



Owner-recorded data as source of information for genetic analyses of health traits of dairy cattle

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Background



- considerable improvement of dairy performance (production traits) over the last decades
- increasing importance of functional traits: influence on long-term efficiency of milk production
- need for new and more specific functional traits
→ dairy health as a major factor, but
 - no standardized recording routines for health data yet
 - data security issues
 - data quality issues



Recording of health events

- veterinarians
 - legal obligations of documentation
 - high-quality data (exact diagnoses), but possible bias of diagnosis spectrum
- expert groups
 - own interest in documentation (follow-up)
 - small spectrum of specific diagnoses: claws, nutrition
- owners
 - own interest in health monitoring (management control, herd health and performance)
 - expert-support needed to ensure appropriate data quality

Study approach

GKuh ('healthy cow'):

Recording, analysis and genetic evaluation of disease diagnoses in dairy farms to select for health and longevity

- owner-recorded health data
 - 49 farms in the Northwest of Germany (region of traditional dairy farming)
 - no existing health-recording system → installation with intense on-farm support
 - use of existing ways of data transfer (milk recording agencies)
- expert cooperation



Outline of project *GKuh*

- project start in October 2009
→ continuous health recording since January 2010
- study period 01.01.2010 - 30.06.2011
 - average herd size (49 farms):
~ 60-70 cows in milk recording
 - animals under observation:
12,032 females including 7,294 females > 24 months of age
 - health records:
13,081 diagnoses (5,227 females with diagnoses)

Collection of health data

- standardized numerical key of diagnoses
 - set of 176 diagnoses
(possible: comprehensive key with 976 diagnoses)
 - hierarchical structure allowing input of varying specificity
 - documentation of health events
 - disease observations,
 - veterinary medical diagnoses,
 - findings from claw trimming, ...
- by the farmers via herd management software
→ transfer to health data base (vit)

Definition of health traits

- available health information
 - diagnosis + date of diagnosis
 - + location of diagnosis (if applicable: quarter of the udder, limb)
- diseases with period of risk within each lactation
 - observation unit: animal X lactation
- period of risk
 - reference for interpretation of lactations without diagnoses as unaffected or non-informative
 - determinant of total number of observations
 - 'unaffected lactation' = proportion P of period of risk under observation and without diagnosis
 - different restrictiveness (100-75-50% = P100-P75-P50)

Coding of health traits

- binary
 - affected lactations = lactations with at least one diagnosis
 - vs. unaffected lactations = at risk lactations without diagnosis
 - all diseases (any period of risk, single or multiple locations)
 - ⇒
$$\text{lactation incidence rate (LIR)} = \frac{\text{affected lactations}}{\text{affected+unaffected lactations}}$$
- quasi-continuous
 - number of health events in a given lactation (accounting for repeated occurrence of disease and multiple affections)
 - diseases with longer periods of risk and/or multiple locations

Lactation incidence rates (LIR)

Trait	n_{aff}	P100		P75		P50	
		n	LIR (%)	n	LIR (%)	n	LIR (%)
Early mastitis (MAST)	920	5,699	16.1	6,173	14.9	6,514	14.1
Retained placenta (RET)	564	5,379	10.5	5,440	10.4	5,535	10.2
Non-purulent claw diseases (NPCL)	530	4,231	12.5	5,280	10.0	6,438	8.2
Purulent claw diseases (PCL)	1,592	4,819	33.0	5,731	27.8	6,766	23.5

n_{aff} = number of affected lactations; n = total number of observations (affected+unaffected lactations)



Influence of restrictiveness of control definition on LIR:
increasing with duration of period of risk (RET MAST NPCL, PCL)

