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ORIGINAL ARTICLE

Primiparous and multiparous Friesland, Jersey, and crossbred cows' behavior around parturition time at the pasture-based system in South Africa

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ABSTRACT

Objective: The objective of the study was to assess the behavioral attributes of primiparous and multiparous Friesland, Jersey, and Crossbred cows around calving time in a pasture-based dairy system.
Material and methods: A total of 120 pregnant cows were used in the study, comprising of 40 cows per genotype in different parities [A-primiparous (n = 10), B-2 to 4 (n = 10), C-5 and 6 (n = 10), and D-7 and 8 (n = 10)] and kept in a maternity paddock. Five observers monitored cows from the onset of parturition until the calves were fully expelled, recording the frequency and duration of lying, standing, and walking bouts, calf licking, and suckling.
Results: There were differences ($p < 0.05$) observed in the behavioral patterns around the time of calving. Jersey multiparous cows spent ($p < 0.05$) significantly most of their time (20.50 ± 3.10) in lying position as compared to the other genotypes. The Jersey cows also spent most ($p < 0.05$) of their time (48.00 ± 0.34) in a standing position during the calving period. Friesland cows spent ($p < 0.05$) most of their time (12.00 ± 1.19) exhibiting either stepping or walking attributes as compared to Jersey and Crossbred cows. The Jersey genotype spent significantly ($p < 0.05$) more time (123.00 ± 10.43) in expelling their calves compared to the other genotypes. There was a significant ($p < 0.05$) interaction between genotypes and parity on time spent by cows on licking their calves. There was a significant difference ($p < 0.05$) observed between the genotypes of the primiparous cow.
Conclusion: The primiparous cows spent most of their time in standing and the least amount of time in other activities throughout the trial due to the lack of maternal experience. The current study revealed that behavioral activities differ according to genotype and parity.

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Introduction

Calving in dairy cows is an important event and a requirement for the milk industry and herd renewal to maintain the profitability of a dairy production system [1,2]. Parturition is divided into three distinct stages, namely, preparatory, delivery, and cleaning stages [3–5]. During these stages, cows are vulnerable as they are physically challenging, stressing, and painful processes, especially for first time calving or primiparous and very old cow in parity eight and above [6–8].

The parturition period is associated with hormonal, physiological, and behavioral changes. These include changes in the levels of progesterone, luteinizing hormone, gonadotropin-releasing hormone, and plasma concentrations of stress hormones (cortisol, opioids, and catecholamine); increased heart rate, body temperature, and cervix dilation; and physical changes such swollen vulva and body conformation and unusual behavior such as ground licking, reduced appetite, and tail raising [9–12]. These changes occur before the first stage of parturition, which is the period when the calf is moving into its appropriate position intended for parturition [10,12].

Around the time of calving, cows become more restless. The increases in restlessness accompany uterine contractions, which increases frequency and intensity as the calving period progresses. These expulsive contractions

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necessitate an increased surveillance of the abdomen [12–15]. A study by Huzzey et al. [16] also reported a dramatic increase in the number of positional changes such as lying and standing bouts from 2 days before calving. This consequently results in a tendency of the calving cow to isolate itself from the rest of the herd. It was further reported that the parturient cow tends to be restless due to discomfort associated with calving and grouping of pregnant cows. Under normal conditions, water sac or calf feet protruding outside the vulva are visible, and the calving observers can identify these signs as early as possible [13,17]. It has been documented that Friesland multiparous cows spent most of the time in lying down around and during the time of calving compared to Jersey. This is attributed to the large body size in Friesland cows compared to the Jersey cows [13,14,17]. It is, therefore, significant to carefully appraise the periparturient cows more frequently. Hence, in practice, this might be difficult for one calving personnel to closely monitor calving cow at the night and even during the day, due to high stocking densities in pasture-based dairy systems [13].

