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Suckling Behaviour of Piglets Affected by Body Weight and Sex

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ABSTRACT

Piglet suckling behaviour has been extensively studied, but surprisingly, there are not many studies that specifically consider body weight and sex in this context. These two basic individual characteristics have been considered more as supporting data but not as main factors. Therefore, the objective of the present research was to examine the effect body weight on suckling behaviour of piglets during lactation separately by sex. The study comprised 14 litters with a total of 158 piglets (85 male, 73 female, litter size 6–15 piglets). Suckling behaviour was described in terms of suckling position (the teat at which the piglet suckled during suckling), suckling territory (the range two outermost suckling positions of the piglet encompasses) and suckling stability (the tendency to suckle successively at the same position), and was observed in six periods: 0–3, 4–7, 8–10, 11–14, 15–21 and 22–32 days of age. In each period, piglets were also weighed. The udder was divided into three areas: anterior (1st-2nd teat pair), middle (3rd-5th teat pair) and posterior (6th-8th teat pair). Body weight affected suckling behaviour differently in male and female piglets (i.e., all traits in females, suckling stability only in males). The relative body weight of females decreased significantly from the anterior towards the posterior part. Heavy females (but not males) suckled considerably more frequently on the anterior area. Heavier piglets (male and female) established more stable suckling order. Suckling territory of males was quite large, but did not differ among body weight classes. Interestingly, light females visited significantly larger suckling territory than heavy females. The present results fill a gap in the otherwise broad knowledge of pig suckling behaviour, which is of great importance for litter management during lactation, especially when cross-fostering is implemented. In this context, knowledge of the detailed role of sex and body weight is of particular importance because breeders rely mainly on basic body traits when managing litters.

Key words: pig, lactation, body weight, sex, suckling position, suckling stability, suckling territory

INTRODUCTION

The process of suckling in the pig, the only truly polytocous ungulate, is complex but has been extensively studied and is thus relatively well explained (McBride, 1963; Fraser, 1973; Fraser and Jones, 1975; Ewbank, 1976; Skok, 2015). In general, previous studies have shown that neonatal piglets begin to form suckling order immediately after birth, with a relatively stable teat order established as early as in the first few days of lactation (fully in the second week). The suckling order reduces conflicts between littermates and consequently increases the growth and survival rate of piglets (Fraser and Jones, 1975; Puppe and Tuchscrerer, 1999; Skok and Škorjanc, 2014a). Further, it was generally found, that the anterior teat pairs are considered the most attractive to piglets (De Passille et al., 1988; Fraser, 1975; Fraser, 1984), however, the middle part of the udder was found to be most crowded, competitive and stressful environment with the highest frequency of fights/aggressive interactions (Skok and Škorjanc, 2013, 2014a). Consequently, the stability of suckling order is lower in the middle of the udder and higher on both the anterior and posterior teat pairs (De Passille et al., 1988; Puppe and Tuchscrerer, 1999; Skok and Škorjanc, 2014a). According to the literature, several factors could affect teat selection mutually or in interaction such as the amount of milk produced in different parts of the udder (Jeppersen, 1982a), the specific smell and taste of the teats (Jeppersen, 1982b), the proximity of the sow's head and vocalisation (Castren in sod., 1989; Kasanen

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in Algers, 2002), potential recognition of littermates (Ewbank in sod., 1974; McLeman in sod., 2005), aggression/fighting ability (Skok and Škorjanc, 2014b), morphological characteristics of the teats such as teat length and space between teats (English, 1973; Jeppersen et al., 1982b), ancestral suckling preferences (Skok in Gerken, 2016) etc.

