www.roavs.com EISSN: 2223-0343

RESEARCH OPINIONS IN ANIMAL & VETERINARY SCIENCES

Effects of multiple births on gestation length of Iranian Holstein dairy cows

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Abstract

The present study was conducted to investigate the effect of multiple (twin and triplet) birth on gestation length (GL) of Holstein cows in four large-scale dairy herds in Iran. A total of 56,559 records within 7 parities from 21,644 pure breed Holstein dairy cows calved from 2002 through 2012 were used. Factors affecting GL including herd (H), calving year (CY), calving month (CM), parity (P), birth type (single and multiple births), calf sex, birth type within parity and H×CY interaction were examined using generalized linear model (GLM) procedure. Of the factors examined in this research, the primary ones affecting GL were calving month, birth type and calving year respectively. Mean GL was calculated 278.54±4.88 d varied by herd from 278.17 to 278.79 d. Multiple rates increased with an increase in parity number ranging from 0.4 to 3.54% across parities. Gestation length was 4.74 d shorter (P<0.001) for multiples than singles ranging from 4.37 to 4.97 d between herds. The shortest and longest GL were observed, respectively, in parity 1 and 7 in both categories (277.59 vs 279.72 d in singles, 273.76 vs 275.23 d in multiples, P<0.01). Least square means showed GL in multiples were 3.83, 4.79, 4.62, 4.88, 5.04, 5.16 and 4.49 d shorter (P<0.001) than singles from first to seventh parity. It seems a comprehensive study to identify factors affecting GL can lead to more precise prediction of parturition date in dairy cows.

Keywords: Gestation length; birth type; parity; dairy cows

To cite this article: Kheirandish A, S Khalajzadeh and J Yadi, 2014. Effects of multiple births on gestation length of Iranian Holstein dairy cows. Res. Opin. Anim. Vet. Sci., 4(9): 508-511.

Introduction

Gestation length (GL) is defined as number of days between artificial insemination and birth date (Mujibi and Crews, 2009). Mean gestation length (GL) has been reported 279.4±5.7 and 287.5±6.2 days in Holstein and Brown Swiss dairy cows respectively (Norman et al., 2009). These figures indicate that there is a noticeable variation in GL between and within breeds in dairy cows. Certainly, many factors either genetically or environmentally can influence on gestation length of dairy cows. According to previous researches, most important factors that affect GL are calving age of the dam (Andersen and Plum, 1965), dam parity, air temperature (McClintock et al., 2003), calf sex (King et al., 1985), milk production (Hageman et al., 1991), birth type and retained placenta (Echternkamp et al., 1999), abortion rate (Day et al., 1995) and lactation length (Norman et al., 2009). Furthermore, genetic factors like service sire, maternal grandsire, and cow effects should be taken into account (Norman et al. 2009). A significant difference in GL between single and multiple births has been reported in dairy cows population. Echenternkamp et al. (2007) showed that twin and triplet births resulted in 6.8 and 12.7 d shorter GL than single birth respectively. On the other hand, association between GL and some health traits has been reported in dairy cows population. Extreme low and high values in GL can cause more stillbirths in cows (Hansen et al., 2004). It means incidence of some reproductive disorders such as stillbirth or dystocia can be controlled by GL managing in dairy herds. Therefore, in order to fulfil this goal, it is necessary to identify which factors, how and to what extent influence GL.

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The present study aimed to investigate some factors affecting GL in Iranian Holstein dairy cows by emphasis on birth type effect.

Materials and Methods

Data

Observations including 56,559 GL records of 21,644 pure breed Holstein dairy cows across 7 parities within 4 large dairy farms calved from 2002 through 2012 were used. Animals were born from 1999 to 2009 indicating that only some of them had complete records for all seven parities. In order to obtain more precise results, data edition was performed prior to statistical analysis. Unusual observations such as 0, extreme high or low values that caused large variation were excluded. Extreme low and high values considered to be 265 and 295 d respectively because values out of these range are likely to be outlier (Norman et al., 2009). Four dairy herds consisted of 16504, 19382, 6582, and 14091 records respectively, had enough records to provide large sample size. Figure 1 depicts changes in number of calving among herds during studied period. Similar patterns were observed for herd 2, 3, and 4 for number of calving across time. There has been a reduction in number of calving in herds during two last years. Although the reason of size reduction in these herds is not exactly clear, it may be related to management policies of herds. In contrast, a permanent increase without any reduction in size was observed in herd 1.

