

EFFECTS OF CHRONOLOGICAL AGEING ON EPIDERMAL THICKNESS OF HUMAN SKIN IN DIFFERENT AGE GROUPS

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ABSTRACT

Objective: To compare the age related changes in thickness of skin epidermis in different age groups in the Pakistani population.

Study Design: Cross sectional study.

Place and Duration of Study: The study was conducted at Army Medical College, Rawalpindi, for a period of five months, from Jul 2010 to Nov 2010. All protocols were approved by the Ethical committee of centre for research in experimental and applied medicine (CREAM), Army Medical College, Rawalpindi.

Patients and Methods: In this study, 60 volunteers of both genders, fulfilling the inclusion criteria, were divided according to age, into three equal groups, 18-29 years, 30-49 years, and more than 50 years, Groups A, B and C respectively. All study participants gave written consent before their inclusion in the study. Four-mm full-thickness punch biopsy of sun protected upper arm skin of left side was obtained from each individual after administration of local anesthetic injection. The samples were stained with Haematoxylin and Eosin for histomorphological study and comparison of epidermal thickness was done between the three groups. In each section, the epidermal thickness was measured at three points to determine maximum thickness, under 10X objective. Mean of three readings of each sample was taken. Then, mean of each group was taken and that of the three groups was compared to determine the presence or absence of epidermal atrophy.

Results: There was no appreciable difference in epidermal thickness between the three groups. Mean of group A was 144.833 μm , that of group-B was 142.833 μm and the mean value of group C was 125.5 μm .

Conclusion: It was concluded that, although human skin markedly deteriorates visibly with age, the epidermal thickness remains constant.

Keywords: Ageing, Epidermis, Skin.

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INTRODUCTION

Skin ageing becomes conspicuous as a part of a natural human ageing process, which follows different pathways in different organs, tissues and cells with time. Signs of ageing in internal organs are not visible with the eyes, but the skin provides first obvious indication of age. Although ageing is inevitable and a biological, not a pathological condition, it is associated with various skin and body pathologies, including degenerative disorders and neoplasms¹. As the largest visible organ of the body, the ageing changes in skin leave a profound effect on the

individual and have an undeniable social impact. This makes it ideal for investigating the ageing process². The biological clock of our body affects both the skin and the internal organs in a similar way, causing irreversible degeneration^{3,4}. The free radical or oxidative stress theory of ageing states that the accumulation of free radicals within cells leads to oxidative cellular damage, which is a major cause of ageing. The extent of oxidative cellular damage is very important in determining the longevity of the species. Photoageing, in which exposure to solar ultraviolet rays increases the levels of reactive oxygen species (ROS), leads to skin damage. In a study conducted on sea urchin to investigate the cause of its unusual longevity, cells or tissues of long-lived species had a much higher antioxidant activity,

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compared with short-lived species. The results of these theories validate the fact that with lower levels of cellular oxidative damage, there is negligible evidence of ageing, and maintenance of high antioxidant levels minimizes damage to cells and tissues⁵. The skin tissue extensively undergoes proliferation and renewal throughout life. Chromosomal telomere shortening occurs as a result of repeated mitotic division of cells. This shortening is protective in that it prevents abnormal proliferation of cells. As a consequence, cells that do not proliferate, start to age. The telomerase enzyme complex maintains telomere length in epidermal cells. Research suggests that telomerase plays a significant role in maintenance of skin function and proliferation. Telomeres in skin cells may undergo accelerated shortening because of continuous proliferation and also because of reactive oxygen species. Skin tissue being accessible, might be ideal for study of telomerase with a view to controlling the skin diseases associated with ageing⁶. Protection can be provided to our skin externally and internally. Internal protection is due to melanin and enzymatic antioxidants and external given by antioxidants like vitamins A, C, E, in our food. UV-induced photo ageing of the skin becomes visible with age, when anti-oxidative repair processes become ineffective⁷. Topical preparations derived from plant based antioxidant products can then be used for external use. They can reduce the signs of skin ageing and make skin appear younger⁸. It has always been a problem to find living animals which have a skin structure similar to humans, to study the signs of ageing, although studies have been done on skin of rats and rabbits in place of human skin⁹. A better understanding of both the intrinsic and extrinsic influences on skin ageing, and the ageing patterns in different areas and races, is crucial to taking protective measures. However, the ageing patterns in different races or areas, especially our own, are largely unknown. Ethnicity and racial differences in the patterns of skin ageing have also not been studied properly¹⁰. The few studies done, state that the

