

University of Veterinary Medicine Budapest
Department of Obstetrics and Food Animal Medicine Clinic



Control of Foaling Springfield Farm Co. Waterford, Ireland

By
George Hennessy VXYMTC

Supervisor: Prof. Dr. Szenci Ottó **PhD, DSc, Dipl. ECBHM**

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Abstract

The purpose of this retrospective study was to determine the time of day of parturition of the thoroughbred mare, the factors that affect gestation time and gain an understanding of the frequency of dystocia, placental retention, premature placental separation and contracted tendons and the general health status of foals. It also examined the effect of the gestation time on the health status of the foal and the prevalence of dystocia, premature placental separation, retained placenta and contracted tendons

The study examined 588 foalings with 306 being colts and 282 being fillies over a five year period between the years of 2018 to 2022. With 4 stillbirths, 5 mortalities, 22 morbidities and 557 survivals. The majority of births took place between the hours of 21:00 and 04:00. The average gestation period was 343.28 days with the average for colts being 344.8 and for fillies being 341.62. The frequency of dystocia was 8.67%, retained placenta was 5.1%, premature placental separation was 0.85% and for contracted tendons was 4.08%.

Introduction

Ireland has a prosperous thoroughbred breeding industry, being Europe's largest producer of thoroughbreds and the third largest producer in the world behind Australia and the United States of America. There are over 6000 breeders in Ireland, many of which are large scale stud farms.

Foaling is an integral part of the production of thoroughbreds, it is the beginning of the new horse's life. Foaling is one of life's miracles and no matter how many times you witness it, it is impossible to escape the feeling of wonder and joy that new life brings, Safe and effective management of these high value animals is a priority on all thoroughbred breeders lists. In my study I aim to determine events and factors which can help with the understanding of foaling and its management and also look at some of the common complications that occur during foaling and determine their frequency and the subsequent health status of the foal.

Thoroughbred breeders may differ in opinions on different blood lines and crosses but a few simple goals unite them; safe delivery of a healthy foal who can begin to grow and develop into an animal fit to sell or race and have the mare healthy after delivery of her foal in order to be covered again as soon as possible.

Objective

To examine the time of foaling of thoroughbred mares and evaluate factors that influence gestation length; time of year, sex of the foal. To determine the frequency of dystocia, placental retention, premature placental separation and contracted tendons, and subsequent health status of foal. To determine the effects of the gestation time on dystocia, placental retention, premature placental separation and contracted tendons.

Materials and Methods

Data was collected at Springfield Farm in County Waterford Ireland which is the foaling unit for a nearby large scale thoroughbred stud farm. Between the years 2018 to 2022, the foaling time, sex of foal, gestation period, and the event of foaling from mares aged 3 to 21 years of age was recorded. Data from 588 foalings over the five years was obtained.

Springfield Farm is based in the county of Waterford in Ireland. It is a specifically designed yard for foaling with an American style barn with large foaling boxes and turn out paddocks for the mares during the day. All mares are fitted with stitched in foaling alarms and are monitored at all times during the day in the paddocks and through CCTV cameras during the night. The mares at the foaling unit have a regular routine of feeding at 06.45 and turned out to paddocks during the day until 17.00 where they are brought back into their foaling box and fed at 18.00. Mares who began to foal during the day while outside were brought back into their foaling box once the foaling alarm had been triggered or they began to show signs of foaling.

Once foaled the placenta is removed from the stable and examined and also kept to be examined by the visiting vet the next morning. The foal receives an anti-tetanus injection shortly after birth and an enema is also administered to help the passing of meconium. It is preferable on this farm that foals nurse their mother as their first drink however if this does not happen the foal is bottle fed with colostrum for its first feed until it learns how to nurse. Both mare and foal are examined the next morning by the vet ensuring that they are healthy and that the mare has not retained any parts of her placenta. Generally retained placentas on the farm are treated with Oxytocin and Antibiotic treatment. If the foal suffers contracted tendons depending on the severity they can be administered intravenous oxytetracycline, have extensions on their hoofs or a cast or brace fitted.

Literature Review

The majority of mares foal at night. [1] [2] Many studies over the decades have been done to determine and understand the hours that mares foal at. In a study carried out in 2012 [3] they found that 72.7% of mares foaled between 20:01 and 06:00 and only 27.3% foaled between the hours of 06:01 and 20:00; With the majority of mares (52.8%) foaling within the six hour period between 20:00 and 02:00. They found only 13.4% of mares foaled during the “daylight” hours of 08:00 and 17:00. In similar studies done in [4] 2013 where they studied the incidence of foaling time in Arabian mares in Algeria they found similar results with 78.07% of foalings taking place between 19:00 and 06:00 with the main incidence (52.8%) taking place during the hours of 20:00 and 02:00. They also examined the difference in the time of day for each month. In January 75% of births taking place between 19:00 and 06:00. In February 79% of birth taking place between 19:00 and 06:00.

In March 87% of births taking place between 19:00 and 06:00. In April 89% of births taking place between 19:00 and 06:00. Which is conducive with results presented in 1967 [1] where 86% of foalings between 19:00 and 07:00, who also stated that as the nights were becoming shorter the frequency of foalings per hours of darkness increased. With similar results also been present in Poland [5] in 1965 and in Sweden [6] in 1961.

Environmental and management factors have also been proven to have an effect on the time of foaling of mares, [1] contains a personal communication from Messery where in Bristol University a spike of the number of births at 19:00 two hours after staff had left and a reduction in the number of births after staff arrived the next morning at 06:00, which may suggest that human activity in the barns also has a bearing on the foaling of a mare. Another factor which may have an effect on the time of a mare foaling is their own circadian rhythm. The idea of circadian rhythm being an influence on parturition is not one unique to mares. It has also been observed in women [7] and in aows [8]. A study done on mice where they reversed the circadian rhythm by alternating the hours of light and darkness, proved that the circadian rhythm plays a role in the time of parturition [9], [10]. However in cattle very little variation in the frequency of birth throughout the day is seen. [11]

It may be thought that mares predominantly foaling during the hours of darkness can be viewed as an adaptation phenomenon of natural selection in order to conceal the new born foal

from predators during its first few formative hours. However it may also be argued that the activity of predators is at its highest during the hours of darkness.

The gestation period of a mare can be extremely varied, between 320-360 days [12]. Anything less than 320 days gestation is associated with foaling of a premature foal. A prolonged or extended pregnancy is considered to be longer than 360 days in length [3]. The gestation period of a mare was discovered to be under the influence of both the genotype of the foal and environmental factors that the mare is subjected to [13]. The great difference between gestation period of mares, it is thought that environmental factors can play a great role. Colt foals were found to have longer gestation periods when compared with filly foals [14] , [15]. In a study done looking at 1047 births they found the average gestation period to be 342.7 days [3]. With mares in January having shorter gestation periods at a average of 338.1 days. They found that mares carrying colt foals had a gestation period average of 344 days and filly foals had an average 341.3 days of gestation. They did not however find a difference in gestation for the age of the mare which contradicts the findings of other studies [13], who found that mare age and parity had an effect on gestation period with younger mares having longer gestation periods. However, it has also been reported shorter gestation in younger mares compared with older mares [16]. Mares between the age of 8-12 years have shorter gestation periods compared with mares aged 13-17 years [16]

Older studies by in 1951 [13], [17] in 1982 and [18] in 1988, Have shown that mares bred to foal during January and February with short length of daylight hours have longer gestation periods compared with mares bred to foal later in the breeding season with longer hours of daylight have shorter gestation periods but this was not found in the [3] study, which showed a reduction in the length of the average gestation period which was put down to the management of mares due to foal during the winter months which were kept in barns with extended periods of artificial lights. The idea of artificial light shortening the gestation periods of mares was also demonstrated [17] with quarter horse mares kept inside with 16 hours of light and 8 hours of darkness, it successfully shortened the gestation period.

In a study done in Belgrade [19], they found the average gestation period for mares to be 336.57 days with the average for mares with filly foals being 335.8 days and mares with colt foals 337.7 with a very weak correlation between age of mare and gestation length.

It seems to be well proven that colt foals have a longer gestation period compared with fillies. This is a theory subscribed to in many domestic animals. It is thought that female foetal development takes less time than males. A phenomenon which was studied in humans explained by the differences in androgen production and its effects related to differentiation of X Y chromosomes [20]. However this has not been explained in mares .

The prevalence of dystocia in thoroughbred mares is around 4% [21]. In their study they found abnormal orientation of the foetus (postural abnormalities) the most common cause of dystocia. In another study it was found dystocia occurred in 10.1% of births [3]. Here 96% of these births had the foal in cranial position. Another study report dystocia occurring in 11.2% of births and that in 31% of these dystocia the foals were in normal position and posture so the dystocia was due to either a very large foal or weak contractions of the mare [22].

Breed of mare also seems to have a bearing on the occurrence of dystocia with higher rates of dystocia in thoroughbred mares compared with draught horse breeds [23]. [3] found that dystocia rate in thoroughbreds to be 13.7% and in quarter horse mares to be 7.9%. Very few studies seem to be reporting rates of dystocia as low as 4% as reported by [21] in 1974.

Retained placenta is defined as a failure to expel all or parts of the foetal membranes within a time period after foaling [24]. Normally a time period longer than 3 hours is considered to be retained. In normal circumstances the placenta is expelled within a half an hour to 3 hours [25]. In 1971 a study reports the incidence of retained placenta to be between 2%-10% [26]. Hypocalcaemia and often hypomagnesia in cows are often risk factors for placental retention [27]. However there has been no differences of serum calcium levels in mares at different stages of reproduction [28]. Supplementing selenium and vitamin E in cattle has been found to reduce incidence of retained placenta [29]. It was also reported that retained placenta has been linked to selenium and vitamin E deficiency in horses [30].

