

The Association Between Disease, Production and Culling in a University Dairy Herd

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SUMMARY

The impact of ten diseases of dairy cattle on milk production, calving interval and culling were studied in a university operated dairy herd. Cows with clinical mastitis, ketosis or displaced abomasum had lowered milk production. Cows with metritis, retained placenta, cystic graafian follicles or ovarian hypofunction had longer calving intervals. Cows with clinical mastitis, metritis, pneumonia or retained placenta had increased risks of culling.

The relationship between disease and culling was based on the medical history of culled and nonculled cows using a case control approach. Therefore, it is likely that in many cases, the association between disease and culling is due to the impact of that disease on productivity.

RÉSUMÉ

La relation entre la maladie, la productivité et l'élimination, au sein d'un troupeau laitier appartenant à une université

Cette expérience visait à étudier, au sein d'un troupeau appartenant à une université, l'impact de dix maladies des vaches laitières sur la production lactée, l'intervalle entre les vêlages et l'élimination éventuelle du troupeau. Les vaches atteintes de mammite clinique, d'acétonémie ou d'un déplacement de la caillette donnèrent moins de lait. Celles qui souffraient de métrite, de rétention placentaire, de kystes folliculaires ou d'hypo-ovaire présentèrent un intervalle plus long entre deux vêlages. Celles qui souffraient de mammite clinique, de métrite, de pneumonie ou de rétention placentaire représentaient les sujets les plus susceptibles de se faire éliminer du troupeau.

La relation entre la maladie d'une vache et son élimination éventuelle du troupeau reposait sur son dossier médical que l'on comparait à celui d'autres vaches déjà éliminées ou non, d'après une

approche du contrôle des cas individuels. Il semble par conséquent que, dans plusieurs cas, la relation entre la maladie d'une vache et son élimination du troupeau résulte de l'impact de cette maladie sur sa productivité.

INTRODUCTION

A number of workers have examined the association between disease and level of production, of milk and/or calves, and the premature disposal of dairy cows. Low milk production, the occurrence of infertility and abnormalities of the mammary gland, including mastitis, are the most common reasons cited for premature disposal of dairy cows. Specific diseases, other than mastitis, are only infrequently reported as reasons for culling.

The objective of this study was to examine a number of diseases for possible associations with culling and for their association with changes in milk production and calving intervals.

MATERIALS AND METHODS

The data source for this study has been described in a previous paper (3).

Ten diseases were selected and their association with culling and production, in the Elora Dairy Herd (EDH), was studied using various statistical techniques. Only cows entering the herd between December 31, 1969 and January 1, 1977 were included in this study.

For each disease, a set of eight, two by two tables was created, describing the presence or absence of that disease, in the different age groups, from two to nine years, in relation to the age at culling. Hence, each of the eight two by two tables contained counts of: animals that had the disease, at or before that age, and were culled at that age; animals that had the disease, at or before that age, but were not culled at that age; animals that did not have the disease, at or before that age, and were culled at that age; and animals that did not have the disease, at or before that age, and were not culled at that age.

The logarithms of odds ratios method was used to test for an association between each disease and culling. Odds ratios greater than one imply an increased risk of culling subsequent to developing a disease; whereas odds ratios of less than one imply a decreased risk of culling subsequent to developing that disease (6).

Milk production in terms of deviation from herd average (DFHA), in breed class average units (BCM), was recorded for those lactations in which the diseases under study occurred. These data were compared with the lifetime average production in DFHA points, from the same cow, using a paired t-test for analysis of results (16). The same

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TABLE I
THE ASSOCIATION, AS MEASURED BY THE ODDS RATIO,
BETWEEN CULLING AND OCCURRENCE OF DISEASE IN
EIGHT AGE GROUPS OF COWS IN THE ELORA DAIRY
HERD DURING THE PERIOD 1970-1976

Disease	Average Odds Ratio	X ² Association	X ² Homogeneity
Mastitis	4.95	16.36 ^a	3.45
Pneumonia	2.94	4.61 ^a	4.99
Metritis	4.11	11.07 ^a	3.40
Retained placenta	2.33	4.57 ^a	2.61
Cystic graafian follicles	0.70	0.90	8.75
Ovarian hypofunction	1.66	1.48	4.03
Ketosis	1.12	0.09	8.08
Displaced abomasum	1.61	1.27	3.36
Hypocalcemia	0.83	0.19	2.51
Foot problems	1.74	1.96	2.87

^aSignificant at $p \leq 0.05$ (6).

procedures were used to compare the association between the occurrence of disease and calving interval.

