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Evaluating Possible Factors Affecting Anatomical Changes in Facial Skin

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Abstract

Background: The study examines potential factors influencing wrinkle formation in facial skin among populations in Iraqi governorates.

Methods: Employing a descriptive cross-sectional study from October 2022 to January 2023, 114 participants were selected, excluding those with prior facial surgeries or treatments influencing skin aging. Using structured questionnaires and a numerical wrinkle scoring system at seven facial sites, the study assessed correlations between wrinkle severity and variables such as age, sex, number of children, lifestyle, and environmental exposures.

Results: Significant correlations were found between increased wrinkle scores and factors including male sex ($p<0.01$), age ($p<0.01$), number of children ($p<0.01$), occupational physical labor ($p<0.01$), economic status ($p<0.01$), sunlight exposure ($p<0.01$), stress levels ($p<0.01$), and number of lost teeth ($p<0.01$). Education level was not significantly correlated with wrinkle severity. Differences in wrinkle scores between sexes varied by age group.

Conclusions: Facial wrinkle severity is determined by a complex interplay of demographic, lifestyle, in addition to environmental elements. The findings highlight key areas for targeted aging skin research and potential interventions.

Introduction:

Facial anatomical changes arise due to alterations in the soft tissue layers and the facial bones beneath them. While these factors are undoubtedly interconnected, the specific impact of each, including how they vary across different facial regions and from person to person, is not fully understood (1). Skin ageing in particular is a continuous procedure that affects skin functionality and alters its look, mirroring

an individual's overall health and emotional state. Thiscomplex phenomenon encompasses various characteristics, with facial wrinkles standing out as particularly prominent. The pathophysiology of wrinkles garners significant attention as it represents a prime focus for enhancing skin appearance and serves as a critical goal in the anti- aging sector of the cosmetic industry (2).

Factors affecting wrinkle formation.

Wrinkle formation is influenced by a blend of intrinsic and extrinsic factors.

Intrinsic Factors in Wrinkle Formation include:

Aging: Age is the primary factor in the development of wrinkles, with its influence strongerin females than in males. Initially, men exhibit more wrinkles at a younger age, but as age advances, women surpass men in wrinkle formation, a trend that may be attributed to the rapid hormonal shifts experienced by women during post-menopause. Studies confirm that with advancing age, there is a consistent increase in skin aging indicators, including wrinkles and sagging. The severity of facial wrinkles escalates with age across all groups, underscoring the strong correlation between aging and wrinkle severity (2–4).

Sex and sexual hormones: male sex and sexual hormones are significant factors in premature skin aging, impacting wrinkling, hypervascularity, and pigmentation. In postmenopausal women, hormonal changes, especially estrogen deficiency, critically affect women's skin quality, leading to dryness, thinning, and decreased firmness and elasticity. Skin receptors for estrogen and androgens play a considerable role in these changes (2,5–7).

Extrinsic Factors in Wrinkle Formation include:

Stress: Exposure to stress, particularly due to work-related pressure, has been identified to significantly impact skin health, with individuals operating under stressful conditions exhibiting

a higher degree of wrinkle formation. This correlation suggests that occupational stress may accelerate the skin's aging process, leading to more pronounced signs of aging such as wrinkles (8).

Ultraviolet radiation and sunlight exposure: Exposure to ultraviolet (UV) rays and sunlight over a lifetime has been correlated with the development of wrinkles. Studies indicate that the prevalence of wrinkled skin serves as a reliable measure of cumulative UV exposure, with a notable correlation observed between the quantity of wrinkles and the total number of hours spent in the sun (7,9).

Educational level: Studies showed that women with lower educational attainment tended to exhibit a greater degree of wrinkling compared to their highly educated counterparts. The highest level of education attained and the frequency of wrinkles show a clear negative association, indicating that educational attainment may be adversely related to the degree of wrinkle creation (2,5).

Number of children: research indicates that as the number of full-term pregnancies in women increases, so does the risk of developing facial wrinkles. This correlation might be partially explained by hormonal fluctuations. Specifically, pregnancy causes a surge in plasma estrogen levels, but over time, women who have had multiple pregnancies tend to have higher levels of sex hormone-binding globulin, leading to reduced levels of free estradiol, as opposed to women who have never given birth. This hormonal shift could contribute to lower estrogen levelsin women with more pregnancies, potentially exacerbating the formation of wrinkles on the face(4).