The reported the incidence of retained placenta is 10% [24]. Retained placenta is more likely to happen following abortion, prolonged gestation period, dystocia [31] , [32]. It is also suspected that mares bred during their foal heat or mares bred during uterine infection were more likely to have retained placenta. [33] , [26].

There are various treatments for retained placenta. [34] has reported that systemic use of oxytocin is the most effective therapy for retained placenta. Manual removal of the placenta is also a treatment option however studies in cattle show that manual removal can be damaging to the conception rates of the next breeding. [35] , [36].

Premature placental separation is also known as a red bag foaling. It has been reported that occurrence of premature placental separation is 1.6% of foalings. [3] An occurrence of 2% was reported by [22]

Premature placental separation is the failure of the chorioallantoic membrane to rupture which leads to separation of the micro cotyledonary attachments between the foetal membranes and the uterus, this leads to a decrease in oxygen to the foetus which can result in hypoxia or anoxia which may result in what is know as dummy foal.

[3] reports premature placental separation can account for 5%-10% of all cases of still births and perinatal deaths. In a study done of 210 equine foetus and placenta they found premature placental separation to be the cause of 8.1% of the abortions [37]

Congenital flexural deformities are also known as contracted tendons, although this technically is not the correct term as the tendons are not contracted. It is more the fact that the tendons didn't grow long enough or in proportion with the bones. [38] Congenital flexural deformities can have many causative factors and therefore there extract origin or cause can be hard to explain. [39]

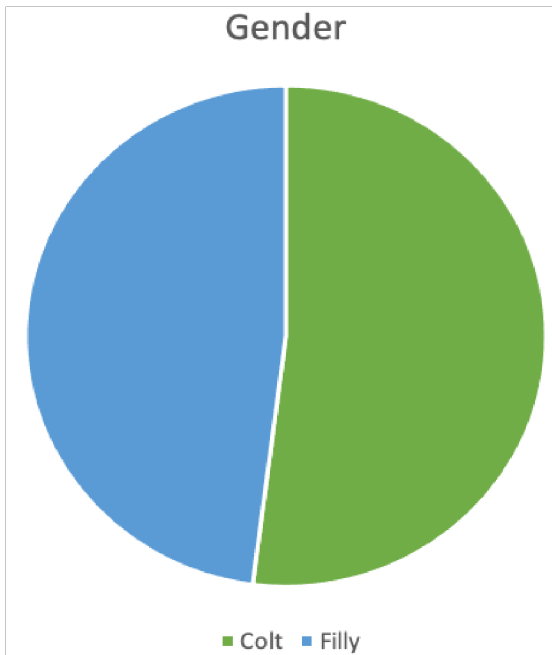
It has been suggested that one of the causes of flexor limb deformities is intrauterine malposition. [40] [41] In a 2012 study done in New Zealand it was reported that larger foals are 2.8 times more likely to have contracted tendons when compared with medium foals and that foals born mid breeding season was 3.28 times more likely to have contracted tendons then foals born early in the breeding season. [42] Mares that ate Locoweed while in foal was reported as a teratogenic cause of contracted tendons in foals, [43] and also ingestion of a hybrid Sudan grass was also highlighted as a possible cause [44]. In 1977 influenza outbreaks in mares were identified as a possible cause of contracted tendons. [45] There is a dominant gene mutation in stallions which contributes to the occurrence of contracted tendons. [46] Thoroughbred foals are 0.35 times more likely to have contracted tendons when compared with standard bred foals [42], this study also reported 63.63% of foals with contracted tendons were bilateral and 20.45% were unilateral, 4.55% had three legs with contracted tendons and 11.37% were contracted on four legs. Congenital flexural deformities are most often in the carpus or the fetlock joint [41]. Contracted tendons if severe enough can be a cause of dystocia. [47]

Results and Discussion

Over the time of this study 588 foalings took place overall, 282 fillies and 306 colts overall. With 37 mares in total during the month of January, 78 mares in total during the month of February, 132 mares in total during the month of March, 154 mares in total during the month of April, 142 mares in total during the month of May, with 45 mares in total during the month of June.

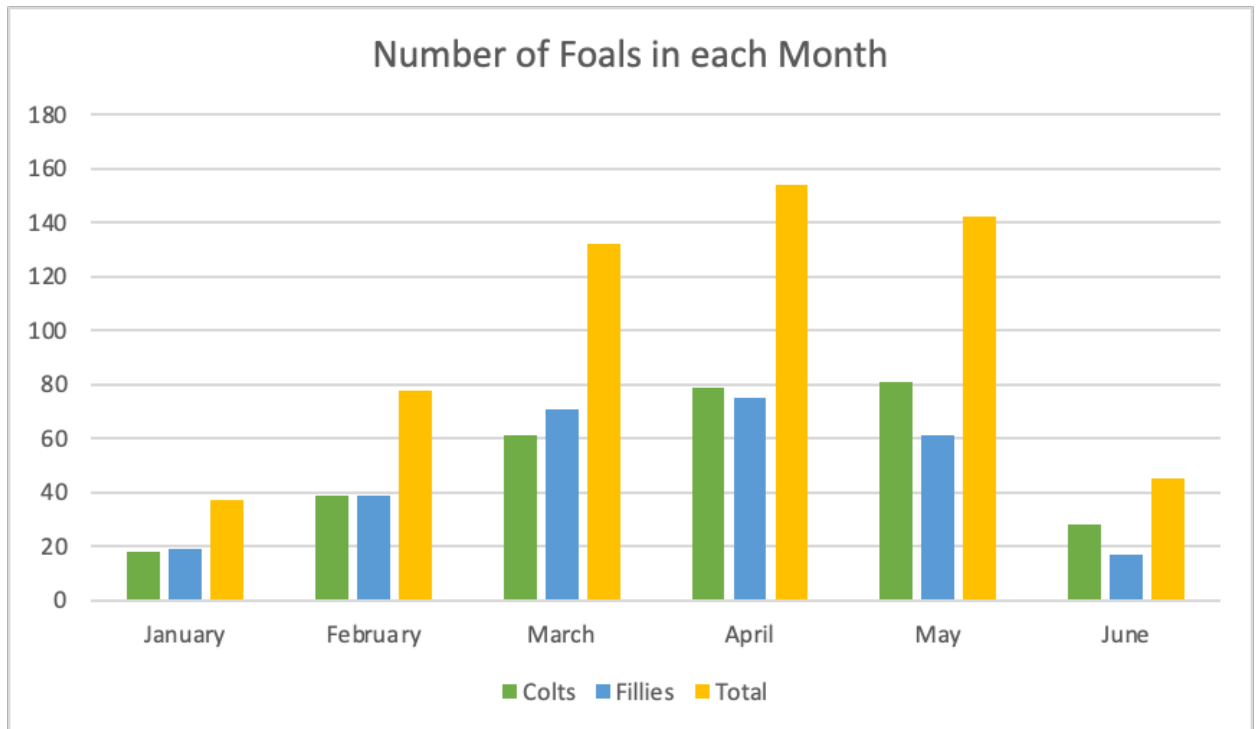
<i>Month</i>	Colt	Filly	Total
<i>January</i>	18	19	37
<i>February</i>	39	39	78
<i>March</i>	61	71	132
<i>April</i>	79	75	154
<i>May</i>	81	61	142
<i>June</i>	28	17	45
<i>Total</i>	306	282	588

Table 1: Number of foalings in each month and overall



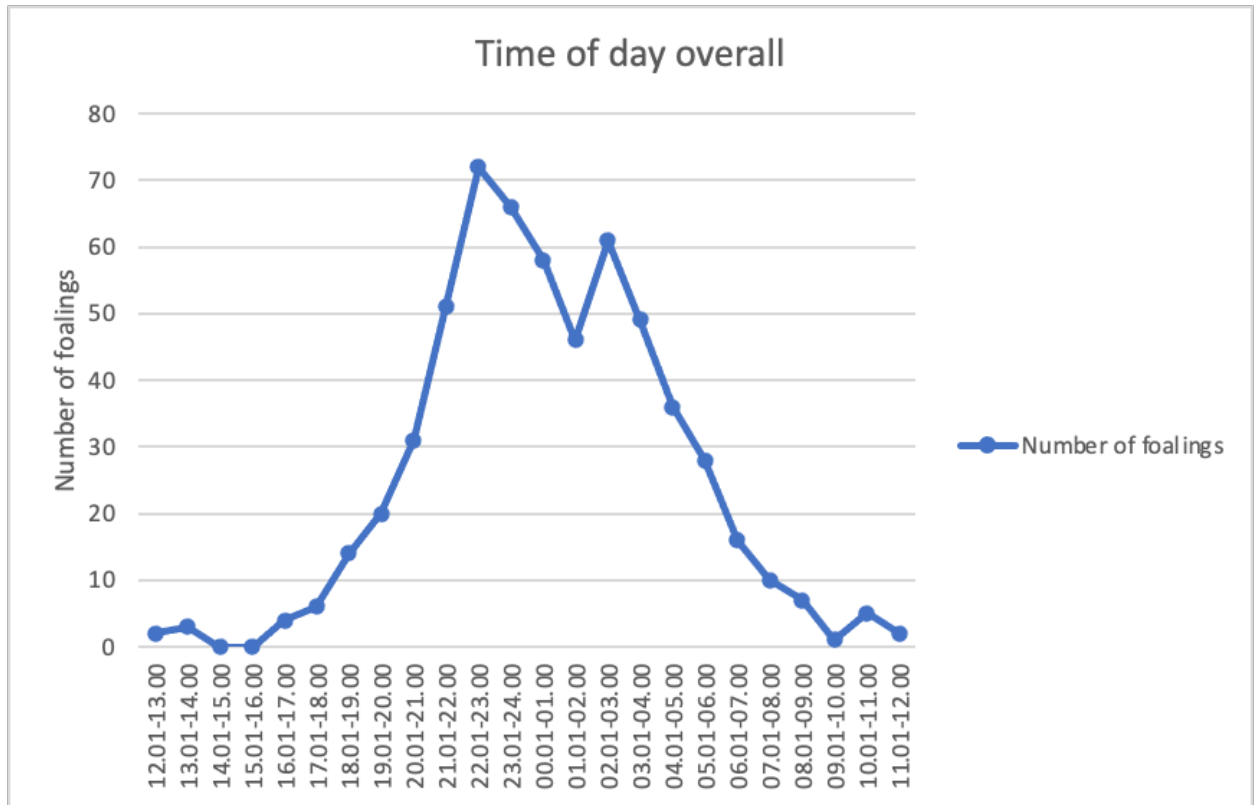
Graph 1: Colts versus Fillies born overall

There was 52.04% colts born and 47.96% fillies born out of the 588 foalings over all.



