

Absolute Growth Rate (AGR) - A Statistical Tool for Body Weight and Age Calculation in Large White Yorkshire Pigs

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ABSTRACT

This study provides crucial insights into the growth performance of Large White Yorkshire (LWY) pigs in the North-Eastern Agro-Climatic Zone of Tamil Nadu, which is essential for optimizing breeding and management practices. Growth performance data were collected over six years at the Pig Breeding Unit, Post Graduate Research Institute in Animal Sciences (PGRIAS), Kattupakkam. Information on pedigree, sex, growth performance, and disposal weights from 2011 to 2016 was utilized for this study. Statistical analyses were conducted using SPSS to determine the Absolute Growth Rate (AGR). The overall AGR measures for the age intervals from birth to 56 days, 56 to 120 days, 120 to 180 days, and 180 to 240 days were 118.77 ± 0.75 g/day, 268.80 ± 2.24 g/day, 270.93 ± 2.75 g/day, and 385.98 ± 7.19 g/day, respectively. The maximum AGR (412.57 ± 9.92 g/day) was found during the post-weaning growth period, while the minimum AGR (114.87 ± 1.73 g/day) occurred during the pre-weaning growth period. These insights can lead to better resource allocation, improved animal welfare, and increased economic returns in pig farming.

Keywords: Large White Yorkshire Pigs, AGR, Body weight, Pig Breeding Management.

INTRODUCTION

Pigs are one of the best meat-producing animals and have many biological attributes such as high prolificacy, efficient mothering ability, rapid growth, economical feed conversion efficiency and shorter generation interval (Kumar et al., 2023; & Ji et al., 2017). Whereas Pig farming has been adopted to both

diversified and intensive agriculture. Pigs convert inedible feeds, forages, certain grain byproducts obtained from mills, damaged feeds and garbage into valuable nutritious meat. (Yang et al., 2021). Exotic pigs are potential animal protein suppliers in developing countries like India.

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Among the exotic breeds of pig introduced, Large White Yorkshire is more popular, found suited and adapted to the Indian climate. (Chakurkar et al., 2021). As per the 20th livestock census in India, the total pig

population in the country was 9.06 million during 2019, which decreased by 12.0% over the previous Livestock Census (2012) (Figure 1). About 1.7% of the total livestock is contributed by pigs.

