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Sex-Specific Body Weight Prediction Accuracy in Improved and Exotic Chicken Strains In Nigeria

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ABSTRACT

This study evaluated the accuracy of body weight prediction in three chicken strains—Aco Black, Noiler, and ISA Brown—using regression models, with a focus on sex-specific and growth-stage-specific relationships. Methods: A total of 360 day-old chicks (comprising 60 males and 60 females per strain) were raised under uniform management conditions at the University of Abuja Research Farm. Weekly body weights were recorded from day-old to week 8. Regression analysis was employed to assess the predictive power of early and mid-growth body weights for subsequent growth stages. Results: Hatch weight was a poor predictor of subsequent growth across all strains and sexes ($R^2 < 0.20$), indicating that initial weight alone does not reliably reflect later performance. In contrast, body weights recorded during the mid-growth phase exhibited stronger predictive relationships. For Aco Black, week 4 body weight was a significant predictor of week 7 ($R^2 = 0.779$, $p < 0.001$) and week 8 ($R^2 = 0.518$, $p < 0.001$). In Noilers, week 5 body weight provided the highest prediction accuracy for week 8 ($R^2 = 0.867$, $p < 0.001$). Sex-specific analysis revealed notable differences; for example, in Aco Black males, week 5 significantly predicted week 6 ($R^2 = 0.674$, $p < 0.01$), while in females, week 1 predicted week 4 ($R^2 = 0.463$, $p < 0.05$). ISA Brown showed predictive relationships, although with generally weaker correlations than the dual-purpose strains. Conclusion: These findings demonstrate that growth-stage-specific and sex-specific prediction models are more effective than relying on hatch weight alone. The study underscores the importance of using intermediate growth measurements for accurate forecasting of final body weight, which is critical for selection, breeding decisions, and efficient management practices in poultry production

INTRODUCTION

Poultry production plays a crucial role in global food security, providing a significant source of animal protein through meat and eggs [1]. Chickens are the most widely reared poultry species due to their adaptability, rapid growth, and high reproductive efficiency. Within poultry production systems, genetic diversity among strains and the inherent biological differences between sexes contribute significantly to variations in productivity, growth patterns, and reproductive traits [2]. The phenomenon of sexual dimorphism—the physical and physiological differences between males and females of the same species—has been widely observed in poultry and is a key factor influencing productive performance across different chicken strains [3].

Sexual dimorphism in chickens is primarily manifested in differences in growth rates, body weight, feed efficiency, and reproductive traits [4]. This dimorphism necessitates different management strategies and selection criteria for males and females to optimize overall flock productivity. In commercial broiler production, males are often managed separately to capitalize on their superior growth potential, while in layer strains, such as the ISA Brown, females are the sole contributors to egg production, and their growth patterns are managed to optimize laying performance. Dual-purpose and indigenous strains, including Noiler and Aco Black, exhibit intermediate traits where both meat and egg production potentials vary between sexes [1]. Therefore, understanding the effect of sexual dimorphism on productive performance is essential for optimizing poultry production efficiency, particularly in diverse production systems.

Accurate prediction of body weight in poultry is vital for effective feed planning, selection of breeding stock, and strategic marketing decisions [5]. Farmers and breeders who can reliably forecast final body weight can make more informed decisions about culling, feed allocation, and market timing, thereby improving profitability and resource use efficiency. However, hatch weight often provides weak predictive value for later growth, particularly in dual-purpose and improved chicken strains [6]. The reasons for this are multifaceted, involving complex gene expression patterns, epigenetic effects, and environmental interactions that unfold during the growth period. Improved strains such as Noiler, Aco Black, and ISA Brown are increasingly adopted in Nigeria due to their enhanced productivity, but limited research has developed and validated sex-specific predictive models for these genotypes.

This study aimed to address this gap by assessing the predictive accuracy of weekly body weights in estimating later growth in three commercially important strains. The specific objectives were to: (i) determine the relationship between early (hatch, week 1) body weights and subsequent growth, (ii) evaluate the predictive power of mid-growth phase weights (weeks 3-6) for final weight (week 8), and (iii) develop sex-specific regression models for each strain. We hypothesized that mid-growth weights would provide significantly more accurate predictions of final body weight than hatch weight, and that these predictive relationships would differ between males and females due to sexual dimorphism.

LITERATURE REVIEW

Experimental Site

The research was conducted at the University of Abuja Research and Teaching Farm, located in Gwagwalada, Nigeria (Latitude 8°57'N, Longitude 7°04'E). The farm lies in a hot, humid tropical climate zone. The area experiences a distinct wet and dry season, with mean annual rainfall between 1,100 and 1,450 mm and ambient temperatures ranging from 21°C to 37°C.

Experimental Animals and Management

A total of 360 day-old unsexed chicks were used for this study, comprising 120 Aco Black, 120 Noiler, and 120 ISA Brown strains. The chicks were sourced from a reputable commercial hatchery in Ibadan, Nigeria. Upon arrival, all chicks were weighed, wing-banded for individual identification, and randomly allocated to experimental pens based on a Completely Randomized Design (CRD). Each strain was divided into two sex groups (male and female) after sexing at week 3, with 60 birds per strain per sex. Each sex-strain group was replicated three times with 20 birds per replicate.

