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Influence of Parental Age on Linear Body Measurements of Progeny in Indigenous Naked Neck Chicken Varieties

Mohammad Farooque Hassan[1], Syeda Saba Sajjad[2], Ahmed Hussain[3], Syed Sairum Hassan[4], Syeda Tooba Sajjad[5], Syeda Ukasha Mati[6*], Syeda Ayesha Mati[7], Jamal Muhammad Khan[8]

[1] Shaheed Benazir Bhutto University of Veterinary & Animal Sciences, Sakrand, Sindh. drfaruqmati72@gmail.com

[2] Liaquat University of Medical & Health Sciences, Jamshoro, Sindh. matee.saba@gmaisl.com

[3] Liaquat University of Medical & Health Sciences, Jamshoro, Sindh. ahmedsajjad579@gmail.com

[4] Bilawal Medical College, Liaquat University of Medical & Health Sciences, Jamshoro Sindh. sairumhassan@yahoo.com

[5] Azra Naheed Medical & Dental College Lahore. Toobasajjad11@gmail.com

[6] Liaquat Institute of Medical & Health Sciences, Thatta, Sindh. ukasha.farooquematee@gmail.com

[7] Peoples University of Medical & Health Sciences, Nawabshah, Sindh. aishasyeda955@gmail.com

[8] Department of Parasitology, Cholistan University of Veterinary and Animal Sciences, Bahawalpur. jamalmkhan@cuvas.edu.pk

***(Corresponding Author)** Email: ukasha.farooquematee@gmail.com

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Abstract

The current research was done to determine the effect of parental age on morphometric data of progeny in three types of native Naked Neck chicken. There were 126 day-old chicks raised in 20 weeks by parents of two age groups (45 and 55 weeks) of light brown, black and dark brown varieties. The morphometric measurements were taken on a weekly basis and recorded as body length, beak length, neck length, keel length, shank length, shank circumference, drumstick length, drumstick circumference, and wing spreads. It was found that parental age had a strong effect on a number of morphometric characteristics of progeny ($P \leq 0.05$). The length of the body, the shank length, the shank circumference, the length of the drumstick, and the wing spread were higher in the progeny of 55-week-old parents than in the progeny of 45-week-old parents. Varietal differences were also found in body length and shank-related parameters, with the black variety recording better measurements in most of the parameters. Parental age and variation of age interacted to have a significant effect on shank circumference, keel length, and wing spread. It was established that parental age is a big factor in defining skeletal growth and linear body sizes of Naked Neck chicken offspring.

Keywords: Parental Age, Morphometric Traits, Skeletal Development, Naked Neck Chicken, Indigenous Poultry

1. Introduction

Morphometric characters play a significant role in the development of skeletons, body structures, and the growth of poultry. Physical development and adaptability of birds in genetic and management conditions have most often been assessed using linear body measurements of body length, shank length, keel length, drumstick dimensions, and wing spread [1]. These characteristics are useful in informing about the growth pattern and sound structure of poultry, more so in the native breeds raised under low-input production systems [2].

The environment of parents is also important in influencing embryonic growth and the physical features of offspring after birth. Parental age has been known as one of these factors that affects skeletal development and morphometric characteristics [3]. Older age of breeders is usually correlated with higher egg size as well as better nutrient deposition that can result in better embryonic bone development and later linear growth of chicks. Investigations have been conducted on business poultry genetics and have shown that offspring of older breeders tend to have better skeletal size than offspring of younger breeders. Nonetheless, this information is still sparse on indigenous chicken breeds [4, 5].

The naked neck chicken is an excellent indigenous genetic resource as it is adaptable to hot climatic conditions and can be reared in large and semi-intensive scale production systems. Na gene presence leads to decreased feather coverage; heat dissipation increases and thus indirectly affects skeletal growth and body composition [6]. Naked Neck chickens in Pakistan are found in various phenotypic variations of light brown, black, and dark brown that might vary in morphometric features due to genetic variation [7].

Although morphometric characteristics are relevant in assessing structural development, there is a scarcity of research studies that have tried to examine how parental age impacts on the linear body measurements of the Naked Neck chicken progeny. Furthermore, there is a lack of information on the existence of differences in varietal and interaction effects between parental age and variety on morphological traits [8].

Thus, the current research was aimed at assessing the age of the parent on the morphometric characteristics of the progeny in three types of native Naked Neck chickens. The analysis is centered on the linear body measurements to offer an insight into the skeletal development and structural growth patterns with a view to optimizing breeding performance in the indigenous poultry in the local conditions.

2. Materials and Methods

2.1 Experimental Site

The present study was conducted at the Indigenous Chicken Genetic Resource Center (ICGRC), Department of Poultry Production, University of Veterinary and Animal Sciences (UVAS), Ravi Campus, Pattoki, Pakistan. The experiment was carried out for a duration of 20 weeks under standard management and environmental conditions, as described in the thesis.

2.2 Experimental Birds and Design

A total of 126 day-old Naked Neck chicken chicks were used in this experiment. The chicks were obtained from parent stocks of two age groups, 45 and 55 weeks, belonging to three phenotypic varieties of Naked Neck chickens, namely light brown, black, and dark brown. The experiment was arranged in a 3 × 2 factorial arrangement under a randomized complete block design (RCBD). Each treatment was replicated seven times, with three birds per replicate (one male and two females). Birds were individually tagged for identification purposes.

2.3 Housing and Management

After transportation from the hatchery, chicks were brooded and later reared in a well-ventilated, semi-controlled poultry house. Birds were maintained in battery cages equipped with trough feeders and nipple drinking systems. Feed and fresh drinking water were provided ad libitum throughout the experimental period. All birds were vaccinated according to the local vaccination schedule, and uniform management practices were applied to all treatment groups to minimize environmental variation.

2.4 Measurement of Morphometric Traits

Morphometric traits were recorded on a weekly basis using a measuring tape. Measurements were taken carefully to ensure accuracy and consistency. The following linear body measurements were recorded:

- **Body length (cm):** Distance from the tip of the beak to the tip of the tail
- **Beak length (cm):** Distance from the base to the tip of the beak
- **Neck length (cm):** Distance from the base of the skull to the shoulder joint
- **Keel length (cm):** Length of the keel bone
- **Shank length (cm):** Length from the hock joint to the footpad
- **Shank circumference (cm):** Measured at the midpoint of the shank
- **Drumstick length (cm):** Length from the hock joint to the knee joint
- **Drumstick circumference (cm):** Measured at the midpoint of the drumstick
- **Wing spread (cm):** Distance between the tips of fully extended wings

2.5 Statistical Analysis

Data collected on morphometric traits were analyzed using two-way analysis of variance (ANOVA) through PROC GLM in SAS software (version 9.1). The statistical model included the effects of variety, parental age, and their interaction. Mean differences were compared using Tukey's Honestly Significant Difference (HSD) test at a significant level of $P \leq 0.05$. Each cage was considered as the experimental unit.

