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The number of piglets born with the intrauterine growth retardation syndrome may vary depending on the season

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ABSTRACT. Intrauterine growth retardation (IUGR) is a phenomenon that occurs in mammalian foetuses due to a reduced placental transfer of nutrients from the mother, most often associated with chronic stress exposure in sows during the second and third trimester of pregnancy. The aim of the present study was to investigate the frequency of IUGR in relation to parity and seasonal variation in climate parameters, including temperature, humidity, and light conditions in the gestation area. The study was conducted on a production farm with strict biosecurity and animal health management. Pig neonates were identified as IUGR based on established criteria, including birth body weight and head morphology. The frequency of IUGR pigs in a litter increased with parity, from null in primiparous sows to 13.3% in multiparous sows (>7 gestations). The lowest frequency of IUGR neonates (stillborn and live-born) was observed in summer, whereas the highest proportion was recorded in autumn. In conclusion, significant differences in the frequency of stillbirths and live births of piglets with IUGR were demonstrated at different times of the year, and it was hypothesised that reduced daylight duration could contribute to this effect.

Introduction

Intrauterine growth retardation (IUGR) is a condition occurring in mammalian foetuses as a result of reduced transfer of nutrients from the mother through the placenta (Ferenc et al., 2014). Non-infectious factors, such as inadequate nutrition and/or chronic stress, are the primary causes of IUGR in pigs (Wang et al., 2017). Additionally, nutritional factors have been shown to affect the occurrence of IUGR, as demonstrated by the effects of iron and vitamin B_{12} deficiency in humans (Rondó and Tomkins, 1999; Muthayya et al., 2006), and folic acid supplementation in pigs (Liu et al., 2012). IUGR can be readily identified in neonatal piglets based on characteristic anatomical features described by Hales et al. (2013). According to these authors, IUGRs have low birth body weight (<1.0 kg),

a dolphin-like shape of the facial region, bulging eyes, wrinkles perpendicular to the mouth, and a lean abdominal profile. IUGR neonates also show a significantly reduced overall survival rate compared to non-IUGR littermates. Moreover, IUGR pigs that survive the neonatal period demonstrate a marked decline in body weight gain throughout the production cycle relative to their normal-for-gestational-age (NGA) counterparts. However, it was demonstrated that despite a relatively lower carcass weight and meatiness (by 2–4% points), meat quality was evaluated favourably in consumer tests (Matyba et al., 2021). Nevertheless, there is no clear consensus on the prevalence of IUGR in swine populations. Reported prevalence ranges from 6–7% IUGR in some herds to as high as 20% in others (Ferenc et al., 2014; Wang et al., 2017; Hsu and Tain, 2020). A review of the methods employed suggests that,

in certain studies, IUGR piglets may not have been accurately identified. Specifically, neonates with a birth body weight below 1.0 kg and classified as small-for-gestational-age (SGA), but lacking the characteristic anatomical features described by Hales et al. (2013) may have been incorrectly included as IUGR cases. It also remains uncertain whether environmental factors, such as high summer temperatures or other stressors contribute to these discrepancies. For farmers, reliable data on the frequency of IUGR syndrome are crucial for informed herd management, as changes in IUGR prevalence may reflect the welfare and nutritional status of pregnant sows. Therefore, reference data from a well-managed farm are needed. The objective of the present study was to record the occurrence of IUGR neonates in four seasons on a pig farm in central Poland, using the diagnostic criteria proposed by Hales et al. (2013).

Material and methods

Animal health status and nutrition

The protocol was conducted in compliance with European Union regulations on the protection of experimental animals. Since the study protocol did not involve any procedures beyond routine farm practices, approval from a Local Ethics Committee was not necessary. The study was carried out on a private commercial pig farm located in central Poland, housing 600 sows (PIC® hybrid: Camborough plus ♀ × PIC410 ♂). The farm produces approximately 18 100 weaners and about 12 300 fattening pigs annually and sells approximately 5 800 growing pigs per year to nearby fattening farms. The farm's production performance in 2019 is outlined below. The mean number of pigs born alive was 13.92, with a preweaning mortality rate of 9.4% (weaning at approximately 28 days postnatal). The mean number of piglets weaned per sow was 12.69, and the annual production reached 33.13. The nursery mortality rate was 1.38%, and the fattening mortality rate was 1.9%. Regarding health status, the herd was free of porcine reproductive and respiratory syndrome virus and swine influenza, negative for *Actinobacillus pleuropneumoniae* (APP), as confirmed by ELISA tests, and negative for leptospirosis, as confirmed by a microagglutination test. The following pathogens/diseases were present on the farm but effectively controlled through vaccination/medication protocols: circovirus (PCV2), *Mycoplasma hyopneumoniae*, atrophic rhinitis, streptococcosis, oedema disease, enterotoxigenic *Escherichia coli*, intestinal adenomatosis, and coccidiosis.

