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Phenotypic associations and genetic correlations between claw Health disorders and milk production, fertility, somatic cell score and type traits in Holstein Spanish dairy cattle

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OUTLINE

- Background
- Data & Models
- Results and discussion
  - Phenotypic associations
  - Genetic correlations
- Conclusions

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BACKGROUND

Claw disorders

- lead to big economic losses
  - Reduced milk production
  - Poor fertility performance
  - Treatment cost
  - Discarded milk
  - Increased involuntary culling
  - Etc.
- Compromise the animal welfare
- Overuse of antibiotics

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BACKGROUND

2012: I-SAP program for claw health recording data was implemented

Agreement with Private TRIMMERS was signed

An Electronic application for PC-tablet was developed

AIM

TO:

1- Estimate the phenotypic associations between claw disorders and milk production, somatic cell and fertility performance

2- Estimate the genetic correlations between claw disorders and milk production, somatic cell, days open and type traits

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Claw health data

108,468 records collected from 2012 to 2014 in 804 Holstein dairy herds by 25 trimmers

Six claw disorders:

- Interdigital and digital dermatitis (DE)
- Sole ulcer (SU)
- White line disease (WL)
- Interdigital hyperplasia (IH)
- Interdigital phlegmon (IP)
- Chronic laminitis (CL)

Scored for each claw as : 0 Absence
1 mild lesion
2 severe lesion

A Combined trait was defined: Overall claw disorder (OCD)

Table: Cow-level prevalence (%) of the claw disorders

Claw disorders	Total	Mild lesion	Severe lesion
DE	10.21	9.61	0.60
SU	14.71	13.09	1.62
WL	11.87	10.58	1.29
CL	2.96	2.68	0.28
IH	0.44	0.38	0.06
IP	1.00	0.74	0.26
OCD	37.6	33.77	3.83

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Milk recording data

Test day and 305d milk data

of 48,895 lactations:

- **Milk production**
- **Fat content**
- **Protein content**

Daily energy corrected milk (ECM) was defined : Milk
At 3.5% fat and 3.2% protein

- **Somatic cell count**: transformed to somatic cell score (SCS)

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Fertility performance data

Calving date, Services date and Conception date of 15,159 lactations were used :

- **Calving first service (CFS)**
- **Calving service conception (CSC)**
- **Services per conception (SPC)**
- **Days Open (DO)**

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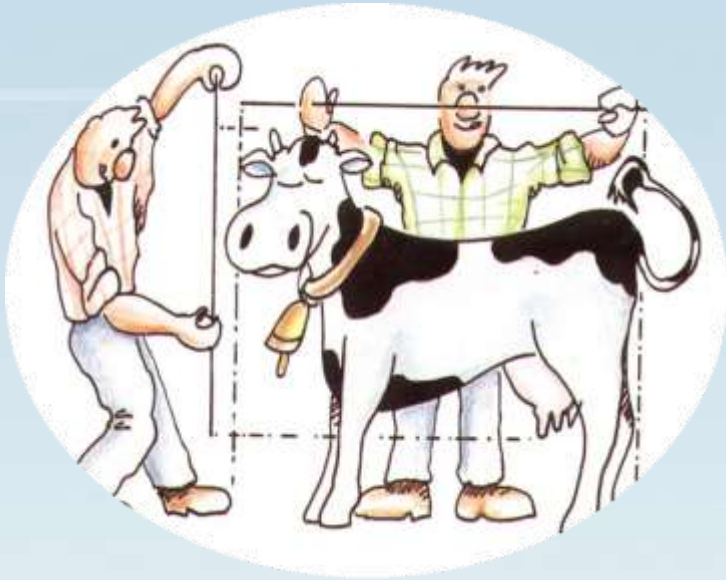
Type classification data