Birds were raised on a deep litter system in a well-ventilated poultry house. Standard husbandry practices were followed throughout the 8-week experimental period. Feed and clean water were provided ad libitum. Commercial diets were provided as recommended for poultry birds [13] ad libitum. A standard vaccination and medication program was strictly followed to prevent common poultry diseases, including Newcastle disease, Infectious Bursal Disease (Gumboro), and coccidiosis.

METHODOLOGY

Data Collection

Weekly body weight was measured for each bird from week 0 (day-old) to week 8. Weighing was done on the same day each week, before feeding, using a sensitive electronic digital scale (Model: SF-400, capacity 5 kg, accuracy ± 0.1 g for lighter birds and ± 1 g for heavier birds). Individual body weights were recorded in grams.

Statistical Analysis

Data were analyzed using SPSS software (version 25). Simple linear regression analysis was used to evaluate the predictive relationship between early (independent variable) and later (dependent variable) body weights. The regression model used was: $Y = a + bX$, where Y is the dependent variable (later body weight), X is the independent variable (earlier body weight), a is the intercept, and b is the regression coefficient. The coefficient of determination (R^2) was used to assess the proportion of variance in the dependent variable explained by the independent variable, thus indicating the reliability of the prediction models. The significance of the regression coefficients was tested using an F-test, with statistical significance set at $p < 0.05$. Analysis was performed for the entire population of each strain and then separately for males and females within each strain.

RESULTS

The study revealed distinct differences in the accuracy of body weight prediction across the three chicken strains and between sexes. Early-life weights, particularly hatch weight, showed weak associations with later growth, while mid-growth measurements provided stronger and more significant predictive models.

3.1. Body Weight Prediction in Aco Black Strain

For the combined Aco Black population (Table 1), hatch weight (week 0) was a poor predictor of weight at any subsequent week, with all R^2 values below 0.21 and most non-significant ($p > 0.05$). Predictive power began to increase from week 3 onwards. Week 3 body weight significantly predicted week 4 ($R^2 = 0.590$, $p < 0.001$), week 7 ($R^2 = 0.559$, $p < 0.001$), and week 8 ($R^2 = 0.391$, $p < 0.01$). The strongest predictive models were observed when using week 4 as the independent variable. Week 4 weight was a highly significant predictor of week 6 ($R^2 = 0.253$, $p < 0.05$), week 7 ($R^2 = 0.779$, $p < 0.001$), and week 8 ($R^2 = 0.518$, $p < 0.001$).

Table 1. Body Weight Prediction Accuracy of Aco Black

Weeks (Independent)	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
0	1	$Y= 1.786X - 2.786$	0.206	0.827	0.045
0	2	$Y= 0.092X + 156.143$	0.000	1.884	0.961
0	3	$Y= 3.791X + 30.738$	0.045	4.112	0.369
0	4	$Y= 3.972X + 164.008$	0.041	4.516	0.391
0	5	$Y = -1.394X + 616.825$	0.002	7.794	0.860
0	6	$Y = -3.882X + 830.0$	0.022	6.123	0.534
0	7	$Y = 9.207X + 300.754$	0.129	5.651	0.121
0	8	$Y = 6.458X + 517.944$	0.031	8.546	0.460

Weeks (Independent)	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
1	2	$Y = -0.301X + 186.326$	0.022	0.473	0.533
1	3	$Y = 1.606X + 80.738$	0.125	0.999	0.125
1	4	$Y = 0.467X + 320.026$	0.009	1.166	0.693
1	5	$Y = 0.865X + 474.328$	0.011	1.970	0.666
1	6	$Y = -1.655X + 779.650$	0.062	1.523	0.292
1	7	$Y = 1.590X + 619.124$	0.059	1.491	0.300
1	8	$Y = 3.917X + 502.345$	0.175	2.002	0.066
2	3	$Y = -0.230X + 254.609$	0.011	0.524	0.666
2	4	$Y = 0.685X + 249.739$	0.078	0.554	0.232
2	5	$Y = -0.077X + 560.549$	0.000	0.976	0.938
2	6	$Y = 0.215X + 604.019$	0.004	0.773	0.784
2	7	$Y = 0.519X + 671.203$	0.26	0.747	0.496
2	8	$Y = 0.829X + 703.088$	0.032	1.068	0.448
3	**4**	**$Y = 0.842X + 176.693$**	**0.590**	**0.166**	**<0.001****

Weeks (Independent)	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
3	5	Y = -0.133X + 576.972	0.005	0.436	0.764
3	6	Y = 0.494X + 530.983	0.113	0.327	0.147
3	7	**Y = 1.075X + 520.681**	**0.559**	0.225	**<0.001****
3	8	**Y = 1.289X + 555.697**	**0.391**	0.379	**0.003****
4	5	Y = -0.272X + 645.889	0.026	0.393	0.499
4	6	**Y = 0.675X + 395.640**	**0.253**	0.273	**0.024***
4	7	**Y = 1.159X + 337.745**	**0.779**	0.145	**<0.001****
4	8	**Y = 1.355X + 348.739**	**0.518**	0.308	**<0.001****
5	6	Y = 0.047X + 613.057	0.003	0.187	0.806
5	7	Y = -0.056X + 785.256	0.005	0.182	0.763
5	8	Y = -0.231X + 962.955	0.043	0.257	0.380
6	7	Y = 0.330X + 544.180	0.114	0.217	0.146
6	8	Y = 0.352X + 611.215	0.063	0.320	0.285