progression of skin ageing differs markedly among ethnic groups^{10,11}. Ethnicity causes structural and functional differences in skin, due to which the cutaneous effects of ageing differ, and these effects are also influenced by intrinsic and extrinsic factors. Ethnicity and race although having different definitions, are often used interchangeably in the medical literature. Broader groups of populations having a common culture and/or language are referred to as an ethnic group, while race is often a group of genetically similar people. A comprehensive knowledge of the structural and functional principles of ageing is essential to properly care for the ageing skin of colored population, which includes those of African, African American, Asian, and Latino/Hispanic descent. In this age of medical advancement, as people are living more and more productive lives up till later years, it has become essential to understand the fundamentals of mature skin, as it is everyone's desire to maintain a youthful appearance¹². In our country also, we see an increasing awareness of both the middle aged and ageing population towards skin care. The rationale of this study was to identify the skin ageing patterns in our population with a view to understanding the differences in our race with other races of the world, and also to decrease the damaging effects of chronological ageing in later years of life.

MATERIAL AND METHODS

The cross sectional study was conducted at Army Medical College, Rawalpindi, for a period of five months, in Ethical Committee Centre for Research in Experimental and Applied Medicine (CREAM), Army Medical College, Rawalpindi. The study was conducted at Anatomy department, Army Medical College, Rawalpindi, in collaboration with Rawalpindi Leprosy Hospital and Military Hospital Rawalpindi. Sixty volunteers of both sexes, age greater than 18 years, having no history of use of anti-ageing creams, concurrent medical conditions or skin infections or obvious signs of malignancy, were included in the study through non-probability purposive sampling. All study participants gave

written consent before their inclusion in the study. According to their ages, subjects were divided into three equal groups¹³. Group A had volunteers from 18-29 years of age, Group B from 30-49 years and Group C more than 50 years. Sun protected upper arm skin was taken by four-mm full-thickness punch biopsy¹⁴ from each individual after giving local anaes-thetic injection. The left upper inner arm was selected because being a covered part of the body, it escapes the effects of ultraviolet radiation. Studies on ageing skin are complicated by extrinsic factors that augment the intrinsic effects of time. Most studies have been done on the hands, forearms and face. Protected areas have often been neglected¹⁴. Tissues were fixed in 10% formalin solution and embedded in paraffin wax to make blocks. Sections were stained with Haematoxylin and Eosin. The thickness of epidermis was measured at the sites of maximum thickness, at three points, under 10X objective (fig-1, 2 & 3). Thickness was measured from the surface of stratum corneum upto the dermo-epidermal junction. The mean of these three readings was taken as final reading of that sample. The mean of all readings in a single group was taken as final reading of that group. The final reading of groups A, B and C were compared with each other. Data were analysed using SPSS version 16. Descriptive statistics like mean and standard deviation were calculated. The statistical significance of difference of various quantitative changes between different groups was determined by using Anova. Post hoc test was applied to make comparisons between the three age groups. For categorical variables, frequency along with percentages were calculated. The difference was regarded statistically significant if the "*p*-value was ≤ 0.05 .

RESULTS

The epidermal thickness was measured at three points in each slide and their mean was taken, to determine maximum thickness, at 10X objective (fig-1, 2 & 3). Initially, final reading was taken of each sample. Then final mean of all the readings in each group was taken. Both males

and females were present in each group. There were 15 males (75%) and 05 females (25%) in group A, 18 males (90%) and 02 females (10%) were present in group B, while group C had 16 males (80%) and 04 females (20%). Final mean of all the readings in group A was $144.833\mu\text{m}$, that

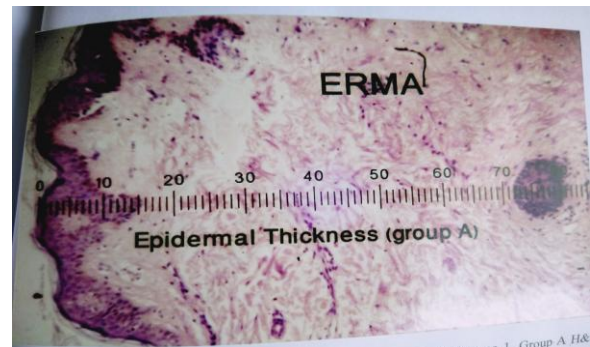


Figure-1: Epidermal thickness in a subject from group A. H & E stain. Approx X 400.