Number of lost teeth: There appears to be a negative relationship between the state of dental health and the visible signs of skin aging. Specifically, it has been observed that individuals with diminished numbers of teeth, including those who have lost all their teeth, tend to exhibit a more marked presence of wrinkles. This correlation points to the notion that tooth loss could be a contributing factor to the accelerated

appearance of wrinkles, suggesting an intriguing link between oral health and the aging of the skin (10–12).

This study embarks on a comprehensive exploration of the myriad factors that may influence alterations in the facial skin's anatomy, with a particular emphasis on identifying the roles played by demographic and lifestyle variables on the facial skin's structural changes.

Methodology

A descriptive cross-sectional approach was employed from October 2022 to January 2023, engaging participants from various Iraqi governorates, including Salah al-Din, Diyala, and Diwaniyah. The current study was designed to identify and evaluate potential risk factors influencing anatomical alterations in facial skin leading to the formation of wrinkles. Data were gathered using a structured questionnaire to capture participant demographics and risk factors, including sex, age, number of children, chronic diseases, daily exposure to sunlight, and the number of lost teeth. Participants also underwent a comprehensive oral examination utilizing disposable mirrors to assess the number of missing teeth and any abnormalities in bones or soft tissues. Additionally, facial photographs (anterior and lateral views) were taken with the individuals' consent to facilitate the subsequent analysis of facial skin changes, particularly the presence and severity of wrinkles.

Exclusion criteria: individuals who had any of the following:

Undergone facial surgery.

Experienced accidents or burns affecting the face.

Under the age of thirty.

Received treatments like fillers or Botox aimed at skin rejuvenation.

Wrinkle Assessment

The extent of facial wrinkles was documented and scored based on a numerical scoring system for the assessment of wrinkles at seven specific facial sites. Each site is assigned a score from 0 to 2, where: 0 indicates no visible wrinkles, 1 indicates the presence of a line, and 2 indicates the presence of folds. As demonstrated in figure (1)

The sites assessed are:

HF (Horizontal Forehead Lines)
GF (Glabellar Frown Lines)
PO (Periorbital Lines)
NL (Nasolabial Folds)
UL (Upper Radial Lip Lines)
LL (Lower Radial Lip Lines)
ML (Marionette Lines)

The aggregate wrinkle score is computed by adding the individual scores from each of the seven sites, resulting in a total score that ranges from 0 to 14. A score of 0 corresponds to completely smooth skin, devoid of any wrinkles, whereas a score of 14 denotes skin that is severely wrinkled.

Data Analysis

Descriptive statistics were generated to provide an overview of the study population characteristics. Frequency and percentage distributions were calculated for categorical variables such as sex, age groups, number of children, educational levels, economic status, sunlight exposure, stress levels, and the extent of occupational physical labor. This was performed with. Excel 2020 from Microsoft. Independent sample T-tests and one-way Analysis of Variance (ANOVA) were used to assess the relationship between the different risk factors and the wrinkle score when comparing two groups and more than two groups, respectively. The T-test compared mean wrinkle scores between two groups of a categorical variable, such as gender. ANOVA was used to compare means across more than two groups, such as age categories. The strength and direction of the relationship between wrinkle scores and ordinal or non-normally distributed continuous variables were evaluated using Spearman's rank correlation coefficient. Version 27 of SPSS Statistics was used for all statistical analyses. For every test, the significance level was set at $p<0.05$.

Ethical Considerations

The current study was conducted with strict adherence to ethical standards. All participants gave their prior consent for the publication of the research and the use of

their images for the documentation of findings.

Results

With 114 participants, 53.5% of them were female and 46.5% of them were male, showinga balanced representation of both genders for ages 30 to 77. The ages of participants were well- distributed, with the largest group being those aged 40-49 years (38.6%), followed by those in the50-59 years range (28.9%) (Table 1).

The number of children participants had was quite balanced, with approximately a third of the study population in each of the three categories. A substantial proportion had a bachelor's degree (40.4%), indicating a moderately high level of education within the sample. Economic status skewed towards the medium range (71.9%), with few individuals categorized as low economic status (4.4%). A significant majority of participants had moderate sun exposure (77.2%), the occupation-related physical labor was predominantly moderate (79.8%).

The relationships between various risk factors and their association with wrinkle score was assessed. The mean wrinkle score served as the dependent variable against which the risk factors were measured (Table 2).