3. Results

3.1 Body Length, Beak Length, and Neck Length

Mean values of body length, beak length, and neck length of male and female progeny at 20 weeks of age are presented in Table 3.1, while weekly trends are illustrated in Figures 3.1–3.12. Parental age significantly influenced the body length of female progeny ($P \leq 0.05$). Female birds derived from 55-week-old parents exhibited greater body length compared to those from 45-week-old parents. Among varieties, black Naked Neck chickens showed significantly higher body length in females compared to light brown and dark brown varieties. However, the body length of male progeny was not significantly affected by parental age or variety. Beak length was significantly affected by parental age in male progeny ($P \leq 0.05$), with longer beaks observed in birds from 55-week-old parents compared to those from younger parents. No significant differences were observed among varieties or in female progeny for beak length.

Table 3.1. *Effect of two Parental Ages on Progeny beak, neck and body length (20 weeks) among three varieties of Naked Neck chickens*

Variety		Body length (cm)		Beak length (cm)		Neck length (cm)	
		Male	**Female**	**Male**	**Female**	**Male**	**Female**
Light Brown		64.62±0.42	61.74^{ab}±0.52	3.61±0.09	3.38±0.04	15.77±0.20	14.39±0.18
Black		67.41±0.78	62.65^{a}±0.51	3.59±0.08	3.29±0.04	16.23±0.31	14.49±0.15
Dark Brown		64.46±0.94	60.90^{b}±0.60	3.56±0.06	3.31±0.05	15.78±0.28	14.46±0.16
Parental age group							
45 weeks		65.34±0.33	62.80^{a}±0.40	3.45^{b}±0.07	3.31±0.04	15.60^{b}±0.25	14.64^{a}±0.13
55 weeks		65.60±0.87	60.71^{b}±0.45	3.68^{a}±0.04	3.34±0.04	16.17^{a}±0.20	14.25^{b}±0.13
Variety × Parental age group							
Light Brown	45 weeks	65.20 ±0.90	62.51±0.69	3.43±0.12	3.34±0.06	15.38±0.38	14.42±0.30
	55 weeks	64.15±0.10	60.97±0.74	3.76±0.10	3.42±0.06	16.09±0.06	14.35±0.22
Black	45 weeks	65.38±0.55	63.21±0.76	3.33±0.13	3.24±0.05	15.33±0.57	14.75±0.15
	55 weeks	68.58±0.93	62.08±0.68	3.74±0.06	3.33±0.07	16.75±0.17	14.23±0.26
Dark Brown	45 weeks	65.42±0.45	62.68±0.64	3.55±0.12	3.36±0.08	15.93±0.41	14.71 ±0.25
	55 weeks	63.65±1.70	58.64±0.63	3.57±0.07	3.26±0.05	15.64 ±0.42	14.14±0.16
***P*-value**							
Variety		0.0665	0.0241	0.8312	0.3229	0.6916	0.8986
Parental age		0.8910	0.0002	0.0035	0.6296	0.0515	0.0450
Variety × Parental age		0.0706	0.0973	0.0950	0.2993	0.0658	0.4965

Neck length was significantly influenced by parental age in both male and female progeny ($P \leq 0.05$). Male progeny from 55-week-old parents exhibited greater neck length, whereas female progeny from 45-week-old parents showed slightly higher neck length. Varietal differences and interaction effects for neck length were non-significant.

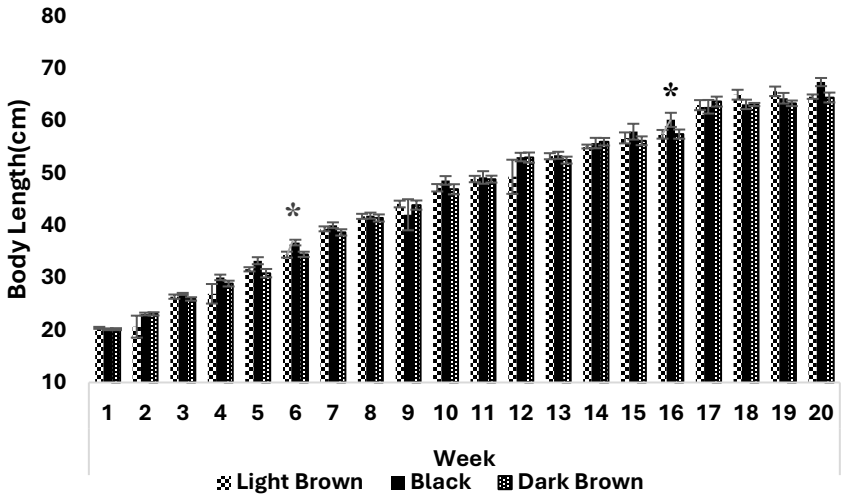

Figure 3.1. Trend of weekly body length among the male progeny of three Naked Neck chicken varieties; *Significant at P ≤ 0.05

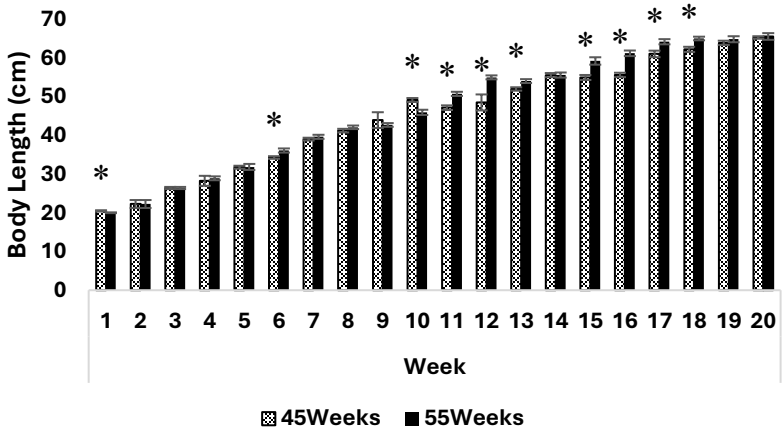

Figure 3.2. Weekly trend of body length in male progeny of Naked Neck chicken between two parental ages; *Significant at P ≤ 0.05

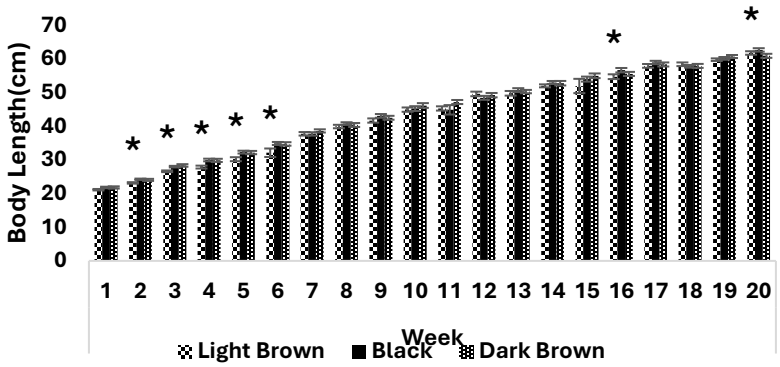

Figure 3.3. Trend of weekly body length among the female progeny of three Naked Neck chicken varieties; *Significant at $P \leq 0.05$

