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IMPACT OF DAM PARITY ON MATERNAL AND NEONATAL BEHAVIOURS IN EGYPTIAN BUFFALOES

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ABSTRACT: This study was carried out at the Animal Behaviour Research Unit, Faculty of Agriculture, Menoufia University, Egypt. The study aimed to investigate the maternal behaviour of Egyptian buffalo cows and the Behaviour of their newborn calves, as well as assess their birth weight and body measurements across different parity groups. A total of 29 Egyptian buffaloes, with an average body weight of 671 ± 95 kg, were included in the study. The buffaloes were categorized into four groups based on their number of parities as follows: parity 1 (n = 5), parity 2 (n = 6), parity 3–4 (n = 7), and parity ≥ 5 (n = 11). The experiment spanned 35 months, from February 2021 to January 2024. The results indicated that the animals in the Parity2 group had the longest period of vision at their newborn (36.54 ±19.30 sec. /h.), followed by parity 1, being 27.16 ±17.88 sec /h. There was a significant effect of the dam's parity on both the frequency and duration of licking her calf behaviour. The frequency of licking behaviour was the highest with the Parity ≥5 groups (6.45±4.26 times/h.). Licking periods were the lowest in the first parity (102.92±59.06 sec. /h.) with a dramatic increase as the parity increased, reaching the highest in Parity ≥5 (164.75±96.90 sec. /h.). The suckling behaviour period was significantly affected by parity, which was the lowest at parity1 (77.28±32.86 sec. /h.). There were significant effects (P≤0.05) of dams' parity on calves' standing attempts (STA) and the time needed to stand successfully after born (TNST). The highest incidence of STA was 16.66 ±8.08 times in Parity 1 and the longest TNST was 278.00± 68.46 min in Parity 1. Suckling Attempts (SUA) weren't affected by the parity. However, the times that need to first suckle successfully after birth (TNSU) had been significantly affected (P≤ 0.05). The heifers' calves took the most time, 392.66 ±24.78 min, from birth to first suckling successfully. The movement activities of calves decreased (P≤ 0.05) in parity 1 and parity ≥5 groups than in parity 2 and parity 3. The buffalo heifers' calves, parity 1, scored the lowest birth weight, 32.20 kg, and the lowest body measurement, 85.20±3.42, 42.20±3.76, 77.20 ±3.27, 79.80 ±4.86 and 75.60 ±10.92 cm for animal length, back length, withers height, chest girth, and flank girth, respectively. The results of the correlation coefficient show that, as the weight and size of neonatal calves' increase, their activity increases by standing up quickly and suckling from their mothers quickly, which is positively reflected in the performance, health, and immunity of these newborn calves.

Key words: Egyptian buffaloes, maternal behaviour, new natal calves, parity

INTRODUCTION

Newborn calves represent the future of the herd and are a significant source of farm income. The neonatal period is crucial for the calf's survival (Duncan *et al.*, 2023) and its future productive performance. Maternal behaviour has a direct impact on neonatal behaviour (Dubey *et al.*, 2018; Mota-Rojas *et al.*, 2024). In many mammalian species, maternal behaviour is characterized by actions the mother takes to ensure the survival and health of her dependent offspring (Mills *et al.*, 2010). This behaviour is essentially the cow's care for her calf, encompassing strong social interactions, milk provision and nursing, and protection from danger or predation (Geburt *et al.*, 2015; Michenet *et al.*, 2016). These Behaviours can be summarized as the animal's commitment to

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devote time, energy, and resources to protect and rear her offspring (Stookey, 1997).

Successfully raising and nurturing a calf from birth to weaning relies heavily on the cow's maternal abilities (Orihuela and Galina, 2021). Most calf deaths occur within the first 24 hours to seven days of life (Patterson *et al.,* 1987), with 30–50% of losses happening within a day to a week after birth (Fordyce, 2020). During this critical first week, the cow's maternal behaviour is a key factor in the calf's survival (Veissier *et al.,* 1998; Barrier *et al.,* 2012). Immediately after giving birth, the cow spends most of her time licking and sniffing the calf. This behaviour likely stimulates the calf's activity, helps dry the calf from uterine fluids to reduce heat loss, and strengthens the social bond between mother and calf (Edwards and Broom, 1982). Such actions are essential for forming the cow-calf bond, which is vital for the calf's ongoing survival, health, and performance up to weaning (Michenet *et al.,* 2016). Interestingly, Friesian dairy cows with multiple births lick their calves more intensely in the first-hour post-calving compared to first-time mothers (Edwards and Broom, 1982). This maternal bond is established immediately following the birth of the infant (Nevard et al., 2023). In summary, the cow must bond with her calf immediately postpartum to recognize and distinguish her calf from others (Kent and Kelly, 1987). Close contact, licking, and suckling are crucial for developing this bond (Von Keyserlingk and Weary, 2007). Providing milk and nursing are critical aspects of maternal behaviour in postpartum cows and are essential for the calf's survival and success (Geburt *et al.,* 2015).

Breed, parity, cow body condition, calf sex, and calf birth weight are some variables that have been shown to affect maternal Behaviour (Geburt *et al.,* 2015 and Ślehulová *et al.,* 2013). Previous studies indicate that the prevalence of mismothering declines with parity, possibly due to learned maternal instinct fostered over subsequent generations (McCosker, 2016, Schatz, 2011 and Bunter *et al.,* 2013).

