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Research Article

Cytological and Histological Study of Adult and Neonate Epidermis in Thick and Thin Skin of Various Anatomical Sites

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ABSTRACT

The integumentary system covers the surface of the embryo (skin) and its specialized skin structures including hair, nails, sweat glands, mammary glands and teeth. During fetal skin development, the epidermis changes from a single layer of ectodermal cells at 7–8 days of gestation into a more apparent stratified, keratinized epithelium at 22–24 weeks. The aim of the study is to identify the histological and cytological changes that take place during neonatal and adult epidermis development. Human neonatal and adult samples were obtained from fully informed, consenting parent or releatives from Al-hilla mortary / Iraq. Neonatal samples were obtained from neonates after sudden deaths from maternity wards. Anatomical Sites included abdomen, forehead, back, shoulder and feet sole. A totoal of 15 neonates and 10 mature adults were used for this study. Fresh tissues were sectioned using a freezing cryostat. Tissues were sectioned at 5µm in -24°C and collected on microscopic slides. Slides were allowed to air dry for 30 min prior to hematoxyline and eosin staining. Tissues were also photographed using scanning electron microscopy SEM. Cytological measurements were taken using image j software and data was analysed using graph prism. Various cytological and histological changes takes place during neonatal and adult and epidermis development. Our study shows the stages of fair follicule formation as well as number of nucleated layers present at each stage of development and at different anatomical sites. Major histological changes takes places during the transition frm a neonate to a mature adult including the number of basal cells and epidermal thickness depending on the anatomical site.

Keywords: Epidermis, Adult, Postnatal, SEM, Cytoarchitecture.

INTRODUCTION

The human integumentary system is made of thick and thin skin which covers the human body and serves a specific function. Skin appendages ensure a number of critical functions which are essential for human survival. The skin is made of two distinct layers, the epidermis and dermis[1,3,4,9]. The overlying epidermis contains, epidermal appendages such as hair follicle, sweat and sebaceous glands. The two major tissue organizations of epithelial (ectoderm, epidermis) and mesenchyme (mesoderm connective tissue, dermis and hypodermis). An extensive population of melanocytes which are derived from the neural crest and sensory nerve endings[3,9]. During fetal skin development, the epidermis changes from a single layer of ectodermal cells at 7–8 days of gestation into a more apparent stratified, keratinized epithelium at 22–24 weeks[5]. Meanwhile, the epithelial cells express different patterns of cytokeratins and proteins of the cornified cell envelope. The thickness of the skin varies in different parts of the body, and the proportions of dermis and epidermis also differ[1,3,8]. Between the scapula, the dermis is especially thick, whereas on the palms of the hands and soles of the feet, the epidermis is thickened. The terms thick skin and thin skin refer to the *thickness of the epidermis* and not to the thickness of the skin as a whole[10]. In thick skin the epidermis is especially well developed, whereas in thin skin it forms a relatively narrow layer. At its junction with the dermis, the epidermis forms numerous ridge like extensions, the epidermal ridges that project into the underlying dermis[2]. Complementary projections of the dermis fit between the epidermal ridges and form the dermal papillae. The surface patterns of the skin, such as the fingerprints, reflect the pattern of the dermal papillae[7]. The epidermis forms the surface layer of the skin and consists of keratinized stratified squamous epithelium. The cells, keratinocytes, undergo an orderly progression of maturation and keratinization to produce a superficial layer of dense, flattened, dead cells at the surface[1,3,9].

MATERIALS AND METHODS

Subjects

Adult samples free from any skin abnormalities were obtained during routine autopsy examination. A legal consent was obtained from both Baghdad and Hilla mortary/ Iraq. A total of 6 male adult tissues were used for this study. Any adult suffering from skin abnormalities are not included in this study. anatomical Sites included abdomen, shoulder, back and sole. Neonatal tissues were obtained from fully informed

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consenting parents, a total of 10 neonates were used for this study. All subjects were free from skin diseases or Adult and neonatal histology