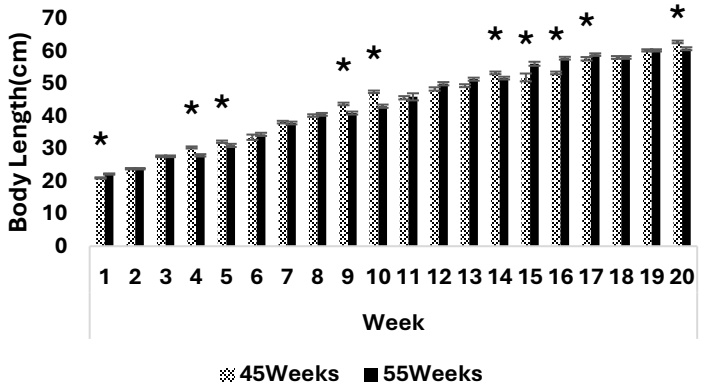

Figure 3.4. Weekly trend of body length in female progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

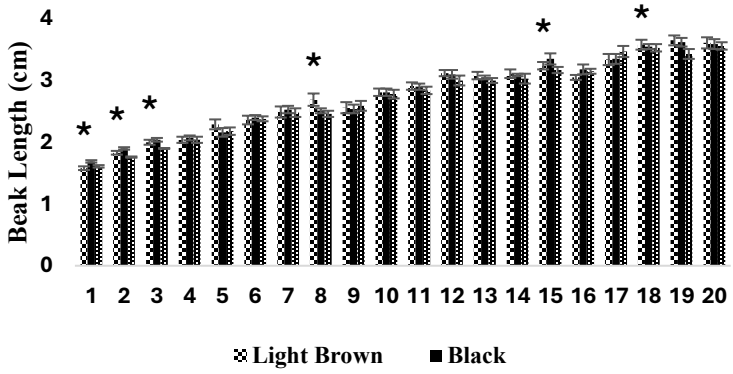

Figure 3.5. Trend of weekly beak length among the male progeny of three Naked Neck chicken varieties; *Significant at $P \leq 0.05$

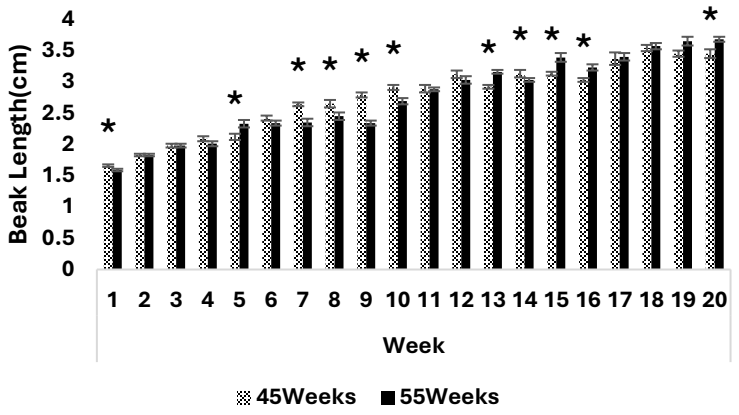

Figure 3.6. Weekly trend of beak length in male progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

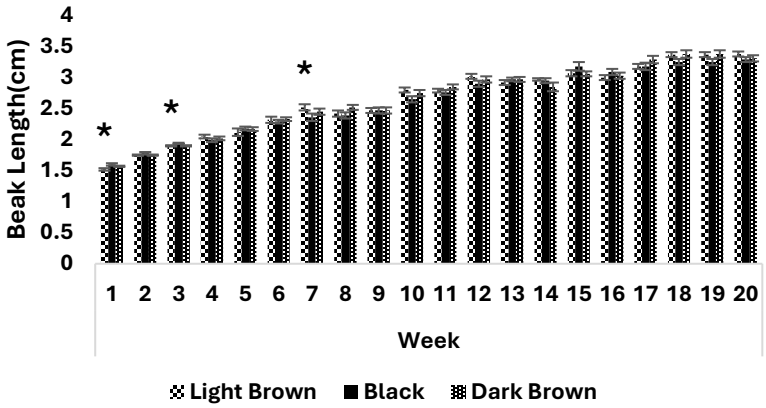

Figure 3.7. Trend of weekly beak length among the female progeny of three Naked Neck chicken varieties; *Significant at $P \leq 0.05$

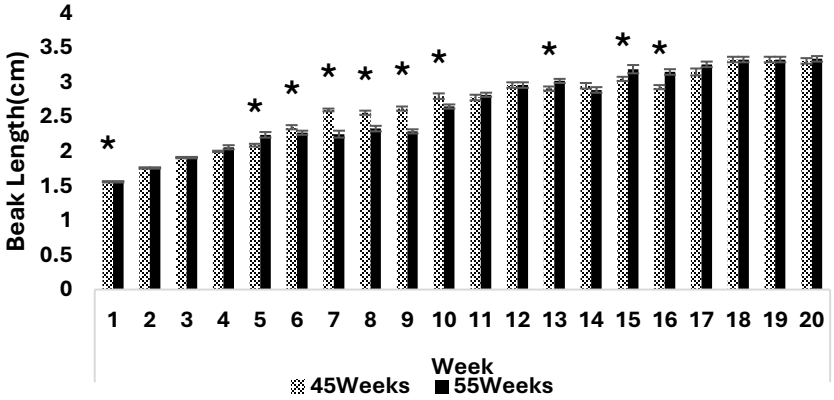

Figure 3.8. Weekly trend of beak length in female progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

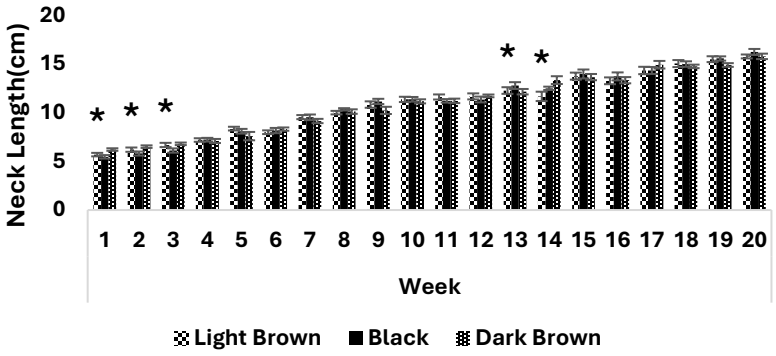

*Figure 3.9. Trend of weekly Neck length among the male progeny of three Naked Neck chicken varieties; *Significant at P ≤ 0.05*

