and dry skins described earlier.

Acne Skin

Any people around the world suffer from acne and this is found among males and female at different age. Findings from different studies reported statistics that are significant in numbers. In Acne is an inflammatory disorder of the skin, which has sebaceous (oil) glands that connects to the hair follicle, which contains a fine hair. In healthy skin, the sebaceous glands make sebum that empties on to the skin surface through the pore, which is an opening in the follicle. Keratinocytes, a type of skin cell, line the follicle. acne study conducted in Australia by Kilkenny shows that It was more common for girls than boys to have acne. They also found that the most common type of blemish was come dones (33%), followed by papules or pustules (29%), post inflammatory pigmentation (7%), acne scars (6%) and nodules (1%) (Kilkenny *et al*., 1998 Whiteheads: Plugged hair follicles that stay beneath the skin and produce a white bump.

- Black heads: Plugged folic les that reach the surface of the skin and open up. They look black on the skin surface because the air discolors the sebum, not because they are dirty.
- Papules: Inflamed lesions that usually appear as small, pink bumps on the skin and can be tender to the touch.
- Pustules or pimples: Papule stopped by white or yellow pus-filled lesions that may be red at the base.
- Nodules: Large, painful solid lesions that are lodged deep within the skin.
- Severe nodular acne (sometimes called cystic acne): Deep, painful, pus-filled lesions.

In a study based on clinical examinations, it was estimated that clinical acne lies in the range of 10% to 12% (Holzmann and Shakery, 2014). In a study involving student sin Riyadh, It was found that 53.4% often suffered from Acne Vulgaris (Al-Hoqail, 2003). In a more recent study in Kuwait, Al Khabbaz *et al*., Clinically examined 714 patients and reported that 479 were found to have Vulgaris (Al Khabbaz *et al*., 2019). They also concluded that females and overweight adolescents were more likely to have Acne Vulgaris.

On factors affecting acne, there are common causes found in literatures such as environmental exposure, hormone, stress and genetic (Adebamowo*et al*., 2005; Al-Hoqail, 2003). However, the relation between diet and acne are controversially discussed in some papers. Based on literatures, the cause- and- effect diagram for acne skin was created and presented inFigure10 (Adebamowo*et al*., 2005; Al-Hoqail, 2003). In 2005, Adebamowo*et al*., had foundthatacnewaspositivelyrelated to milkespecially skim milk as it was speculated that during manufacturing of skim milk, the bioavailability of comedogenic components might increase. Compared to whole milk, skim milk was found to have less estrogen, a hormone that may reduce acne (Adebamowo*et al*., 2005). Based on this study, it shows that diet selection has some bearings on promoting or reducing acne.