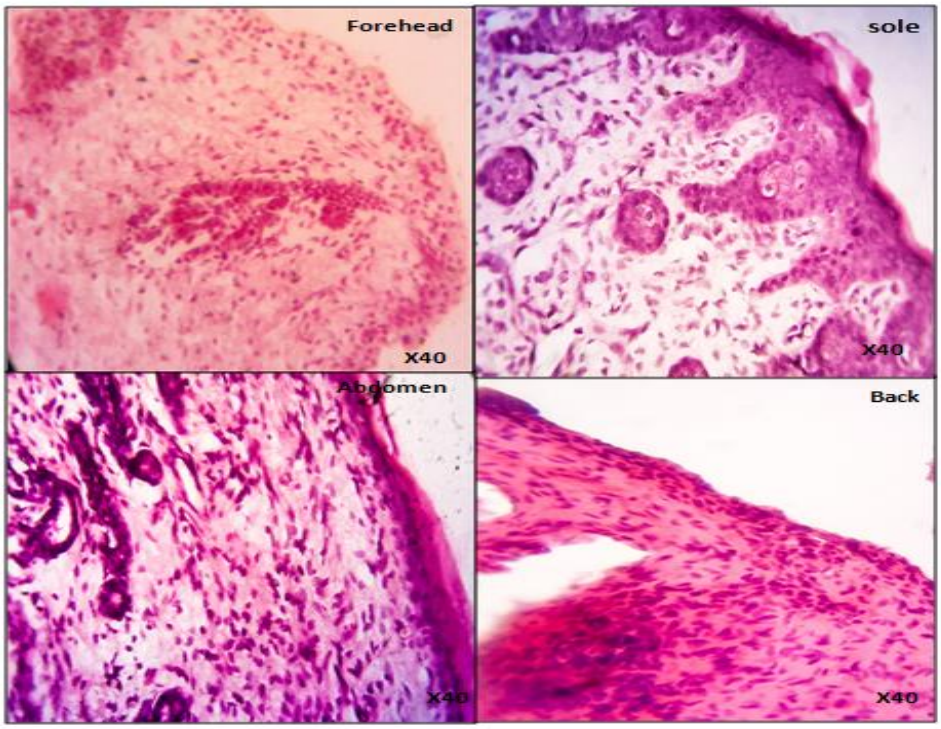

Figure 1: Histology of neonatal tissues (H&E). Top left: Tissue from the forehead area showing 6 or more nucleated layers with a horny layer present. Top right: Tissue of a feet sole area showing several nucleated layers representing a stratum basale and defined epidermal layers and what appears to be sweat glands. Lower left: A tissue from the abdomen area also showing a simple horny layer and a defined germinative layer. Lower right: A tissue from the back area showing a number of nucleated layers and a simple horny layer with epidermal hair follicles extending into the mesoderm. General germinative (basal) cell repeated division is noticeable. General proliferation generates folds in basement membrane is seen in all tissues.