The study of maternal and neonatal behaviours in Egyptian buffaloes is a crucial area of research that helps improve the management and productivity of these animals. Understanding their maternal and neonatal behaviours can lead to better breeding practices, improved animal welfare, and increased productivity. By understanding the factors that influence these behaviours, farmers can improve the health and productivity of their animals, leading to a more sustainable and profitable livestock industry. Therefore, this research aimed to study the maternal behaviour of Egyptian buffalo cows and the behaviour of their newborn calves, as well as their weight and body measurements at birth in different dams' parity.

MATERIALS AND METHODS

This study was carried out at the research unit for animal behaviour, belonging to the faculty of agriculture at Menoufia University, Shebin El-Kom, Egypt. All experimental procedures were approved by the Scientific Research Ethics and Animal Use Committee (SRE & AUC) – Faculty of Agriculture – Menoufia University, Egypt. Approval №: 23 – SRE & AUC-MUAGR - 09-2024

Animals and Management

Twenty-nine Egyptian buffaloes, five primiparous and 24 multiparous averaging 671 ± 95 kg of body weight, were used in this experiment. The buffaloes were grouped based on their number of parities into four categories: Parity 1 (n = 5), Parity 2 (n = 6), Parity 3–4 (n = 7), and Parity ≥ 5 (n = 11). The experiment lasted 35 months, from February 2021 to January 2024.

The animals were kept in a closed housing system in a tie-stall barn with a hard surface. The Farm was constructed to be vertical in the wind direction, north, to provide good ventilation. Further, the farm is provided with 45-degree-angled opening windows and six extractors and fans to maintain a healthy ventilation system. The feeding regime was practiced as follows: during the period from December through May, animals were fed an Egyptian clover (*Trifolium alexandrinum*), concentrate mixture, and rice straw, while during the rest of the year, they were fed clover hay, concentrate mixture and rice

straw. A concentrated mixture was offered daily at 10 a.m., based on their maintenance and productivity needs. Roughage was served ad-lib twice a day at the feed manger (10 a.m. and 6 p.m.). Water was available on demand from automatic drinkers.

The buffaloes were moved to individual calving pens one week before the expected parturition day. The calving pens diameter was 3.5×3.5× 4 m in length, width, and height. The calving pens had a concrete floor which was covered and bedded with rice straw; the bedding was replaced daily in the morning. These pens were equipped with automatic drinkers, a concrete manger, and two extractors to maintain optimum ventilation with four open windows. The lighting was adequate for monitoring the animals during the day while industrial dim lighting was used at night.

Studied Criteria

The experiment lasted 35 months, from February 2021 to January 2024. During this period all newly born buffaloes were monitored for 36 h post-partum with a total observation time of 1044 hours for all studied animals using a complete digital behavioural observation unit, which consists of digital observation cameras, a digital storage unit, and a control unit. Continuous observation methods were used to record the activity patterns, such as frequency (time/h) and duration (second/h), of each animal during observation periods, which included:

Maternal Behaviour

The relationship between dam and their newborn, maternal behaviour was studied for 36 hours after calving. Thus, the following behaviours were recorded:

A. Vision behaviour: Mother looks at their newborn; Mother's head lifted and orientated towards their newborn calf.
B. Licking behaviour: Mother licking their newborn; Tongue in contact with the calf’s head or body (Lanzoni *et al.*, 2021).
C. Suckling behaviour: Calves suckling behaviour; The teat was in the calf’s mouth to consume milk from the udder (Bertelsen and Margit, 2023)

Newborn calves' Behaviour

Concerning the newborn calves' Behaviours, the following criteria were estimated 36 hours after birth.

A. Attempts to standing: The number of calf attempts to reach the fully upright position where it's body is supported by four legs, standing still, or standing and walking.
B. Attempts to suckle: The number of calves attempt to get a teat into their mouth without success (Paranhos da *et al.*, 2006) until it succeeds in suckling.
C. Times need to stand successfully after birth: The period (min.) from birth until the calf stands upright with all 4 legs fully for the first time.
D. Times need to first suckle successfully after birth: The period (min.) from birth until the calf succeeded in getting a teat into its mouth, accompanied by observable sucking and swallowing (Paranhos da *et al.*, 2006).
E. Movement activities: The frequencies of standing attempts and leg movements, making steps forward or backward.
F. Lying behaviour: All legs relaxed with the underside in contact with the floor (Weimer, 2012).

All of the previous Behaviours were recorded for frequency (Time/h) and duration (second/h).

Newborn calves' body weight and body measurements

The newborn calf's weight (kg) and some external body measurements (cm) were scored within 24 hours after birth as described below:

A. Animal length: The distance from the forehead to the last point in the animal's body.
B. Back length: The dorsal line length extends from the withers to the hip.
C. Withers height: Vertical distance from the highest point of the withers to the ground surface at the level of the forelegs. (Ruchay *et al.*, 2020).
D. Chest girth: Circumference of the body at a point immediately posterior to the front leg

and shoulder and perpendicular to the body axis. (Ruchay *et al.*, 2020).

E. Flank girth: Circumference of the body at a point immediately interior to the rear leg and perpendicular to the body axis.

Statistical analysis

The effects of parity on studied criteria were statistically declared by One-way ANOVA using IBM SPSS statistics for Windows, version 22.0. (2013) according to the following model:

$$Y_{pk} = \mu + T_p + e_{pk}$$

Where: Y_{pk}= Criteria studied for buffaloes in the pk subclass; μ = Overall mean; Tp = the effect due to the p_{th} dam parity, p = 1, 2, 3, and 4; (1= first parity, 2= second parity, 3= third and fourth parity, and 4= fifth parity and more); e_{pk} = Random error. Means among different groups were tested by the Duncan test (Duncan, 1955). Pearson's correlation coefficient between calves' birth weight and body measurements and maternal behaviour was done, as well as between calves' birth weight, body measurements, and newborn calves' behaviour.