Yet, suckling behaviour is also affected by several piglet-related factors such as the basic ones, body weight and sex. However, previous studies, although numerous, did not clearly explain the effect of body weight and sex of piglets on suckling behaviour. Such studies were rare, and body weight and sex appeared to be supporting information rather than influencing factors subjected to comprehensive analysis. First, body weight may play an important role in the selection of suckling position. However, the studies indicated only a tendency, if any, for heavier/larger piglets with higher dominance rank in the social structure to occupy the anterior (and middle) teat pairs (Fraser and Jones, 1975; Orihuela in Solano, 1995; Puppe and Tuchschrerer, 1999; Skok et al., 2007, Skok & Škorjanc, 2013). Further, the effect of body weight on the suckling stability is even less clear. De Passille et al. (1988), for instance, showed a significant positive correlation between body weight and suckling stability after the fourth day of lactation. This is not entirely consistent with several other studies which showed higher suckling stability at both ends of the udder than at the middle teat pairs (Fraser, 1975; Puppe and Tuchscherer, 1999), as heavier piglets suckle at the front and lighter at the last teat pairs. Indirectly, the relationship between body weight and suckling stability was also studied through litter growth rate and litter size (faster growing litters and smaller litters showed more stable teat order; Winfield et al., 1974) or litter body weight variability (there was little evidence that higher variation in birth body weight allowed faster establishment of dominance; Milligan et al., 2001a). As for piglet sex, there is an even greater lack of studies directly addressing this issue. Rosillon-Warnier and Paquay (1984) found, for instance, that sex (in addition to birth weight and order) had no effect on teat order. Further, differences between the sexes were mainly related to differences in body weight and aggressiveness (Milligan et al., 2001b; Bonisoli-Alquati et al., 2010), which may implicitly be related also to suckling behaviour.

A considerable gap in the understanding the complex relationship between body weight and sex of piglets and its effect on suckling behaviour was a motive for the present research. Our objective was to study the effect of piglet body weight on suckling behaviour in terms of suckling order stability, suckling position and the size of suckling territory (range) separately in male and female piglets. We hypothesised that heavier piglets would establish a stable suckling order earlier, occupy the anterior and middle teat pairs more frequently and have a smaller suckling range. As for the sex of the piglets, similar behavioural patterns were expected in case of male and female piglets of different weights.

MATERIAL AND METHODS

Animals and housing

Data was collected at the Pig Research Centre of the Faculty of Agriculture and Life Sciences, University of Maribor in accordance with Animal Protection Act (Ur. l. RS, No. 38/2013). The data set comprised 14 litters with a total of 158 piglets (85 male piglets and 73 female piglets). The size of the litters ranged from 6 to 15 piglets with a median of 10.5 piglets. Sows were of different breeds/crossings and were in different parities. During lactation, the sows with their litters were housed in conventional pens with farrowing crates. From the 14th day of age, piglets were additionally offered solid feed. All piglets were individually marked on the back within 24 hours after birth. These markings were maintained until the end of lactation. Piglets were given ear numbers at the first weighing.

Performance of measurements

Measurements were carried out during lactation (from birth to weaning). Data comprised piglet characteristics (body weight and sex) and suckling behaviour parameters (suckling position, suckling territory and suckling stability). Sex of piglets was determined at birth. Piglets were weighed 6-times during lactation, always after observation of suckling behaviour. Body weight was further converted to relative body weight within each litter using the formula: relative body weight = (body weight – mean) / standard deviation. The values of relative body weight ranged from –2.75 to 2.29. Based on relative body weight, piglets were divided into three classes: light, medium and heavy piglets, with values of –0.5 and +0.5 as cut-off values between classes.

Behaviour observation

To determine the order of suckling, each piglet was observed individually. Therefore, data were collected by direct observation of sows and litters. Behavioural observations were carried out in six periods of lactation: 0–3, 4–7, 8–10, 11–14, 15–21 and 22–32 days of age. At least two consecutive suckling sessions were considered on each observation day. The following was recorded: piglet identification and teat(s) visited throughout the suckling session (visited teats) including pre- and post-massage phase and milk outflow with special attention given to the latter (teats selected during milk outflow, i.e. preferential teats).

Suckling position

Suckling position of each piglet was determined based on preferential teats (selected during milk outflow). Preferential teats were divided into three suckling areas: anterior (1st and 2nd teat pair), middle (3rd, 4th and 5th teat pair) and posterior (6th, 7th and 8th teat pair). Final results were expressed as the number of sucklings per teat pair in each suckling area.

Suckling territory

Suckling territory (or range) was calculated based on the area of the udder encompassed by the teats that the piglet suckled, with a 'teat pair' as the unit of measurement. Particularly, it is the number of teat pairs in the range of the outermost teat pairs that are also included in the count; for example, the suckling territory of the piglet that visited the 2nd, 4th, and 7th teat pair in a given period was 6. Suckling territory in our case, with sows having up to 8 teat pairs, could therefore range from 1 to 8.

