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Prediction of Transmitting Ability of Heifers from Genetic Evaluations of Dams When Dams and Herdmates Are Required to Have a First Record

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Prediction of Transmitting Ability of Heifers from Genetic Evaluations of Dams When Dams and Herdmates Are Required to Have a First Record

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ABSTRACT

Estimated transmitting ability for milk production calculated from only first lactation records was regressed on milk proofs of the sire and maternal grandsire and either estimated transmitting ability of the dam calculated from only first lactations or estimated transmitting ability of the dam calculated from all lactations of a data set in which all cows were required to have milk records of first lactation. Records of 222,576 Holstein heifers in the northeastern United States were analyzed. Partial regression coefficients were similar to those from reports in which all records in the data file were used to estimate transmitting abilities. The partial regression coefficient for estimated transmitting ability of the dam from all lactation records (.17) was smaller than the approximate theoretical regression coefficient (.70). The partial regression coefficient for estimated transmitting ability of the dam calculated from first records (.72) was similar to the approximate theoretical regression coefficient (.80).

INTRODUCTION

Partial regression coefficients for estimated transmitting ability (ETA) of the dam calculated from all lactation records for prediction of breeding values of progeny have been smaller than approximate theoretical regression coefficients, although partial regression coefficients for the ETA of the dam calculated from first lactation records alone are similar to theoretical approximations (5, 10). In (10), dams were required to have first lactation records prior to calculation of their ETA from all lactation records, but herdmates were not under that restriction. The purpose of this study was to determine whether partial regression coefficients for ETA of the dam would be similar to approximate theoretical regression coefficients with all cows (dams and herdmates) required to have first lactation records in calculation of ETA from all lactation records.

DATA AND METHODS

Production records from the Dairy Records Processing Laboratory (DRPL) in Ithaca, NY, were edited by deleting all records of cows that did not have a first lactation record on file. Estimated transmitting abilities for remaining cows were calculated by the Northeast ETA procedure from records of all lactations (4, 5). Records of 222,576 Holstein heifers had ETA based only on milk records of first lactation when each dam had an ETA based only on records of first lactation and an ETA based on milk records of all lactations (calculated from a data set in which all cows had a first record), the Northeast Artificial Insemination Sire Comparison (NEAISC) of her sire, and the NEAISC of her maternal grandsire (MGS). Partial regression coefficients for the regression of heifer's first lactation ETA on sire's NEAISC, NEAISC of MGS, and either dam's first lactation ETA or dam's all lactation ETA were calculated according to procedures in (10), which included sorting the data into deciles based on dam's milk ETA for first lactation, milk ETA for all lactations, birth date, fat ETA of first lactation, and fat ETA of all lactations. Partial regression coefficients were compared to approximate theoretical partial regression coefficients.

The approximate theoretical partial regression coefficients (10) for a dam with one record are .80 for the dam, .51 for the sire, and −.23 for the MGS. For a dam with three records, the theoretical regression coefficients

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are .70 for the dam, .51 for the sire, and −.14 for the maternal grandsire. These regression coefficients vary only slightly depending on the number of records in the sire and maternal grandsire proofs (10).

RESULTS AND DISCUSSION

When dam's first lactation ETA was included in the multiple regression equation, the empirical partial regression coefficients for milk were .72 for the dam, .49 for the sire, and −.11 for the MGS with a squared multiple correlation coefficient of .85. When the dam's all lactation ETA was substituted, partial regression coefficients were .17 for the dam, .48 for the sire, and .08 for the maternal grandsire with a squared multiple correlation coefficient of .73.

Within deciles, regression coefficients for all equations including dam's first lactation ETA were nearly the same as the regression coefficients over all the data, e.g., see the left half of Table 1. These are in reasonable agreement with the approximate theoretical partial regression coefficients both over the whole data set and across all deciles and methods of sorting into deciles.