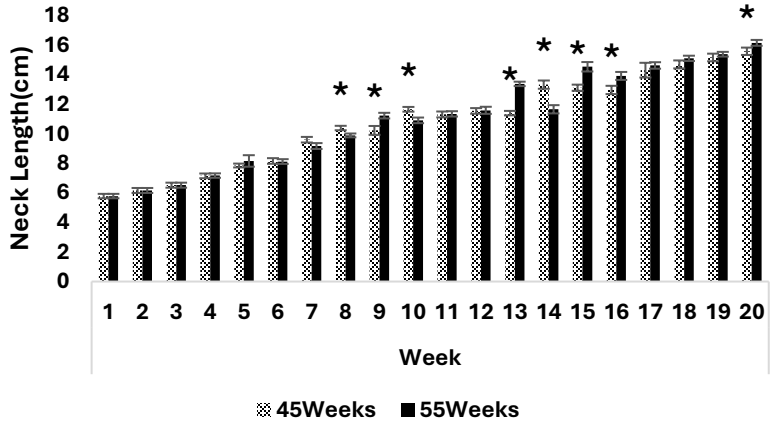

Figure 3.10. Weekly trend of Neck length in male progeny of Naked Neck chicken between two parental ages; *Significant at *P* ≤ 0.05

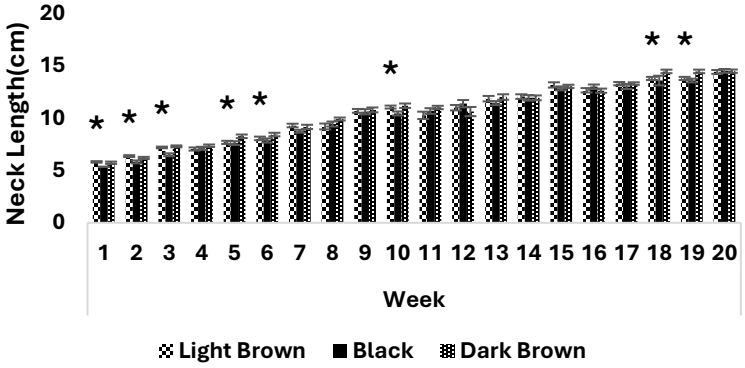

Figure 3.11. Trend of weekly Neck length among the female progeny of three Naked Neck chicken varieties; *Significant at *P* ≤ 0.05

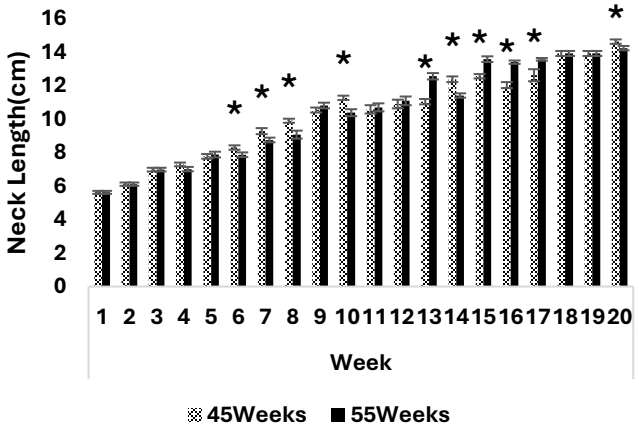

Figure 3.12. Weekly trend of Neck length in female progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

3.2 Keel Length, Shank Length, and Shank Circumference

Mean values of keel length, shank length, and shank circumference at 20 weeks of age are presented in **Table 3.2**, while weekly trends are illustrated in **Figures 3.13–3.24**.

Table 3.2. Effect of two Parental Ages on Progeny keel and shank length and shank circumference (20 weeks) among three varieties of Naked Neck chickens

Variety		Keel length (cm)		Shank length (cm)		Shank circumference (cm)	
		Male	Female	Male	Female	Male	Female
Light Brown		10.85±0.20	10.22±0.16	10.12±0.19	8.73±0.13	3.79±0.13	3.26±0.04
Black		11.72±0.33	10.42±0.14	10.73±0.30	8.54±0.17	3.92±0.13	3.29±0.04
Dark Brown		11.21±0.20	10.08±0.16	9.99±0.27	8.34±0.18	3.75 ±0.08	3.35±0.07
Parental age group							
45 weeks		11.03±0.14	10.20±0.14	9.74^{b}±0.12	8.55±0.13	3.46^{b}±0.04	3.20^{b}±0.04
55 weeks		11.47±0.24	10.30±0.11	10.67^{a}±0.23	8.52±0.15	4.08^{a}±0.05	3.41^{a}±0.05
Variety × Parental age group							
Light Brown	45 weeks	11.28^{ab}±0.25	10.25±0.28	9.60 ±0.24	8.63±0.20	3.40^{b}±0.10	3.20^{b}±0.04
	55 weeks	10.51^{b}±0.21	10.20± 0.20	10.54±0.02	8.83±0.18	4.11^{a}±0.04	3.32^{b}±0.06

Black	45 weeks	10.70 ^{b}±0.07	10.35±0.21	9.68±0.28	8.81±0.17	3.43^{b}±0.06	3.27^{b}±0.04
	55 weeks	12.31^{a}±0.35	10.50 ±0.19	11.34±0.22	8.27±0.28	4.21^{a}±0.06	3.31^{b}±0.08
Dark Brown	45 weeks	11.08^{b}±0.26	10.00±0.25	9.88±0.16	8.23±0.26	3.53^{b}±0.03	3.13^{b}±0.09
	55 weeks	11.31^{ab}±0.32	10.17±0.20	10.08±0.51	8.48±0.27	3.94^{a}±0.11	3.63^{a}±0.05
***P*-value**							
Variety		0.1828	0.3158	0.2413	0.2967	0.5459	0.1806
Parental age		0.1663	0.6184	0.0017	0.8784	<.0001	<.0001
Variety × Parental age		0.0037	0.8742	0.0844	0.1630	0.0364	0.0020

Keel length was not significantly affected by parental age or variety in either sex. However, a significant interaction between parental age and variety was observed in male progeny ($P \leq 0.05$), with maximum keel length recorded in male progeny from 55-week-old parents of black variety.

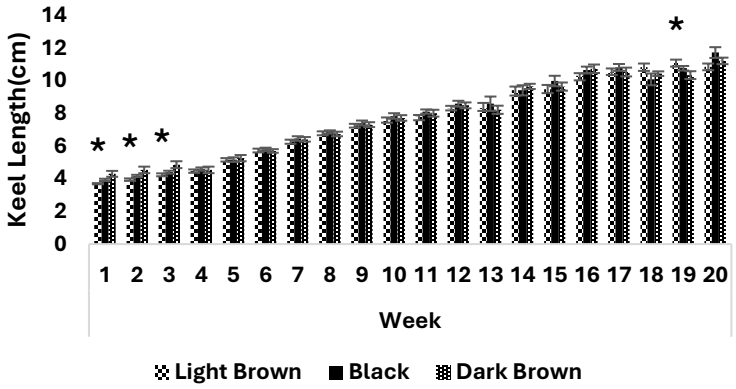

Figure 3.13. Trend of weekly Keel length among the male progeny of three Naked Neck chicken varieties; *Significant at P ≤ 0.05