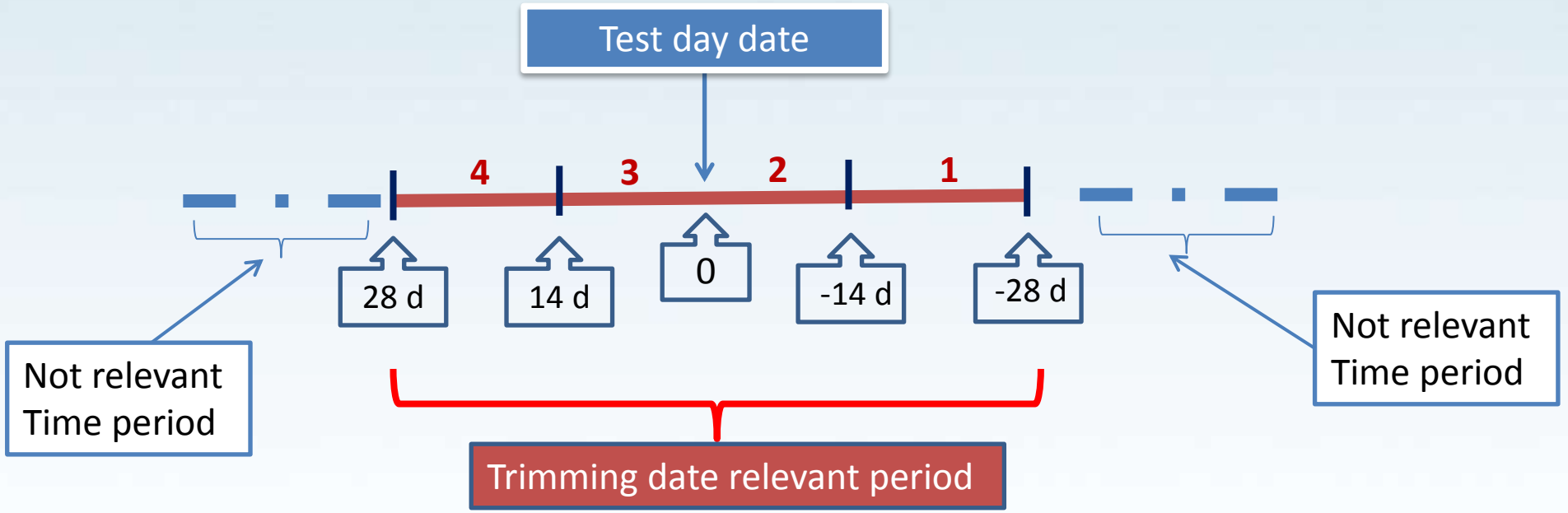
6 Feet and legs type traits scored by 17 classifiers In 18,916 first lactation cows:

- **Feet and legs composite (F&L)**
- **Foot angle (FA)**
- **Bone quality (BQ)**
- **Rear leg side view (RLSV)**
- **Rear leg rear view (RLRV)**
- **Locomotion (LOC)**

DATA EDITING

For Phenotypic association only **DE, SU, WL** and, **OCD** were analyzed.

To perform ECM and SCS associations with claw disorders a **disease index (DI)** variable was created and scored from 1 to 5



For cows without any disorder or cows with the diagnosis date out of the relevant period, DI was set as 5 and used as reference level

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MODELS: Phenotypic association analyses

For ECM and SCS

- **Random effects**:
  Cow and Herd effects
- **Systematic effects**:
  - Season of calving
  - Lactation
  - Age at calving
  - Stage of lactation
  - DI

For CFS, CSC and SPC

- **Random effects**:
  Cow and Herd effects
- **Systematic effects**:
  - Season of calving
  - Lactation
  - Production level
  - Claw disorder diagnosis within 100 first days of lactation

All analyses were carried out using PROC MIXED (SAS Institute Inc., Cary, NC)

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MODELS: Genetic parameters estimation

Multi-trait linear animal model (VCE 6.0 Software, Groeneveld et al., 2008)

CLAW DISORDERS

Lactation_calving age, days in milk, Herd-visit-trimmer, permanent effect and additive animal effect