The regression equations including dam's all lactation ETA were, with some minor variation, similar to those over all the data when the data were sorted into deciles by dam's all lactation milk or fat ETA and birthdate. Except for the coefficient for the sire's proof the empirical partial regression coefficients are not in agreement with the theoretical approximations. The reduction of the coefficient for the dam appears to be compensated by an increase and change in sign of the coefficient for the MGS (1, 5, 9, 10).

As shown on the right side of Table 1, when the data were sorted into deciles by dam's milk ETA for first lactation, the pattern in (10) emerged. Except for the two extreme deciles the coefficient for the dam was about .01 (.07 and .10 in the extreme two deciles), about .48 for the sire, and −.10 for the maternal grandsire (−.06 and −.02 in the extreme two deciles). Within deciles determined by first lactation ETA, the dam's all lactation ETA does not aid in predicting daughter performance, although the MGS contribution is about as expected

TABLE 1. Partial regression coefficients for daughter's milk estimated transmitting ability (ETA) for first lactation on dam's first or all lactation ETA[1] (DAM), sire's sire comparison (SIRE), and maternal grandsire's sire comparison (MGS), within deciles sorted by dam's first lactation ETA. Total number of heifers was 222,576.

	Partial regression coefficients							
	Regression equation including dam's first lactation ETA				Regression equation including dam's all lactation ETA			
Decile[2]	DAM	SIRE	MGS	R^2 [3]	DAM	SIRE	MGS	R^2
1	.711	.483	−.111	.74	.067	.479	−.057	.66
2	.725	.484	−.109	.74	.000	.482	−.100	.73
3	.778	.482	−.112	.75	.007	.482	−.107	.74
4	.770	.483	−.120	.76	.008	.484	−.116	.75
5	.708	.487	−.116	.76	.008	.487	−.110	.75
6	.737	.489	−.117	.76	.010	.488	−.110	.75
7	.748	.488	−.116	.76	.008	.488	−.110	.75
8	.746	.491	−.115	.77	.012	.490	−.108	.76
9	.705	.494	−.109	.76	.016	.475	−.095	.75
10	.669	.495	−.101	.79	.100	.488	−.015	.72
All	.718	.488	−.113	.85	.173	.481	.082	.73
SE[4]	.0329	.0020	.0038		.0020	.0024	.0043	

[1] All lactation ETA were estimated from a data set that included only cows whose records included at least a first lactation milk record.

[2] Heifer records with highest ranking dams for first lactation ETA.

[3] R^2, squared multiple correlation coefficient.

[4] SE, largest standard error of the partial regression coefficients across deciles.

TABLE 2. Partial regression coefficients for prediction of progeny breeding value from estimates of sire (S), maternal grandsire (MGS), and dam breeding value obtained from mixed model procedure.[1]

Reference	Progeny breeding value being predicted	Regression equations	No. of observations	Comments
Everett (1)	Son's proof	$.09D^{A,A} + .45S + .17MGS$	324	Half of dams did not have a first lactation record
Murphy et al. (5)	Son's proof	$.33D^{1,1} + .45S - .02MGS$	165	Only first records used to calculate ETA
		$.12D^{A}1,^{A} + .44S + .07MGS$	165	All dams required to have a first lactation record
Van Vleck and Murphy (9)	Son's proof	$.12D^{1,A} + .45S + .07MGS$	159	Dam with first record only, herdmates with all records
Westell and Van Vleck (10)	Heifer's ETA	$.76D^{1,1} + .48S - .14MGS$	258,201	Only first records used to calculate ETA
		$.39D^{A}1,^{A} + .47S + .05MGS$	258,201	All dams required to have a first lactation record
Current study	Heifer's ETA	$.72D^{1,1} + .49S - .11MGS$	222,576	Only first records used to calculate ETA
		$.17D^{A}1,^{A}1 + .48S + .08MGS$	222,576	Dam and herdmate required to have a first record

