Genetic aspects of heifer fertility in Italian Holstein population

Ferrari V., Visentin G., van Kaam J.B.C.H.M., Penasa M., Marusi M., Finocchiaro R., Cassandro M.

your COW our FUTURE

Università degli Studi di Padova

DAFNAE Dipartimento di Agronomia, Alimenti, Risorse naturali, Animali e Ambiente

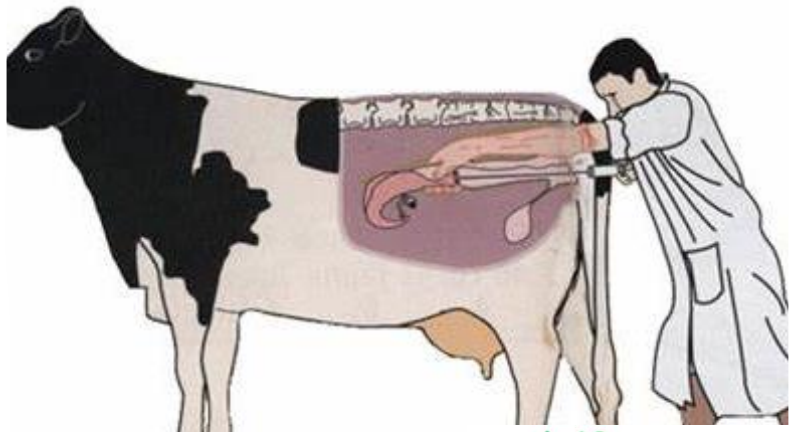
Ph.D. COURSE ANIMAL & FOOD SCIENCE UNIVERSITY OF PADOVA

25th Congress
ASPA2023
Animal Production Science: innovations and sustainability for future generations
Monopoli (Bari, Italy), June 13-16, 2023

Why heifer fertility?

- **Essential** for dairy farmers (animal welfare and herd profit)
- Exploitable additive genetic variation (although lowly heritable)
- **Heifer fertility** traits → available early in life

Breeding objective: maximize conception rate (CR), favor shorter calving interval, reduce the number of heifers that fail to conceive.