Stress in gestating sows was monitored by evaluating their behaviour, health, and performance by farm staff and a veterinary clinician. Respiration rate, skin temperature, and tear staining (Telkänranta et al., 2016) were assessed, along with behavioural indicators of stress, including reduced rooting, increased sleeping, decreased overall activity, and a higher incidence of stereotypic behaviours, such as oral and nasal stereotypies. Lameness, recognised as a significant source of stress that may lead to various behavioural and physiological alterations, was rare on this farm, with a prevalence below 2%.

On the day of weaning, sows were transferred from the farrowing/maternity area to the insemination area for a 28-day period. During this time, oestrus was stimulated by light exposure (16 h of white light at an intensity of 200–250 lux) and increased feed allowance for 2–3 days. Insemination was performed on day 4 or 5 after transfer. Pregnancy was confirmed via ultrasound examination (performed between day 25 and 28 of stay in the insemination area), after which all pregnant sows were transferred to the gestation area. In cases of non-pregnancy and subsequent return to oestrus, sows were included in the subsequent production cycle and inseminated again. Consequently, the number of sows in individual production cycles was not constant (approximately n = 50). The insemination area was equipped with individual stalls and slatted flooring, whereas the gestation area consisted of group pens with straw bedding, where sows remained until one week before farrowing. Both the insemination and gestation areas were air-ventilated. Mean temperature and relative humidity in the gestation area were continuously recorded using an RTW 2 Wireless Temperature and Humidity Recorder (CZAKI THERMO-PRODUCT Sp. z o.o., Raszyn-Rybie, Poland), and the averaged values are presented in Table 1. The gestation room (second and third trimesters) was illuminated naturally, the window-to-floor ratio was 1:20, and the inflow of daylight was regulated by automatic curtains. Daylight intensity in the gestation room was between 40 and 50 lux, as measured with a LXP-2 Luxmeter (WMGBLXP2, SONEL S.A., Poland). Figure 1 presents weekly sunrise and sunset times and day length recorded at the meteorological station nearest to the farm (Time and Date AS, Stavanger, Norway). Additional artificial light (40–50 lux) was used during morning cleaning and maintenance activities in late autumn and winter.

Table 1. The sow's backfat thickness was measured one week before gestation. The average temperature and humidity in the gestation area were recorded during the 2nd, 3rd, and 4th months of gestation. In the 4th month, one week before the expected farrowing, the sows were transferred to the farrowing/maternal area, which had the same temperature and humidity as the gestation area. The ambient temperature in the farrowing/maternal area was increased by 3 °C one day before farrowing.

Artificial insemination Farrowing	November'18 February'19	February'19 May'19	May'19 August'19	September'19 November'19	*P*-value
Right flank, mm	15.67 ± 4.86	16.71 ± 4.57	17.22 ± 4.55	17.90 ± 5.53	0.12
Left flank, mm	15.30 ± 4.75	16.75 ± 4.42	17.12 ± 4.55	17.57 ± 5.16	0.08
Temperature in gestation area, °C					
2nd	18.82 ± 0.51[a]	18.41 ± 1.07[a]	21.21 ± 1.28[b]	19.22 ± 2.21[a]	0.0001
3rd	18.20 ± 2.48[a]	18.02 ± 1.86[a]	20.09 ± 1.27[b]	18.26 ± 1.39[a]	0.0001
4th	18.73 ± 1.29[a]	18.58 ± 1.28[a]	21.00 ± 1.19[b]	17.95 ± 1.25[a]	0.0001
Humidity in gestation area,%					
2nd	72.16 ± 3.81[a]	67.42 ± 9.86[ab]	74.11 ± 6.51[ab]	67.08 ± 4.19[a]	0.001
3rd	71.32 ± 9.11[a]	62.97 ± 7.74[bc]	70.09 ± 8.29[ac]	68.87 ± 6.66[a]	0.001
4th	71.52 ± 8.53[a]	68.61 ± 8.29[ab]	71.83 ± 4.32[abc]	67.67 ± 5.22[ac]	0.01