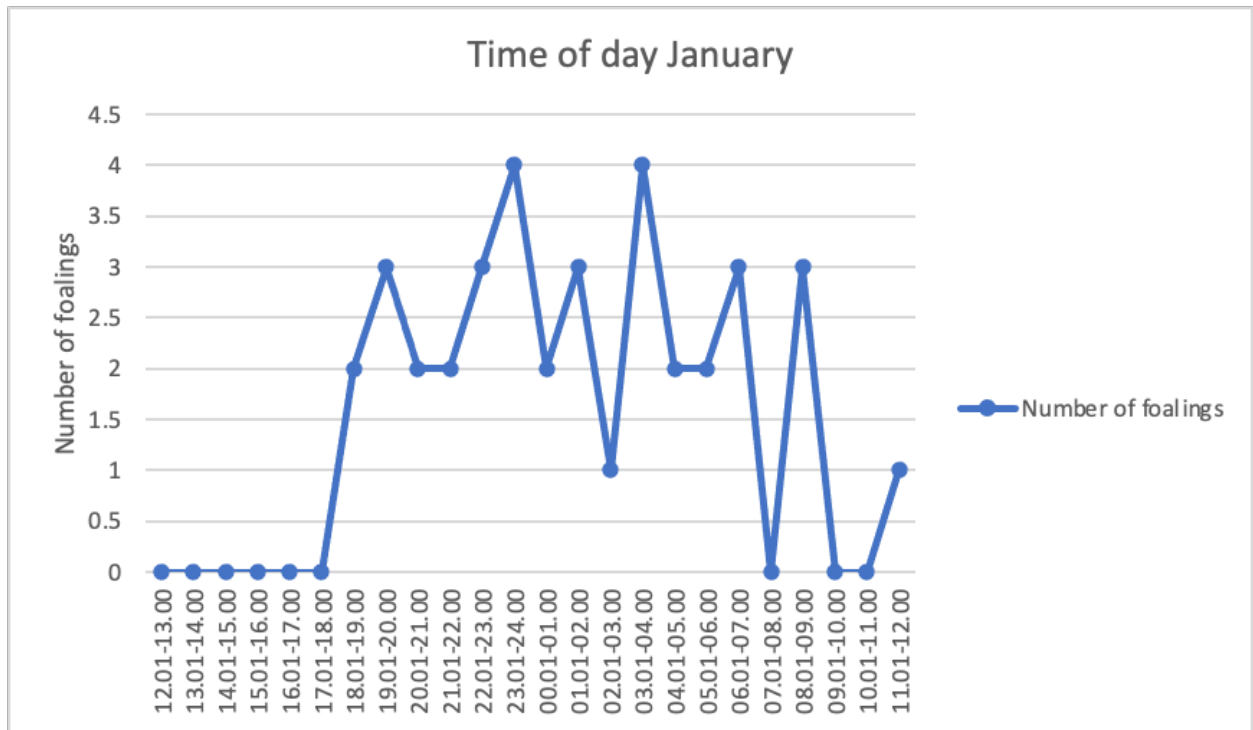
Graph 2: Number of foals born in each month

Out of the 588 foalings 84.7% took place between 20:01 and 06:00 and 15.3% of foalings took place between 06.01 and 20:00. With the most foalings taking place between 22:00-23:00. The majority of foalings (68.5%) taking place between the hours of 21:01-04.00.



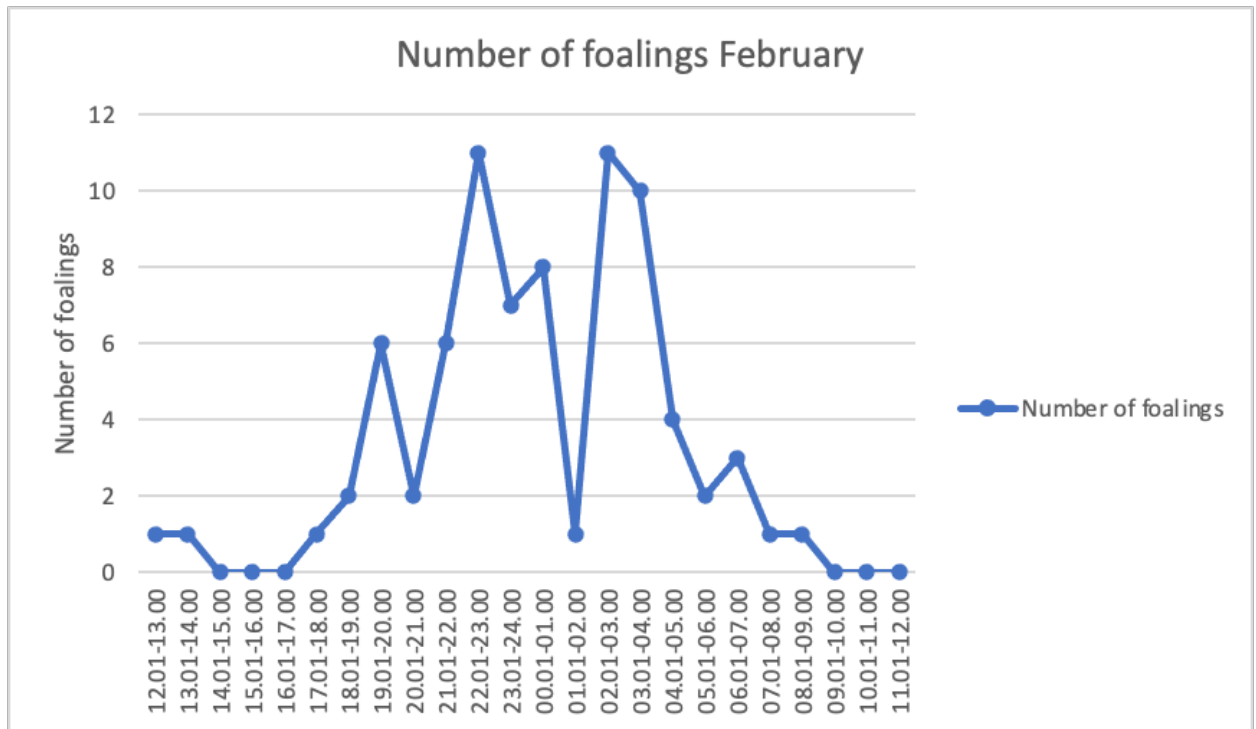
Graph 3: Time of day of foaling overall

Out of the 37 foalings in January 67.6% took place between 20:01 and 06:00 and 32.4% of foalings took place between 06.01 and 20:00. With the most foalings taking place between 23:01-24:00 and 03:01-04.00. The majority of foalings (75.6%) taking place between the hours of 19.01-.07.00, this likely accounts for the increase in the hours of darkness during the month of January



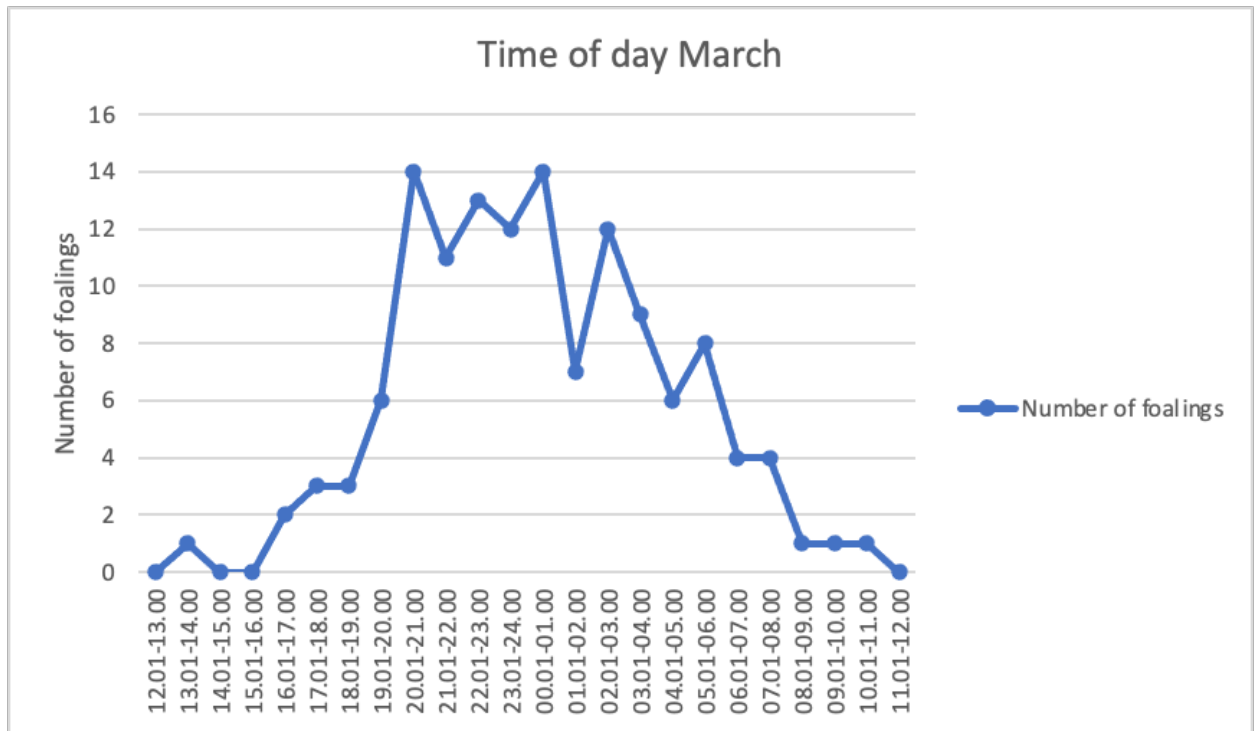
Graph 4: Time of day of foaling in the month of January

Out of the 78 foalings in February, 79.5% took place between 20:01 and 06:00 and 20.5% of foalings took place between 06.01 and 20:00. With the most foalings taking place between 22:01-23:00 and 02:01-03:00. The majority of foalings (61.5%) taking place between the hours of 22:01-04:00.