***Significant regression ($p<0.05$); **Significant regression ($p<0.01$)

Sex-specific analysis for Aco Black revealed differing patterns. In males (Table 2), a significant negative predictive relationship was observed between week 5 and week 6 ($R^2 = 0.674$, $p < 0.01$), and between week 4 and week 7 ($R^2 = 0.422$, $p < 0.05$). In females (Table 3), week 1 was a significant predictor of week 4 ($R^2 = 0.463$, $p < 0.05$), and week 2 was a significant predictor of week 3 ($R^2 = 0.488$, $p < 0.05$).

Table 2. Body Weight Prediction Accuracy of Aco Black Male

Weeks (Independent)	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
0	1	Y = 2.749X + 49.146	0.404	1.181	0.048
0	2	Y = -1.590X + 242.539	0.066	2.110	0.473
0	3	Y = 0.815X +229.189	0.009	3.025	0.795
0	4	Y = 0.822X + 459.199	0.016	2.257	0.725
0	5	Y = 5.555X + 251.571	0.338	2.750	0.078
0	6	Y = -10.256X + 1190.826	0.417	4.291	0.044
0	7	Y = 3.888X + 636.136	0.112	3.861	0.343
0	8	Y = 2.327X + 807.398	0.007	9.618	0.815
1	2	Y = -0.125X + 173.969	0.008	0.503	0.810
1	3	Y = 0.552X + 221.116	0.077	0.675	0.437
1	4	Y = -0.269X + 441.872	0.033	0.517	0.617
1	5	Y = 1.303X + 414.482	0.348	0.631	0.073

Weeks (Independent)	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
1	6	$Y = -1.552X + 814.469$	0.178	1.177	0.224
1	7	$Y = -0.376X + 864.226$	0.020	0.938	0.699
1	8	$Y = 3.215X + 639.109$	0.260	1.920	0.133
2	3	$Y = -0.277X + 315.157$	0.040	0.482	0.581
2	4	$Y = 0.277X + 372.876$	0.071	0.355	0.458
2	5	$Y = 0.194X + 498.297$	0.016	0.543	0.730
2	6	$Y = 0.129X + 655.929$	0.003	0.908	0.890
2	7	$Y = 0.475X+ 753.543$	0.064	0.642	0.481
2	8	$Y = 0.321X + 871.786$	0.005	1.559	0.842
3	4	$Y = -0.027X + 425.286$	0.001	0.265	0.921
3	5	$Y = 0.561X + 378.457$	0.254	0.339	0.137
3	6	$Y = -0.430X + 793.119$	0.054	0.636	0.518
3	7	$Y = -0.465X + 956.431$	0.119	0.448	0.329
3	8	$Y = 0.140X + 886.267$	0.002	1.122	0.904

Weeks (Independent)	*Dependent*	*Regression Equation*	*R²*	*SE*	*Sig.*
4	5	Y = -0.321X + 664.274	0.047	0.513	0.548
4	6	Y = 0.367X + 523.519	0.022	0.863	0.682
4	7	**Y = 1.170X + 342.033**	**0.422**	0.484	**0.042***
4	8	Y = 0.467X + 728.939	0.012	1.491	0.762
5	6	**Y = -1.365X+ 1400.145**	**0.674**	0.336	**0.004****
5	7	Y = -0.021X + 841.840	0.000	0.429	0.963
5	8	Y = 1.082X + 350.398	0.144	0.935	0.280
6	7	Y = -0.019X + 843.486	0.001	0.258	0.944
6	8	Y = -0.927X + 1551.490	0.291	0.512	0.108

***Significant regression ($p<0.05$); **Significant regression ($p<0.01$)

Table 3. Body Weight Prediction Accuracy of Aco Black Female

Weeks (Independent)	***Dependent***	***Regression Equation***	***R²***	***SE***	***Sig.***
0	1	Y = -0.352X + 98.959	0.013	1.080	0.753
0	2	Y = 2.614X + 31.731	0.057	3.755	0.506

Weeks (Independent)	***Dependent***	***Regression Equation***	R^2	***SE***	***Sig.***
0	3	Y = -1.800X + 252.600	0.059	2.531	0.497
0	4	Y = 0.366X + 283.972	0.001	3.950	0.929
0	5	Y = -9.979X + 1050.297	0.033	18.983	0.613
0	6	Y = -1.710X + 683.152	0.002	12.144	0.891
0	7	Y = 3.462X + 510.490	0.113	3.424	0.342
0	8	Y = -4.414X + 962.669	0.035	8.220	0.606
1	2	Y = -1.233X + 259.485	0.120	1.180	0.327
1	3	Y = 0.725X + 105.953	0.091	0.809	0.397
1	4	**Y = -2.474X + 504.304**	**0.463**	0.943	**0.030***
1	5	Y = 1.389X + 452.544	0.006	6.263	0.830
1	6	Y = -6.316X + 1117.477	0.319	3.265	0.089
1	7	Y = 1.576X + 549.326	0.222	1.044	0.170
1	8	Y = -0.906X + 822.787	0.014	2.703	0.746
2	3	**Y = -0.471X + 240.005**	**0.488**	0.171	**0.025***