Moreover, there is little information on how primiparous and multiparous, Friesland, Jersey, and Crossbred cows behave around the time of calving at the pasture-based system of South Africa. Therefore, this study sought to assess the behavioral attributes of primiparous and multiparous Friesland, Jersey, and Crossbred cows around the time of calving at the pasture-based dairy system.

Material and Methods

Ethical approval

The University of Fort Hare Research Ethics Committee approved the research protocol, and an approval certificate was issued with reference number JAJ011SMPI01/19/A.

Site description

The current study was conducted at the University of Fort Hare Dairy Farm, which is situated 120 km inland of Eastern Cape in South Africa. The farm is 520 m above the sea level and is located at 32.8^0 S and 26.9^0 E. The average annual rainfall received at the farm is 480 mm and is mostly received in the summer season. The mean annual temperature of the farm is 18.7°C, and the farm is situated in the Bisho Thornveld of Eastern Cape. The total area of the farm is 200 hectares under *Lolium perenne, Lolium multiflorum, Pennisetum clandestinum,* and *Trifolium repens*. The cold moist season is characterized by cold weather with the moist wind coming from Hogsback average temperature range of 3°C and 20°C. The post-rain season is characterized by low rainfall and cold weather.

Experimental design and animal management

The selection of cows was done based on the stage of pregnancy in different parities. The animal selection was done purposively to select only pregnant cows. Pregnancy diagnosis was using rectal palpation on dairy cows and heifers that were artificially inseminated before the experiment. This stage of pregnancy (7 months) was determined by the rectal palpation method, which gives high precision and accuracy in predicting the expected calving date. The experimental design was a 3 × 4 factorial design (three breeds and four parities). A total of 120 pregnant cows were used in the study, comprising 40 cows per genotype (Friesland, Jersey, and Friesland × Jersey cross) in different parities (A-primiparous (n = 10), B-2 to 4 (n = 10), C-5 and 6 (n = 10), and D-7 and 8 (n = 10). The multiparous cows were in the second parity up to the eighth parity, and the primiparous animals were between 20 and 24 months of age and kept at the steam-up camp waiting for calving. The crossbreds were a mixture of Jersey × Friesland. Ear tags were used to identify the cows and heifers since these cows were managed within the usual farm management system. Each dairy cow and heifer were given 6 kg of silage, and 2 kg of super 18 dairy concentrates per day (6 kg + 2 kg = 8 kg per day) to maintain body weight and body condition score.

Measurements and data collection

Five well-trained observers monitored visually the behavioral activity patterns shown by dairy primiparous and multiparous cows from the onset of parturition until the time when the calf was expelled from the vulva using digital stopwatches from 0,800 h in the morning to 1,700 h the same day. Trained observers have used in a training method for animal-based measures and result in images, videos, and observers which were not significantly different [18]. In this study, the behavioral activity patterns were recorded in data collection sheets. The behavioral activities monitored include duration and number of lying bouts (body in contact with the ground using left side), standing up, walking bouts (step or steps taken by a cow from one place to another with head up), calf licking, and suckling duration. Monitoring sheets and stopwatches were also used to record the time duration of behaviors shown by each cow. The time duration recorded for each activity was expressed in minutes. After a period of between 6 and 12 h from the parturition, the calves were removed from their dams, and the dams were allowed to join the milking herd. Thereafter, the cows were given concentrates and minerals to enhance the milk production. The information about the parity was recorded at the beginning of the observation.

Statistical analyses

The quantitative data on behavioral attributes from the parturient cows were analyzed using the general linear model of SAS (2003) to determine the effect of genotype, parity, and interaction between genotype and parity on different behavioral activity patterns around the time of parturition. A comparison of means for the behavioral activities was done using the Fisher' least significant difference method option of SAS (2003). The differences in percentages and individual least of square means and standard errors of the means (LSM ± SEM) reported were considered to be statistically significant at $p < 0.05$.

The model is as follows:

$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + e_{ijk}$

Y_{ijk} = time spent on lying down, standing, walking, fetal expulsion, calf licking, and suckling.