305d Production traits, DO and LSCS

Age at calving

Calving month

Herd-year of calving

Animal additive effect

Feet and legs type traits

Age at calving

Stage of lactation

Herd-visit-classifier

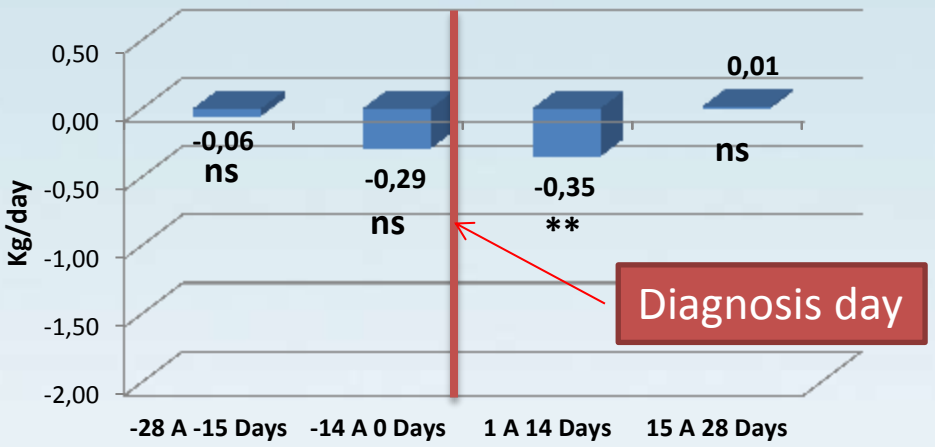
Animal additive effect

RESULTS & DISCUSSION:

Phenotypic associations between ECM and Claw disorders

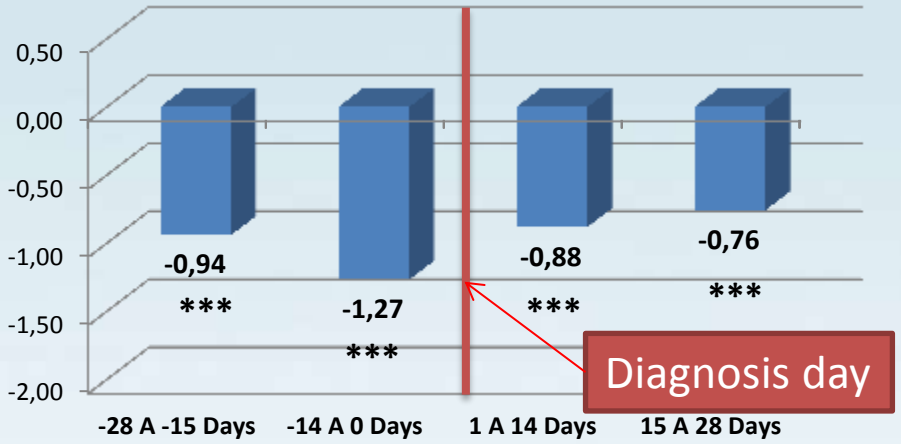
ns: Not significant * $P<0.05$ ** $P<0.01$ *** $P<0.0001$

Dermatitis (DE)