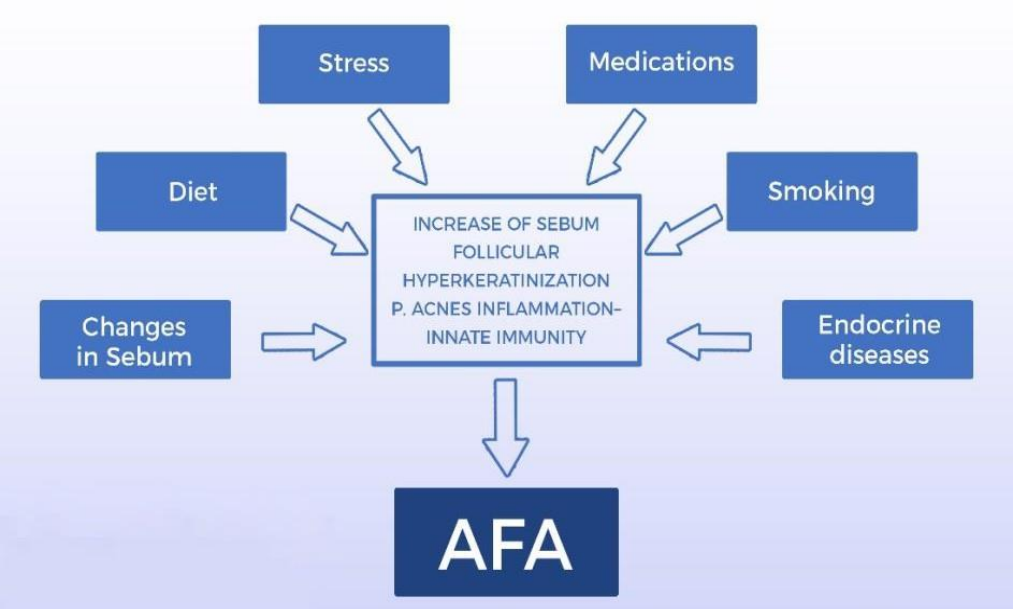

Figure 10: Causes and-effect or fish bone diagram of factors that worsen acne

Another diet related factor discussed in literatures is consumption of chocolate. In an early study entitled 'Effect of Chocolate on Acne Vulgaris' published by Minkin and Cohen in 1970, it was found that chocolate consumption did not affect the skin sebum condition of the 65 respondents. Thus, the study did not support anotion that chocolates timulates sebaceous secretion and affect acne vulgaris (Minkin and Cohen, 1970). However, later in 2011, a published study by Block *et al*., was able to prove that chocolate could cause acne when the respondents of their study had shown significant changes in acne severity after a single chocolate consumption (Block *et al*., 2011). However, there are no solid proof son the types of chocolate that are likely tocause acne. In another study, Cordain*et al*., investigated the dietary effects on acne vulgaris in rural and western areas (Cordain*et al*., 2002). In the findings, the incidence of acne in rural and non- industrialized areas was lower than that in Western populations. It is believed that the lower incidence of acne observed was at tributed to the regular diet of mostly fish, fruits and coconut. Inthe study, rural areas were referred to Hawaii and the western areas other parts of USA.

Acne Formation and Types of Acne Lesions

This section describes acne formation and the types of acne lesions. Understanding this topic is the interest of the authors in managing acne for those affected. Acne is a chronic inflammatory disease of the pilosebaceous, cell-lined follicle with large sebaceous glands and a fine hair that seldom spreads out of the follicle (Reddy and Jain, 2019). The formation of acne undergoes four stages as illustrated in Figure 11: (1) inflammatory mediators released into the skin, (2) keratinisation alteration process leading to comedones, (3) increased sebum production under androgen control, and (4) bacterial colonization of hair folic leson the face (commonly forehead, cheek, nose and chin), neck, chest and at the back for Propionibacterium acnes (Eichen field and Leyden, 1991; Thiboutot *et al*., 2009; Williams *et al*., 2012).

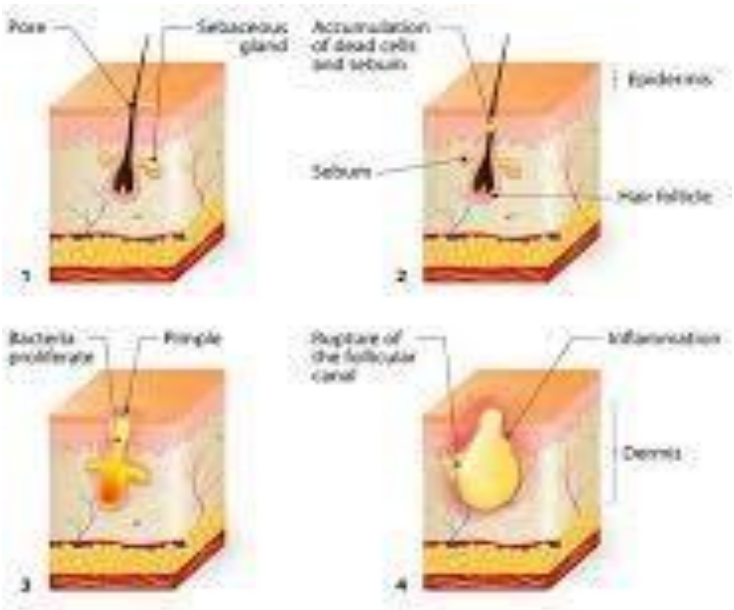

Figure 11: The process of acne formation on the skin. Sebum travels up hair follicles and out through pores on to the surface of skin. When skin produces extra sebum and dead skin cells, they can stick together an

