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Original article

Factors associated with stillborn and mummified piglets in high-prolific sows

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Abstract — Stillbirth concerns about 2.5 million piglets each year in France and is expected to worsen in the coming years, due to hyperprolific sows. The present study was performed to determine the risk factors of the presence of stillborn piglets or mummies in the litter using data from three experimental herds. From June 1999 until June 2000, sow, stillborn and mummy characteristics were closely recorded around farrowing. Information was recorded on 455 litters, from 308 sows. After selection, a total of 447 litters, originating from 302 crossbred (Large White × Landrace) sows were used. Two hundred and fifty-five litters had no stillborn. Neither individual piglet body weight nor variability of piglet body weight within litters were found to influence stillbirth. A reduction in the average litter or sow live weights increased the probability of having a stillbirth. When a full litter was born with a human presence, the proportion of litters without a stillborn was higher than in cases of partial supervision (65.7 vs. 4.5 to 45.6%). At the same time, the number of litters with two or more stillborn piglets was lower (11.2 vs. 23.6 to 30.9%). Only 46% of the litters had no stillborn when no supervision was performed. These results indicate that good supervision (more than 75% of births with a human presence) decreased stillbirth in pigs, while individual piglet weight did not alter it. A reduction in litter live weight decreased the risk of having mummies, whereas an increased litter size had the opposite effect.

sow / parturition / stillbirth / mummies / risk factors / supervision

Résumé — **Facteurs associés à la présence de porcelets momifiés ou mort-nés dans les portées de truies hyperprolifiques.** La mortinatalité touche chaque année 2,5 millions de porcelets en France et devrait augmenter encore dans les années à venir, à cause de l'introduction des truies

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hyperprolifiques dans les troupeaux. L'objectif de cette étude est de déterminer les facteurs de risques liés à la présence de porcelets mort-nés et momifiés dans une portée, à partir d'observations réalisées dans trois stations expérimentales. De juin 1999 à juin 2000, les informations autour de la mise bas concernant les truies, les porcelets mort-nés et momifiées sont enregistrées. Ces informations sont disponibles sur 455 portées, issues de 308 truies. Après sélection, 447 portées provenant de 302 truies croisées (Large White × Landrace) sont utilisées. Au total, 255 portées n'ont pas de porcelets mort-nés. Le poids individuel du porcelet et la variabilité du poids individuel intra-portée n'ont pas d'influence sur la mortinatalité. La réduction du poids de la portée ou de la truie augmente la probabilité d'avoir des porcelets mort-nés. Lorsque toutes les naissances se déroulent en présence humaine, la proportion de portée sans mort-né est plus élevée que dans le cas d'une présence partielle (65,7 % contre 4,5 à 45,6 %). Dans ce cas, le nombre de portée avec deux porcelets mort-nés ou plus, est plus faible (11,2 % contre 23,6 à 30,9 %). En absence de surveillance, seulement 46 % des portées n'ont pas de porcelets mort-nés. Ces résultats indiquent également qu'une bonne surveillance des mises bas (plus de 75 % des naissances en présence humaine) permet de diminuer la mortinatalité chez le porc, et que le poids individuel n'a pas d'effet. Une diminution du poids moyen de la portée entraîne une baisse du risque de présence de porcelets momifiés, la taille de la portée a, quant à elle, un effet inverse.

truie / mise bas / mort-nés / porcelets momifiés / facteurs de risques / surveillance

1. INTRODUCTION

Several studies in the past were focused on stillborn and mummified piglets [1, 5–7, 9, 12, 14, 18, 25, 26]. However, recent trends have shown a drastic evolution during the last few years, due to the introduction of hyperprolific sows in commercial herds. For instance, in France, the analysis of performance data of French sow herds showed that the total number of piglets born per litter increased from 10.7 in 1980 to 12.5 in 1999 [10]. Similarly, the number of stillborn piglets per litter increased from 0.5 to 0.9. Dagorn and Boulot [4] estimated that 2.4 million piglets were stillborn in 1998. Since litter size is expected to increase even more in the coming years [8], stillbirth is expected to worsen.

Pathogenic agents cause around 30% of stillbirths [23]. The remaining 70% of stillbirths are related to various factors, including previous litter size, age and body condition of the sow, duration of farrowing, litter size and the piglets live weight [6, 16, 18]. According to Zaleski and Hacker [26], many of these parameters were correlated. For example, the duration of farrowing increases when litter size increases. Thus, when comparing litters with or without stillborn piglets, analysing the individual influence of each of these parameters on stillbirth risk is not easy. Information on mummified piglets is also scarce [25] and analysis of risk factors associated with the incidence of mummies in the litters of hyperprolific sows has not been performed.