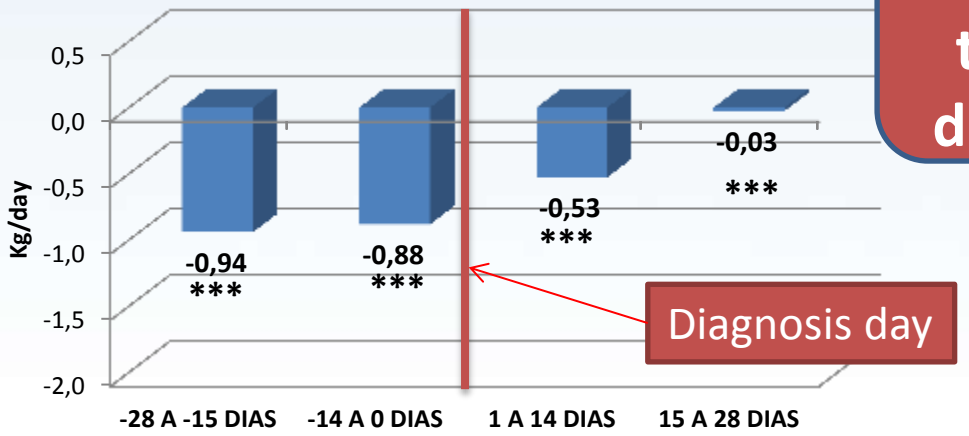
SU and WL have the major impact

Sole Ulcer (SU)

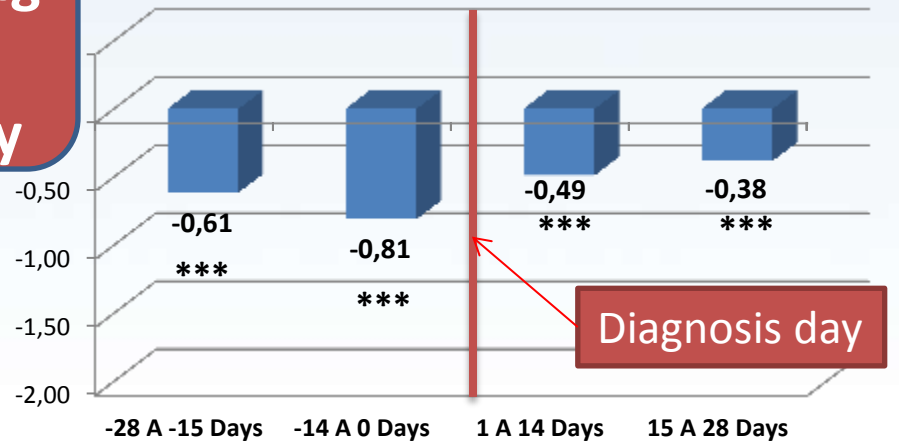


Production loss starts long time before diagnosis day

White line disease (WL)



Overall Claw disease (OCD)

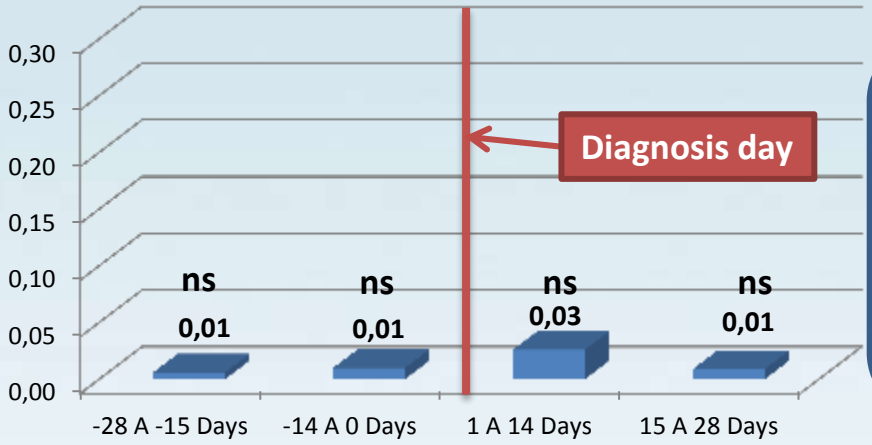


RESULTS & DISCUSSION:

Phenotypic associations between SCS and Claw disorders

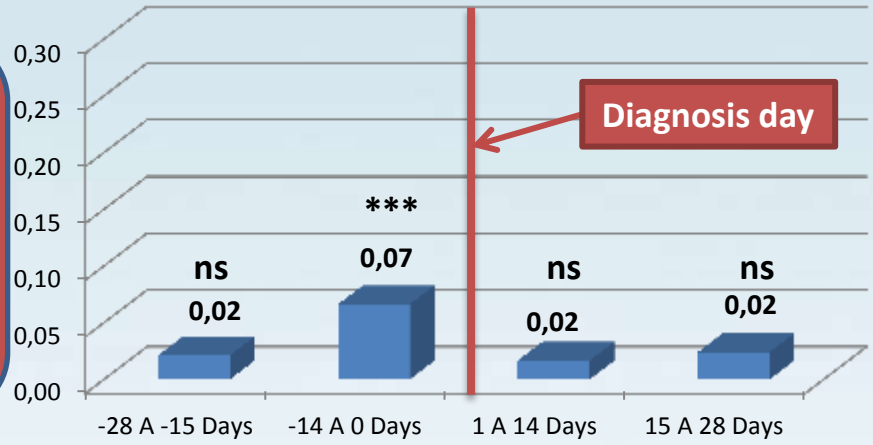
ns: Not significant * $P<0.05$ ** $P<0.01$ *** $P<0.0001$

Dermatitis (DE)

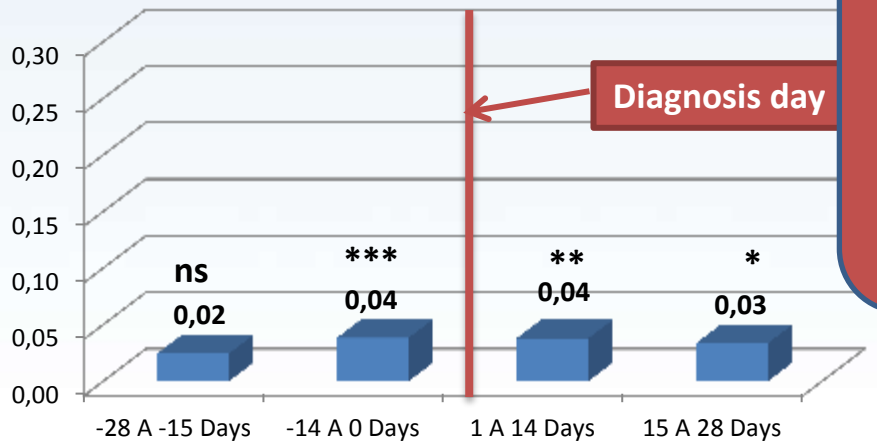


Low effect and mainly significant around the diagnosis day

Sole Ulcer (SU)

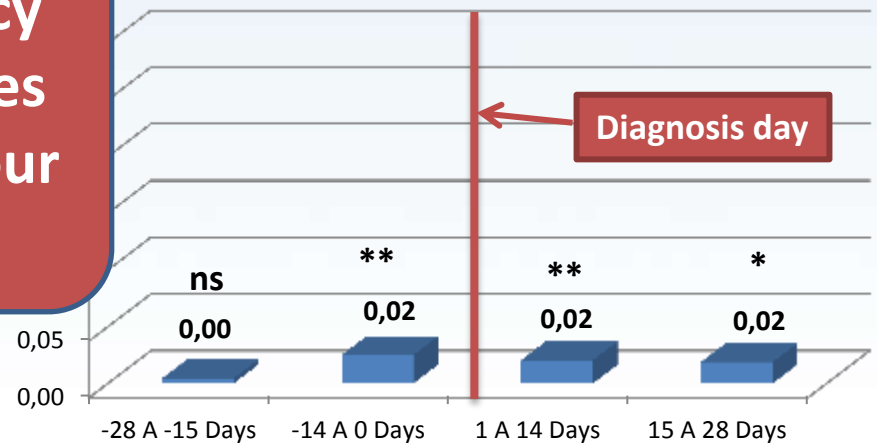


White line disease (WL)



