

# National Genetic Evaluation of Udder Health And Other Health Traits in Denmark

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## Abstract

An improved index for udder health and a new index for other health traits than mastitis have been introduced in Denmark. Index for udder health includes information about mastitis in first, second and third parity. SCC and some linear type traits are utilized as information traits. AI bulls with only first batch of daughters (80-100) obtain indexes with reliabilities of approx. 75%.

Index for other health traits combines information on reproductive diseases, digestive diseases and feet and leg diseases in the period 10 to 180 days after calving in first, second and third parity. Bulls with only first batch of daughters obtain indexes with reliabilities of approx. 60 %. None of the linear type traits are good indicators of other health traits, and for some of the linear traits the favourable correlation is in the opposite direction of the breeding goal for the trait.

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## 1. Introduction

Diseases reduce animal welfare and result in economic loss for the farmer in the form of extra veterinary treatments, extra labour, decreasing milk production, discarded milk and involuntary culling.

In 1992 an index for mastitis resistance was introduced in Denmark. This index has been very successful and receive a lot of attention when both farmers and AI-organisations select bulls. In order to provide better tools for selection, the index has been improved by including traits that are correlated to mastitis. The new index is named "udder health" and it was published for the first time in March 2000. At the same time a new index for other diseases than mastitis was introduced, and this index is named "other health traits".

## 2. Data

Data from the Danish health recording system are used. The recording system started in 1990. Herds with more than 0.3 treatments per calving in the period 0-9 months after calving and at least 10

calvings in this period are assumed to participate actively in the registration of diseases and data are used in the estimating of breeding values. These summaries are done separately for each calving month. The treatments are combined in four main categories: Udder diseases, reproductive diseases, digestive diseases and feet and leg diseases:

- *Udder diseases* include summer mastitis, teat dermatitis, teat amputation, teat surgery, teat tramp, mastitis, acute mastitis, necrotizing mastitis, subclinical mastitis, dry period mastitis, mastitis due to teat tramp and other udder diseases.
- *Reproductive diseases* include abortion, endometritis, uterine prolapse, uterine torsion, endometritis treatment, follicular cysts, retained placenta, caesarian section, vaginitis and other reproductive diseases.
- *Digestive diseases* include diarrhoea, traumatic reticuloperitonitis, ludigestion, hypomagnesemia, ketosis, milk fever, abomasal displacement, abomasal indigestion, rumen acidosis, enteritis, bloat and other digestive and metabolic diseases.

- *Feet and leg diseases* include heel erosion, interdigital dermatitis, claw trimming by veterinarian, interdigital necrobacillosis, interdigital skin hyperplasia, laminitis, arthritis, sole ulcer, pressure injuries, tenosynovitis of hoofs and other leg diseases.

These recordings are collected by veterinarians or farmers and are available in the national database. Table 1 shows the frequency of cows calved with a least one treatment in the period 10 days before calving until 100 days after calving in

first and third parity for Danish Red Dairy Breed (RD), Danish Holstein (DH) and Danish Jerseys (DJ). Linear type classifications for dairy form, foreudder support and udder depth scored in first parity by officially appointed classifiers are used as information traits in estimating the BV for udder health.

A geometric mean of somatic cell count in the period 10-180 days after calving in first lactation is used as a information trait as well.

Table 1. Frequency of cows with at least one treatment in the period 10 days before calving until 100 days after calving

	1st parity			3rd parity		
Type of disease	RD	DH	DJ	RD	DH	DJ
Udder diseases	0.219	0.213	0.236	0.279	0.282	0.213
Reproductive	0.116	0.099	0.025	0.153	0.123	0.051
Digestive	0.028	0.027	0.022	0.120	0.093	0.099
Feet and legs	0.060	0.056	0.038	0.050	0.043	0.023

### 3. Index for udder health

Information about mastitis is treated as four different traits:

- 10 days before calving until 50 days after calving in first parity
- 10 days before calving until 305 days after calving in first parity
- 10 days before calving until 100 days after calving in second parity
- 10 days before calving until 100 days after calving in third parity.

Mastitis in each of these periods is recorded as a binary trait. Linear type classifications for dairy form, foreudder support and udder depth in first

parity done by classifiers, and somatic cell count in the period 10-180 days after calving in first parity are used as information traits when the index for udder health are calculated.

Heritabilities and genetic correlations are shown for the different breeds in Table 2.

For Danish Red Dairy Breed (RD), Danish Holstein (DH), and Danish Red and White (DRW) the same genetic parameters are used, whereas the heritabilities and genetic correlations are different for Danish Jerseys (DJ). The heritabilities for mastitis are generally lower for DJ compared with other breeds, and especially the genetic correlation between SCC and mastitis in first lactation is very low.

