Why do the cows become hyperketolactic in Poland?

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System of ketosis (hyperketolactia) monitoring in Poland

Polish Federation of Cattle Breeders and Dairy Farmers

Total number of dairy cows: 2 035 188

Total number of cows recorded: 792 963 (~37%)

Total number of herds recorded: 18 559

Average size of the herd: 42,8 cows

Average milk yield of cows recorded: 8 837 kg

2021-12-31

X – milk recording system labs with FTIR technology

What are risk factors?

A risk factor is a characteristic, condition, or behaviour that increases the likelihood of getting a disease. Risk factors are often presented individually, however in practice they do not occur alone. They often coexist and interact with one another.

Ekenene, 2020

Risk factors for hiperketonemia (blood BHB)

DRY AND PARTURIENT PREDICTORS OF HYPERKETONEMIA

Table 1. Descriptive statistics and chi-squared analysis of 1,618 Holstein cows from 4 herds undergoing repeated testing for hyperketonemia from 3 to 16 DIM[1]

Variable	Hyperketonemic [no. (%)]	Nonhyperketonemic [no. (%)]	*P*-value[2]
Herd			
Farm A	143 (42.7)	192 (57.3)	<0.001
Farm B	95 (27.1)	256 (72.9)	
Farm C	120 (43.5)	156 (56.5)	
Farm D	381 (58.1)	275 (41.9)	
BCSG			
1	215 (41.5)	303 (58.5)	<0.001
2	293 (41.5)	413 (58.5)	
3	231 (58.6)	163 (41.4)	
LS			
1 or 2	667 (45.0)	815 (55.0)	0.08
3 or 4	72 (52.9)	64 (47.1)	
CEASE			
1	596 (46.1)	697 (53.9)	0.75
2	98 (43.4)	128 (56.6)	
≥3	45 (45.5)	54 (54.5)	
CSEX			
Female	347 (44.4)	435 (55.6)	0.31
Male	392 (46.9)	444 (53.1)	
Twins			
0	703 (45.7)	835 (54.3)	0.90
1	36 (45.0)	44 (55.0)	
Stillbirth			
0	702 (45.8)	832 (54.2)	0.76
1	37 (44.0)	47 (56.0)	
PDCC			
<272	96 (36.6)	166 (63.4)	0.001
≥272	643 (47.4)	713 (52.6)	
Parity			
1	206 (37.4)	345 (62.6)	<0.001
2	182 (37.4)	305 (62.6)	
≥3	351 (60.5)	229 (39.5)	

[1]Cows were categorized as hyperketonemic if at any time between 3 and 16 DIM their blood BHBA concentration was ≥1.2 mmol/L. Analyzed variables included herd, BCS group (BCSG), locomotion score (LS), calving ease (CEASE), calf sex (CSEX: female or females only, at least 1 male), twins, stillbirth (at least 1 dead calf), previous days carried calf (PDCC), and parity.

[2]*P*-value reported for χ^2 statistic.

Herd, BCS, PDCC, parity – YES

LS, Cease, Csex, twins, stillbirth – NO

McArt et al., 2013

Risk factors for hyperketonemia

- Well known, universal
  - Excessive BCS ↑
  - Low DMI in close up and transition period *postpartum* ↑
  - Increased parity ↑
  - Dry period length ↑
  - Poor transition feed management ↑
  - Poor welfare standards ↑
  - Season of calving

Vanholder et al., 2015

- Specific for the region, area, breed, welfare conditions, etc.

Risk factors for hyperketolactia

Hungary, 52 herds, 1 669 HF dairy cows, 0-75 DIM
Diagnosis of ketolactia by Keto-Test,
determining BHB concentration in milk

Veterinary Record Open

Survey of ketolactia, determining the main predisposing management factors and consequences in Hungarian dairy herds by using a cow-side milk test

Péter Hejel,[1] Gerhard Zechner,[2] Csaba Csorba,[3] László Könyves[1]

TABLE 4: Effects of investigated factors on OR of each ketolactia categories

	BHBA 0			BHBA 50			BHBA 100			BHBA 200			BHBA 500			BHBA 1000		
	OR	95% CI	P values	OR	95% CI	P values	OR	95% CI	P values	OR	95% CI	P values	OR	95% CI	P values	OR	95% CI	P values
DIM	1.03	1.012 to 1.04	**0.00038***	0.98	0.96 to 1.00	**0.033***	0.99	0.97 to 1.01	0.19	0.97	0.94 to 1.01	**0.045***	0.98	0.94 to 1.03	0.48	1.06	0.99 to 1.13	0.11
Parity	0.89	0.83 to 0.95	**0.0007***	0.98	0.90 to 1.07	0.61	1.19	1.10 to 1.29	**0.00003***	0.997	0.87 to 1.15	0.96	1.13	0.92 to 1.37	0.24	1.16	0.86 to 1.56	0.334
Twins (n=42)	0.83	0.43 to 1.61	0.64	0.50	0.15 to 1.30	0.1791	1.01	0.40 to 2.25	1	1.51	0.38 to 4.31	0.3532	4.17	1.03 to 12.42	**0.02268***	4.73	0.51 to 21.02	0.0807
Dystocia (n=37)	1.20	0.59 to 2.45	0.6212	1.04	0.41 to 2.37	0.8405	0.66	0.2 to 1.74	0.5252	0.81	0.09 to 3.21	1	0.00	0.00 to 3.94	0.6229	5.41	0.59 to 24.26	0.06455
Dystocia in first lactation	0.69	0.24 to 2.00	0.4702	1.51	0.41 to 4.67	0.3884	0.90	0.10 to 4.01	1	2.00	0.21 to 9.29	0.2988	0.00	0.00 to 15.37	1	0.00	0.00 to 61.88	1
Dystocia in 2+ lactation	1.62	0.59 to 4.68	0.3563	0.70	0.13 to 2.46	0.7786	0.68	0.13 to 2.39	0.7791	0.00	0.00 to 2.94	0.6345	0.00	0.00 to 7.16	1	10.53	1.07 to 52.52	**0.02196***
Premature calving (n=21)	0.92	0.35 to 2.40	1	0.40	0.04 to 1.65	0.2815	2.68	0.95 to 7.03	**0.04295***	0.71	0.02 to 4.50	1	0.00	0.00 to 7.28	1	0.00	0.00 to 17.99	1
RP (n=155)	0.77	0.55 to 1.09	0.1515	0.60	0.36 to 0.97	**0.02959***	1.94	1.31 to 2.84	**0.0008***	0.75	0.31 to 1.58	0.6089	1.89	0.70 to 4.39	0.1796	2.65	0.63 to 8.44	0.09219
Milk fever (n=16)	0.79	0.25 to 2.39	0.8027	1.26	0.30 to 4.20	0.7564	1.43	0.33 to 4.77	0.5225	0.94	0.02 to 6.25	1	0.00	0.00 to 9.84	1	0.00	0.00 to 24.28	1
Metritis (n=140)	0.98	0.69 to 1.41	0.9299	0.77	0.46 to 1.22	0.2786	1.13	0.71 to 1.75	0.5736	1.10	0.50 to 2.18	0.7231	1.42	0.43 to 3.68	0.4105	2.07	0.38 to 7.36	0.2094
Mastitis (n=114)	0.62	0.41 to 0.93	**0.01522***	1.07	0.65 to 1.71	0.8114	1.66	1.04 to 2.60	**0.02527***	1.08	0.44 to 2.28	0.8443	0.998	0.20 to 3.21	1	2.60	0.48 to 9.27	0.1354
Clinical ketosis (n=27)	0.59	0.24 to 1.38	0.2442	1.33	0.47 to 3.31	0.4802	0.16	0.004-0-995	**0.04484***	0.54	0.013 to 3.36	1	4.87	0.90 to 17.04	**0.03217***	26.17	6.79 to 85.71	**<0.0001***
Lameness (n=41)	1.99	0.997 to 4.13	**0.0399***	0.77	0.29 to 1.80	0.6976	0.46	0.12 to 1.28	0.1582	0.35	0.01 to 2.10	0.5171	1.94	0.22 to 7.92	0.2946	0.00	0.00 to 8.76	1
Digestive disorders (n=12)	3.06	0.76 to 17.64	0.08918	0.00	0.00 to 1.36	0.08282	0.86	0.09 to 4.04	1	0.00	0.00 to 5.14	1	3.41	0.08 to 24.43	0.2751	0.00	0.00 to 33.61	1

*P value (bold) shows significance.
BHBA, beta-hydroxybutyrate; DIM, days in milk; RP, retained placenta.

Risk factors for hyperketolactia

J. Dairy Sci. 99:9263–9270
http://dx.doi.org/10.3168/jds.2016-11128

Prevalence of elevated milk β-hydroxybutyrate concentrations in Holstein cows measured by Fourier-transform infrared analysis in Dairy Herd Improvement milk samples and association with milk yield and components

D. E. Santschi,[1] R. Lacroix, J. Durocher, M. Duplessis, R. K. Moore, and D. M. Lefebvre
Valacta, 555, boul. Des Anciens-Combattants, Ste-Anne-de-Bellevue, Québec, H9X 3R4, Canada

- Canada, 4 242 herds, 498 310 HF dairy cows, 5-35 DIM
- Diagnostic ketolactia by Foss MilkoScan FT 6000, determining BHB levels in milk
- Threshold BHB 0.15 mmol/L

Risk factors: DIM, parity, season, herd size

J. Dairy Sci. 100:1308–1318
https://doi.org/10.3168/jds.2016-11453

Investigating the within-herd prevalence and risk factors for ketosis in dairy cattle in Ontario as diagnosed by the test-day concentration of β-hydroxybutyrate in milk

Elise H. Tatone,* Todd F. Duffield,*[1] Stephen J. LeBlanc,* Trevor J. DeVries,† and Jessica L. Gordon*
*Department of Population Medicine, and
†Department of Animal Biosciences, University of Guelph, Guelph, ON, Canada, N1G 2W1

- Canada
- Diagnostic ketolactia by Foss MilkoScan FT 6000, determining BHB levels in milk
- Threshold BHB ≥ 0.15 mmol/L

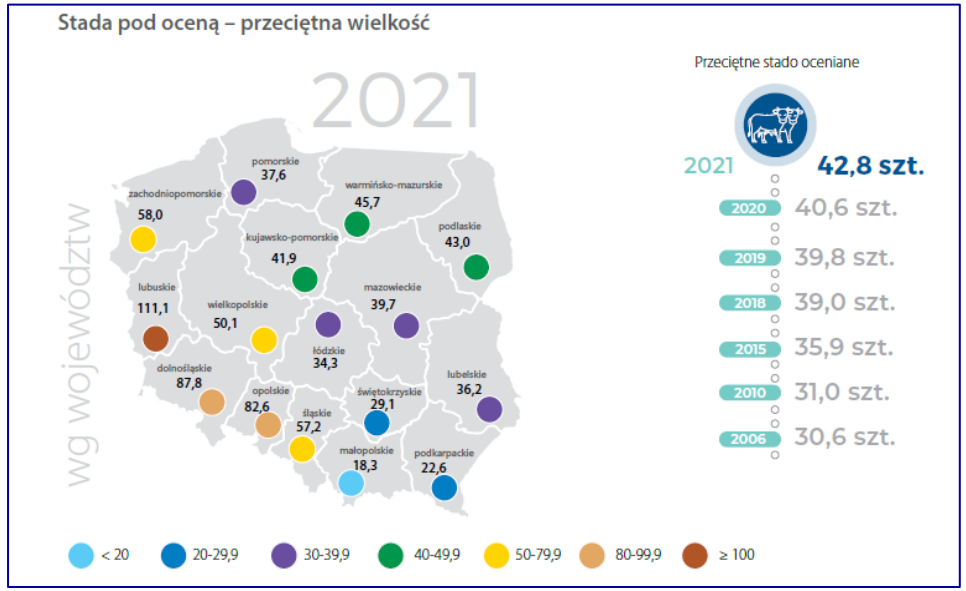
Risk factors for primaparous:

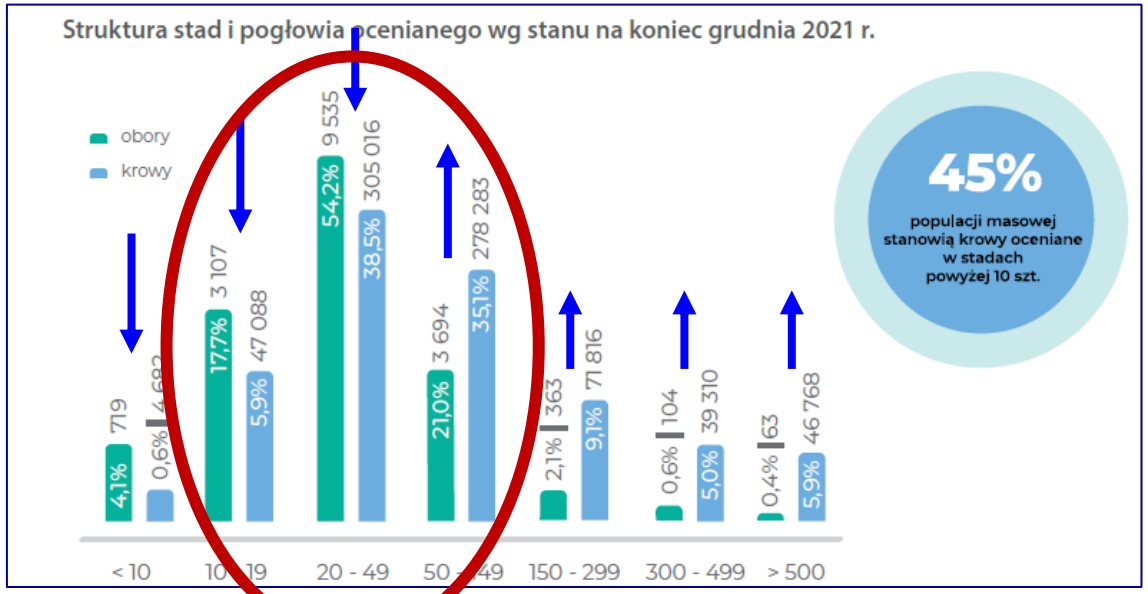
- Breed
- DIM
- Season
- Age at calving
- Herd milk yield

Risk factors for multiparous:

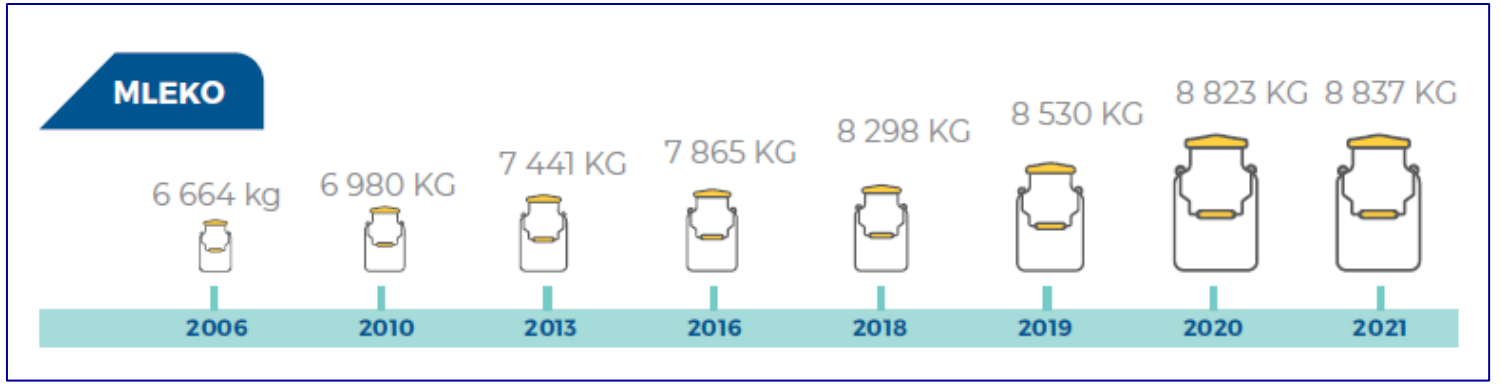
- Breed
- Parity
- DIM
- Season
- Calving interval
- Number of days dry
- Herd milk yield
- Previous lactation last test fat yield

Risk factors for hyperketolactia in Poland





Herd size



Milk yield

2021-12-31

The characteristics of dairy cow herds in Poland may suggest that the risk factors for hyperketonemia or hyperketolactia can be different from those described in other countries

Ketolactia definitions

Non ketolactia (NKL)
mACE <0.15 mmol/L **and** mBHB <0.10 mmol/L

Hyperketolactia (HYKL)
mACE ≥0.15 mmol/L **or** mBHB ≥0.10 mmol/L

Subpopulations classified:

- hyperketolactia from only ACE ($HYKL_{ACE}$)
  mACE ≥0.15 mmol/L and mBHB <0.10 mmol/L
- hyperketolactia from only BHB ($HYKL_{BHB}$)
  mACE <0.15 mmol/L and mBHB ≥0.10 mmol/L
- hyperketolactic from both ACE and BHB ($HYKL_{ACEBHB}$)
  mACE ≥0.15 mmol/L and mBHB ≥0.10 mmol/L

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Article

Screening for Subclinical Ketosis in Dairy Cattle by Fourier Transform Infrared Spectrometry

A.P.W. de Roos *, H.J.C.M. van den Bijgaart †, J. Hørlyk ‡, G. de Jong *

ELSEVIER
Journal of Dairy Science
Volume 104, Issue 12, December 2021, Pages 12800-12815

Research

Characterization of ketolactia in dairy cows during early lactation

Z.M. Kowalski [1], M. Sabatowicz [1], J. Barć [1], W. Jagusiak [2], W. Młocek [3], R.J. Van Saun [4], C.D. Dechow [5]

Risk factors for hyperketolactia in Poland ?

RESULTS of monitoring of ketosis in Poland – 4 months

Period: from 01-05-2018 to 31-08-2018
Milk samples: 220 241
Dataset 1

Questionare:

- *10 questions*
- *14 005 answers*

Dataset 2

All cows considered, including primiparous and multiparous

Risk factors for hyperketolactia in Poland

Variables evaluated for individual cows

	Type of variable	Value
Dataset 1		
Parity	Categorical	1, 2, 3, 4, 5, 6 and ≥7
Days in milk	Continuous	6-13, 14-21, 22-29, 30-37, 38-45, 46-53, 54-60
Herd size (N cows)	Continuous	≤20, 21-50, 51-100, 101-200, 201-500, 501-1000 , >1000
Daily herd milk yield, kg/d	Continuous	≤16, 16.1-20, 20.1-24, 24.1-28, 28.1-32, 32.1-36, and ≥36.1
Dataset 2		
Housing system	Categorical	Tie-stalls, Free-stalls or Deep-litter free-stalls
Grazing	Categorical	Yes or No
Feeding system	Categorical	Traditional, TMR, PMR
Cow grouping	Categorical	Yes or No
Dry cow groups	Categorical	0, 1 or ≥ 2
Checking BCS	Categorical	Yes or No
Farmers education	Categorical	Primary, basic vocational education, secondary, high
Agricultural education	Categorical	Yes or No
Feed chemical analysis	Categorical	Yes or No
Farm modernization, years/ago	Categorical	<5, 5-10, 10-15, 15-20 and >20

Risk factors for hyperketolactia in Poland

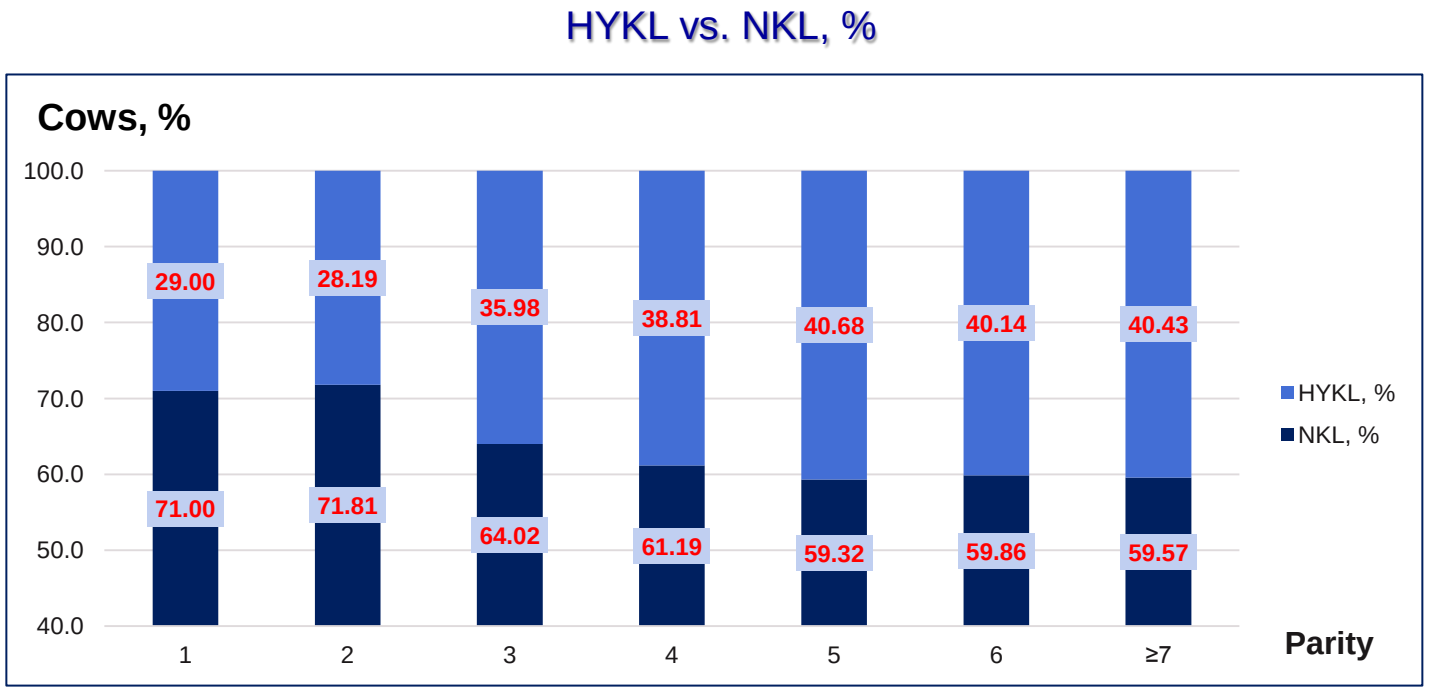
	Type of variable
Dataset 1	
Parity	Categorical
Days in milk	Continuous
Herd size (N cows)	Continuous
Daily herd milk yield, kg/d	Continuous
Dataset 2	
Housing system	Categorical
Grazing	Categorical
Feeding system	Categorical
Cow grouping	Categorical
Dry cow groups	Categorical
Checking BCS	Categorical
Farmers education	Categorical
Agricultural education	Categorical
Feed chemical analysis	Categorical
Farm modernization, years/ago	Categorical