The aim of the present study was therefore to determine the risk factors of the occurrence of stillborn piglets or mummies in high-prolific sows using data from three experimental herds.

2. MATERIALS AND METHODS

2.1. Animals

Parturition was closely observed in three experimental herds, in the Western part of France. A total of 455 litters originating from 308 (Large White × Landrace) crossbred sows were included in the study. Parity of the sows varied between 1 and 9. Litters with no piglets born alive or with less than 6 total piglets born were excluded. In the final analysis, 447 litters from 302 sows were used.

2.2. Data records

Sow condition score at the end of gestation was estimated using a scale of one to five, with one, three and five representing respectively a very thin, a normal and a very fat sow. One week before the expected day of parturition, sows were weighed and moved into the farrowing facilities. To describe sow behaviour just before and during parturition, sows were classified as "quiet" or "nervous". Sow rectal temperature was recorded at the beginning of parturition. Injections of prostaglandins to induce parturition and oxytocin during parturition were registered when used.

The numbers of piglets born (alive, stillborn and mummies) in previous and present parities were registered. Individual body weight of the piglets and the hour of birth were recorded, as well as sex and birth order for stillborn piglets. In addition, the status of the umbilical cord (cut or not) was checked. Only rank and body weight were noted for mummified piglets.

Since some piglets may breath a few seconds before dying, the lungs of all stillborn piglets were examined. When the lungs sank in the water, it was concluded that the piglet did not breath and was a true stillborn. Concerning mummies, a careful examination of animals and placentae were performed, extracting mummies from the placentae when necessary.

During parturition, the technical staffs of the herds were present as often as possible. When they observed a birth, "observed" was noted. When they did not, it was recorded as "not observed". In both cases, the time of the observation and body weight of the piglets were registered. For each litter, a supervision rate was defined as the number of piglets "observed", divided by the total number of piglets born. Time of manual extraction of the piglets was also registered when it was performed.

2.3. Calculations and statistical analysis

The supervision rate of parturition was defined as the percentage of piglets born in the presence of technicians.

The relations of sow variables (body weight, behaviour, litter size, backfat thickness) to the presence of stillbirth or mummies within a litter were determined by logistic regression using the Proc Catmod procedures [22]. All non related variables, including sow, litter and piglet characteristics, extractions and injections were included in the full model. Variables not significant at $P = 0.1$ were removed from the final models. In the case of stillbirths, the number of piglets born alive, the average birth weight of the litter, parity, sow body weight and condition score, sow behaviour before parturition, sow rectal temperature during farrowing and the use or not of oxytocin were finally used. For mummies, the model included average litter weight, the number of piglets born alive during previous and present parities, and the interval between induction and parturition.

3. RESULTS

There were an average 13.4 piglets born per litter, including 0.7 stillborn piglets and 0.5 mummies. A total of 5 780 piglets were born, of which 324 were stillborn (5.6%) and 228 were mummified (3.9%). Nearly 80% of the stillborn piglets and 69% of the mummified piglets were born in the second half of parturition (Fig. 1).

When the supervision rate increased (from 0 to 100%), the number of litters without stillborn piglets increased, from 40–45% in cases of small supervision (less than 50% of the births per litter were observed) to 59–66% in cases of good supervision (more than 50% of the births per litter were observed) (Tab. I). The number of litters with more than two stillborn

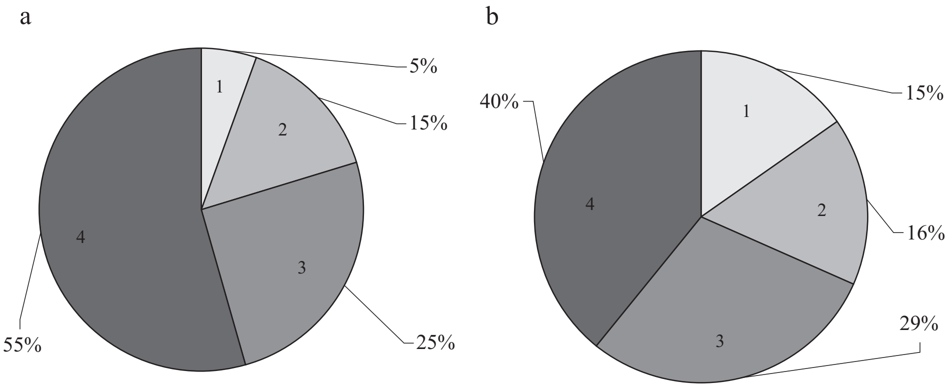

Figure 1. Distribution of the births of stillborn (a) and mummified (b) piglets during parturition (1, 2, 3 and 4 corresponded respectively to the 1st, 2nd, 3rd and 4th part of parturition, which length was equally divided in 4 parts).