The following are common types of blemishes associated with acne and their commonly-used terms:

- Closed comedones, or white heads
- Open comedones, or black heads
- Pustules, or pimples
- Papules
- cysts
- nodules

Sebum is an oily substance that is produced by sebaceous gland, which is connected to the hair follicles (Kuley, 1961). Propionibacterium acnes starts in the sebaceous follicle and is carried by sebum along side dead cells and bacteria to the skin surface. The on set of acne later may develop into inflammatory pustules, papules and nodules (Johnson and Cummins, 1972; Reddy and Jain, 2019). Inflammatory skin can be characterized by pus, swelling and redness. therefore, it is critical to regulate sebum in skin in order to control acne efectively. for treatment, some studies found that vitamin D could increase the regulation of sebum production and oxidized lipids can stimulate keratinocyte proliferation (Johnson

& Cummins, 1972; KULEY, 1961).

Gland secretion that's well under the tissue while black head is the opening pore that get plugged with a mixture of keratin and sebum, resulting in the darkened surface on the skin. Nodules are solid lesions that tend to extend into deeper layer so the skin and use tissue damage. It is very painful acne lesions and is likely to leave scars on the skin. Papules are solid inflammatory acne lesion without pus while pustules are small swollen acne filled with pus. Pus is the combination of dead skin cells, bacteria, leukocytes that formed around hair follicles. different level of everity of acne skin is shown in Figure 13, where the most severe acne skins are shown to suffer from inflammation lesions of comedones, papules, pustules and some nodulocystic lesions.

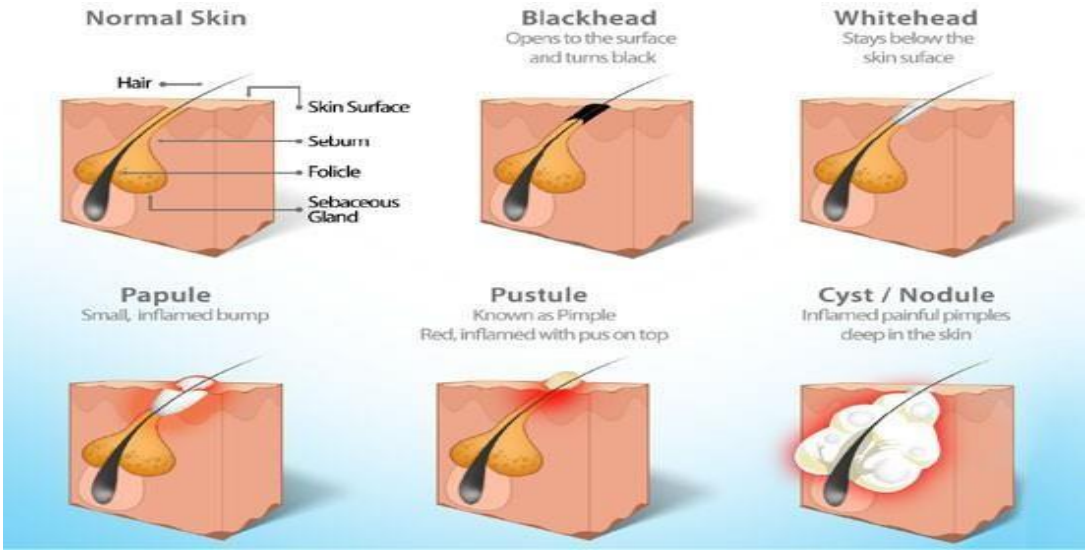

Figure 12: Types of lesions on skin

Figure 13: Severity level diagram for acne skin. The quantities of non-inflammatory and inflammatory lesions on skin indicate the severity of acne skin. The acne becomes severe if the quantities of inflammatory increases on the skin (Do, 2018)

Adolescent Acne Vs Post adolescentAcne

As mention earlier, acne can happen to adolescents and adults and it is quite different from each individual. Usually, acne often age boys disappear by the age of 20 to 25 years old.