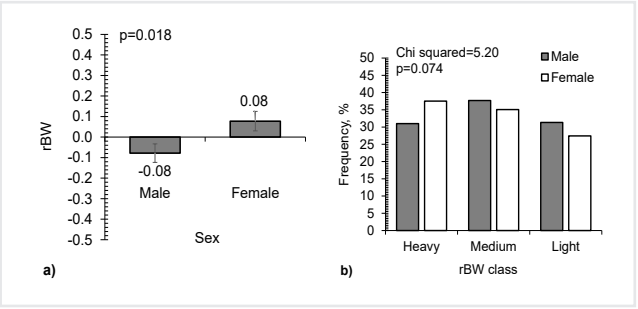
Suckling stability

Suckling stability was calculated using an equation derived from basic probability theory as described in Skok (2015). Suckling order stability ranges from 0 to 1, with 0 indicating complete instability (no piglet in the litter sucked more than once on a given teat) and a value of 1 indicating complete stability (a given suckling pair was used only for one piglet; Skok and Škorjanc, 2013). The value n represents the number of sucklings on a particular suckling pair that a given piglet performs, and N represents the total number of sucklings observed on a specific suckling pair.

Statistical analysis

Statistical analysis was performed in the IMB SPSS Statistics program (Version 28.0). First, we analysed the relationship between body weight and sex. Independent samples t-test was used to test the differences in relative body weight between sexes. Additionally, the distribution of male and female piglets was calculated according to relative body weight classes and the differences checked using Chi squared test. Results indicated somewhat higher relative body weight of female compared to male piglets (Fig. 1a) as well as the tendency of different distributions of male and female piglets among relative body weight classes (Fig. 1b). All further analyses on the effect of body weight of piglets on behavioural traits were carried out by sexes.

Analysis of suckling position included calculation of frequencies of male and female piglets of different weights across suckling areas (anterior, middle, posterior). The differences in distributions were tested using the Chi squared test. Additionally, means with standard errors for relative body weight were calculated for each suckling area (anterior, middle, posterior) and the differences among them tested using analysis of variance and Tukey's post-hoc test (separately by sexes). In case of suckling stability and suckling territory, the effect of body weight (light, medium and heavy) was calculated using Kruskal-Wallis test separately for male and female piglets. Non-parametric test was used as both behavioural traits were not normally distributed (tested with Shapiro-Wilk test of normality).



rBW – relative body weight calculated within each litter as rBW=(body weight–mean)/standard deviation

Figure 1: Relationship between relative body weight and sex of piglets

RESULTS

Suckling position

The frequency of suckling in male piglets (castrates) and female piglets (gilts) on different suckling areas showed different distribution (Fig. 2). Female piglets most frequently occupied the anterior teat pairs (45%), followed by middle teat pairs (39%) and *vice versa* in male piglets who suckled most often on the middle (46%) followed by anterior teat pairs (34%). Posterior teat pairs were used much less frequently in both sexes (16% and 20% for female and male piglets, respectively).

The results further showed different distributions of male and female piglets of different body weight classes across suckling areas (Fig. 2) whereby the difference between sexes mainly concerned anterior part of udder (significant difference, $p<0.001$ – not shown). Body weight of piglets significantly affected suckling position in females and only tended to affect it in males (Fig. 2b). The distributions of heavy, medium and light females differed significantly among suckling areas ($p<0.001$), especially in the anterior suckling area. Heavy females predominate on anterior area and rarely used posterior teat pairs. Medium weight females occupied equally often anterior and middle teat pairs. Light females most often suckled on middle teat pairs, followed by posterior and anterior teat pairs. The distributions of male piglets of different weight classes differed to a lesser

extent across suckling areas compared to females. Male piglets of all three body weight classes suckled most often on middle area, followed by anterior and finally posterior area. Additional analysis on body weight effect (Fig. 3) confirmed pronounced differences among suckling areas in case of females only (p<0.001) with relative body weight decreasing significantly from the anterior to the posterior area (Fig. 3b). In male piglets, relative body weight was similar across suckling areas (p=108; Fig. 3a)

Suckling stability

According to the results, body weight significantly affected suckling stability (Fig. 4). The effect of interaction between body weight and sex was not significant as the same pattern of suckling stability could be seen for male and female piglets. In both sexes, suckling stability significantly increased with piglet body weight. Medians for light, medium and heavy males were 0.35, 0.43 and 0.60, respectively (p<0.001). In females, medians were 0.40, 0.42 and 0.48 for light, medium and heavy piglets, respectively (p=0.038).