Healthy (NKL) or Hyperketolactic (HYKL)

- Generalized logit mixed models of factors associated with dependent variable Y (NKL or HYKL)
- Multivariate multinominal logistic regression compared the odds ratio (OR) of a cow being NKL or HYKL for various risk factors
- Variables were tested for inclusion in the model by stepwise selection procedure (P-value for retention $P < 0.05$)
- Model for all cows

Vanholder et al., 2015

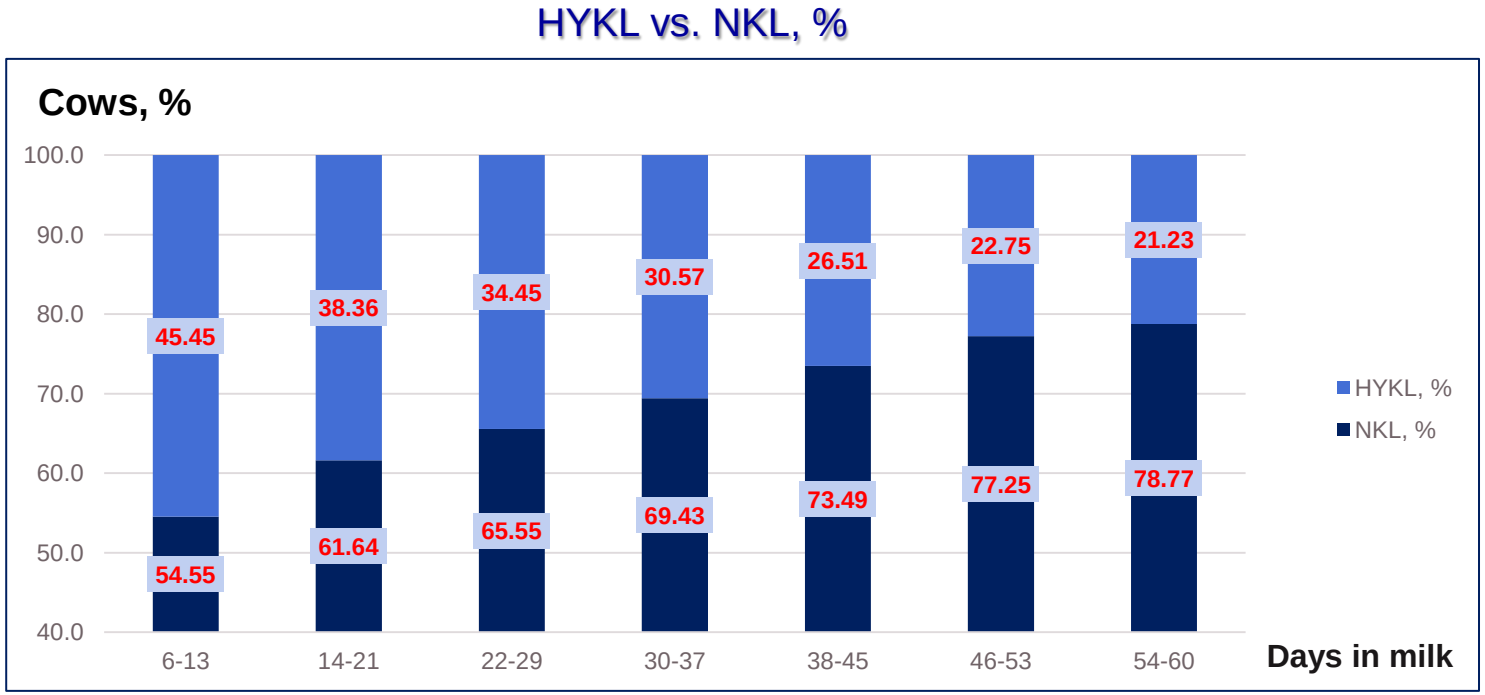
Prevalence of hyperketolactia – effect of parity



STEPWISE NHYKL vs. HYKL

Risk factors	Value	Estimate	SE	OR	95% Confidence limits Lower	Higher	P-value
Parity	2 vs. 1	-0.07	0.01	0.94	0.91	0.96	<.0001
	3 vs. 1	0.30	0.01	1.34	1.31	1.38	<.0001
	4 vs. 1	0.38	0.02	1.46	1.42	1.51	<.0001
	5 vs. 1	0.42	0.02	1.52	1.46	1.58	<.0001
	6 vs. 1	0.32	0.03	1.37	1.30	1.45	<.0001
	≤ 7 vs. 1	0.25	0.03	1.28	1.21	1.36	<.0001

Prevalence of hyperketolactia – effect of days in milk

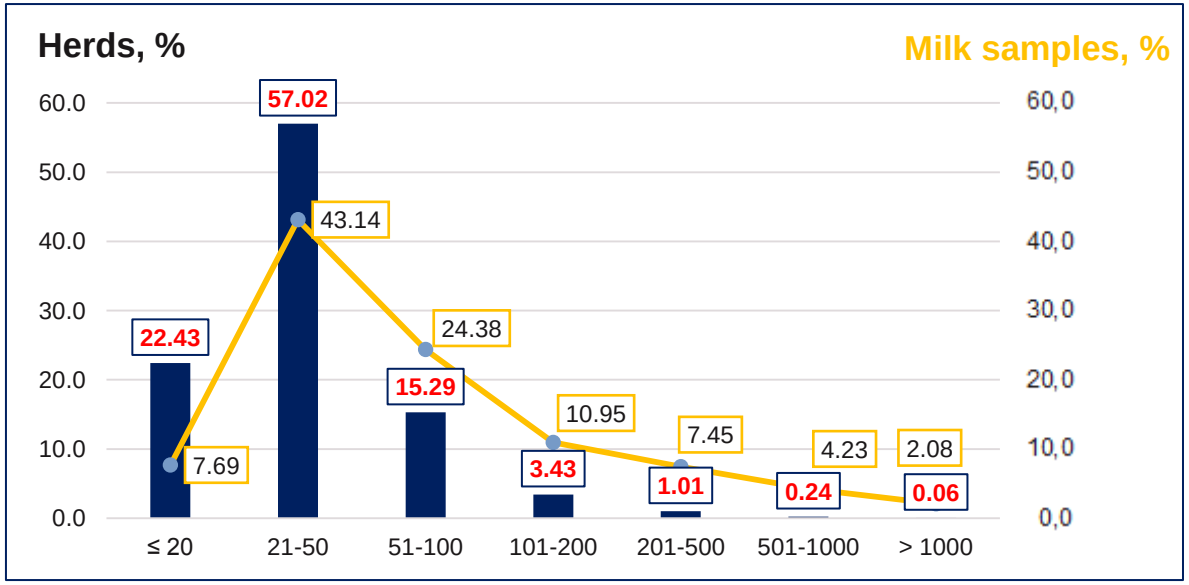


STEPWISE NHYKL vs. HYKL

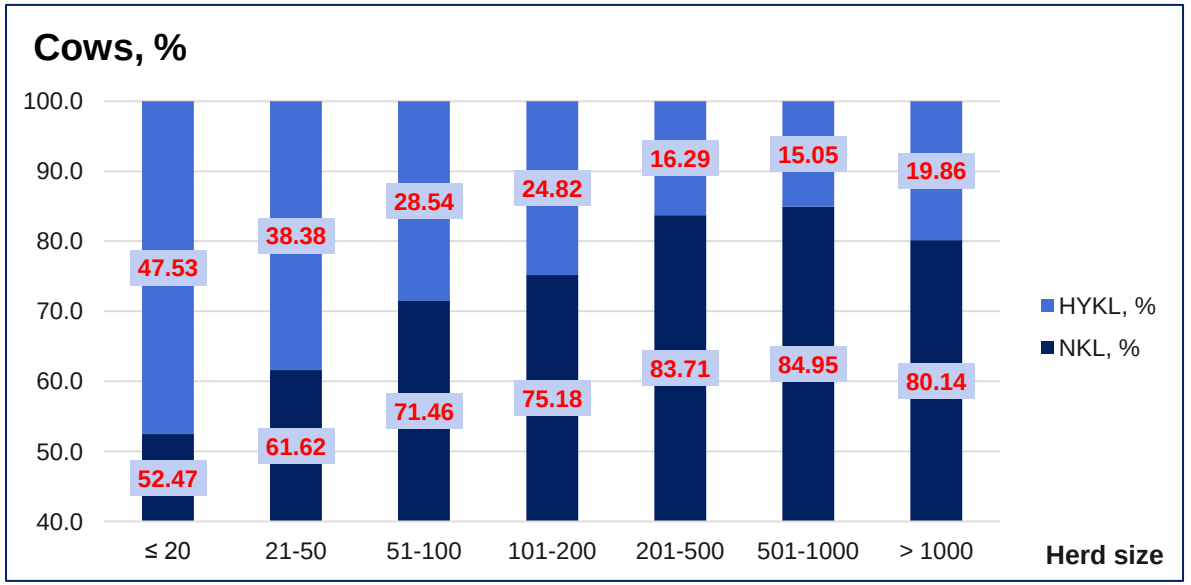
Risk factors	Value	Estimate	SE	OR	95% Confidence limits Lower	95% Confidence limits Higher	P-value
Days in milk	14-21 vs. 6-13	-0.29	0.02	0.75	0.73	0.77	<.0001
	22-29 vs. 6-13	-0.44	0.02	0.64	0.62	0.66	<.0001
	30-37 vs. 6-13	-0.67	0.02	0.52	0.50	0.54	<.0001
	38-45 vs. 6-13	-0.88	0.02	0.42	0.40	0.43	<.0001
	46-53 vs. 6-13	-1.06	0.02	0.35	0.33	0.36	<.0001
	54-60 vs. 6-13	-1.15	0.02	0.32	0.30	0.33	<.0001

Prevalence of hyperketolactia – effect of herd size

Herds by number of cows, % and milk samples by herds, %



HYKL vs. NKL, %



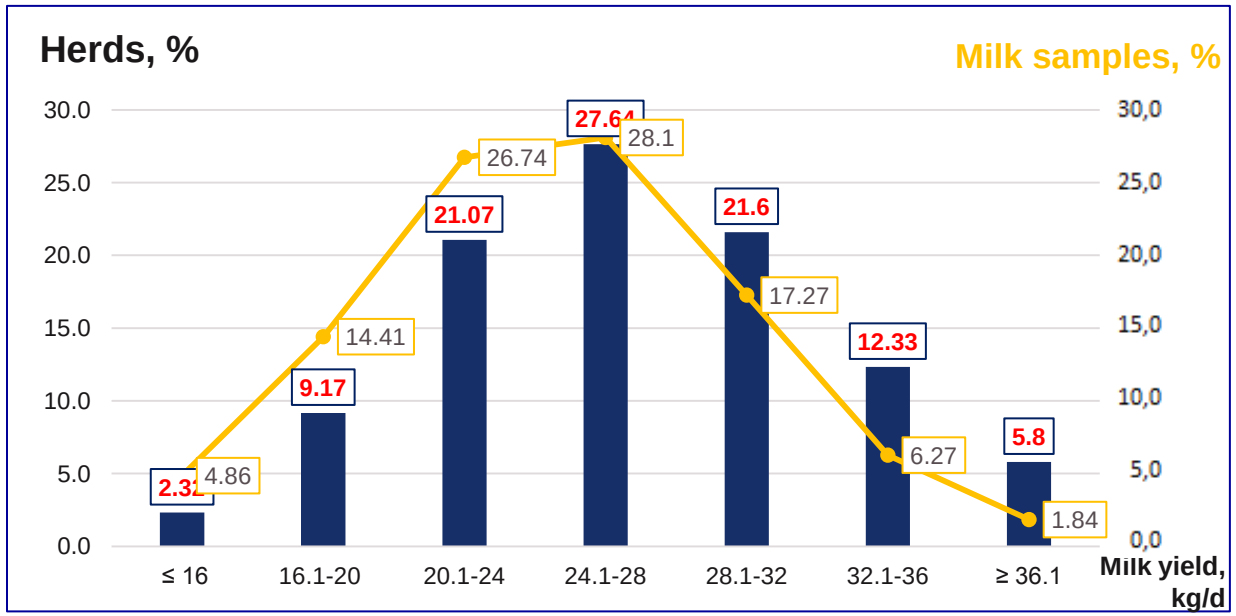
STEPWISE NHYKL vs. HYKL

Risk factors	Value	Estimate	SE	OR	95% Confidence limits		P-value
					Lower	Higher	
Herd size	21-50 vs. ≤ 20	-0.22	0.02	0.81	0.78	0.84	<.0001
	51-100 vs. ≤ 20	-0.47	0.02	0.62	0.59	0.65	<.0001
	101-200 vs. ≤ 20	-0.58	0.03	0.56	0.53	0.59	<.0001
	201-500 vs. ≤ 20	-0.85	0.03	0.43	0.40	0.45	<.0001
	501-1000 vs. ≤ 20	-0.83	0.04	0.43	0.40	0.47	<.0001
	> 1000 vs. ≤ 20	-0.36	0.05	0.70	0.63	0.77	<.0001

