Ovozoa 11 No. 1, April 2022 p-ISSN 2302-6464 e-ISSN 2722-967X
Available at https://e-journal.unair.ac.id/OVZ/index

Original article

Correlation of parity and age to services per conception, conception rate, and gestation length in Holstein Friesian cross cows

Norma Amalia Ulfah[1*], Abdul Samik[2], Mas'ud Hariadi[2], Tri Wahyu Suprayogi[2], Sri Hidanah[3]

[1] Anantya Riding Club, Jalan Caringin, RT. 04/RW. 04, Karanggan, Gunung Putri, Bojong Nangka, Gn. Putri, Bogor, Jawa Barat 16963, Indonesia
[2] Division of Veterinary Reproduction, [3] Division of Animal Husbandry
Faculty of Veterinary Medicine, Universitas Airlangga
[*] Corresponding author, e-mail: normaamalia26@gmail.com

Open access under CC BY – SA license, DOI: 10.20473/ovz.v11i1.2022.9-14
Received December 31 2021, Revised February 27 2022, Accepted March 4 2022
Published online April 2022

How to cite this article: Ulfah NA, Samik A, Hariadi M, Suprayogi TW, Hidanah S. 2022. Correlation of parity and age to services per conception, conception rate, and gestation length in Holstein Friesian cross cows. Ovozoa: Journal of Animal Reproduction 11: 9-14.

ABSTRACT

Small farmers dominate dairy farming in Indonesia, and the average productivity is low. The contribution of domestic production only reaches about 23% of the total national milk consumption needs as a source of human nutrition. This study was aimed to identify the relationship between cow's parity and age to services per conception (S/C), conception rate (CR), and gestation length (GL) of Holstein Friesian (HF) cross dairy cows. Data of this study consisted of primary data obtained from farmers interview, and secondary data from the Cooperative Unit of Argopuro village, Krucil, Probolinggo. Sample size was 200 cows, which was 10% of the total population. Data were analyzed for correlation and linear regression using the Statistic Package and Service Solution (SPSS) software version 20 (IBM Corp., USA) at a 95% confidence level. The average S/C, CR, and GL were 2.55 ± 1.57, 21%, and 278.19 ± 11.92 days, respectively. There was no significant correlation ($p > 0.05$) between the parity with S/C, CR, and GL and the age with CR and GL. The only significant correlation ($p < 0.05$) was between the age and S/C. Regression of S/C based on age followed the equation S/C = 0.104 + 0.407*age, with a correlation coefficient and determination coefficient of 0.733 and 0.538, respectively. It could be concluded that S/C could be predicted based on the age of the cows.

Keywords: age, conception rate, gestation length, parity, services per conception

INTRODUCTION

The Indonesia Central Statistics Agency had reported that the number of dairy cattle farmers in Indonesia in 2021 was 534 units (BPS, 2021). Smallholder farmers dominate dairy farming in Indonesia, and the average productivity is low. The contribution of domestic production only reaches about 23% of the total national milk consumption needs (Purwantini *et al*., 2021). Milk productivity increased along with reproductive performance. Poor fertility meant cows spend longer producing lower amounts of less efficiently produced milk (Krpálková *et al*., 2020). Cows with 305-day milk yields below 9,000 kg were most profitable if they calve every year (Römer *et al*., 2020). Holstein Friesian (HF) cross cow's milk production is about 17.66 ±

3.47 liters/day, equivalent to 5,400 kg yearly (Soeharsono *et al*., 2020). There was a high incidence of reproductive disorders in smallholder dairy farms that decreased reproductive performance (Yusuf *et al*., 2019). The highest reasons for culling dairy cows are reproductive inefficiency, followed by mastitis, feet and leg problem, and the lowest is low milk production (Dallago *et al*., 2021).