RESULTS AND DISCUSSION

The effect of dam's parity

Data in Table 1 shows the maternal behaviour of Egyptian buffalo as an overall mean for the studied animals, as well as the effect of the dam's parity on it. During the first 36 hours after birth, the buffaloes exhibited vision behaviour and licked their newborns for an average of 26.34 and 124.24 sec. /h. with frequencies of 2.59 and 4.03 times per hour, respectively. The calves suckled from their mothers at a rate of 0.44 times per hour for 136.02 sec. /h.

Table 1: The effect of dam's parity on their maternal behaviour (LSM±SD).

Parity	№	Vision Behaviour		Licking Behaviour		suckling Behaviour	
		Freq. (Time/h.)	Period (sec. /h.)	Freq. (Time/h.)	Period (sec. /h.)	Freq. (Time/h.)	Period (sec. /h.)
Overall Mean	29	2.59 ±1.29	26.34 ±9.37	4.03 ±2.98	124.24 ±75.01	0.44 ±0.21	136.02 ±55.96
Parity 1	5	2.92 ±1.20	27.16 ^{b} ±17.88	3.82 ^{b} ±1.31	102.92 ^{c} ±59.06	0.23 ±0.04	77.28 ^{b} ±32.86
Parity 2	6	3.06 ±1.22	36.54^{a} ±19.30	3.86 ^{b} ±2.90	114.62 ^{b} ±48.95	0.36 ±0.24	130.90 ^{a} ±60.93
Parity 3-4	7	1.89 ±1.24	18.49 ^{c} ± 8.97	3.55 ^{b} ±1.56	112.68 ^{b} ±86.53	0.45 ±0.27	159.42 ^{a} ±70.02
Parity ≥5	11	2.82 ±1.99	24.60 ^{b} ±14.58	6.45 ^{a} ±4.26	164.75 ^{a} ±96.90	0.37 ±0.19	144.84 ^{a} ±74.30
P value	29	0.144	0.035	0.025	0.033	0.340	0.017

Note: a, b, c... means within each column with different superscripts differ significantly P≤0.05.

The frequency of vision behaviour shows slight variation across different parities, with parity 2 having the highest mean and parity 3-4 having the lowest mean. However, the difference is not statistically significant (P=0.144). Licking behaviour, this is crucial for bonding and stimulating the calf, showed a more pronounced difference across groups. Parity 2 buffaloes exhibit the highest licking frequency (36.54±19.30 sec. /h.), while parity 3-4 buffaloes have the lowest (18.49 ± 8.97 sec. /h.). The differences are statistically significant (P< 0.05). In a previous study, Edwards and Broom (1982) noted that heifers turned towards their calves more frequently than older cows, keeping the calf in front of their head. This behaviour could be motivated by intense interest in the calf and

desire to lick it, or by fear of the calf (Table 1, Figures 1 and 2).

The dam's parity significantly influenced both the frequency and duration of licking behaviour towards her calf. Dams in the Parity≥5 group exhibited the highest licking frequency (6.45±4.26 times per hour) compared to other groups (3.82±1.31, 3.86±2.90, and 3.55±1.56 times per hour for Parity 1, Parity 2, and Parity 3-4, respectively). The duration of licking was shortest in first-parity dams (102.92±59.06 seconds per hour) and increased notably with higher parity, peaking in the Parity≥5 groups (164.75±96.90 seconds per hour). Selman *et al.* (1970) also found that the initial intense licking period was shorter in heifers compared to older cows, likely due to their greater sensitivity to external disturbances, leading to shorter licking bouts (Edwards and Broom, 1982).

The suckling behaviour period was significantly affected by parity, which was the lowest at parity1 (77.28±32.86 sec. /h.); however, the rest did not significantly differ (130.90±60.93, 159.42±70.02 and 144.84±74.30 sec. /h. for Parity2, Parity3-4, and Parity≥5, respectively) (Table 1, Figures 1 and 2). This may be due to the sensitive udder of primiparous, flinching when contacted, rather than multiparous (Barty, 1974). The opposite of this, has previously been reported for cows by Jensen *et al.* (2024) and Edwards and Broom (1982) who found that calves of primiparous dams spent more time suckling. This may be explained by primiparous cows having lower milk flow and smaller cisternal capacity (Edwards *et al.*, 2014 and Vrhel *et al.*, 2021), requiring that the calves suckle for longer to ingest similar milk amounts (Jensen *et al.*, 2024). The frequencies of vision and suckling behaviour were not significantly affected by parity.

It can be noted that the decrease in the duration of licking and suckling behaviour in primiparous buffaloes is not evidence of reduced maternal behaviour, but may be due to several factors, including: 1) Heifers being more stressed than older animals during birth. 2) Heifers are afraid and anxious about the newborn, due to their lack of experience (Edwards and Broom, 1982). 3) Heifer's udders are more sensitive to touch than older mothers (Barty, 1974). This requires further study. It is also clear that the Egyptian buffalo increases the bonds between mothers and their young as the mother gets older. The data suggests that higher parity (more births) is associated with increased licking and suckling behaviours, which are beneficial for calf survival and health. This information can be valuable for livestock management practices, as it highlights the importance of maternal care in ensuring the well-being of newborn calves.