Weeks (Independent)	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
2	4	Y = 0.629X + 201.963	0.379	0.285	0.058
2	5	Y = -0.140X + 588.473	0.001	1.765	0.939
2	6	Y = 0.071X + 588.871	0.001	1.111	0.950
2	7	Y = 0.163X + 652.490	0.030	0.327	0.631
2	8	Y = 0.682X + 640.576	0.099	0.726	0.375
3	4	Y = -0.801X + 434.066	0.280	0.454	0.116
3	5	Y = 1.178X + 371.498	0.025	2.582	0.660
3	6	Y = -0.594X + 698.356	0.016	1.634	0.726
3	7	Y = -0.507X + 762.144	0.132	0.459	0.302
3	8	Y = -1.296X + 962.765	0.163	1.037	0.247
4	5	Y = 0.065X + 546.590	0.000	1.727	0.971
4	6	Y = 0.967X + 308.407	0.099	1.033	0.376
4	7	Y = 0.012X + 674.730	0.000	0.325	0.971
4	8	Y = 0.734X + 527.096	0.120	0.702	0.326

Weeks (Independent)	*Dependent*	*Regression Equation*	*R²*	*SE*	*Sig.*
5	6	Y = 0.190X + 492.874	0.091	0.212	0.398
5	7	Y = 0.069X + 639.389	0.134	0.062	0.299
5	8	Y = -0.162X + 840.373	0.140	0.142	0.287
6	7	Y = -0.108X + 743.138	0.130	0.099	0.306
6	8	Y = 0.174X + 644.314	0.064	0.235	0.482

*Significant regression ($p<0.05$)

Body Weight Prediction in Noiler Strain

In the Noiler strain (Table 4), hatch weight was also a poor predictor. The predictive power became evident from week 3 onwards. Week 3 body weight significantly predicted week 5 ($R^2 = 0.292$, $p < 0.05$). Week 4 body weight was a significant predictor of week 6 ($R^2 = 0.319$, $p < 0.05$). The most robust predictions were observed from week 5. Week 5 weight was a highly significant predictor of week 7 ($R^2 = 0.482$, $p < 0.01$) and, most notably, of week 8 ($R^2 = 0.867$, $p < 0.001$), explaining nearly 87% of the variance in final weight.

Table 4. Body Weight Prediction Accuracy of Noiler

Weeks (Independent)	*Dependent*	*Regression Equation*	*R²*	*SE*	*Sig.*
0	1	Y = 0.048X + 105.383	0.000	0.772	0.951
0	2	Y = 0.674X + 178.616	0.009	1.837	0.719
0	3	Y = 3.307X + 188.963	0.060	3.370	0.342
0	4	Y = 3.644X + 296.271	0.046	4.264	0.406

Weeks (Independent)	*Dependent*	*Regression Equation*	*R²*	*SE*	*Sig.*
0	5	Y = 18.497X - 345.166	0.225	8.875	0.055
0	6	Y = 0.637X + 861.404	0.001	4.947	0.899
0	7	Y = 7.575X + 609.439	0.206	3.845	0.068
0	8	Y = 7.170X + 726.545	0.134	4.697	0.148
1	2	Y = 1.074X + 96.211	0.202	0.551	0.070
1	3	Y = 0.251X + 325.667	0.003	1.160	0.831
1	4	Y = -0.532X + 534.093	0.009	1.453	0.719
1	5	Y = -0.005X + 571.507	0.000	3.369	0.999
1	6	Y = 0.604X + 827.800	0.009	1.647	0.719
1	7	Y = 0.520X + 928.642	0.009	1.436	0.722
1	8	Y = 0.820X + 993.287	0.016	1.675	0.631
2	3	Y =0.403X + 267.243	0.046	0.475	0.409
2	4	Y = 0.151X + 444.684	0.004	0.610	0.807
2	5	Y = -1.529X + 895.235	0.078	1.354	0.276

Weeks (Independent)	***Dependent***	***Regression Equation***	***R^2***	***SE***	***Sig.***
2	6	Y = 0.366X + 815.403	0.19	0.686	0.602
2	7	Y = -0.663X + 1125.217	0.080	0.579	0.270
2	8	Y = -0.706X + 1231.243	0.066	0.683	0.318
3	4	Y = 0.231X + 395.197	0.034	0.319	0.479
3	5	**Y = 1.566X + 18.554**	**0.292**	0.630	**0.025***
3	6	Y = 0.288X +791.434	0.041	0.360	0.437
3	7	Y = 0.348X + 861.856	0.079	0.308	0.275
3	8	Y = 0.604X + 868.607	0.173	0.341	0.097
4	5	Y = 1.054X + 68.414	0.209	0.530	0.065
4	6	**Y = 0.640X + 587.574**	**0.319**	0.242	**0.018***
4	7	Y = 0.121X + 927.097	0.015	0.253	0.640
4	8	Y = 0.520X + 833.822	0.202	0.267	0.070
5	6	Y = 0.098X + 836.799	0.040	0.124	0.441
5	7	**Y = 0.297X + 814.882**	**0.482**	0.080	**0.002****

Weeks (Independent)	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
5	8	**Y = 0.466X + 815.299**	**0.867**	0.047	**<0.001****
6	7	Y = 0.058X + 932.945	0.004	0.225	0.800
6	8	Y = 0.373X + 748.217	0.134	0.245	0.148

***Significant regression ($p<0.05$); **Significant regression ($p<0.01$)

Sex-specific analysis for Noiler revealed that many significant relationships were driven by one sex. In males (Table 5), week 1 was a strong predictor of week 2 ($R^2 = 0.642$, $p < 0.05$). In females (Table 6), a significant negative predictive relationship was found between week 5 and week 6 ($R^2 = 0.484$, $p < 0.05$).