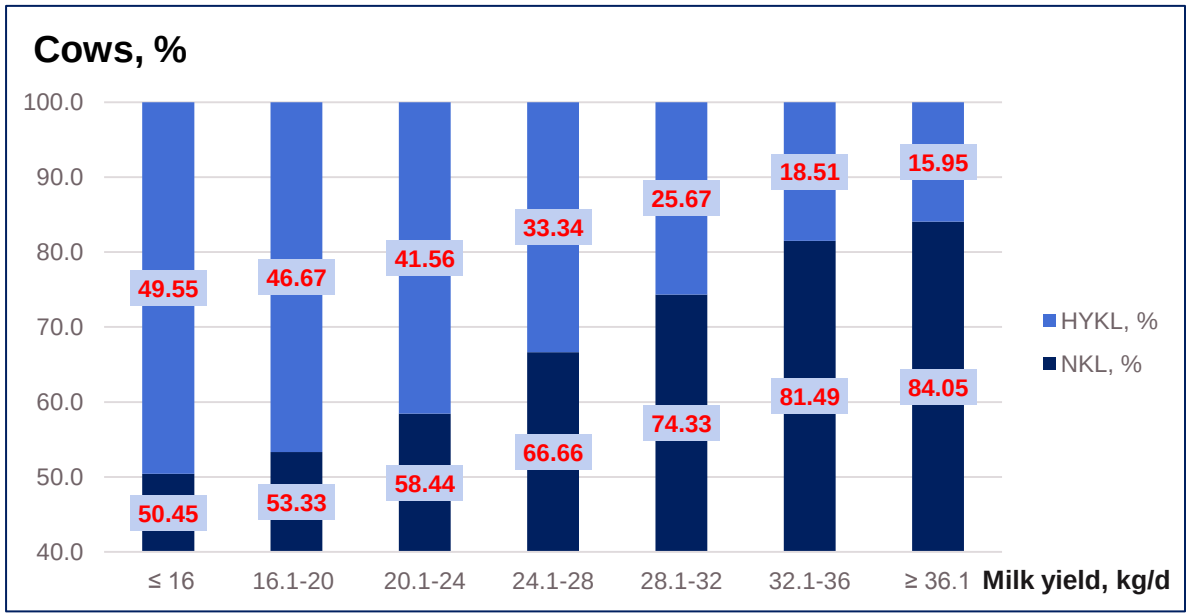
Risk factors for hyperketolactia in Poland

Prevalence of hyperketolactia – effect of herd average daily milk yield

Herds by average daily milk yield, % and milk samples by herds, %



HYKL vs. NKL, %

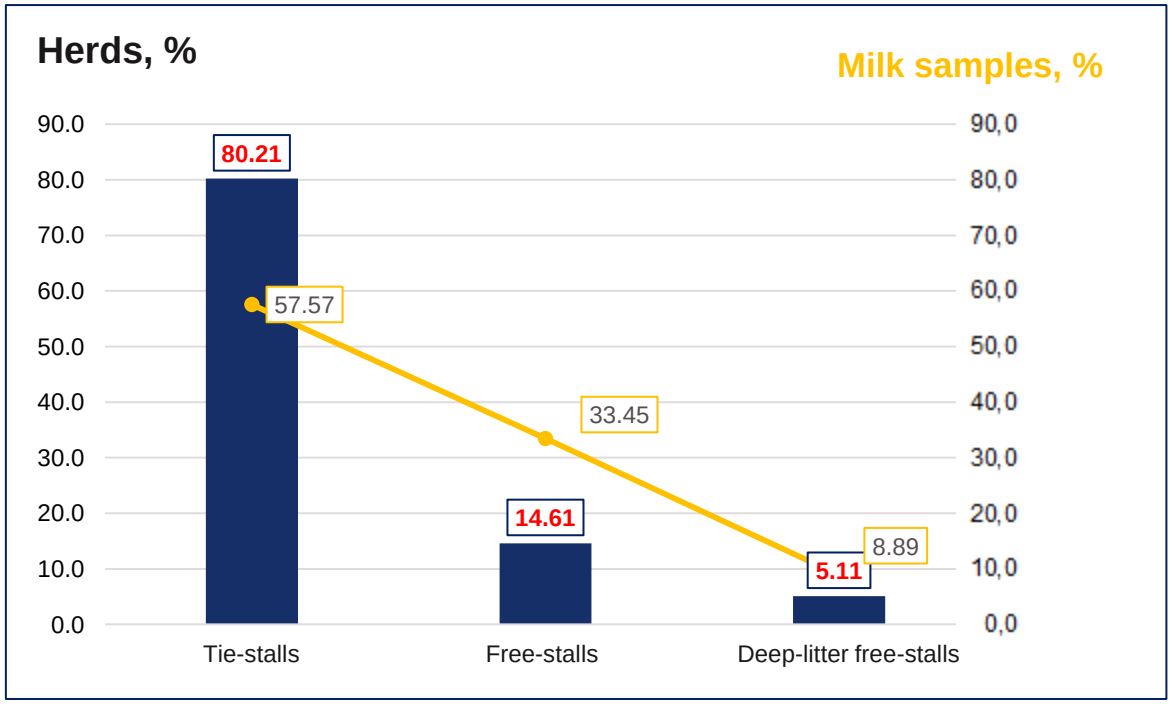


STEPWISE NHYKL vs. HYKL

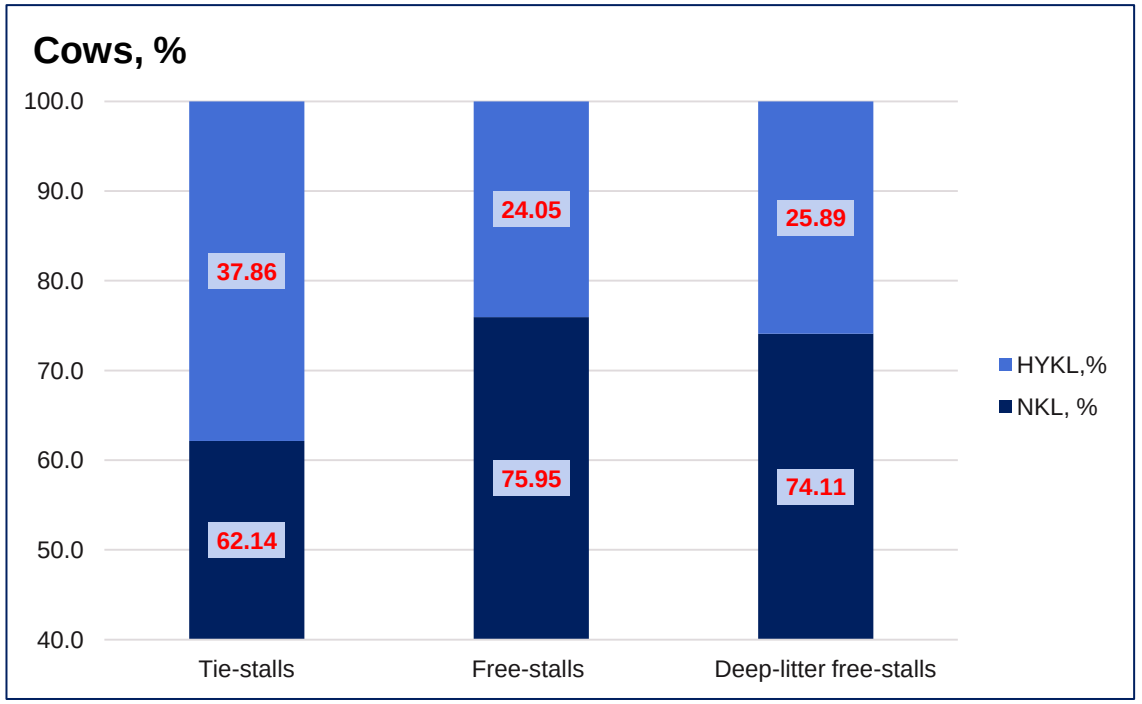
Risk factors	Value	Estimate	SE	OR	95% Confidence limits		P-value
					Lower	Higher	
Daily herd milk yield, kg/d	16.1-20 vs. ≤ 16	-0.04	0.03	0.96	0.90	1.02	0.1825
	20.1-24 vs. ≤ 16	-0.19	0.03	0.83	0.78	0.88	<.0001
	24.1-28 vs. ≤ 16	-0.45	0.03	0.64	0.60	0.68	<.0001
	28.1-32 vs. ≤ 16	-0.70	0.03	0.50	0.47	0.53	<.0001
	32.1-36 vs. ≤ 16	-0.98	0.04	0.38	0.35	0.41	<.0001
	≥ 36.1 vs. ≤ 16	-1.09	0.04	0.34	0.31	0.37	<.0001