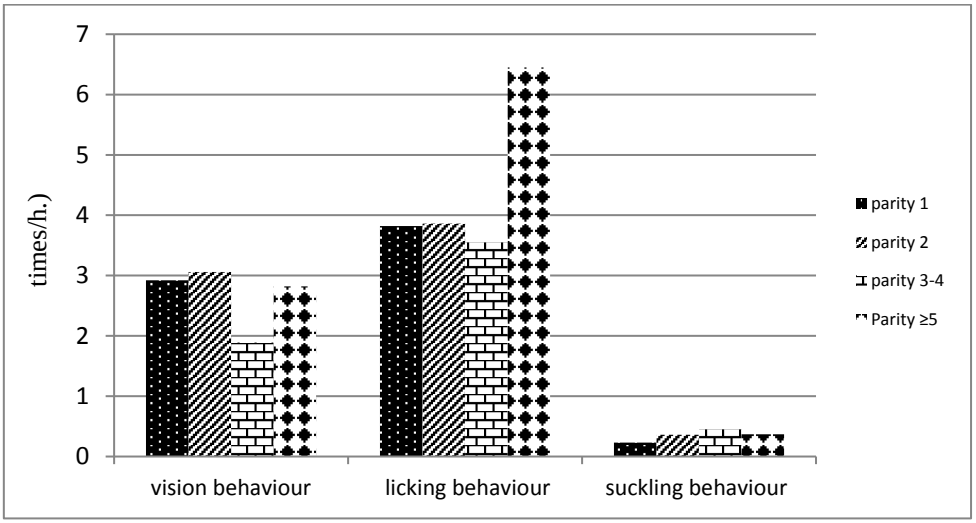

Fig. (1): The effect of dam's parity on their maternal behaviour Freq. (times/h.)

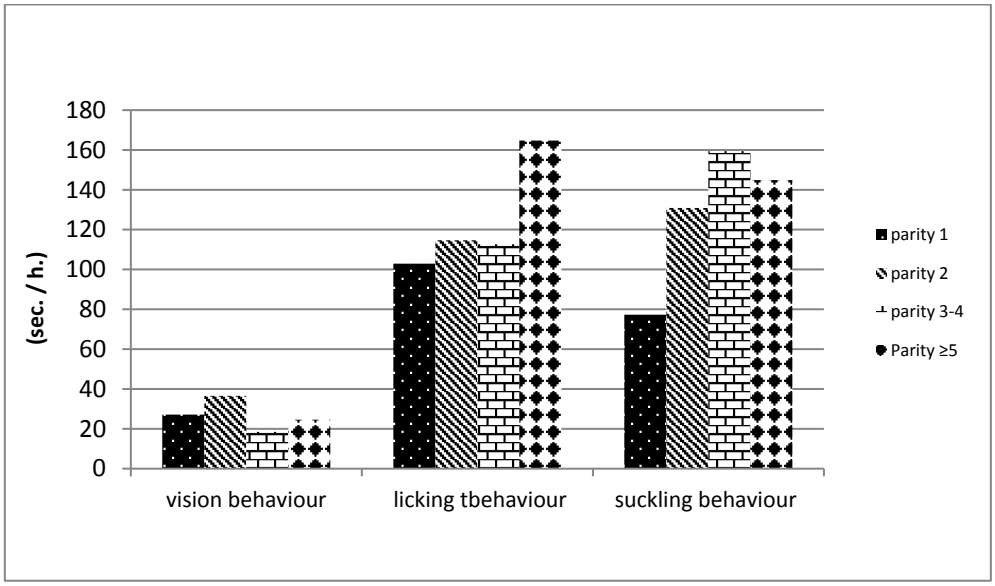

Fig. (2): The effect of dam's parity on their maternal behaviour period (sec. / h.)

Data in Table 2 shows the effect of Egyptian buffalo dams' parity on Calves' behaviour as an overall Mean for the studied animals, as well as the effect of the dam's parity on it. During the first 36 hours after birth, the buffalo calves scored 12.19, 4.23, and 21.30 times as Standing Attempts (STA), suckling Attempts (SUA), and movement activities respectively; also lasted 198.85 min and 280.61 min to standing successfully after born (TNST) and to first suckling successfully after born (TNSU) respectively. The calves were lying down at 51.01 sec/h with a frequency of 1.53 times /h.

Table 2: The effect of dam's parity on calves' behaviour (LSM±SD).

Parity	№	STA (times)	SUA (times)	TNST (min.)	TNSU (min.)	Movement activities (times)	Lying behaviour	
							Freq. (Time/ h.)	Period (Sec. /h.)
Overall Means	29	12.19 ±5.81	4.23 ±2.54	198.85 ±115.72	280.61 ±135.75	21.30 ±8.36	1.53 ±0.18	51.01 ±2.88
Parity1	5	16.66[a] ±8.08	5.00 ±2.00	278.00[a] ±68.46	392.66[a] ±24.78	14.22[b] ±7.06	1.42 ±0.12	52.54 ±3.92
Parity2	6	10.83[b] ±3.12	5.00 ±2.60	167.66[c] ±80.19	278.83[b] ±143.16	21.81[a] ±8.18	1.68 ±0.21	49.96 ±3.54
Parity3-4	7	13.28[ab] ±4.57	2.57 ±1.39	230.71[b] ±113.58	259.57[b] ±116.27	29.49[a] ±11.54	1.52 ±0.07	51.04 ±3.50
Parity≥5	11	9.60[b] ±4.54	5.20 ±3.42	144.20[c] ±96.86	245.00[b] ±104.80	11.87[b] ±8.52	1.55 ±0.25	50.98 ±1.93
P value	29	0.055	0.488	0.028	0.056	0. 048	0.532	0.594

Note: STA, Standing Attempts., SUA, suckling Attempts., TNST, Time need to stand successfully after born, TNSU, Times need to first suckle successfully after born; a, b, c... means within each column with different superscripts differ significantly P≤0.05.