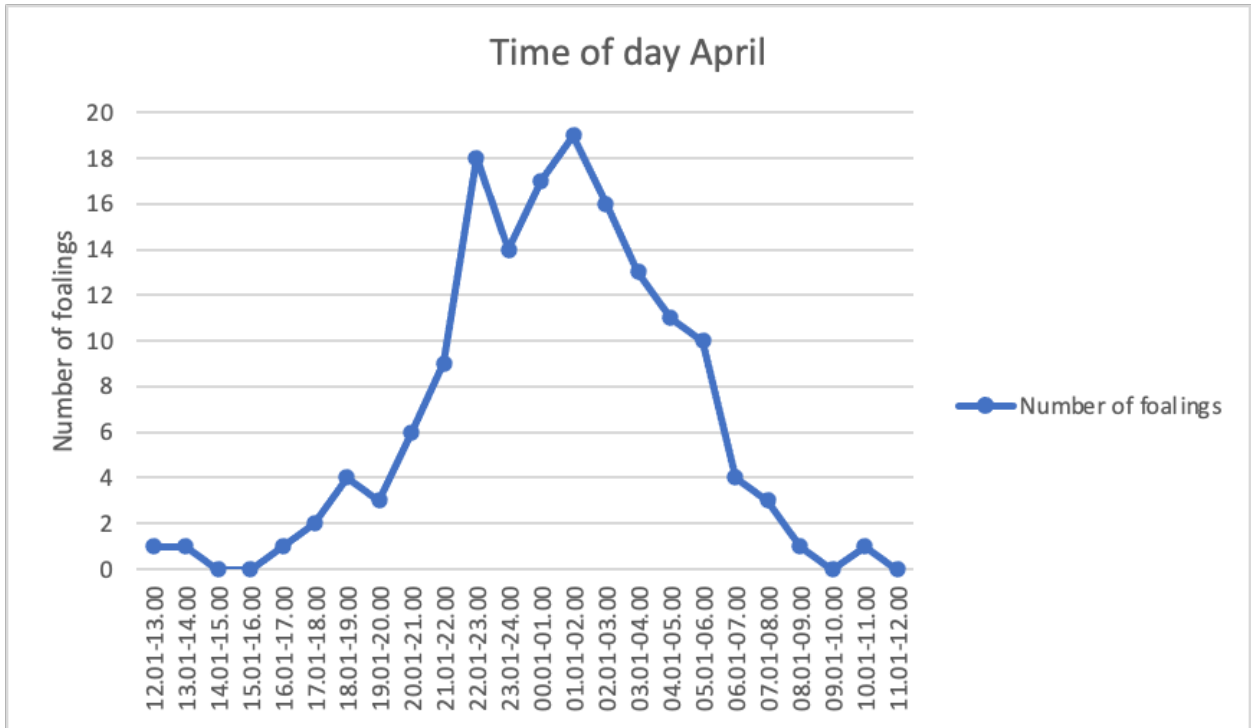
Graph 5: Time of day of foaling in the month of February

Out of the 132 foalings in March, 80.3% took place between 20:01 and 06:00 and 19.7% of foalings took place between 06.01 and 20:00. With the most foalings taking place between 20:01-21:00 and 00:01-01:00. The majority of foalings (62.8%) taking place between the hours of 20:01-03.00.



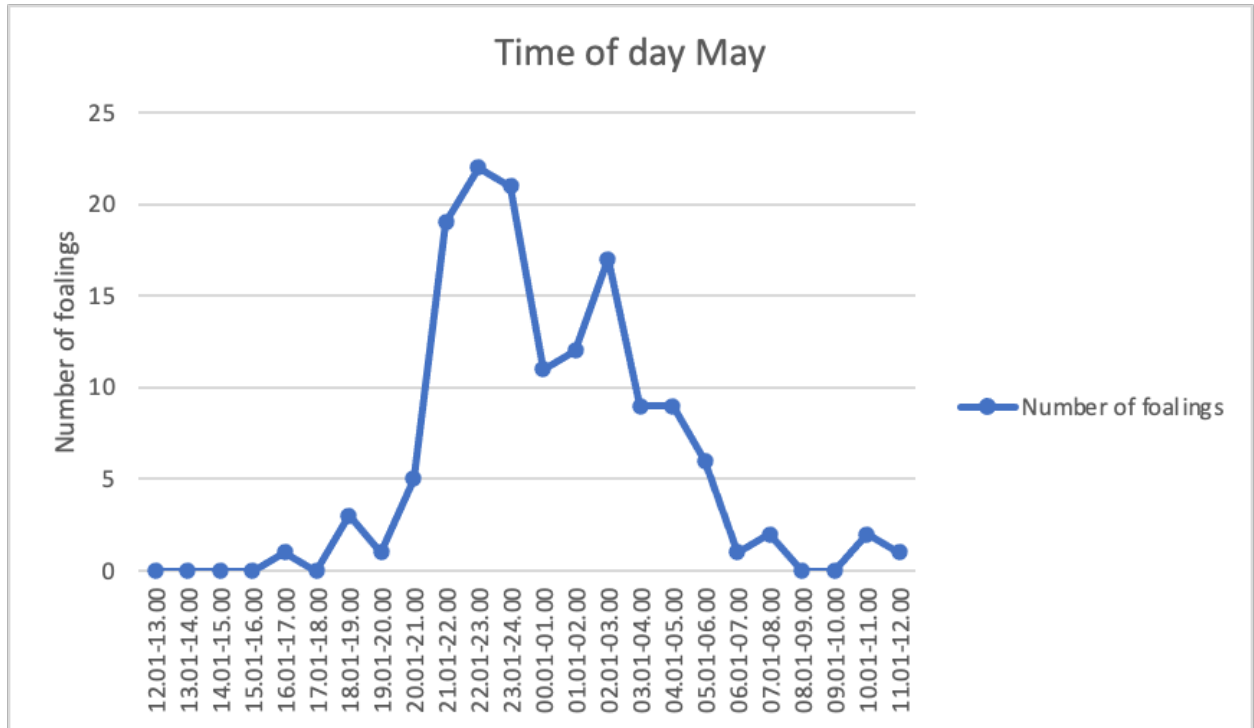
Graph 6: Time of day of foaling in the month of March

Out of the 154 foalings in April, 86.4% took place between 20:01 and 06:00 and 13.6% of foalings took place between 06.01 and 20:00. With the most foalings taking place between 01:01-02:00. The majority of foalings (54.5%) taking place between the hours of 22:01-04:00.



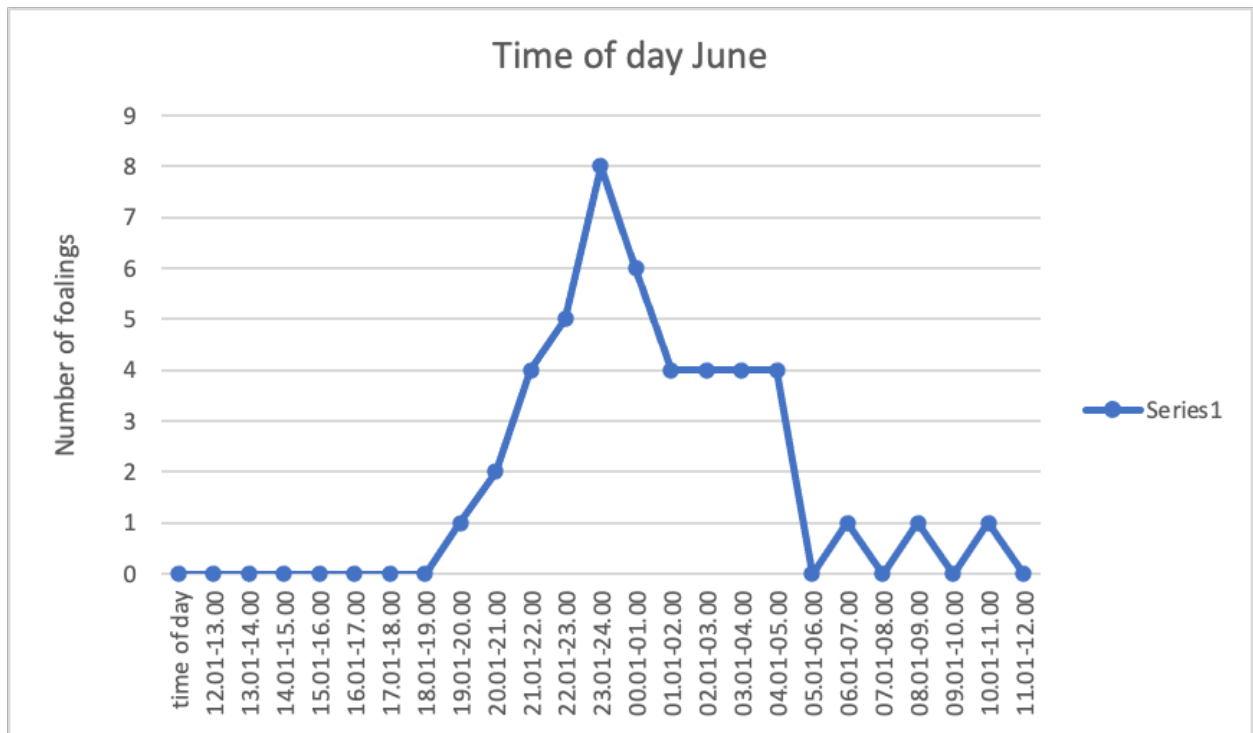
Graph 7: Time of day of foaling in the month of April

Out of the 142 foalings in May, 92.3% took place between 20:01 and 06:00 and 7.7% of foalings took place between 06.01 and 20:00. With the most foalings taking place between 21:01-23:00. The majority of foalings (71.8%) taking place between the hours of 22:01-04:00.