Sex differences were prominent, with males exhibiting a higher mean wrinkle score ($p<0.01$). This finding may reflect biological differences in skin composition and aging processes between genders. A strong statistical significance was observed with age ($p<0.01$), where mean wrinkle scores increased progressively with each age group. The oldest age group (≥60 years) displayed the highest mean wrinkle score (9.5 ± 2.4), suggesting a significant relationship between wrinkle severity and age. Interestingly, the number of children showed a positive relationship with wrinkle scores ($p<0.01$), suggesting that having more children may be associated with an increase in wrinkle formation. Occupational physical labor was also strongly connected to higher wrinkle scores ($p<0.01$), with those engaged in high physical labor exhibiting the highest wrinkle score (8.1 ± 1.2). Economic status displayed an inverse relationship, where those with low economic status had significantly higher wrinkle scores ($p<0.01$).

Participants with high exposure to sunlight had significantly greater wrinkle scores ($p<0.01$), reinforcing the role of UV exposure in skin aging. Contrary to expectations, individuals with low stress levels exhibited higher wrinkle scores ($p<0.01$), which could suggest a possible confounding variable not accounted for in the study or a non-linear relationship between stress and skin aging.

Education level did not show significant differences in wrinkle scores ($p>0.05$), indicating this factor might not have a straightforward relationship with wrinkle formation. However, the number of lost teeth, which could be an indicator of long-term health status, did show a significant association with wrinkle score ($p<0.01$).

The correlation analysis (Table 3) provided a quantitative measure of the strength of association between wrinkle scores and various factors.

Age displayed a strong positive correlation ($r = 0.740$, $p<0.01$), reaffirming its strong predictive value for wrinkle formation. The number of children and the number of lost teeth alsoshowed positive correlations with wrinkle scores ($r = 0.556$ and $r = 0.504$, respectively, both $p<0.01$). Occupational physical labor and exposure to sunlight had moderate positive correlations with wrinkle scores ($r = 0.488$ and $r = 0.526$, respectively, both $p<0.01$), indicating significant but less strong relationships compared to age.

Interestingly, economic status ($r = -0.235$, $p<0.05$) and stress ($r = -0.330$, $p<0.01$) were inversely correlated with wrinkle scores. This could suggest that higher economic status and moderate stress levels may play protective roles against wrinkle development. Whereas education level did not show a significant correlation ($r = -0.159$, $p>0.05$), suggesting that it may not have a direct impact on wrinkle formation.

Table 4 presents an analysis that extends the understanding of how sex differences influence wrinkle formation across various

age groups. The following findings were observed:

In the 30-39 age group, there was a significant difference in mean wrinkle scores between females and males ($p<0.05$). Female participants had a lower mean wrinkle score (2.82 ± 0.73) compared to males (4.71 ± 1.38), suggesting that in early adulthood, men may develop wrinkles more prominently or at an earlier age than women. The 40-49 age group also showed a significant sex difference in wrinkle scores ($p<0.05$). Females had a mean score of 4.13 ± 1.29, whereas males had a higher mean of 5.24 ± 1.22. This indicates that the trend observed in the younger cohort persists into middle adulthood, with males continuing to exhibit more pronounced wrinkle formation. Interestingly, in the oldest age group (≥60 years), females exhibited a significantly higher mean wrinkle score (11.50 ± 1.91) than males (8.56 ± 2.07) ($p<0.05$). This reversal of the trend observed in younger age groups might be related to post-menopausal hormonal changes in women, which could accelerate skin aging and wrinkle development compared to men, who experience a more gradual hormonal decline.

Discussion:

Role of Sex, age and Menopausal Status

Age was the strongest determinant of wrinkle formation in both the present study and previous studies with regards to skin aging (2,8,13). This was previously proven by the scientist Fisher, as he confirmed that internal aging occurs with the advancing age of a person and causes a reduction in collagen and elastin synthesis, the rate at which new skin cells are produced may slightly slow down and dead skin cells do not shed as quickly. (14). The findings of the present study also echo those of Hillebrand et al., research shown that middle age or the onset of menopause were associated with quicker, permanent wrinkles (13). Consistent with findings by Hamer et al., According to the current study, men had more wrinkles than women did, which supports the idea that sex plays a factor in skin ageing (2). This is also in agreement with Tsukahara et al. and other studies that have noted that Men often have wrinkles that are more severe (15). The current study found this trend to be age-dependent, with a reversal occurring in individuals over 60 years old, where women had significantly higher wrinkle scores, which also aligns with previous literature (4,15).