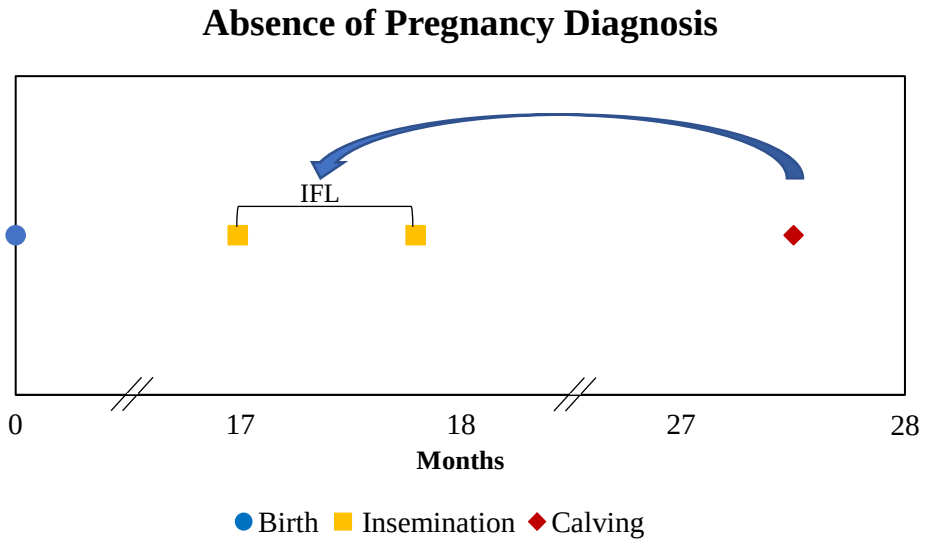


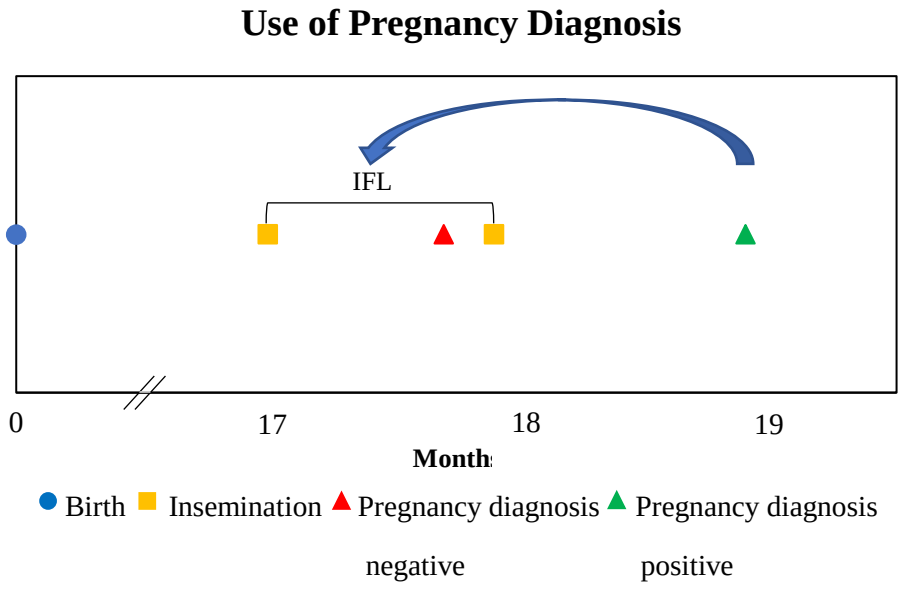
your COW our FUTURE

25th Congress ASPA2023 Animal Production Science: innovations and sustainability for future generations Monopoli (Bari, Italy), June 13-16, 2023

What's new?

Since 2015, **pregnancy diagnoses** have been routinely collected by ANAFIBJ





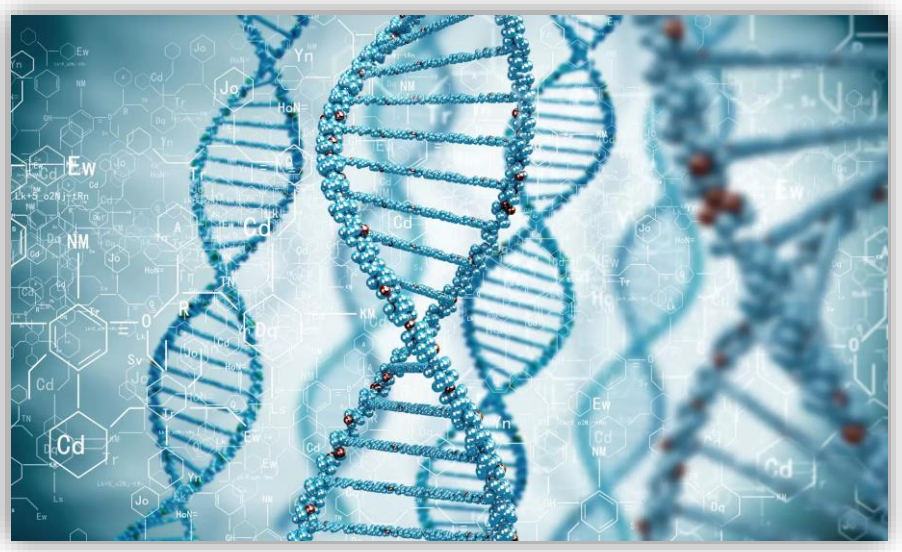
✓ IFL: interval first-last insemination → NEW

your COW our FUTURE

25th Congress ASPA2023 Animal Production Science: innovations and sustainability for future generations Monopoli (Bari, Italy), June 13-16, 2023

Aims

- Quantify **genetic and nongenetic variation** of fertility in nulliparous Italian Holstein heifers
- Develop an **aggregate index** for heifer fertility



Materials and methods

Data retrieved from ANAFIBJ:

- 5,596,046 first inseminations
- 1,561,743 pregnancy diagnosis
- 4,863,802 calving events

Traits:

Age at first insemination (**AFI**): restricted between 9 and 27 mo

Interval first-last insemination (**IFL**): from 1 to 230 d

Nonreturn rate at 56 d (**NRR56**)

Conception rate at first insemination (**CR1**)

Materials and methods: data editing

IFL
- = 1: only one ins. followed by calving or positive pregnancy diagnosis
- = first – last ins. followed by calving or pregnancy diagnosis ok
- = 230: IFL ≥ 230 d and calving occurred
- = missing: last ins. < 300 d from first ins. but no calving

NRR56
- = 0: second ins. within 56 d from first ins.
- = 1: otherwise
- = missing: second ins. within 14 d from first ins.