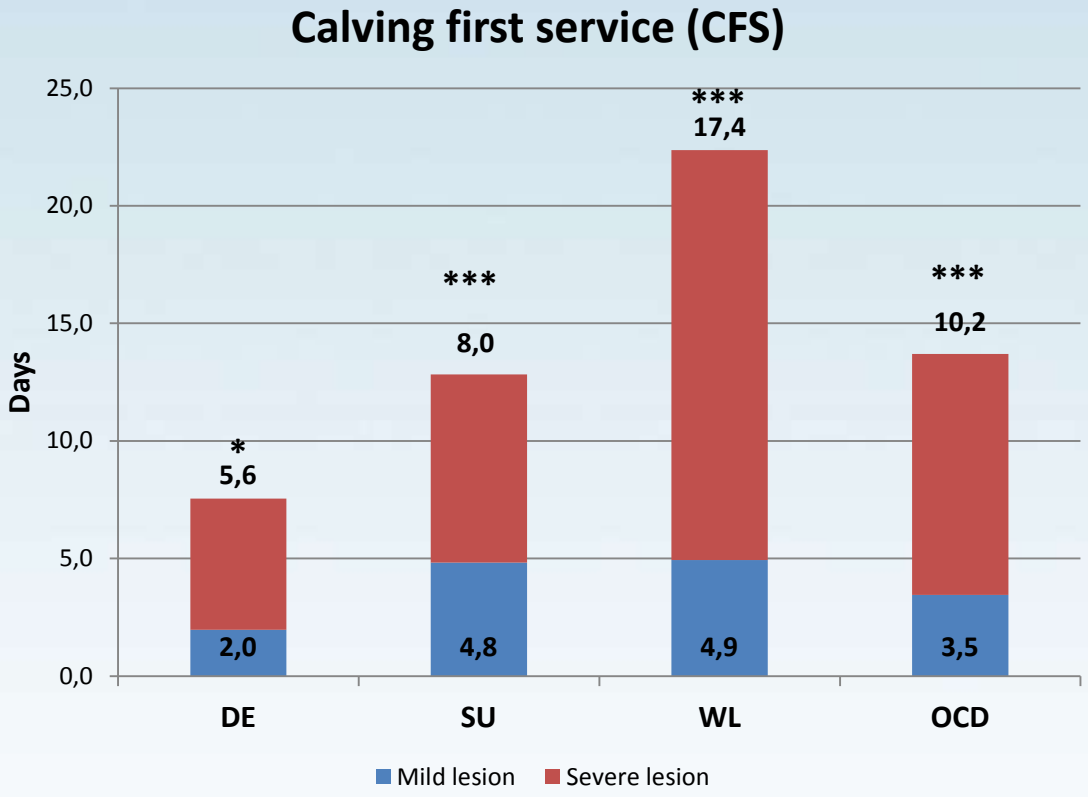
Low frequency of severe cases may explain our results

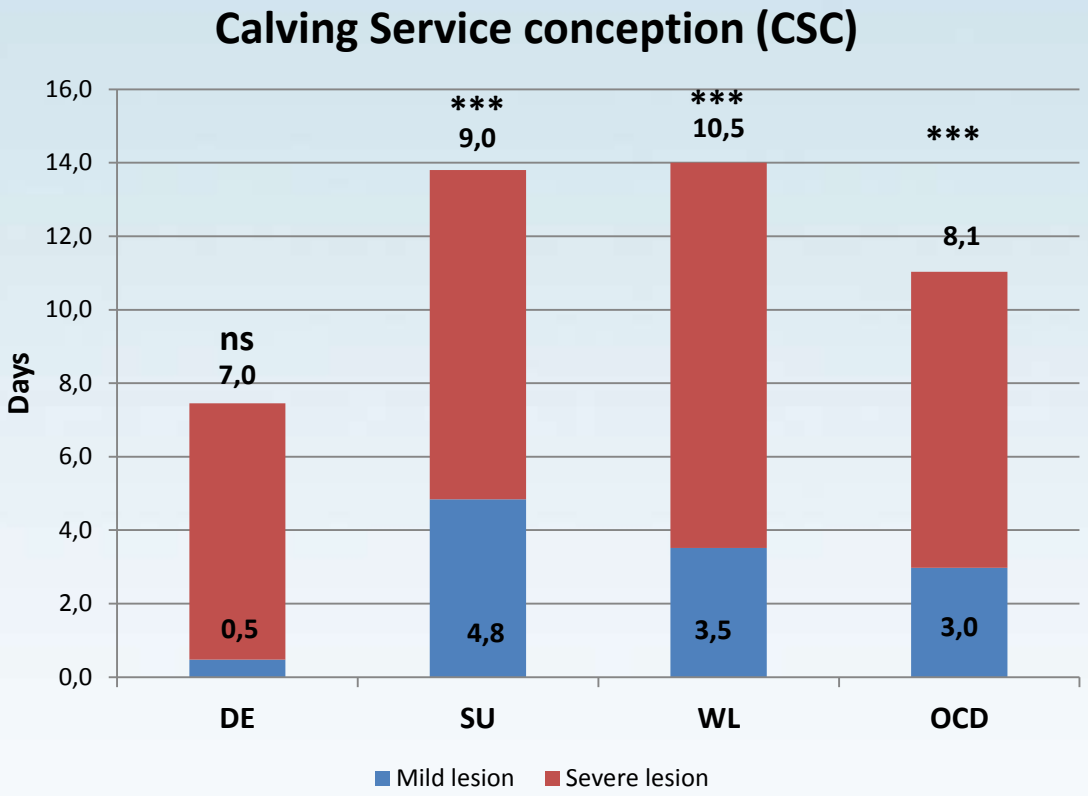
Overall Claw disease (OCD)