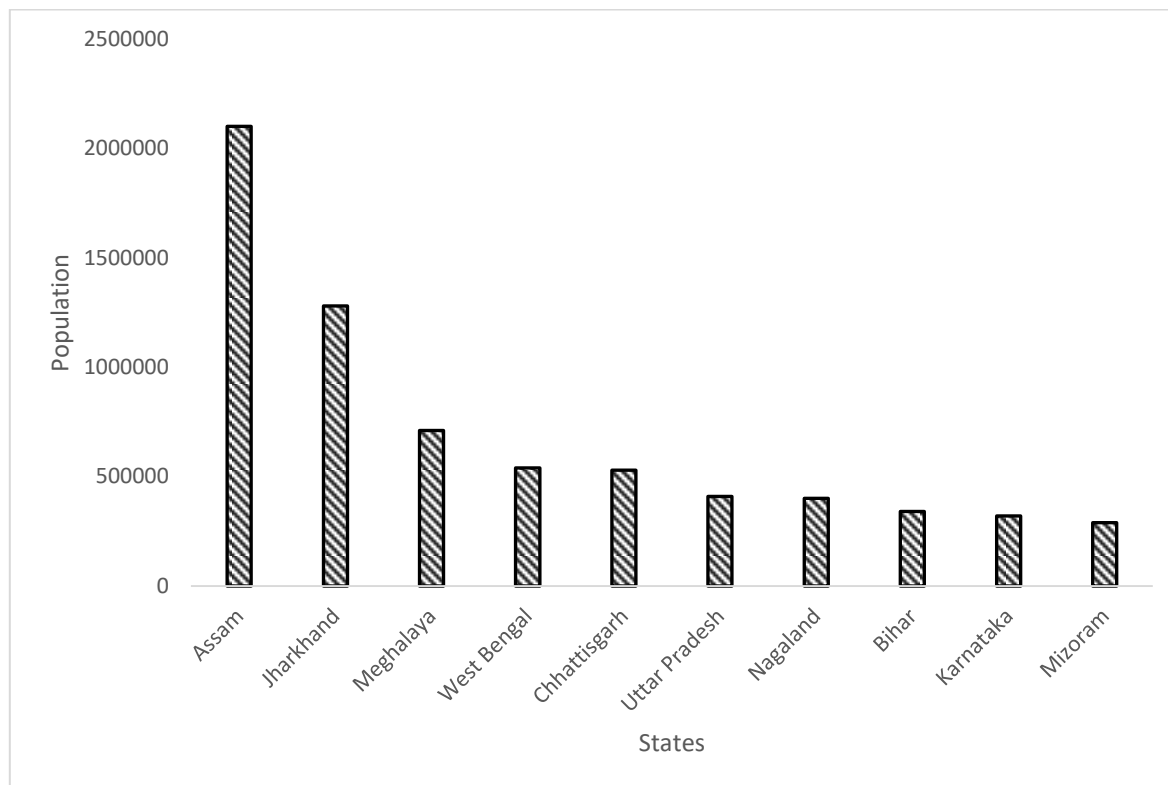


Figure 1 Population census of pigs in India (top 10 states)

Accurate livestock growth performance assessment is crucial for optimizing breeding programs, improving management practices, and maximizing economic returns (Cole et al., 2021). In swine production, understanding growth patterns and weight gain at various developmental stages can inform strategies for nutrition, health management, and genetic selection (Flowers, 2020; & Rodrigues et al., 2022). The Large White Yorkshire (LWY) pig, renowned for its adaptability and prolificacy, serves as a primary breed in commercial pig farming (Ponraj et al., 2021; & Zhang et al., 2022). However, the specific growth dynamics of LWY pigs under varying agro-climatic conditions remain under-explored.

The North-Eastern Agro-Climatic Zone of Tamil Nadu offers unique environmental conditions that can significantly influence the growth performance of LWY pigs. This study aims to provide detailed

insights into the growth rates of LWY pigs in this region, using the Absolute Growth Rate (AGR) as a key statistical tool. The AGR, which measures the daily weight gain over specified age intervals, serves as a robust indicator of growth efficiency and overall health in livestock.

Data for this study were collected over six years at the Pig Breeding Unit of the Post Graduate Research Institute in Animal Sciences (PGRIAS), Kattupakkam. The dataset includes comprehensive information on pedigree, sex, growth performance, and disposal weights from 2011 to 2016. By analyzing these data using SPSS, this study aims to delineate growth patterns, identify critical growth phases, and provide actionable insights for enhancing the productivity of LWY pigs in this agro-climatic zone.

Understanding the growth dynamics of LWY pigs through precise measurement tools like

AGR can lead to better resource allocation, improved animal welfare, and increased economic efficiency in pig farming. This paper presents the methodology, findings, and implications of using AGR as a statistical tool for body weight and age calculation in LWY pigs, highlighting its potential to transform breeding and management practices in swine production.

MATERIAL AND METHODS

This study on the growth performance of Large White Yorkshire (LWY) pigs in the North-Eastern agro-climatic zone of Tamil Nadu is based on data collected over six years at the Pig Breeding Unit, Post Graduate Research Institute in Animal Sciences (PGRIAS), Kattupakkam. The data utilized for this study includes information on pedigree, sex, growth performance, and disposal weights from 2011 to 2016. To achieve the study's objectives, the data were grouped into five equal periods: Period I (2011-2012), Period II (2012-2013), Period III (2013-2014), Period IV (2014-2015), and Period V (2015-2016). Additionally, to assess seasonal fluctuations, the study incorporated seasonal factors categorized as Season I (March-June), Season II (July-October), and Season III (November-February). The statistical analyses were performed using IBM® SPSS® 20.0 Software.

Absolute Growth Rate (AGR)

Absolute Growth Rate (AGR) is the change in size over time, calculated as $(y_{t_2} - y_{t_1}) / (t_2 - t_1)$, where 'y' refers to body weight and t_1 and t_2 refer to age in days. AGR is often called average daily gain, which is expressed in grams per day.

In the study, AGR was evaluated at the following intervals;

- 1) Birth to 56 days
- 2) 56 days to 120days
- 3) 120 days to 180days
- 4) 180 days to 240days

The growth period from birth to 56 days was considered pre-weaning, and age intervals of 56-120 days, 120-180 days, and 180-240 days were considered post-weaning growth periods.