Estimation of genetic parameters

- variance component estimation with REML (VCE6)
- repeatability linear animal model
- comparative analyses
 - binary vs. quasi-continuous coding of health traits
 - varying restrictiveness of control definitions of controls (lactations at risk)
 - uni- and bivariate analyses

$$y_{ijkl} = \mu + PAR_i + hys_j + pe_k + a_k + e_{ijkl}$$

with PAR_i = fixed effect of parity class,

hys_j = random effect of herd X year-season of calving,

pe_k = random permanent environmental effect of the animal,

a_k = random additive genetic effect of the animal, e_{ijkl} = random residual

Heritabilities

Trait		P100	P75	P50
		$h^2 \pm SE_{h^2}$	$h^2 \pm SE_{h^2}$	$h^2 \pm SE_{h^2}$
Early mastitis (MAST)	- BIN	0.072 ± 0.027 (0.163 ± 0.061)	0.066 ± 0.020 (0.155 ± 0.048)	0.055 ± 0.017 (0.133 ± 0.041)
	- CAT	0.104 ± 0.039	0.093 ± 0.036	0.078 ± 0.027
Retained placenta (RET)	- BIN	0.035 ± 0.019 (0.098 ± 0.054)	0.036 ± 0.020 (0.104 ± 0.058)	0.038 ± 0.021 (0.108 ± 0.060)
Non-purulent claw dis. (NPCL)	- BIN	0.036 ± 0.014 (0.093 ± 0.035)	0.054 ± 0.017 (0.156 ± 0.051)	0.048 ± 0.013 (0.157 ± 0.043)
	- CAT	0.038 ± 0.013	0.050 ± 0.016	0.044 ± 0.014
Purulent claw dis. (PCL)	- BIN	0.042 ± 0.015 (0.070 ± 0.025)	0.056 ± 0.018 (0.100 ± 0.033)	0.042 ± 0.016 (0.080 ± 0.030)
	- CAT	0.087 ± 0.021	0.086 ± 0.021	0.071 ± 0.021



Influence of restrictiveness of control definition on h^2 :
 increasing with duration of period of risk (RET MAST NPCL, PCL)
 Benefit of quasi-continuous trait definition: NPCL MAST PCL

Heritabilities & genetic correlations

Trait		P75 - UNIVARIATE	P75 - BIVARIATE	
		$h^2 \pm SE_{h^2}$	$h^2 \pm SE_{h^2}$	$r_g \pm SE_{r_g}$
Retained placenta (RET)	- BIN	0.036 ± 0.020 (0.104 ± 0.058)	0.048 ± 0.020 (0.137 ± 0.057)	0.722 ± 0.188
Other puerperal disorders	- BIN	0.038 ± 0.023 (0.330 ± 0.201)	0.048 ± 0.021 (0.422 ± 0.186)	
Purulent claw dis. (PCL)	- BIN	0.056 ± 0.018 (0.100 ± 0.033)		
Sole ulcers	- BIN	0.071 ± 0.027 (0.208 ± 0.078)	0.058 ± 0.022 (0.169 ± 0.064)	-0.088 ± 0.267
Dermatitis digitalis / Mortellaro	- BIN	0.026 ± 0.015 (0.065 ± 0.036)	0.027 ± 0.010 (0.066 ± 0.024)	



Benefit of refined trait definition
 (e.g., reproductive disorders, PCL)

Conclusions

- owner-recorded health data as valuable source of information for genetic analyses
- quantitatively most important health traits
 - claw diseases, mastitis, retained placenta: LIR ~ 10-30%
 - heritability estimates of 0.04-0.10 (liability scale: 0.07-0.16)
- trait-dependent impact of definition of at risk lactations
- possible use of detailed information on health events for refined trait definition (repeated and/or multiple affections)

Implications

- high quality of owner-recorded health data justifying the efforts of implementing health recording systems with intense expert support
- health reports as immediate rewards for the owners ensuring continuous data flow
- use of experiences from projects like *GKuh* when extending health data collection
→ sound basis for genetic evaluation for health traits to allow selection for improved health and longevity

Thank you !



owners of
GKuh farms



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IT Solutions for Animal Production

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