mean values ± standard deviation; backfat thickness – analyzed using one-way ANOVA and Tukey's test; temperature and humidity – analyzed using nonparametric ANOVA and Dunn's multiple comparisons test. [abc] means with different superscripts within the row are significantly different
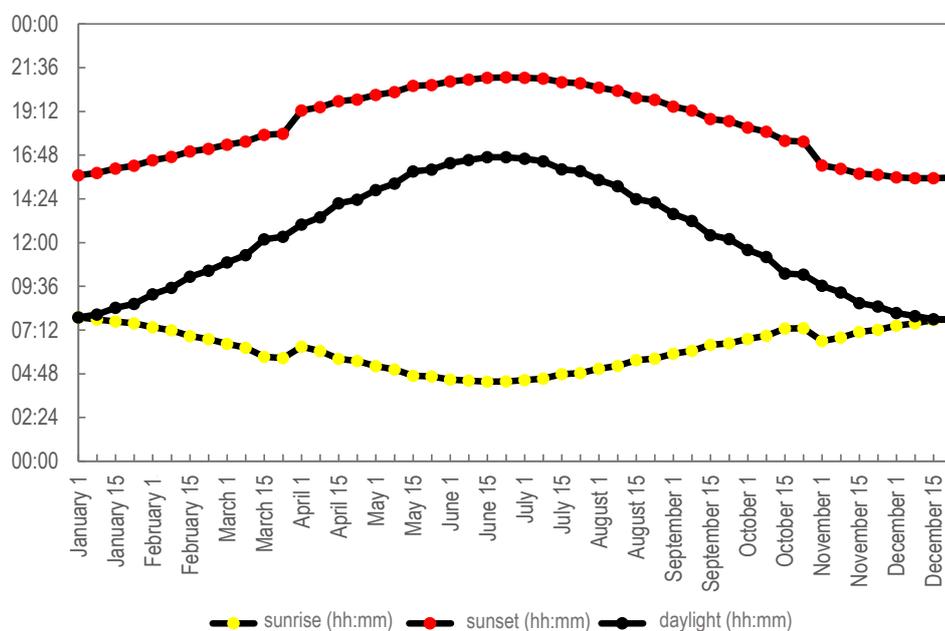

Figure 1. Weekly sunrise time, sunset time and daylight duration recorded for the meteorological station nearest to the farm during the study period.

The timing of farrowing was synchronised using an intramuscular injection of the prostaglandin F2-alpha analogue alfaprostol (Gabbrostim, 2 mg/ml, Ceva Salute Animale S.p.A., Italy), administered on day 111 or 112 of pregnancy at a dose of 2 mg per sow. On the same day, sow health status and backfat thickness were assessed (Table 1). All backfat thickness measurements were performed by the same researcher in standing sows, approximately 6–8 cm from the dorsal midline at the level of the last rib curve (Maes et al., 2004) using a Series 12 nr 68417 Digital Backfat Indicator (Renco Lean-Meater®, Minneapolis, USA). Measurements were taken on both sides of each sow.

Feeding protocol of pregnant and lactating sows

The pregnant sows were fed a standard wet diet (Table 2) on a concentrate base by De Heus sp. z o.o. (Łęczyca Poland), and three weeks prior to farrowing, the diet was transitioned to a wet diet for lactating sows.

Pregnant sows were fed a standard wet concentrate-based diet supplied by De Heus sp. z o.o. (Łęczyca, Poland) (Table 2). Three weeks before farrowing, the diet was gradually transitioned to a wet feed formulated for lactating sows.

During gestation, sows received a liquid feed composed of barley, wheat, maize, and concentrate

Table 2. Feeding protocol of pregnant and lactating sows

Group	Water/whey/dry feed, %	Dry matter, %	Metabolizable energy, MJ/kg	Crude protein, %
Pregnant sows	39.5/42.0/18.5	88.00	9.50	12.83
Lactating sows	36.8/40.0/23.2	88.00	9.84	16.04