Prevalence of hyperketolactia – effect of type of barn

Herds by type of barn, % and milk samples by herds, %



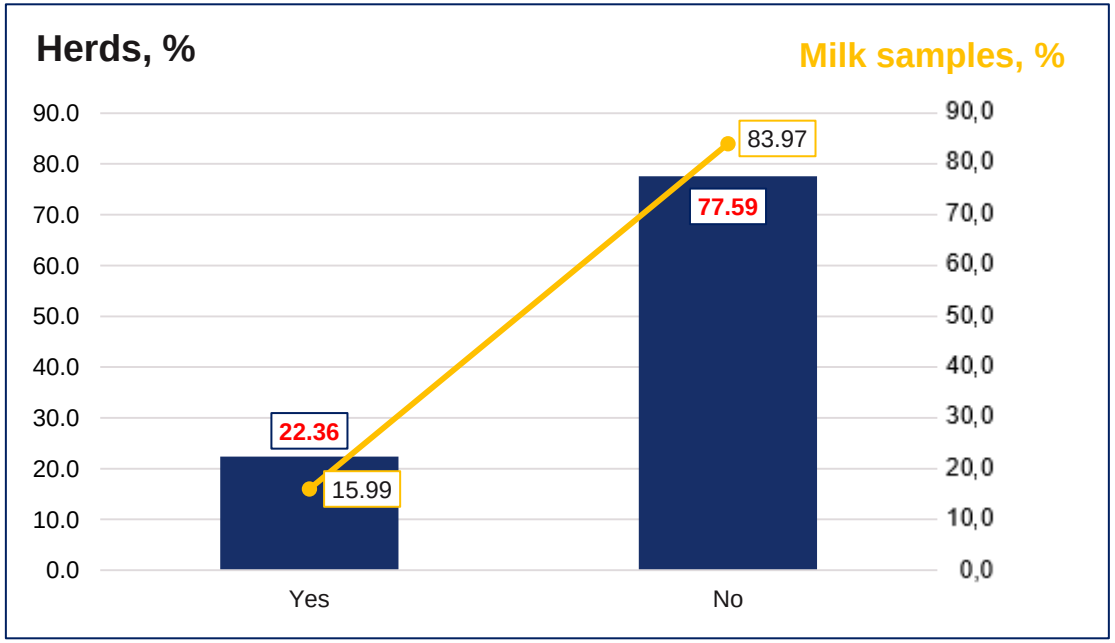
HYKL vs. NKL, %



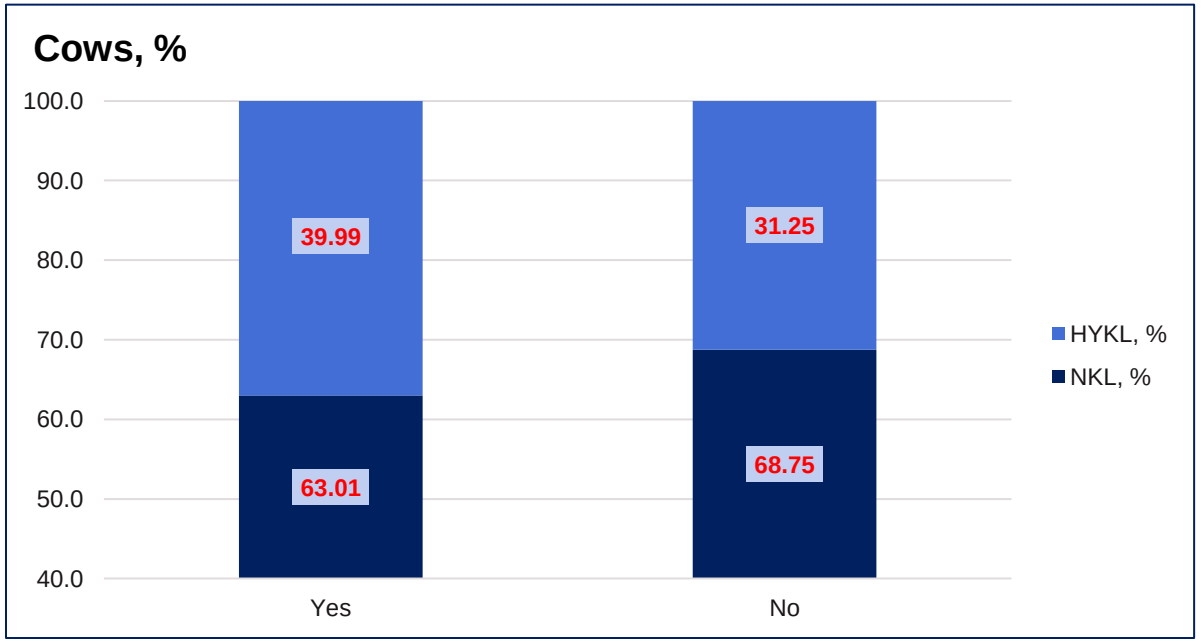
P > 0.05

Prevalence of hyperketolactia – effect of grazing

Herds by grazing, % and milk samples by herds, %



HYKL vs. NKL, %

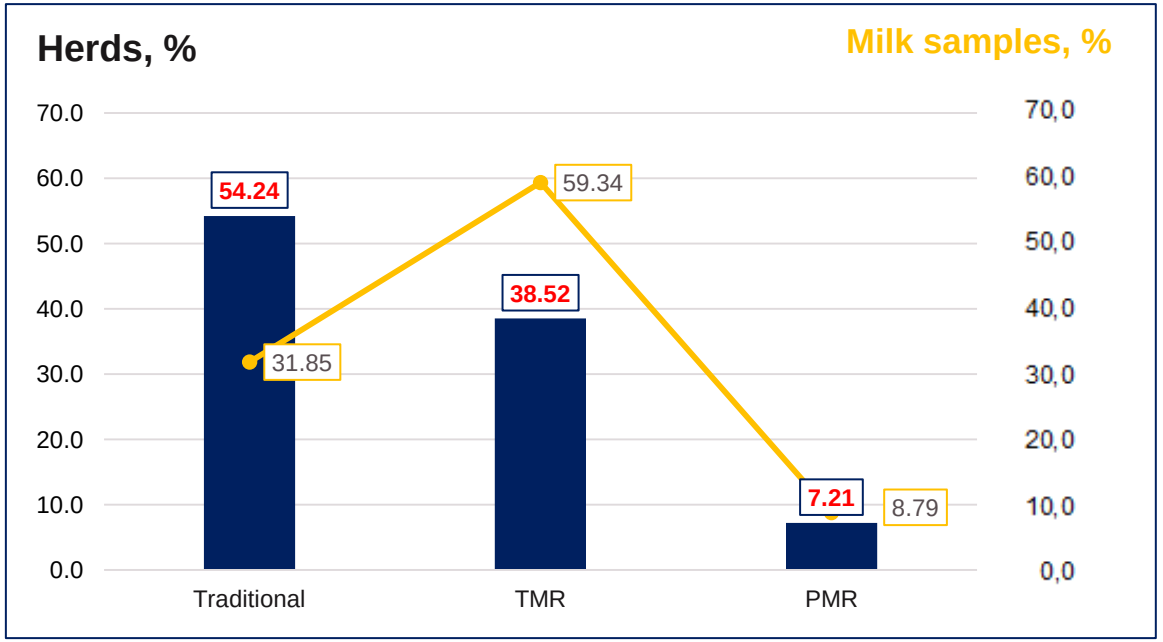


STEPWISE NHYKL vs. HYKL

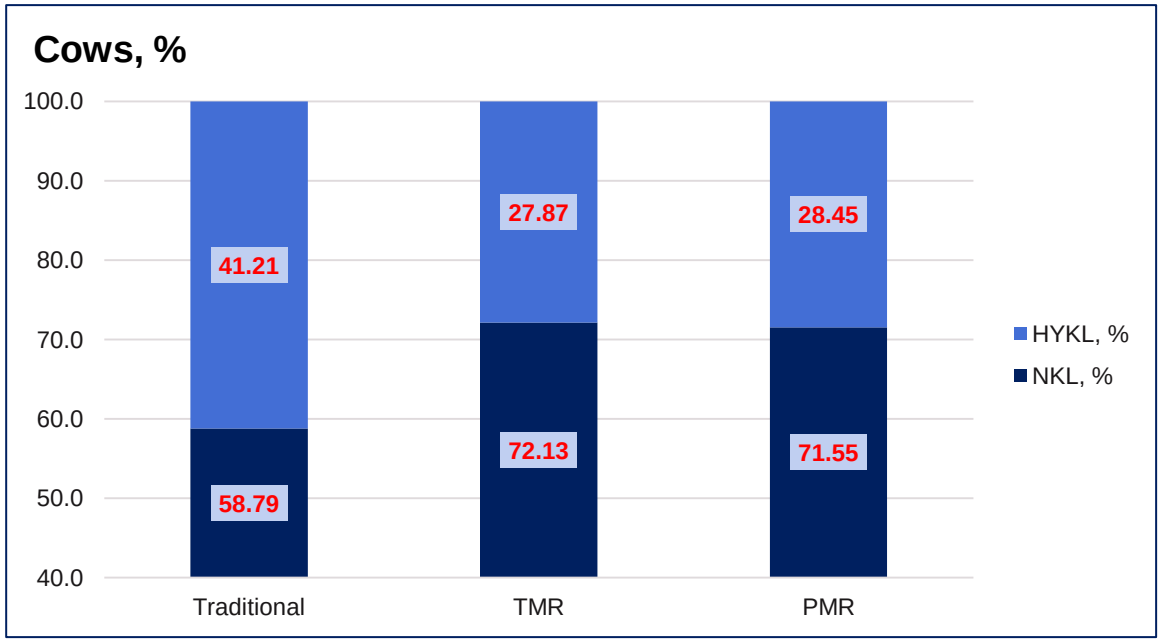
Risk factors	Value	Estimate	SE	OR	95% Confidence limits		P-value
					Lower	Higher	
Grazing	No vs. Yes	0.18	0.01	1.20	1.17	1.23	<.0001