RESULTS AND DISCUSSION

The study aimed to utilize classical mathematical non-linear models to determine the growth patterns of Large White Yorkshire pigs at the Post Graduate Research Institute in Animal Sciences (PGRIAS), Kattupakkam, as presented in Table 1. The collected data were grouped into five equal periods: Period I (2011-2012), Period II (2012-2013), Period III (2013-2014), Period IV (2014-2015), and Period V (2015-2016). Additionally, to assess seasonal fluctuations, the data were categorized into Season I (March-June), Season II (July-October), and Season III (November-February).

Absolute Growth Rate (AGR)

The mean AGR (Absolute Growth Rate) at different intervals during Pre-weaning (Birth to 56 days) and Post-weaning (56 to 120 days, 120 to 180 days, 180 days to 240 days) periods were ascertained. The influence of environmental factors such as Period and Season of farrowing on the Absolute Growth Rate in Large White Yorkshire pigs were evaluated, and the results were presented in the section that follows. Table 1 presents the Least Square Means (\pm S.E.) of post-weaning (180 - 240 days) growth rates (g/day) in Large White Yorkshire (LWY) pigs, categorized by period, season, and sex.

Pre weaning growth rate

The pooled pre-weaning (birth to 56 days) Absolute Growth Rate (AGR) averaged 118.77 ± 0.75 g/day. Among the periods studied, period V (2015-2016) exhibited the highest mean pre-weaning AGR (122.84 ± 2.13 g/day), followed by periods II (119.65 ± 1.56 g/day), IV (119.50 ± 1.74 g/day), III (117.05 ± 1.58 g/day), and I (114.87 ± 1.73 g/day). Farrowing period significantly influenced ($P < 0.05$) pre-weaning AGR. Within each period, pre-weaning AGR varied across seasons, with period-specific trends observed: period II showed higher AGR in season I (120.55 ± 0.73 g/day) compared to seasons II and III (117.38 ± 0.78 g/day; 116.49 ± 0.84 g/day); period III exhibited higher AGR in season III (118.55 ± 1.12 g/day) compared to seasons I and II (114.35 ± 0.78 g/day; 111.39 ± 0.79 g/day);

period IV displayed higher AGR in season II (120.73 ± 0.78 g/day) compared to seasons I and III (118.33 ± 0.87 g/day; 116.27 ± 1.73 g/day); and period V recorded higher AGR in season II (130.95 ± 0.74 g/day) compared to seasons III and I (124.50 ± 0.56 g/day; 117.78 ± 0.56 g/day). Season of farrowing did not significantly affect ($P > 0.05$) pre-weaning AGR across the studied periods. Additionally, there were no significant differences in pre-weaning AGR between male and female pigs during birth to 56 days. Similar findings have been reported previously by Ganesan et al. 2013.

Post weaning growth rate

The study examined Absolute Growth Rates (AGR) in Large White Yorkshire (LWY) pigs across post-weaning phases (56 days to 120 days) and (120 days to 180 days), revealing significant insights. The pooled AGR for the post-weaning (56 days to 120 days) phase averaged 268.80 ± 2.24 g/day, with period V (2015-2016) displaying the highest mean AGR (271.66 ± 6.09 g/day), followed by periods II, IV, III, and I. Farrowing period did not exert a significant effect ($P > 0.05$) on post-weaning AGR. Moving to the post-weaning (120 days to 180 days) phase, the pooled AGR was 270.93 ± 2.75 g/day, with period IV (2014-2015) recording the highest mean AGR (270.57 ± 6.14 g/day), followed by periods V, I, III, and II. Seasonal analysis indicated variability, with period IV showing higher AGR in season III (278.25 ± 1.27 g/day) compared to seasons I and II, whereas period

II exhibited higher AGR in season II (259.24 ± 1.26 g/day) compared to seasons I and III.

