

## PERIPARTURIENT BODY CONDITION SCORE AND SUBSEQUENT MILK PRODUCTION, DISEASE INCIDENCE, FERTILITY AND CULLING

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*Des informations sur l'état d'entretien des vaches et le lait ont été collectées dans 12 élevages laitiers participant à un programme informatisé de suivi de la santé du troupeau. L'état d'entretien a été mesuré tous les mois pendant 18 mois environ. La mesure était faite avec une échelle de 1 à 5, 1 étant émacié, 5 très gras. Les données de production, les événements pathologiques, les événements liés à la reproduction et les réformes étaient collectés au cours de visites mensuelles des élevages. 989 lactations ont été utilisables pour l'analyse, après suppression des lactations comportant des données manquantes. Une analyse descriptive des données a été réalisée, puis une path analysis, de manière à étudier les interrelations entre les événements, prenant en compte l'ordre chronologique des faits. La path analysis a été réalisée en utilisant une combinaison de régressions linéaires et logistiques. Toutes les analyses ont été corrigées pour les effets troupeau et parité. Lors de la première mesure après vêlage, 3,8% des vaches avaient une note d'état d'entretien égale ou supérieure à 4. Les vaches avec un score élevé ont eu tendance à perdre plus d'état entre la première (14 jours postpartum) et la deuxième mesure (42 jours postpartum) que les vaches avec un score inférieur. La perte d'état n'était pas associée avec la pathologie, la fertilité ou le niveau de production, mais il y avait une tendance à ce qu'elle soit supérieure pour les vaches ayant une production laitière supérieure lors du premier contrôle et un rapport matières grasses/protéines du lait supérieur à 1,5. Un très bon état d'entretien en début de lactation était lié à un taux de réussite inférieur en première insémination. Le niveau de production laitière lors du premier contrôle était corrélé positivement à l'incidence des kystes ovariens et au nombre d'inséminations avant fécondation, et négativement avec la réussite en première insémination. 25% approximativement des vaches avaient un rapport matières grasses/protéines du lait supérieur à 1,5 au premier contrôle, non corrélé au niveau de production. Il était lié positivement à l'incidence de cétozes, de kystes ovariens, de boiteries, au nombre d'inséminations avant fécondation et à la production laitière à 100 jours, et lié négativement au taux de réussite en première insémination.*

### INTRODUCTION

Herd health programs for dairy farms need prognostic indicators for the early detection of impaired health, fertility or productivity and for timely preventive measures. Body condition and results of the first milk test after calving receive increasing attention of herd health practitioners and management advisors. High body condition at calving and a fat/protein ratio of more than 1.5 were stated to be risk factors for postparturient metabolic diseases, conception and milk production. Quantitative relations between such periparturient risk factors and subsequent lactation events have not yet been investigated, however. With this study we therefore intended to investigate such relationships using monthly body condition scores and milk test results obtained from routine herd health activities.

### MATERIAL AND METHODS

After exclusion of missing data (346 lactations), complete information was available from 989 lactations of 16 dairy herds participating in the computerized herd health service of the Veterinary Faculty, University of Utrecht, Netherlands. Calvings occurred over a period of 14 months from October 1990 to November 1991. As part of the herd health program, clinical diagnoses were recorded by farmers or veterinarians along with their date of occurrence. A body condition score at a scale of 1-5 (1=emaciated, 5=extremely fat) with quarter intervals was assigned to each lactating cow by the veterinarian once a month. Milk test results were obtained from a central milk testing laboratory. Disease occurrence was described as cumulative lactation incidence. Only first cases of disease were considered and lactation events later than 365 days post partum were excluded from the analyses. The first service conception rate and the number of services per conception was limited to cows with veterinary confirmed pregnancy. The 100-day corrected milk production was estimated from the initial 4 milk tests after calving and corrected for 4% fat and 3.2% protein. For appropriate consideration of the time order by which the events occurred in lactation, a path analysis was used. It consisted of multifactorial logistic regression if the dependent variable was binary (presence or absence of disease or pregnancy) or multiple linear regression if the outcome was continuous (services per conception, 100-day corrected milk production). Fixed effects for herd and parity were forced into all models; season of calving was omitted because there was no seasonal trend of calving in the data. All models also contained the 'risk factors' of interest as independent variables (table I). One model was developed for each disease (production, fertility) parameter as dependent variable. A cow was a case if the event (1st case only) was present during lactation, and a control if the event was absent. The independent variables were re-coded for every model