The effect of dams' parity on calves' behaviour (LSM±SD) is listed in Table (2). There was a significant effect (P≤0.05) of dams' parity on calves' standing attempts (STA) and the time needed to stand successfully after born (TNST). The highest incidence of STA was 16.66 ±8.08 times in Parity1, followed by 13.28 ±4.57times in parity3-4, then 10.83 ±3.12 times in Parity2 and finally 9.60 ±4.54 times in Parity≥5. Calves from first-parity (Parity1) had

the highest frequency of standing attempts, which significantly decreased as the parity increased, with Parity≥5 showing the lowest frequency.

On the other hand, the longest TNST was 278.00± 68.46 min. in Parity1, followed by 230.71±113.58 min. in parity3-4 then 167.66 ±80.19 and 144.20±96.86 min. in Parity2 and Parity≥5 group respectively. Calves from first-parity dams took the longest time to stand successfully after birth, while those from higher-parity dams (≥5) stood up much quicker. The differences are statistically significant (P<0.05). This has previously been reported by Hammadi *et al.* (2021) who noted that Multiparous dams stood up sooner (P= 0.019) after calving than primiparous dams, but this is not consistent with a previous study that proved that Heifers' calves required fewer standing attempts before standing (Houwing *et al.,* 1990).

The elevate of STA and TNST of the heifers' calves, parity 1, may be due to the weakness of the newborn calf and its small size (Table 3) or due to the difficulty of birth, often occurs in heifers, which affects the calf's attempts to stand and its activity after birth (NEJA *et al.,* 2017) or to the lack of maternal instinct in the heifer and her failure to provide the required assistance to her newborn. This requires the intervention of herd's men with more attention to this newborn to help it stand and have its first feeding, as they are able (Barrier *et al.,* 2012b). This plays an important role in acquiring passive immunity (Ventorp and Michanek, 1991).

Suckling attempts were relatively consistent across different parities, with no significant differences observed. On the other hand, the times that need to first suckle successfully after born (TNSU) had been affected significantly (P≤0.05). The heifers' calves took the most time, 392.66 ±24.78 min, from birth to first suckling successfully. While there were no differences for that period among the rest parities. The calves need times to stand successfully 278.83±143.16, 259.57±116.27, and 245.00±104.80 min for Parity2, Parity3-4, and Parity≥5, respectively. These results agree with Hammadi *et al*. (2021) who noted that Multiparous dams suckled their calves earlier (P= 0.043) than primiparous dams. But disagree with Edwards and Broom (1979) who reported a greater latency to first suckling seen in older cows. The elevating of TNSU in parity 1 may be due to the greater sensitivity of the heifer's udder to touch than other parities (Barty, 1974) or the weakness of the heifer's calves, which the STA and TNST confirm increased.

Movement activities were highest in calves from parity 3-4 and lowest in parity 1 and ≥5 groups. The differences are statistically significant (P< 0.05). The movement activities were 29.49 ±11.54 times in Parity 3-4, followed by 21.81 ±8.18 times in Parity2, then 14.22 ±7.06 times in Parity1 and finally 11.87 ±8.52 times in Parity≥5 groups. The low rate of movement activities of the heifers' calves may be due to the weakness of these calves (Table 3), which is evident from the increased lying period of those calves (52.54 ±3.92 sec. /h.), and the mother's failure to help him get up and take care of him adequately, as mentioned previously. Neither the calves' lying frequency nor the duration of lying was significantly affected by the dam's parity (P≥ 0.05), as both were almost equal across parities (Table 2). First-parity dams' calves generally take longer to perform these activities, indicating that experience and previous births might enhance maternal efficiency and neonatal behaviour. Understanding these nuances can help optimize livestock management strategies to improve calf survival and productivity.

Calves from first-parity dams had a significantly lower birth weight compared to those from higher-parity dams (≥5), with the latter group having the highest birth weight. The differences are statistically significant (P<0.01), indicating that parity significantly affects birth weight, with higher parity dams generally giving birth to heavier calves. The birth weight of Egyptian buffalo calves was 43.93 ± 8.83 kg, while their body measurements were 89.51 ± 6.31 cm for animal length, 45.34 ± 4.28 cm for back length, 82.98 ± 5.09 cm for withers height, 85.58 ± 5.45 cm for chest girth, and 84.17 ± 7.78 cm for flank girth. These are the overall means for the studied dams' parity (Table 3 and Figure

3). It can be noted that the birth weight of Egyptian buffalo calves in this study is higher than that recorded in previous studies, 34.12, 33.5, and 35.1kg, as reported by El-Bramony *et al.* (2008), Mostageer *et al.* (1981) and Fooda (2005); Moreover, higher than that the range of estimates (26 and 41kg) reviewed by Taneja (1998) and 27.21- 21.09 kg that revealed by Kumaravelu *et al.* (2004) for some Asian buffalo breeds. However, it is less than that mentioned by Estes (1992), where it was 45 kg.