Graph 8: Time of day of foaling in the month of May

Out of the 45 foalings, 91.2% took place between 20:01 and 06:00 and 8.8% of foalings took place between 06.01 and 20:00. With the most foalings taking place between 23:01-24:00. The majority of foalings (60.00%) taking place between the hours of 21:01-02:00.

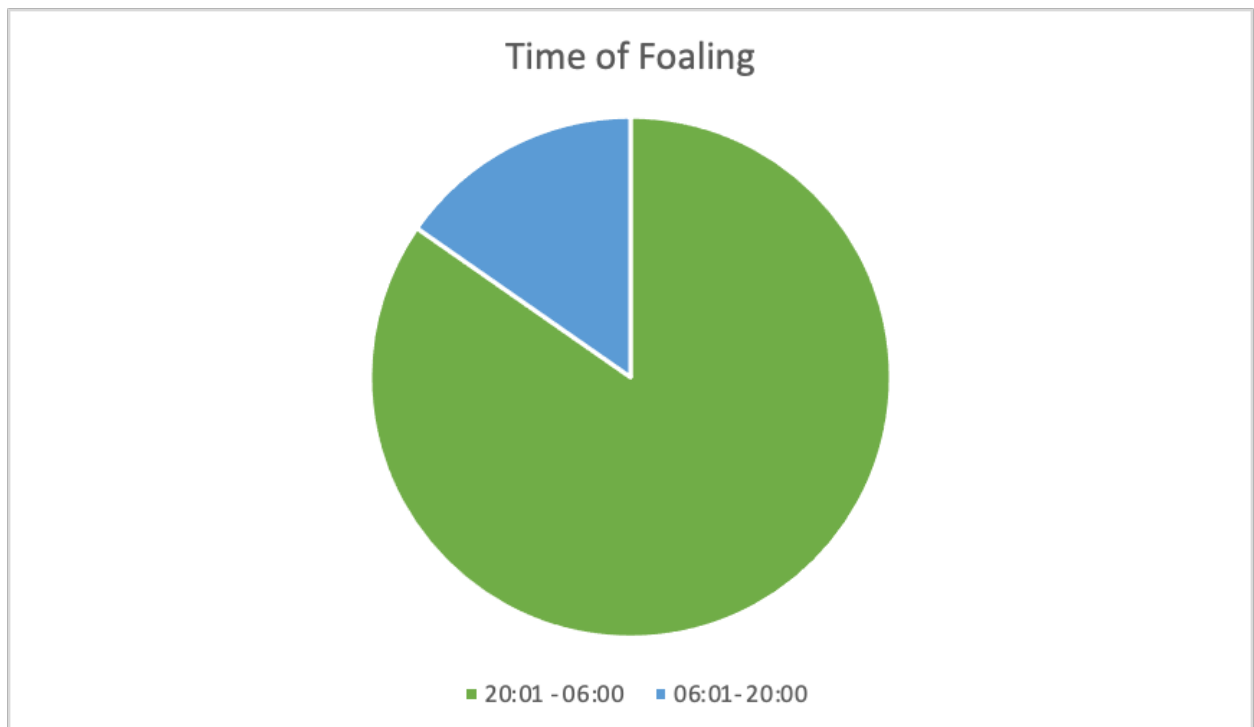


Graph 9: Time of day of foaling in the month of June

We can see that a large majority of the mares foal during the hours of darkness and the hours where human activity in the barn is at a minimum which both supports the theories of the circadian rhythm and environment stimulus playing a role in the time of the mares foaling. It is also evident that as the months go on the foalings as less spread out throughout the night and the majority of births take place within a shorter time period which matches with the less hours of darkness during the later months

Month	Number of foalings	% between 20:01-06:00	%between 06:01-20:00
<i>January</i>	37	67.6%	32.4%
<i>February</i>	78	79.5%	20.5%
<i>March</i>	132	80.3%	19.7%
<i>April</i>	154	86.4%	13.6%
<i>May</i>	142	92.3%	7.7%
<i>June</i>	45	91.2%	8.8%
<i>Total</i>	588	84.7%	15.3%

Table 2: Percentage of foalings between 20:01-06:00 and 06:01-20:00



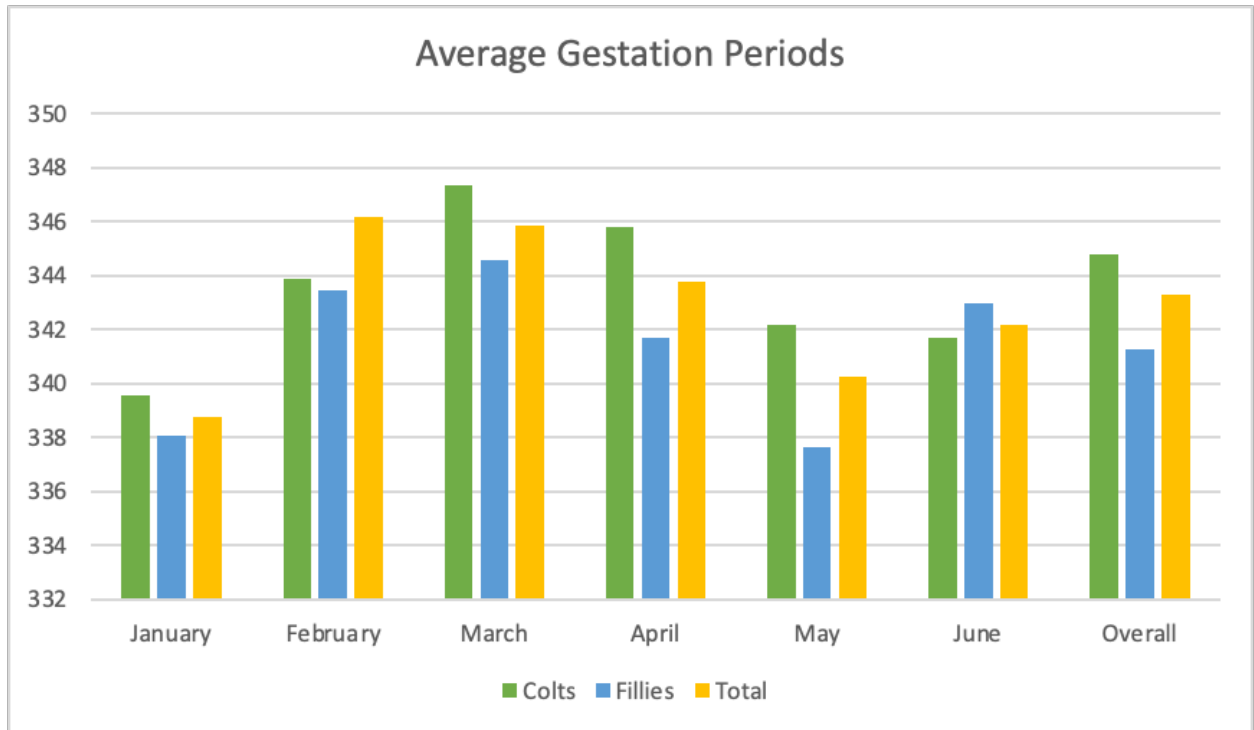
Graph 10: Number of foalings between 20:01-06:00 and 06:01-20:00

The average gestation period overall was 343.28 days. The average for colts was higher overall at 344.8 days and lower overall for fillies at 341.62 days. This is characteristic with previous studies showing that colts had a longer gestation period than fillies.