(LT321X11K-L00, Koncentrat LP SQ 24.9%, De Heus, Łęczyca, Poland), supplemented with whey and water (Table 2). Feeding was carried out twice daily, with the daily ration adjusted to body condition and body weight, ranging from 2.5 to 4.0 kg per sow. Two to three weeks before parturition, sows were fed *ad libitum*, whereas feed allowance was reduced to 1.5 kg per sow during the last 24 h before farrowing. The Koncentrat LP contained the following analytical components: %: crude protein 14.80%, crude fat 5.90, crude fibre 15.60, ash 10.20, lysine 0.88, methionine 0.24, calcium 2.30, phosphorus 0.43, and sodium 0.29. Technological additives included propionic acid (1k280, 3.00 mg/kg), bentonite (1m558, 925.00 mg/kg), butylhydroxytoluene (E321, 1.00 mg/kg), and natrolite-phonolite (E566, 90.00 mg/kg). Dietetic additives comprised D_3 (3a670a, 0.21 mg/kg), vitamin A (3a672a, 49 500 IU/kg), vitamin E (3a700i, 455.00 mg/kg), iron as iron(II) sulphate monohydrate (3b103, 518.00 mg/kg), iodine as coated granulated calcium iodate (3b203, 12.00 mg/kg), copper as copper(II) sulphate pentahydrate (3b405, 62.00 mg/kg), manganese as manganese(II) oxide (3b502, 165.00 mg/kg), zinc as zinc oxide (3b603, 330.00 mg/kg), selenium as sodium selenite (3b801, 0.83 mg/kg), and L-lysine sulphate (3c324, 2532.70 mg/kg). Functional additives included 6-phytase (4a19, EC 3.1.3.26, 4131.00 FTU/kg) and benzoic acid (4d210, 8040.00 mg/kg). The ingredient composition included wheat bran, soybean husks, dried beet pulp, oats, sunflower fodder extraction meal from hulled sunflower seeds, oat husks, calcium carbonate, barley, rapeseed extraction meal, soybean extraction meal, linseed, vegetable oils and fats, animal fat, sodium bicarbonate, wheat, and soluble fractions derived from onion and grape seeds. The LP concentrate constituted up to 24.9% of the daily ration calculated on a dry matter basis.

Lactating sows (Table 2) were fed a liquid diet based on barley, wheat, maize, and a concentrate (LT421X11K-L00, Koncentrat LK SQ 25%, De Heus, Łęczyca, Poland) supplemented with whey and water. Feeding was carried out twice daily during the first 5 days of lactation, and subsequently three times daily *ad libitum*. The Koncentrat LK contained the following analytical components, %: crude protein 27.50, crude fat 8.60, crude fibre 10.30, ash 14.00, lysine 2.38, methionine 0.61, calcium 3.30, phosphorus 0.73, sodium 0.29. Technological additives clinoptilolite of sedimentary origin (1g568, 42.00 mg/kg), propionic acid (1k280, 3.00 mg/kg), bentonite (1m558, 971.00 mg/kg), butylhydroxytoluene (E321, 1.00 mg/kg), and natrolite-phonolite (E566, 89.00 mg/kg). Nutritional additives comprised vitamin D_3 (3a670a, 0.21 mg/kg), vitamin A (3a672a, 49 500 IU/kg), vitamin E (3a700i, 453.00 mg/kg), iron as iron(II) sulphate monohydrate (3b103, 515.00 mg/kg), iodine as coated granulated calcium iodate (3b203, 12.00 mg/kg), copper as copper(II) sulphate pentahydrate (3b405, 62.00 mg/kg), manganese as manganese(II) oxide (3b502, 165.00 mg/kg), zinc as zinc oxide (3b603, 330.00 mg/kg), selenium as sodium selenite (3b801, 0.82 mg/kg), and L-lysine sulphate (3c324, 13 226.10 mg/kg). Functional additives included 6-phytase (4a19, EC 3.1.3.26, 4 131.00 FTU/kg), endo-1,4-β-glucanase (4a7, EC 3.2.1.4, 1 040.00 TGU/kg), endo-1,4-β-xylanase (4a7, EC 3.2.1.8, 2 330.00 TXU/kg), and benzoic acid (4d210, 8 040.00 mg/kg). The concentrate was composed of soybean extraction meal, rapeseed extraction meal, sunflower fodder extraction meal from dehulled sunflower seeds, wheat bran, calcium carbonate, dried beet pulp, linseed, soybean husks, toasted soybeans, vegetable oils and fats, oat husks, barley, wheat, animal fat, sodium chloride, monocalcium phosphate, vinase, soluble onion fractions, and soluble grape seed fractions. The Koncentrat LK constituted up to 25% of the daily ration calculated on a dry matter basis. During the experiment, the sows had free access to water.