Table 3: The effect of dams' parity on Calves' birth weight and calves' body measurements (LSM±SD)

Parity	№	Birth weight (kg)	Body measurements (cm)				
			Animal length	Back length	Withers height	Chest girth	Flank girth
Overall Means	29	43.93 ±8.83	89.51 ±6.31	45.34 ±4.28	82.89 ±5.09	85.58 ±5.45	84.17 ±7.78
Parity1	5	32.20^{b} ±7.32	85.20 ±3.42	42.20^{b} ±3.76	77.20^{b} ±3.27	79.80^{b} ±4.86	75.60^{b} ±10.92
Parity2	6	44.33^{a} ±6.68	91.66 ±2.42	48.66^{a} ±3.55	83.33^{a} ±3.98	83.83^{a} ±3.76	84.50^{a} ±6.37
Parity3-4	7	44.42^{a} ±5.62	86.42 ±7.41	43.14^{b} ±3.89	82.00^{ab} ±3.91	83.00^{a} ±2.58	84.00^{a} ±6.16
Parity≥5	11	48.72^{a} ±7.84	92.27 ±6.61	46.36^{ab} ±3.77	85.81^{a} ±4.99	88.09^{a} ±5.30	88.00^{a} ±5.09
P value	29	0.002	0.069	0.023	0.010	0. 003	0.023

Note: a, b, c... means within each column with different superscripts differ significantly P≤0.05.

The present study clearly demonstrates that the buffalo heifers' calves, parity 1, scored the lowest birth weight, 32.20 kg, and the lowest body measurement criteria, 85.20±3.42, 42.20±3.76, 77.20 ±3.27, 79.80 ±4.86 and 75.60 ±10.92 cm for animal length, back length, withers height, chest girth, and flank girth respectively. The differences in calf's birth weight and all body measurement criteria among studied parities were significant except animal length was not (Table 3). The highest birth weight was achieved by Parity≥5 group (48.72±7.84 kg) but parity2 and Parity3-4 groups had had intermediate values, 44.33±6.68 and 44.42 ±5.62 kg respectively. Parity of the dam is known to significantly influence birth weight of the calf (Nelson and Beavers, 1982). Where, the birth weight of calves born from cows in subsequent parities increased (Kertz *et al.*, 1997, Dhakal *et al.*, 2013) and Condon *et al*, 2024); Also (Johanson and Berger, 2003) noted that Primiparous cows tended to have smaller calves (38.2 kg) than multiparous cows (41.7 kg). This may be due to the high body conformation traits of large cows' compared to primiparous which influenced the calves' birth weight (Yang *et al.*, 2023). On the other hand, Naazie *et al.* (1989) and Kolkman *et al.* (2010) show that the birth weight of the calf was not affected by the parity of the dam. Calves from first-parity dams tend to be smaller and lighter, while those from higher-parity dams (particularly Parity≥5) are larger and heavier. These findings highlight the importance of considering parity in breeding and management practices to optimize calf health and growth.

The majority of calves' body measurements were the highest in Parity≥5 groups; where animal length, withers height, chest girth and flank girth were 92.27±6.61, 85.81±4.99, 88.09 ±5.30 and 88.00±5.09 cm respectively with Parity≥5 groups. While the Parity2 and Parity3-4 groups scored intermediate values; as

91.66±2.42, 83.33±3.98, 83.83±3.76 and 84.50±6.37 cm for animal length, withers height, chest girth, and flank girth respectively and were 86.42±7.41, 82.00±3.91, 83.00±2.58 and 84.00±6.16 cm of Parity2 and Parity3-4 respectively (Table 3). These results were in agreement with Johanson and Berger (2003) who noted that primiparous cows tended to have smaller calves than multiparous cows. Kertz *et al.*, (1997) mentioned that wither height of calves averaged 138 cm at first parity and increased by 3 cm from first to second parity.

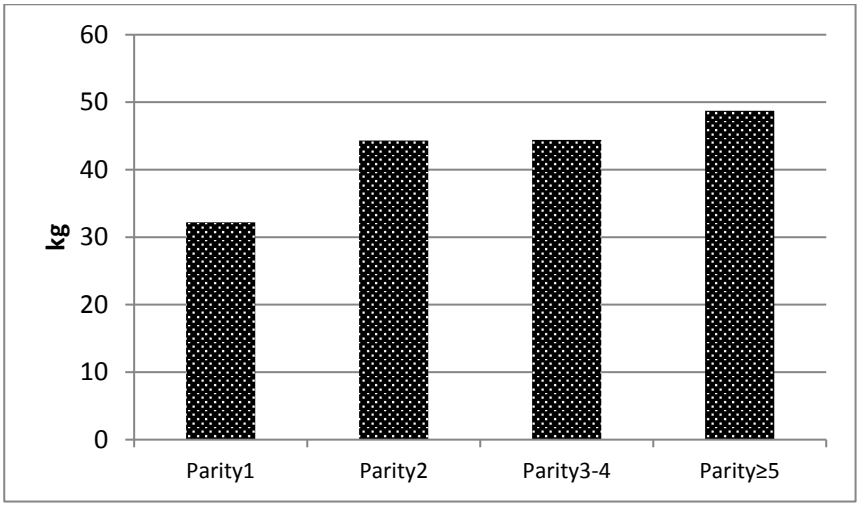

Fig. (3): The effect of dams' parity on calves' birth weight.

Table 4 shows Correlation coefficients between calves' birth weight, body measurements, and dam's maternal behaviour. It clearly appears, there is a significant correlation between calf weight at birth and the mother's vision behaviour. The correlation coefficient was highly significant (P≤0.01) negative for the frequency of vision (r= -0.255) and significantly (P≤0.05) positive for the period of the behaviour (r= 0.196). This supports the assumption that mothers with low birth weight calves, which are often first parity heifers, are more stressed and fearful of their calves (Edwards and Broom 1982). None of the calf body measurements were significantly correlated with either the frequency or duration of vision behaviour except the highly significant (P≤0.01) negative correlation that was between calf back length and vision frequency (r= -0.323). This may be due to the association of back length with calf weight.

