Selection of cows at risk of subclinical ketosis as part of the milk recording of dairy cattle in Poland in 2014-2022

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Abstract

In 2013, in Polish Federation of Cattle Breeders and Dairy Farmers, the new service was introduced - selecting cows which are in a state of subclinical ketosis (SK). This method is based on checking beta-hydroxybutyrate and acetone levels in milk sample, taken during test day. Those results constitute components for a logistic regression model, which indicates the probability of ketosis incidence. Above specific threshold, cow is marked on reports delivered to farmer. During period of 10 years, the incidence of SK in cows decreased with each subsequent year. The incidence of SK in cows is influenced, among other things, by milk yield in the herd and the size of the herd, as well as the housing system. The lower the herd efficiency and the smaller the herd size, the higher the incidence of SK. The results indicate a constant improvement in the health situation of recorded cows in Poland, in the context of the frequency of subclinical ketosis. This is due to breeders expanding their knowledge about nutrition, prevention and good practices related to the keeping of dairy cows, as well as greater awareness of the negative effects of metabolic diseases.

Materials and methods

The data for analysis was downloaded from the Fedinfo database, belonging to the PFCBDF, in which the results of test milkings carried out as a part of milk recording are collected and processed. Set 1 contained data on milk samples taken from cows of various breeds, mainly the Holstein-Friesian breed, from 2014-2022. Set 2 contained herd data (average number of cows, average yield and location). Cows marked with K! index in Fedinfo were probably in a state of ketosis on test day. Sensitivity and specificity of the method are 0.7 and 0.9, respectively (7).

Based on the K! index prevalence in the herd, as well as the herd size, the probable prevalence of SCK in the herd is calculated. If it exceeds 10%, herd is at risk of SCK. If this indicator exceeds 20%, the herd is considered to be at high risk of SCK. Data analysis and graphs were performed using the R language (https://www.r-project.org/) and the RStudio program. To check the relationship between the health status of a cow and the size and average milk yield of the herd, the chi-square test and measures based on this test were used, including the V-Cramer and the contingency coefficients.

Results

The share of primiparous cows was 33%, cows in the second lactation 26%, and in the third and beyond - 41%. The animals were on average in 31.7 DIM, with a daily milk yield of 31.97 kg (Table 1).

Table 1. The share of primiparous cows

Variable	n	Average	Median	Minimum	Maximum	SD	CV
Number of samples							
All	10 631 322						
Primiparous cows	3 554 722						
2nd lactation cows	2 761 429						
From cows in 3rd and further lactation	4 315 171						
Parity		2,54	2	1	22	1,7	65,9
Days in milk		31,7	32	5	60	16,3	51,6
Daily milk yield, kg		31,97	31,0	1	107	9,6	29,9
Number of records containing farm data	1 651 657						
Number of cows in herd		42,53	30	1	1546	56,6	133,1
Average milk yield on test day/per whole herd, kg		20,33	20,3	0,2	61,3	5,4	26,5
Average milk yield on test day/milked cows, kg		24,30	23,4	2,3	61,9	5,7	23,4

The median for the parity was 2. The average number of animals per herd was 43 (from 1 to 1546), and the average milk yield of cows on test day was 24.3 kg. Since the introduction of SCK monitoring in 2013, the prevalence (cows with the K! index) in the recorded population has decreased. However, there is a slight increase in this frequency in 2022. In all parity groups, there has been a continued tendency to reduce the share of the K! cows. Within the ≥ 3rd lactation cows, the share of such cows was higher than in younger cows (Figure 1).