μ = overall mean

α_i = i^{th} effect of parity (primiparous, 2–4, 5–6, and 7–8)

β_j = j^{th} effect of genotype (Jersey, Friesland, and crossbreds)

$(\alpha\beta)_{ij}$ = interaction between class and genotype

e_{ijk} = experimental error

Results

Behavioral activity patterns

The results for the behavioral activity between the primiparous and multiparous from the three dairy cattle genotypes around the time of parturition are shown in Table 1. There were distinct differences ($p < 0.05$) observed on behavioral patterns during parturition. Friesland multiparous cows spent (30.83 ± 3.13) significantly most of the time on lying down as compared to Jersey (22.25 ± 5.41) and Crossbred (11.50 ± 5.41 min) min. Meanwhile, Jersey primiparous spent most (48.00 ± 0.34) of their time on standing during parturition as compared to Friesland (39.00 ± 0.34) and Crossbred (1.70 ± 0.34 min). Furthermore, Friesland cows spent (12.00 ± 1.19) most of their time during parturition stepping or walking compared to Jersey (1.95 ± 1.19) and Crossbred cows. Jersey multiparous cows also spent significantly (123.00 ± 10.43) the most time on expelling their calves compared to Friesland (100.00 ± 8.52) and Crossbred cows (55.00 ± 4.66 min).

Interaction between genotype and parity on lying behavior around the time of calving

Crossbred primiparous cow spent significantly (16.45 ± 1.39) of their time on lying down on the first bout, compared to Jersey (13.95 ± 1.39) and Friesland (12.80 ± 1.39 min). Meanwhile, Friesland cows in parity B spent (20.40 ± 2.77) most of their time on lying down compared to Jersey (17.14 ± 1.66) and Crossbred (14.86) same parity. However, no distinct differences ($p > 0.05$) were observed between the three genotypes in parity C. Besides, cows in parity D Jersey spent significantly (20.50 ± 3.10) and Friesland (19.83 ± 2.52) most of their time lying down compared to Crossbred (8.00 ± 1.39) cows.

In the second lying bout, Jersey primiparous cows spent significantly (23.45 ± 2.03) the most time on lying down compared to Crossbred (17.45 ± 2.02) and Friesland (9.90 ± 2.03) cows. Besides, Friesland cows in parity B spent (20.40 ± 2.77) most of their time in lying down than other genotypes such as Jersey (17.14 ± 1.66) and Crossbred (14.86 ± 1.66). In addition, the mean duration spent by Jersey cows in parity C and D was significantly ($p < 0.05$) higher than other genotypes.

In the third lying bout, Jersey primiparous and parity B spent ($p < 0.05$) most of their time in lying down compared

Table 1. The interaction effect between parity and genotype on lying behavior.

Parity	Genotype	1st bout	2nd bout	3rd bout	Total lying time
	Crossbred	$16.45^{c} \pm 1.39$	$17.45^{c} \pm 2.02$	$7.70^{b} \pm 1.94$	$22.95^{d} \pm 1.71$
a	Friesland	$12.80^{b} \pm 1.39$	$9.90^{ab} \pm 2.03$	$3.05^{a} \pm 1.94$	$27.15^{e} \pm 1.71$
	Jersey	$13.95^{b} \pm 1.39$	$23.45^{d} \pm 2.03$	$12.95^{c} \pm 1.94$	$21.25^{c} \pm 1.71$
	Crossbred	$14.86^{b} \pm 1.66$	$10.00^{b} \pm 2.42$	$4.21^{a} \pm 2.32$	$19.71^{c} \pm 2.05$
b	Friesland	$20.40^{c} \pm 2.77$	$16.20^{c} \pm 4.05^{c}$	$5.00^{ab} \pm 3.89$	$16.71^{b} \pm 3.42$
	Jersey	$17.14^{c} \pm 1.66$	$6.64^{a} \pm 2.42$	$34.20^{d} \pm 2.32$	$21.50^{d} \pm 2.05$
	Crossbred	$20.00^{c} \pm 3.10$	$4.00^{a} \pm 4.52$	$8.75^{b} \pm 4.35$	$5.25^{a} \pm 3.83$
c	Friesland	$18.50^{c} \pm 2.77$	$14.25^{c} \pm 3.19$	$5.25^{ab} \pm 3.07$	$25.00^{d} \pm 2.11$
	Jersey	$19.0^{c} \pm 4.39$	$19.50^{d} \pm 6.40$	$5.50^{ab} \pm 6.15$	$22.00^{d} \pm 5.41$
	Crossbred	$8.00^{a} \pm 1.39$	$7.50^{ab} \pm 6.40$	$1.00^{a} \pm 6.15$	$11.50^{b} \pm 5.14$
d	Friesland	$19.83^{c} \pm 2.53$	$16.17^{c} \pm 3.69$	$13.83^{c} \pm 3.55$	$30.83^{e} \pm 3.13$
	Jersey	$20.50^{c} \pm 3.10$	$21.25^{d} \pm 4.53$	$22.00^{d} \pm 4.35$	$22.25^{d} \pm 5.41$
p-value		0.04	0.0003	0.01	0.02