CR1
- = 1: first and only ins. followed by calving or positive pregnancy diagnosis
- = 0: otherwise

Statistical analysis

1 - fertility traits → univariate linear animal model

- to reduce computational time → 10 random subset of 100 herds extracted from the entire dataset (G and R (co)variance components estimation)

2 - multivariate linear animal model:

- Fixed effects: *herd-year of birth* and *month of birth* for AFI, and *herd-year-season of birth* and *month-year of insemination* for IFL, NRR56, and CR1.

3 - aggregate index for heifer fertility with CR1 as the breeding goal and AFI, IFL, and NRR56 as selection criteria

→ The I was standardized to mean 100 and SD 5

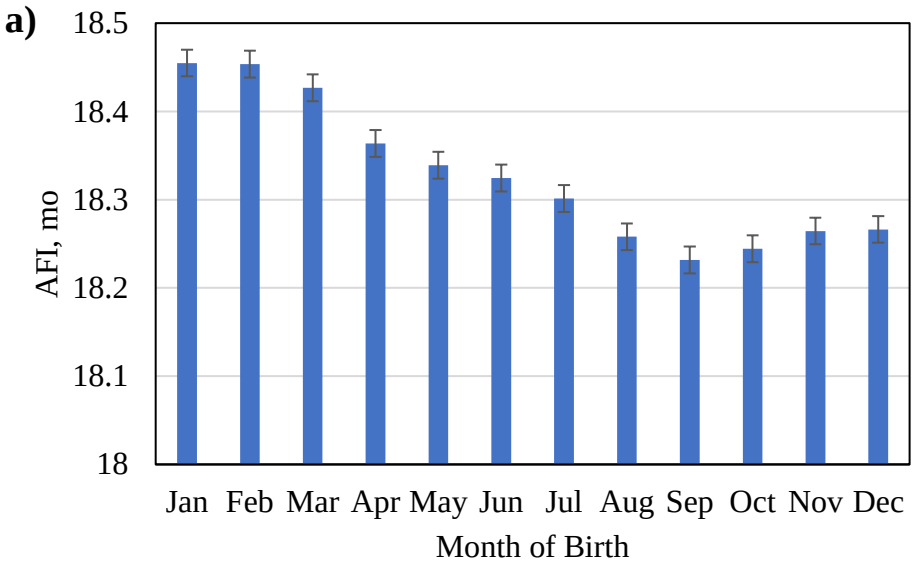
Results

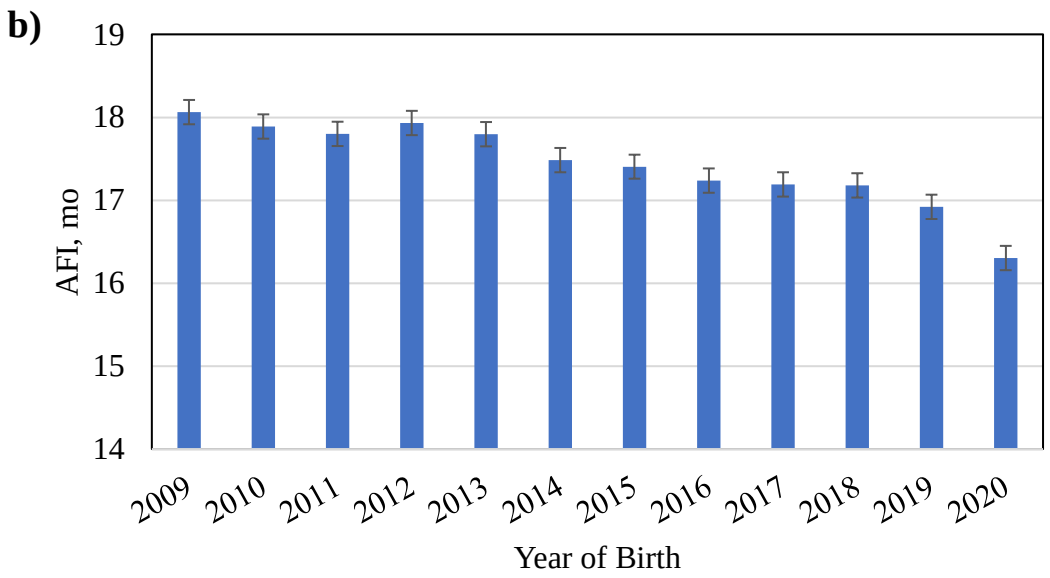
Descriptive statistics of heifer fertility traits