RESULTS & DISCUSSION:

Phenotypic associations between Fertility performances and Claw disorders



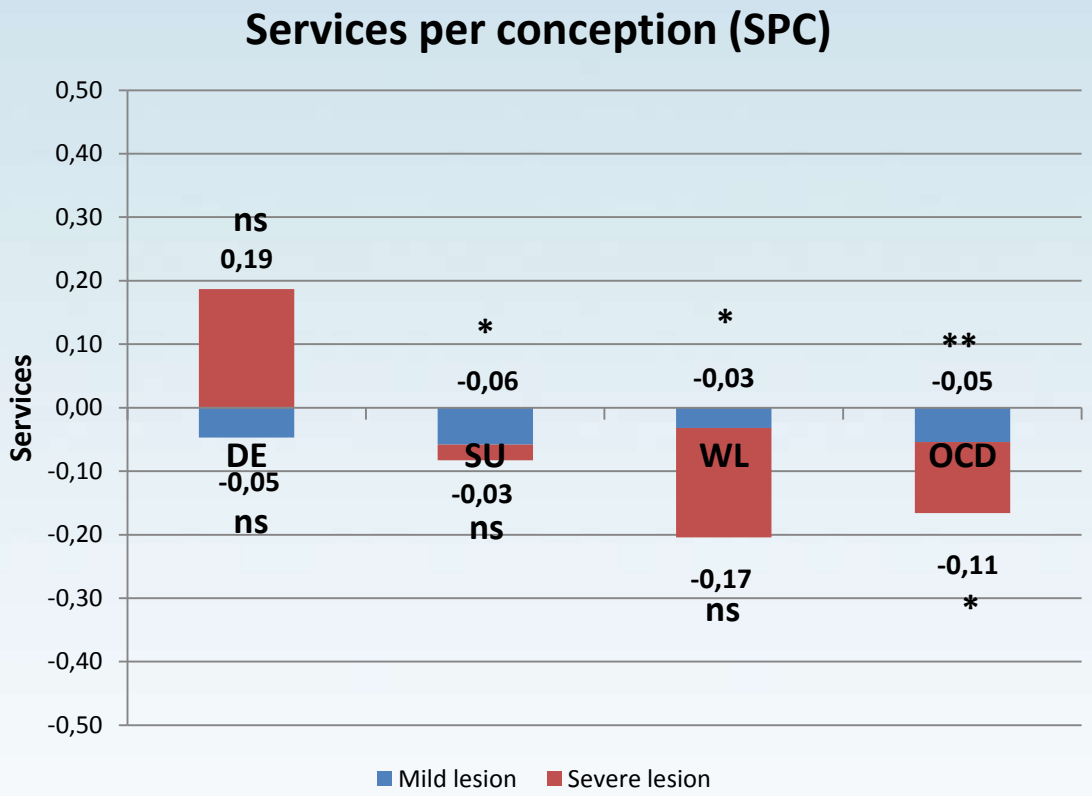


Claw disorders, mainly **SU** and **WL**, increase **CFS** and **CSC** intervals.
Severe cases have a double or triple effect than mild lesions