Suckling territory

The effect of body weight of piglets on suckling territory is presented in Fig. 5. There was no significant effect of body weight on suckling territory in male piglets (p=0.934) where median value for suckling territory of all three body weight classes amounted to 2. In females, body weight significantly affected suckling territory (p=0.047). The results indicated that light females selected teats to suckle on broader suckling territory compared to heavy females, with medium weight females having intermediate position.

DISCUSSION

A noteworthy result of present study is that male and female piglets showed different patterns of suckling behaviour. Thus, the results to a certain extent complement published data where a large majority of studies treated suckling behaviour of all piglets together not paying attention to possible sex differences. Moreover, general patterns of udder occupation during suckling – with the highest crowd on middle area, similar or somewhat lower occupancy in the anterior area and considerably lower in posterior area – that was shown in many studies (Puppe and Tuchscherer, 1999; Skok & Škorjanc, 2013; Skok et al., 2014), was in our study confirmed in case of male piglets only. Females, namely, most often occupied anterior positions, but in accordance with literature, posterior teat pairs were generally seldom visited in all piglets. During

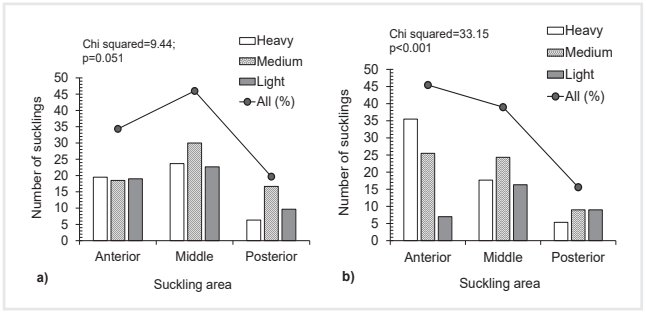
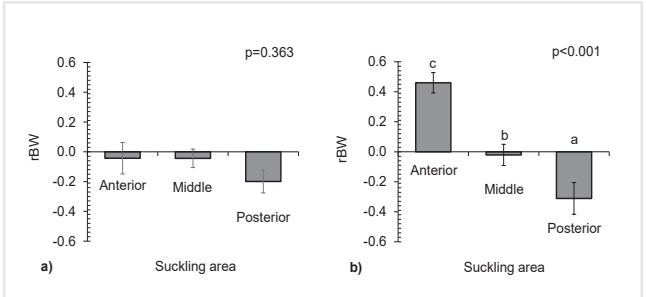
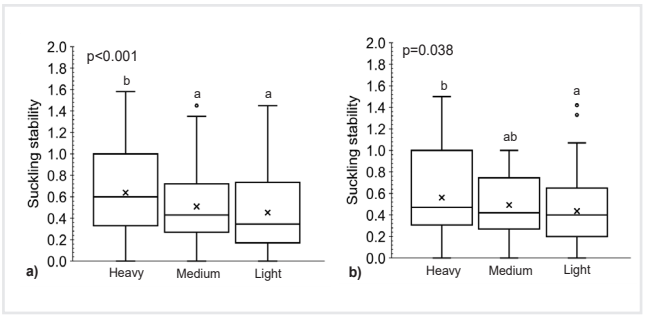


Figure 2: Suckling position according to body weight in male (a) and female piglets (b)



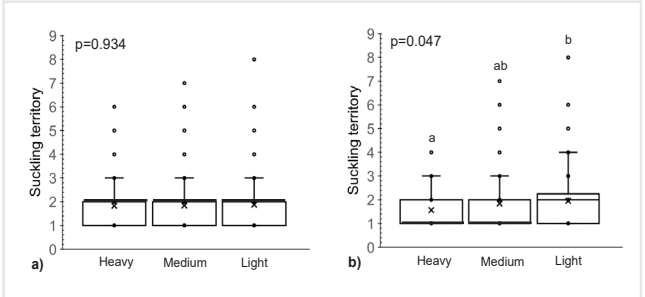
rBW – relative body weight calculated within each litter as rBW=(body weight–mean)/standard deviation

Figure 3: Relative body weight of male (a) and female piglets (b) suckling on different suckling areas