[1]ETA = Estimated transmitting ability. S = sire's Northeast Artificial Insemination Sire Comparison (NEAISC). MGS = maternal grandsire's NEAISC. $D^{1,1}$ = dam's ETA calculated from dam's first lactation record and first lactation records of herdmates. $D^{1,A}$ = dam's ETA calculated from dam's first lactation record with all lactation records of herdmates; herdmates not required to have a first lactation record. $D^{A,A}$ = dam's ETA calculated from all available lactation records of dam with all available lactation records of herdmates; neither dam nor herdmates were required to have a first lactation record. $D^{A}1,^{A}$ = dam's ETA calculated from first and any other available lactation records of dam with all available records of herdmates; herdmates not required to have a first lactation record. $D^{A}1,^{A}1$ = dam's ETA calculated from all available lactation records of dam with all available records of herdmates; both dam and herdmates required to have a first lactation record.

(empirical and theoretical partial regression coefficients of −.10 and −.14).

Reasons for the small partial regression coefficients for dam's all lactation ETA as compared to those predicted by theory and to those for dam's first lactation ETA are still not known. Requiring all cows in the ETA procedure to have a first lactation record did not explain why partial regression coefficients for dam's all lactation ETA do not agree with theoretical approximations. Herdmates without first records do not seem to be the reason why all lactation ETA do not predict progeny performance as well as first lactation ETA.

Table 2 summarizes partial regression coefficients for prediction of progeny breeding value from estimates of relatives' breeding values for (1, 5, 9, 10) and the current study. The partial regression coefficient for the sire's NEAISC is consistently about .5. The regression coefficient for the NEAISC of MGS is always small. Use of more than a first lactation record of the dam in estimation of her ETA decreases the size of the partial regression coefficient for the dam's ETA. For example, the partial regression coefficient for the dam's ETA decreased from .76 to .39 when all available records of the dam were used in calculation of the dam's ETA (10). In the current study, the partial regression coefficient for the dam's ETA was .72 when the dam's ETA was calculated from only first lactation records of the dam and her herdmates and was only .17 when the dam's ETA was calculated from all available lactation records of the dam and her herdmates when both the dam and her herdmates were required to have first lactation records.

Why ETA calculated from all lactation records do not predict progeny evaluations as well as ETA calculated from first lactation records has not been determined. It seems unlikely that the disparity is due to programming error because results were similar from ETA calculated with mixed model procedures and from ETA calculated by contemporary comparison methods (6, 7). Differential selection on herdmates as a reason seems ruled out because mixed model procedures account for selection based on first records if first records are included in the analysis (3). Preferential treatment of cows that do well in the first lactation as a major reason for the discrepancy seems unlikely because the same patterns hold for cows ranked high and those ranked low on their first lactations (10). One possibility that has not been examined is an effect of variation changing over time with production or with other factors (2).

An improper model for repeated records is another possibility, although selection index procedures can be used to show that moderate violation of the assumption of equal covariances among all lactations does not affect seriously estimates of genetic value (Van Raden, 1983 personal communication; 8).

An alternate explanation is that if genetic trend is not uniform, then ETA procedures may not account fully for generation differences in genetic merit. However, regression coefficients for first lactation ETA are similar to those predicted by theory, whereas regression coefficients for all lactation ETA are considerably smaller than expected, and discrepancies due to generation differences would be anticipated to be in ETA calculated from either first or all lactations.

CONCLUSIONS

These results indicate that the reason the partial regression coefficient for the ETA of the dam calculated from first and all later available lactations to predict the daughter's ETA is smaller than approximate theoretical partial regression coefficients is not due to records of herdmates being included that do not have a first record.

The problem of why all lactation ETA do not predict progeny performance as well as first lactation ETA or as well as theoretically expected is serious and warrants a strong research effort. Superficial studies such as this and others using both mixed model evaluations and selection index evaluations merely highlight the problem.

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