

FEATURES OF SUCKLING BEHAVIOUR OF *GAZELLA MARICA* FAWNS IN SEMI-CAPTIVE CONDITIONS

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ABSTRACT

In ungulate species, adequate and balanced nutrition for newborns is crucial, and it is primarily achieved through effective suckling by their mothers. This study investigated the suckling behavior of *Gazella marica* fawns under semi-captive conditions. Observations were conducted using the Focal Animal Sampling Method, and in total 177 gazelles were observed in the study period. The Kruskal-Wallis test was employed to analyze the duration between long suckling bouts and total suckling duration, while the Mann-Whitney U test was used for pairwise comparisons of suckling duration, duration between short suckling bouts, and total suckling duration. Results showed a significant difference in suckling duration between twin fawns (14.1 seconds) and single fawns (16.5 seconds) ($P < 0.001$). Additionally, the average suckling duration was higher in May compared to other months ($P < 0.001$). As the fawns matured, the frequency of suckling bouts increased, with the duration between long suckling bouts reaching 321 minutes in August ($P < 0.001$). However, no significant differences were observed in the total suckling duration between twin and single fawns ($P > 0.05$). These findings indicate some differences in the suckling behavior of gazelle fawns in semi-captivity compared to those in the wild. Further research on gazelles under consistent conditions across different breeding stations is necessary to fully understand the suckling behavior of gazelle fawns.

Keywords: Gazella fawns, average suckling duration, suckling bouts, total suckling.

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INTRODUCTION

Suckling behavior is vital in ungulate species, as in other mammals. It plays an important role in ensuring that offspring receive colostrum and have a healthy diet (Skok, 2022). Effective suckling requires a strong mother-offspring bond. In ungulate species, mothers protect and hide their young well in order to feed them in the wild environment (Blank and Yang, 2017). Ungulate maternal care strategies can be broadly divided into two categories: followers, where offspring stay close to and follow their mother shortly after birth, and hiders, where offspring remain hidden from their mothers, coming out only for feeding. In the context of gazelles, particularly *Gazella subgutturosa*, suckling behavior presents unique challenges for study because of their hider strategy. For the first ten days after birth, gazelle fawns are particularly vulnerable and spend most of their time lying down, resting, and hiding to avoid predators. Mothers aid this strategy by keeping their fawns hidden in safe areas and visiting them periodically for suckling (Blank, 1985;

2017). Therefore, studying suckling behavior in the wild is challenging, particularly for species such as gazelles which hide their offspring to protect them from predators (Spitzer *et al.*, 2022).

Suckling behavior is more well-known in domestic animals (cow, sheep, goat) than in wild animals (deer, antelope, gazelle, mountain goat etc.). For example, in cattle, calves growing up with their dams suckle their dams at intervals of 8-11 minutes (Alvarez-Rodriguez *et al.*, 2009). Italian Mediterranean Buffaloes were reported to have an average suckling duration of 1.2 minutes per hour during the first 48 hours after birth (Lanzoni *et al.*, 2021). Suckling bouts in calves are more frequent in the early months compared to later stages (Kour *et al.*, 2021b). For deer fawns, the average suckling duration is about 94 seconds in the first three days of life, decreasing to approximately 60-61 seconds by the second or third week (Neto *et al.*, 2021; Tajchman *et al.*, 2022). The total suckling duration of *G. subgutturosa* fawns on May 15-31 was very higher than that in June, July, and August (Blank and Yang, 2015b). Suckling behavior in

Gazelle subgutturosa fawns is most prolonged in the first 4 weeks after birth, with suckling durations being the longest (Blank and Yang, 2015a). Although the duration and frequency of suckling decrease progressively from May to August, and it remains rarely observed in the wild (Blank and Yang, 2015a). Additionally, twin gazelle fawns have longer suckling durations than single fawns during the initial weeks (May 15-31) of life (Blank and Yang, 2015b).