Adolescent acne is caused by hormonal changes during puberty that stimulate oil glands in the skin. Post-adolescent acne can be caused by a number of factors, including hormonal fluctuations, bacteria, and cosmetics

Previous studies have reported that up to 9.3% of acne occurs after 25 years of age. Acne > 25 years is called post-adolescent or adult acne. Similarly, the authors believe that the term "adult acne" can be more appropriate than "post-adolescence" since post-adolescence suggests individuals above 19 years of age. Based on the study in 2012 by

Khunger and Kumar, the prevalent observed to be 73.2%, while late on set acne was 26.8% (Khunger and Kumar, 2012). Comparably, the inflammatory lesions of post adolescent are within U- zone (chin, jawline and neck), while non inflammatory and inflammatory lesion so adolescent acnes lies on T-zone area (forehead, nose and cheeks). Post adolescent remains mild to moderate acne condition but adolescent acne can become severe (Choi *et al*., 2011). In another study, it was found that the cases of increasing pore diameter of late-onset acne and the higher sebum secretion among adult women with persistent acne might also be higher compared to cases among the without acne (C. Williams and Layton, 2006).

Hyperpigmented Skin

Pigment skins disorders can be defined as the loss or reduction of skin color. Hyperpigmentation isa common condition that causes patches of skin to darken in color. It occurs when the skin produces too much melanin, a pigment that gives skin its color Some causes of hyperpigmentation include:

- **Sun damage**

  Sun exposure can cause the skin to darken, or tan. Age spots, also known as solar lentigines, are a common type of hyperpigmentation caused by sun damage.

- **Hormonal changes**

  Pregnancy and birth control pills can cause hormonal changes that lead to hyperpigmentation.

- **Skin injuries**

  Injuries like cuts and burns, or other causes of inflammation like acne or lupus, can cause hyper pigmentation.

- **Medications**

  Some medications, including some anti cancer drugs, can cause hyper pigmentation.

Pigmentation is related to melanin production in ability or inability to transport melanosomes correctly. It is not only affected by keratinocytes but also by mast cells, Langerhans cells and lymphocytes. There are three major classifications of pigmented skin: depigmentation, hypopigmentation and hyperpigmentation shown in Figure 14. depigmentation is a complete pigment reduction while hypopigmentation is an unusually low amount of melanin. In this paper, the focus is more on hyperpigmentation, as it is more common cases compared to depigmentation and hypopigmentation.

