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Prevalence of lactational oestrus in cats and consequences for kittens

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Abstract

Objectives Although lactation and suckling suppresses fertility in most mammals, some feline breeders have reported spontaneous oestrus during lactation, causing distress to kittens. This led the Official French Feline Pedigree Registry (Livre Officiel des Origines Félines – LOOF) to send a questionnaire to cat breeders requesting data on their last three litters. The aim of this study was to investigate the prevalence of lactational oestrus, its impact on litters and potential associations with litter size, age, parity, breed and seasonality.

Methods Answers from 108 breeders were collected, providing data on 238 litters in 23 different breeds. Data were also collected on successive litters from multiparous queens (n = 20) and were analysed separately from the 195 independent births.

Results Of the 195 independent births with complete data sets, 96 (49%) queens came into oestrus during lactation, 37 (38%) of which were associated with loss of maternal interest (n = 20), milk quality variation (n = 2), clotted milk (n = 3), reduced milk quantity (n = 13), which in kittens led to reduced weight (n = 6), diarrhoea (n = 9), vomiting (n = 4), nausea (n = 2) or death (n = 4), and bottle feeding (n = 2), early weaning (n = 4) or modified litter behaviour (n = 1). A significant association was found between small litter size (one or two kittens) and the onset of lactational oestrus ($P = 0.007$) and between births occurring in February, March and April and lactational oestrus ($P = 0.005$); there was no association with age or breed.

Conclusions and relevance Breeders perceived a relationship in 38% of cases of lactational oestrus with maternal disinterest, clotted milk, reduced milk yield and in kittens, weight loss, vomiting, diarrhoea or even death. An association between small litter size and lactational oestrus was found, as well as with births occurring between February and April. Breeders presenting with at-risk females should be warned. Conservative and preventive measures such as contraceptive options are discussed as a possible therapy.

Keywords: Lactation; oestrus; neonate; neonatal mortality; maternal behaviour; purebred; weaning; neonatology

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Introduction

Studies from the 1980s have shown that lactation in queens may inhibit folliculogenesis, as well as gonadal and pituitary secretions.[1] The onset of oestrus may vary between 1 and 28 weeks after parturition, with an average of 8 weeks,[2,3] corresponding to 2–3 weeks after weaning.[4,5] Some queens may still exhibit an oestrus that may be shorter and less fertile while nursing their offspring.[6] Maternal disinterest has been linked to kitten mortality,[7,8] but, until now, it has not been linked to lactational oestrus. The factors influencing lactational oestrus in queens and the consequences for kittens are essentially unknown. In sows, the parturition to first fertile oestrus interval has been thoroughly studied to increase yearly farrowing rates. Multiple influencing factors have been proposed, such as temperature, nutrition, stress,[9] illness, lactation length,[10,11] the number of suckling piglets and intermittent suckling.[12] The aim of this observational study was to focus on the prevalence of lactational oestrus in queens, its impact on litters and potential associations with litter size, age, parity, breed and seasonality.

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Materials and methods

A questionnaire was emailed to 14,768 registered Official French Feline Pedigree Registry (Livre Officiel des Origines Félines – LOOF) breeders; 4935 emails were opened and 937 breeders opened the link to the questionnaire. Breeders were asked to answer the questionnaire with regard to their three last litters. No ethical committee approval was required as the study was based on the free will of owners to provide information, respecting the European General Data Protection Regulation. Answers were collected from 108 breeders, giving data on 238 litters representing 23 different breeds. Incomplete or non-rational answers were removed from the analysis (n = 13). Data on the date of birth of the mother, date of birth of the kittens, litter size, presence of an oestrus during lactation, date of first oestrus after parturition and use of contraceptives were collected in a close-ended response fashion. In the case of a lactational oestrus, breeders were asked if they had observed any impact on kittens (yes or no). In the case of a positive response, they were asked to describe the consequences observed in an open-ended response fashion. There was an option to comment at the end of the questionnaire. The wording used to describe oestrus was a 'female in heat', as the questionnaire was designed for breeders. When data were collected on successive litters from multiparous queens (n = 20), they were analysed separately from the 195 independent births. The URL for the questionnaire is available in the supplementary material.