The distribution of the Arabian sand gazelle (*Gazella marica*) began in China and spread throughout Afghanistan, Iran, and southeastern Turkey (Cunningham and Wachter 2009). *G. marica* in Turkey is found in both wild and semi-captive (Uztemur and Orman, 2022; Uztemur and Orman, 2024a; Uztemur and Orman, 2024b; Uztemur and Orman, 2024c). Breeding stations have been established in order to prevent the extinction of *G. marica* in Turkey (Gürler *et al.*, 2015). However, there is limited information on whether there is a change in suckling and nursing behavior in this species in semi-captivated breeding stations. Semi-captive conditions allowed more detailed information to be collected than in field studies of other species. Therefore, this study was designed to investigate suckling behavior of the fawns to understand whether there are changes in the behavior of gazelles raised in semi-captivity.

MATERIALS AND METHODS

Study area: This study was carried out at the Kızılkuyu Gazelle Breeding Station in the Şanlıurfa province in Turkey from May 15-31 to August 1-31 in 2022. The study was conducted during these months because births at this breeding station commenced in May and continued through June. Additionally, these periods were chosen because the most fawn gazelles were weaned by the end of August. This breeding station (37°02'N-38°42'E) consists of an area of 22.72 hectares surrounded by wire fences. The altitude varies between 545-600 meters. The average annual temperature is 18.5 °C (highest, 46.8 °C; lowest, -12.4 °C), and the average annual precipitation is 463.3 mm. The animals were kept under semi-captive conditions, i.e., the area where gazelles naturally spread in the wild was surrounded by wires and their general behavior was monitored without interference. This area is where gazelles spread completely naturally. The breeding station is situated at steppe area. Therefore, there are no trees or other objects that provide shade. There were artificial shades in the shaded areas. All gazelles were free in the herd. No grouping was performed for the herd. All gazelles were able to move freely at the breeding station. Gazelles were fed an average of 300 g black barley and 350 g *Medicago sativa* per animal once a day. All animals were fed freely in the feed troughs once a

day. In total 177 gazelles were observed during the study period. They also consumed grass growing in an area of 22.72 hectares. Because the breeding station is surrounded by wires, predators cannot enter from the outside. Furthermore, this breeding station was established to preserve the extinction of gazelles and to release them back into the wild. Because the number of gazelles in the wild is decreasing daily, it was established to ensure the continuity of the species.

Working equipments: The following instruments were used for the study: Swarovski EL 10X42 binoculars, Swarovski ATX 25-60X85 telescope, Canon EOS 1300 D camera with 18-55 mm and 75-300 mm lenses, Redmi Note 8 mobile phone (for photo, video, and time recording), and Mi Band 4 digital wrist watch (to record suckling time).

Suckling behavior: Mother gazelles have two mammary lobes and two teats, and the fawns suckle both teats simultaneously during the suckling period. Twins usually suckle one teat each at a time. Suckling behavior is defined as follows: suckling duration is the time the fawn spends suckling the mother in one session. A suckling bout is defined as the time between two sucklings (Das *et al.* 2000). Visual information is also provided to the readers by recording photographs of single (Figure 1) and twin (Figure 2) fawns while displaying suckling behavior. The different variables related to sucking behavior are defined as follows.

Suckling duration: The duration from when the gazelle fawn starts suckling until the fawn or the mother ends suckling.

Duration between short suckling bouts: After the fawn suckles the mother, it suckles the mother again after a short rest.

Duration between long suckling bouts: After the fawn suckles the mother, it suckles the mother again after a long rest.

Total suckling duration: The total duration during which the fawn shows suckling behaviour during the observation period. The fawns who ended suckling were recorded, and it was found that the fawns ended suckling between May 15 and 31. However, the mothers ended suckling between June 1-30 and August 1-31. However, it was not possible to determine which teat was used because the fawns always suckled both teats in one suckling duration.

Study program: Daily observations were made between 08.00 and 17.00, varying between 6 and 9 hours per day. During the observation period, 77 hours of observations were made in May, 134 hours in June, 129 hours in July, and 61 hours in August.