Prevalence of hyperketolactia – effect of feeding system

Herds by feeding system, % and milk samples by herds, %



HYKL vs. NKL, %

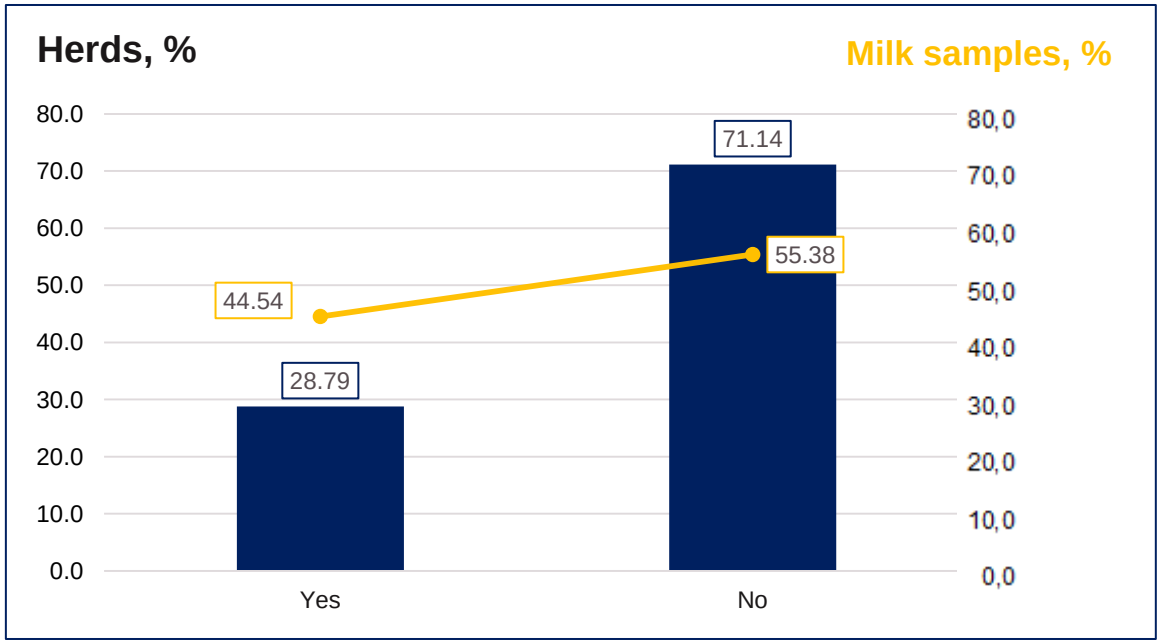


STEPWISE NHYKL vs. HYKL

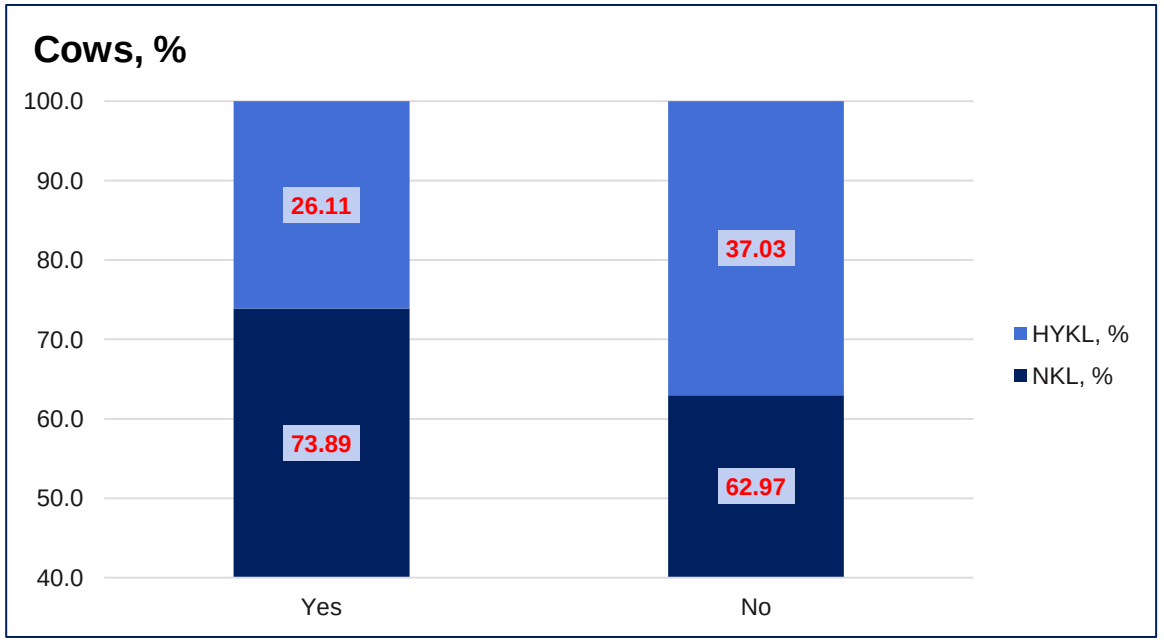
Risk factors	Value	Estimate	SE	OR	95% Confidence limits Lower	Higher	P-value
Feeding system	TMR vs. Traditional	-0.03	0.01	0.97	0.95	1.00	0.0239
	PMR vs. Traditional	-0.13	0.02	0.87	0.84	0.91	<.0001

Prevalence of hyperketolactia – effect of cow grouping

Herds by cow grouping, % and milk samples by herds, %



HYKL vs. NKL, %

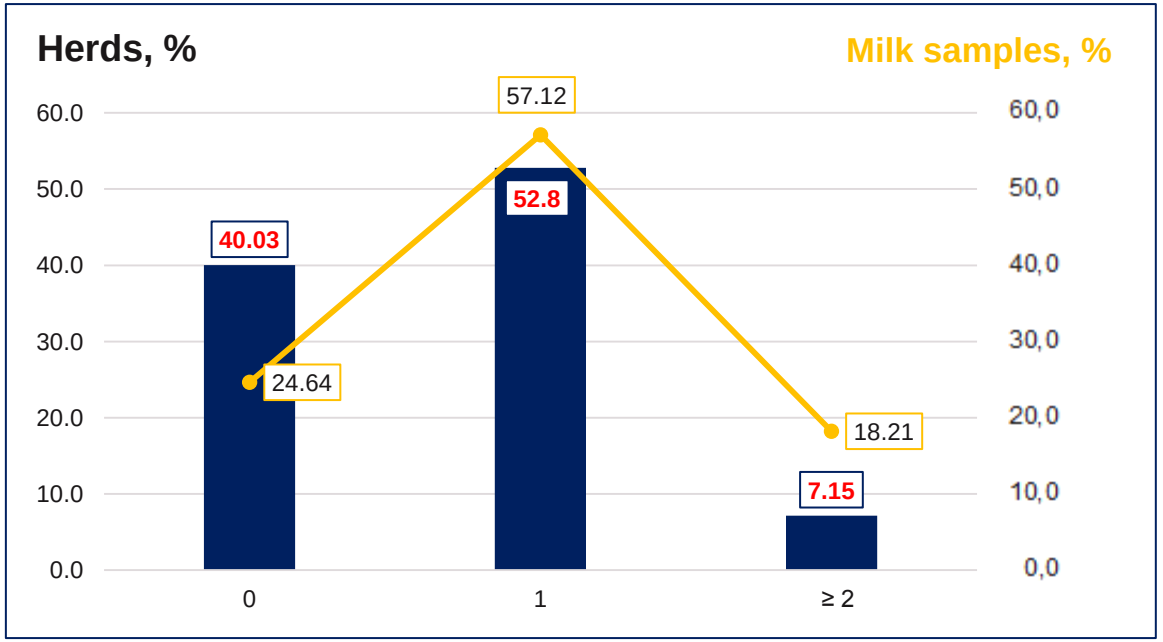


STEPWISE NHYKL vs. HYKL

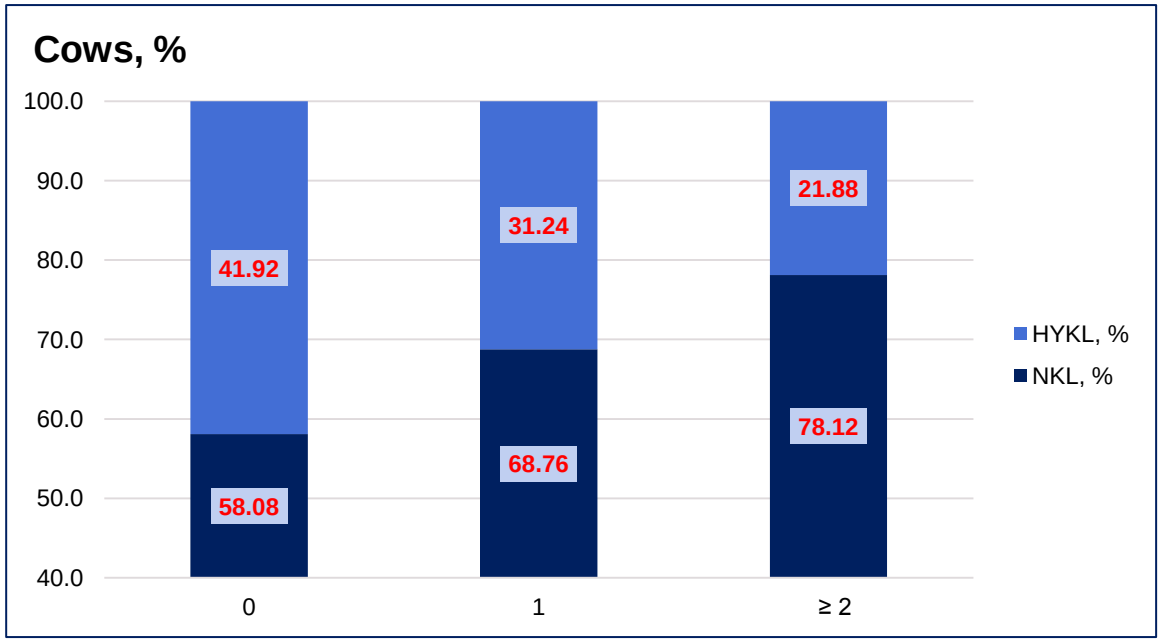
Risk factors	Value	Estimate	SE	OR	95% Confidence limits		P-value
					Lower	Higher	
Cow grouping	No vs. Yes	0.03	0.01	1.04	1.01	1.06	0.0045

Prevalence of hyperketolactia – effect of dry cow grouping

Herds by dry cow grouping, % and milk samples by herds, %



HYKL vs. NKL, %

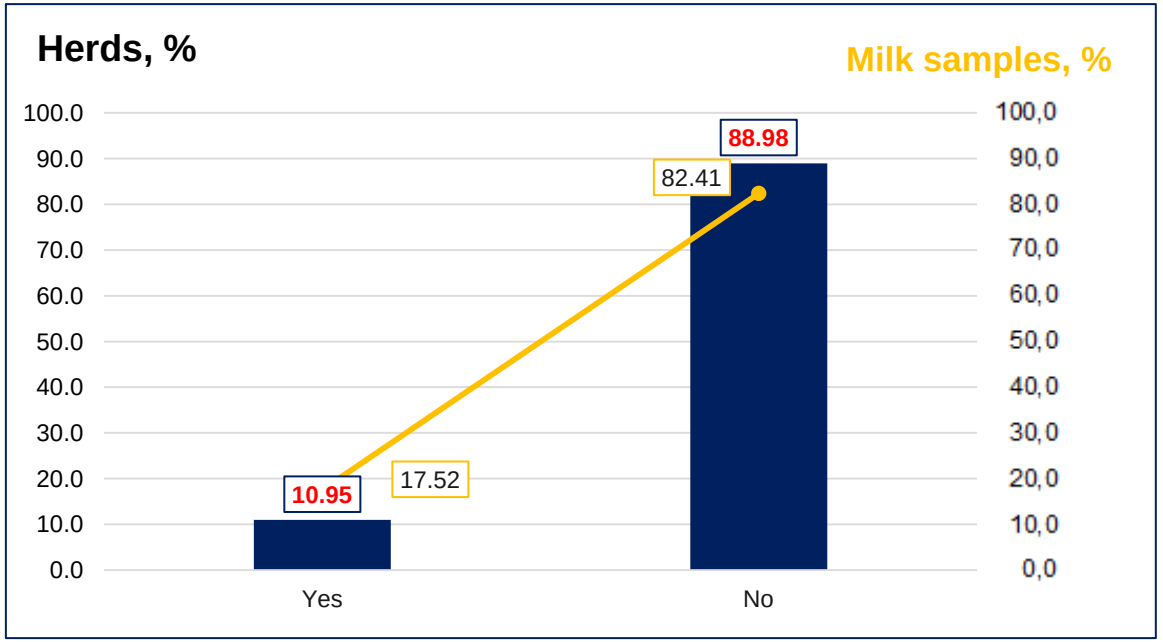


STEPWISE NHYKL vs. HYKL

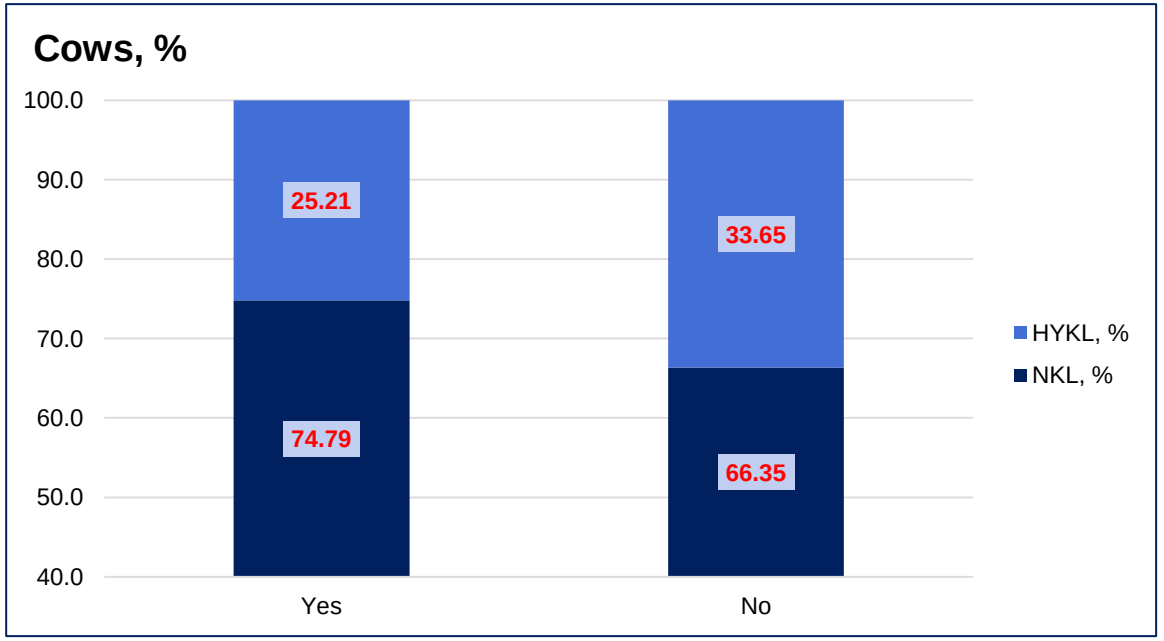
Risk factors	Value	Estimate	SE	OR	95% Confidence limits Lower	Higher	P-value
Dry cow groups	1 vs. 0	-0.10	0.01	0.91	0.88	0.93	<.0001
	> 2 vs. 0	-0.08	0.02	0.92	0.89	0.96	0.0002