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individually on the condition that they had preceded the case. Controls were considered not at risk from the median days post partum of the dependent variable.

**Table I**  
**Description of lactation events of 16 HF dairy herds (989 cows)**

Variables	Abbreviation	days of event p.p.			n	mean $\pm$ s.d.
		25%	median	75%		
<b>Independent variables (risk factors):</b>						
kg milk 1st test day	MILK1	12	18	25	989	29.8 $\pm$ 7.6 kg
Fat/protein ratio of 1st test day milk >1.5	FP1-hi	12	18	25	989	25.6 $\pm$ 43.7 %
1st body condition score p.p. $\geq$ 4.0	BCS1-hi	7	14	24	989	3.8 $\pm$ 19.2 %
Difference 1st-2nd BCS post partum >0.5	BC-loss-hi	<32	<42	<52	852	15.4 $\pm$ 36.1 %
<b>Dependent variables:</b>						
Milk fever	MF	0	0	0	989	6.0 $\pm$ 23.7 %
Retained placenta	RETSEC	1	1	1	989	6.5 $\pm$ 24.6 %
Lochiometra	LOCHIO	6	9	12	989	7.6 $\pm$ 26.5 %
Displaced abomasum	DA	8	12	27	989	0.9 $\pm$ 9.5 %
Endo-/metritis	ENDO	14	21	38	989	15.0 $\pm$ 35.7 %
Ketosis	KET	12	24	46	989	2.1 $\pm$ 14.4 %
Mastitis	MAST	4	34	95	989	13.8 $\pm$ 34.4 %
Cystic ovarian disease	CYST	40	57	88	989	9.9 $\pm$ 29.9 %
Lameness	LAME	27	64	134	989	25.9 $\pm$ 43.8 %
1st service conception rate	PREG1	57	72	91	672	58.2 $\pm$ 49.4 %
Services/conception	SERV_PC	68	92	130	672	1.71 $\pm$ 1.06
100-day corrected. milk (4% F, 3.2% P)	FCM100	-	100	-	989	3308 $\pm$ 750 kg
Culled	CULL	106	197	365	989	21.2 $\pm$ 40.9 %

## RESULTS AND DISCUSSION

Routine monthly visits provided the first body condition score approximately 2 weeks after parturition and the second 4 weeks later. At the first scoring, 3.8% of all cows were in relatively fat body condition (scores of 4.0 or higher) and 96.2% were in normal condition (scores lower than 4.0). Compared to 'normal' cows of which 14% lost more than 0.5 condition points from approximately 14 to 42 days post partum, the proportion of fat cows losing condition was 5.6 times higher (78%). Strong herd effects increased the strength of the association between initial condition score and subsequent condition loss nearly twofold compared to a bi-variate association without the consideration of herd effects. Body condition loss, however, was not affected by any preceding disease, but there was a tendency that it was higher in cows with more milk at first test day and with a milk fat/protein ratio of more than 1.5 ( $p=0.058$ ). Post partum change in body condition did not affect subsequent disease, conception or 100-day milk production. Cows with a fat body condition 2 weeks after calving had a 41% lower first service conception rate than cows in normal condition (table II). The results suggested that the prognostic value of body condition scoring may be limited to first service conception, and that it had little bearing on the lactational incidence of clinical diseases or productivity. Our study, however, lacked statistical power, hence, small existing effects might not have been detected.