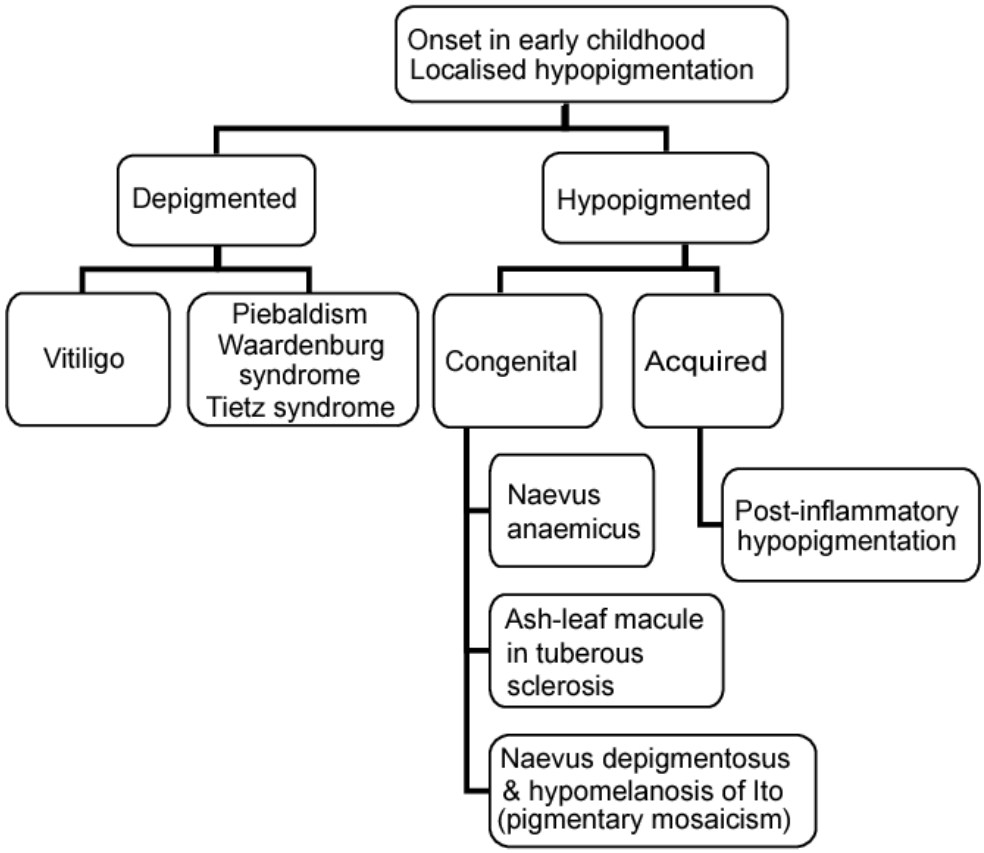

Figure 14: Classification of pigmented disorders: Albanism and vitiligo are two most common pigmented disorders in the Hypopigmentation group while in the Hyperpigmentation, PIH or acne scarring and melasma are usually the case

Hyper pigmentation is a harmless skin condition in which certain are as of skin become darker in color compared to actual skin color and this is caused by abnormally high amount of melanin. Hyper pigmentation is very common skin condition among skin of color including African Americans, Native Americans, Latinos, Middle Eastern and Asians. This was confirmed by are cent study; it was found that the most common hyper pigmentation cases were among African with 73.3%, followed by Indian 21.8%, white 2.6% and mixed race 2.3% (Dlova*et al*., 2019). Majority of the hyper pigmentation cases were observed among female with 75.8%. A survey study, conducted by Alexis *et al*., on 1412 patients who had visited Skin of Color Center from August 2004 to July 2005, found that Dyschromia or Pigmented Disorders is the second most diagnosed after acne in black patients and none in white patients (Alexis *et al*., 2007). In another study, Ogunbiyi *et al*., Estimated the frequency of Nigerian pigmentary skin disorders was 8.6% (Ogunbiyi *et al*., 2004).

The common causes of hyperpigmentation is some medications like antibiotics, oral pills contraceptives, hormonal condition, sun exposure, health condition, stress, exposure to heavy metal, etc. it is occur due to deficiency of protein energy malnutrition, zinc deficiency and pellagra. In hyperpigmentation melanosome is important for the transport of melanin. melanosomes were packed in to membrane-delimited compounds calliedmelano some complexes in the skin of whites who were American Indian and mongoloids. In blacks and Australian aborigines, they were distributed singly within the epidermal cell cytoplasm S Szabe *et al*., also found that black melanosomes tend to be larger and wider in comparison to those of other races Honda *et al*., also supported these findings in which the black melanosomes were found larger than those of whites according to the conducted experiments (Honda, Takamatsu, & Wei, 1972).

The melanosome size and distribution patterns of melanosome were examined in 14 white from different ethnic groups using electron microscopic by Konrad and Wolff. They reported that there was a remarkable propensity for small melanosomes to be complex and for large melanosomes to be distributed as single melanosomes; it was apparent that there is a direct relationship between melanosomes size and distribution (Konrad & Wolff, 1973). It was also reported that melanosomes of the dark-skinned individuals are larger, elongated and more numerous resulting in disrupted degradation in keratinocytes and consequently in increased visible pigmentation (Costin and Hearing, 2007; Schiaffino, 2010).