Table 2. Heritabilities and genetic correlations for trait used in the index for udder health<sup>1)</sup>.

Trait	Breed	1	2	3	4	5	6	7	8
1. Mastitis ) 10-50 days in 1st parity	RD, DH, DRW	0.04	0.95	0.90	0.84	0.56	0.43	-0.36	-0.49
	DJ	0.019	0.90	0.60	0.60	0.20	0.40	-0.41	-0.40
2. Mastitis ) 10-305 days in 1st parity	RD, DH, DRW		0.047	0.95	0.88	0.49	0.40	-0.35	-0.54
	DJ		0.024	0.70	0.63	0.22	0.40	-0.35	-0.45
3. Mastitis ) 10-100 days in 2nd parity	RD, DH, DRW			0.045	0.98	0.50	0.40	-0.35	-0.55
	DJ			0.012	0.90	0.45	0.30	-0.30	-0.40
4. Mastitis ) 10-100 days in 3rd parity	RD, DH, DRW				0.049	0.48	0.40	-0.35	-0.55
	DJ				0.032	0.49	0.30	-0.30	-0.40
5. SCC 10-180 days in 1st parity	RD, DH, DRW					0.11	0.49	-0.19	-0.30
	DJ					0.11	0.20	-0.20	-0.20
6. Dairy form 1st parity	RD, DH, DRW						0.26	-0.05	-0.05
	DJ						0.21	-0.30	-0.25
7. Fore udder attach 1st parity	RD, DH, DRW							0.24	0.65
	DJ							0.26	0.65
8. Udder depth 1st parity	RD, DH, DRW								0.33
	DJ								0.38

1) Heritabilities on diagonal, genetic correlations above diagonal.

### 3.1 Model

The following linear multi-trait Sire Model is applied for all disease traits and SCC:

<i>Effect</i>	<i>Type of effect</i>
Y = Herd*year*season	fixed
+ year*month	fixed
+ calving age (only first parity)	fixed
+ additive breed effects (not for DH and DRW)	covariable
+ heterosis effects (only RD)	covariable
+ sire	random
+ residual	random

No preadjustments are made.

### 3.2 Economic weights and reliabilities

The EBV=s for mastitis are summarized in the index, called Audder@ health. Each of the four indexes have the same economic weight in the overall index for udder health.

The new index for udder health is published if the reliability is at least 40 %. RD and DH bulls very quickly obtain reliabilities of 60-65 %, and when the daughters are in their third parity most of the bulls have reliabilities of app. 75 % (Table 3). In many cases bulls obtain their first index for udder health at the same time when they obtain their first index for production. For DJ the reliabilities are lower.

Tabel 3. Reliability of the index for udder health depending of the birth year of the bull.

Birth year					
Reliability, %	1991	1992	1993	1994	1995
Number of bulls					
45					1
50				1	2
55				1	13
60				14	74
65	1	5	4	77	55
70	35	33	94	158	4
75	208	220	197	77	
80	141	104	41	10	
85	4	3	1		
90	3				
95	4				

#### 4. Index for other health traits

The index for other health factors include reproductive diseases, digestive diseases, feet and leg diseases in the period 10 days before calving to 100 days after calving in first, second, and third parity. Mastitis in first parity is used as a information trait. A linear multi-trait Sire Model with a total of 10 traits is applied. The effects in the model are the same as for mastitis in the index for udder health. Table 4 shows the heritabilities and genetic correlations.

The estimated heritabilities and genetic correlations were different for RD and DH, and the different genetic correlations are used for the two breeds. Jerseys have very low frequencies of reproductive and feet and leg problems, and the heritabilities for these diseases are nearly zero, and therefore the index only consists of digestive diseases.

Table 4. Heritability and genetic correlation for traits used in the index for other health traits<sup>1)</sup>.

Trait	Breed	1	2	3	4	5	6	7	8	9	10
<b>1st parity</b>											
1. Repro.	RD	0.032	0.0	0.18	0.0	0.88	0.21	0.0	0.85	0.0	0.0
	DH, DRW	0.018	0.22	0.33	0.20	0.68	0.17	0.11	0.59	0.11	0.11
2. Mastitis	RD		0.047	0.24	0.40	0.0	0.25	0.35	0.0	0.25	0.20
	DH, DRW		0.047	0.41	0.40	0.20	0.30	0.30	0.15	0.25	0.26
3. Digestive	RD			0.084	0.0	0.20	0.86	0.0	0.19	0.81	0.40
	DH, DRW			0.006	0.40	0.10	0.88	0.46	0.10	0.79	0.36
	DJ			0.004			0.39			-0.08	
4. Feet and legs	RD				0.007	0.0	0.08	0.83	0.0	0.20	0.77
	DH, DRW				0.008	0.10	0.30	0.89	0.08	0.30	0.85
<b>2nd parity</b>											
5. Repro.	RD					0.023	0.25	0.0	0.91	0.11	0.0
	DH, DRW					0.023	0.20	0.20	0.90	0.20	0.18
6. Digestive	RD						0.022	0.0	0.23	0.86	0.40
	DH, DRW						0.012	0.56	0.11	0.85	0.40
	DJ						0.014			0.76	
7. Feet and legs	RD							0.009	0.0	0.20	0.74
	DH, DRW							0.012	0.15	0.25	0.90
<b>3rd parity</b>											
8. Repr.	RD								0.038	0.09	0.00
	DH, DRW								0.038	0.36	0.13
9. Digestive	RD									0.031	0.40
	DH, DRW									0.022	0.40
	DJ									0.047	
10. Feet	RD										0.018
	DH, DRW										0.013