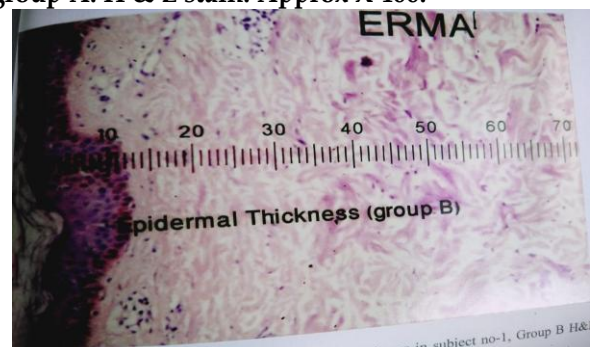


Figure-2: Epidermal thickness in a subject from group B. H & E stain. Approx X 400.

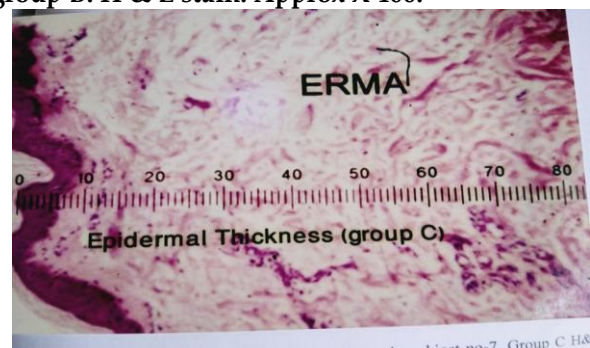


Figure-3: Epidermal thickness in a subject from Group C. H & E stain. Approx X 400.

of group B was $142.833\mu\text{m}$ and the mean value of group C was $125.5\mu\text{m}$ (fig-4). The mean \pm SE for group A was $144.833 \pm 6.349\mu\text{m}$, that for group B was $142.833 \pm 9.196\mu\text{m}$, and for group C mean \pm SE was $125.500 \pm 8.652\mu\text{m}$. The mean difference between group A and B was $2\mu\text{m}$, with a

significance of >0.05 , the difference between groups A and C was $19.33\mu\text{m}$, with a significance of >0.05 . and that between groups B and C was $17.33\mu\text{m}$, with a significance of >0.05 .

DISCUSSION

This study failed to show epidermal atrophy with purely chronological ageing. This may indicate a protective effect against ageing. Studies done on photo-aged skin, have shown a thickening of epidermis, due to accumulation of elastin just below the dermoepidermal junction. On exposure to sunlight, skin molecules absorb ultraviolet radiation, resulting in the generation of reactive oxygen species (ROS), which causes

results are contradictory. The absence of epidermal thinning with age in our population, seems to have an ethnic basis, as most of the other studies have been conducted on caucasians and other asian races. Most have shown that purely chronologically aged human skin shows significant dermal and epidermal atrophy. Studies on rat skin show similar results. Ageing epidermis shows reduced number of cell layers, with the dermal collagen fibers appearing to be fewer in number, slender, fragmented or broken¹⁸. In a study done in the department of dermatology, copenhagen, denmark, it was concluded after measuring epidermal thickness