Statistical Analysis

Generalized linear model (GLM) procedure of SPSS 19 software was applied to estimate least square means of interest factors in the whole dataset. Model included herd (H, 4 levels), calving year (CY, 11 levels), calving month (12 levels), parity (7 levels), birth type (Single and multiple births, 2 levels), calf sex (2 levels), birth type within parity (14 levels) and H×CY interaction (44 levels) as fixed factors. In addition, the model was used for statistical analysis of observations in each herd after removing the effects of herd and H×CY interaction. Duncan multiple range test was used for mean comparison and differences were considered to be significant at P-value <0.01.

Results and Discussion

Generalized linear model revealed all factors examined in the model had high significant effect on gestation length of dairy cows. Of the factors considered in this research, primary ones affecting GL were calving month, birth type and calving year respectively (P<0.001).

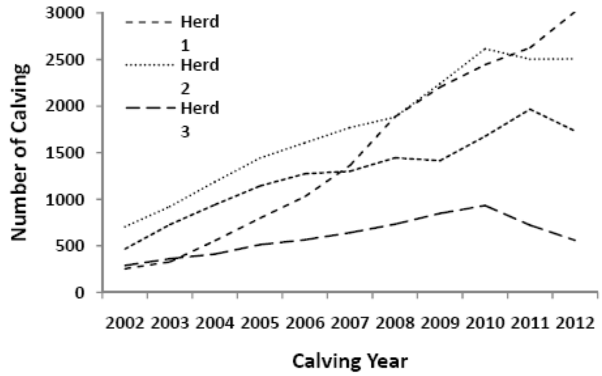

Fig. 1: Changes in numbers of calving in four dairy farms from 2002 through 2012

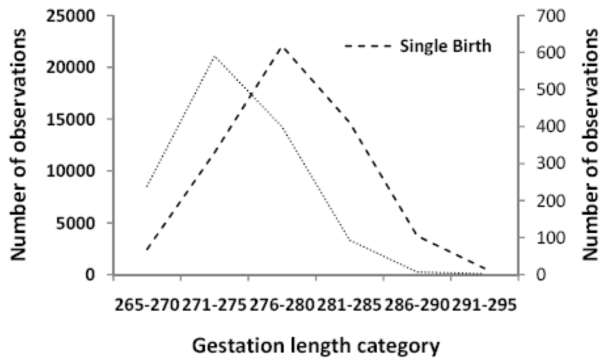

Fig. 2: Distribution of gestation length in single and multiple birth categories

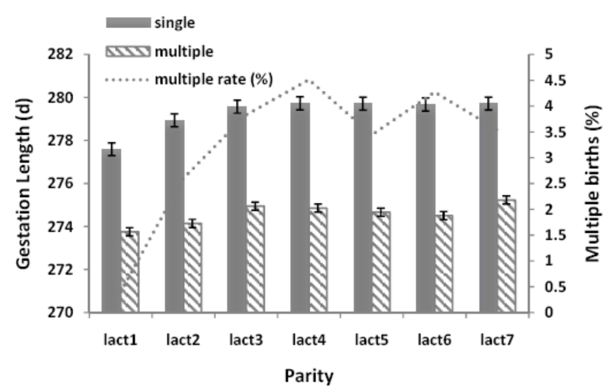

Fig. 3: Marginal means (±SD) of GL for single and multiple births within parities. Columns in each parity differ significantly at P<0.001

Characteristics of gestation length

Total average and standard deviation of gestation length were calculated 278.54±4.88 d respectively (Table 1). The difference of 0.6 d was observed between herd means (P<0.001). GL in seven US dairy breeds was reported by Norman et al. (2009) ranging from 279.4 to 287.62 d with the shortest and longest values in Holstein and Brown Swiss breeds respectively.