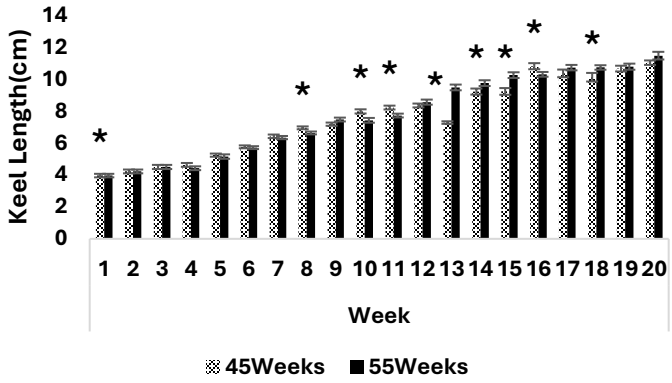

Figure 3.14. Weekly trend of Keel length in male progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

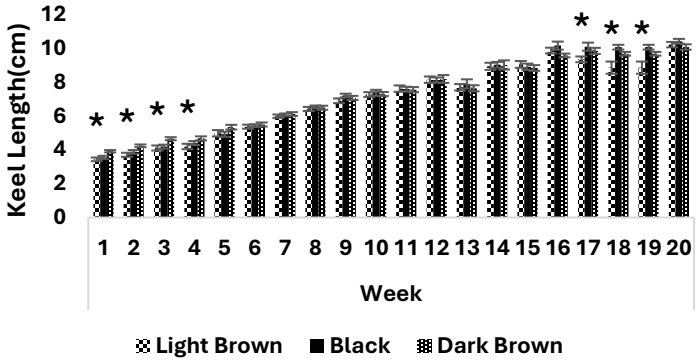

Figure 3.15. Trend of weekly Keel length among the female progeny of three Naked Neck chicken varieties; *Significant at $P \leq 0.05$

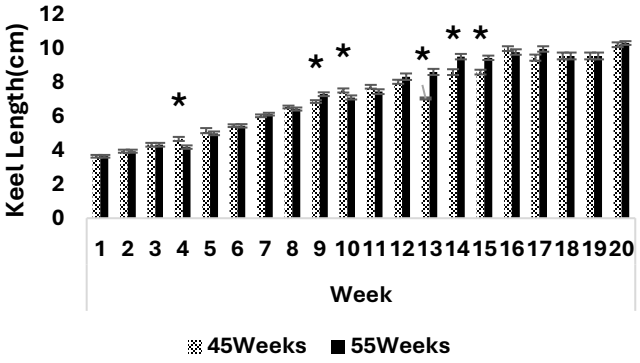

Figure 3.16. Weekly trend of Keel length in female progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

Shank length was significantly influenced by parental age in male progeny ($P \leq 0.05$). Male birds from 55-week-old parents exhibited longer shanks compared to those from 45-week-old parents. Shank length of female progeny was not significantly affected by parental age, variety, or their interaction.

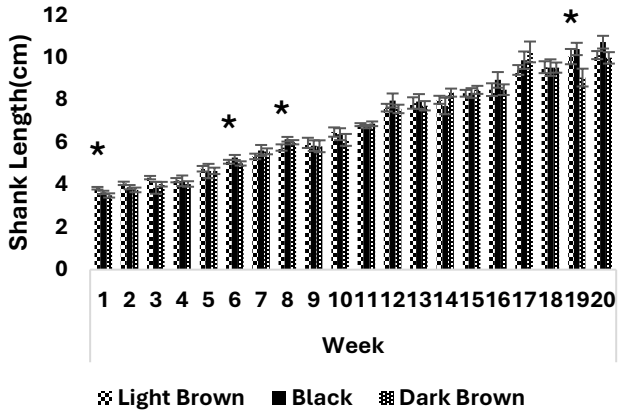

Figure 3.17. Trend of weekly Shank length among the male progeny of three Naked Neck chicken varieties; *Significant at $P \leq 0.05$

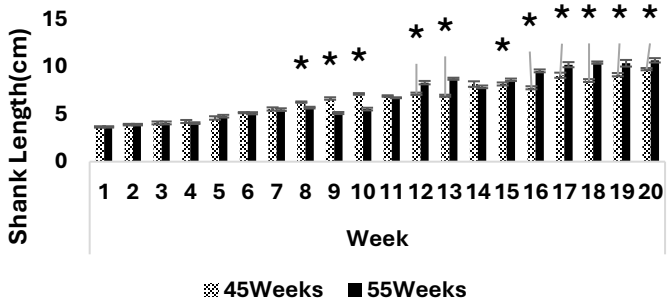

Figure 3.18. Weekly trend of Shank length in male progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

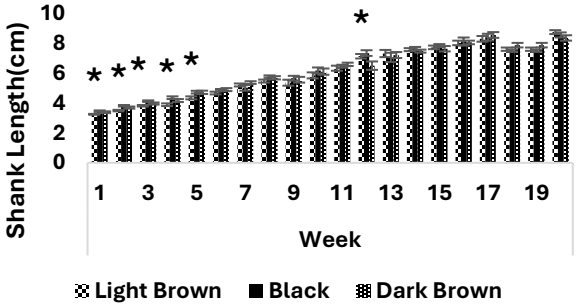

Figure 3.19. Trend of weekly Shank length among the female progeny of three Naked Neck chicken varieties; *Significant at $P \leq 0.05$

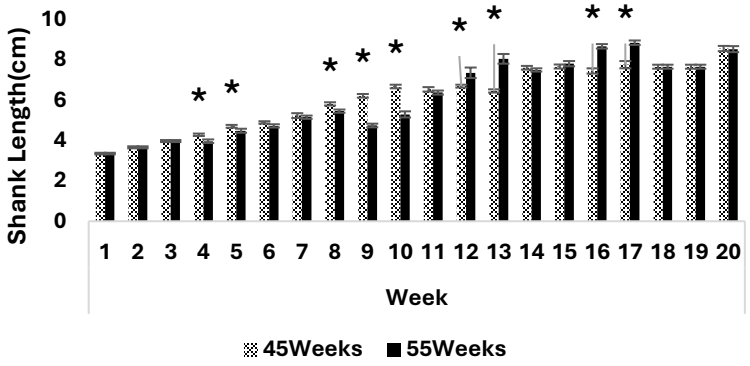

Figure 3.20. Weekly trend of Shank length in female progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

Shank circumference was significantly affected by parental age in both male and female progeny ($P \leq 0.05$). Progeny from 55-week-old parents exhibited greater shank circumference compared to progeny from younger parents. Interaction between parental age and variety was also significant, with maximum shank circumference observed in progeny of 55-week-old parents belonging to the black variety.