The reproductive performance of dairy cows has a significant effect on the farmers' profitability. Standard measures of reproductive performance are days to the first service, days to conception, calving interval (CI), services per conception (S/C), conception rate (CR), estrus detection rate, and pregnancy rate. Cattle farm would benefit economically, among others by reducing culling rates due to non-pregnant females and shortening their calving interval (Dayyani *et al*., 2013). Dairy cows with favorable S/C, DO, CI, conception at 28 days, mastitis, ketosis, and endometritis were at a lower risk of culling rate (Nasr *et al*., 2021).

Field observations showed that the farmers considered their dairy cattle like their own family. Some farmers build their dairy cowsheds next to or in their houses. Dairy cows are kept even though they are no longer productive. Dairy cows were not culled even though they were 18 years old and failed to get pregnant despite had been artificially inseminated up to eleven times. Smallholder dairy farmers need a guideline for identifying the reproductive efficiency of their cows based on the parity and age of their cows. Therefore, this study was aimed to identify the relationship between parity and age on S/C, CR, and GL of artificial insemination (AI) acceptor HF cross cows.

MATERIALS AND METHODS

The data of this study consisted of primary data obtained from farmers interview, and secondary data from the Cooperative Unit of Argopuro village, Krucil, Probolinggo. Probolinggo is located at 112'50' - 113'30' East Longitude and 7'40' - 8'10' South Latitude. The population in this study was HF cross cows that had given birth or were currently pregnant, which were 1969 lactating dairy cows. The sample size was 200 cows, which was 10% of the total population. Data of parity and age of dams and reproductive data (S/C, CR, and GL) were recorded and descriptively tabulated. The data were analyzed for correlation and linear regression using the Statistic Package and Service Solution (SPSS) software version 20 (IBM Corp., USA) at a 95% confidence level.

RESULTS

Farmers interview showed a cattle ownership rate of 1-6 heads; almost all (93.5%) farmers fed elephant grass, and concentrate to their cows; all farmers have the ability to detect estrus, however, 40.5% of them did not report directly to the inseminator; while, the inseminators inseminate the cows 6-12 hours after farmers report.

Table 1 Descriptive data of S/C, CR, and GL based on parity of HF cross cows

parity	number of cows	range of services	S/C	CR (%)	range of GL	GL (days)
1	40	1 - 9	2.28	25.0	239 - 307	277.0 ± 10.4
2	57	1 - 5	2.30	22.8	249 - 378	280.4 ± 16.1
3	39	1 - 10	3.03	12.8	214 - 292	275.8 ± 12.8
4	36	1 - 5	2.36	19.4	257 - 290	278.0 ± 6.7
5	11	1 - 11	3.18	18.2	267 - 293	279.1 ± 9.1
6	9	1 - 11	3.56	22.2	275 - 286	279.3 ± 3.4
7	5	1 - 3	2.00	20.0	270 - 285	277.4 ± 5.5
8	3	2 - 4	2.67	0.0	277 - 280	278.3 ± 1.5

S/C: services per conception; CR: conception rate; GL: gestation length; HF: Holstein Friesian

Table 2 Descriptive data of S/C, CR, and GL based on age of HF cross cows

age (years)	number of cows	range of services	S/C	CR (%)	range of GL	GL (days)
2	32	1 - 9	2.25	25.0	255 - 307	278.4 ± 8.8
3	34	1 - 4	1.94	32.4	239 - 298	279.8 ± 20.5
4	41	1 - 5	2.41	19.5	263 - 296	278.6 ± 8.3
5	30	1 - 6	2.97	6.7	251 - 292	276.7 ± 9.2
6	25	1 - 10	2.92	16.0	214 - 287	275.8 ± 14.4
7	20	1 - 11	2.85	25.0	267 - 293	280.1 ± 6.9
8	9	1 - 5	2.56	22.2	269 - 280	276.2 ± 3.8

S/C: services per conception; CR: conception rate; GL: gestation length; HF: Holstein Friesian.

Table 3 The average of S/C, CR, and GL of HF cross cows

parameters	observed	interpretation	reference values	references
S/C	2.55 ± 1.57	inefficient	1.6 - 2.0	(Darmawan *et al*., 2019)
CR (%)	21	inefficient	> 60	(Abdillah *et al*., 2015)
GL (days)	278.19 ± 11.92	efficient	278 - 284	(Prabowo *et al*., 2021)

S/C: services per conception; CR: conception rate; GL: gestation length; HF: Holstein Friesian.