Suckling stability – the tendency to suckle successively at the same position

Figure 4: Suckling order stability according to body weight in male (a) and female piglets (b)



Suckling territory – the range two outermost suckling positions of the piglet encompasses

Figure 5: Suckling territory according to body weight in male (a) and female piglets (b)

lactation, the front teat pairs were found as being the most often occupied by heavier piglets with higher dominance rank in the social structure as these teats are supposed to be more attractive (Fraser, 1975; Orihuela & Solano, 1995; Puppe and Tuchscherer, 1999). The reasons for higher affinity of piglets for the front teats have still not been unambiguously explained. Several interacting factors are probably involved such as milk productivity in relation to higher intensity of stimulation in this part of udder due to higher crowd (review in Skok and Škorjanc, 2014b), higher degree of safety (lower risk of being trampled the anterior area; Scheel et al., 1977), morphological characteristics of teats (e. g. shape and length; Fraser, 1984) or proximity of the mother's head and sow vocalisation (Castren in sod., 1989; Kasanen in Algers, 2002). However, it should be emphasised that only the tendency or very weak effect of body weight on suckling position was mainly reported. Our results conversely showed strong effect of body weight on suckling position, but was not uniform in both sexes, as it had highly significant effect in females but not in males. This difference between sexes that was found in our research could explain weak correlations of suckling position with body weight reported in literature when considering both sexes together.

According to the results, females were more successful in acquiring the positions in the anterior part of the udder, where presumably suckle the piglets with the highest position in the dominance rank (Fraser, 1975; Orihuela & Solano, 1995; Puppe and Tuchscherer, 1999). It is known from some other contexts (e. g. weaning), that females may participate more in aggressive interactions which are otherwise a core tool in the establishment of the dominance hierarchy (Mesarec et al., 2021). Higher dominance rank is associated with higher body weight (Ewbank, 1976; Puppe and Tuchscherer, 1999). Indeed, females in our study proved to be heavier than males (Fig. 1). Although literature data are not consistent in this regard; some studies showed one sex (mainly males) as heavier, while no differences in weight were observed between the sexes in other studies (Milligan, 2001b; Škorjanc et al., 2007). When studying the effect of sex on suckling behaviour during lactation, it is worth mentioning possible consequences of castration of male piglets. Castration is usually carried out in the first few days after birth, at the time of the most intensive establishment of the teat order. It is a stressful and painful procedure, which can hinder growth and cause changes in behaviour of male piglets (e.g., reduced participation in teat fights, altered suckling behaviour; Prunier at al., 2006).

In our research, piglet body weight turned out to be an important influential factor affecting suckling stability in the same direction (positive correlation) in both sexes. Opposite, previously published papers showed no important impact of body weight on suckling stability, e.g., only a weak correlation with suckling stability/teat fidelity (De Passillé et al., 1988; see also Skok and Škorjanc, 2013). Regarding the effect of sex, only one study (Rosillon-Warnier and Paquay, 1984) found comparable results showing no effect of the sex of piglets on teat order stability.

Interestingly, male piglets occupied a similar and relatively broad suckling territory regardless of body weight, and the same was true for lower body weight females. Heavy females, on the other hand, were clearly more territorial and, according to the results on suckling position (anterior) and stability, also more dominant. To our knowledge, there are no studies that directly address suckling territory or range in pigs in relation to sex and/or body weight. However, one is tempted to suspect that the pattern observed here for suckling territory mirrors to some extent the situation of territorial/home range dynamics in the wild counterpart of the domestic pig. Firstly, the male wild boar is a dispersing, mostly solitary sex and therefore has an innate tendency to occupy a larger territory/home range than the female, which has been demonstrated in numerous studies (Massei et al., 1997; Dexter, 1999; Saïd et al., 2012; Podgórski et al., 2014; but see also Russo et al., 1997). In addition, the pig/wild boar has a matrilineal social system in which sows and their offspring live in family groups, with some females dispersing after weaning but the others remaining in the natal group (Kaminski et al., 2005; Podgórski et al., 2014). In social species, subordinate females suffer from competition with more dominant group members. Therefore, the tendency to disperse may allow subordinate females to escape from groups or territories where there is intense competition for resources or reproductive opportunities (Clutton-Brock and Lukas, 2012). Following this analogy, it can be hypothesised that female piglets, which are lighter and thus subordinate, show dispersal tendencies early in life (excavating wide suckling territories), while heavier and thus dominant females show a tendency towards greater territorial behaviour (speaking in a later temporal context, show a tendency to remain in the natal group/territory). Although no simple parallels can be drawn between domestic animals and their wild counterparts (e.g. Price, 1984), it can be assumed that domesticated forms of animals retain a large proportion of the traits that were 'programmed' during the evolutionary time of the species, as divergence has occurred relatively recently, with the random genome sequences of wild boars and domestic pigs being very similar and indistinguishable (Rubin et al., 2012).