Figure 1: Single fawns suckling their mother



Figure 2: Twin fawns suckling their mother

Observation method: Observations were made using the Focal Animal Sampling Method (Altman, 1974; Bosholn and Anciães, 2018). Observations were made in an observation tower that overlooks the entire field inside the 22.72-hectare breeding station surrounded by wires. It was observed that the gazelles easily exhibited their natural behavior, assuming they did not notice the observer. A single observer performed observations during the observation period.

Data collection: For correct and precise recording, many herds were marked with individual ear tags in 2020-2021 for individual identification, which could be easily identified and read from the distance using binoculars. These ear tags consist of two parts: male and female. Technical specifications of the female part were as: width 31 mm, length 43 mm, weight 3.00 g, made of plastic. Male part: width 31 mm, length 35 mm, weight 2.00 g, made of plastic. At the beginning of the observations, a gazelle fawn was randomly selected and followed until it disappeared from view. From the moment the observations began, a fawn was detected and started to be followed with binoculars. When this fawn came together with its mother, the mother's earring number was determined by using a telescope. Records were kept during suckling using a chronometer and a mobile phone. All measurements were recorded immediately throughout the observation period. The observation ended when the fawn ran away or joined the herd with its mother, and was monitored for the suckling behavior of another fawn. Each observation was captured with a camera. In addition, the suckling and remarkable behavior of many fawns were video-recorded with a camera. For gazelle fawns, a suckling duration of less than 2 seconds is defined as unsuccessful, and a suckling duration of 2 seconds or more is defined as successful and nutritious (Haley *et al.*, 1998). Based on this information, suckling behavior for less than 2 seconds were not recorded.

Since the sex of the fawns could not be determined using the focal observation method, this parameter was not taken into account in our statistical analysis.

Sample sizes: There were 104 mothers at the breeding station during the observations, and there were 120 fawns. Among these fawns, 30 fawns were twins. Because some mothers do not have ear tags, data on suckling behavior were recorded based on the number of fawns observed in each behavior category. For example, 192 successful suckling behaviors were observed for the average suckling duration between May 15-31. Since the same fawn suckled on different days, the number of sucklings was high. In addition, the data of each twin born sibling was taken separately.

Statistical analysis: All statistical analyses were performed using the SPSS program (version 28.0). Our data were non-normally distributed according to the Shapiro-Wilk test. The Kruskal-Wallis test was used for the duration between the long suckling bouts and the total suckling duration. The Mann-Whitney U test was used for pairwise comparisons of suckling duration, duration between short suckling bouts, duration between short suckling bouts and total suckling duration. The Kruskal-Wallis Bonferroni correction was used for total suckling duration. In cases of multiple comparisons, the Bonferroni correction to the alpha level was applied. The alpha level for the duration between long suckling bouts was 0.008 and for total suckling duration was 0.003. Results were declared significantly different at $P < 0.05$.

RESULTS

Suckling duration: The results showed that the average suckling duration of twin and single fawns was highest in May and lowest in August. Average suckling durations continued to decrease each month for single and twin

fawns after May. In addition, remarkable observations were made. In May, the duration of a single fawn suckled once was 303 seconds. Twins were observed on different days on May 15-31, suckling their mothers for 226 seconds in a single bout. Another set of twins suckled for 262 seconds and then for 256 seconds on the same day in May, which was significant.

The average suckling durations for the periods May 15-31, June 1-15, June 15-30, July 1-15, July 15-31 August 1-31 were 24.76, 12.30, 9.48, 7.19, 4.18, and 3.87 seconds, respectively. In May and June, the average suckling duration of twin fawns was longer than that of single fawns (Table 1). A significant difference was found between May 15-31 and June 1-15 in terms of sucking duration ($Z = -4.036$, $P < 0.001$). Gazella fawns

suckled for an average of 12.46 seconds more on May 15-31 than on June 1-15. The sucking duration on May 15-31 was average 15.28 seconds longer than the sucking duration on June 16-30 ($Z = -5.735$, $P < 0.001$). Fawns suckled for an average of 17.57 seconds longer on May 15-31 than on July 1-15 ($Z = -6.602$, $P < 0.001$). The Fawns suckled for an average of 20.58 seconds longer on May 15-31 than on July 16-31 ($Z = -8.919$, $P < 0.001$). On May 15-31, fawns suckled for an average of 20.89 seconds more than on August 1-31 ($Z = -7.957$, $P < 0.001$) (Table 1). No significant difference was found between June 1-15 and June 16-30 in terms of suckling duration ($Z = -1.835$, $P = 0.66$). Fawns suckled for an average of 5.11 seconds more in June 1-15 than in July 1-15 ($Z = -3.931$, $P < 0.001$).