Lifestyle Factors and Environmental Exposure

Our results, in conjunction with those of Ekiz et al., suggest that high sun exposure is significantly associated with increased wrinkling (16). This was also confirmed by Fisher, who clarified that Skin pigment and sun exposure intensity are the main factors that contribute to photoaging. As a result, those who lead outdoor lifestyles or reside in sunny regions will age more quickly (17). The protective role of physical activity was less clear in the present study, as it was not significantly associated with wrinkle formation, contrasting with findings that physical activity may be related to skin aging (16).

Number of children

The current study also identified correlations with the number of children birthed and wrinkle formation, suggesting that physiological changes related to childbirth and child-rearing stress might contribute to skin aging. This aligns with the results of Youn et. al in which demonstrated that the number of full-term pregnancies correlates directly with wrinkle severity

(4). Though it seems the number of children also affects men as well so it might be associated with responsibilities and stress of life as parents, an observation seen in a study by Inoue et al (18). Environmental elements like weather and noise, bodily issues like accidents and injuries, psychological ones like tension and anxiety, and social factors like hectic schedules and heavy duties are all contributing causes to people's stress levels. Our bodies may react to stress in different ways. Stress in particular may have an immediate effect on the skin. Overstress causes a variety of skin issues, including the acceleration of dermal

discases and the promotion of skin ageing, by interfering with the autonomic nerves or hormone balance (24,25).

Impact of Tooth Loss

The present investigation, along with that by Wei Yin et al., emphasizes the relationship between tooth loss and wrinkle severity (10). The loss of teeth can affect facial structure and skin tautness, leading to more pronounced wrinkles, especially around the mouth and cheeks. this wasfurther elaborated by Albert et al.; they explain the courses of this results. When a human loses teeth, There will be less need for support in the surrounding bone of the teeth. This causes bone to resorb in those inactive places; the upper jaw experiences this process more than the lower jaw. The lower jaw seems more prominent and the face appears shorter when there is less bone tissue in the upper jaw. Wrinkles and weakened lower face muscles are the results of the loss of supporting tissues in the face. Both a narrowing of the face and a hollowing of the checks may result from tooth loss in the lateral regions of the jaw (26).

Loss of anterior teeth will result in a concave profile. The thickness and density of the jaw bones will be impacted if all of the teeth are lost (27), resulting in a shorter facial look and a smaller jaw arc. In this approach, losing teeth significantly affects the soft tissues that cover the teeth as well as the skeletal proportions of the face (28).

Educational Level and Economic Status

In the current study, economic status was found to be associated with wrinkle formation, where individuals with higher economic status showed lower wrinkle scores. This may reflect differences in lifestyle and access to skincare or professional treatments. Our findings did not indicate a strong association between educational level and wrinkle severity, unlike in the study by Hamer et al., where low educational levels were associated with more wrinkling in women(2).

Limitations and Directions for Future Research

Although the conducted study offers insightful information, it is important to acknowledge its limitations, including the possibility of unaccounted-for confounding factors and the cross-sectional design's inability to infer causality. Longitudinal designs, more comprehensive demographic sampling, and the incorporation of a wider range of environmental and genetic factors should be the goals of future study.

The synthesis of findings from the current study and the existing literature underscores the multifactorial nature of skin aging, where biological, lifestyle, and environmental factors interplay. It becomes clear that interventions to mitigate wrinkle formation must be multifaceted, addressing protective behaviors like sunscreen use, as well as considering the biological impact of aging and hormonal changes.

Conclusion:

This study provides a comprehensive analysis of factors affecting anatomical changes in facial skin with an emphasis on wrinkle formation. The investigation delineated how variables such as age, sex, number of children, occupational physical labor, economic status, exposure to sunlight, stress, and number of lost teeth contribute to the development and severity of wrinkles. Among these, age emerged as the strongest predictor, followed by factors that signify both intrinsic aging processes and environmental exposures. Sex differences in wrinkle formation were evident, varying across different age groups, with males generally exhibiting higher wrinkle scores in early and middle adulthood, and females showing a significant increase post-60 years, likely due to hormonal changes associated with menopause. The lack of significant correlations between wrinkle formation and factors such as educationlevel may suggest that the impact of these variables is either negligible or is mediated through complex interactions with other risk factors that were not captured in this study.