Tabel 4 Correlation of S/C, CR, and GL based on parity of HF cross cows

variables	R	R^2	p
parity on S/C	0.198	0.039	0.639
parity on CR	0.592	0.351	0.122
parity on GL	0.115	0.013	0.787

S/C: services per conception; CR: conception rate; GL: gestation length; HF: Holstein Friesian

Tabel 5 Correlation of S/C, CR, and GL based on age (years) of HF cross cows

variables	R	R2	p
age on S/C	0.733	0.538	0.007
age on CR	0.254	0.064	0.583
age on GL	0.176	0.31	0.584

S/C: services per conception; CR: conception rate; GL: gestation length; HF: Holstein Friesian

The parity of the cows in this study was in the range of 1-8 with 1-11 AI services, S/C of 2.00-3.56, CR of 0-25%, and GL range of 214-378 days (Table 1), while the age of the cows in this study was in the range of 2-8 years with 1-11 AI services, S/C of 1.94-2.97, CR of 6.7-32.4%, and GL range of 214-307 days (Table 2). Based on the reference values (Table 3), the S/C and CR of HF cross cows in this study were inefficient, however, the gestation length parameter was efficient.

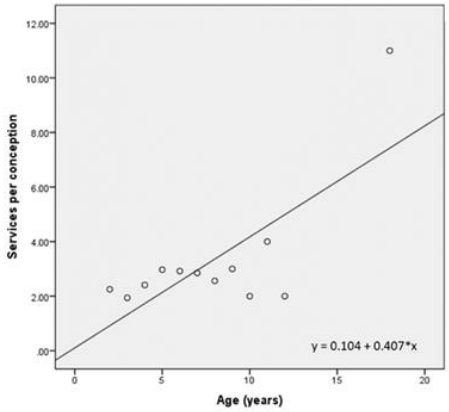

Figure 1 Regression equation of services per conception based on age (years) as predictor in HF cross cows

Pearson correlation analysis showed no significant correlation (p >0.05) between the parity parameter with S/C, CR, and GL and between the age parameter with CR and GL. The only significant correlation (p <0.05) was between the age parameter with S/C (Table 4, Table 5). Regression of S/C based on age parameter followed the equation S/C = 0.104 + 0.407*Age (Figure 1), with a correlation coefficient and determination coefficient of 0.733 and 0.538, respectively.

DISCUSSION

Reproductive efficiency is closely related to the profitability of dairy farms. A high 21-day pregnancy rates would shorten the calving interval and days in the herd's milk. To achieve a high 21-day pregnancy rates, the services per conception and CR should be improved (Cardoso Consentini *et al*., 2021). Calving interval, calving to first service interval, S/C, CR at first AI were related to lactation yield (Burgers *et al*., 2021).

In postpartum dairy cows, pathologic ovarian, either ovulatory (cystic corpora lutea) or anovulatory (follicular and luteal cysts) frequently caused decreased fertility (Gábor *et al*., 2016). The overall S/C of 200 cows in this study was 2.55 ± 1.57, which was worse compared to those reported by others in heifers (1.6 ± 1.2) (Yusuf *et al*., 2019) and cows (1.6 - 2.0) (Darmawan *et al*., 2019), (1.95 - 2.54) (Siatka *et al*., 2017), but it was better than those reported by Yusuf *et al*. (2019) (3.4 ± 3.0) in cows. S/C range of 1.3 to 1.6 was recommended as optimum S/C for the well-managed dairy herd (Haile and Yoseph, 2018).

