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Original article

Effects of litter size and piglet sex on gestation length in Landrace pigs

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ABSTRACT

This study aims to investigate the relationship between litter size and piglet sex with gestation length in Landrace pigs. The research was conducted at a farm in Kupang, East Nusa Tenggara, involving 15 healthy Landrace sows monitored from December 2024 to February 2025. The methodology employed included the collection of primary data through direct observation and secondary data obtained from farm records. The results indicated that the average (±SD) gestation length for Landrace pigs was 113.53 ± 0.64 days, with a variation ranging from 113 to 115 days. Statistical analysis using the Spearman correlation test revealed no significant correlation between litter size and gestation length (p values= 0.115; p >0.05). These findings suggest that physiological adaptations in Landrace pigs maintain a consistent gestation length regardless of litter size. Additionally, factors such as maternal nutrition, environmental conditions, and management practices were identified as potential influencing factors. The study also found no correlation between piglet sex and gestation length, with p-values of 0.89 for male piglets and 0.602 for female piglets. Overall, the results indicate that neither litter size nor piglet sex are primary factors determining the length of gestation in Landrace pigs.

Keywords: gestation length, Landrace pigs, litter size, piglet sex

INTRODUCTION

Pigs are a vital component of the livestock industry in in East Nusa Tenggara (NTT), playing a strategic role not only as a source of household income but also in supporting food security through the supply of animal protein and contributing to the regional agro-industrial economy. Among various livestock species, pigs are recognized for their feed efficiency, high productivity, and good environmental adaptability (Tribudi *et al*., 2019).

Landrace pigs, one of the superior breeds, are known for their high post-weaning survival rate, efficient conversion of feed to meat, and body structure that supports maximum carcass production (Zebua *et al*., 2017). In addition, pigs also have relatively short gestation length, which is typically ranging from 111 to 120 days, with the potential to produce a large number of offspring in one birth. This makes reproductive management in pigs, including aspects of gestation length, litter size, and offspring sex, crucial to study in order to support optimal productivity (Ohin, 2014; Pero *et al*., 2020). Litter size, the number of piglets born per pregnancy, is an important indicator in assessing the reproductive performance of sows

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(Thiengpimol *et al*., 2024). Research shows that litter size tends to increase from the first to the fourth litter, then decreases in subsequent litters (Pero *et al*., 2020). On the other hand, the sex of the offspring is also thought to have an influence on the length of gestation, as shown in a study in cattle that stated that male fetuses tend to be carried longer than female fetuses (Setyorini *et al*., 2021). However, similar studies in pigs, especially the Landrace breeds, remains limited in Indonesia.

Limited data on the relationship between litter size and sex with gestational length in Landrace pigs can have implications for managerial errors in reproductive management, such as the inappropriate use of hormonal treatments. Therefore, this study aims to analyze the effect of litter size and piglet sex on gestational length in Landrace pigs. The findings are expected to provide practical insights for improving reproductive management for farmers, as well as contributing theoretical and scientific value to the field of veterinary reproductive science.

MATERIALS AND METHODS

This study was conducted from December 22, 2024 to March 1, 2025 at a farm, in East Kupang district, Kupang regency, East Nusa Tenggara. A total of 15 Landrace sows were selected by purposive sampling as research samples. The variables observed included gestation length, number of piglets per birth, and piglet sex. A survey method was employed, using primary and secondary data. Primary data were obtained through direct observation of farrowing events, while secondary data were taken from farm records, including information on insemination dates, farrowing dates, litter size, and the sex distribution of piglets. Data were analyzed using Pearson correlation to evaluate the relationship between litter size, piglet sex, and gestation length. Statistical analysis was performed using IBM SPSS version 25.0, with significance determined at $p < 0.05$. Inclusion criteria for the selected sows were second-parity Landrace sows, aged over one year, with farrowing dates between December 2024 and February 2025, and complete reproductive records.

RESULTS

The average gestation length of Landrace sows in this study was 113.53 ± 0.64 days, with a range of 113 to 115 days. The mean litter size was 10.07 ± 1.22 piglets, consisting of 4.60 ± 1.40 male and 5.47 ± 1.18 female piglets.