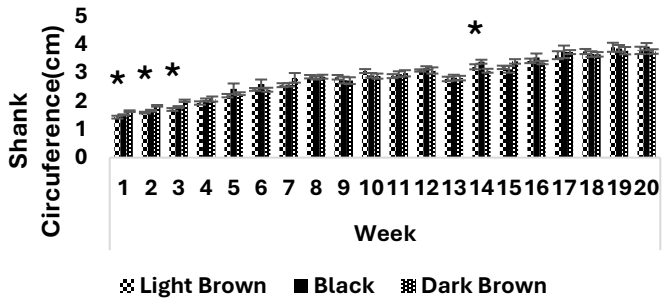

Figure 3.21. Trend of weekly Shank Circumference among the male progeny of three Naked Neck chicken varieties; *Significant at $P \leq 0.05$

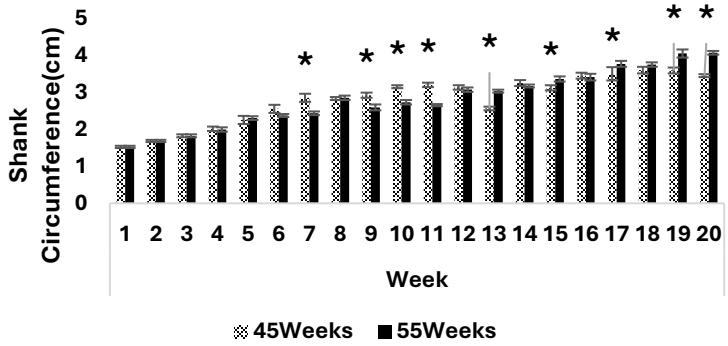

Figure 3.22. Weekly trend of Shank Circumference in male progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

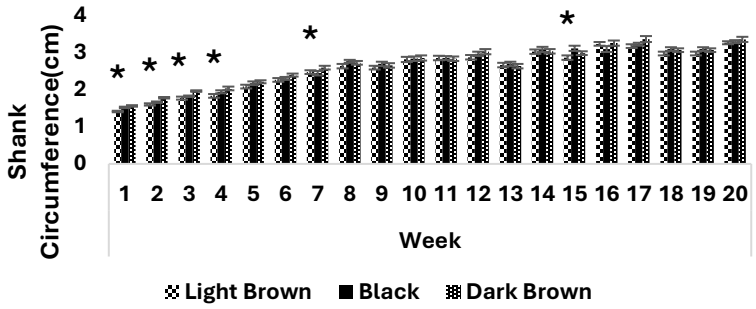

Figure 3.23. Trend of weekly body Shank Circumference among the female progeny of three Naked Neck chicken varieties; *Significant at $P \leq 0.05$

Variety		Drumstick length (cm)		Drumstick circumference (cm)		Wing spread (cm)	
		Male	Female	Male	Female	Male	Female
Light Brown		13.81±0.33	12.17±0.15	9.71±0.23	8.75±0.15	9.61±0.13	8.46±0.10
Black		14.26±0.44	11.99±0.19	10.40±0.34	9.06±0.13	9.92±0.22	8.8 ±0.11
Dark Brown		13.33±0.36	11.92±0.17	9.88±0.25	8.93±0.15	9.53±0.16	8.64±0.10
Parental age group							
45 weeks		12.69^{b}±0.12	12.01^{b}±0.13	9.19^{b}±0.14	8.73^{b}±0.08	9.29^{b}±0.09	8.62±0.08
55 weeks		14.56^{a}±0.27	12.05^{a}±0.16	10.61^{a}±0.15	9.11^{a}±0.14	9.97^{a}±0.13	8.67±0.10
Variety × Parental age group							
Light Brown	45 weeks	12.80±0.17	12.11±0.22	9.13±0.13	8.60±0.14	9.35^{b}±0.22	8.42±0.17
	55 weeks	14.62±0.11	12.23±0.22	10.17±0.23	8.89±0.26	9.82^{b}±0.08	8.50±0.12
Black	45 weeks	12.50±0.26	12.13±0.23	9.25±0.38	8.78±0.15	9.08^{b}±0.12	8.73±0.11
	55 weeks	15.27±0.17	11.84±0.31	11.06±0.23	9.34±0.19	10.40^{a}±0.11	8.91±0.20
Dark Brown	45 weeks	12.75±0.19	11.79±0.22	9.18±0.25	8.80±0.15	9.38^{b}±0.11	8.69±0.12
	55 weeks	13.82±0.61	12.09±0.29	10.47±0.23	9.09±0.28	9.66^{b}±0.27	8.50±0.17
***P*-value**							

Variety	0.2306	0.2732	0.1764	0.2732	0.4918	0.0638
Parental age	<.0001	0.0215	<.0001	0.0215	0.0001	0.7102
Variety × Parental age	0.0735	0.7155	0.3555	0.7155	0.0198	0.6021

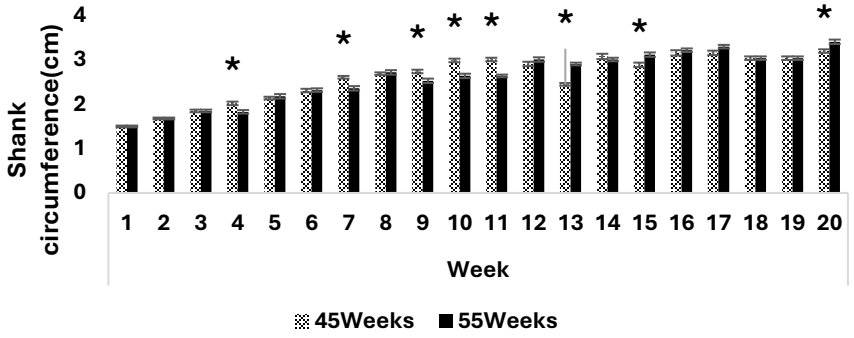

Figure 3.24. Weekly trend of Shank Circumference in female progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

3.3 Drumstick Length, Drumstick Circumference, and Wing Spread

Mean values of drumstick length, drumstick circumference, and wing spread at 20 weeks of age are presented in **Table 3.3**, while weekly trends are illustrated in **Figures 3.26–4.37**.

Table 3.3. Effect of two Parental Ages on Progeny drumstick length and circumference and wing spread (0-20 weeks) among three varieties of Naked Neck chickens

Drumstick length was significantly influenced by parental age in both male and female progeny ($P \leq 0.05$). Progeny derived from 55-week-old parents exhibited longer drumsticks compared to those from 45-week-old parents. Varietal differences and interaction effects for drumstick length were non-significant.