CONCLUSIONS

As oppose to the hypothesis, body weight affected suckling behaviour differently in male and female piglets. Although considerably stronger effect of piglet body weight on suckling behaviour was observed than has been demonstrated in previous studies, this effect was found only in female piglets with the exception of suckling stability. Heavier male piglets

had higher suckling stability, but did not differ from lighter piglets in suckling position and territory. Heavier female piglets selected more frequently anterior teat pairs, established a more stable suckling order, and consequently had a smaller suckling territory compared to lighter females. The present findings complement understanding of the detailed role of piglet body weight and sex in suckling behaviour, which was lacking in the otherwise well-explained behaviour of piglets during lactation.

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Vpliv telesne mase in spola pujskov na sesno obnašanje

IZVLEČEK

Sesno obnašanje pujskov je bilo v preteklosti sicer obsežno raziskano, pa vendar presenetljivo ni prav veliko raziskav, ki bi posebej obravnavale vpliv telesne mase in spola na sesno obnašanje. Ti dve osnovni lastnosti pujskov sta bili v raziskavah vključeni kot podporni podatki, ne pa kot glavni dejavniki preučevanja. Iz tega razloga je bil cilj naše raziskave preučiti vpliv telesne mase na sesno obnašanje pujskov v času laktacije ločeno po spolu. V raziskavo je bilo vključenih 14 gnezd s skupno 158 pujski (85 pujskov moškega spola, 73 pujskov ženskega spola, velikost gnezda 6–15 pujskov). Sesno obnašanje smo opisali kot sesni položaj (sesek, ki ga je pujsek sesal med sesanjem), območje sesanja (razpon, ki sta ga zavzemala dva najbolj oddaljena seska, ki jih je pujsek sesal med sesanjem) in stabilnost sesanja (nagnjenost k zaporednemu sesanju na istem sesku). Opazovanja so bila izvedena v šestih obdobjih laktacije: 0–3, 4–7, 8–10, 11–14, 15–21 in 22–32 dni starosti. V vsakem obdobju smo pujske tudi stehtali. Vime svinje smo razdelili na tri dele: sprednji ali anteriorni (sesni par 1 in 2), srednji (sesni par 3 in 4) in zadnji ali posteriorni (sesni pari 6, 7 in 8). Rezultati so pokazali, da ima telesna masa različen vpliv na sesno obnašanje pri pujskih ženskega in moškega spola in sicer vpliva na vse preučevane lastnosti pri ženskih pujskih, pri moških pujskih pa le na stabilnost sesanja. Telesna masa pujskov ženskega spola je bila na sprednjem delu vimena v primerjavi z zadnjim delom značilno večja. Pri ženskem spolu se je izkazalo, da težji pujski precej pogosteje sesajo na prednjem delu vimena. Težki pujski obeh spolov so vzpostavili stabilnejši sesni red v primerjavi z lahkimi pujski. Območje sesanja je bilo pri moških pujskih precej obsežno, vendar se ni razlikovalo glede na telesno maso pujskov. Zanimivo pa so lahki pujski ženskega spola sesali na značilno večjem območju sesanja kot težki pujski ženskega spola. Dobljeni rezultati zapolnjujejo vrzel v sicer dobrem poznavanju sesnega obnašanja pujskov, kar je pomembno za rejsko delo v času laktacije, še zlasti pri izvajanju navzkrižnega premeščanja pujskov. V tem kontekstu je poznavanje podrobne vloge spola in telesne mase še posebej pomembno, saj se rejci pri delu pogosto odločajo predvsem na osnovni telesne lastnosti pujskov.

Ključne besede: prašič, laktacija, telesna masa, spol, položaj sesanja, stabilnost sesanja, območje sesanja