Month	Total	Colts	Fillies
<i>January</i>	338.78	339.55	338.05
<i>February</i>	346.15	348.87	343.44
<i>March</i>	345.86	347.33	344.59
<i>April</i>	343.79	345.78	341.68
<i>May</i>	340.25	342.2	337.67
<i>June</i>	342.20	341.71	343.0
<i>Total</i>	343.28	344.8	341.28

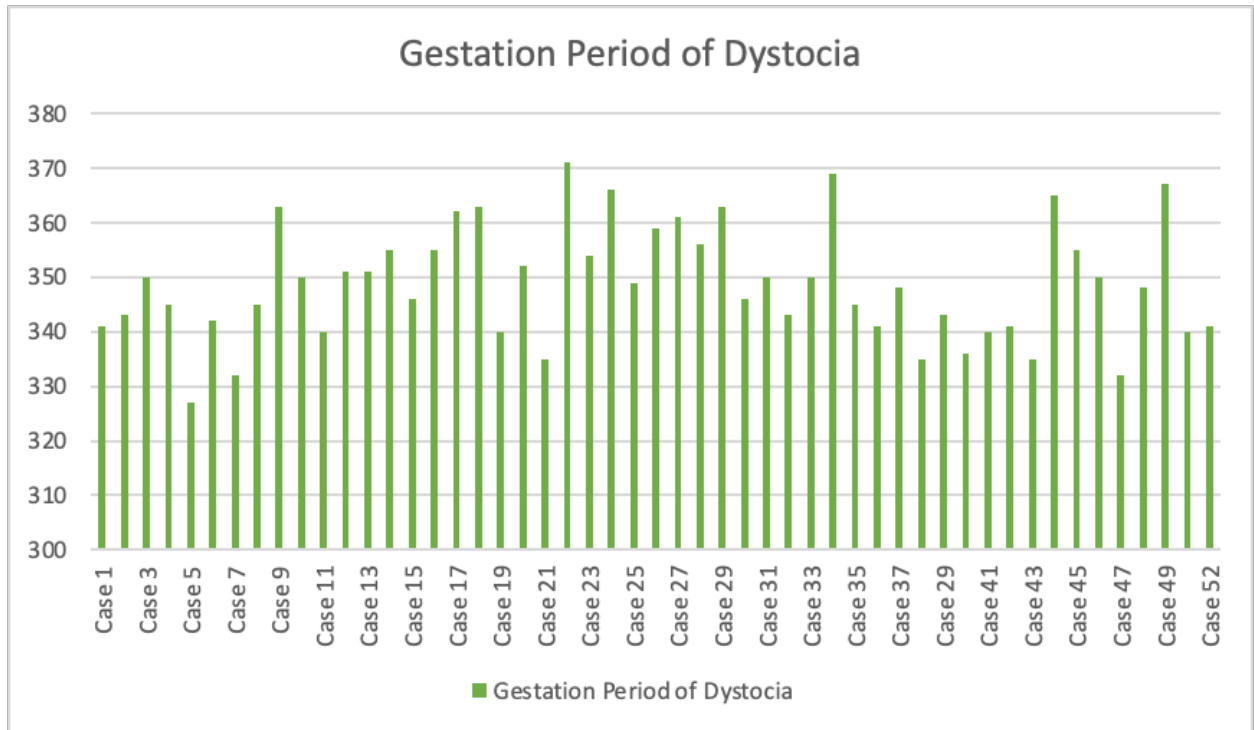
Table 3: Average gestation periods

In table 3 each months average gestation for colts and fillies and also colts and fillies combined is displayed. The average gestation period in January is shorter than other months when is contradictory to some other studies done but this can be accounted for in the management of these mares due to foal in January when they are kept inside for longer periods than other mares and kept under artificial lighting for longer periods than what would be natural daylight hours during these times, which other studies have showed to have an effect on shortening the gestation period.



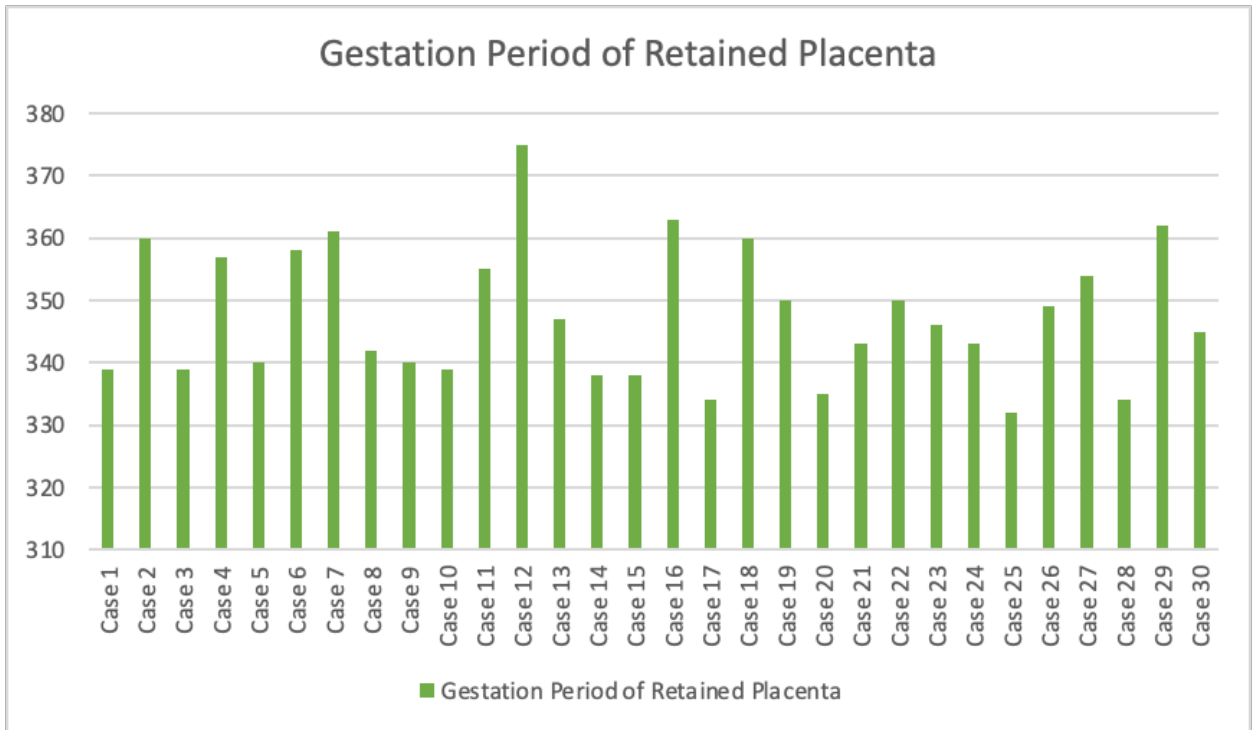
Graph 11: Average gestation periods

Unfortunately the records of dystocia occurrence at the foaling unit did not differentiate between the different types of dystocia. The occurrence rate for dystocia over all was 8.67%. The average gestation period for a mare with dystocia was 348.76 which is 5.48 days above the average gestation period which suggests there could be a link between dystocia and prolonged gestation. The longest gestation period with a dystocia was a colt foal with a gestation period of 371 days. The shortest gestation period with a dystocia was a filly foal with a gestation period of 327 days. Of the dystocia that occurred 62.75% were colt foals and 37.25% were filly foals. Showing an increase in the likelihood of a colt foal suffering a dystocia when compared with filly foals.



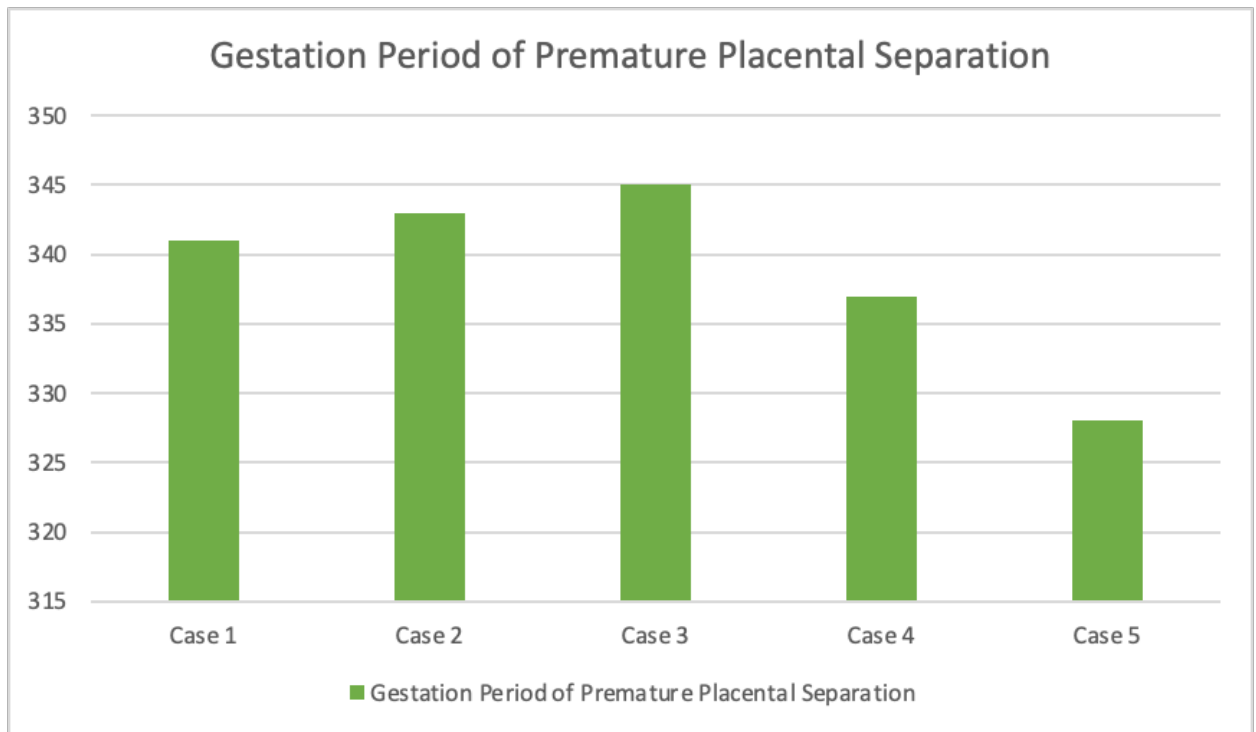
Graph 12: Gestation period for each dystocia case

In my study the frequency of occurrence of retained placenta was 5.1%. All mares with retained placenta were treated with oxytocin and antibiotics and uterine lavage. This result is in the lower echelons of the reported 2% - 10%. This may be put down to a number of reasons in the management of the stud farm. They do not breed mares on foal heats which is seen as a reason for increased risk of retained placenta. And most mares who are found to have uterine infections are not bred on that cycle and are treated with intrauterine antibiotics. The average gestation period for mares who had retained placenta was 347.6 days which is 4.32 days more than the average gestation period overall. There was no statistical difference between colt and filly foals and the occurrence of retained placenta in the mare. Previous literature also suggested that not only did larger foals with longer gestation periods increase the risk of retained placenta but so did difficult births in the case of dystocia. However, in this study only 1 of the 30 occurrences of dystocia did retained placenta also occur.