Post-Inflammatory Hyperpigmentation

Post-Inflammatory Hyperpigmentation-ion (PIH) is a common hyper pigmentation recognized by the darkening of certain areas of the skin (see Figure 15) that occurs after an inflammatory dermatoses or cutaneous injury and tends to affect dark-skinned patients with greater severity. Nieuweboer revealed that the spots could be worst if the skin is exposed to the sunlight, chemical and some medication consumption (Nieuweboer-Krobotova, 2013). Lacz*et al*., presented two classifications of PIH namely epidermal and dermal pigmentation (Lacz*et al*., 2004). In most cases, epidermal pigmentation is brown and fadesoutina few months while dermal pigmentation has a gray-brown color and is usually persistant.

Figure 15: Post-inflammatory hyper pigmentation caused by acne inflammation. The area of skin affected by acne wounds became darker and pigmented (Davis & Callender, 2010).

There is a wide range of PIH a etiological factors, including infections such as dermatophytosis; allergic reactions such as contact dermatitis; those from insect bites; papulosquamous diseases such as psoriasis; and skin damage from irritants or burn. Nevertheless, acne vulgaris, atopic dermatitis and impetigo are the most common causes of PIH in the colored skin (Davis and Callender, 2010). In one perspective, PIH is described as the outcome of melanocytes responses to cutaneous inflammation which can cause over production of melanin or an irregular dispersion of pigment (Grimes, 2009; Vashi and Kundu, 2013).

Previous studies suggested that PIH could occur both in the epidermis and dermis. When PIH is confined in the epidermis, there is an increase in the melanin production and transfer to keratinocytes. PIH within the dermis could result in damaged basement membrane, allowing melanin into enter the epidermis, where it is phagocytosed by dermal macrophages or melanophages. The recaution for post inflammator hyperpigmentation soo protect from sun, avoid picking use moisturiser, to avoid certain food and drink, be careful with retinoids, etc.

Melasma

Melasma is other common occurence that could affect the quality of is another common occurence that could affect the quaity of life for those affected in terms of emotional state and confidence level. Melasma are refers to irregular brown macule on skin that are exposed to the sun and is one of the most common causes of hyperpigmentation. The most common melasma forms on the face of certain pregnant women due to birth control pills consumption; usually the symmetrical hyperpigmented spots are most noticeable on the forehead, cheeks, upper lip, nose and chin as shown in Figure 16.

Figure 16: Irregular brown macules of melasma on common parts of the face: upper lip, forehead, nose and cheek

Although the exact cause of melasma is unclear, the pathogenesis of the disorder involves multiple factors. Exposure to UV radiation or visible light and genetic influences are two of the main factors of melasma. Other causes of melasma include use of oral contraceptives, pregnancy, estrogen progesterone therapy, anticonvulsants, thyroid dysfunction, medications and cosmetics. In a clinical study of melasma in 160 patients by Sardesai *et al.*, it was found that increasing incidence of melasma in females could be attributed to hormonal effects such as during pregnancy with 32%; cosmetics such as whitening creams and all-purpose moisturizing creams with perfume with 10%; and the use of oral contraceptive pills with 8.5% (Sardesai *et al*., 2013).

Wood's light examination of the skin can seveal the presence of melasma, which can be divided into three types namely epidermal, dermal, and mixed. In an article by Pandya and Guevara, the differences of all the types are presented in details (Pandya and Guevara, 2000). The epidermal type of hyperpigmented skin shows excessive quantities of melanin in the basal and supra-basal epidermis but a normal number of melanocytes. During Wood slight examination, the borders of melasma spots are clearly demarcated. In the dermis type, the causes of melasma are related to melanin with in the dermis, collagen bundles, or melanophages. The precaution for melasma is that the protect skin from sun exposure, avoid tanning beds and sunlamps, use gentle skin care product, avoid hormonal medication get regular skin check Figure 17 show differences between two types of hyperpigmentation; post-inflammatory hyperpigmentation (PIG)

and melasma.