In the regression equation S/C = 0.104 + 0.407*Age, the constant in the age variable is positive, indicating that the older the cows, the higher the S/C value in dairy cows. One unit increase in the age variable would provide an additional contribution of 0.407 in the S/C variable unit. The mathematical equation applies to the variable age range 2-8 years of the HF cross cows. Ideally, the S/C of cows was one, which means that one artificial service directly resulted in pregnancy. Based on the reference, normal S/C was ranged from 1.6-2. S/C value of 3 or more indicates a cow's failure to calving annually. Based on the regression equation S/C = 0.104 + 0.407*Age, the ages of cows with S/C of 1, 1.6-2, and 3 were found in cows aged 2.1, 3.68-4.66, and 7.12 years. This result was in accordance with the report of Ananda *et al*. (2019) that there was a positive correlation between age and S/C, where S/C increased from 2.6 ± 1.1 in young dairy cows aged 4-5 years to 4.3 ± 1.9 in 6 years old cows.

The determination coefficient of age on S/C was 0.538, which means that age was influenced by 53.8% of S/C values, and 46.2% influenced the other factors. The higher value of S/C was related to lower BCS, the time of first AI, peri- or postpartum disorders (Kim *et al*., 2019). Increasing S/C value extended the interval between calving. The increase of the S/C value was caused by an increase of age at the calving in later lactations, which lowered the number of potential lactations in the cow's life and decreased the reproductive performance (Cielava *et al*., 2017). Feeding influenced S/C, thereby, improvement of nutrition on repeat breeder cows (S/C more than three) would improve the S/C to the normal range (1.30 ± 0.48 to 1.40 ± 0.52) (Susilowati *et al*., 2020).

In this study, the CR of 200 cows was only 21%, lower than the minimum standard of 60% (Abdillah *et al*., 2015) (Table 3). The farm management and environmental factors were responsible for 96% of the variation in CRs. Nutrition, metabolic disorders, reproductive health, heat detection, insemination practices, and climate could influence significant differences in CRs (Howlader *et al*., 2019). Therefore, to increase the CR, dairy cows should be inseminated early when they show signs of estrous; the owners of dairy cows should be trained on how to detect estrous signs in dairy cows, and AI technicians should also take training to improve their skills (Hamid *et al*., 2021).

Gestation length of cows in this study was 278.19 ± 11.92 days, which was in the normal range of 278 - 284 days (Prabowo *et al*., 2021). The number of insemination services required to produce a live calf is one of the most valuable parameters of reproductive efficiency, which mainly depends on the breeding system used. Improving the reproductive efficiency of the cows should be proper on heat detection, health care, adequate feeding, and reproductive problems of cows should be considered (Haile and Yoseph, 2018).

Gestation length was influenced by the cow's age, male fetuses, and fetus weight. Optimum gestation length was in the range of 275-277 days based on calving ease and stillbirth rates (Nogalski *et al*., 2012). Gestation of singletons was lengthened than twins, those of male calves were lengthened than female ones. Parity was not associated with GL (Jeon and Rho, 2019). Gestation length in HF cross gestation was 279.5 ± 0.06. Sire breed, calving season, body score condition, sex of calf, year of

insemination, and calving year were significant sources of variation in the GL in HF cross (Potdar *et al*., 2017). Gestation length was shorter for FH cows conceived from FH bull frozen-thawed semen (274.9 ± 0.6 days) than those of crossbred (Scanavez and Mendonça, 2018).

Several factors influenced reproductive performance, but none required more visual attention than heat or estrus detection (Dayyani *et al*., 2013). The lower reproductive efficiency might be due to the lack of proper heat detection, missed or silent heat, ovarian cyst or embryonic mortality, and nutritional factors. Poor expression of estrus, failure to detect estrus by AI technicians, or both may be the major causes for the low reproduction performance of dairy cows. This needs a close attention for a proper heat detection, well-skilled AI technician, and proper feeding followed by better reproductive health management (Haile and Yoseph, 2018).

CONCLUSION

S/C could be predicted based on age parameter by following the equation **S/C** = 0.104 + 0.407*Age, with correlation and determination coefficient of 0.733 and 0.538, respectively. The good reproductive ages of HF cross cows based on S/C < 2 was found under 4.66 years old. However, there was no correlation of the parity to **S/C**, CR, and GL, and between age parameter to CR and GL.

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