Statistical analysis

Statistical analysis was performed using SPSS for Windows, version 28.0.1.1 (IBM). Analysis of an association between small (one or two kittens) and normal (three or more kittens) litter size with the presence or absence of lactational oestrus was tested using the non-parametric two-sided χ^2 test. A P value <0.05 was considered to be statistically significant, with a 95% confidence interval. Analysis of an association between queens giving birth in February, March and April, in May, June and July, in August, September and October and in November December and January with the presence or absence of lactational oestrus was also tested using the non-parametric two-sided χ^2 test. A χ^2 post-hoc test with P value correction (Bonferroni) was then conducted to confirm the temporal continuity and unimodality of any seasonal variation;[13] the results of these post-hoc tests are reported in Table B1 in the supplementary material. The analysis of association between the age of the queens (<2 years, 2–4 years and ≥4 years old) and the presence or absence of lactational oestrus was also conducted using a two-sided χ^2 test. Analysis of association between breeds represented by ≥10 queens (Bengal, n = 10; British Shorthair, n = 13; Maine Coon, n = 59; Norwegian Forest Cat, n = 12; Ragdoll, n = 14; Birman, n = 19; Siberian, n = 11), with the presence or absence of lactational oestrus was also tested using the non-parametric two-sided χ^2 test.

Results

From 195 independent births, 96 (49%) queens came into oestrus during lactation, 37 (38%) of which were associated with loss of maternal interest (n = 20), milk quality variation (n = 2), clotted milk (n = 3), reduced milk quantity (n = 13), which in kittens led to reduced weight (n = 6), diarrhoea (n = 9), vomiting (n = 4), nausea (n = 2) or death (n = 4), and bottle feeding (n = 2), early weaning (n = 4) or modified litter behaviour (n = 1). In the last case, socialisation was not considered to be optimal by the breeder due to the early absence of the mother. The first onset of oestrus in queens with lactational oestrus, in queens without lactational oestrus and in queens altogether was observed at a mean 40 ± 20 days (range 2–86), 122 ± 60 days (range 62–271) and 71 ± 56 days (range 2–271) after birth, respectively. Overall, four queens showed a lactational oestrus as early as the first week after parturition, 12 queens during the first 2 weeks and 20 in the first 3 weeks. Mean age at parturition in the lactational oestrus and non-lactational oestrus groups was 30.3 ± 16.0 months (range 11.7–72.7) and 34.4 ± 18.6 months (range 8.2–82.5), respectively.

Small litter size (one or two kittens per litter; n = 32) was significantly associated with the onset of lactational oestrus ($P = 0.007$) (see Table 1 and Table A in the supplementary material).

There was a significant association between the onset of lactational oestrus and births occurring in February, March and April ($P = 0.005$; see Table B2 in the supplementary material). These months represent the beginning of the breeding season of queens in France, when the length of daylight begins to increase (Figure 1).[14] There was no association when births occurred in May, June and July ($P = 0.76$), in August, September, October and November ($P = 0.27$) or in December, January and February ($P = 0.09$).

Age was not associated with the onset of lactational oestrus ($P = 0.447$; see Table C in the supplementary material) and neither was breed ($P = 0.959$; see Table D in the supplementary material). There was no association

Table 1 Total number of queens with low litter size (one or two kittens), normal litter size (three or more kittens) and parturition to first oestrus interval (in days) with regard to the presence or absence of oestrus during lactation

	1–2 kittens	≥3 kittens	Parturition to first oestrus interval (days)
No lactational oestrus	9	88	122 ± 60 (62–271)
Oestrus during lactation	23	74	40 ± 20 (2–86)
Total	32	162	71 ± 56 (2–271)

Pearson $\chi^2 = 7.335$; degrees of freedom: 1; $P = 0.007$
Data are provided as n or mean ± SD (range)