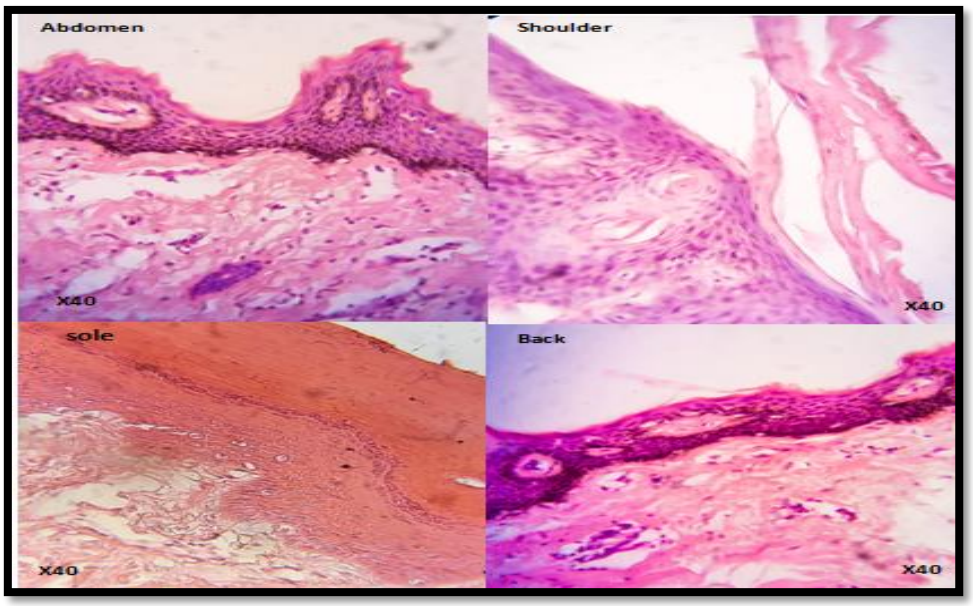

Figure 2: Histology of adult tissues (H&E). Top left: Tissue from the abdomen area showing 6 or more nucleated layers with a horny layer present. Top right: Tissue of a shoulder area showing several nucleated layers representing. Lower left: A tissue from feet sole area showing a number of nucleated layers and a thick horny layer with epidermal ridges and defined layers. Lower right: A tissue from the back area showing a number of nucleated layers and epidermal layers clearly defined. General germinative (basal) cell repeated division is noticeable. General proliferation generates folds in basement membrane is seen in all tissues.

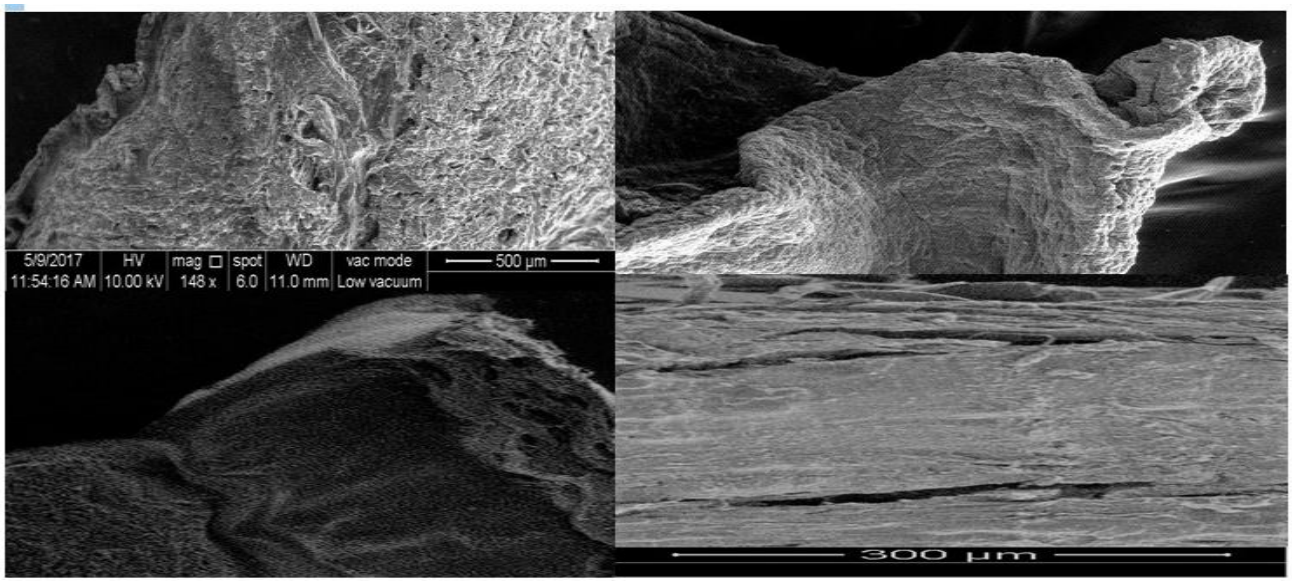

Figure 3: Electron micrograph of a neonate X 640. Top left a micrograph of an abdomen area showing several layers of epidermis present. Top right: A micrograph of forehead area with no defined epidermal features. Bottom left: A micrograph of a back area showing some layers of the epidermis and a horny layer. Bottom right: A micrograph of a feet sole showing some layers with rough surface and epidermal layers with dermis transition.