Table 5. Body Weight Prediction Accuracy of Noiler Male

Weeks (Independent)	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
0	1	Y = 2.387X - 16.844	0.132	2.736	0.423
0	2	Y = 5.199X - 76.084	0.111	6.590	0.466
0	3	Y = -0.945X + 448.962	0.003	7.945	0.910
0	4	Y = -1.081X + 583.266	0.007	5.973	0.864
0	5	Y = -17.702X + 1746.165	0.238	14.183	0.267
0	6	Y = -5.870X + 1248.858	0.177	5.661	0.347
0	7	Y = 4.486X + 833.405	0.057	8.148	0.606

Weeks (Independent)	***Dependent***	***Regression Equation***	***R^2***	***SE***	***Sig.***
0	8	Y = -13.156X + 1895.370	0.321	8.566	0.185
1	2	**Y = 1.906X - 9.724**	**0.642**	0.637	**0.030***
1	3	Y = -0.394X + 442.037	0.021	1.199	0.756
1	4	Y = 1.059X + 410.844	0.269	0.780	0.233
1	5	Y = 0.185X + 792.805	0.001	2.472	0.943
1	6	Y = 0.408X + 894.949	0.037	0.932	0.680
1	7	Y = -0.922X + 1170.370	0.104	1.209	0.480
1	8	Y = 1.167X + 1074.656	0.109	1.492	0.470
2	3	Y = 0.298X + 340.176	0.068	0.491	0.571
2	4	Y = 0.189X + 488.927	0.048	0.374	0.635
2	5	Y = 0.371X + 739.497	0.026	1.026	0.732
2	6	Y = 0.052X + 929.207	0.003	0.399	0.902
2	7	Y = -0.613X + 1191.236	0.261	0.462	0.242
2	8	Y = 0.265X + 1149.322	0.032	0.654	0.702

Weeks (Independent)	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
3	4	Y = 0.169X + 458.752	0.050	0.328	0.628
3	5	Y = 0.943X + 436.486	0.213	0.810	0.297
3	6	Y = -0.453X + 1120.322	0.334	0.286	0.174
3	7	Y = -0.608X + 1312.383	0.332	0.386	0.176
3	8	Y = -0.446X + 1379.725	0.117	0.549	0.454
4	5	Y = 1.616X - 37.733	0.356	0.973	0.158
4	6	Y = -0.268X + 1080.369	0.066	0.450	0.578
4	7	Y = -0.512X + 1339.523	0.134	0.583	0.420
4	8	Y = 0.670X + 849.261	0.149	0.715	0.392
5	6	Y = -0.080X + 1004.564	0.043	0.168	0.654
5	7	Y = -0.163X + 1202.223	0.099	0.219	0.491
5	8	Y = 0.383X + 890.268	0.359	0.229	0.155
6	7	Y = 0.274X + 812.597	0.041	0.589	0.661
6	8	Y = 0.789X + 461.007	0.225	0.655	0.283

*Significant regression ($p<0.05$)

Table 6. Body Weight Prediction Accuracy of Noiler Female

Weeks (Independent)	***Dependent***	***Regression Equation***	***R^2***	***SE***	***Sig.***
0	1	Y = -0.397X + 125.667	0.022	0.936	0.683
0	2	Y = 1.777X + 137.759	0.091	1.989	0.398
0	3	Y = 0.046X + 318.137	0.000	4.356	0.992
0	4	Y = 0.226X + 431.393	0.000	6.285	0.972
0	5	Y = 3.872X + 218.472	0.157	3.166	0.256
0	6	Y = -3.235X + 1013.437	0.024	7.368	0.672
0	7	Y = 1.434X + 857.160	0.017	3.828	0.718
0	8	Y = -0.459X + 1019.195	0.069	0.597	0.464
1	2	Y = 0.461X + 172.488	0.044	0.762	0.562
1	3	Y = 0.528X + 263.848	0.013	1.617	0.752
1	4	Y = -2.169X + 673.955	0.107	2.220	0.357
1	5	Y = -1.575X + 570.003	0.187	1.162	0.212
1	6	Y = 0.504X + 806.528	0.004	2.780	0.861