Trait	Mean	SD	Minimum	Maximum
Age at first insemination (AFI), mo	17.25	2.89	9	27
Interval first-last insemination (IFL), d	26.09	51.85	1	294
Non-return rate at 56 d (NRR56)	0.78	0.41	0	1
Conception rate at first service (CR1)	0.61	0.49	0	1

Results

Least squares means of age at first insemination (AFI) across month and year of birth



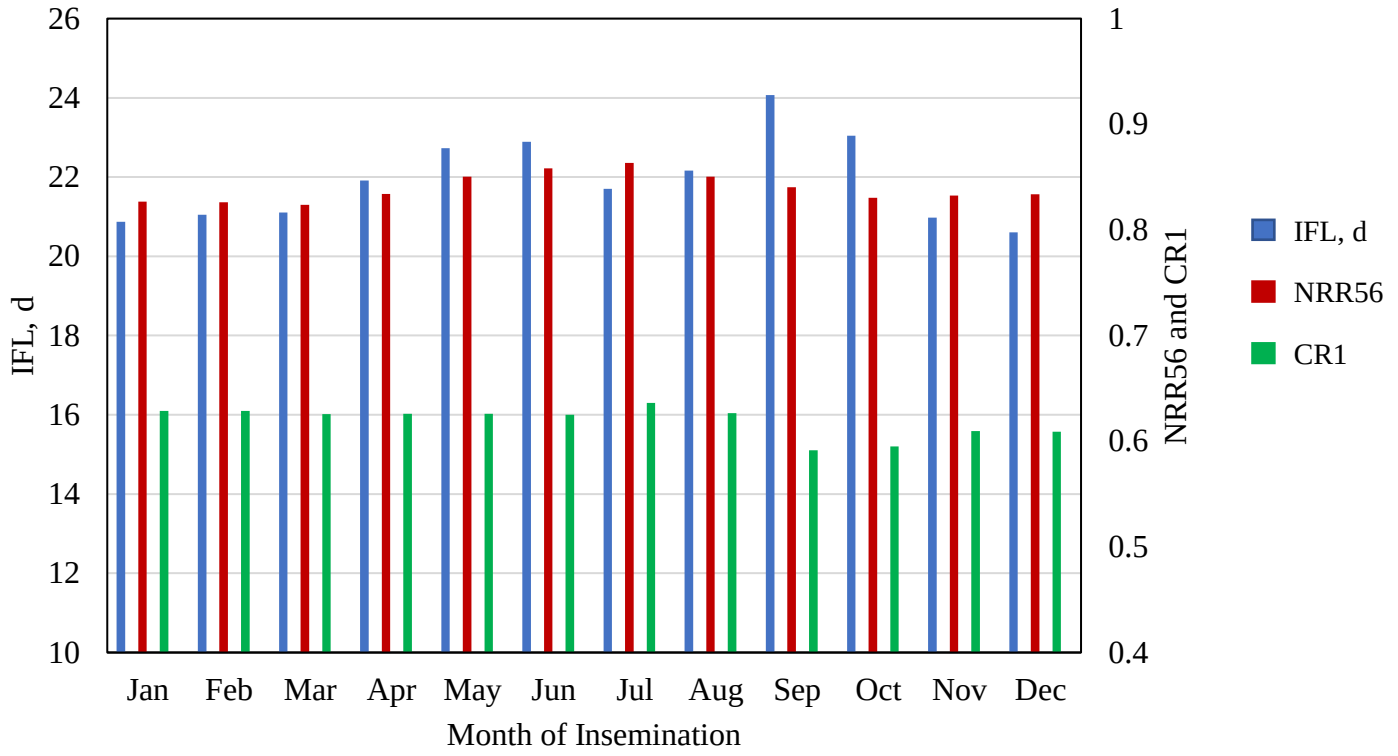


your COW our FUTURE

25th Congress ASPA2023 Animal Production Science: innovations and sustainability for future generations Monopoli (Bari, Italy), June 13-16, 2023