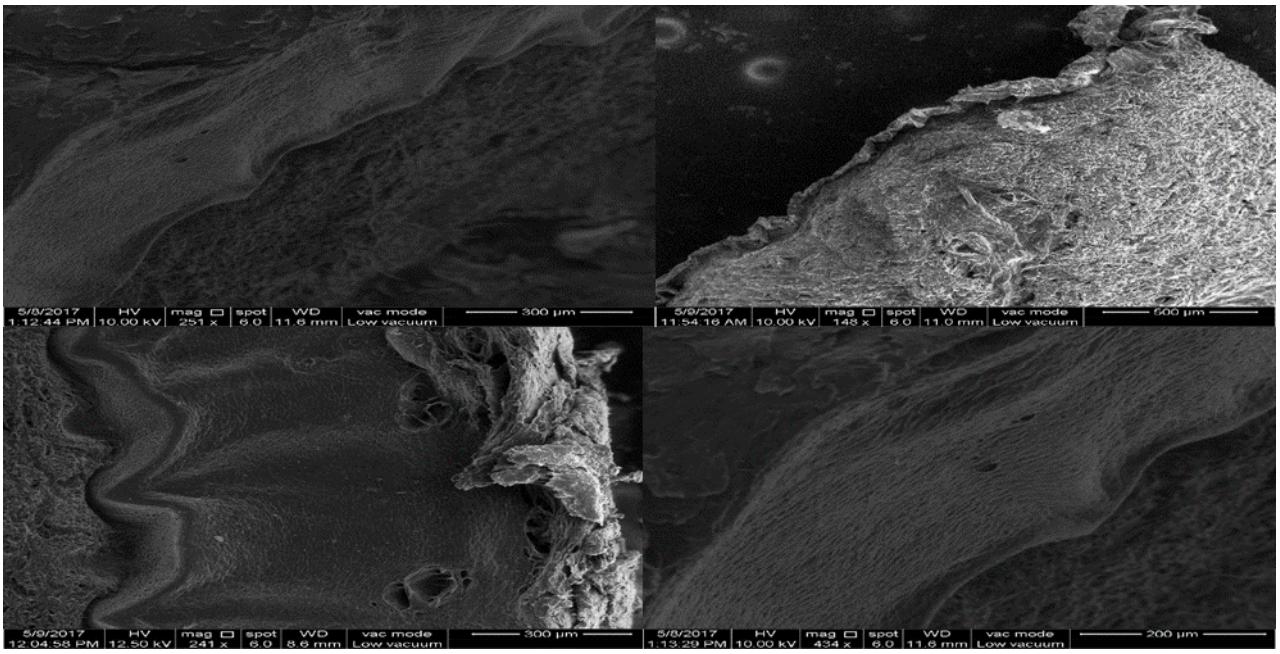

Figure 4: Electron micrograph of adult tissues X 640. Top left a micrograph of an abdomen area showing several layers of epidermis present with hard cornified layer. Top right : A micrograph of shoulder area with clear defined epidermal features and hard cornified layer. Bottom left: A micrograph of a feet sole area showing thick and large cornified layer and epidermal layers with basement membrane present. Bottom right: A micrograph of a back area showing all layers of the epidermis with rough surface and epidermal layers with dermis transition.

abnormalities, any abnormal or deformed skin was not used in this study. Histology: Fresh tissues were fixed in optimum cutting temperature (OCT) and sectioned using a freezing cryostat at 5µm in -24°C and collected on microscopic slides. Slides were allowed to air dry for 30 min prior to hematoxyline and eosin processing. Scanning electron microscopy: Fresh tissues of all 4 sites from all ages were embedded in glutaraldehyde then processed with osmium tetroxide and a series of alcohol concentration according to manufacturer protocol before coated with gold and photographed using scanning electron microscope (SEM). Measurements: Cytological measurements were taken using image j software using pixel calibration according to software instructions. Data was analysed using graph prism.

RESULTS

Our results show a several histological and cytological changes that takes place at the age of 2-3 months of gestation these include the formation of A major transition is seen after 4 and 5 months of gestation