RESULTS

The association between each disease and culling is shown in Table I. The occurrence of mastitis, pneumonia, metritis and retained placenta was associated, to a significant degree ($p \leq 0.05$), with an elevated risk of culling. Mastitis appeared to have the greatest impact on culling (average odds ratio of 4.95) followed by metritis (4.11), pneumonia (2.94) and retained placenta (2.33). There were no significant differences between these disease-culling associations at different age levels. (χ^2 for homogeneity was nonsignificant.)

The proportion of all cows, culled and non-culled, having had one or more of the specified diseases is shown in Table II. [These proportions are adjusted for age by using the combined population of culled and non-culled cows as the standard (16)]. The largest differences between culled and nonculled cows were observed for cows having had mastitis, pneumonia, metritis or retained placenta. It may be noteworthy that the proportion of culled cows having had ovarian hypofunction, ketosis, displaced abomasum, or foot problems also tended to be higher than the proportion affected amongst nonculled cows.

The association between each disease and milk production is shown in Table III. Cows having had mastitis, ketosis or displaced abomasum, pro-

TABLE II
THE PROPORTION OF CULLED AND NONCULLED COWS
HAVING HAD A SPECIFIED DISEASE IN THE UNIVERSITY
OF GUELPH, ELORA DAIRY HERD 1970-1976

Disease	Proportion ^a of Culled Cows Having Had the Disease	Proportion ^a of Nonculled Cows Having Had the Disease
Mastitis	0.298	0.050
Pneumonia	0.144	0.021
Metritis	0.248	0.046
Retained placenta	0.166	0.054
Cystic graafian follicles	0.102	0.101
Ovarian hypofunction	0.128	0.051
Ketosis	0.165	0.102
Displaced abomasum	0.125	0.055
Hypocalcemia	0.078	0.077
Foot problems	0.141	0.060

^aThe proportions are standardized for differences in age distribution of culled and nonculled cows (16).

duced significantly less milk in those lactations when the disease occurred in comparison with their lifetime average. In addition, cows having had one or more occurrences of mastitis, pneumonia or foot problems tended to have lower than average lifetime averages.

The association between each disease and calving interval is shown in Table IV. Cows having had metritis, retained placenta, cystic graafian follicles, or ovarian hypofunction had significantly larger calving intervals for the lactations when the disease occurred, than their lifetime average.

DISCUSSION

The results of this study provide evidence for an association between the occurrence of disease and premature disposal in at least one herd of dairy cows.

Previous studies examining the relationship between disease and culling have generally been concerned with immediate causes of culling. In such instances, the farmer usually is asked to specify one or more reasons for culling. This tends to identify only those diseases which have a dramatic effect and/or those diseases occurring in close temporal proximity to the event of culling (3). In the current study, we examined the past medical history of a group of culled cows and compared this to the medical history of nonculled cows. In this manner, we were able to identify diseases which may have occurred many months or years

TABLE III
THE ASSOCIATION BETWEEN DISEASE AND MILK PRODUCTION FOR COWS IN THE ELORA DAIRY HERD DURING THE PERIOD 1970-1976

Disease	Number of Cases	Mean		Standard Deviation		Difference Mean	Standard Deviation	t Value	2-Tail Probability
		DFHA ^a Milk	DFHA LTA ^b Milk	DFHA ^a Milk	DFHA LTA ^b Milk				
Mastitis	57	-9.298	-2.877	27.757	19.126	- 6.421	22.928	-2.11 ^c	0.039
Pneumonia	6	-18.833	-5.333	31.934	23.880	-13.500	20.423	-1.62	0.166
Metritis	52	2.192	2.308	26.945	22.944	- 0.115	14.211	-0.06	0.954
Retained placenta	40	2.975	4.250	24.452	18.702	- 1.275	16.128	-0.50	0.620
Cystic graafian follicles	46	8.652	5.348	30.672	25.480	+ 3.304	16.729	1.34	0.187
Ovarian hypofunction	26	1.731	4.500	27.909	16.616	- 2.7692	22.564	-0.63	0.537
Ketosis	28	1.714	9.857	25.867	17.141	- 8.143	18.618	-2.31 ^c	0.028
Displaced abomasum	27	-3.630	6.889	19.113	16.175	-10.519	15.378	-3.55 ^c	0.001
Hypocalcemia	29	-2.931	0.379	21.260	16.048	- 3.310	17.491	-1.02	0.317
Foot problems	29	-1.448	-0.931	21.520	15.364	- 0.517	16.531	-0.17	0.867

