

## Adult dairy cow performance is influenced by her maternal intrauterine environment during development

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**Introduction.** A substantial amount of evidence, based primarily on epidemiological studies of human data, suggests that perturbations during fetal life are associated with hypertension, vascular dysfunction, dyslipidaemia, and insulin resistance in adulthood (Barker, 1995). Few studies have attempted to quantify the influence of maternal environment on subsequent progeny performance in dairy cattle. Pryce et al. (2002) reported no significant effect of dam parity or milk production, dry matter intake or BCS in the first or second 13 weeks post-partum on subsequent female progeny reproductive performance. The objective of this study was to quantify the maternal variance for performance indicators in first, second and third lactation dairy females using a large national database.

**Materials and Methods.** National data on Holstein-Friesian dairy cows from the Irish Cattle Breeding Federation database were obtained. Non-singleton animals, animals born from embryo transfer, and animals with no known sire or dam or from paternal half-sib groups of less than 5 were removed; maternal grandsires with less than 5 granddaughters with records were also removed. Dam lineage was determined for each animal by tracing back the pedigree to the founder female; lines with less than three females with records were removed. Following all edits 188,144 parity 1 to 3 lactation records from 80,881 animals remained. (Co)variance components were estimated for 305-day milk yield, somatic cell score (SCS; i.e., Log<sub>e</sub>SCC), calving interval, and survival separately within parity using a linear mixed model in ASREML (Gilmour et al., 2007); (co)variance components were also estimated for age at first calving. Fixed effects differed by trait analyzed, but for age at first calving were herd-year of calving, year of birth-month of birth interaction, heterosis, recombination and Holstein percent; while for all other traits herd-year of calving, year of calving-month of calving interaction, heterosis, recombination, Holstein percent, age at calving and whether calving difficulty was experienced at calving were included in the model. Random effects included in the model were an additive direct genetic, cytoplasmic, remaining maternal (nuclear) genetic, permanent environmental effect of the dam, and a residual component. A covariance component was also estimated between the additive direct and maternal components where possible. Because calves in Ireland are generally separated at birth from dairy cows, a significant maternal variance (with all other random effects in the model) was assumed to suggest the presence of intrauterine effects on progeny performance.

**Results and Discussion.** All additive direct genetic effects were significant and direct heritability estimates varied from 0.01 (survival to parity 3) to 0.34 (milk yield in parity 2 animals). The maternal component was only significant for milk yield in first and third parity, survival to second lactation and SCS in first parity. Despite its statistical significance, however, the maternal variance accounted for less than 1% of the phenotypic variation. Furthermore, the coefficient of variation accounted for by the maternal component was less than 3%. The significance of the maternal genetic effect (excluding cytoplasmic effects) and covariance with the direct additive genetic effect for milk yield is in contrast to previous results from US Holsteins (Schutz et al., 1992) where no significant (co)variance was reported. However, our data suggest that intrauterine conditions during gestation may have repercussions for subsequent progeny lactation performance. The significance of the maternal variance for survival to second lactation remained even when first lactation milk yield and SCS were included as fixed effects in the model; this implies that intrauterine conditions affect survival over and above the intrauterine effect on progeny milk yield and SCS. Maternal lineage had a significant effect only on milk yield in third parity animals and SCS in second parity animals explaining less than 1% of the phenotypic variation in both traits. The correlation between the direct additive genetic component and the maternal component where estimated were all negative thereby indicating a difficulty in improving both components simultaneously; this may be an artifact of the change in allelic frequency due to simultaneous selection on both components over time.

### Conclusion.

Significant maternal variation was observed in milk production, SCS and survival to second lactation. Because of the dairy farming system operated in Ireland where the calf is generally removed immediately post-calving from the cow this suggests that pre-natal factors (i.e., intrauterine condition) affect the subsequent performance of the offspring. Although the effect is small and unlikely to bias greatly genetic evaluations of sires it does suggest that adverse conditions experienced by the dam during pregnancy may have repercussions for offspring performance.

### References

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