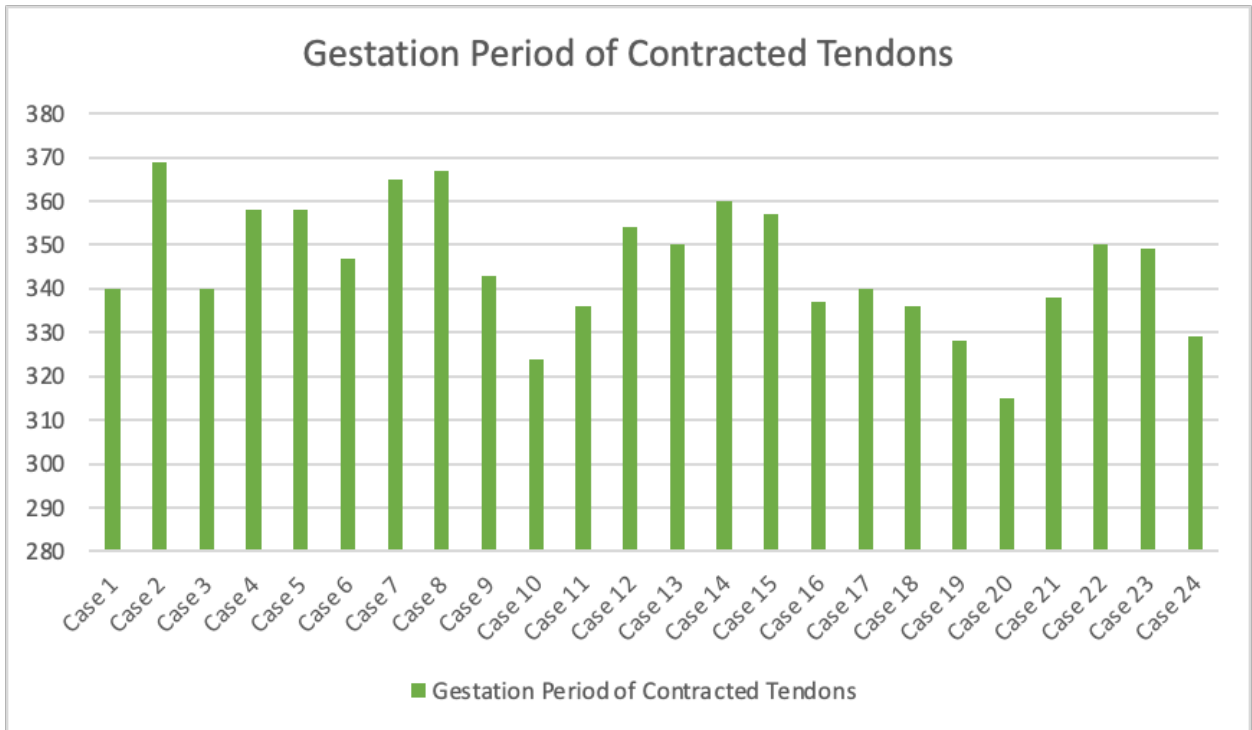
Graph 13: Gestation period for each retained placenta case

Premature placental separation occurred in 0.85% of births with foals that had an average gestation time of 338.8 days which is 4.48 days less than the average gestation period overall with no statistical significance between colts and fillies.



Graph 14: Gestation period for each premature placental separation case

The occurrence of contracted tendons overall was 4.08%. The months of May and June had the highest occurrence of contracted tendons, with May being 6.34% and June being 6.66%. The average gestation time for foals with contracted tendons was 345.4 days, 2.12 days over the overall average gestation period. There was no statistical significance between colts and fillies with contracted tendons.

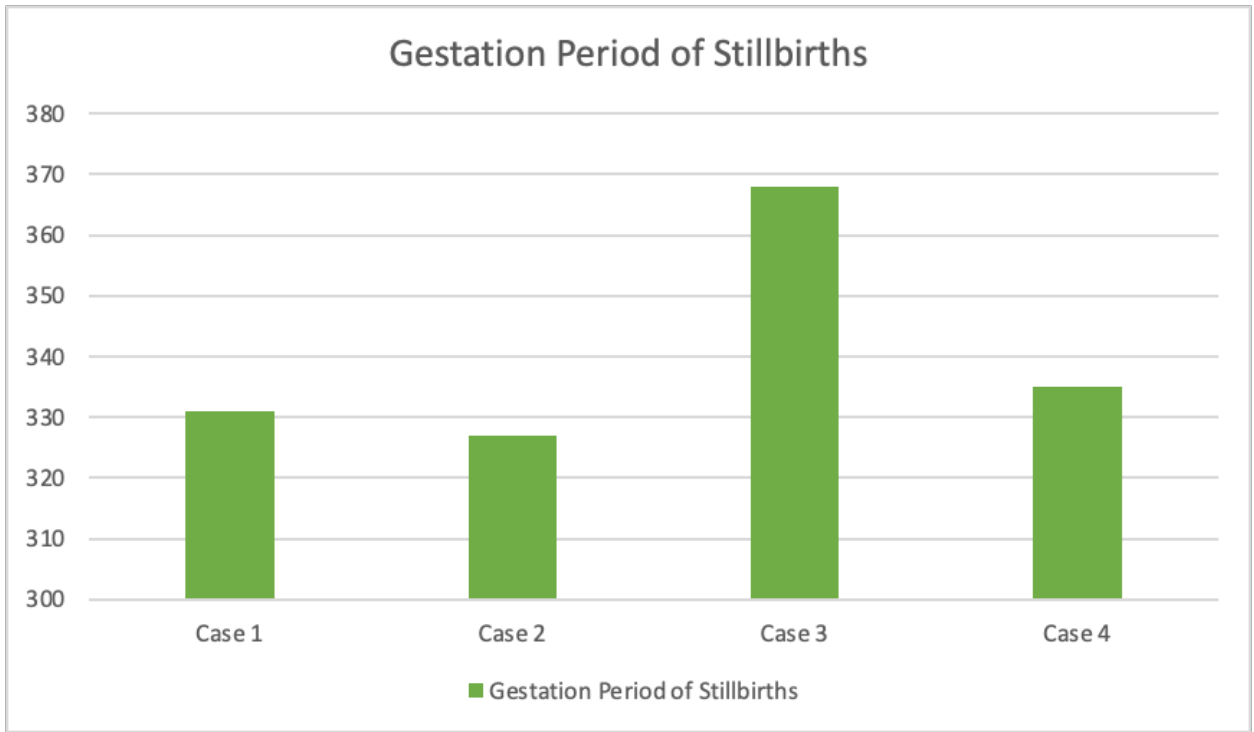


Graph 15: Gestation period for each contracted tendon case

In order to understand how these problems that occurred affect the foals immediate health, one of four states of health status were assigned to each foal. Foals that were born alive and continued to be healthy for the next five days nursing and showing no signs of illness such as diarrhoea, lack of appetite or temperature were defined as Survivals. Foals who were born dead and never took their first breath were defined as Stillbirths. Foals that were born alive but died or were put down within the first five days of life were defined as Mortalities. Foals that suffered medical conditions and were unwell within the first five days were defined as Morbidities.

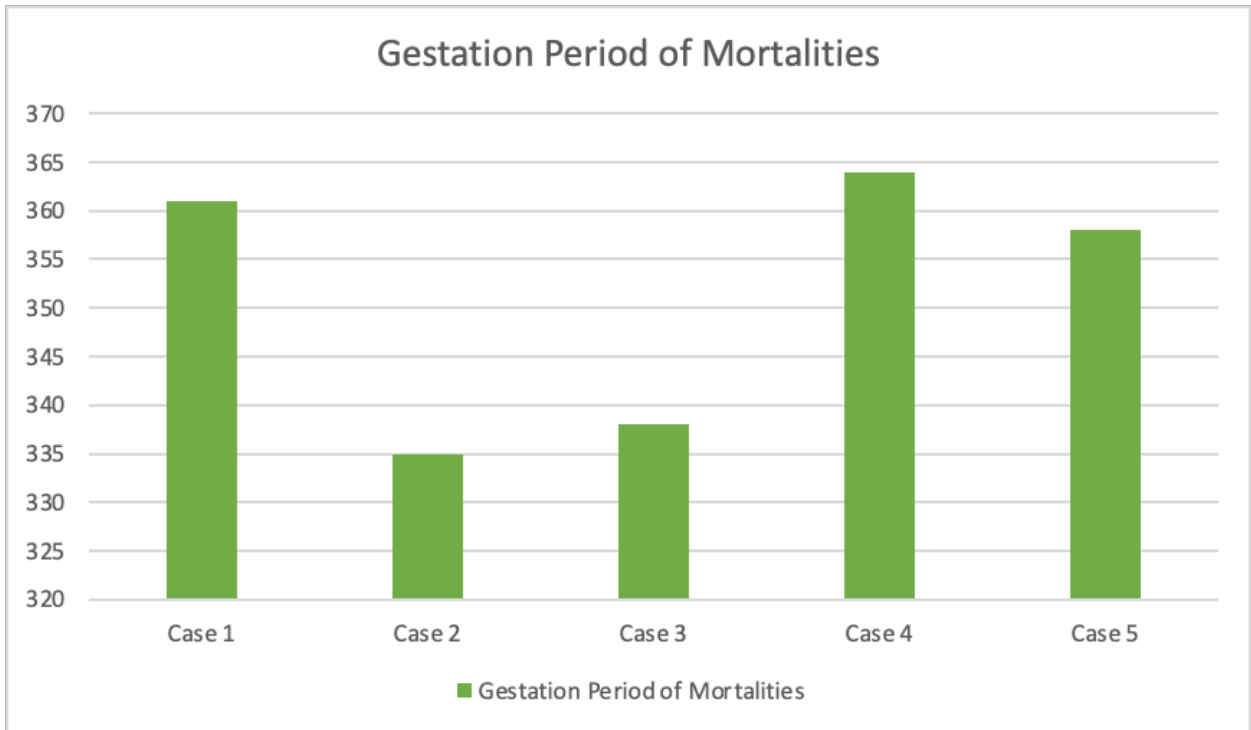
Out of the 588 foalings included in this study there was 557 survivals which resulted in a 94.73% rate of survivals. There was 22 morbid foals or 3.74%. There was 5 mortalities or 0.85% and there was 4 stillbirths or 0.68%.

