Universitat Autònoma de Barcelona

Facultat de Veterinària

ANALYSIS OF FERTILITY IN DAIRY HEIFERS AT FIRST ARTIFICIAL INSEMINATION AND ITS RELATIONSHIP WITH FERTILITY AT FIRST INSEMINATION DURING FIRST LACTATION

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INTRODUCTION AND OBJECTIVES

Optimizing the age at first artificial insemination (AI) in dairy heifers is a key factor for improving reproductive performance and economic efficiency in dairy herds. While inseminating too early may compromise physical maturity, delaying AI can increase rearing costs and may also reflect underlying developmental or health issues.

This study investigates the relationship between the age at first AI and fertility at first lactation, using data collected over 13 years (2011–2024) from a commercial dairy farm in Osona, Catalonia.

We hypothesize that both early and late inseminations may negatively impact future fertility, and that could improve reproductive performance and long-term productivity.

BACKGROUND

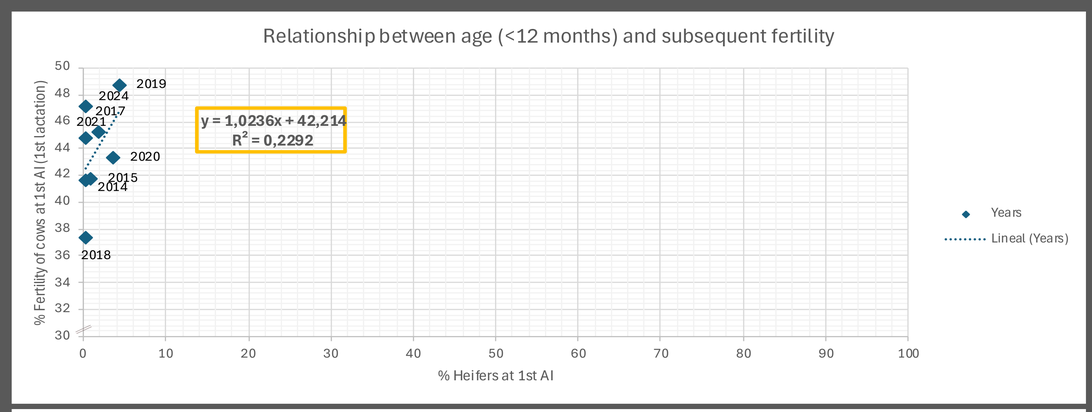
Puberty	1st AI	Calving
9-11 months 250-280 kg	13-15 months 340-370 kg	22-24 months

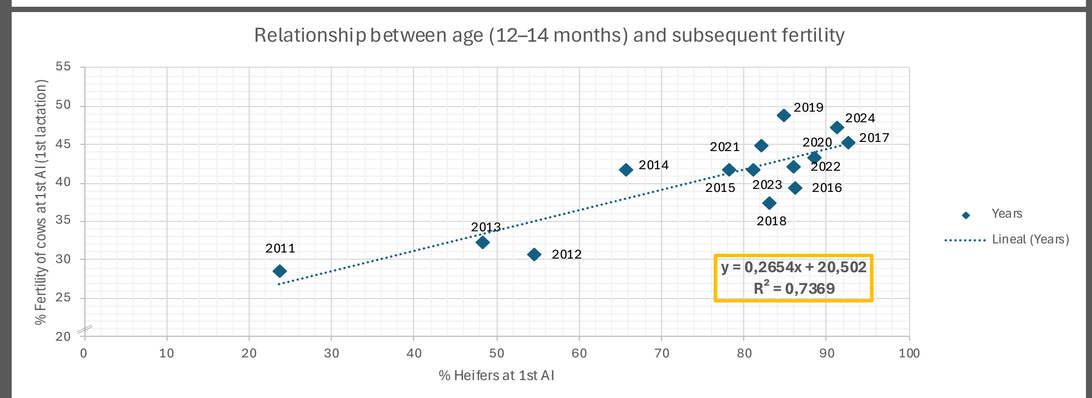
MATERIALS AND METHODS

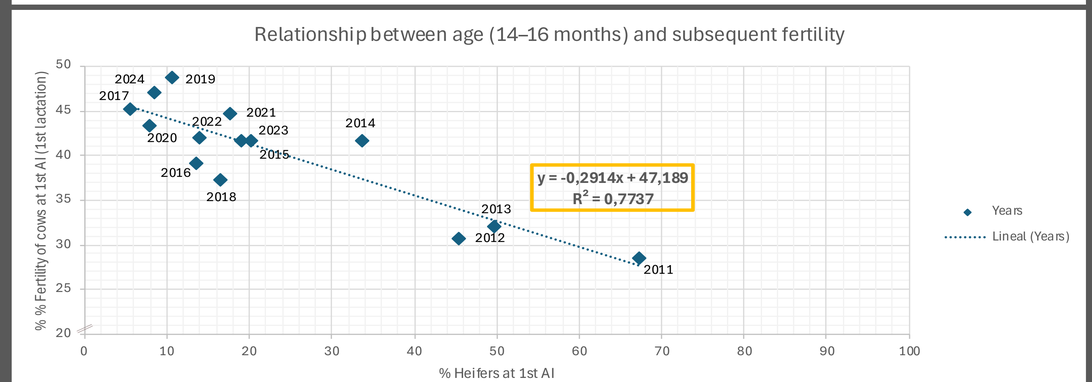
- **Design:** Retrospective observational study conducted on a single dairy farm located in Osona, Catalonia.
- **Study period:** 2011–2024.
- **Animals:** Holstein heifers inseminated for the first time between <12 and 18 months of age.
- **Data collected:**
  - Age at first artificial insemination (AI), grouped into four age ranges: <12 months, 12–14 months, 14–16 months, and 16–18 months.
  - Fertility at first AI during the first lactation.
- **Analysis methods**:
  1. Pearson correlation: Assessed the strength and direction of the relationship between age at first AI and fertility at first lactation, within each age group.
  2. Simple linear regression: Analysed the association between the % of heifers AI within each age range and their subsequent fertility. R^2 quantified the explanatory power of age on fertility outcomes.
  3. Time-series analysis: to assess the annual trends in heifer fertility and average age at first AI across the study period (2011–2024).