Table 4: Correlation coefficients (r) between calves' birth weight, body measurements, and dam's maternal behaviour.

	Vision Behaviour		**Licking behaviour**		**Suckling behaviour**	
	Freq. (Time/h.)	**Period (sec. /h.)**	**Freq. (Time/h.)**	**Period (sec. /h.)**	**Freq. (Time/h.)**	**Period (sec. /h.)**
Birth weight	-0.255**	0.196*	0.323**	0.227*	-0.088	-0.240*
Animal length	-0.093	-0.186	0.275**	-0.016	-0.337**	-0.504**
Back length	-0.323**	-0.164	0.017	-0.055	-0.486**	-0.462**
Withers height	-0.153	-0.173	0.017	0.154	-0.196*	-0.282**
chest girth	-0.160	-0.017	0.091	0.152	-0.315**	-0.376**
Flank girth	-0.102	-0.038	-0.094	-0.054	-0.152	-0.202*

Note: ** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed).

There was a highly significant (P≤0.01) positive correlation between the frequency of licking behaviour of the mother and the birth weight of the calf as well as its body length (r= 0.323 and 0.275 respectively). A significant (P≤0.05) correlation was also recorded between the duration of licking behaviour and birth weight (r= 0.227). This supports the hypothesis that maternal instinct increases with the age of the mother, which is often accompanied by increased weight of the newborn calf (Table 3).

The correlation coefficients in Table 4 highlight important relationships between calves' physical attributes and the maternal Behaviours of their dams. Significant correlations (at the 0.01 and 0.05 levels) provide insights into how specific Behaviours like vision, licking, and suckling affect calf growth metrics such as birth weight, animal length, back length, withers height, chest girth, and flank girth. Understanding these relationships can help improve maternal care practices to optimize calf health and growth. By studying the correlation coefficient between suckling behaviour, calf weight at birth, and calf body measurements, it is noted that there was a negative correlation between both the frequency and duration of suckling behaviour and calf weight and body measurements at birth (Table 4). This confirms the increased frequency of attempts by the weak calf, often from first-parity mothers, to suckle from its mother; this may be due to the sensitive udder of primiparous, flinching when contacted, then multiparous (Barty, 1974), as well as the length of its suckling period from her. this may be explained by primiparous cows having lower milk flow and smaller cisternal capacity (Edwards *et al.,* 2014; Vrhel *et al.,* 2021), requiring that the calves suckle for longer to ingest similar milk amounts (Jensen *et al.* 2024).

The correlations presented in Table 5 provide valuable insights into how various body measurements of calves relate to their Behaviours. Key findings include significant positive correlations between birth weight and movement activities, and between suckling attempts and both chest girth and withers height. Additionally, negative correlations between times needed to stand and birth weight, and between suckling frequency and back length, emphasize the importance of physical traits in determining early calf behaviour. Understanding these relationships can help optimize management practices to enhance calf health and development. The correlation coefficient of the calf's attempts to stand (STA) with its birth weight or any of the calf's body measurements did not reach the level of significance. On the other hand, the correlation coefficient of the calf's attempts to suckle (SUA) with its birth weight and all of the calf's body measurements were significant. Which SUA correlated positive significant (P≤0.05) with Calf birth weight, animal length, Back length and flank girth (r= 0.206, 0.227, 0.196 and 0.219 respectively); and correlated positive highly significant with Withers height and chest girth (r= 0.340 and 0.299 respectively). This confirms that the increase in the size and weight of the calf at birth indicates its good physical and health condition, which helps it to repeat attempts to suckle, unlike weak calves.

Calf birth weight correlated negatively and was highly significant (P< 0.01) with TNST (r=-0.351) and TNSU (r=-0.294). On the other hand, it correlated positively and highly significant (P< 0.01) with movement activities (r=0.392). Furthermore, animal length correlated negatively significantly (P≤0.05) with TNST (r=-0.245) while it correlated positively (P≤0.05) with SUA (r=0.227). Calf back length had a significant positive correlation (P≤0.05) with lying frequency (r=0.235). The withers height correlated positively with movement activities (r=0.326), but negatively with TNST (r=-0.214) and lying frequency (r=-0.248). Calf chest girth has a positive and highly significant correlation (P≤0.01) with movement activities (r=0.252). Table 5 shows that the flank girth correlated negatively (r=-0.279) with lying frequency and positively (r=0.245) with movement activities.

Table 5: Correlation coefficients (r) between calves' birth weight, body measurements, and behaviour

	STA (times)	SUA (times)	TNST (min.)	TNSU (min.)	Movement activities (times)	Lying behaviour	
						Freq. (Time/h.)	Period (sec. /h.)
birth weight	0.018	0.206*	-0.351**	-0.294**	0.392**	0.127	0.144
Animal length	0.022	0.227*	-0.245*	-0.140	0.028	0.101	0.111
Back length	0.034	0.196*	-0.116	-0.029	-0.157	0.235*	-0.037
Withers height	0.011	0.340**	-0.214*	0.020	0.326**	-0.248*	0.035
chest girth	0.010	0.299**	-0.187	0.035	0.252**	-0.030	0.076
Flank girth	0.174	0.219*	-0.156	-0.055	0.245*	-0.279**	0.092

Note: **STA**, Standing Attempts., **SUA**, suckling Attempts., **TNST**, Time needed to stand successfully after birth, **TNSU**, Times need to first suckle successfully after birth, ****** Correlation is significant at the 0.01 level (2-tailed), ***** Correlation is significant at the 0.05 level (2-tailed).