Results

Least squares means of interval from first to last insemination (IFL, d), non-return rate at 56 d (NRR56), and conception rate at first insemination (CR1) across month of insemination



your COW our FUTURE

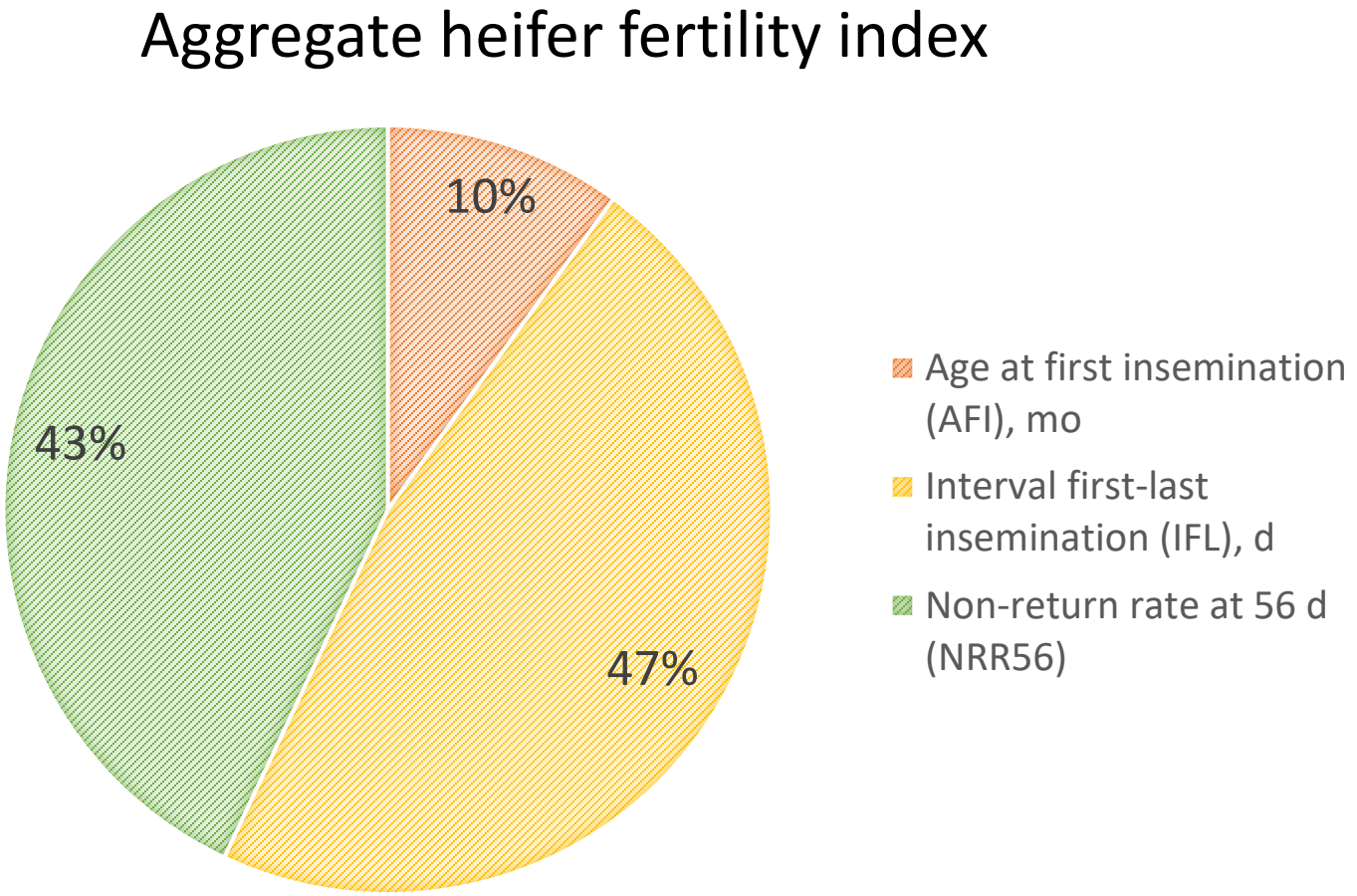
25th Congress ASPA2023 Animal Production Science: innovations and sustainability for future generations Monopoli (Bari, Italy), June 13-16, 2023