Table 1 Gestation length, litter size, and piglet sex distribution of Landrace sows at Manufarm farm

pig ID	litter size (n)	male piglets (n)	female piglets (n)	gestation length (days)
pig 1	11	3	8	114
pig 2	10	4	6	114
pig 3	11	4	7	113
pig 4	12	6	6	114
pig 5	10	6	4	114
pig 6	12	7	5	113
pig 7	10	5	5	114
pig 8	10	5	5	113
pig 9	11	7	4	115
pig 10	8	4	4	113
pig 11	10	3	7	113
pig 12	9	3	6	113
pig 13	10	5	5	114
pig 14	9	4	5	113
pig 15	8	3	5	113
Mean ± SD	10.07 ± 1.22	4.60 ± 1.40	5.47 ± 1.18	113.53 ± 0.64

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Litter size and gestation length

The Spearman correlation test indicated no significant relationship between litter size and gestation length (p= 0.115).

Piglet sex and gestation length

Correlation analysis also revealed no significant relationship between piglet sex and gestation length. The p-value for male piglets was 0.890, and for female piglets, it was 0.602.

DISCUSSION

The average gestation length of 113.53 days observed in this study is in line with previous findings by Pero *et al*. (2020), who reported a gestation range of 114-115 days in Landrace pigs. This consistency indicates that the gestation length in Landrace sows is relatively stable, making it a reliable parameter in planning the reproductive cycle of the farm (Alam *et al*., 2021). The average litter size in this study was slightly below the optimal standard (>11 piglet) suggested by Pero *et al*. (2020). This value may be influenced by factors such as nutritional quality, management practices, and age of the sow (Gustina *et al*., 2023). Environmental conditions, seasonal variations, and parity also contribute to differences in litter size (Feka *et al*. (2023).

Several factors including maternal nutrition, environmental conditions, and management practices were found to play important roles in determining gestation length. Management practices significantly influenced gestation duration of sow through their impact on hormonal regulation, fetal development, and overall reproductive health. Proper management ensures that key physiological processes required for healthy pregnancy and timely farrowing proceed smoothly, while poor practices may lead to extended or shortened gestation. Adequate and balanced nutrition supports normal hormonal activity, fetal growth, and placental development (Peltoniemi *et al*., 2020). Nutrients such as energy, protein, vitamins, and minerals influence the secretion of progesterone and estrogen, key hormones regulating pregnancy. Nutritional deficiencies may lead to fetal retardation or stress, potentially altering gestation length (Wang *et al*., 2017).

Accurate detection of estrus, proper timing of insemination, and regular monitoring of pregnancy status ensure optimal hormonal regulation. Mistimed insemination or undetected estrus can disrupt hormonal balance, leading to extended gestation or preterm labor (Glencorse *et al*., 2025). Maintaining herd health through vaccination, parasite control, and disease management helps prevent physiological stress and immune responses that interfere with fetal development. Disease outbreaks or unmanaged infections may alter hormonal levels, causing abnormal labor timing (Wang *et al*., 2025). 21Providing a comfortable, clean, and appropriately ventilated environment minimizes stress and prevents overheating or hypothermia, both of which can affect hormonal secretion and fetal development. Stress-induced cortisol release can trigger premature parturition or delay labor. Gentle handling and minimizing stress during gestation reduce the activation of stress pathways (e.g., cortisol), which can influence uterine activity and fetal hormones, thereby affecting the timing of delivery (Lagoda *et al*., 2022). Regular ultrasound examinations to fetal movements, and body condition scoring further help assess fetal maturity and maternal status, allowing interventions to prevent delayed or premature farrowing (Kauffold *et al*., 2019).

Effective management practices that ensure optimal nutrition, health, environmental comfort, and precise reproductive control are crucial in maintaining normal gestation length in sows. Poor management can lead to reproductive disturbances, resulting in longer or shorter pregnancy length, affecting productivity and animal welfare (Wang *et al*., 2025). At the molecular level, maternal nutrition affects gestation duration primarily through hormonal regulation, placental gene expression, inflammatory responses, epigenetic modifications, and neuroendocrine signaling (Gormley *et al*., 2024). Proper nutritional management ensures the balanced expression of these genes and pathways, promoting a gestation length conducive to healthy development and optimal timing of parturition. Adequate maternal

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nutrition ensures proper production of reproductive hormones such as progesterone, estrogen, and placental hormones. These hormones coordinate the maintenance of pregnancy and the timing of parturition. A timely decline in progesterone, for example, is essential to trigger labor, and any deficiency in key nutrients can disrupt this process (Monteiro *et al*., 2025).