First test day milk quantity averaged 29.8 kg, it was uncorrelated to its fat/protein ratio. Higher milk yield was related to lower conception rates and lower services per conception. Rising milk production increased the incidence of ovarian cyst and tended to increase mastitis, but it did not elevate the risk for lameness. Daily milk yield itself was 1.6 kg lower in cows that had retained fetal membranes, 6.9 kg lower in cases of displaced abomasum, and 1.5 kg lower in cows with endometritis before the first test day; milk fever, however, was followed by 1.6 kg higher milk production.

A first test day fat/protein ratio in milk above the threshold of 1.5 was found in 26% of all cows. It was associated with increased incidences of ketosis (+3.5%), cystic ovarian disease (+7.1%), and especially lameness (+14%). High fat/protein in early lactation predicted lower first service conception rates (-35%) and more services per conception (+0.35). Path analysis showed that cows with high fat/protein on the first test day also had higher 100-day milk production if they were non-diseased. But through its association with lameness and the path FP1-hi  $\rightarrow$  ovarian cyst  $\rightarrow$  endometritis, the 100-day milk production was reduced. Lameness lowered 100-day milk production on average by 102 kg, endometritis by 136 kg. Cows with a high fat/protein ratio had a 2.7 times higher incidence of clinical ketosis, independent of milk yield. Fat/protein in milk may therefore likely be related to post partum energy deficiency.

We concluded that the consideration of milk test results in conjunction with body condition score may refine the risk assessment for individual cows. Especially, the fat/protein ratio of the first milk test after calving appears to have useful prognostic properties. Further investigations will focus on the question how such risk factors perform at the herd level.

**Table II**  
**Association between risk factors of the early post partum period and subsequent lactation events**

Risk factor	subsequent lact.event	no. cows	mean at 'no risk'	change due to risk factor	adjusted OR
MILK1	CYST	969	10.0 %	+ 5.3 %	1.058 /kg ***
	PREG1	672	58.2 %	- 17.8 %	0.953 /kg ***
	SERV_PC	672	1.75	+ 0.02	1.011 /kg ***
	FCM100	672	3354 kg	+ 230 kg	1.009 /kg ***
FP1-hi	KET	987	1.5 %	+ 2.5 %	2.67 *
	CYST	969	9.0 %	+ 6.4 %	1.71 *
	LAME	965	24.4 %	+ 13.2 %	1.54 *
	PREG1	672	61.0 %	- 34.8 %	0.43 ***
	SERV_PC	672	1.60	+ 0.35	1.22 ***
	FCM100	672	3258 kg	+ 272 kg	1.08 ***
BCS1-hi	MF	989	5.5 %	+ 11.3 %	3.06 *
	BC-loss-hi	852	14.2 %	+ 65.7 %	5.63 ***
	PREG1	672	57.1 %	- 40.5 %	0.29 *

BC-loss-hi    no significant effects

Change in a cow's risk of disease or loss of production associated with 1 s.d. more milk; fat/protein ratio >1.5; or body condition score  $\geq$  4.0 .; \* p<.05, \*\* p<.01, \*\*\* p<.001

#### BIBLIOGRAPHY

- Correa M.T., Erb H., Scarlett J., 1993. Path analysis for seven postpartum disorders of Holstein cows. *J.Dairy Sci.* 76, 1305-1312.
- Ruegg P.L., Milton R.L., 1995. Body condition score of Holstein cows on Prince Edward Island, Canada: relationships with yield, reproductive performance, and disease. *J.Dairy Sci.* 78, 552-564.
- Uribe H.A., Kennedy B.W., Martin S.W., Kelton D.F., 1995. Genetic parameters for common health disorders of Holstein cows. *J.Dairy Sci.* 78, 421-430.
- Groehn Y.T., Erb H.N., 1989. Epidemiology of metabolic disorders in dairy cattle: association among host characteristics, disease, and production. *J.Dairy Sci.* 72, 1876-1885.