Prevalence of hyperketolactia – effect of BCS checking

Herds by BCS checking, % and milk samples by herds, %



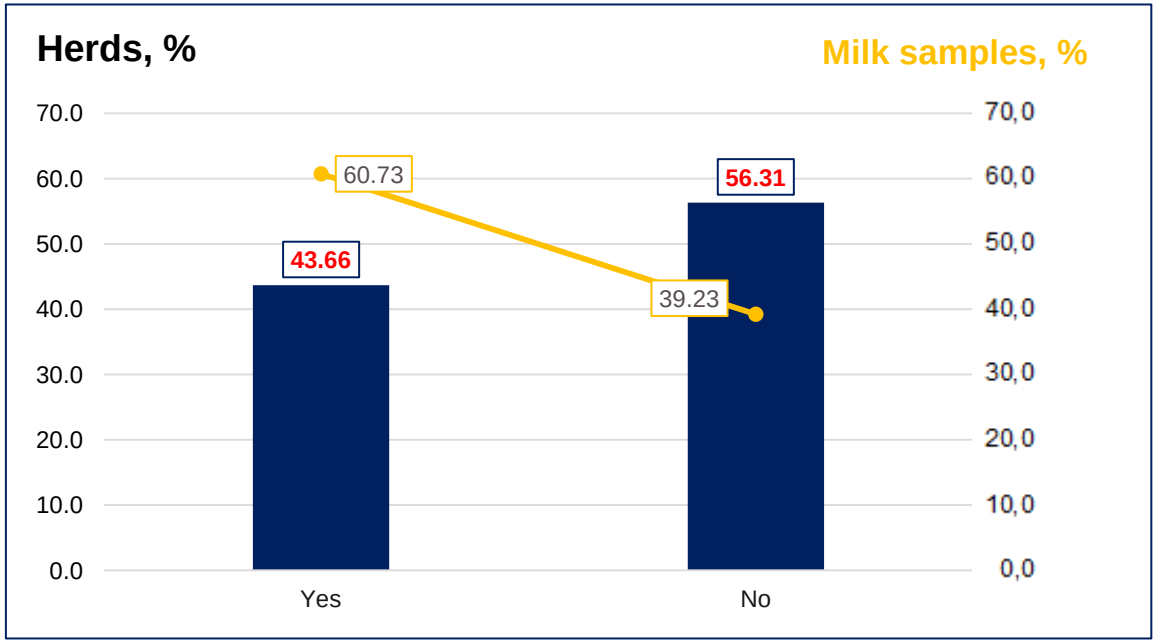
HYKL vs. NKL, %



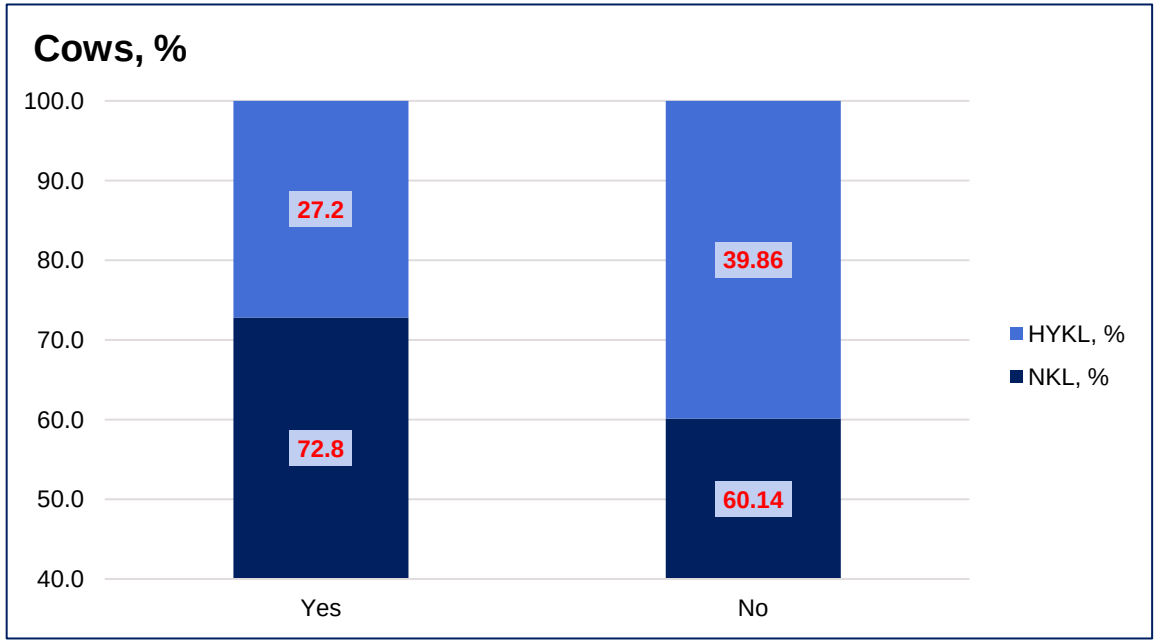
P > 0.05

Prevalence of hyperketolactia – effect of performing of feed analyses

Herds by feed analyses, % and milk samples by herds, %



HYKL vs. NKL, %

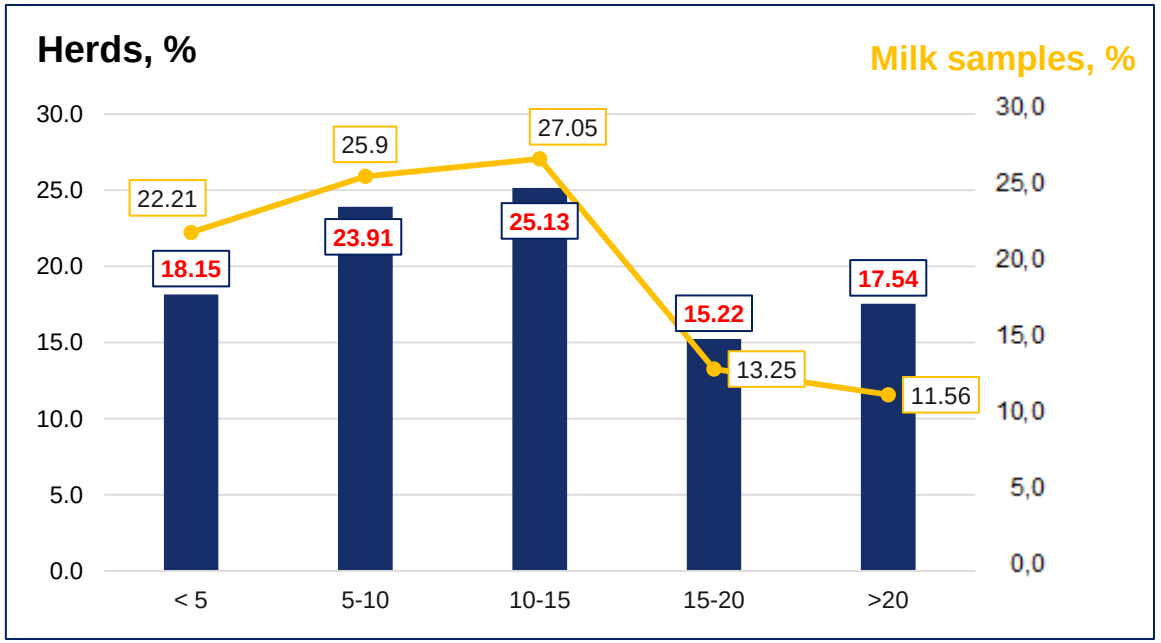


STEPWISE NHYKL vs. HYKL

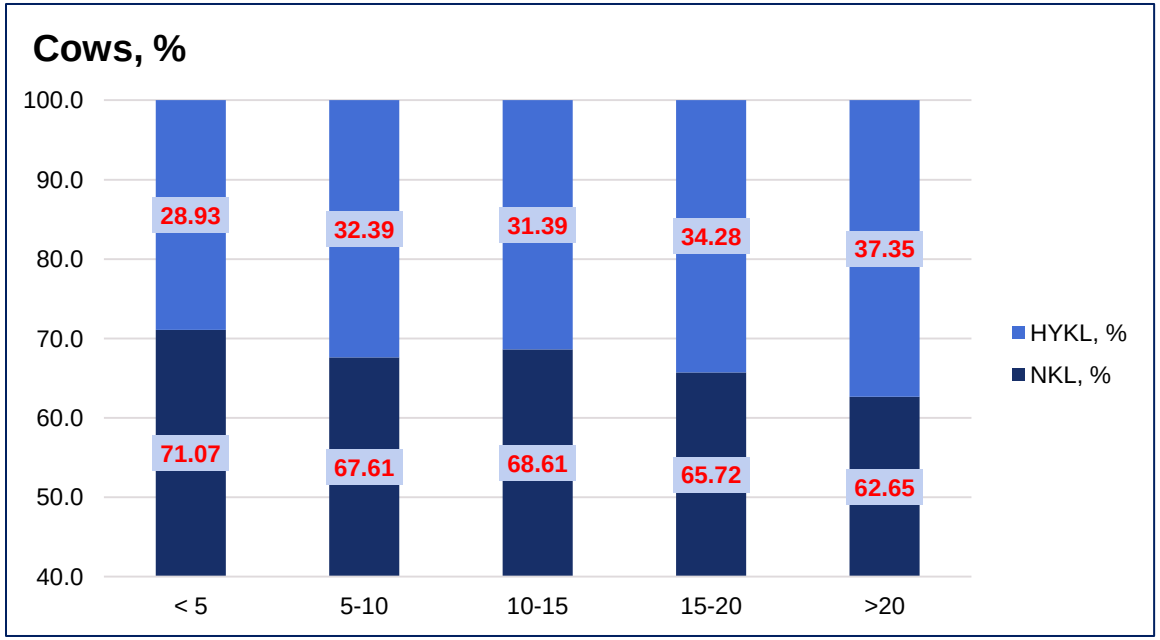
Risk factors	Value	Estimate	SE	OR	95% Confidence limits		P-value
					Lower	Higher	
Feed chemical analysis	No vs. Yes	0.09	0.01	1.10	1.07	1.12	<.0001