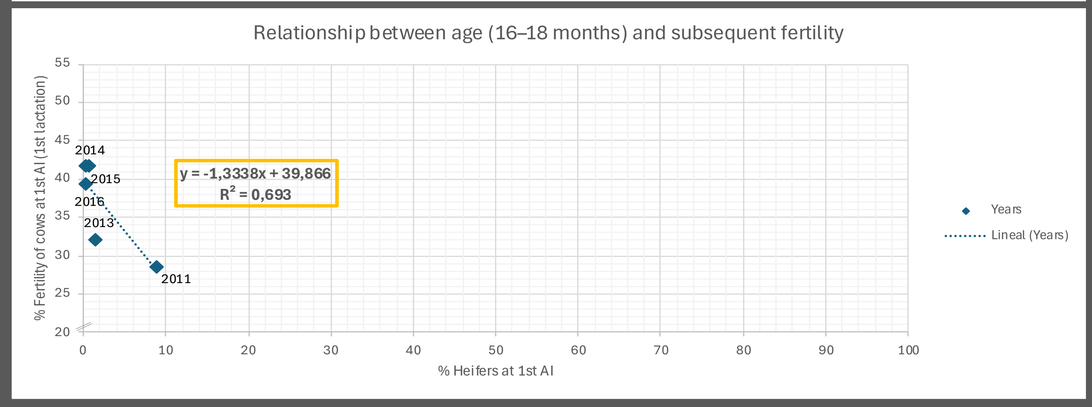
RESULTS AND DISCUSSION

Franja d'edat a la 1a IA	r (Pearson)	p-valor	n
<12 mesos	0,03	0,95	7
12–14 mesos	0,67	0,012	13
14–16 mesos	−0,65	0,015	13
16–18 mesos	−0,93	0,022	5

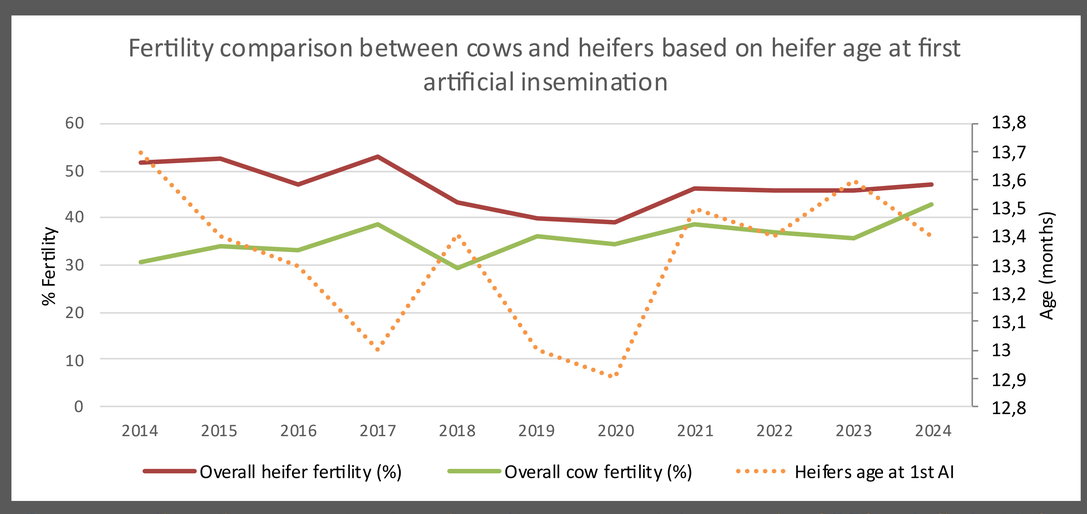








Relationship between conception rate (CR) at first AI in heifers and CR at first AI during their first lactation, grouped by heifer's age at first AI



Comparative line graph showing the annual trends in (CR) at first AI for heifers and cows in first lactation, and average age of heifers at first AI.

Heifers inseminated between **12 and 14 months** showed the **best reproductive performance** during first lactation, with a strong and significant positive correlation.

Heifers inseminated at **14–18 months** showed a marked decline in fertility, with negative and statistically significant correlations, suggesting that insemination during this period may be linked to delayed growth or past health problems.

Insemination **before 12 months** showed **no clear effect.**

CONCLUSIONS

This study has shown that artificial insemination (AI) between 12 and 14 months of age is associated with better fertility outcomes during first lactation. Heifers inseminated later exhibited a significant decline in fertility, likely related to delayed growth or health issues rather than differences in management, given the consistency of the farm's reproductive protocol.

Therefore, selection of the optimal time for first AI should consider not only chronological age, but also body development, body condition, and overall health status.

Although the study was conducted on a single farm, the results are consistent with the existing literature and may be applicable to similar dairy systems.