Weeks (Independent)	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
1	7	Y = 1.245X + 791.868	0.093	1.374	0.391
1	8	Y = -0.168X + 1015.444	0.066	0.223	0.474
2	3	Y = 1.214X + 50.929	0.338	0.601	0.078
2	4	Y = 0.816X + 261.021	0.073	1.026	0.449
2	5	Y = -0.403X + 490.877	0.059	0.567	0.498
2	6	Y = 1.376X + 555.107	0.148	1.166	0.272
2	7	Y= 0.320X + 854.104	0.030	0.645	0.633
2	8	Y = -0.162X + 1033.436	0.298	0.088	0.102
3	4	Y = -0.151X + 490.551	0.011	0.507	0.773
3	5	Y = -0.001X + 401.827	0.000	0.280	0.998
3	6	Y = 0.162X + 808.392	0.009	0.603	0.794
3	7	Y = -0.085X + 952.359	0.009	0.312	0.791
3	8	Y = -0.041X + 1010.640	0.083	0.048	0.418
4	5	Y = 0.004X + 399.668	0.000	0.194	0.983

Weeks (Independent)	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
4	6	$Y = 0.635X + 579.785$	0.286	0.354	0.111
4	7	$Y = -0.248X + 1034.785$	0.163	0.199	0.247
4	8	$Y = 0.008X + 994.126$	0.006	0.035	0.831
5	6	**$Y = -1.504X + 1464.487$**	**0.484**	0.549	**0.025***
5	7	$Y = 0.053X + 903.674$	0.002	0.395	0.896
5	8	$Y = -0.001X + 997.967$	0.000	0.063	0.986
6	7	$Y = -0.247X + 1137.377$	0.227	0.161	0.164
6	8	$Y = -0.015X + 1010.745$	0.034	0.029	0.608

*Significant regression ($p<0.05$)

Body Weight Prediction in ISA Brown Strain

For the ISA Brown strain (Table 7), hatch weight showed some weak predictive power for week 5 ($R^2 = 0.266$, $p < 0.05$) and week 7 ($R^2 = 0.271$, $p < 0.05$), but was not a reliable predictor overall. The mid-growth phase from week 3 onwards provided more consistent predictive relationships. Week 3 weight significantly predicted all subsequent weeks from week 4 to week 8, with R^2 values ranging from 0.222 to 0.437 ($p < 0.05$ to $p < 0.01$). Week 4 was a strong predictor of week 8 ($R^2 = 0.529$, $p < 0.001$). The strongest predictions for final weight came from week 5, which significantly predicted week 6 ($R^2 = 0.376$, $p < 0.01$), week 7 ($R^2 = 0.428$, $p < 0.01$), and week 8 ($R^2 = 0.576$, $p < 0.001$).

Table 7. Body Weight Prediction Accuracy of Isa Brown

Weeks	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
0	1	$Y = 0.120X + 69.324$	0.006	0.369	0.748

Weeks	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
0	2	Y = 0.607X + 113.975	0.071	0.517	0.256
0	3	Y = 1.550X + 148.133	0.069	1.346	0.265
0	4	Y =3.508X + 175.552	0.134	2.098	0.112
0	5	**Y = 7.146X + 130.157**	**0.266**	2.798	**0.020***
0	6	Y = 7.069X + 307.458	0.108	4.795	0.158
0	7	**Y = 7.717X + 354.170**	**0.271**	2.984	**0.019***
0	8	Y = 14.034X + 232.118	0.193	6.756	0.052
1	2	Y = -0.023X + 141.015	0.000	0.342	0.947
1	3	Y = 0.582X + 169.596	0.024	0.879	0.516
1	4	Y = -1.459X + 430.450	0.057	1.396	0.310
1	5	Y = 1.216X + 338.057	0.019	2.062	0.563
1	6	Y =3.728X + 325.394	0.074	3.115	0.247
1	7	Y = 2.275X + 507.208	0.058	2.162	0.307
1	8	Y = 2.945X + 599.065	0.021	4.746	0.543
2	3	Y = 0.573X + 133.069	0.048	0.599	0.351
2	4	Y = -0.281X + 361.133	0.004	0.990	0.780
2	5	Y = 1.931X + 159.567	0.100	1.362	0.173
2	6	Y = -3.254X + 1055.937	0.118	2.096	0.138
2	7	Y = 0.681X + 581.495	0.011	1.528	0.661
2	8	Y = 0.115X + 801.984	0.000	3.308	0.973
3	4	**Y = 0.761X + 159.983**	**0.222**	0.336	**0.036***

Weeks	*Dependent*	*Regression Equation*	*R²*	*SE*	*Sig.*
3	5	**Y = 1.437X + 122.598**	**0.377**	0.435	**0.004****
3	6	**Y = 2.406X + 90.520**	**0.437**	0.643	**0.002****
3	7	**Y = 1.238X + 412.929**	**0.244**	0.513	**0.027***
3	8	**Y = 3.215X + 133.750**	**0.356**	1.020	**0.006****
4	5	**Y = 0.789X + 174.461**	**0.297**	0.286	**0.013***
4	6	**Y = 1.319X + 178.025**	**0.343**	0.430	**0.007****
4	7	**Y = 0.838X + 406.636**	**0.292**	0.307	**0.014***
4	8	**Y = 2.426X + 36.937**	**0.529**	0.540	**<0.001****
5	6	**Y = 0.953X + 194.212**	**0.376**	0.289	**0.004****
5	7	**Y = 0.700X + 376.506**	**0.428**	0.191	**0.002****
5	8	**Y = 1.748X + 69.155**	**0.576**	0.354	**<0.001****
6	7	**Y = 0.347X + 467.521**	**0.253**	0.140	**0.024***
6	8	**Y = 0.998X + 216.563**	**0.454**	0.258	**0.001****

***Significant regression ($p<0.05$); **Significant regression ($p<0.01$)

Sex-specific analysis for ISA Brown showed a stark contrast between males and females. In males (Table 8), the only significant predictive relationship was a negative one between week 2 and week 6 ($R^2 = 0.599$, $p < 0.01$). In contrast, females (Table 9) showed several significant predictive relationships, particularly from early weeks. Week 1 significantly predicted week 4 ($R^2 = 0.433$, $p < 0.05$) and week 6 ($R^2 = 0.621$, $p < 0.01$). Week 2 was a significant predictor of week 5 ($R^2 = 0.503$, $p < 0.05$).