Table I. The effect of the supervision rate on the number of litters with or without stillborn piglets.

% of piglets born in the presence of technicians	Number of litters	% of litters with 0 stillborn piglet	1 stillborn piglet	2 stillborn piglets or more
0	68	45.6	30.9	23.6
1–50	42	40.5	28.6	30.9
51–99	159	59.1	22.6	18.2
100	178	65.7	23.0	11.2

piglets was nearly halved (26.4 and 14.8%, respectively).

In the statistical analysis, the average gestation length was not included in the present analysis, because only 29% of the sows farrowed naturally. Also, the duration of parturition was not included in the model, because it was closely connected with litter size and injections of oxytocin, which were already included, and because 24% of the farrowings had no piglet extraction.

A total of 149 sows had no oxytocin injections. In this case, farrowing length averaged 182 ± 116 min, with an average litter size of a total of 13.1 piglets and 0.86 stillborn piglets. For a similar litter size (12.9 total piglets born) one injection of oxytocin induced a reduction in farrowing length to 160 ± 79 min, and a fewer number of stillborn piglets (0.61).

An increased probability of stillbirth in a litter was correlated with a lower average birth weight of the litter, lower body weight of sows at farrowing, and a lower use of oxytocin during parturition. This probability also increased with an increasing parity, a higher condition score of the sow, larger number of piglets born alive, more

Table II. Variables related to the presence of stillborn piglets in the litter.

Variable	Coefficient	Standard error	*P*
Intercept	25.5	12.7	0.05
Litter birth weight, kg	–0.19	0.06	0.001
Number of piglets born alive	0.31	0.08	0.001
Sow body weight, kg	–0.029	0.0098	0.001
Parity at farrowing	0.36	0.13	0.010
Use of oxytocin	–0.42	0.19	0.050
Sow condition score	0.72	0.30	0.050
Sow behaviour before farrowing	0.55	0.30	0.060
Sow rectal temperature, °C	–0.53	0.32	0.095
Behaviour* during farrowing	0.62	0.41	ns

* Behaviour was determined as "quiet" or "nervous".

Table III. Sow variables related to the risk of mummies in the litter.

Variable	Coefficient	Standard error	*P*
Intercept	4.31	2.34	0.060
Litter weight, kg	–0.35	0.07	0.001
Number of piglets born alive n*	0.45	0.10	0.001
Number of piglets born alive n-1**	–0.18	0.07	0.009
Interval induction-parturition	–0.0007	0.0005	0.080
Number of mummies n–1	0.53	0.34	ns
Number of stillborn piglets n–1	0.25	0.25	ns
Sow body weight, kg	–0.002	0.007	ns

* Present litter.
** Previous litter.

aggressive behaviour before farrowing and, but to a lower extent, lower rectal temperature of the sow (Tab. II).

An increased probability of mummified piglets in a litter was connected with a lower average birth weight of the litter, larger number of piglets born alive at previous and present parities, and to a limited extent, a decreased interval between the induction and start of farrowing (Tab. III).

4. DISCUSSION

The aim of this study was to identify some risk factors of mummies and stillborn piglets in a litter, with a special focus on factors associated to sow and litter characteristics.

The sow performances in the three herds presented in this study were higher than the average performance recorded in the western part of France during the same period (a total of 12.6 piglets born, with 0.9 stillborn piglets) [11]. The performance data of French sow herds did not include mummies and some of them might have been confounded with stillborn and wrongly recorded.