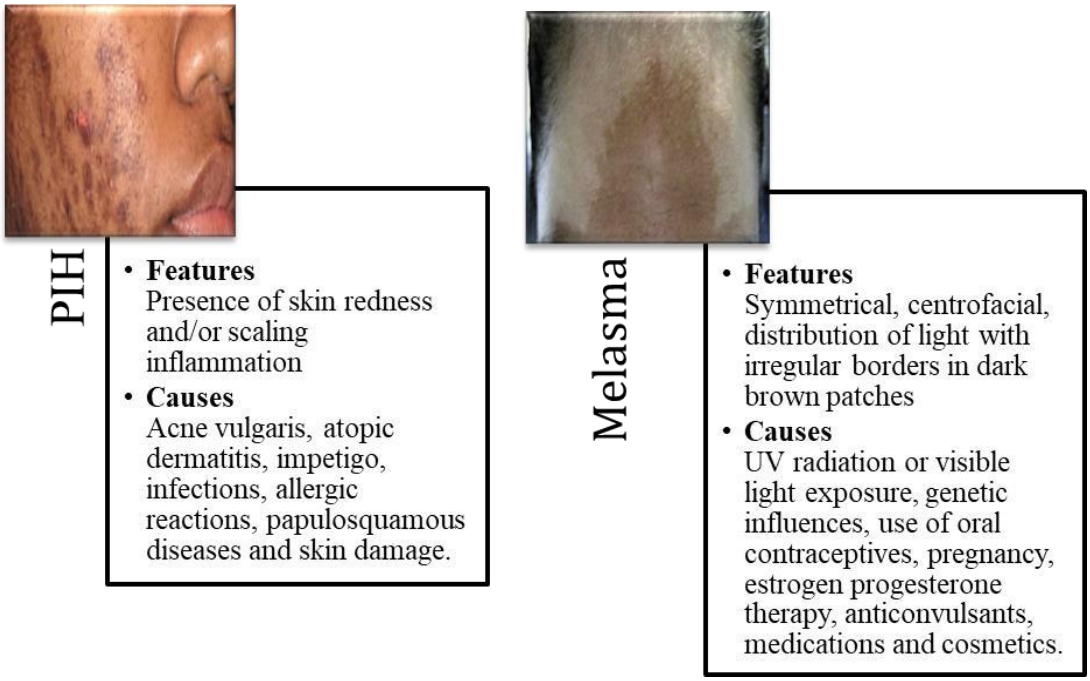

Figure 17: Cases of hyperpigmentation: PIH on the cheek versus irregular brown macules of melasma on the forehead

5.0 CONCLUSION

Skin disorder is a big concern and the three tops in the list are dryness, acne, and hyperpigmentation. Literatures on dry skin problem have a growing interest especially in the last five years with a very sharp increase in publications over the years. There area number of etiologies for dry and acne skin in patients such as environment exposure, genetic factors and hormone while exposure of chemical, sun and injury cause hyperpigmentation on skin. In addition, all these common skin disorders are related to each other; for instance, the acne skin effect is one of the causes of post-inflammatory hyperpigmentation. Extremely dry skin can cause acne too as sebum production is high in response to irritation tough the skin may be rough and scaly. Skin disorders are such burdens to most of people as it is not only painful but could lead to psychological impact and can be very costly to treat. In the long run, it could affect the quality of life. This review paper serves as a groundwork for a current research on skin tribology and the general interest is to provide more understanding on skin disorders. Better understanding can empower the public to make informed decisions on Why, What, and How in dealing with skin disorders and the choice of treatment and skin products that works for them. They know which parts of skin component are likely to become dysfunctional and the triggering factors of specific skin disorders. The triggering factors are important considerations in formulating and adopting effective management of skin disorders tailored to specific individual needs.

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