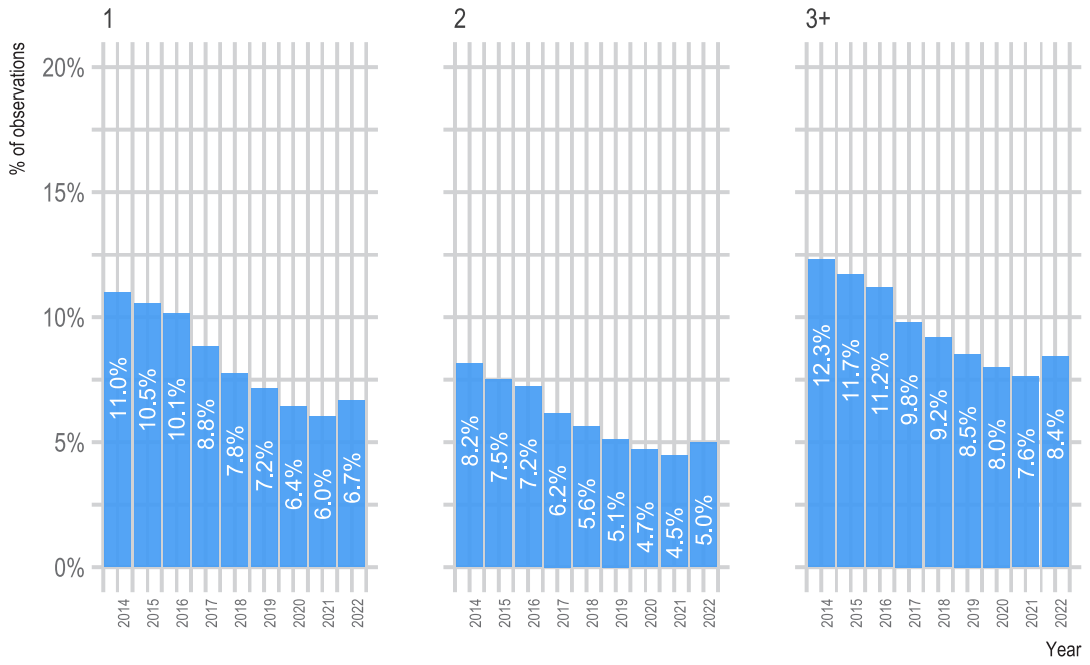

Figure 1.Tthe share of 3rd lactation cows compared to younger cows.

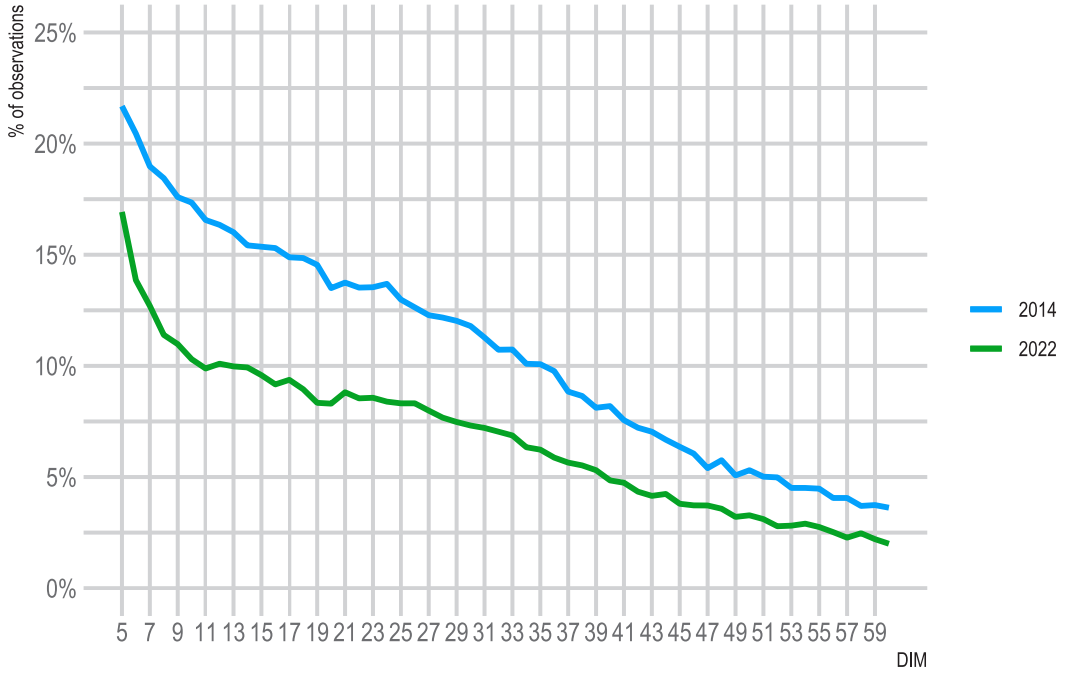

Figure 2. Percentage of cows suspected of being in the SCK state.