The average gestation time for stillbirth foals was 340.25 days which is 3.03 days below the overall average.



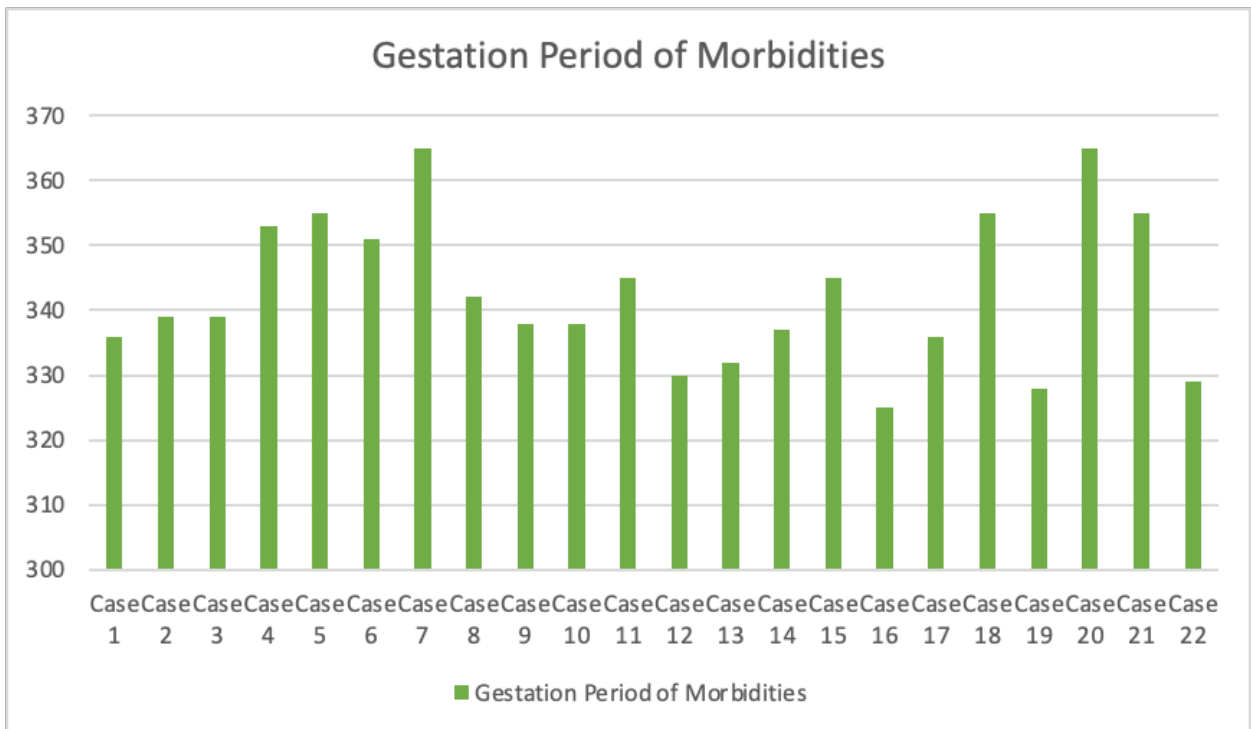
Graph 16: Gestation period for each stillbirth case

The average gestation time for Mortalities was 351.2 days which is 7.92 days above the overall average gestation time.



Graph 17: Gestation period for each mortality case

The average gestation time for morbidities was 342.6 which is 0.68 days below the overall gestation time.

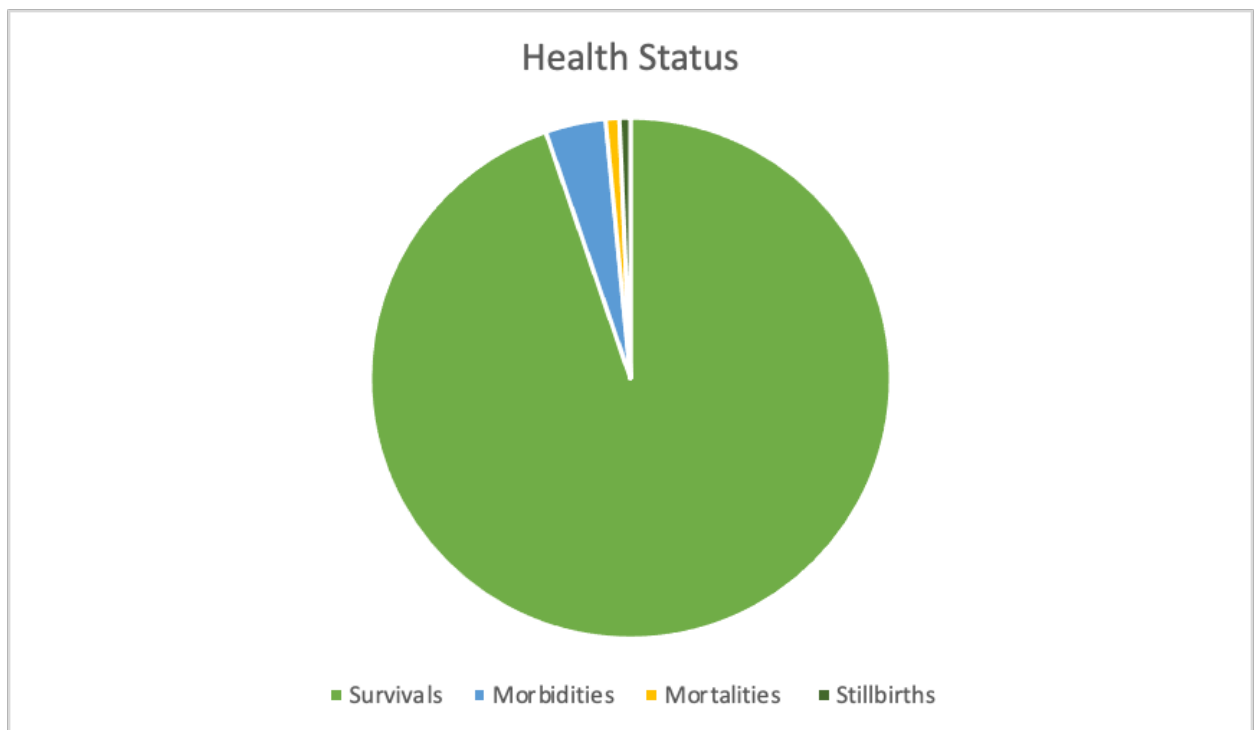


Graph 18: Gestation period for each morbidity case

Of the four stillborn, only one foal had a determined cause of stillbirth which was a colt with a gestation time of 368 days with a severe hip lock dystocia.

Of the five mortalities 2 foals died due to unexplainable reasons. Two foals were put down, one had broken ribs and the other one was malformed with a curved spine, and one foal had a very large naval hernia with the majority of its intestines coming out its naval.

Of the 22 morbid foals, 6 of these had passed meconium in utero and were sent to an ICU hospital for care, one foal suffered a meconium impaction which was treated with antiinflammatories and multiple enemas at intervals; 2 suffered from swollen navels which was treated with oral antibiotics and one with swollen joints and a slightly evaluated temperature. Of the other Morbidities these were mainly foals which were slow to nurse and not doing well overall only one was a direct result of a dystocia.



Graph 19: Health status

Acknowledgments

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Thesis progress report for veterinary students

Name of student: George Hennessy

Neptun code of the student: VXYMTC



Name and title of the supervisor: Prof. Dr. Szenci Ottó

Department: Department of Obstetrics and Food Animal Medicine Clinic

Thesis title: Control of foaling in Springfield Farm Co. Waterford, Ireland




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Consultation – 1st semester

	Timing			Topic / Remarks of the supervisor	Signature of the supervisor
	year	month	day		
1.	2022	09	07 & 09.19	Selection of the topic for the thesis	
2.	2023	05	03	Discussing the progress of the thesis	
3.					
4.					
5.					

Grade achieved at the end of the first semester: five (5)

Consultation – 2nd semester

	Timing			Topic / Remarks of the supervisor	Signature of the supervisor
	year	month	day		
1.	2023	10.	23.	Discussing the progress of the thesis	
2.	2023	10.	28.	Discussing the progress of the thesis	
3.	2023	11.	13.	Discussing the final version of the thesis	



4.					
5.					

Grade achieved at the end of the second semester:5 (five)

The thesis meets the requirements of the Study and Examination Rules of the University and the Guide to Thesis Writing.

I accept the thesis and found suitable to defence,

Dr. Ottó Szenci

.....
signature of the supervisor

Signature of the student:

Signature of the secretary of the department:

Date of handing the thesis in.....