Table 8. Body Weight Prediction Accuracy of Isa Brown Male

Weeks (Independent)	*Dependent*	*Regression Equation*	*R²*	*SE*	*Sig.*
0	1	Y = -0.246X + 85.919	0.021	0.597	0.691

Weeks (Independent)	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
0	2	Y = 0.754X + 106.419	0.104	0.784	0.364
0	3	Y = -1.055X + 278.418	0.086	1.219	0.412
0	4	Y = 0.385X + 338.297	0.005	1.901	0.844
0	5	Y = 2.763X + 355.016	0.134	2.485	0.298
0	6	Y = -2.177X + 772.637	0.039	3.813	0.584
0	7	Y = 5.191X + 492.759	0.191	3.777	0.207
0	8	Y = 1.250X + 884.380	0.006	5.891	0.837
1	2	Y = 0.021X + 137.699	0.000	0.485	0.966
1	3	Y = -0.195X + 247.067	0.009	0.744	0.800
1	4	Y = -1.700X + 482.926	0.289	0.942	0.109
1	5	Y = -0.734X + 530.682	0.027	1.544	0.647
1	6	Y = -0.377X + 706.055	0.003	2.277	0.873
1	7	Y = 2.134X +558.595	0.094	2.344	0.389
1	8	Y = -0.155X + 950.581	0.000	3.463	0.965

Weeks (Independent)	***Dependent***	***Regression Equation***	R^2	***SE***	***Sig.***
2	3	Y = 0.889X + 108.520	0.334	0.444	0.080
2	4	Y = -0.620X + 441.456	0.072	0.784	0.452
2	5	Y = 1.154X + 314.778	0.128	1.065	0.310
2	6	**Y = -3.636X + 1184.247**	**0.599**	1.053	**0.009****
2	7	Y = 0.501X + 649.374	0.010	1.785	0.786
2	8	Y = 0.062X + 930.291	0.000	2.523	0.981
3	4	Y = -0.273X + 418.431	0.033	0.520	0.614
3	5	Y = 0.243X + 418.978	0.013	0.736	0.749
3	6	Y = -0.544X + 804.114	0.032	1.062	0.622
3	7	Y = 0.216X + 668.892	0.004	1.162	0.857
3	8	Y = -0.871X + 1141.403	0.035	1.609	0.603
4	5	Y = -0.236X + 559.351	0.028	0.488	0.642
4	6	Y = 0.214X + 601.593	0.011	0.718	0.773
4	7	Y = 0.145X + 667.457	0.004	0.777	0.856

Weeks (Independent)	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
4	8	Y = 0.318X + 825.832	0.011	1.090	0.778
5	6	Y = -0.413X + 874.052	0.080	0.494	0.427
5	7	Y = 0.495X + 483.690	0.099	0.528	0.375
5	8	Y = 0.621X + 643.593	0.079	0.751	0.432
6	7	Y = -0.107X + 791.420	0.010	0.380	0.786
6	8	Y = -0.559X + 1318.059	0.136	0.499	0.295

***Significant regression ($p<0.05$); **Significant regression ($p<0.01$)

Table 9. Body Weight Prediction Accuracy of Isa Brown Female

Weeks (Independent)	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
0	1	Y = 0.765X + 42.967	0.188	0.562	0.210
0	2	Y = 0.717X + 110.695	0.061	0.997	0.493
0	3	Y = 0.936X + 155.971	0.030	1.893	0.634
0	4	Y = -0.047X + 290.783	0.000	2.897	0.987
0	5	Y = 3.677X + 234.802	0.079	4.432	0.431
0	6	Y = 3.688X + 380.343	0.035	6.811	0.603

Weeks (Independent)	***Dependent***	***Regression Equation***	***R^2***	***SE***	***Sig.***
0	7	Y = 1.883X + 558.483	0.021	4.537	0.689
0	8	Y = 5.468X + 479.013	0.099	5.820	0.375
1	2	Y = -0.128X + 148.674	0.006	0.581	0.832
1	3	Y = 1.192X + 105.671	0.150	1.005	0.269
1	4	**Y = -3.055X + 513.476**	**0.433**	1.237	**0.039***
1	5	Y = 2.867X + 170.782	0.150	2.413	0.269
1	6	**Y = 8.763X - 116.610**	**0.621**	2.418	**0.007****
1	7	Y = 0.037X + 630.883	0.000	2.599	0.989
1	8	Y = 2.725X + 496.943	0.077	3.340	0.438
2	3	Y = 0.063X + 184.576	0.001	0.660	0.927
2	4	Y = 0.265X + 251.941	0.009	0.991	0.796
2	5	**Y = 3.182X - 61.796**	**0.503**	1.119	**0.022***
2	6	Y = -2.639X + 895.100	0.153	2.192	0.263
2	7	Y = 0.972X + 498.255	0.048	1.538	0.545