Results

Heritability (**on the diagonal**), genetic correlations (below the diagonal), and phenotypic correlations (above the diagonal) of heifer fertility traits

Trait	AFI	IFL	NRR56	CR
Age at first insemination (AFI), mo	**0.07**	-0.09	0.01	0.05
Interval first-last insemination (IFL), d	0.05	**0.02**	-0.31	-0.73
Non-return rate at 56 d (NRR56)	0.15	-0.26	**0.01**	0.76
Conception rate at first service (CR1)	-0.07	-0.73	0.67	**0.01**

Results



your COW our FUTURE

25th Congress ASPA2023 Animal Production Science: innovations and sustainability for future generations Monopoli (Bari, Italy), June 13-16, 2023

Conclusions

- **Pregnancy diagnosis** allows collection of new phenotypes (IFL)
- Exploitable **additive genetic variation** exists for fertility in Italian Holstein heifers
- The **aggregate index of heifer fertility** can be **included** in the aggregate index of cow fertility → this is expected to be beneficial in terms of overall improvement of fertility in the dairy herd
- Partecipation to **Interbull MACE** for the trait «dairy heifers' ability to conceive»

Work in progress

Dr. Marcos PG Rezende

New

- Dataset editing (inclusion of Machine learning)
- Inclusion of syncro effect

→Updated model

New breeding objective under investigation

- Conception Rate
- Days from first insemination to calving

your COW our FUTURE

25th Congress ASPA2023 Animal Production Science: innovations and sustainability for future generations Monopoli (Bari, Italy), June 13-16, 2023

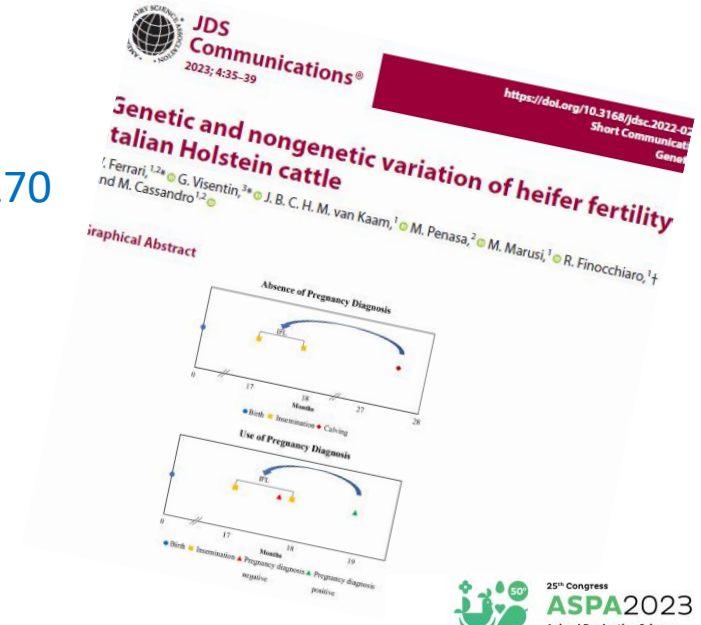
Thank you for your attention!

Valentina Ferrari

valentinaferrari@anafi.it

www.anafibj.it

https://doi.org/10.3168/jdsc.2022-0270



your COW our FUTURE

Università degli Studi di Padova
DAFNAE Dipartimento di Agronomia, Alimenti, Risorse naturali, Animali e Ambiente
Ph.D. Animal & Food Science University of Padova

25th Congress ASPA2023 Animal Production Science: innovations and sustainability for future generations
Monopoli (Bari, Italy), June 13–16, 2023