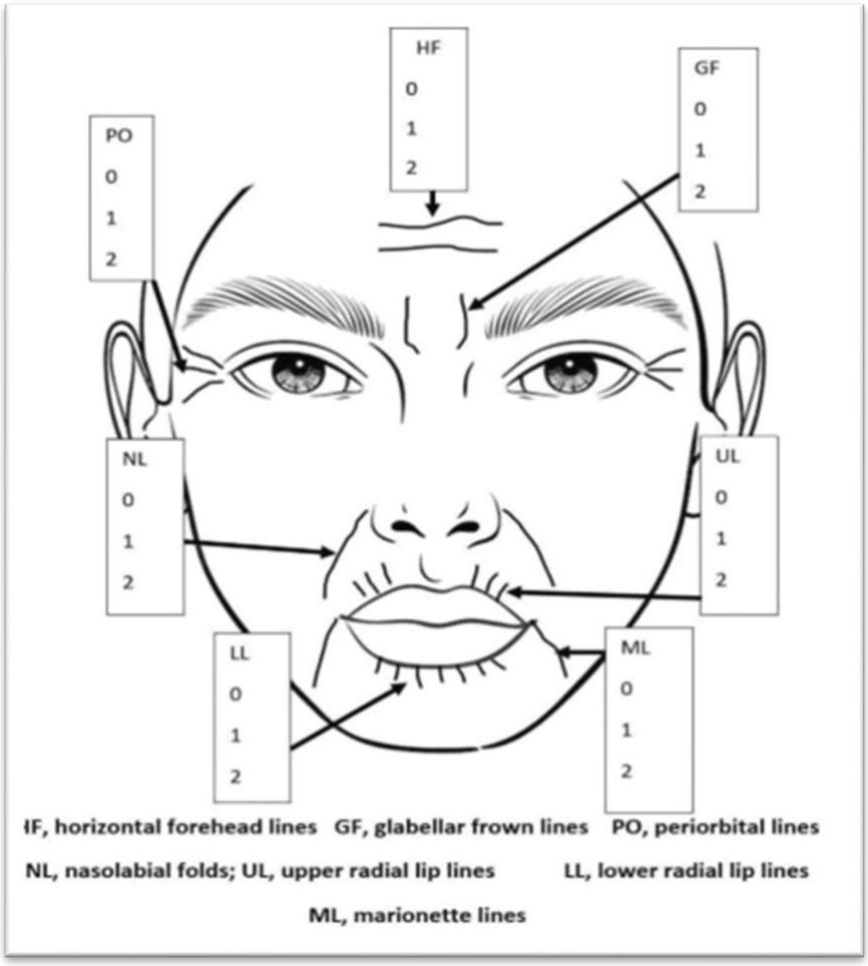

Figure 1: wrinkle scoring system utilized in the study.

Table 1: Descriptive statistics of study population

Variable	Group	Frequency	Percentage %
Sex	Female	61	**53.5%**
	Male	53	**46.5%**
Age	30-39	24	**21.1%**
	40-49	44	**38.6%**
	50-59	33	**28.9%**
	≥ 60 y	13	**11.4%**
Number of children	0-2	37	**32.5%**
	3-4	37	**32.5%**
	≥5	40	**35.1%**
Level of education	None	33	**28.9%**
	Primary – Secondary	18	**15.8%**
	Bachelor	46	**40.4%**
	Higher education	17	**14.9%**

Economic status	Low	5	**4.4%**
	Medium	82	**71.9%**
	High	27	**23.7%**
Exposure to sun light	Little	23	**20.2%**
	Moderate	88	**77.2%**
	High	3	**2.6%**
Number of lost teeth	0-2	54	**47.4%**
	3-4	31	**27.2%**
	≥5	29	**25.4%**
Stress	Low	7	**6.1%**
	Moderate	81	**71.1%**
	High	26	**22.8%**
Occupational Physical Labor	Little	15	**13.2%**
	Moderate	91	**79.8%**
	High	8	**7.0%**

Table 2: Statistical analysis of various risk factors among different groups with wrinkle score