Means in the same column with different superscripts are statistically different at $p < 0.05$.
First, second, and third bouts and total lying time were recorded in minutes.

to Friesland and Crossbred cows. However, no distinct differences ($p > 0.05$) were observed between genotypes in parity C cows. Conversely, cows in parity D Jersey spent significantly ($p < 0.05$) most of their time in lying down compared to Friesland and Crossbred cows.

Total lying, standing, and walking duration between genotypes and parities

The total amount of time spent by primiparous Friesland cows was significantly ($p < 0.05$) higher, compared to Jersey and Crossbred cows. Meanwhile, the time spent by Jersey cows in parity B was significantly ($p < 0.05$) higher than the other two genotypes of the same group. However, there was no significant ($p > 0.05$) difference observed between three genotypes on parity C, whereas multiparous Friesland cows grouped spent significantly ($p < 0.05$) most of their time in lying down compared to Jersey and Crossbred cows.

No distinct differences ($p > 0.05$) were observed between three genotypes in primiparous. Similarly, no significant differences ($p > 0.05$) were observed between genotypes in parities B and C. Meanwhile, there was a significant difference ($p < 0.05$) existing between genotypes, and Jersey (11.75 ± 1.65 min) and Friesland (10.50 ± 2.33 min) most of their time in standing compared to compared to Crossbred cows.

Table 2 shows that there was a significant difference ($p < 0.05$) observed between genotypes, and Jersey (48.00 ± 0.34) and Friesland (39.00 ± 0.34) primiparous cows spent most of their time in standing compared to Crossbred (1.70 ± 0.34) cows. Conversely, cows in parity B crossbred spent significantly (38.20 ± 0.40) most of their time in standing compared to Jersey (12.60 ± 0.40) and Friesland (1.60 ± 0.67). No significant ($p > 0.05$) differences were observed between the cows in parity C across all the genotypes. Meanwhile, Jersey cows in parity D (11.8 ± 1.65) and Crossbred (10.5 ± 2.33) spent most of their time on standing compared to Friesland (3.2 ± 1.34) cows. No significant differences ($p > 0.05$) were observed between the genotypes from different parities (B, C, and D) of cows.

Table 3 shows that no differences ($p > 0.05$) were observed among parities A, B, and C or across genotypes for the first walking bout. Friesland in parity D (4.50 ± 0.67) spent most of the time on walking during the parturition period. Besides, Friesland in parities B (12.00 ± 1.19) and A (6.00 ± 1.19) spent significantly the most time on walking as compared to other genotypes. Furthermore, Jersey (6.00 ± 3.75) and Friesland (5.75 ± 1.87) cows in parity C spent most of the time on walking as compared to crossbred (0.50 ± 2.65) cows. No significant differences ($p > 0.05$) were observed between the cows in parity D.