^aDFHA = Deviation from herd average in breed class average units (BCM)

^bLTA = Lifetime average in BCM units

^cSignificant at $p \leq 0.05$

prior to culling and diseases which may have had a small to moderate negative effect on production as well as those dramatic and immediate causes of culling referred to above.

Thus, in this study, the identification of a disease being associated with culling is likely the identification of an indirect cause of culling. It is probable that the negative effects of disease on production are the real or direct causes of disposal (i.e. the lack of production becomes the actual reason for culling rather than the disease per se). Nonetheless, the identification of diseases as indirectly responsible for culling will enable the veterinarian and the dairyman to concentrate their efforts towards preventing these diseases.

Based on results of this study, we imply that mastitis, pneumonia, metritis and retained placenta all are associated with culling. The actual effects of pneumonia may be greater than reported here since calves having pneumonia and being culled for this reason prior to herd entry, were not included in the study (12). The magnitude of the odds ratios, suggests that the effects of mastitis and metritis are greater than those of pneumonia, when the age at occurrence of these diseases is controlled. The latter is substantiated by the proportion of animals, in the culled and nonculled groups, affected with these diseases.

In general, our level of disease in culled and non-culled cows is in agreement with levels reported by other workers. For example, mastitis may account for 18-22% of all culls (1, 17). In addition, 23.1% of

culled cows were disposed due to genital problems including metritis and retained placenta (5).

Our results tend to disagree somewhat with another study of the association between disease and culling conducted in eight private dairy herds from the same geographic area (11). In that study, cows with cystic graafian follicles, ovarian hypofunction or mastitis were at increased risk of culling. Cows having foot problems were at increased risk of culling only when related diseases were absent.

Mastitis, ketosis and displaced abomasum lead to a reduction of milk production in cows during the lactation of disease occurrence. Displaced abomasum produced the greatest lowering of production followed by ketosis and mastitis. The fact that most of the cases of ketosis were secondary, suggests that any disease capable of producing ketosis may lower milk production. Since one BCM unit represents about 45 kilograms of milk in a two year old Holstein, we estimate the losses due to mastitis, ketosis and displaced abomasum to be 95 kg, 103 kg and 160 kg per lactation respectively. These losses are likely to be conservative since the cow's lifetime average was used as the standard for comparison and this would be reduced if that cow experienced one or more of these diseases in other lactations. This is particularly likely to happen with diseases that tend to reoccur such as mastitis and pneumonia (3). Our findings are in basic agreement, despite being conservative, with previous reports on the

TABLE IV
THE ASSOCIATION BETWEEN DISEASE AND CALVING INTERVAL (IN MONTHS) FOR COWS IN THE ELORA DAIRY HERD
DURING THE PERIOD 1970-1976

Disease	Number of Cases	Mean		Standard Deviation		Difference Mean	Standard Deviation	t Value	2-Tail Probability
		Calving Interval	Calving Interval LTA ^a	Calving Interval	Calving Interval LTA ^a				
Mastitis	39	14.321	14.033	3.609	2.007	+0.287	2.797	0.64	0.525
Pneumonia	4	18.050	15.475	3.439	1.094	+2.575	3.004	1.71	0.185
Metritis	36	16.578	14.828	6.830	2.531	+1.750	4.929	2.13 ^b	0.040
Retained placenta	31	15.168	14.029	4.005	1.975	+1.139	2.877	2.20 ^b	0.035
Cystic graafian follicles	30	15.807	14.520	4.251	1.754	+1.287	3.329	2.12 ^b	0.043
Ovarian hypofunction	20	15.340	14.150	2.622	1.800	+1.190	2.290	2.32 ^b	0.031
Ketosis	23	14.517	14.778	7.966	2.676	-0.261	5.927	-0.21	0.835
Displaced abomasum	16	13.219	14.344	2.441	2.197	-1.125	1.631	-2.76 ^b	0.015
Hypocalcemia	21	13.195	12.862	2.260	1.034	+0.333	1.850	0.83	0.419
Foot problems	21	14.148	13.738	2.762	1.730	+0.410	1.952	0.96	0.348

^aLTA = Lifetime average

^bSignificant at $p \leq 0.05$

effects of mastitis (14, 15), ketosis (5) and left abomasal displacement (10) on milk production.