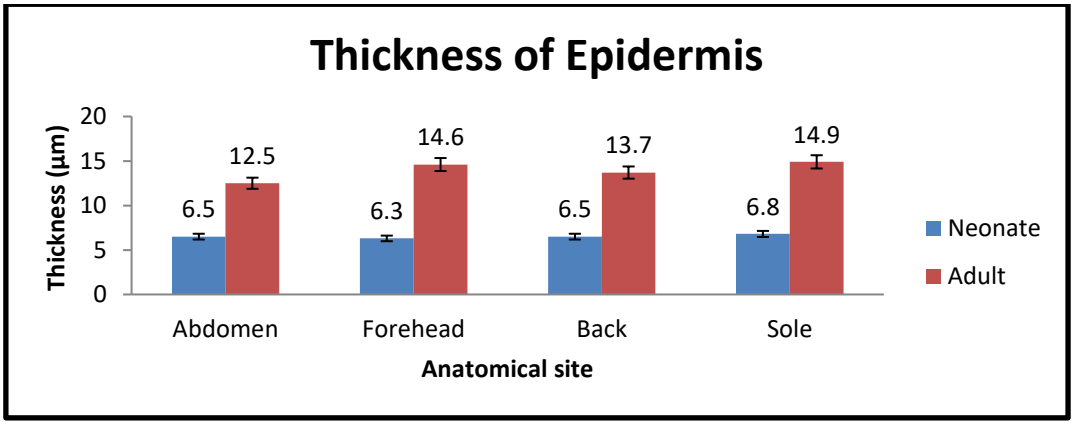

Figure 5: Graphical comparison between neonate and adult epidermal thickness of all selected anatomical sites showing an increase in epidermal thickness in adults however the epidermal thickness remains constant with no apparent increase in all anatomical sites of neonatal tissues. Statistical analysis shows statistical significance $P < 0.05$ between anatomical sites and ages.

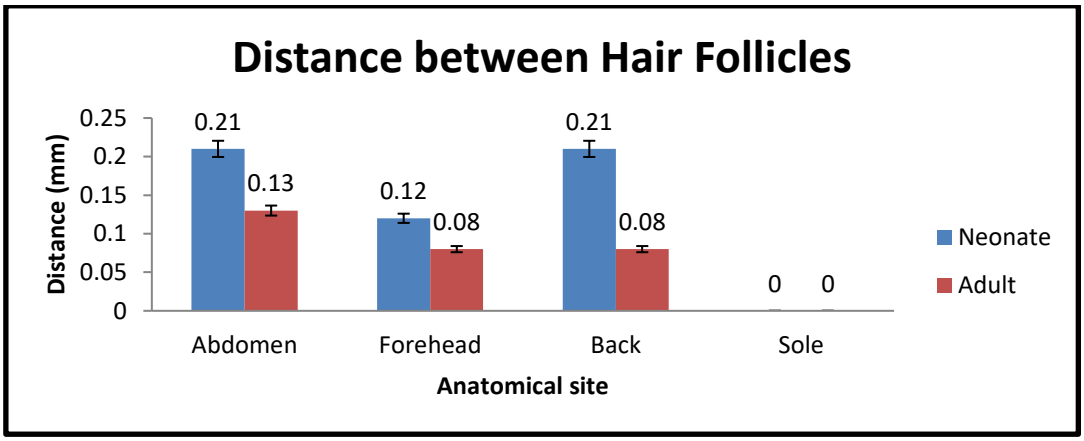

Figure 6: Graphical comparison between neonate and adult distance between hair follicles of all selected anatomical sites. An apparent decrease in distance between hair follicles which is expected between neonate and adult comparison. No difference in the distance is observed between the abdomen and back of neonates. No appearance of follicles is seen in the feet sole area at all ages. Statistical analysis shows significance $P < 0.05$ between all values at both ages.