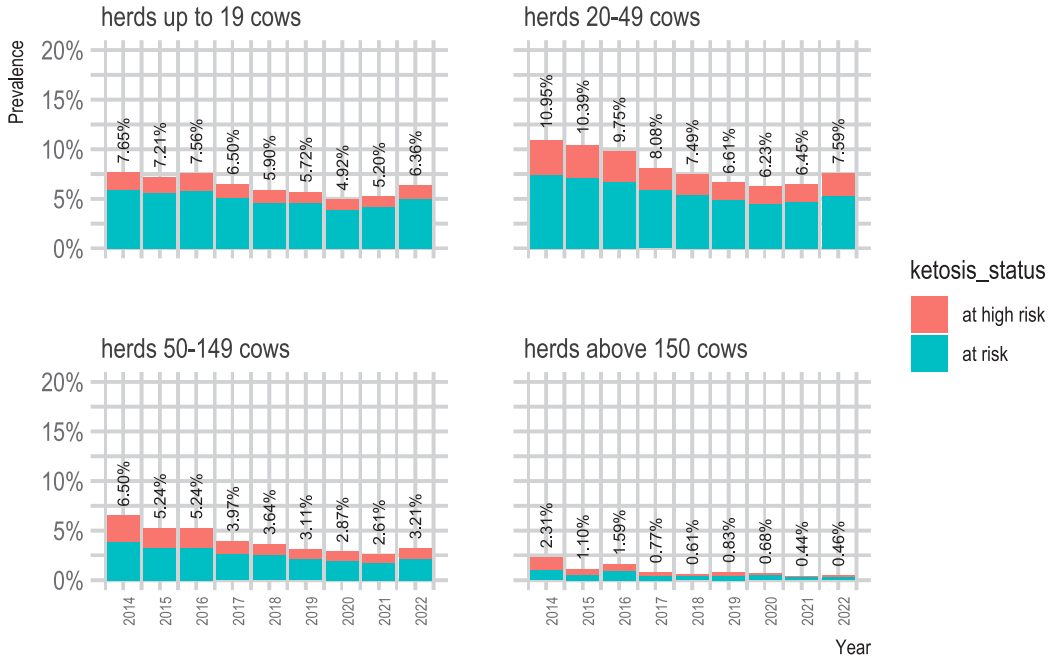

Figure 3. Risk of SCK by herd-size classes.