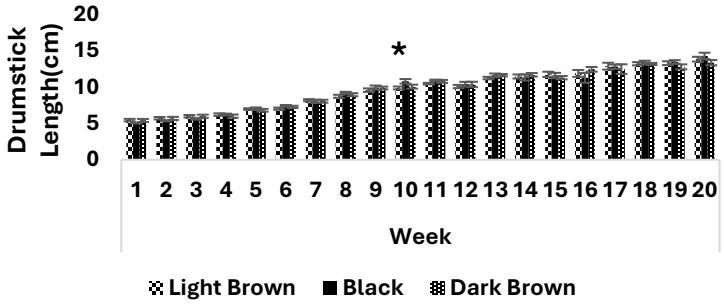

Figure 3.26. Trend of weekly Drumstick length among the male progeny of three Naked Neck chicken varieties; *Significant at $P \leq 0.05$

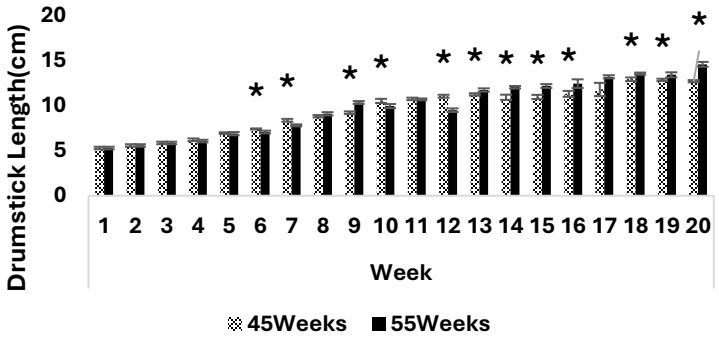

Figure 3.27. Weekly trend of Drumstick length in male progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

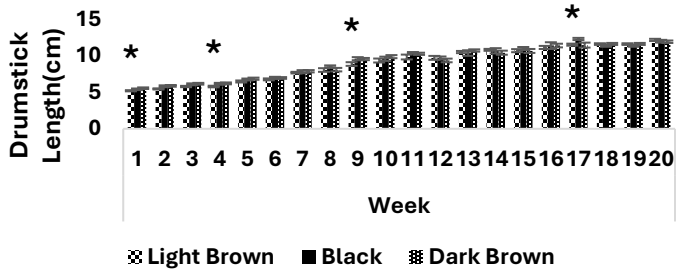

Figure 3.28. Trend of weekly Drumstick length among the female progeny of three Naked Neck chicken varieties; *Significant at $P \leq 0.05$

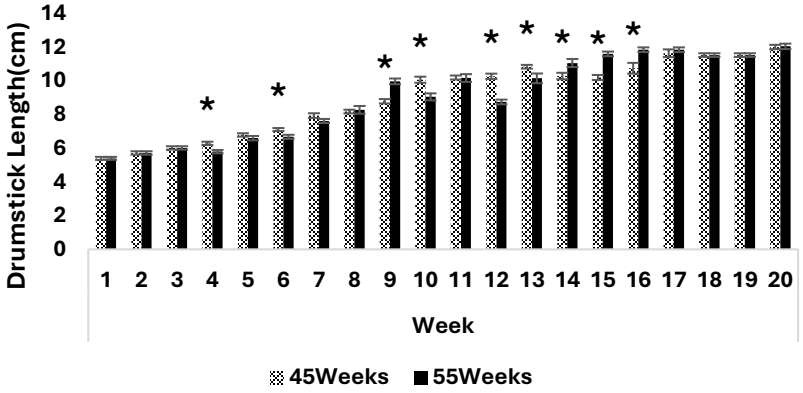

Figure 3.29. Weekly trend of Drumstick length in female progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

Similarly, drumstick circumference was significantly higher in progeny from older parents ($P \leq 0.05$), indicating improved muscular and skeletal development associated with increased parental age. No significant differences were observed among varieties.

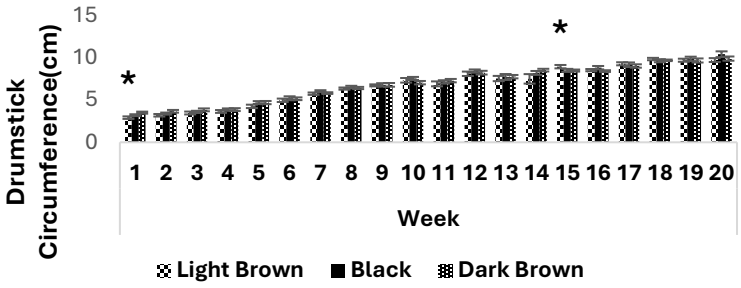

Figure 3.30. Trend of the week Drumstick Circumference among the male progeny of three Naked Neck chicken varieties; *Significant at $P \leq 0.05$

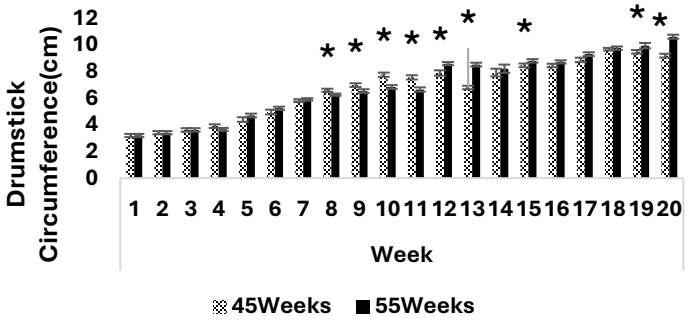

Figure 3.31. Weekly trend of Drumstick Circumference in male progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

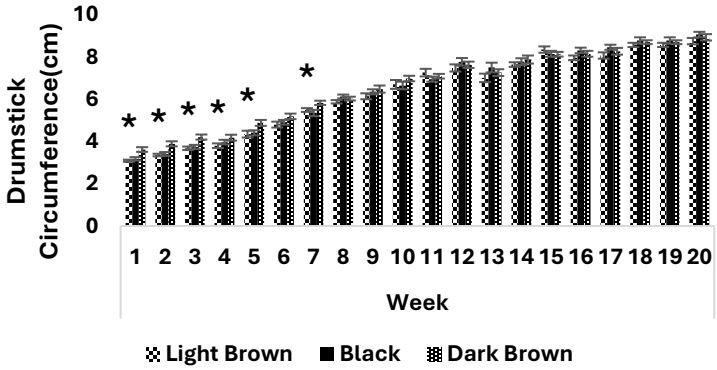

Figure 3.32. Trend of weekly Drumstick Circumference among the female progeny of three Naked Neck chicken varieties; *Significant at $P \leq 0.05$

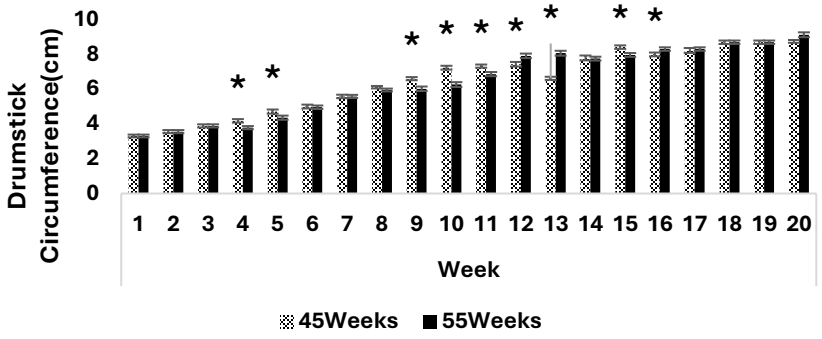

Figure3.33. Weekly trend of Drumstick Circumference in female progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

Wing spread was significantly affected by parental age in male progeny ($P \leq 0.05$), with greater wing spread observed in birds from 55-week-old parents. Interaction between parental age and variety was significant, with maximum wing spread recorded in male progeny from 55-week-old parents of black variety. Female progeny did not show significant differences in wing spread across parental age groups or varieties.