Factor	Group	Mean wrinkle score ± SD	P value
Sex	Female Male	4.8 ± 2.5 6.3 ± 2	**<0.01****
Age	30 - 39 y 40 - 49 y 50 - 59 y ≥ 60 y	3.4 ± 1.3 4.7 ± 1.4 6.5 ± 1.5 9.5 ± 2.4	**<0.01****
Number of children	0-2 3-4 ≥5	4 ± 1.6 5.2 ± 1.7 7.2 ± 2.5	**<0.01****
Level of education	None Primary - Secondary Bachelor Higher education	6.3 ± 2.6 5.3 ± 2.5 5 ± 2 5.5 ± 2.3	>0.05
Occupational Physical Labor	Little Moderate High	3.3 ± 1.6 5.6 ± 2.2 8.1 ± 1.2	**<0.01****
Economic status	Low Medium High	9.4 ± 2.1 5.5 ± 2.3 4.8 ± 2.4	**<0.01****
Exposure to sun light	Little Moderate High	3.4 ± 1.4 6 ± 2.3 8.3 ± 0.6	**<0.01****
Stress	Low Moderate High	7.9 ± 1.2 5.6 ± 2.4 4.6 ± 2.2	**<0.01****
Number of lost teeth	0-2 3-4 ≥5	4.4 ± 1.6 5.6 ± 2.2 7.4 ± 2.6	**<0.01****

Table 3: Correlation analysis of various risk factors with wrinkle score

Factor	Correlation Coefficient	P value
Age	0.740	**<0.01****
Number of Children	0.556	**<0.01****
Level of Education	-0.159	>0.05
Occupational Physical Labor	0.488	**<0.01****
Economic Status	-0.235	**<0.05***
Exposure to Sun Light	0.526	**<0.01****
Stress	-0.330	**<0.01****
Number of Lost Teeth	0.504	**<0.01****

Table 4: Sex differences in wrinkle score across different age groups

Age group	Female Mean wrinkle score ± SD	Male Mean wrinkle score ± SD	P value
30-39	2.82 ± 0.73	4.71 ± 1.38	**<0.05***
40-49	4.13 ± 1.29	5.24 ± 1.22	**<0.05***
50-59	6.06 ± 1.14	7.06 ± 1.73	>0.05
= or more than 60	11.50 ± 1.91	8.56 ± 2.07	**<0.05***

References

1. Wong CH, Mendelson B. Newer understanding of specific anatomic targets in the aging face as applied to injectables: Aging changes in the craniofacial skeleton and facial ligaments. Plast Reconstr Surg. 2015;136(5):44S-48S.
2. Hamer MA, Pardo LM, Jacobs LC, Ikram MA, Laven JS, Kayser M, et al. Lifestyle and Physiological Factors Associated with Facial Wrinkling in Men and Women. Journal of Investigative Dermatology. 2017 Aug 1;137(8):1692–9.
3. Trojahn C, Dobos G, Lichterfeld A, Blume-Peytavi U, Kottner J. Characterizing facial skin ageing in humans: Disentangling extrinsic from intrinsic biological phenomena. Biomed Res Int [Internet]. 2015;2015:1–9.
4. Youn CS, Kwon OS, Won CH, Hwang EJ, Park BJ, Eun HC, et al. Effect of Pregnancy and Menopause on Facial Wrinkling in Women. Acta Derm Venereol. 2003;83(6):419–24.
5. Suppa M, Elliott F, Mikeljevic JS, Mukasa Y, Chan M, Leake S, et al. The determinants of periorbital skin ageing in participants of a melanoma case-control study in the U.K. BritishJournal of Dermatology. 2011 Nov;165(5):1011–21.
6. Green AC, Hughes MCB, McBride P, Fourtanier A. Factors associated with premature skin aging (photoaging) before the age of 55: A population-based study. Dermatology. 2011 Feb;222(1):74–80.
7. Bonté F, Girard D, Archambault JC, Desmoulière A. Skin changes during ageing. In: Subcellular Biochemistry. Springer New York; 2019. p. 249–80.
8. Suliman SI, Yusof YM, Julianto T, Baki SM. Preliminary study on factors that influence skin characteristics of UiTM staffs. In2010 International Conference on Computer Applications and Industrial Electronics 2010 Dec 5 (pp. 211-216). IEEE.

9. Akiba S, Shinkura R, Miyamoto K, Hillebrand G, Yamaguchi N, Ichihashi M. Influence of chronic UV exposure and lifestyle on facial skin photo-aging -- results from a pilot study. J Epidemiol [Internet]. 1999;9(6sup):136–42.