Table 1: Characteristics of GL in Iranian Holstein dairy cattle population

	Herd 1	Herd 2	Herd 3	Herd 4	Total
Number of observations	16504	19382	6356	14091	56559
Mean (d)	278.79[c]	278.17[a]	278.62[b]	278.7[bc]	278.54
Standard Deviation (d)	4.63	4.89	4.84	5.14	4.88
Median (d)	279	278	279	279	278
Mode (d)	279	279	278	279	279
First quartile (d)	276	275	275	275	275
Third quartile (d)	282	281	282	282	282
CV (%)	1.66	1.76	1.74	1.84	1.75

Values with different superscript differ at P<0.001. d=days

Table 2: Twinning rates, means (±SD), LSM[1] (±SE) and marginal means (±SE) of GL in population

	Number	Means (±SD)	LSM (±SE)*	Marginal means (±SE)*
Herd 1				
Single	16094	278.88±4.61	4.37±0.22	279.52±0.07
Multiple	410 (2.5%)	275.13±4.06	0	275.15±0.2
Herd 2				
single	18886	278.28±4.86	4.97±0.21	278.9±0.07
multiple	496 (2.6%)	273.88±4.3	0	273.93±0.2
Herd 3				
single	6356	278.79±4.8	4.84±0.32	279.15±0.1
multiple	226 (3.4%)	273.9±3.96	0	274.31±0.3
Herd 4				
single	13893	278.76±5.1	4.71±0.35	279.41±0.07
multiple	198 (1.4%)	274.35±4.5	0	274.7±0.35
Total				
single	55229	278.64±4.85	4.74±0.13	279.27±0.04
multiple	1330 (2.4%)	274.34±4.2	0	274.53±0.13

1=Least Square Means; *(LSM and marginal means differ significantly at P<0.001 between single and multiple births in each herd as well as whole population).

GL near 280 d for Holstein and longer for other breeds has been reported by Andersen and Plum (1965). Long GL in beef cattle breeds such as Charolais (286.48±4.93 d) and de los Valles (287.3±5.67 d) have been also reported (Mujibi and Crews, 2009; Cervantes et al., 2010).

Effect of multiple births

Distribution of gestation length for dams of singles and of multiples (Twin and triplet) is depicted in figure 2. Although similar pattern was seen in distribution of GL between categories, a decrease in mode was observed in multiples regarding to shorter mean GL in this category.

The result showed gestation length was 4.74 d shorter (P<0.001) for multiples (twin and triplet) than singles ranging by herd from 4.37 to 4.97 d (Table 2). Similar differences in gestation length between twins and singles have been reported previously in cows (Gregory et al., 1990; Guerra-Martinez et al., 1990). Shorter gestation length was also reported (Echternkamp et al., 1999) for twin than for single pregnancies (275.6 vs 281.3 d, P<0.01).

Figure 3 illustrates GL for single and multiple births within parities. The shortest and longest GL were observed, respectively, in parity 1 and 7 in both categories (277.59 vs 279.72 d in single, 273.76 vs 275.23 d in multiple, P<0.01) indicating parity affects GL. Based on previous experiments, older cows carry calves longer than younger cows varied by parity from 1 to 2 d (King et al., 1985).

As incidence of twining increases with increase in parity numbers (from 0.4% in parity 1 to 3.54% in parity 7, Fig. 3), so it is worthwhile to investigate the effect of multiple births on GL across parities. Least square means showed GL in multiples were 3.83, 4.79, 4.62, 4.88, 5.04, 5.16 and 4.49 d shorter (P<0.001) than singles from first to seventh parity (Fig. 3). Similar changes in twinning rate have been reported previously in dairy cows. As an example, 1.1 and 5.7% twining has been reported in Iranian Holstein dairy population for parity 1 and 5 respectively (Ghavi-Hossein-Zadeh et al., 2008). Increasing trend for twinning with parity is relevant to greater occurrence of multiple ovulations in dairy cows in compared with non-lactating cows (Silva del Rio et al., 2007). Milk production as a main reason has been concluded for explanation of ovulation rate increase in dairy cows (Fricke and Wiltbank, 1999).

Conclusions

Many environmental factors can influence gestation length of dairy cows. Of the factors considered in this research, birth type impacts GL impressively. Twinning shortens gestation length of Holstein dairy cows varied by parity from 4 to 5 d. It seems more accurate prediction of parturition date is possible by identification of all factors influence GL. Undoubtedly; it demands a comprehensive study on all factors affecting GL both genetically and environmentally. More precise prediction of calving date can help dairy producers to manage pregnant cows better and maximize dairy cows' profitability.

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