Prevalence of hyperketolactia – effect of farm modernization

Herds by farm modernization, % and milk samples by herds, %



HYKL vs. NKL, %

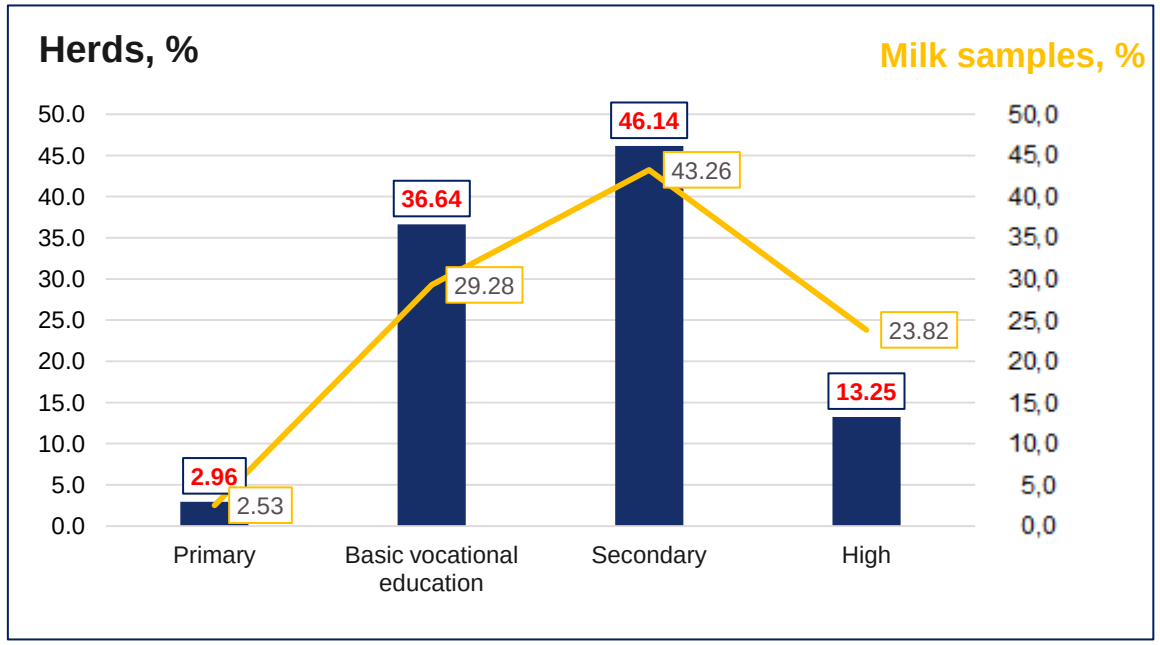


STEPWISE NHYKL vs. HYKL

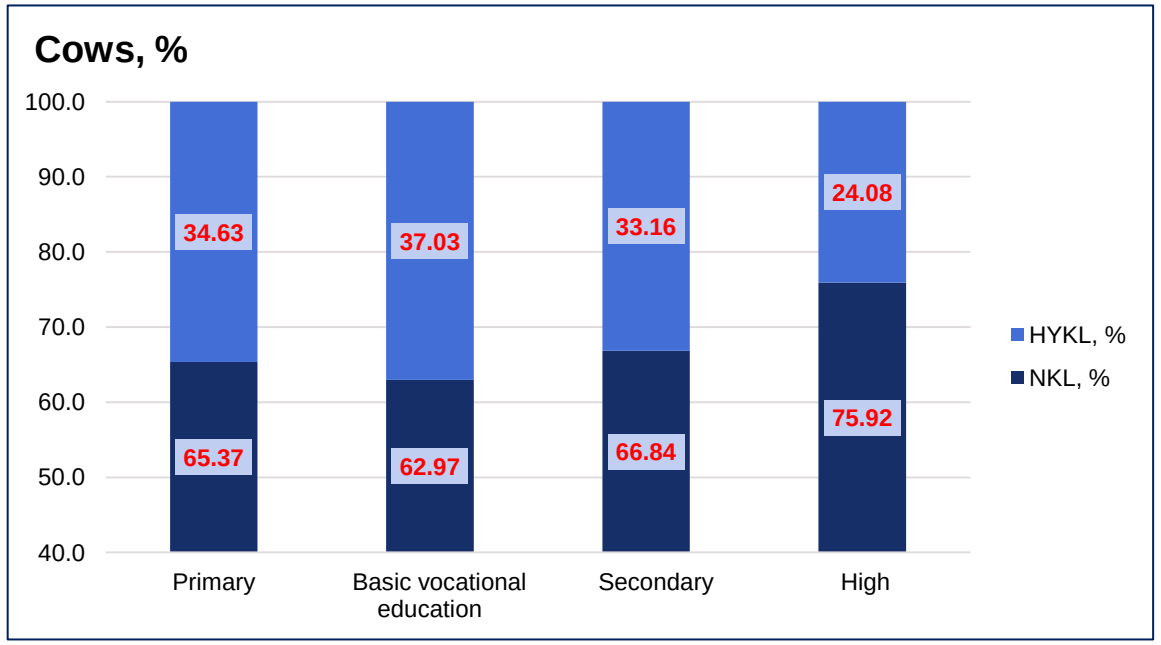
Risk factors	Value	Estimate	SE	OR	95% Confidence limits		P-value
					Lower	Higher	
Farm modernization, years/ago	5-10 vs. < 5	0.08	0.01	1.09	1.06	1.12	<.0001
	10-15 vs. < 5	0.05	0.01	1.06	1.03	1.09	0.0002
	15-20 vs. < 5	0.06	0.02	1.06	1.03	1.10	0.0003
	>20 vs. < 5	0.05	0.02	1.05	1.02	1.09	0.0040

Prevalence of hyperketolactia – effect of farmer's education

Herds by farmers education, % and milk samples by herds, %



HYKL vs. NKL, %

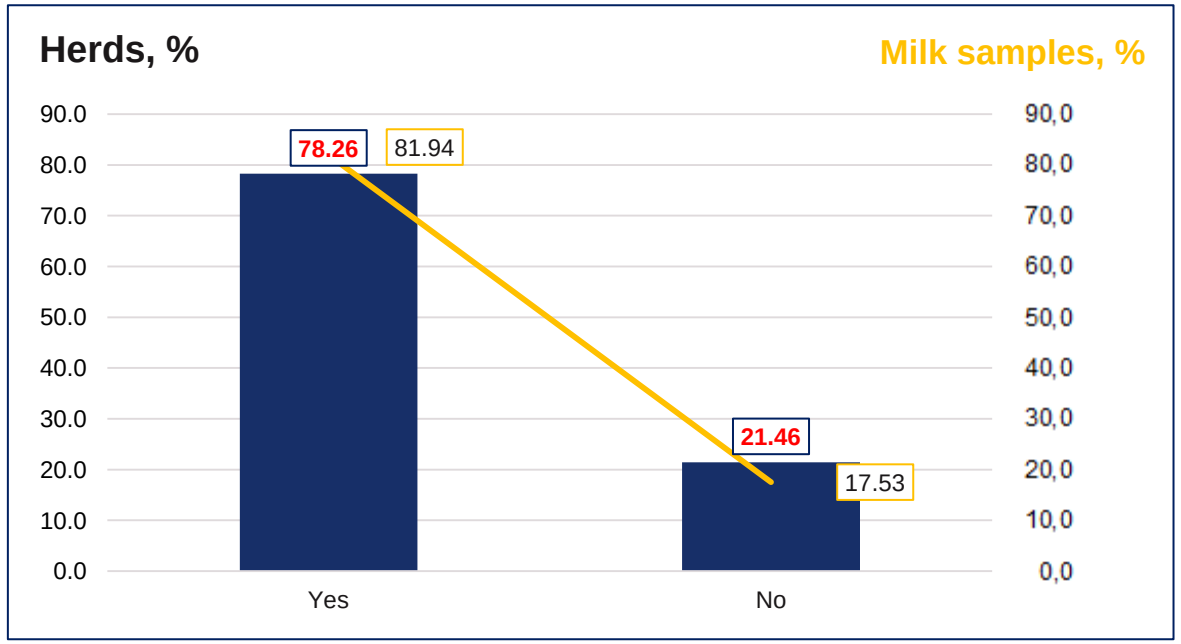


STEPWISE NHYKL vs. HYKL

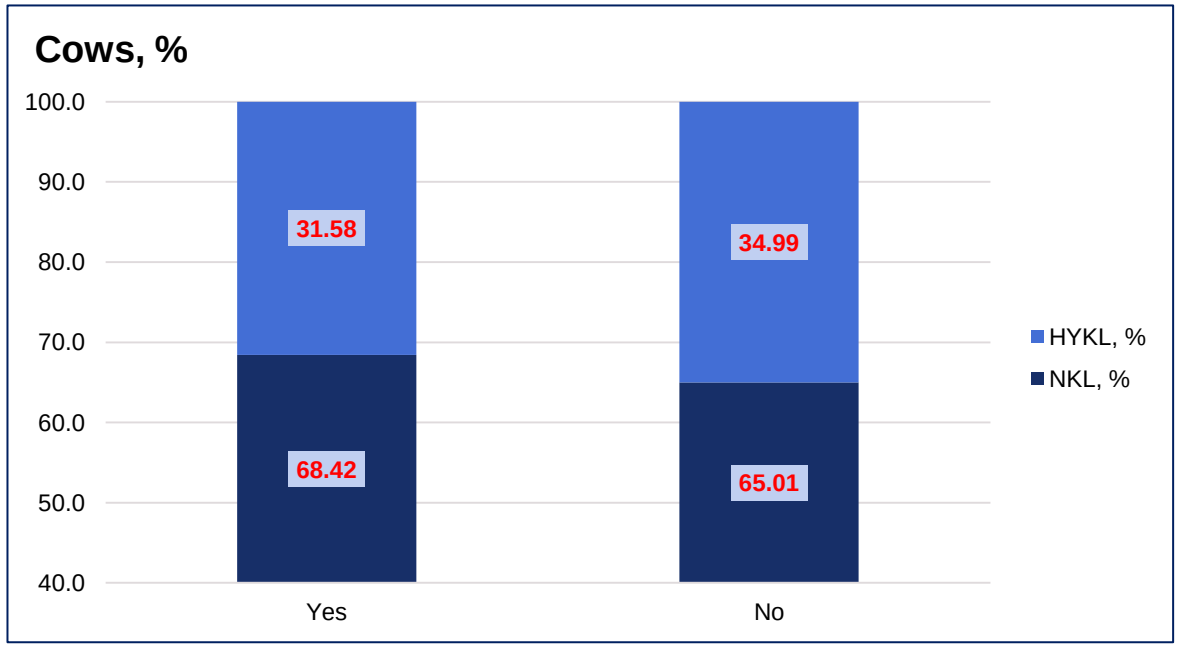
Risk factors	Value	Estimate	SE	OR	95% Confidence limits		P-value
					Lower	Higher	
Farmers education	Basic vocational education vs. Primary	0.10	0.03	1.11	1.04	1.18	0.0014
	Secondary vs. Primary	0.06	0.03	1.06	1.00	1.13	0.0545
	High vs. Primary	0.03	0.03	1.02	0.96	1.09	0.4924

Prevalence of hyperketolactia – effect of farmer's agri education

Herds by agricultular education, % and milk samples by herds, %



HYKL vs. NKL, %



STEPWISE NHYKL vs. HYKL

Risk factors	Value	Estimate	SE	OR	95% Confidence limits		P-value
					Lower	Higher	
Agricultural education	No vs. Yes	-0.04	0.01	0.96	0.94	0.99	0.0018

Conclusions

- Among risk factors for hyperketolactia in Poland, the most important are parity, days in milk, herd size, average herd daily milk yield, grazing, dry cow grouping, performing of feed chemical analysis, farmer's agri education and farm modernization

- At least in Poland, hyperketolactia is not a disorder of high-yielding cows. In contrast, it is a disorder of cows kept in small farms, not high-yielding with poor environmental conditions and poor feeding standards

Thanks for cooperation

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Thank you for your attention !