Table 1: Suckling duration fawns by date ranges (seconds).

Birth type and Dates	Number of individuals (n)	Average suckling duration (seconds)±Standard Error (SE)	Suckling duration (seconds) (min-max)
May 15-31	192	24.76±1.96	2-149
Single	100	22.05±2.63	2-149
Twins	92	27.70±2.90	4-128
June 1-15	79	12.30±0.90	3-40
Single	25	10.76±1.82	3-40
Twins	54	13.02±1.00	3-37
June 16-30	67	9.48±0.63	2-35
Single	40	9.63±0.94	2-35
Twins	27	9.26±0.75	5-17
July 1-15	43	7.19±0.61	1-23
Single	27	6.70±0.82	1-23
Twins	16	8.00±0.84	5-15
July 16-31	44	4.18±0.42	1-15
Single	24	5.23±0.67	1.5-15
Twins	20	2.93±0.25	1-5
August 1-31	31	3.87±0.39	1-10
Single	13	4.62±0.83	2-10
Twins	18	3.33±0.29	1-5

On June 1-15, Fawns suckled an average of 8.12 seconds more than on July 16-31 ($Z = -7.228$, $P < 0.001$). The fawns suckled for an average of 8.43 seconds more on June 1-15 than on August 1-31 ($Z = -6.807$, $P < 0.001$). On June 16-30, fawns suckled an average of 2.29 seconds more than on July 1-15 ($Z = -2.682$, $P < 0.01$). On June 16-30, fawns suckled an average of 5.30 seconds more than on July 16-31 ($Z = -6.635$, $P < 0.001$). The fawns suckled for an average of 5.61 seconds more on June 16-30 than on August 1-31 ($Z = -6.394$, $P < 0.001$). Fawns suckled for an average of 3.01 seconds more on July 1-15 than on July 16-31 ($Z = -4.422$, $P < 0.001$). On July 1-15, fawns suckled an average of 3.32 seconds more than on August 1-31 ($Z = 4.406$, $P < 0.001$). No significant difference was observed between July 16-31 and August 1-31 in terms of sucking duration ($Z = -0.115$, $P = 0.909$). A significant difference was found

between the suckling duration of twin fawns and single fawns ($Z = -2.144$, $P < 0.001$). When the total and average suckling duration of 227 twin fawns and 229 single fawns were examined, single fawns' average suckling durations was 14.1 seconds, and twin fawns' average suckling durations was 16.5 seconds. Twin fawns suckled for an average of 2.42 seconds longer than single fawns ($Z = -2.144$, $P < 0.05$).

Duration between short suckling bouts: The average durations between two short sucklings bouts in May 15-31, June 1-15, June 15-30, July 1-15, July 15-31, and August 1-31 were 5.38, 16.48, 42.16, 134.50, 150.30, and 277.33 minutes, respectively. There was no significant difference in short suckling bouts between twin fawns and single fawns ($Z = -0.783$, $P = 0.43$). It was determined that there was a significant relationship in