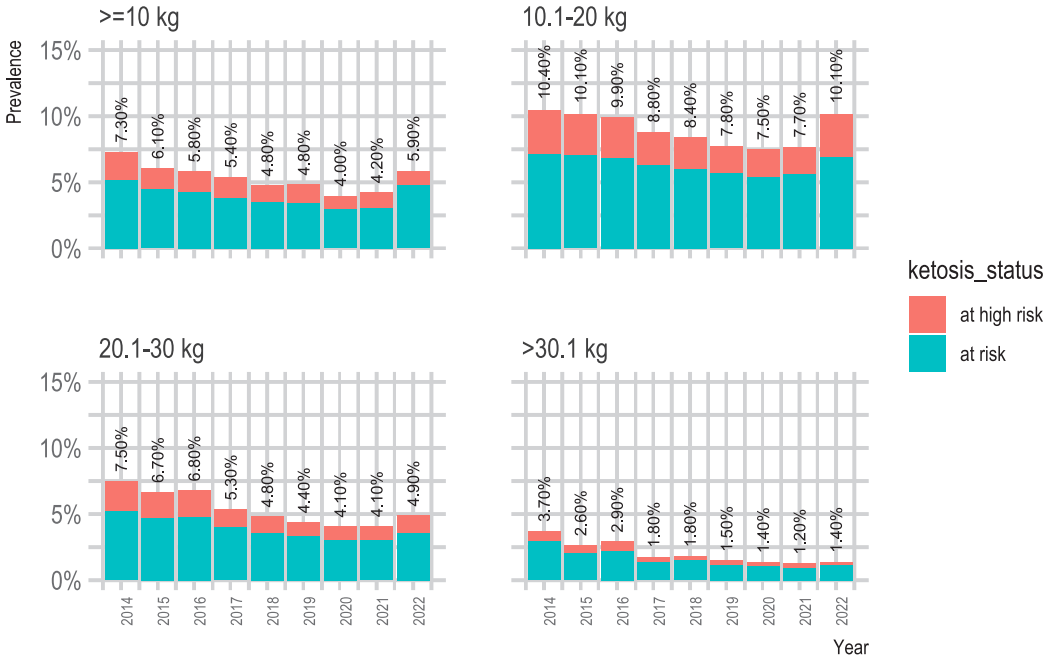

Figure 4. Risk of SCK by milk production classes.

In 2022, the number of the K! cows between 5 and 7 DIM decreased faster than in the corresponding group in 2014. In 2014 19.6% of cows between 5 and 7 DIM were suspected of being in the SCK state (in 2022 13.6% cows; Figure 2). The K! cows were the most frequent among the lowest producing cows, i.e. ≤ 10 kg/d. As the daily milk yield increased, the prevalence of SCK decreased and the relationship was significant, although very weak (p-value = 0.0005, Cramer's V coefficient = 0.143, contingency coefficient = 0.142). The share of herds at risk or high risk of ketosis has decreased from year to year. Herds with 20 to 49 cows were at the highest risk of SCK, and the relationship was significant, although very weak (p-value = 0.0004998, V-Cramer coefficient = 0.045, contingency coefficient = 0.078). SCK occurred least frequently in herds with over 150 animals (Figure 3).

SCK most often occurred in herds with an average daily milk yield 10.1-20 kg and 20.1-30 kg, while the most productive herds were characterized by a low share of the K! cows (Figure 4). The ketosis status of herd and yield level were significantly, although very weakly, correlated (p-value = 0.0005, V-Cramer coefficient = 0.05, contingency coefficient = 0.088).

Discussion and conclusions

Compared to the average prevalence of SCK recorded in dairy cow populations in 10 European countries, which was 11.2-36.6% (9), the prevalence of SCK in the Polish population was much lower. The increase in SCK prevalence in 2022 can probably be associated with rising inflation and prices of products and services, which could translate into lower standards of veterinary care, the quality of cow nutrition or the use of consultancy. Lower prevalence, than in the other studies (1,8,9) may result from different diagnosis models. Our model is very conservative and therefore selects significantly fewer cows in the SCK status. SCK most often occurred in older cows, which is consistent with the results of previous studies (3,5). The fact that SCK was much more common in herds with a daily milk yield of 10.1-20 and 20.1-30 kg is

surprising, since other studies have shown that the occurrence of ketosis increases with increasing milk yield (2,4). The presented population data, based on a large amount of data, indicate that SCK is not a metabolic disorder associated with a high cow performance, but a disorder associated with poor cow welfare, including poor nutritional standards (6). In the herds with the largest number of animals, SCK occurred less frequently, which could be related to the fact that large farms more often use the services of nutritional consultants, had the opportunity to divide animals into production groups, and consequently adjust feed rations to the needs of cows in particular stages of lactation. The above results indicate a constant improvement in the health situation of recorded cows in Poland. This is due to breeders expanding their knowledge of nutrition, prevention and good practices related to the maintenance of dairy cows, as well as greater awareness of the negative effects of metabolic diseases. Introduction of this type of service contributed to the gradual reduction of the prevalence of ketosis.

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