Study protocol

The study protocol involved the systematic counting, weighing, and classifying the status (normal or IUGR) of all newborn pigs (dead and alive) in each of the four quarters of the year in one of the sow production groups. Specifically, farrowing sow groups were recorded in November, February, May, and August, with an additional assessment in February of the following year to confirm the trend observed in winter. Farrowing sector staff were trained to identify IUGR neonates according to the study protocol. IUGR piglets were identified by low birth body weight and at least one of three

morphological features described by Hales et al. (2013): (1) a steep, dolphin-like forehead; (2) bulging eyes; and (3) wrinkles perpendicular to the mouth. Piglets lacking these cranial features were classified as 'normal' (NGA or SGA). All measurements and classifications were performed within 2 h of birth.

Statistical analysis

The results were subjected to a two-stage statistical analysis. In the first stage, the homogeneity of standard deviations (SD) was assessed, and the Kolmogorov-Smirnov test was used to determine whether the data followed a normal distribution. Based on these assessments, the data were analysed using either one-way ANOVA followed by the Tukey's post hoc test for normally distributed data or nonparametric ANOVA (Kruskal-Wallis test) followed by Dunn's multiple comparison test for non-normally distributed data. To compare the data from the two winter seasons, an unpaired t-test was applied. All statistical analyses were conducted using GraphPad Prism v5.0 software (San Diego, CA, USA). In this study, a P-value of ≤ 0.05 was considered statistically significant, a P-value of ≤ 0.01 was considered highly significant, and a P-value in the range of 0.05–0.1 was considered indicative of a trend.

Results

The results of this study are presented in Tables 3 and 4. The total number of newborns examined in each farrowing group ranged from 759 (born in November) to 866 (born in August). The proportion of live-born piglets without IUGR symptoms was the lowest in November (82.7%, gestation from September to November) and the highest in August (90.2%, gestation from May to August). Piglet mortality was the lowest for the May–August gestation period (5.9%), while the highest mortality rates were observed in winter (7.8%), spring (8.3%), and autumn (7.7%). Mummified foetuses were delivered only during the winter period, specifically in February. Additionally, the lowest percentage of live IUGR piglets was observed in May (3.6%) and August (3.8%), while the highest occurred in November (9.5%) and February (6.6%) (Table 3). Notably, the frequency of IUGR occurrence did not vary between the two winter seasons ($P = 0.93$) (Table 4). The seasonality was also observed in the percentage of IUGRs born dead, although the differences were less pronounced than for live-born IUGR (Table 3). A significant difference was observed in the average birth weight; the heaviest 'normal' piglets (without IUGR symptoms) were

Table 3. Frequency of births of intrauterine growth retardation (IUGR) piglets in four seasons.

Artificial insemination Farrowing	November'18 February'19	February'19 May'19	May'19 August'19	September'19 November'19	*P*-value
Number of sows/production group	54	51	58	49	
New-born piglets/production group, total	854	759	866	759	
Non-IUGR alive	731 (85.6%)	669 (88.1%)	781 (90.2%)	628 (82.7%)	
Non-IUGR dead	45 (5.3%)	54 (7.1%)	42 (4.8%)	45 (5.9%)	
IUGR alive	56 (6.6%)	27 (3.6%)	33 (3.8%)	72 (9.5%)	
IUGR dead	15 (1.7%)	9 (1.2%)	10 (1.1%)	14 (1.8%)	
Mummified	7 (0.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Average birth body weight, kg					
Non-IUGR	1.46 ± 0.42[a]	1.47 ± 0.13[a]	1.63 ± 0.15[b]	1.54 ± 0.07[c]	0.0001
IUGR	0.70 ± 0.21[a]	0.63 ± 0.11[ab]	0.63 ± 0.11[ab]	0.60 ± 0.08[b]	0.001
Number of new-born piglets per litter, all sows					
All piglets/litter, total	15.70	14.96	15.33	15.49	
IUGR alive/litter, total	1.07[abc] (6.8%)	0.69[b] (4.6%)	0.66[b] (4.3%)	1.47[c] (9.5%)	0.01
Number of new-born piglets per litter, sows in the first pregnancy					
All piglets/litter	12.00	12.86	14.43	16.20	
IUGR alive/litter	0 (0%)	0.57 (4.3%)	0.43 (2.9%)	1.00 (6.2%)	NS
Number of new-born piglets per litter, sows in the 1st to 6th pregnancy					
All piglets/litter	15.85	15.30	15.45	15.49	
IUGR alive/litter	1.12[ab] (7.1%)	0.7[a] (4.6%)	0.69[a] (4.5%)	1.47[b] (9.5%)	0.01
Number of new-born piglets per litter, oldest sows (>6th pregnancy)					
All piglets/litter	17.80	14.45	15.23	15.29	
IUGR alive/litter	1.60[ab] (10.1%)	0.75[b] (5.2%)	0.77[b] (5.1%)	2.04[a] (13.3%)	0.01