The results in Table 4 shows the significant differences in the number of observations that exist between genotypes and parities. Jersey primiparous cows (79.45 ± 4.46 min) spent expelling their fetuses or calves compared to Crossbred (74.80 ± 4.66) and Friesland (59.95 ± 4.66) cows, whereas Friesland cows in parity B ($p < 0.05$) spent most of the time in expelling their calves compared to Jersey and Crossbred cows. There was a significant ($p < 0.05$) difference existing between parity C. Jersey cows spent (74.50 ± 14.75 min) expelling their fetuses, compared to Friesland (71.50 ± 7.35) and Crossbred (54.74 ± 10.75) cows. Besides, Jersey cows in parity D ($p < 0.05$) spent significantly most of their time on expelling their calves, compared to Friesland and Crossbred cows.

There was a significant ($p < 0.05$) difference between parities within genotype. Crossbred primiparous (74.30 ± 4.66) spent more of the time on expelling their fetuses, compared to parities B (54.45 ± 5.75), C (52.14 ± 10.75), and D (55.00 ± 4.66), whereas Friesland in parity D (100.00

Table 2. Least square means (± standard error) of parity and genotype on standing bouts and total standing duration in minutes.

Parity	Genotype	1st bout	2nd bout	3rd bout	Total standing duration
a	Crossbreed	$1.8^{a} \pm 0.74$	$1.70^{a} \pm 0.34$	$1.40^{a} \pm 0.34$	$1.85^{a} \pm 0.45$
	Friesland	$1.8^{a} \pm 0.74$	$39.00^{d} \pm 0.34$	$1.00^{a} \pm 0.34$	$1.90^{a} \pm 0.45$
	Jersey	$2.3^{a} \pm 0.74$	$48.00^{e} \pm 0.34$	$2.30^{a} \pm 0.74$	$2.15^{a} \pm 0.45$
	Crossbred	$1.6^{a} \pm 0.88$	$38.20^{d} \pm 0.04$	$2.20^{a} \pm 0.40$	$1.71^{a} \pm 0.55$
b	Friesland	$2.8^{a} \pm 1.47$	$1.60^{a} \pm 0.67$	$1.00^{a} \pm 0.67$	$4.00^{b} \pm 0.92$
	Jersey	$1.6^{a} \pm 0.86$	$12.60^{c} \pm 0.40$	$1.50^{a} \pm 0.86$	$1.43^{a} \pm 0.55$
	Crossbred	$3.3^{a} \pm 1.65$	$3.00^{ab} \pm 0.75$	$2.50^{a} \pm 0.75$	$3.05^{b} \pm 1.03$
c	Friesland	$2.5^{a} \pm 1.64$	$1.75^{a} \pm 0.53$	$1.25^{a} \pm 0.53$	$3.18^{b} \pm 0.73$
	Jersey	$2.0^{a} \pm 2.33$	$1.00^{a} \pm 1.06$	$2.00^{a} \pm 2.3$	$1.50^{a} \pm 1.45$
	Crossbred	$10.5^{b} \pm 2.33$	$2.00^{a} \pm 1.07$	$2.00^{a} \pm 1.07$	$5.00^{c} \pm 1.45$
d	Friesland	$3.2^{a} \pm 1.34$	$1.67^{a} \pm 0.61$	$2.00^{a} \pm 0.62$	$3.83^{b} \pm 0.84$
	Jersey	$11.8^{b} \pm 1.65$	$6.00^{b} \pm 0.75$	$3.00^{a} \pm 0.75$	$4.00^{b} \pm 1.03$
p value		0.01	0.0004	0.19	0.32

Means in the same column with different superscripts are statistically different at $p < 0.05$.
First, second, and third bouts and total standing time were recorded in minutes.

Table 3. Least square means (± standard error) of parity and genotype walking bouts and total walking duration.

