

# Impact of DIM at hyperketonemia diagnosis on milk yield, early reproductive performance, and herd removal in dairy cattle

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## INTRODUCTION

High prevalence of hyperketonemia - defined as an elevated concentration of ketone bodies in blood, serum, or plasma (Doré et al., 2015) and traditionally considered an indicator of problems in the transition period (Rodríguez et al., 2022)- is still present in many Spanish herds (Guadagnini et al., 2019). Screening protocols to diagnose HYK typically involve the testing of cows during the first weeks of lactation (van der Drift et al., 2012). Previous studies have suggested that an increase in disease and culling events and a decrease in milk yield and reproductive efficiency are observed with lower BHB concentration thresholds in the first week (wk1) compared with the second (wk2; Walsh et al., 2007; Duffield et al., 2009; Rodríguez et al., 2022).

## OBJECTIVE

The aim of the present study is to evaluate the effect of HYK evaluate the association of HYK in two different time point during early lactation (9 and 16 days in milk, DIM) with milk yield, reproductive performance, and herd removal throughout a single entire lactation.



## MATERIAL AND METHODS

- **441 cows** tested for hyperketonemia at both 9 and 16 DIM using a milk ketone test strip (**Keto-Test**; Elanco Animal Health, Greenfield, IN).
- Determination of hyperketonemia was done by comparing the color of the test strip to a semiquantitative scale, and following manufacturer indication, those colors correlating with BHBA concentration of **100 µmol/L** or above tested positive for subclinical ketosis.
- Information about cow ID (CowID), date of birth (BirthDate), lactation group (LACT; 1,2 or ≥3), date of first AI (FstAIDate), date of pregnancy (IAFec), date of first test-day after calving (FstTestDate), first test-day milk yield (FstTMY, kg), data of culling (CullDate).
- Based on ketosis results at each test (Ketosis), cows were classified on either **healthy (Healthy), positive at first test (1stT+), second test (2ndT+), or both (BothT+)**.
- Statistical analyses were carried out to evaluate Ketosis impact of these different days of testing on a) the incidence of the disease and b) on the consequences of a positive for ketosis in production (FrstTMY), reproduction (risk of pregnancy in the first 150 DEL) and culling (at 60 and 500 DEL). For the evaluation of the impact on milk production, multiple linear regression model was built for Ketosis values, including the lactation group and the DEL1stT as predictors. For reproductive and culling impact assessments, Cox regression analyzes were performed for Ketosis.
- Data have been managed through Gando 1.0 (Gando nuevas tecnologías SL, Spain) and all the statistical analyzes were carried out with STATA 14.2 (StataCorp LP, USA).

## RESULTS

20 out of 441 animals (4.54% incidence) tested positive to ketosis at 9 DIM, compared with 37 animals at day 16 (8.39% incidence). 389 animals were classified as healthy cows at both test (Healthy, 88.21%), 15 animals were positive only at 9 DIM (1stT, 3.4%), 32 at 16 DIM (2ndT, 7.26%) and only 5 were positive at both tests (BothT, 1.13%).