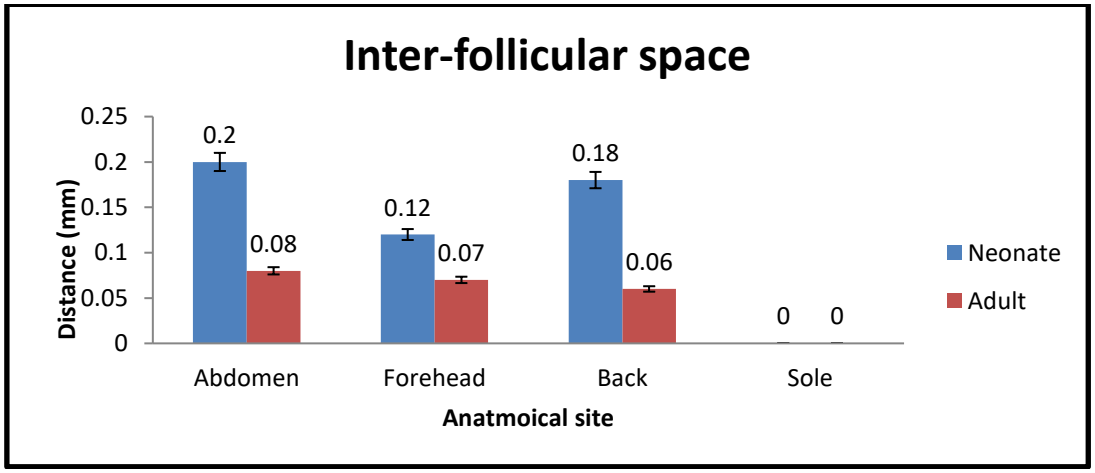

Figure 7: Graphical comparison between neonatal and adult inter-follicular space in the selected anatomical sites. An gradual decrease in the distance between 2 hair follicles due to the transition from a neonate to a mature adult. Statistical analysis shows statistical significance $P < 0.05$ between all neonate and adult inter-follicular distance of all selected anatomical sites.

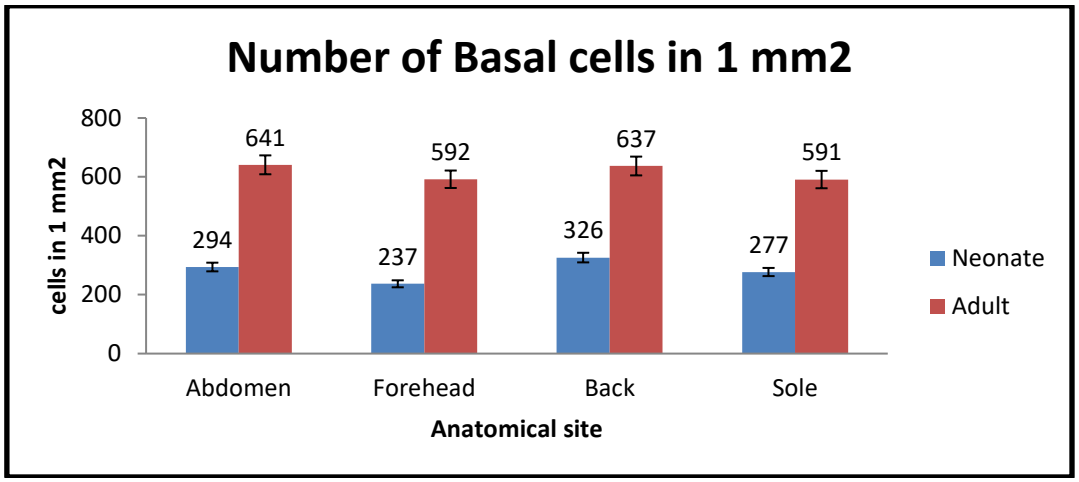

Figure 8: Graphical comparison between neonate and adult showing the number of basal cells in 1mm^2 in the selected anatomical sites. An apparent increase in the number of basal cells present layers in all sites which is expected with an increase in age and metabolic activity as well as regeneration of the epidermis. Statistical analysis shows significance $P < 0.05$ between all values of all selected anatomical sites.