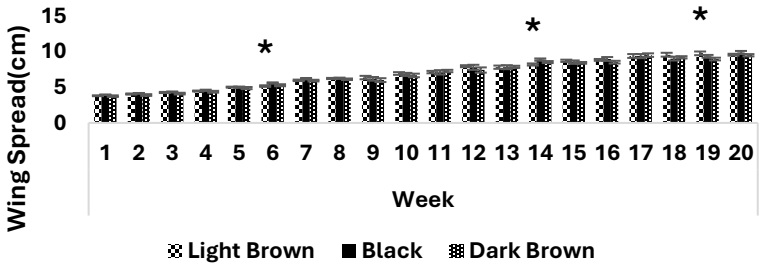

Figure 3.34. Trend of weekly Wing Spread among the male progeny of three Naked Neck chicken varieties; *Significant at $P \leq 0.05$

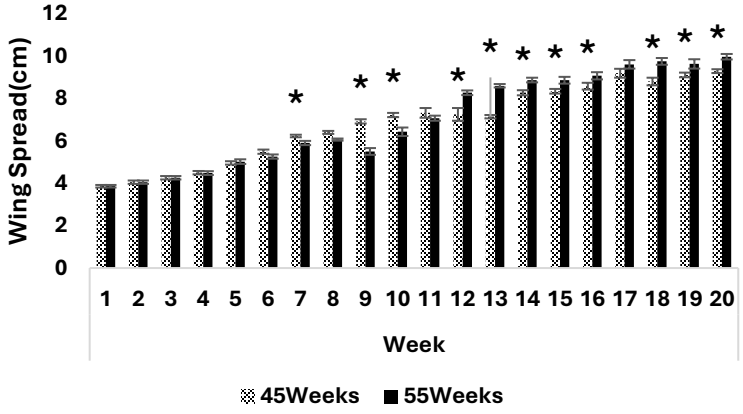

Figure 3.35. Weekly trend of Wing Spread in male progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

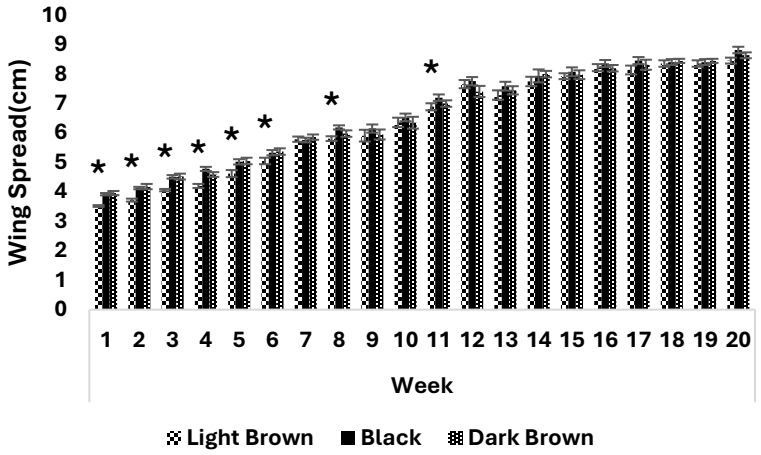

Figure 3.36. Trend of weekly Wing Spread among the female progeny of three Naked Neck chicken varieties; *Significant at $P \leq 0.05$

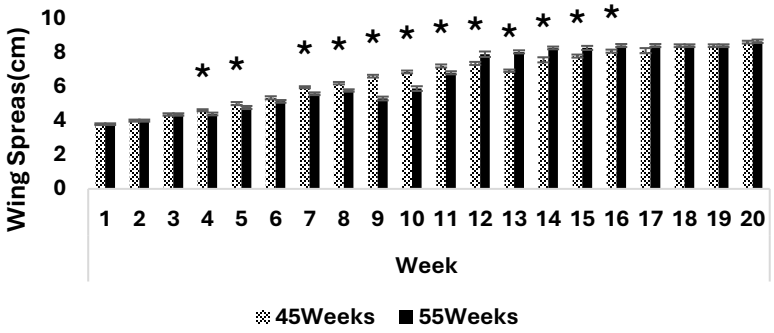

Figure 3.37. Weekly trend of Wing Spread in female progeny of Naked Neck chicken between two parental ages; *Significant at $P \leq 0.05$

4. Discussion

The current study determined that parental age was tremendously affected by some morphometric measures of Naked Neck chicken offspring [9]. Offspring of older parents (55 weeks) also had better linear body measurements than the offspring of younger parents (45 weeks). This demonstrates more skeletal development with an increase in breeder age [2]. These results demonstrate the role of parental age as a factor that affects structural development in native poultry. Greater morphometric features in offspring of older parents could be explained by better egg quality, such as higher egg size and more nutrient deposition, which could support better skeletal development of the embryo [10]. Better embryogenesis can lead to increased bone growth and muscular attachment, which translates into an increase in the linear body measures that include shank circumference, wing spread, and drumstick length, as was observed in the current experiment [8].

The differences in morphometric traits that are evident through the observation of varieties indicate that there is a genetic variation in the Naked Neck chicken varieties. Chickens with black naked necks had better body length and shank-related measurements, which showed a more skeletal structure. These genetic variations could affect the adaptability, physical strength, and general body structure of the birds in local production conditions [11, 12].

The high interaction effects of parental age and parental variety with respect to keel length, shank circumference, and wing spread all signal that the parental age effect on morphometric traits depends on the genotype. Children of black variety born to older parents always had better skeletal measures, indicating synergism between genetic background and parents' age [13].

The results of this research are also similar to the previous literature on poultry studies that show that breeder age influences skeletal development and body structure of offspring [14]. Nevertheless, the majority of previous research was done on commercial strains of poultry, and the current study can offer a new understanding on native Naked Neck chicken. The findings are useful in the optimization of breeding practices to enhance the structural growth and bodily structure of the native poultry [15].

In general, the experiment proves the hypothesis that the age of the parent has a significant role in determining morphometric characteristics of Naked Neck chicken offspring. The positive changes in the linear body measurements as parental age advances identify the necessity to take into consideration breeder age-related considerations in breeding and conservation programs of native poultry genetic resources.

5. Conclusion

The conclusion is that the age of parents is a very important factor affecting the morphometric characteristics of Naked Neck chicken offspring. Progeny of parents that had been 55 weeks of age showed better linear body measurements, such as body length, shank circumference, drumstick sizes, and wing spread, than progeny of younger parents. Also, morphological differences had a further influence on morphometric with black Naked Neck chickens usually having superior skeletal development compared to light brown and dark brown. There were also significant interaction effects between parental age and variety, which showed that the parental age effect on morphometric traits depends on the genotype. These investigations may propose that age optimization can result in better skeletal development and body structure of native Naked Neck chickens, thus helping to develop better breeding practices and sustainable exploitation of local poultry genetic resources.

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