short suckling bouts between May 15-31, June 1-15, June 16-30, July 1-15, July 16-31, and August 1-31. ($Z = -3.582$, $Z = -6.319$, $Z = -5.292$, $Z = -5.594$, $Z = -4.058$; $P < 0.001$). The time between short suckling bouts during May 15-31 had an average of 11.1 minutes less short suckling bouts than June 1-15. Fawns were suckled at short suckling bouts of 38.78 minutes on average from June 16-30, 55.74 minutes on average from July 1-15, 129.12 minutes on average from July 16-31, and 271.95 minutes on average from August 1-31. *G. marica* fawns were suckled at average short suckling bouts of 25.68 minutes between June 1-15 and June 16-30 ($Z = -2.212$, $P < 0.001$). Fawns suckled at average short suckling bouts of 118.02 minutes less from July 1-15 and 133.82 minutes less from July 16-31 ($Z = -3.672$, $P < 0.001$, $Z = -3.094$, $P < 0.001$). Fawns sucked for an average short

suckling bout of 260.85 minutes less between August 1-31 ($Z = -3.216$, $P < 0.001$). On June 16-30, Fawns was suckled at an average short suckling bouts of 92.34 minutes less than July 1-15, on average 108.14 minutes less than July 16-31, and on average 235.17 minutes less than August 1-31 ($Z = -3.036$, $Z = -2.647$, $Z = -3.118$, $P < 0.001$). There were no significant differences between the periods of short suckling bouts on July 1-15 and July 16-31 ($Z = -0.097$, $P = 0.922$). On July 1-15, fawns were suckled at an average of 142.83 minutes less short suckling bouts compared to August 1-31 ($Z = -1.970$, $P = 0.049$). On July 16-31, fawns were suckled at an average of 127.03 minutes less intervals between short suckling bouts than on August 1-31 ($Z = -2.192$, $P = 0.028$) (Table 2).

Table 2: Duration between two short sucklings bouts (minutes) by date ranges

Birth type and Dates	Number of individuals (n)	Average duration short suckling bouts (minutes) \pm Standard error (SE)	Two short suckling durations (minutes) (min-max)
May 15-31	108	5.38 \pm 0.75	0.20-39.00
Single	51	3.78 \pm 0.76	0.20-30.00
Twins	57	6.81 \pm 1.22	0.25-39.00
June 1-15	21	16.48 \pm 2.84	0.33-41.00
Single	7	15.29 \pm 5.58	2.00-41.00
Twins	14	17.07 \pm 3.37	0.33-39.00
June 16-30	38	42.16 \pm 6.39	1.00-122.00
Single	23	29.52 \pm 6.60	1.00-104.00
Twins	15	61.53 \pm 11.12	2.00-122.00
July 1-15	12	134.50 \pm 35.95	7.00-451.00
Single	8	144.00 \pm 54.57	7.00-451.00
Twins	4	115.50 \pm 11.26	96.00-135.00
July 16-31	20	150.30 \pm 30.06	2.00-450.00
Single	10	174.40 \pm 48.50	2.00-450.00
Twins	10	126.20 \pm 36.54	3.00-279.00
August 1-31	6	277.33 \pm 53.29	20.00-375.00
Single	3	334.00 \pm 29.82	276.00-375.00
Twins	3	220.67 \pm 100.50	20.00-331.00

Duration between long suckling bouts: The average durations between two long sucklings bouts on May 15-31, June 1-31, July 1-31, August 1-31 were 177.19, 139.62, 197.30, and 321 minutes, respectively (Table 3). A significant relationship was found between long suckling bouts and date [$\chi^2(3, N = 102) = 11.166$, $P < 0.001$]. It was also found to be significant according to the Bonferroni correction. There was no significant difference in the duration of long suckling bouts between twin fawns and single fawns ($Z = -0.229$, $P = 0.819$).

The duration between long suckling bouts on May 15-31 was found to be an average of 37.57 minutes longer than June 1-30, but an average of 143.81 minutes

less than August 1-31 ($Z = -2.120$, $Z = -2.326$, $P < 0.001$). There was no significant relationship between the duration of long suckling bouts on May 15-31 and July 1-31 ($Z = 0.419$, $P = 0.675$). It was found that fawns suckled at an average of 57.68 minutes and 181.38 minutes more frequently in June 1-30 than in July 1-31 and August 1-31 ($Z = -2.067$, $Z = -2.190$, $P < 0.001$). There was no significant relationship between the duration long suckling bouts on July 1-31 and August 1-31 ($Z = -1.704$, $P = 0.088$).