All the previously presented correlations are very logical and show that as the weight and size of neonatal Egyptian buffalo calves increase, their activity increases by standing up quickly and suckling from their mothers quickly, which is positively reflected in the performance, health, and immunity of these newborn calves.

CONCLUSION

This study demonstrates that a dam's parity significantly influences maternal behaviour, as well as the Behaviour, weight, and body measurements of the newborn calf. Maternal instincts are more pronounced in multiparous buffaloes compared to primiparous buffaloes. Calves born to multiparous buffaloes were larger, heavier, and more active than those born to heifers. The significant correlations between the weight, size, and Behaviour of neonatal Egyptian buffalo calves indicate that as the calves' size and weight increase, their activity levels also rise, with calves standing and suckling more quickly. This increased activity positively impacts the performance and health of the newborn calves.

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تأثير ترتيب موسم ولادة الأم على سلوكيات الأمومة والمولود في الجاموس المصري

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أجريت هذه الدراسة في وحدة بحوث سلوك الحيوان، كلية الزراعة، جامعة المنوفية، مصر. وكان الهدف من هذا البحث دراسة سلوك أمومة الجاموس المصري وسلوك عجولها حديثي الولادة، وكذلك تقييم وزنها وقياسات أجسامها عند الولادة في مواسم ولادة مختلفه. تم استخدام تسعة وعشرين جاموسة مصرية، خمسة منها أحادية الولادة وأربعة وعشرون متعددة الولادة بمتوسط وزن ٦٧١ ± ٩٥ كجم. تم تصنيف الجاموسات إلى أربع مجموعات بناءًا على عدد الولادات على النحو التالي: الولادات ١ (ن = ٥)، والولادات ٢ (ن = ٦)، والولادات ٣-٤ (ن = ٧)، والولادات ≤ ٥ (ن = ١١). استمرت التجربة ٣٥ شهرًا، من فبراير ٢٠٢١ إلى يناير ٢٠٢٤. أشارت النتائج إلى أن الحيوانات في مجموعة الحيوانات ذات موسم الولادة الثاني كان لديها أطول فترة رؤية عند ولادتها (٣٦,٥٤ ± ١٩,٣٠ ثانية / ساعة)، تليها الموسم الاول الأول وهي ٢٧,١٦ ± ١٧,٨٨ ثانية / ساعة. كان هناك تأثير كبير لترتيب موسم ولادة الأم على كل من تكرار ومدة لعق عجلها. كان معدل سلوك اللعق هو الأعلى في مجموعة الولادات ≤ ٥ (٦,٤٥ ± ٤,٢٦ مرة / ساعة). كانت فترات اللعق هي الأدنى في الولادات الأولى (١٠٢,٩٢ ± ٥٩,٠٦ ثانية / ساعة) مع زيادة كبيرة بزيادة الولادات، حيث وصلت إلى أعلى مستوى في الولادات ≤ ٥ (١٦٤,٧٥ ± ٩٦,٩٠ ثانية / ساعة). تأثرت فترة سلوك الرضاعة بشكل كبير بترتيب موسم الولادة، والتي كانت الأقل في الولادات ١ (٧٧,٢٨ ± ٣٢,٨٦ ثانية / ساعة). كان هناك تأثير كبير ($P \leq 0.05$) لترتيب موسم ولادة الأمهات على محاولات وقوف العجول (STA) والوقت اللازم للوقوف بنجاح بعد الولادة (TNST). كان أعلى معدل لحدوث محاولات وقوف العجول (8.08 ± 16.66 STA) مرة في الولادات ١ وكان أطول وقت 68.46 ± 278.00 TNST دقيقة في الولادات ١. لم تتأثر محاولات الرضاعة (SUA). لكن الأوقات التي يحتاجها العجل إلى الرضاعة الأولى بنجاح بعد الولادة (TNSU) تأثرت بشكل كبير ($P \leq 0.05$). استغرقت عجول العجلات أطول وقت ٣٩٢,٦٦ ± ٢٤,٧٨ دقيقة من الولادة إلى الرضاعة الأولى بنجاح. انخفض النشاط الحركي للعجول (P≤٠,٠٥) في مجموعتي الولادات ١ والولادات ≤٥ عن مجموعتي الولادات ٢ والولادات ٣. وسجلت عجول عجول الجاموس الولادات ١ أقل وزن عند الولادة ٣٢,٢٠ كجم وأقل قياس للجسم ٨٥,٢٠±٣,٤٢ و٤٢,٢٠±٣,٧٦ و٧٧,٢٠±٣,٢٧ و٧٩,٨٠±٤,٨٦ و٧٥,٦٠±١٠,٩٢ سم لطول الحيوان وطول الظهر وارتفاع الكاهل ومحيط الصدر ومحيط الخاصرة على التوالي. وتبين نتائج معامل الإرتباط أنه مع زيادة وزن وحجم العجول حديثي الولادة يزداد نشاطها بالوقوف بسرعة والرضاعة من أمهاتها بسرعة مما ينعكس إيجاباً على أداء وصحة ومناعة هذه العجول حديثي الولادة.

الكلمات المفتاحية: الجاموس المصري، السلوك الأمومي، العجول حديثة الولادة، التوالد.