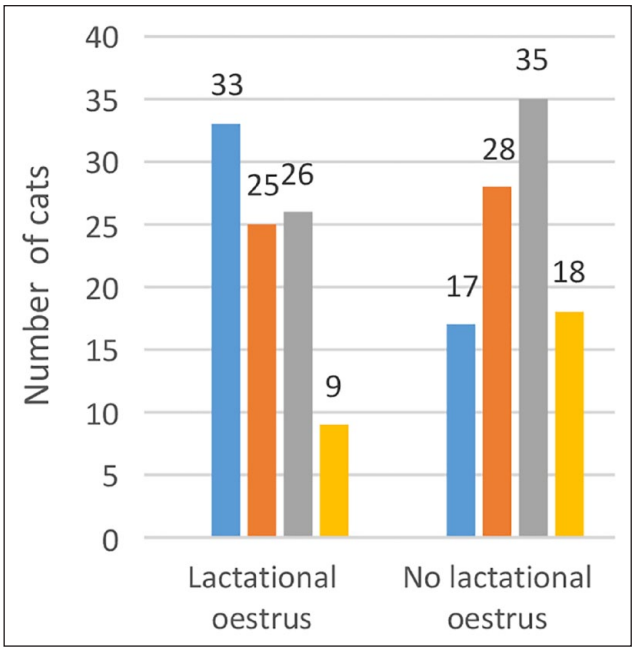

Figure 1 Number of cats with (n = 93) and without (n = 98) lactational oestrus, depending on the date of parturition. Blue bar = number of births occurring in February–April; orange bar = births in May–July; grey bar = births in August–October; yellow bar = births in November–January

between small litter size and date of birth ($P = 0.204$; see Table E in the supplementary material).

Of the 20 females with data available on multiple litters, seven did not show any signs of oestrus during lactation. All four females with small litter sizes (one or two kittens) had an oestrus during lactation (Table 2). Seven females came into oestrus repeatedly during all their lactation periods, although they had given birth to normal-sized litters.

Discussion

This is the first study to document lactational oestrus in breeding queens, as well as perceived associations with the litter. The questionnaire response rate was 11.5% (based on the overall number of breeders who clicked through to the questionnaire [n = 937]). The response rate in this study is comparable to other questionnaire-based studies.[15,16] Nevertheless, a convenience sampling technique was used, introducing some bias. Some breeders who did not experience any lactational oestrus in their cats may have been discouraged from answering the questionnaire due to their lack of experience and therefore interest in the subject. This may explain the high prevalence of lactational oestrus (49%), which may be an overestimation of the reality. Some breeders described oestrus taking place around the time of weaning, with some counting this as oestrus during lactation and some not. In some instances, the onset of oestrus

Table 2 Breed and litter size of the first, second and third pregnancy in the 20 reported multiparous queens

Breed	Pregnancy 1 litter size (n)	Pregnancy 2 litter size (n)	Pregnancy 3 litter size (n)
Birman	7	5	NA
Maine Coon	7	6	NA
Maine Coon	5	3	NA
Oriental	6	6	NA
Highland Fold	7	6	NA
Ragdoll	3	4	NA
Ragdoll	7	5	4
Maine Coon	9*	10	NA
Maine Coon	8	4*	NA
Maine Coon	5	5	2**
Exotic	3	1**	7
British Shorthair	1**	4	4
Cornish Rex	3	3*	2**
Maine Coon	5*	5*	NA
Maine Coon	5*	5*	NA
Siberian	6*	3*	NA
Russian Blue	5*	5*	NA
Maine Coon	7*	3*	7*
Maine Coon	4*	4*	4*
Birman	4*	8*	5*

*Lactational oestruses with normal size litters
**Queens with low litter size, all showing lactational oestrus
NA = not applicable

was the incentive to begin the weaning transition earlier than planned. Another bias may be associated with the difficulty in detecting an oestrous behaviour in queens by some breeders. To try to minimise the bias of distant memory recollections, breeders were asked to provide data on their last three litters. Whenever lactational oestrus was observed, breeders were asked if there were any consequences, but the described consequences may have been coincidental; the cause–effect association may not be true. The accuracy of the answers tended to improve whenever close-ended questions, such as multiple-choice questions with a list of signs, were offered.[17] When asked for the possible consequences of lactational oestrus on kittens, an open-ended question was chosen because the subject had not been studied before. Offering a list of signs may have been limiting and may not have covered the range of comments provided.

In 38% of cases, signs in kittens were associated with the lactational oestrus of their mother, according to the breeders. In four litters, breeders associated the deaths of kittens with the onset of lactational oestrus; one breeder described not understanding early enough that behavioural changes in the mother might be harmful to the kittens, eventually leading to their deaths. A better knowledge of the reasons for the onset of lactational oestrus may help determine appropriate therapy. Kitten