10. Yin W, Ye X, Bian Z. Phenotypic findings in Chinese families with X-linked hypohydrotic ectodermal dysplasia. Arch Oral Biol. 2012 Oct;57(10):1418–22.

11. Burger K, Schneider AT, Wohlfart S, Kiesewetter F, Huttner K, Johnson R, et al. Genotype-phenotype correlation in boys with X-linked hypohidrotic ectodermal dysplasia. Am J MedGenet A. 2014 Oct 1;164(10):2424–32.

12. Gunn DA, Dick JL, Van Heemst D, Griffiths CEM, Tomlin CC, Murray PG, et al. Lifestyle and youthful looks. British Journal of Dermatology. 2015 May 1;172(5):1338–45.

13. Hillebrand GG, Liang Z, Yan X, Yoshii T. New wrinkles on wrinkling: An 8-year longitudinal study on the progression of expression lines into persistent wrinkles. British Journal of Dermatology. 2010 Jun;162(6):1233–41.

14. Fisher GJ. The pathophysiology of photoaging of the skin. Cutis. 2005 Feb;75(2 Suppl):5– 8; discussion 8-9.

15. Tsukahara K, Hotta M, Osanai O, Kawada H, Kitahara T, Takema Y. Gender-dependent differences in degree of facial wrinkles. Skin Research and Technology. 2013 Feb;19(1).

16. Ekiz Ö, Yüce G, Ulaşli SS, Ekiz F, Yüce S, Başar Ö. Factors influencing skin ageing in a Mediterranean population from Turkey. Clin Exp Dermatol. 2012 Jul;37(5):492–6.

17. Fisher GJ, Kang S, Varani J, Bata-Csorgo Z, Wan Y, Datta S, et al. Mechanisms of Photoaging and Chronological Skin Aging. Arch Dermatol. 2002 Nov 1;138(11).

18. Inoue Y, Hasebe Y, Igarashi T, Kawagishi-Hotta M, Okuno R, Yamada T, et al. Analysis of the effect of daily stress on the skin and search for genetic loci involved in the perceived stress of an individual. Skin Health and Disease. 2022 Sep;2(3).

19. Lee CM, Watson REB, Kleyn CE. The impact of perceived stress on skin ageing. Journal of the European Academy of Dermatology and Venereology. 2020 Jan 16;34(1):54–8.

20. Hunter HJA, Griffiths CEM, Kleyn CE. Does psychosocial stress play a role in the exacerbation of psoriasis? British Journal of Dermatology. 2013 Nov;169(5):965–74.

21. Saif GA Bin, Alotaibi HM, Alzolibani AA, Almodihesh NA, Albraidi HF, Alotaibi NM, et al. Association of psychological stress with skin symptoms among medical students. SaudiMed J. 2018 Jan;39(1):59–66.

22. Aioi A, Okuda M, Matsui M, Tonogaito H, Hamada K. Effect of high population density environment on skin barrier function in mice. J Dermatol Sci. 2001 Apr;25(3):189–97.

23. Wang Y na, Fang H, Zhu W fang. Survey on skin aging status and related influential factors in Southeast China. J Zhejiang Univ Sci B. 2009 Jan;10(1):57–66.

24. Choi EH, Brown BE, Crumrine D, Chang S, Man MQ, Elias PM, et al. Mechanisms by Which Psychologic Stress Alters Cutaneous Permeability Barrier Homeostasis and Stratum Corneum Integrity. Journal of Investigative Dermatology. 2005 Mar;124(3):587–95.

25. Hunter HJA, Momen SE, Kleyn CE. The impact of psychosocial stress on healthy skin. Clin Exp Dermatol. 2015 Jul;40(5):540–6.

26. Albert AM, Ricanek K, Patterson E. A review of the literature on the aging adult skull and face: Implications for forensic science research and applications. Forensic Sci Int. 2007 Oct;172(1):1–9.

27. Megson E, Kapellas K, Bartold MP. Relationship between periodontal disease and osteoporosis. Int J Evid Based Healthc. 2010 Sep;8(3):129–39.

28. Crothers A, Sandham A. Vertical height differences in subjects with severe dental wear. The European Journal of Orthodontics. 1993 Dec 1;15(6):519–25.