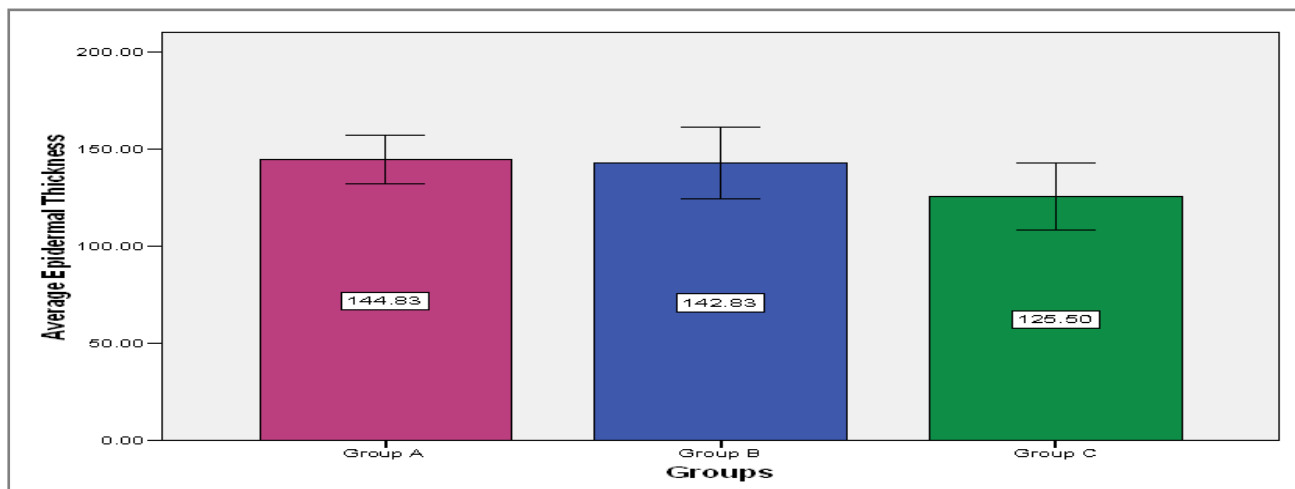


Figure-4: Graph showing the comparison of mean epidermal thickness in μm , between the groups A, B & C.

significant damage¹⁵. Distinguishing between the effects of chronological ageing and photo ageing is a very complex process. Fair skinned populations due to a lack of protective effect of melanin, are more severely affected by the sun than those with darker skins¹⁶. The rate of extrinsic skin ageing, in contrast to intrinsic skin ageing, shows a marked variation, both among individuals and ethnic populations. The rate of extrinsic skin ageing depends on the lifestyle of the individual, exposure to different environmental factors and the genetic make-up are also important. Some individuals might be more susceptible to skin damages by environmental exposure and differences are observed in the manifestation of extrinsic and chronological skin ageing between ethnic groups¹⁷. In chronologically aged skin the

at various body sites, that more exposure to ultraviolet radiation led to a thicker stratum corneum, while the sun-protected sites had thinner stratum corneum. This study also showed a correlation between the vascular supply of the site and thickness of epidermis, a higher blood supply nourishing a thicker epidermis. But the study found no difference in epidermal thickness between black and white people and no change with age¹⁹. Chronologically aged skin is characterized by a gradual atrophy of both the epidermis and dermis. Expression of gene expression is also altered, and there is difference between young and older sun-protected and sun-exposed skin, although the changes may be similar. Photo ageing produces more severe changes in gene expression than chronologic

ageing²⁰. At the ultra-structural level, flattening of the rete pegs is evident, accompanied by general disorganization of components of basement membrane, which leads to significant increase in skin fragility in the aged population²¹. In caucasian skin, it was noted that epidermal thickness did not vary between different age groups, but the dermoepidermal junction was flattened with age, which made ageing skin less resistant to shearing forces and more vulnerable to injury. This study also reported alterations in protein composition in addition to the morphological changes occurring in ageing skin. This altered protein composition leads to loss of structural integrity of skin²². Studies conducted on dark skinned individuals, have reported that photo ageing changes were seen less commonly than chronological ageing changes. In addition, malignant tumors are rare in dark skinned people, but the incidence of benign tumors increases with age. This makes it essential to understand processes occurring in ageing skin so as to provide better care to an increasing geriatric population, who have a lot of dermatologic problems. The elderly form a large percentage of our population now because of increasing longevity caused by advancement in health care. Dermatologists need to be aware of these ageing changes as well as to equip themselves accordingly to treat these conditions. With age, the epidermal turnover rate is said to decrease by 50%. The number of melanocytes decreases by 20% making the skin appear pale. There are published studies regarding skin disorders among the elderly population from different countries such as Taiwan, USA, Norway, the Philippines, Turkey and India, but very few studies regarding the chronological and photo-ageing changes seen in Asians with skin type IV and V²³. Although epidermal thinning with age is recorded, it is difficult to determine whether it is due to extrinsic or intrinsic ageing. These two processes are not clearly separable because of the frequent superimposition of changes associated with photoageing onto those of chronological ageing. This makes photoaged skin appear more

severely changed than it would seem with the mere passage of time²⁴. A decrease in epidermal turnover rate results in epidermal atrophy and delayed wound-healing. There is also delayed immune response and increased incidence of tumors²⁵. As the geriatric population is increasing worldwide, and the demand for their care is also increasing, it is essential to identify their skin problems and to provide them with proper care. This important aspect, makes it necessary to study the skin ageing patterns in our country, and then take appropriate anti-ageing measures to prevent them.

CONCLUSION

At the end of this study, it was concluded that, although human skin markedly deteriorates visibly with age, the epidermal thickness remains constant.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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