mortality has been associated with maternal disinterest,[7,8] but, to date, maternal disinterest has not been linked with the onset of lactational oestrus. Loss of maternal interest was the most commonly reported observation associated with lactational oestrus in this study. Small litter size has been identified as a risk factor, while age, breed or parity did not seem to influence the onset of lactational oestrus. An association was found between lactational oestrus and births occurring between February and April ($P = 0.005$), illustrating a potential seasonal effect. These females gave birth at the beginning of the reproductive season, meaning they mated 2 months previously in the off-season. Off-season oestrus has previously been described in cats.[18] No association was found between off-season breeding and litter size. Therefore, breeders should not be discouraged to breed females during the off-season, but they should be warned of the association between off-season mating and potential early return into oestrus during lactation. Other risk factors may contribute to the onset of lactational oestrus, because multiple queens displayed an oestrus even with normal sized litters and during out-of-season months: of the 20 queens from which data could be collected on multiple litters, seven repeatedly came into oestrus at each lactation, with normal litter sizes both in and out of season. In sows, multiple factors influencing the onset of the first oestrus after parturition have been identified, including temperature, food, stress, illness, duration of lactation, number of suckling piglets and intermittent suckling (in 51–64% of sows oestrus returned during lactation whenever piglets were removed daily from the mother for 10 h).[12] More studies are required to determine whether reduced suckling stimulation from small litters may be the cause of lactational oestrus in queens. These factors are potential future fields of study to better understand how to reduce the risks of the onset of lactational oestrus, while studies focusing on feline milk quality should carefully assess the cyclicity of the studied queens in order to identify a potential association between milk quality variation and lactational oestrus.

In queens developing lactational oestrus, either conservative or preventive strategies may be considered. The majority of lactational oestrus periods do not impact on litters, but in 38% of cases, breeders described problems such as variation in milk quality, clotted milk and reduced milk yield. Therefore, once an oestrus is identified, macroscopic analysis of the milk should be performed (Figure 2), and the weight of the kittens should be monitored. Indeed, assessing daily weight gain is a way to detect at-risk litters,[19] and is thought to be a good marker of an eventual decrease in milk quality or yield.[8] If detected early enough, supplementation with feline milk substitutes may be advocated for.[20] Depending on the age of the kittens, early weaning may be considered. If clotted milk is observed, or the kittens are presenting with diarrhoea and vomiting, more intensive care may be warranted, with specific evaluation of hypoxia, hydration, glycaemia, temperature and reflexes in the kitten,[8] and corresponding corrective treatments.

Figure 2 Modified milk in a female Bengal after expressing a lactational oestrus

For prevention, contraceptive measures could be used in queens that tend to come into oestrus systematically (Table 2), for those with small litter sizes or those giving birth between February and April. Short-term contraceptive implants (melatonin 18 mg) have been studied in cats; these implants provide an average period of contraception of 60–90 days,[15] but the consequences of melatonin on milk quality and transfer to kittens have not yet been described. High doses in late pregnancy in ewes (200 times the normal concentration)[21] and mice (200 mg/kg)[22] did not induce signs of maternal or fetotoxicity. Melatonin is known to be secreted in milk in higher quantities during the night,[23] and has been shown to have antioxidative[24] and anti-inflammatory properties with beneficial results in neonates,[25] while the melatonin implant increases milk quality in ewes.[26] Therefore, it seems a promising contraceptive option but requires more study of its safety during lactation.

Conclusions

Small litter size and births between February and April in France were associated with the onset of oestrus during lactation, and in 38% of cases a negative outcome was reported, including variations in milk quality, reduced general condition of kittens and, in worst-case scenarios, deaths were described. To better counter the potential risks, there should be improved detection of lactational oestrus and breeders should be prepared to bottle feed kittens when necessary or take preventive contraceptive measures in queens.

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Supplementary material The following files are available online:
Questionnaire sur les chaleurs de lactation [in French].
Table A: Prevalence of lactational oestrus and non-lactational oestrus depending on the litter size and data analysis.
Table B1: Prevalence of lactational oestrus and non-lactational oestrus depending on the season.
Table B2: Lactational records by month.
Table C: Prevalence of lactational oestrus and non-lactational oestrus depending on the age (<2 years old, 2 to 4 years old and >4 years old) and data analysis.
Table D: Prevalence of lactational oestrus and non-lactational oestrus depending on the breed and data analysis.
Table E: Prevalence of low litter size (one or two kittens) and normal litter size (three or more kittens) depending on the month and data analysis.

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Ethical approval This work did not involve the use of animals and therefore ethical approval was not specifically required for publication in *JFMS*.

Informed consent This work did not involve the use of animals (including cadavers) and therefore informed consent was not required. No animals or people are identifiable within this publication, and therefore additional informed consent for publication was not required.

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