Parity	Genotype	1st bout (min)	2nd bout (min)	Total walking duration
	Crossbred	$1.85^{a} \pm 0.37$	$1.95^{a} \pm 1.18$	$3.80^{b} \pm 0.36$
a	Friesland	$0.75^{a} \pm 0.33$	$6.00^{b} \pm 1.19$	$2.00^{b} \pm 0.36$
	Jersey	$1.20^{a} \pm 0.87$	$0.20^{a} \pm 1.19$	$2.85^{b} \pm 0.36$
	Crossbred	$1.93^{a} \pm 0.44$	$1.00^{a} \pm 1.42$	$0.64^{a} \pm 0.43$
b	Friesland	$0.40^{a} \pm 0.74$	$12.00^{c} \pm 1.19$	$3.20^{b} \pm 0.71$
	Jersey	$0.70^{a} \pm 0.44$	$0.64^{a} \pm 1.42$	$2.50^{b} \pm 0.43$
	Crossbred	$1.25^{a} \pm 0.83$	$0.50^{a} \pm 2.65$	$1.50^{a} \pm 0.79$
c	Friesland	$1.50^{a} \pm 0.59$	$8.75^{b} \pm 1.87$	$2.07^{b} \pm 0.56$
	Jersey	$0.50^{a} \pm 1.18$	$6.00^{b} \pm 3.75$	$3.50^{b} \pm 1.25$
	Crossbred	$0.50^{a} \pm 1.85$	$1.00^{a} \pm 3.75$	$1.00^{a} \pm 1.13$
d	Friesland	$4.50^{b} \pm 0.67$	$0.33^{a} \pm 2.17$	$2.83^{b} \pm 0.65$
	Jersey	$1.75^{a} \pm 0.83$	$1.25^{a} \pm 2.65$	$3.75^{ab} \pm 0.79$
p value		0.008	0.14	0.85

Means in the same column with different superscript are statistically different at $p < 0.05$.
First, second, and third bout and total walking time were recorded in minutes.

Table 4. Least square means (± standard error) of parity and genotype on different activity patterns around the time of calving.

Parity	Genotype	Foetal expulsion (min)	Licking (min)	Suckling (min)
	Crossbred	$74.30^{c} \pm 4.66$	$18.75^{b} \pm 0.98$	$16.30^{bc} \pm 1.57$
a	Friesland	$59.95^{b} \pm 4.66$	$13.80^{a} \pm 0.98$	$11.25^{b} \pm 1.51$
	Jersey	$79.45^{d} \pm 4.46$	$18.80^{b} \pm 0.98$	$7.25^{a} \pm 1.52$
	Crossbred	$54.45^{ab} \pm 5.75$	$18.75^{b} \pm 1.17$	$10.28^{ab} \pm 1.82$
b	Friesland	$71.60^{c} \pm 9.33$	$22.60^{b} \pm 1.97$	$13.20^{b} \pm 3.03$
	Jersey	$52.14^{a} \pm 5.57$	$17.14^{ab} \pm 1.17$	$14.88^{b} \pm 1.81$
	Crossbred	$52.74^{a} \pm 10.75$	$21.50^{b} \pm 2.20$	$20.80^{c} \pm 3.38$
c	Friesland	$71.50^{c} \pm 7.35$	$20.85^{b} \pm 1.56$	$22.14^{c} \pm 2.56$
	Jersey	$74.50^{d} \pm 14.75$	$15.00^{a} \pm 3.11$	$18.50^{c} \pm 4.79$
	Crossbred	$55.00^{ab} \pm 4.66$	$22.00^{b} \pm 3.11$	$32.50^{d} \pm 4.79$
d	Friesland	$100,00^{e} \pm 8.52$	$21.33^{b} \pm 1.79$	$29.33^{d} \pm 2.76$
	Jersey	$123.00^{f} \pm 10.43$	$13.50^{a} \pm 2.20$	$21.75^{c} \pm 3.38$
p value		0.0007	0.0001	0.005

Means in the same column with different superscripts are statistically different at $p < 0.05$.