mean values ± standard deviation, relative values in brackets; one-way ANOVA and Tukey test; [abc] means with different superscripts within the row are significantly different

Table 4. Frequency of intrauterine growth retardation (IUGR) in winter season depending on the number of farrowings in the sow

Farrowing	February '19	February '20	*P*-value
Number of sows/production group	54	52	
New-born piglets/production group	854	842	
Piglets/liter, total	15.70	16.17	0.52
IUGR alive	1.07 (6.8%)	1.15 (7.1%)	0.78
Piglets/liter (primiparous sows)	12,0	15.50	0.15
IUGR alive	0 (0%)	0 (0%)	
Piglets/liter (2nd-6th pregnancy)	15.85	16,23	0.62
IUGR alive	1.12 (7.1%)	1.25 (7.7%)	0.66
Piglets/liter (>6th pregnancy)	17.80	15.41	0.22
IUGR alive	1.60 (10.1%)	1.10 (7.1%)	0.52

mean values and relative values (%) in brackets; T-test

delivered in August, while the lightest were born in February and May. Among IUGRs, the heaviest were born in February, with a mean difference of approximately 100 g compared to autumn IUGRs. Litter size and the number of IUGRs per litter were influenced by sow age and parity (Table 3). Primiparous sows delivered fewer piglets in total, as well as fewer IUGRs compared with multiparous sows. However, a seasonal peak in the percentage of IUGRs born in November was observed in all sows regardless of parity. Older sows (>6th pregnancy) produced large litters (up to 17.8 piglets per litter in February), and they also had the highest percentage of IUGRs, particularly in November and February (13.3 and 10.1%, respectively; Table 3).

Discussion

This study, conducted on a commercial pig farm, revealed significant seasonal fluctuations in the prevalence of IUGR in litters. The number of newborn piglets showing IUGR symptoms was more than twice as high in autumn compared to spring and summer. This pattern was observed in both primiparous and multiparous sows.

As discussed by Doole et al. (2023), conducting studies on commercial production farms has both advantages and limitations, which we acknowledge. On one hand, our study had certain constraints, such as limited possibilities for blood sampling (e.g., for stress hormone analysis), restricted control over some environmental parameters (e.g., light spectrum and intensity), and inability to monitor individual feed intake (Table 2). On the other hand, the study was performed on modern farm with a well-known and stable epizootic status, with 600 breeding sows and their offspring, yielding approximately 50 sows and 750–860 neonatal piglets per production group, and supported by well-trained staff, all of which were essential for obtaining precise and

meaningful results. Experiments conducted on active farms benefit from high external validity, ensuring that the findings are directly applicable to real farming conditions and can be directly relevant to other farms.

Litter size is one of the most important factors affecting the seasonal dynamics of IUGR prevalence. As the number of piglets increases, competition for limited uterine space and placental resources intensifies, potentially impairing foetal development and contributing to growth restriction. This mechanism is particularly relevant in highly prolific sows. Chaiyapatmaetee et al. (2025) demonstrated a significant positive correlation between litter size and IUGR incidence, noting that higher parity was associated with an increased proportion of affected piglets. Their findings suggest that both uterine crowding and the cumulative physiological burden in multiparous sows may contribute to IUGR pathogenesis. These observations are consistent with the present study, which found that higher parity was associated with larger litters and an increased number of IUGR piglets, especially in the autumn months.