Table 3: Duration between long suckling bouts (minutes) by date ranges

Birth type and Dates	Number of individuals (n)	Average (minutes) duration between long suckling bouts \pm Standard error (SE)	Duration (minutes) between suckling bouts (min-max)
May 15-31	27	177.19 \pm 15.44	40-300
Single	11	169.82 \pm 29.13	46-300
Twins	16	182.25 \pm 17.43	40-270
June 1-30	50	139.62 \pm 12.30	39-430
Single	22	152.09 \pm 22.39	41-430
Twins	28	129.82 \pm 13.25	39-249
July 1-31	23	197.30 \pm 23.77	59-451
Single	13	220.92 \pm 37.03	59-451
Twins	10	166.60 \pm 24.78	92-279
August 1-31	2	321.00 \pm 10.00	311-331
Single	-	-	-
Twins	2	321.00 \pm 10.00	311-331

Total suckling duration: The average total suckling durations on May 15-31, June 1-15, June 15-30, July 1-15, July 15-31 August 1-31 were 169.25, 21.61, 18.68, 8.13, 5.14, and 4 seconds, respectively. There was a significant relationship between total suckling duration and date according to the Kruskal-Wallis test [$\chi^2(5, N = 220) = 155.515, P < 0.001$]. It was also found to be significant according to the Bonferroni correction. There was no significant difference in the total suckling duration between twins and single fawns ($Z = -1.274, P = 0.203$). It was determined that there was a significant and strong relationship between the total suckling durations on May 15-31, June 1-15, June 16-30, July 1-15, July 16-31, and August 1-31 ($Z = -6.940, Z = -6.690, Z = -7.400, Z = -7.310, Z = -6.964, P < 0.001$). An average of 147.64 seconds more suckling was observed on May 15-31 than on June 1-15, 150.57 on June 16-30, 161.12 on July 1-15, 164.11 on July 16-31, and 165.25 seconds on August 1-

31. No significant relationship was found between the total suckling duration for June 1-15 and June 16-30 ($Z = -1.009, P = 0.313$) (Table 4).

It was found that the total average suckling duration of June 1-15 was 13.48, 16.47, and 17.61 seconds longer compared to July 1-15, July 16-31, and August 1-31, respectively ($Z = -5.220, Z = -6.615, Z = -6.785, P < 0.001$). It was found that the total average suckling duration June 16-30 was 10.55, 13.54, and 14.68 seconds longer compared to July 1-15, July 16-31, and August 1-31, respectively ($Z = -4.112, Z = -6.103, Z = -6.379, P < 0.001$). The total average suckling duration was found to be 2.99, and 4.13 seconds longer on July 1-15 than on July 16-31 and August 1-31, respectively ($Z = -3.552, Z = -4.869, P < 0.001$). It was determined that there was no significant relationship between the total suckling durations for July 16-31 and August 1-31 ($Z = -1.611, P = 0.107$).

Table 4: Total suckling duration (seconds) by date ranges

Birth type and Dates	Number of individuals (n)	Total average suckling duration (seconds) \pm Standard error (SE)	Total suckling duration (seconds) (min-max)
May 15-31	36	169.25 \pm 26.10	22-651
Single	14	129.93 \pm 21.09	22-281
Twins	22	194.27 \pm 40.07	24-651
June 1-15	46	21.61 \pm 2.30	3-67
Single	17	18.70 \pm 2.96	3-41
Twins	29	23.31 \pm 3.20	5-67
June 16-30	34	18.68 \pm 2.32	7-50
Single	19	20.26 \pm 3.07	7-50
Twins	15	16.67 \pm 3.59	7-44
July 1-15	38	8.13 \pm 0.70	1-23
Single	22	8.22 \pm 1.04	1-23
Twins	16	8.00 \pm 0.84	5-15
July 16-31	36	5.14 \pm 0.49	2-15
Single	24	5.33 \pm 0.69	2-15
Twins	12	4.75 \pm 0.51	2-8
August 1-31	30	4.00 \pm 0.40	1-10
Single	13	4.62 \pm 0.83	2-10
Twins	17	3.53 \pm 0.29	1-5