1) Heritabilities on diagonal, genetic correlations above diagonal.

#### 4.1 Economic weights and reliabilities

Table 5 shows the relative economic weight factors for the 9 traits in the index for other health traits.

The reliabilities of the index for other health traits are lower than for udder health, because the heritabilities in general are lower than for

udder health, and because the genetic correlations between the different disease traits are moderate. The index for other health factors are published when they have a minimum reliability of 35 %. RD and DH bulls obtain their health index a little later than their production index. Bulls with only first batch of daughters seldom get an index with reliabilities above 65% (Table 6).

Table 5. The relative economic weighting factor given to the first disease in a parity.

Trait	1st parity	2nd parity	3rd parity
Reproductive	10%	5%	5%
Digestive	20%	10%	10%
Feet and legs	20%	10%	10%

Table 6. Reliability of the index for other health traits depending of the birth year of the bull.

Birth year					
Reliability, %	1991	1992	1993	1994	1995
Number of bulls					
35		1	1	30	28
40	2	9	28	135	55
45	24	26	114	105	1
50	124	131	141	34	
55	173	161	45	6	
60	64	34	7		
65	2	3			
70	1				
80	4				
85	2				

#### 4.2 Correlations with other traits

Previous results have shown no genetic correlation between other diseases than mastitis and SCC, and consequently SCC cannot be used as indicator trait (Nielsen et al., 1997). Other traits can be used as information traits, if the genetic correlation is high. For DH bulls born in 1990-1993 correlations between traits in the total merit index and index for other health traits have been calculated (Table 7).

There is a small negative correlation between yield and other health traits, but the correlation is lower than between udder health and yield. There are positive correlations between other health traits and female fertility, calving index (maternal trait) and udder health.

There is a positive correlation between other health traits and feet and legs, and the correlation between other health traits and "body conformation" is negative. Table 8 shows the correlations between indexes for the 19 linear type traits and other health factors.

There is a favourable correlation between the index for other health traits and the breeding goal for the following type traits: top line, rump angle, hock quality, bone quality, foot angle, udder support, udder depth and teat thickness, which is positive from a selection point of view. Only 4 of the 8 traits are among the international linear traits. For stature, body depth, dairy form, rear legs side view, foreudder attachment and rearudder width the correlations are in the opposite direction of the official "breeding goal" for the traits.

Table 7. Correlation between index for other health traits and traits in the total merit index.

<b>Traits in total merit index</b>	<b>Correlation to other health traits</b>
Y-index	-0.12***
Beef production	-0.03
Female fertility	0.23***
Calving index	0.21***
Udder Health	0.44***
Body	-0,15***
Feet and legs	0.14***
Mammary system	-0.05
Milking speed	+0.08**
Temperament	-0.10***

Table 8. Correlation between index for other health traits and linear type traits.

<b>Linear conformation traits</b>	<b>Correlation to other health traits</b>
Stature	-0.11***
Body depth	-0.12***
Chest width	-0.09***
Dairy form	-0.14***
Top line	0.14***
Rump width	-0.04
Rump angle	0.17***
Rear legs, side view	0.06*
Rear legs, rear view	-0.17***
Hock quality	0,20***
Bone quality	0.16***
Foot angle	0.10***
Foreudder attachment	-0.11***
Rearudder width	-0.11***
Udder cleft	0.17***
Udder depth	0.15***
Teat length	0.06*
Teat thickness	-0.11***
Front teat placement	-0.09***

## 5. Discussion

Former results show that in breeding programs without registration of health traits, selection for longevity will have a relatively large effect on disease resistance to udder disease and feet and legs problems, but minor or no positive effect on reproductive and digestive diseases. Routine recordings of calving performance, female fertility and diseases are the most effective way of improving genetic resistance to diseases.

## References

Nielsen, U.S., Pedersen, G.A., Pedersen, J. & Jensen, J. 1997 Genetic Correlation among Health Traits in Different Lactations. *Interbull Bulletin No. 15*, 68-77.