± 8.52) spent most of their time on expelling their fetuses as compared to parities A (59.95 ± 4.66), B (71.60 ± 9.33), and C (71.50 ± 7.35). There was significant ($p < 0.05$) interaction between different parities of Jersey genotype.

Licking behavior

There was a significant ($p < 0.05$) interaction between genotypes and parity on time spent by licking of cows. Crossbred (18.75 ± 0.98) and Jersey primiparous cows (18.80 ± 0.98) spent significantly more time on licking their calves compared to Friesland (13.80 ± 0.98) cows. However, Friesland and Crossbred cows in parity D (21.33 ± 3.11 and 22.00 ± 3.11) spent significantly more time on licking their calves than Jersey (13.50 ± 2.20) cows. Crossbred cows (21.50 ± 2.20), in parity C, and Friesland (20.85 ± 1.56) spent most of their time on licking their calves compared to Jersey (15.00 ± 3.11) cows. Besides, Crossbred cows in parity D ($p < 0.05$) spent most of their time on licking their calves. There was no variation observed between parities A, B, C, and D of Crossbred genotype. Meanwhile, Friesland primiparous cows ($p > 0.05$) spent least of their time on licking their calves compared with other parities within the same genotype. However, no distinct difference ($p > 0.05$) was observed between the parities of Jersey genotype.

Suckling behavior

There was a significant difference ($p < 0.05$) observed between the genotypes of primiparous cows (parity A). For example, Crossbred cows spent significantly (16.30 ± 1.57) allowing their calves to suckle colostrum compared to Friesland (11.25 ± 1.51) and Jersey (7.25 ± 1.52) cows, whereas no significant difference ($p > 0.05$) was observed between genotypes in parity B and C cows. However, there was a significant difference ($p < 0.05$) observed between genotypes in parity D, and the Crossbred cows spent most of their time on allowing calves to suckle colostrum. There was a significant difference ($p < 0.05$) observed across the parities within the genotype. Crossbred cows in parity D spent (32.50 ± 4.79 min) most of their time on allowing their calves to consume colostrum, compared to parities A, B, and C. Similarly, Friesland and Jersey genotypes on parity D ($p < 0.05$) spent most of their time on allowing their calves to suckle, as compared to other parities.

Discussion

The objective of the study was to assess the behavioral activity patterns of primiparous and multiparous of three dairy genotypes around the time of calving at the pasture-based system in South Africa. Calving is divided into three distinct stages [3,4,19], normally characterized by hormonal, physical (enlargement of the vulva and cervix), and behavioral changes such as tail raising, lying, standing and walking bouts, and their duration. These stages gradually continued from one to another [4,6,10–12] and end with fetal or calf expulsion [17].

The changes in behavioral activity patterns in dairy cows as they approach calving regardless of genotype or parity have been documented in the literature [4,10–13,16,20,21]. This study revealed that the mean number of lying bouts was equal, but their durations were significantly different between the genotypes and parities. Crossbred primiparous cows spent most of their time on lying down compared to other primiparous genotypes (such as Jersey and Friesland), and this could suggest that Crossbred cows were more comfortable to be in the company of multiparous cows. Besides, Jersey primiparous and multiparty cows had a longer lying duration in most of the lying bouts. Perhaps, this could be because they were more comfortable during the early stages of calving [3,4,10]. The finding of this study was also similar to a study in the United States of America, where primiparous females spent less time standing during the final 24-h precalving and more recumbent 2-h prepartum compared with multiparous cows [22,23].

Conversely, Friesland cows had longer lying durations compared to Jersey and Crossbred cows. This might be due to the breed dominance, commencement of calving, and comfort [14,24,25]. In the present study, Jersey and Friesland primiparous cows spent the least amount of time on lying down around the parturition time compared to multiparous. Possibly, the cows were discomfort due to environmental conditions. This result is similar to what observed in studies elsewhere [4,10,11,14] The intensity of abdominal contraction around calving could also contribute to animal behavior pericalving [10,26–28]. It is also important to mention that primiparous cows display an array of behaviors because they are calving for the first time. Titler et al. [13] reported that primiparous cows spent least of their time on lying bout duration and suggested that they have not fully conversant with the maternal experience. Rice et al. [22] also reported that both primiparous and multiparous cows had extended durations of lying bouts. The studies elsewhere reported the same finding buttressing the fact that lying bouts may be an excellent tool for the prediction of calving in beef females regardless of parity [14,22,29].