Weeks (Independent)	***Dependent***	***Regression Equation***	R^2	***SE***	***Sig.***
2	8	Y = 0.202X + 669.117	0.001	2.106	0.926
3	4	Y = -0.881X + 459.137	0.341	0.433	0.076
3	5	Y = -0.133X + 407.280	0.003	0.848	0.879
3	6	Y = 1.363X + 264.019	0.143	1.181	0.282
3	7	Y = -0.469X + 724.210	0.039	0.827	0.586
3	8	Y = -1.140X + 917.635	0.128	1.054	0.311
4	5	Y= -0.476X + 518.872	0.089	0.538	0.403
4	6	Y = -1.060X + 833.660	0.196	0.759	0.200
4	7	Y = 0.121X + 688.477	0.006	0.558	0.834
4	8	Y = 0.232X + 608.723	0.031	0.462	0.629
5	6	Y = 0.169X + 462.988	0.013	0.527	0.757
5	7	Y = 0.245X + 540.132	0.061	0.340	0.492
5	8	Y = 0.232X + 608.723	0.031	0.462	0.629
6	7	Y = -0.050X + 659.810	0.006	0.233	0.837

Weeks (Independent)	*Dependent*	*Regression Equation*	*R^2*	*SE*	*Sig.*
6	8	$Y = 0.157X + 614.371$	0.032	0.308	0.624

DISCUSSION

The results of this study clearly demonstrate that the accuracy of body weight prediction in chickens is highly dependent on the growth stage at which the predictive measurement is taken, and that this relationship is modulated by both strain and sex. The consistently low predictive power of hatch weight ($R^2 < 0.20$) across all strains and sexes confirms earlier observations that initial chick size, while a management indicator, does not reliably determine subsequent growth performance [5, 6]. This is likely because hatch weight is influenced by egg size and maternal factors, which may not directly correlate with the chick's own genetic potential for post-hatch growth, which unfolds as its organ systems, particularly the digestive and metabolic systems, mature [7].

The marked increase in predictive accuracy observed for mid-growth weights (weeks 3-5) aligns with the findings of several authors [8, 9]. For the dual-purpose Aco Black and Noiler strains, the strongest predictors of final weight (week 8) were week 4 and week 5 weights, respectively. This period corresponds to a phase of rapid muscle development and exponential growth, where individual genetic potential for growth is most fully expressed under uniform management [3]. The high R^2 values (0.779 for Aco Black week 4 to week 7, and 0.867 for Noiler week 5 to week 8) indicate that these mid-growth weights are excellent practical tools for forecasting final weight. This allows farmers to make early decisions about which birds to select for breeding or to market, optimizing feed efficiency and pen space utilization.

The sex-specific analyses provide strong evidence for the influence of sexual dimorphism on growth trajectories and, consequently, on prediction models [4, 10]. In Aco Black, the differing significant predictors for males (week 4 -> week 7) and females (week 1 -> week 4) suggest that the growth patterns of the two sexes diverge early. The negative predictive relationships observed in some cases, such as in Noiler females (week 5 -> week 6, $R^2 = 0.484$), are particularly intriguing. This inverse relationship could indicate a period of compensatory growth or a shift in resource allocation from skeletal growth to fat deposition or other physiological processes, which warrants further investigation.

The stark contrast between male and female ISA Brown is especially noteworthy. The almost complete lack of significant predictive models for males, contrasted with several strong models for females, likely reflects the intense selection pressure this layer strain has undergone for female reproductive traits [1]. Female growth and development are tightly regulated to optimize the onset of lay and egg production, leading to more predictable, canalized growth patterns. Male ISA Browns, not being the primary product of this strain, may exhibit more variable growth not captured by simple linear models, or their growth trajectory may be more sensitive to environmental or social factors.

The weaker, yet still significant, predictive relationships in the ISA Brown strain compared to the dual-purpose strains are consistent with their genetic background. Layer strains are selected for reproductive efficiency, not maximum growth, so their growth curves are typically flatter, and individual variation may be lower, making prediction more challenging but still feasible [11]. The significant predictions from week 3 onwards for the combined ISA Brown population support the utility of this approach even in layer-type birds.

CONCLUSIONS AND RECOMMENDATIONS

This study conclusively showed that body weight prediction in improved and exotic chicken strains is significantly more accurate when measurements are taken during the mid-growth phase (weeks 4-5) than at hatch. Early weights, including hatch weight, provided weak correlations and are unreliable for forecasting later performance. The findings strongly highlight the necessity for sex-specific and growth-stage-specific prediction models in poultry research and production. For Aco Black, week 4 weight is a key predictor; for Noiler, week 5 weight is paramount. In ISA Brown, while predictions are possible, models must account for the significant sex-based differences in growth predictability.

FURTHER STUDY

This study still has limitations, so further research is needed on the topic of Sex-Specific Body Weight Prediction Accuracy in Improved and Exotic Chicken Strains in Nigeria in order to perfect this study and increase insight for readers.

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