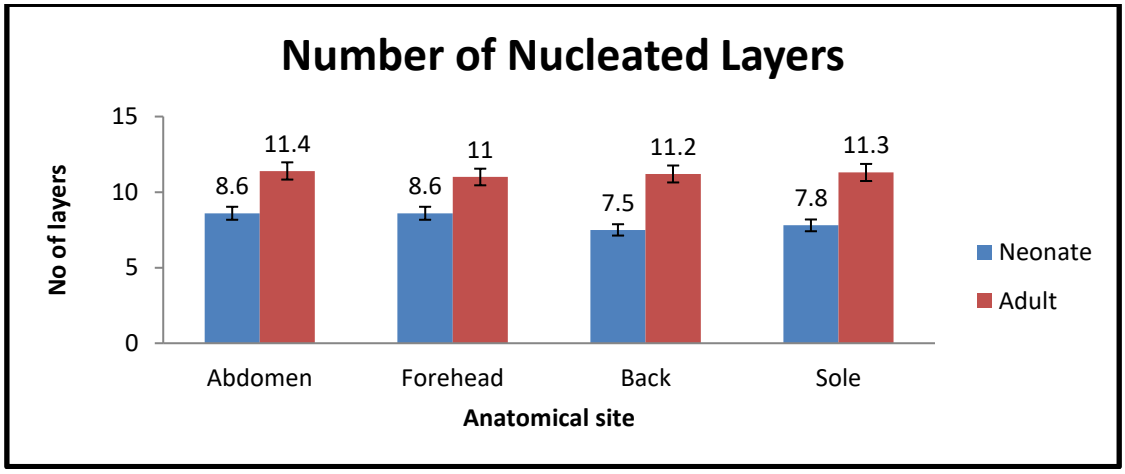

Figure 9: Graphical comparison between neonates and adult no of nucleated layers in all selected anatomical sites. An overall increase in the number of nucleated layers in all sites both in neonates and adults which is expected with an increase in epidermal wear and regeneration. Statistical analysis shows significance $P < 0.05$ between all values at all anatomical sites.

including the formation of germinative layers. Maturation of all epidermal layers was visible after 6 months of gestation. Number of nucleated layers is increased as well as reduction interf-follicular space between hair follicles. Thickness of the epidermis and number of basal cells increases with gestational age. Several skin appendages were also visible after 3 months however their presence and abundance is dependent on the anatomical site. Presence of horny layer becomes apparent and basal cells increases gradually. A positive correlation was seen between epidermal thickness and number of basal cell present. SEM micrographs showed a layer of ectodermal cells at early months of gestation however there is a gradual appearance of several layers and some clearly apparent epidermal appendages were seen.

DISCUSSION

The human epidermis serves an important role in protection and prevention of dehydration as well as absorption of useful sunlight for synthesis of vitamin D. this study examined the histological and cytoarchitecture of mature adult and neonatal epidermis. The results shows an apparent histological difference depending on the selected anatomical site. A major difference is the epidermal thickness of of all adult anatomical sites in comparison to neonatal epidermis. Number of basal cells in neonateal sites of both thick and thin skin increases in comparison with that of adults sites. The distance between hair follicles in nenonates is much larger than that in mature adults due to the decreased number of hair follicules present in all tissues except in thick skin represented by feet sole. An apparent decrease in inter-follicular distance between hair follicles which is expected with an increase in age and hair growth of anatomical sites of both neonates and adults. An apparent

Histological and cytological measurements.

Table 1: Several histological and cytological measurements taken from all anatomical sites for both neonates and adults using calibrated image j software.

Age	Anatomical site	Thickness of epidermis (µm)	Distance between hair follicles (mm)	Inter-follicular space (mm)	No of basal cells in 1 mm^2	No of nucleated layers
Neonata l	Abdomen	6.5 ± 3.31	0.21 ± 0.05	0.20 ± 0.04	294.0± 10.8	8.6 ± 0.30
	Sole	6.8 ± 3.15	-	-	277.0 ± 10.4	7.8 ± 0.14
	Forehead	6.3 ± 3.11	0.12 ± 0.07	0.12 ± 0.05	237.0 ± 7.1	8.6 ± 0.37
	Back	6.5 ± 3.24	0.21 ± 0.09	0.18 ± 0.02	326.0 ± 9.8	7.5 ± 0.22
Adult	Abdomen	12.5 ± 2.60	0.13 ± 0.01	0.08 ± 0.02	641.0 ± 26.8	11.4 ± 0.26
	Sole	14.9 ± 2.73	-	-	591.0 ± 23.4	11.3 ± 0.90
	Shoulder	14.6 ± 2.54	0.08 ± 0.04	0.07 ± 0.02	592.0 ± 26.1	11.0 ± 0.27
	Back	13.7 ± 3.12	0.08 ± 0.05	0.06 ± 0.03	637.0 ± 24.8	11.2 ± 0.12

increase in the number of nucleated layers in neonates compared to that in adults in all sites.

CONCLUSION

This study shows in cytological and histological methods the presence of major changes that takes place during neonatal and adult integumentary system development. Certain histological measurements such as the number of basal cell present and number of nucleated layers vary depending on the anatomical site and age. This can support the scientific evidence that cytological and histological changes will vary depending on the activity of the anatomical site.

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