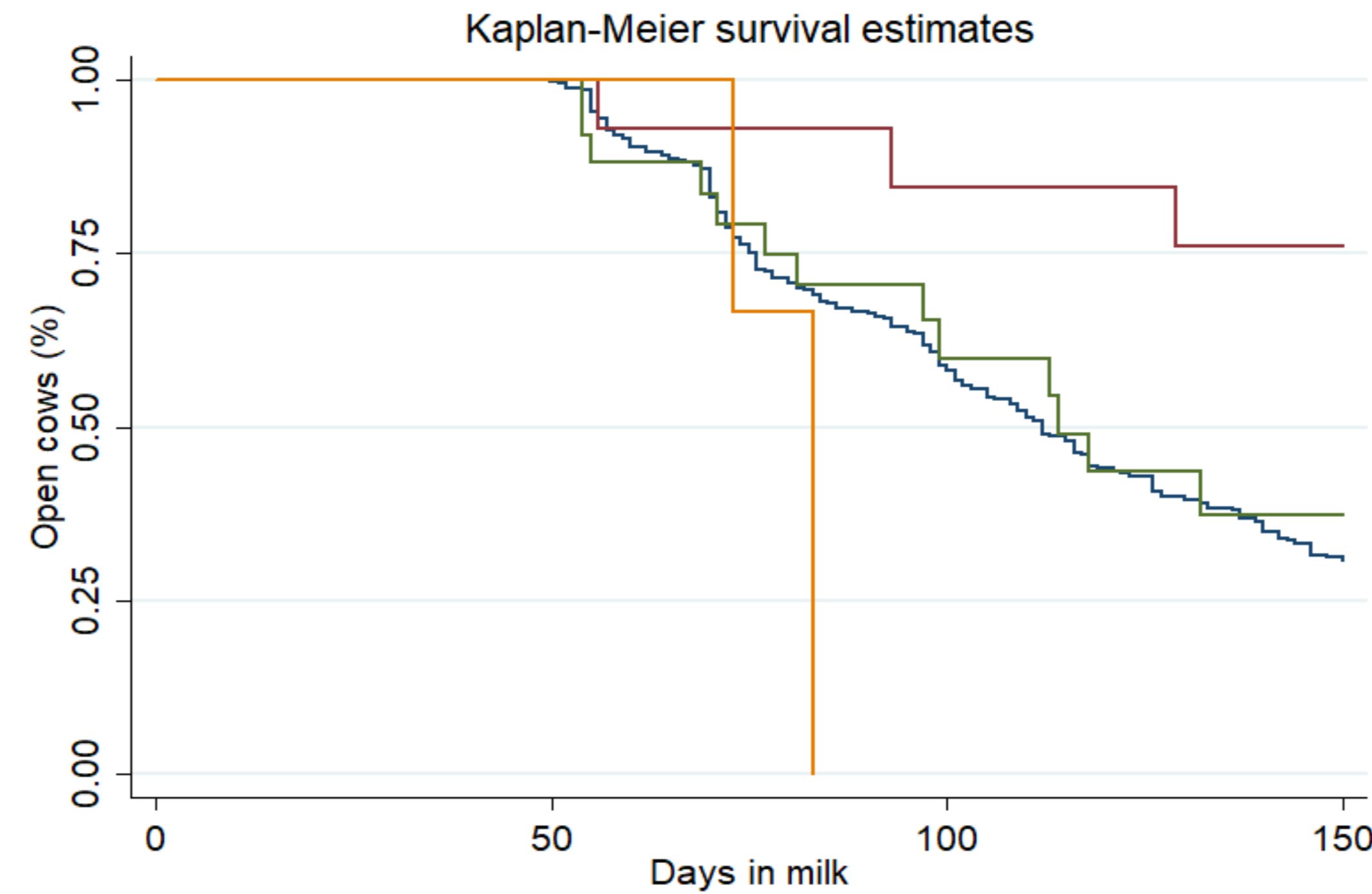
Compared with Healthy animals, 1stT+ yielded 7.94 kg less of milk at first test ( $p < 0.05$ ,  $r^2 = 0.49$ ) but not for 2ndT+ and BothT+ animals ( $\beta = -2.22$  and  $-5.14$  and  $p = 0.12$  and  $0.14$ , respectively).

The 1stT+ animals had a 75% [hazard ratio (HR) = 0.25; 95%CI: 0.08 to 0.77] lower risk of pregnancy within 150DIM and 3.36 times (95% CI: 1.53 to 7.38) higher risk of herd removal within 500 DIM than Healthy cows.

Conversely, no differences between healthy cows and 2ndT+ for risk of pregnancy by 150 DIM (HR = 0.89; 95% CI: 0.51 to 1.56) or removal from the herd within 500 DIM (HR = 1.93; 95%CI: 0.43 to 8.59).

For those cows Both+, only differences on risk for removal (HR = 5.62, 95%CI = 1.75 to 18.07) were found compared with healthy animals.