DISCUSSION

The results of this study supported our first hypothesis. It was found that the average suckling duration of twin fawns was longer than that of single fawns. However, semi-captive *G. marica* fawns were found to suckle for shorter durations than do wild *G. subgutturosa* fawns. These findings do not support the second hypothesis. In general, the average suckling duration of twin fawns was longer than that of single fawns. This suggests that mothers spend more time feeding twin fawns. Single fawns, having access to both of the mother's teats, consume more milk and become satiated more quickly, resulting in shorter suckling periods. In contrast, twin fawns require more time to become full, because each fawn has access to only one teat. The suckling durations of *G. subgutturosa* fawns have been reported to decrease significantly from May to August in both single (21.8 seconds) and twin fawns (28.7 seconds) (Blank and Yang, 2015a), which supports our results. Furthermore, it has been reported that in the first five days of lactation in *G. dorcas*, the offspring usually initiate the end of suckling (Fialkovskiy *et al.*, 2023). This indicates that, since the main nutritional source of fawns in the early days of their lives is milk, they are able to suckle until they are satisfied. In our study, the longest suckling duration occurred in the first two weeks after birth (May 15-31), with fawns suckling for an average of 24.76 seconds. Significant differences between twins and singles in *G. marica* fawns were observed in the present study. However, Gauthier *et al.* (1985) reported that there was no difference in suckling duration between twin and single *Odocoileus virginianus* fawns raised in captivity. Therefore, the nutritional conditions of the mothers should be monitored to ensure adequate nutrition for the offspring (Reale *et al.*, 1999). Results obtained in this study provide a detailed quantification of suckling behavior in *G. marica* under semi-captive conditions for the first time. The amount of milk they receive in the first 3 months is critical for the nutrition and development of *G. subgutturosa* fawns.

Average suckling durations of individual *G. subgutturosa* fawns in the wild from May 15-31 were reported as 21.8 seconds single fawns and 28.7 seconds for twin fawns (Blank and Yang, 2015b). Our results were very similar to those of the single fawns (22.05 seconds) and twin fawns (27.70 seconds). However, in other ungulate species, the average suckling duration is longer than that in gazelles, and is dependent on body size (Kour *et al.*, 2021 a; Lanzoni *et al.*, 2021; Neto *et al.*, 2021; Tajchman *et al.*, 2022). For the period of June 1-15, the average suckling duration was reported as 17.7 seconds for single fawns and 27.1 seconds for twin fawns. For June 16-30, the average suckling durations were 14 and 18 seconds for single for twin fawns,

respectively (Blank and Yang, 2015b). However, in our data for June 1-15 and June 16-30, suckling duration showed a sharp decrease in both single and twin fawns compared to May 15-31. Our results were lower than those reported by Blank and Yang (2015b). One of the important reasons for this is that the plants turn yellow and dry due to the sudden warming of the weather during the transition from spring to summer in Şanlıurfa. The inability of the plants to develop sufficiently and rotational grazing is not sufficient for the number of individuals in the field, which likely causes a decrease in milk production due to increasing nutritional deficiency. In addition, the observed decrease in suckling duration over time could be attributed to factors such as increasing fawn independence as they mature and decreasing milk production or availability from the mother.

According to our results, the average suckling duration of singles was low and the average suckling duration of twin fawns was higher than that of Blank and Yang, (2015b). Additionally, our results for the average suckling duration between July 16-31 were found to be similar to those reported by Blank and Yang (2015b). The average suckling duration of singles was lower, and the average suckling duration of twin fawns was higher than that of Blank and Yang (2015b). The average suckling durations were reported as 9.8 seconds for single fawns and 5.7 seconds for twin fawns on July 1-15. On July 16-31 the average suckling durations were 6.5 seconds for single fawns and 4.3 seconds for twin fawns. On August 1-15, the durations were 4 seconds for single fawns and 6.5 seconds for twin fawns (Blank and Yang, 2015b). Because the number of individuals was low, our results for August were included in the evaluation, which might have affected the results.