The most striking result of the present study is the decreasing rate of stillbirth with the increasing rate of supervision of farrowing. Within each herd, the best performance was obtained when technicians reacted rapidly to abnormal intervals between births (more than 30 min) and manually extracted one or more piglets. These data are consistent with those of Holyoake et al. [9] indicating that attending to farrowing results in a reduction of stillborn piglets from 0.68 to 0.28 piglets per litter. Similarly, in the study of White et al. [24], 0.2 piglets per litter were dead at birth in the attended group and 0.6 piglets in the unattended group. This provides evidence that assistance to farrowings could save piglets which are usually classified as being born dead. This also suggests that these piglets had undoubtedly suffered during the birthing process indicating that the birthing process may be an important cause of mortality.

However, neither individual piglet body weight nor variability in birth weight within the litter affected the probability of stillbirth. In contrast, other authors [15, 21] observed a higher occurrence of stillbirth among piglets with low birth-weights. But the present results agree with those of Zaleski and Hacker [26], suggesting that small piglets are not more likely to be born dead than heavier ones but they have a reduced viability and are more prone to die during lactation than heavy ones (for a review, see Le Dividich and Herpin [13]).

A reduction of sow or litter live weights increases the probability of the occurrence of a stillbirth. According to Zaleski and Hacker [26], this may reflect the quality of uterine support of the litter and the vigour of the litter at the onset of parturition. The decreased uterine space per fœtus explains why piglets from large litters are lighter at birth [20]. Uterine space may partially be connected to sow body weight, which could explain the smaller uterine space of primiparous sows in comparison with multiparous animals [19]. For a given litter size, a reduction in sow body weight would then indicate a smaller uterine capacity and consequently, an increased stillborn rate.

However, in the present study, sow body weight did not affect the number of mummified piglets. This result suggests that during the major part of gestation, uterine space is large enough. According to Wu et al. [25], the uterus length in sows with or without mummies is equivalent, but litters with mummies have a higher number of foetuses. The percentage of mummies in a litter increases then when individual space decreases in the uterine horn [25]. It could be suggested then that the uterine space is more likely to influence prenatal death when growth of foetuses is high in the last part of gestation [17].

The increase in parity resulted in a higher probability of stillbirth, whereas the incidence on mummies was not affected. According to English and Morrisson [6], sows of high parities have poorer muscle tone and Pejsak [18] suggested that previous farrowings modify the uterus tract. Since older sows take longer times to farrow and have a higher incidence of intrapartum stillbirths [6], reducing farrowing length through injections of oxytocin should decrease the risks of stillbirth. This was observed when one injection of oxytocin was performed, which was considered as a normal routine in these herds. When more injections were performed, they were often related to farrowing problems. In these case, oxytocin injections did not reduce parturition length (174 min) or the number of stillborn piglets (0.72). This result illustrates the fact that massive injections of oxytocin are not efficient in reducing farrowing length and the stillbirth rate.

Behaviour prior to farrowing, estimated by a sow being "quiet" or "nervous", but not during parturition influenced the probability of stillbirth. A "nervous" sow before farrowing, even if "quiet" during parturition, had a higher risk of having a stillbirth than a sow who was "quiet" before parturition but aggressive during farrowing. The behaviour of sows may originate from various sources including the type of pen, ambient temperature or handling [18]. Cariolet et al. [2] also observed that during gestation, reactive sows have a lower reproductive performance. Attention should then be paid to the environment of the sow before farrowing, in order to reduce the risk of stillbirth.

Information on mummies is scarce. The analysis of performance data of French sow herds provided a mean value of 0.19 mummies per litter (S. Boulot, personal communication). This was higher than the 0.14 value reported by Zaleski and Hacker [26], but much lower than that in the present work (0.5). This higher number in comparison with the results of Zaleski and Hacker [26] might be a result of the high ovulation number in hyperprolific sows, which also resulted in a higher number of mummies [25]. Although pathogenic agents cause around 30% of stillbirths [23], research of viruses and/or bacteria in stillborn or mummified piglets was not performed in the present study. A few sows had more than 3 mummies (only 14 animals), without any correlation between the number of mummified piglets and the number of stillborn piglets. Cariolet et al. [3] indicate that in air-filtered units, the real stillbirth of pure specific pathogen-free Large White sows is around one piglet per litter, similar to the results observed in selection herds during the same period.

5. CONCLUSION

The present study showed that the increased stillbirth rate observed in the recent past appears to be mainly due to the introduction of hyperprolific sows in commercial herds and therefore to the improved litter size. However, supervision of farrowing including providing assistance to the piglets and to the sow are efficient in reducing the stillbirth rate. In the future, selection programs focusing on piglet viability should be worthwhile.

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