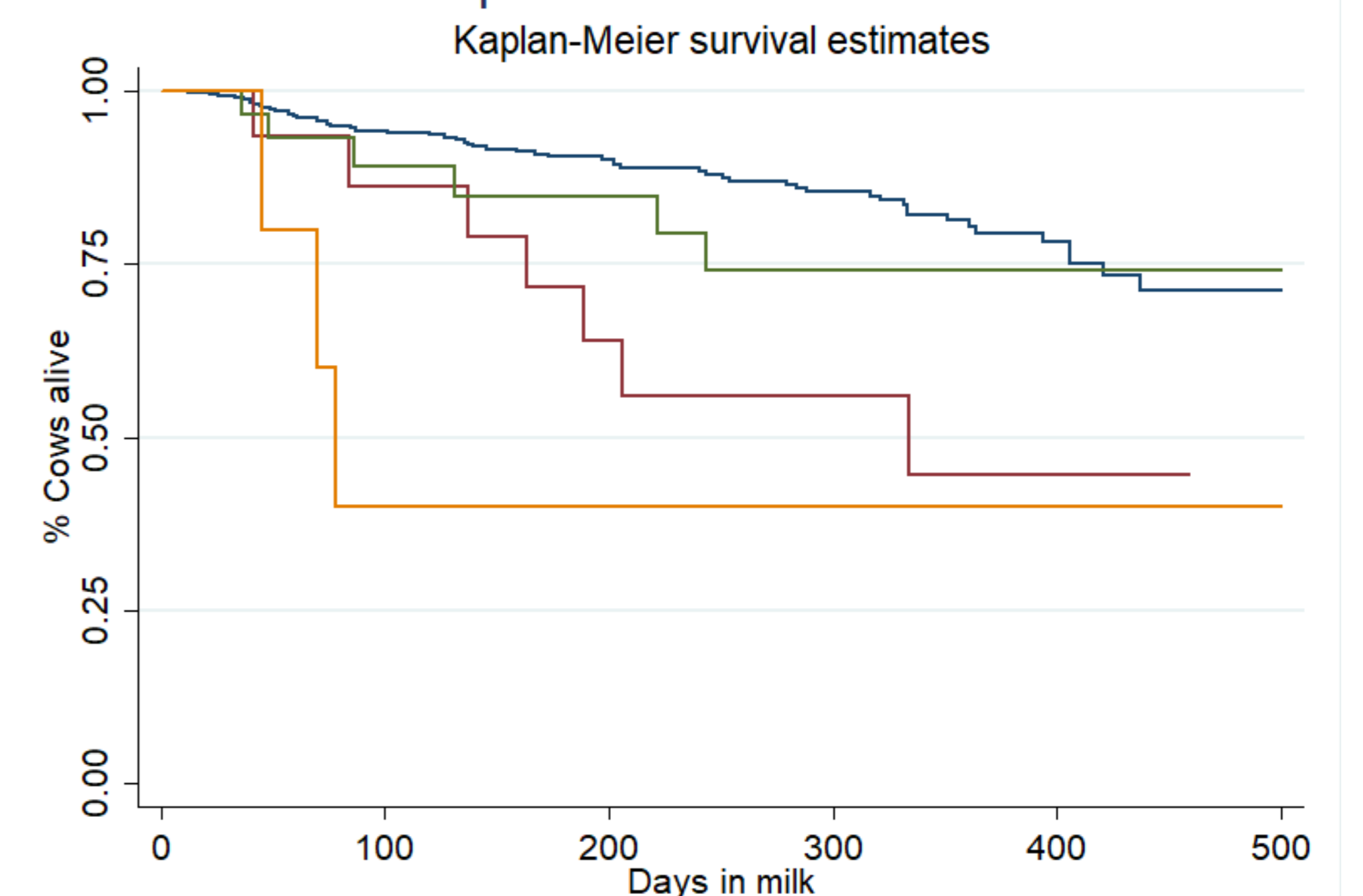
% Open cows per DIM and disease condition



Healthy cows – negative in both tests  
Positive cows to first test (9 DIM)  
Positive cows to second test (16 DIM)  
Positive cows to both tests (9 and 16 DIM)

		16 days in milk		
		Positive	Negative	
9 days in milk	Positive	5	15	20
	% tot	1.13%	3.40%	4.54%
9 days in milk	Negative	32	389	421
	% tot	7.26%	88.21%	95.46%
		37	404	
		8.39%	91.61%	

% cows per DIM and disease condition



## DISCUSSION

Previous studies indicated that the timing of HYK diagnosis may result in different effects on health and production (Duffield et al., 2009), and it may need to be considered when investigating the association of HYK and performance.

Our current results reinforce that idea and are aligned with recent reports (Rodríguez et al., 2022) where comparing 1st and 2nd week test, authors found that HYK diagnosed during first week of lactation is associated with negative performance in terms of milk yield, reproduction, and herd removal but no evidence of association was found for the same outcomes when HYK was diagnosed in second week.

## CONCLUSIONS

Our results suggest that the DIM when ketosis diagnosed should be considered, as its association with performance outcomes might be different. Further research is warranted to understand the underlying causes of the effects of HYK at different time points and to investigate the use of a different threshold when diagnosing HYK at a different time in early lactation.

All data used in these analyses were observational. So, only associations should be drawn from this study and further analysis are necessary for causality determinations.

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