Furthermore, primiparous and parity B cows spent the most time on standing compared to cows in parities C and D, during calving [10,30,31]. Increased standing bouts or standing durations have been associated with discomfort during parturition [10,32,33]. This could also have been due to delivery pain or previous experience [11,12,14]. Titler et al. [13], while observing primiparous and multiparous Holstein cows using activity data loggers, found similar results. Conversely, the mean standing bout duration decreased as parturition progressing from one stage to another stage [34], and this could have been due to calmness as the discomfort decreases as calf protrudes outside the vulva. Friesland cows, on the other hand, spent the least time on standing and were spending most of their time on walking or stepping compared to other genotypes [10,12,15]. Perhaps, this could have been because they were restless during the calving time, as it is highly associated with nest building [3,4,10,15,31,35,36]. This could also mean that they were seeking a proper and quiet place to lie down and continue with the calving process [15,36].

The Jersey cows in parity D, in this study, spent most of their time on expelling their calves compared to Friesland and Crossbred cows of the other parities [17,28,37]. This is probably due to the age or parity factor and energy level to push their calves [38–40]. This could also be associated with the genetic predisposition of the sire used at the farm during insemination although multiparous cows are known to have good calving maternal experience as compared to primiparous cows. This is in contrast to the results by Wehrend et al. [4], who observed that primiparous cows took longer time on expelling their calves compared to multiparous cows. Multiparous cows became muscle tone deteriorated as they grew older (parity 8) [41,42]. This further suggests that old cows were experiencing calving difficulties [5,10,11,13]. The observations agree with the finding in one Indian study, which reported that older cows are prone to experience calving complications compared to primiparous and other groups of cows [43].

Genotypic and parity differences were observed in this study, and Friesland cows in parity B and those in parity D together with multiparous Crossbred cows spent most of their time on licking their calves as compared to other groups of parities within genotypes [5,13,14,21,44–46]. This could be probably due to good maternal behavior compared to Jersey cows [47], which can be described as having a poor mothering ability [11,14,48,49]. Similarly, primiparous cows and cows in parities B and C lacked experience [50]. Apart from that, there was a lot of interaction around the time of calving, and the dominant cows in the herd claimed calves as theirs and lick them [51–53].

In this study, Jersey cows had a low mothering ability. The current study contradicts with Campler et al. [54], who observed that Jersey cows lick their calves sooner after calving. This might be attributed to the fact that they were recumbent after a long calving duration [11,55]. Besides, Crossbred and Friesland multiparous cows spent most amount of time on allowing their calves to suckle colostrum [44,49] as compared to parity (A, B, and C) within genotypes and Jersey cows. This could suggest that these two genotypes have good mothering ability [21,48]. These observations from the study are similar to the findings of Kaufmann et al. [56], who also confirmed maternal genetic behavior such as increasing good mothering ability as the animal grows older.

Conclusion

There were behavioral differences observed between animals from different parities and genotypes around the time of calving. Primiparous cows of all genotypes spent most of their time standing and less time on other activities throughout the trial due to the lack of maternal experience. Jersey multiparous cows spent most of their time on lying down for longer durations and a longer time expelling their calves as compared to Friesland and Crossbred cows and less time nurturing calves, which may be an indication of lower mothering ability.

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Conflict of interests

The authors declare that they have no financial or personal relationships, which may have inappropriately influenced them in writing this article.

Authors' contribution

MP drafted the manuscript submission and conducted the research, and IFJ supervised the project and edited the manuscript.

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