During autumn, primiparous sows delivered an average of one IUGR piglet per litter, whereas this number in winter, spring, and summer ranged from 0.0 to 0.57 per litter. In exceptional cases, the most senior sows (7–10 gestations) delivered up to 2.04 IUGR piglets per litter (13.3%) in autumn. However, this increased risk in older sows was balanced by a significantly higher number of healthy piglets per litter in subsequent gestations. The development of a 'thrifty phenotype,' leading to IUGR, may be influenced by various factors, including both infectious and non-infectious causes (Sharma et al., 2016). The herd's health status was stable and closely monitored, with effective control measures in place for epizootic diseases, parasites, and nutrition, and high biosecurity standards maintained. Stress levels

were monitored and considered low. The nutritional status of late-gestation sows was assessed through backfat thickness measurement, with an optimal subcutaneous range of 16–18 mm (Maes et al., 2004; Decaluwé et al., 2013). Values exceeding 18 mm are indicative of over-conditioning, while those below 16 mm suggest insufficient energy reserves for foetal growth and lactation (Maes et al., 2004; Decaluwé et al., 2013). In the present study, only the February measurements showed a modest decrease in backfat, suggesting a minor energy deficit that may have contributed to the increased prevalence of IUGR piglets during the winter months.

The farm staff were well-trained and unchanged for several years, indicating that they were unlikely to have contributed to the observed seasonal variability. Recordings of ambient temperature and humidity in the gestation area did not show any abrupt fluctuations, and no interruptions in electricity supply or ventilation were reported during the study. Nevertheless, significant differences were recorded in the average temperature and humidity in the gestation area throughout the year (Table 1). The optimal ambient temperature range for sows is 14–25°C, with an ideal range of 17–18°C during the second and third trimesters of gestation – periods critical for the development of IUGR symptoms. Temperature readings in the gestation area were slightly above this ideal range by up to 1 °C in winter, spring, and autumn. During the summer months (June, July, and August), temperatures exceeded the ideal range by 2–3 °C but remained within the overall optimal interval. However, temperature alone was unlikely to be the primary factor causing the increased incidence of IUGR, as the lowest number of sows delivering IUGR piglets was recorded in the warmest summer season. Recommended humidity levels are below 70% for early pregnant sows and below 60% for those in late gestation (Wathes and Whittemore, 2006). However, humidity consistently exceeded these recommendations for late-gestation sows in all four seasons (Table 1). The highest humidity was observed in winter and summer, but not in autumn. Consequently, the elevated incidence of IUGRs in the autumn months cannot be fully accounted for by the temperature and humidity conditions within the facility.

Sanford (1982) and subsequently Almond et al. (1985) documented a recurring pattern of autumn abortions in a commercial swine herd in eastern Canada. This pattern was consistently observed in the autumn months, and to a lesser extent, in winter and spring, and was not associated with any specific pathogen or management practices. Sanford (1982) recommended increasing the temperature around sows to 18 °C and providing additional feed to reduce abortions. Other potential explanations for seasonal abortions included changes in photoperiod and poorer body condition of sows at weaning. Marco (2021) proposed a minimum of 14 h of light per day at an intensity of 250–300 lux during autumn and winter. In the present study, light in the gestation area was not strictly controlled, but a minimum of 8 h of light per day was maintained throughout the year. In spring and summer, sunlight was the sole light source, whereas in late autumn and winter, artificial lighting supplemented daylight. It is possible that the reduction in daylight hours at the end of summer (Figure 1), without sufficient compensation from artificial lighting, contributed to the increased number of piglets born with the IUGR syndrome. This interpretation is supported by Scaillierez et al. (2024), who recently discussed the importance of light for pig welfare. Their conclusion was that photoperiod, light intensity, and spectrum are all critical factors influencing activity patterns, feed intake, growth, behaviour, and hormonal secretion in pigs.

Providing adequate nutrition and maintaining a controlled climate in the gestation area reduced the incidence of abortions and increased the number of born-alive piglets, although some still exhibited IUGR symptoms. Pigs with confirmed IUGR symptoms show reduced performance compared to their 'normal' counterparts (Olszewski et al., 2021). Post-weaning performance of IUGR pigs is suboptimal relative to their 'normal' littermates; however, morbidity rates and meat quality in growers/fatteners remain unaffected. Moreover, consumer preference tests demonstrated that meat from IUGR pigs is often more readily accepted than that from healthy pigs (Matyba et al., 2021).

Conclusions

In conclusion, this study demonstrated significant seasonal variations in the frequency of newborn piglets with intrauterine growth retardation (IUGR) both stillborn and live-born. It is hypothesised that the shortening of daylight may play a role in this phenomenon. These seasonal fluctuations may explain the variation in the number of IUGR piglets per litter reported in the literature and should be considered when analysing farm production data.

Conflict of interest

The Authors declare that there is no conflict of interest.

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