For period 1 (2011-2012), the growth rates during Seasons S1 (343.33 ± 2.17 g/day) and S3 (367.56 ± 2.70 g/day) were significantly higher compared to Season S2 (319.00 ± 2.15 g/day). Females (398.43 ± 2.16 g/day) showed significantly higher growth rates than males (343.41 ± 2.16 g/day). For period 2 (2012-2013), growth rates were similar between Seasons S1 (263.83 ± 2.34 g/day) and S2 (263.81 ± 2.87 g/day) but significantly lower compared to Season S3 (348.62 ± 2.34 g/day). Females (445.37 ± 2.13 g/day) exhibited significantly higher growth rates than males (308.54 ± 3.12 g/day). For period 3 (2013-2014), season S1 (361.52 ± 2.18 g/day) and Season S2 (368.17 ± 2.16 g/day) showed significantly higher growth rates compared to Season S3 (308.35 ± 2.66 g/day). Females (435.94 ± 2.17 g/day) had higher growth rates than males (373.51 ± 2.15 g/day). In period 4 (2014-2015), growth rates in Seasons S1 (370.51 ± 2.13 g/day) and S2 (365.71 ± 2.33 g/day) were significantly higher than in Season S3 (383.66 ± 2.77 g/day). Both males (373.85 ± 2.16 g/day) and females (438.91 ± 2.14 g/day) exhibited similar growth rates. In, period 5 (2015-2016), season S2 (379.54 ± 2.37 g/day) showed significantly higher growth rates compared to Seasons S1 (318.03 ± 2.78 g/day) and S3 (340.21 ± 2.33 g/day). Females (453.92 ± 2.13 g/day) had significantly higher growth rates than males (344.87 ± 2.18 g/day).

Table 1 Least Square Means (\pm S.E.) of Post-weaning (180 - 240 days) growth rate (g/ day) in LWY Pigs

Period	Seasons			Sex	
	S1	S2	S3	Male	Female
P1 (2011-2012)	$343.33 \pm 2.17^{b*}$	319.00 ± 2.15^a	$367.56 \pm 2.70^{c*}$	$343.41 \pm 2.16^{b*}$	$398.43 \pm 2.16^{c*}$
P2 (2012 -2013)	263.83 ± 2.34^a	263.81 ± 2.87^a	$348.62 \pm 2.34^{b*}$	308.54 ± 3.12^a	$445.37 \pm 2.13^{c**}$
P3 (2013- 2014)	$361.52 \pm 2.18^{b*}$	$368.17 \pm 2.16^{b*}$	308.35 ± 2.66^a	$373.51 \pm 2.15^{c*}$	$435.94 \pm 2.17^{c**}$
P4 (2014-2015)	$370.51 \pm 2.13^{b*}$	$365.71 \pm 2.33^{b**}$	$383.66 \pm 2.77^{c*}$	$373.85 \pm 2.16^{c*}$	$438.91 \pm 2.14^{c**}$
P5 (2015-2016)	318.03 ± 2.78^a	$379.54 \pm 2.37^{b**}$	$340.21 \pm 2.33^{b*}$	$344.87 \pm 2.18^{b*}$	$453.92 \pm 2.13^{c**}$

Means bearing same superscript do not differ significantly in each sub classes within periods

* Significant ($P \leq 0.05$); ** Significant ($P \leq 0.01$).

The results highlight significant variations in post-weaning growth rates of LWY pigs across different periods and seasons. Seasonal effects were evident, with certain seasons consistently showing higher growth rates than others within each period. In the study sex-specific differences were observed, with females generally exhibiting higher growth rates compared to males in most periods and seasons. These findings underscore the importance of considering seasonal variations and sex differences when optimizing management practices and nutritional strategies for enhancing growth performance in LWY pigs.

CONCLUSION

This study illuminates the growth dynamics of Large White Yorkshire (LWY) pigs in the North-Eastern Agro-Climatic Zone of Tamil Nadu, focusing on the Absolute Growth Rate (AGR) as a crucial measure. The findings underscore the significant impact of age intervals, periods, seasons, and sex on AGR, revealing distinct growth patterns during both pre-weaning and post-weaning phases. These insights provide essential guidance for refining breeding strategies, nutritional interventions, and management practices aimed at enhancing the productivity and welfare of LWY pigs. Notably, AGR values varied across different age intervals: 118.77 ± 0.75 g/day from birth to 56 days, 268.80 ± 2.24 g/day from 56 days to 120 days, 270.93 ± 2.75 g/day from 120 days to 180 days, and 385.98 ± 7.19 g/day from 180 days to 240 days. The highest AGR (412.57 ± 9.92 g/day) occurred during post-weaning growth periods, while the lowest (114.87 ± 1.73 g/day) was observed in pre-weaning stages. This disparity underscores the effectiveness of farm management practices, technological advancements, and environmental factors in influencing growth performance, particularly during post-weaning phases.

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could appear to influence the work reported in this paper.

Author's contribution

Archana K: Writing the original draft, methodology, investigation, data curation, and conceptualization. **Anantha Narayanan S:** Methodology, Formal analysis, Investigation, Writing-original draft, communication, Review and editing.

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