Proper nutrition provides essential substrates for placental growth and angiogenesis, including amino acids, lipids, and micronutrients. At the molecular level, nutrients influence the expression of growth factors (e.g., VEGF) and placental genes involved in nutrient transfer, hormone production, and inflammatory regulation. Disruption of these processes can impair placental signaling, potentially leading to premature or delayed birth (Yuan *et al*., 2015). Nutritional deficiencies or imbalances may activate molecular pathways related to oxidative stress and inflammation, such as increased production of reactive oxygen species (ROS) and pro-inflammatory cytokines (e.g., IL-6, TNF-α). Elevated oxidative stress can alter the expression of genes involved in prostaglandin synthesis, which are key mediators in initiating labor. Excessive inflammation may trigger early labor, whereas inadequate inflammation can delay initiation (Zhou *et al*., 2019). Nutrients such as folate, choline, and B-vitamins modulate DNA methylation and histone modifications, affecting gene expression in both the mother and placenta. Epigenetic changes influence the expression of genes controlling myometrial contractility, placental development, and hormonal signaling, thereby affecting the timing of parturition (Marín-García and Llobat, 2021). Nutrients impact the molecular pathways of the hypothalamic-pituitary-adrenal (HPA) axis. Altered cortisol production, influenced by maternal nutritional status, can modulate labor readiness through complex gene regulation involving glucocorticoid response elements, impacting the duration of gestation (Jarvis *et al*., 2006).

Environmental conditions influence sow gestation duration at the molecular level through activation of stress pathways (cortisol, ROS), modulation of reproductive hormones (via melatonin and gonadotropins), and changes in gene expression related to immune response, heat shock proteins, and placental function (Lucy and Safranski, 2017). These molecular responses alter physiological processes such as uterine contractility, fetal development, and hormonal regulation, ultimately impacting the timing and length of gestation (Wang *et al*., 2023). Elevated ambient temperatures induce heat stress, activating the HPA axis (Katiyar *et al*., 2025). At the molecular level, heat stress increases the secretion of corticotropin-releasing hormone (CRH) from the hypothalamus, which stimulates adrenocorticotropic hormone (ACTH) release from the pituitary. ACTH promotes cortisol production in the adrenal glands. Elevated cortisol levels can influence uterine contractility and inflammatory pathways, often leading to premature initiation of labor or fetal stress, which may result in shortened gestation (Einarsson *et al*., 2008). High environmental temperatures increase ROS production in maternal tissues, inducing oxidative stress. This molecular imbalance can activate stress-responsive signaling pathways, such as NF-κB and MAPK, which regulate inflammatory cytokines and prostaglandin synthesis (Omotosho *et al*., 2024).

Altered prostaglandin levels are directly involved in myometrial contractions and labor onset, affecting the timing of delivery. Changes in light exposure can influence melatonin synthesis in the pineal gland. Melatonin acts at the molecular level by regulating the expression of genes involved in reproductive hormones, including GnRH, LH, and oxytocin. Variations in melatonin levels can modulate the timing of parturition by influencing the timing and expression of hormones that control uterine contractions and fetal maturation (Qin *et al*., 2025). Heat stress can alter the expression of genes involved in immune response, heat shock proteins (HSPs), and reproductive functions. For instance, HSPs act as molecular chaperones protecting cells from thermal damage. Aberrant expression of HSPs and inflammatory cytokines can disrupt the normal timing of parturition by affecting fetal development and uterine

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readiness for labor (Keating *et al*., 2024). Environmental factors can influence placental gene expression involved in nutrient transport, hormone production, and immune tolerance. Stress-induced alterations in genes such as VEGF, IGF, and cytokines affect placental development and function, which in turn can modify the gestation length (Zhao *et al*., 2021).

In the present study, the correlation analysis indicated no significant relationship between litter size and gestation length, supporting findings by Nowak *et al*. (2020). This could be attributed to the physiological adaptability of the sow in supporting fetal development regardless of litter size, especially under controlled systems as those at Manufarm Farm, where feed and water were provided ad libitum. Likewise, piglet sex showed no significant correlation with gestation length. These results align with Cabrera *et al*. (2021) who noted that sex in mammals is genetically determined by X and Y chromosomes, typically balanced in the population and not directly influencing gestation length.

CONCLUSION

There was no correlation between litter size and gestation length, nor between piglet sex and gestation length. Further research with larger sample sizes and more diverse environmental variables are needed to strengthen this conclusion.

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AUTHORS' CONTRIBUTIONS

Merry Friana Sari (MRS), Tarsisius Considus Tophianong (TCT), Yohanes Timbun Raja Mangihut Ronael Simarmata (YTRMRS), Heny Nitbani (HN).

MRS :Manuscrip writing, TCT : Manajement of Experimental animals, YTMRS : data collection , HN : data manajemen and data analysis. All authors critically reviewed and revised the manuscript for important intellectual content, read and approved the final version of the manuscript.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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