The findings showed that short suckling bouts for single fawns (144 minutes) and twin fawns (115.5 minutes) were higher than those reported by Blank and Yang (2015b). Additionally, the average duration between short suckling bouts on June 16-30 and July 1-15 was higher than that reported by Blank and Yang (2015b). Interestingly, short suckling bouts of twins compared with singles were observed on May 15-31 and June 1-15, which is exactly the opposite of the findings of Blank and Yang (2015b). Blank and Yang (2015b) reported that on May 15-31, single fawns suckled their mothers every 2.18 minutes on average and twin fawns every 1.04 minutes. For the period between June 1-15, single fawns suckled their mothers every 4.46 minutes on average, and twin fawns every 1.47 minutes. Between June 16-30, single fawns suckled their mothers every 23.95 minutes on average, and twin fawns every 28.96 minutes. Between July 1-15, single fawns suckled their mothers on average every 64 minutes, and twin fawns every 16.36 minutes. In beef calves, the average time between suckling bouts is 7.7 minutes and each suckling period is 9.4 minutes (Alvarez-Rodriguez *et al.*, 2009).

Suckling bouts are higher in farm animals than in wild mammals. It has been reported that suckling bouts in male giraffe calves are longer than in females. However, the gender of gazelle fawns cannot be determined by remote observation (Gloneková *et al.*, 2020). It has also been reported that buffaloes exhibiting more frequent suckling behavior are more stimulated in terms of milk production. Based on this idea, when fawn gazelles suckle their mothers more frequently, they produce more milk and receive better nutrition (Mota-Rojas *et al.*, 2022). Suckling periods gradually decrease towards autumn, reducing the benefits offspring receive from their mothers (Scornavacca *et al.*, 2018). The results obtained in this study are consistent with these findings, indicating a decrease in suckling periods and offspring benefits over time.

The total suckling duration in this study was similar to the findings of Blank and Yang (2015b), with the maximum suckling duration occurring from May 15-31 and decreasing in the following two weeks. However, when examining the average total sucking durations in detail, Blank and Yang (2015b), reported that single fawns suckled their mothers for a total average of 169.8 seconds and twin fawns 354.4 seconds between May 15-31. Compared to the findings of Blank and Yang (2015b), the total suckling duration in our results were much lower. The average total suckling duration of twin fawns between June 16-30 was higher than that reported by Blank and Yang (2015b). It was also reported that the total suckling duration for dairy goat kids is approximately 24.3 minutes per day on average (Vickery *et al.*, 2023). This variation is related to the mother's mammalian capacity and milk production. However, wild mammals (deer, antelope, gazelle, mountain goats, etc.) can produce sufficient milk to feed their offspring, which results in shorter suckling periods.

When examining the benefits of observing gazelle fawns under semi-captive conditions, this method allowed for the collection of more data in a limited area and provided the opportunity to observe all animals. Tagged animals were allowed to reach different numbers of individuals for monitoring and the absence of predators in the field created a safe environment. The disadvantages of observing semi-captive conditions includes additional feeding that was provided externally and effects on the feeding behaviors of the mother and fawns. The lack of grouping caused disturbances during suckling in the males. Due to limited space, it created restrictions on the mother and fawns' ability to exhibit completely natural behavior. There were some differences in suckling behavior between the domestic and wild groups. However, to fully understand the suckling behavior of gazelle fawns, studies must be conducted on gazelles under the same conditions at different breeding stations.

For *G. marica* fawns in semi-captivity to receive adequate and balanced nutrition during the suckling durations, it is important to ensure that mothers at the breeding station are well fed. Fawns that do not receive sufficient nutrition may not develop properly and may struggle to adapt or even fail to adapt, when they are released back into the wild.

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Authors' contributions: AU: Field work and data collection, AU and AO: Statistical analysis, AU and AO: writing the manuscript, MD: Searching the literature.

Availability of data and materials: The data results obtained in this study are available from the corresponding author and first author upon request.

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