RESULTS & DISCUSSION:

Phenotypic associations between Fertility performances and Claw disorders

Cows with claw disorders show longer CFS and CSC, but less SPC



claw disorders mask estrus expressions

Negative effect on SPC

RESULTS & DISCUSSION:

Genetic correlations: Claw disorders – Production traits

305-d First lactation Yield	DE	SU	WL	CL	IH	IP	OCD
Milk	0.05	0.13	0.19	0.32	0.12	0.41	0.20
FAT	-0.08	0.11	0.02	0.16	0.02	0.59	0.10
Protein	0.02	0.07	0.11	0.23	0.12	0.59	0.14

Most Correlations were low to moderate and **positive**

RESULTS & DISCUSSION:

Genetic correlations: Claw disorders – Production traits

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Disorders related to **metabolic background** were **unfavorable** correlated to milk production

RESULTS & DISCUSSION:

Genetic correlations: Claw disorders – Production traits

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The **most correlated disorder** with high production traits was the **Interdigital Phlegmon**, though these values were associated to high SE

RESULTS & DISCUSSION:

Genetic correlations: Claw disorders – Type traits

Feet and leg traits	DE	SU	WL	CL	IH	IP	OCD
F&L	-0.26	-0.24	-0.01	-0.08	-0.46	-0.62	-0.29
FA	0.05	0.03	0.25	0.25	-0.17	-0.42	0.16
BQ	-0.06	-0.03	-0.27	-0.10	-0.35	-0.40	-0.21
RLSV	0.12	0.20	-0.01	0.12	-0.01	0.38	0.18
RLRV	-0.28	-0.04	0.24	0.15	-0.38	-0.64	-0.07
LOC	-0.38	-0.27	-0.02	-0.15	-0.43	-0.53	-0.35

Most Correlations were low to moderate and **negative**

RESULTS & DISCUSSION:

Genetic correlations: Claw disorders – Type traits

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F&L, **BQ**, **RLRV** and **LOC** were the most **negative correlated**

RESULTS & DISCUSSION:

Genetic correlations: Claw disorders – Type traits

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Infections disorders (**DE**, **IH** and **IP**) were the **most correlated** with **feet and legs traits**

RESULTS & DISCUSSION:

Genetic correlations: Claw disorders – Functional traits

Functional traits	DE	SU	WL	CL	IH	IP	OCD
LSCS	0.08	0.21	-0.07	0.09	0.09	-0.01	0.14
Days open	0.13	0.42	0.18	0.38	-0.07	-0.77	0.40

Correlations were in general low to moderate and **positive**

RESULTS & DISCUSSION:

Genetic correlations: Claw disorders – Functional traits

Functional traits	DE	SU	WL	CL	IH	IP	OCD
LSCS	0.08	0.21	-0.07	0.09	0.09	-0.01	0.14
Days open	0.13	0.42	0.18	0.38	-0.07	-0.77	0.40

SU was the most correlated to more **SCS** and prolonged **DO**

CONCLUSIONS

- **SU** and **WL** were the **biggest** cause of **production loss**.
- Mild and mainly severe lesions of **SU** and **WL** during early period of lactation **prolonged CFS and CSC intervals**.

- **High yielding** cows are **more prone** to claw disorders.
- **LOC, RLRV, BQ** and **F&L** composite are **favorable correlated to less claw disorders.**
- **SU** shows moderate relationship with **poor fertility and high SCS**.

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Thanks

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