Metritis, retained placenta, cystic graafian follicles, ovarian hypofunction, ketosis and displaced abomasum tend to occur in cows with higher than average lifetime BCM averages, whereas cows with mastitis, pneumonia, hypocalcemia and foot problems tend to occur in cows with lower than average life time average BCM's. It was not possible to ascertain cause and effect in these situations, however, they are noteworthy nonetheless. For example, it has been stated that cows with follicular cysts produce more milk when cystic (8), and that high producing cows tend to have a higher risk of becoming cystic in the first place (2, 17, 13). The tendency for both these patterns was present in our study. However, whether cystic graafian follicles cause higher production or high production causes cystic graafian follicles is unknown. It is worthwhile to consider that perhaps an unknown third variable causes both. Our findings do not substantiate the general belief that hypocalcemia is a disease of high producing cows.

Metritis, retained placenta, cystic graafian follicles and ovarian hypofunction, were associated with longer calving intervals. Cows having metritis had a delay of 1.8 months or 2.5 heat cycles; cows with retained placenta had a delay of 1.14 months or 1.6 heat cycles; cows with cystic graafian follicles had a delay of 1.3 months or 1.8 heat cycles and cows with ovarian hypofunction had a delay of

1.2 months or 1.7 heat cycles. The reader should note that no attempt was made in our study to "control" the effects of other diseases to ensure unbiased estimates of the effect of any specific disease. Such analytical methods were beyond the scope of this study, however, since retained placenta was associated with metritis and both were associated with prolonged calving intervals, it is possible that retained placenta was related to calving interval only because of its association with metritis.

Reports on the quantitative effect of metritis on calving intervals were not seen. However, a previous report stated that cows with retained placenta have an increased calving interval of 0.3 months (9). Others report that cows during their "cystic" lactation had a calving interval prolonged by 0.8 months (7). It is not too difficult to understand how a cow having metritis and/or retained placenta might have a delay in her uterus returning to normal and being capable of supporting the next pregnancy. Obviously, cystic graafian follicles by their nature delay ovulation and since most ovarian hypofunctions were repeat breeders, their effects are also obvious. Our initial belief was that cows with displaced abomasum who usually are off feed, ketotic, go through surgery, etc., would have an inevitable delay in conceiving, but our data did not support such a belief. Despite anorexia, ketosis, etc., the surgical correction of a displaced abomasum allows the cow to return, quite quickly, to normal status.

In this study, we observed an association of mastitis, metritis, retained placenta and pneumonia with culling. In addition, mastitis was associated with a drop of milk production, and metritis and retained placenta were associated with longer calving intervals. Although not significant, perhaps because of too few cases, cattle with pneumonia, as cows or calves, had the lowest lifetime milk production and the largest lifetime calving interval. Thus, it could be argued that these diseases reduce production, milk and/or calves, and therefore, lead to premature disposal. Identifying these indirect reasons for culling highlights their potential impact on the economics of dairy cattle production and provides increased impetus to prevent and control these diseases.

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LETTER TO THE EDITOR

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DEAR SIR:

Recently, CBC televised "Canaries to Clydesdales," a film produced by the National Film Board. I saw a portion of this program which portrays a variety of practice challenges encountered by two Canadian veterinarians. Unfortunately, the film shows two scenes which give a negative impression of our profession's interest in disease

prevention. In the first instance, the veterinarian is shown arriving on a farm wearing dirty white coveralls. In the other, surgery is being performed on a dog without the use of a cap, mask or gloves.

As a health profession constantly perfecting its abilities and techniques for the benefit of our clients, it's unfortunate that aseptic concepts discovered in the last century and practised by the majority of veterinarians today were not shown in this film.

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