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# APGAR score as a method for prediction of survival prognosis in newborn puppies and kittens

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## SUMMARY

Neonatal mortality is a widespread problem in small animal medicine, of both economical and emotional concern. In human medicine, the APGAR scoring scale is used frequently worldwide since the 1950's as an evaluation tool of viability in newborn infants. Scoring is performed by examination of the newborn infants one and five minutes after birth, considering five basal characteristics. Those characteristics includes: heart rate; respiratory effort; muscle tone; reflex irritability and color. Each parameter is graded from 0–2 and then summarized to a total score determining the viability. Low APGAR scores indicate that the newborns require particular attention and care. Even though this method is simple and developed several decades ago, it is still valid. APGAR scoring, however, has not been extensively implemented in veterinary medicine although it is both feasible, cheap and easy to perform. Identifying more critical neonates at the time of birth could possibly decrease mortality, since those individuals might receive an intensive neonatal care more immediately when required.

According to the results of this study, APGAR score was associated with both viability and time of expulsion of each puppy ($P<0.01$). Viability and birth weight were significantly associated in kittens ($P<0.0001$). No significant association was found between birth weight of kittens and litter size or queen's weight or tomcat's weight, neither any significant association with time of expulsion for each kitten and APGAR. Median birth weight in each litter was not associated with the weight of the queen or tomcat or litter size. Nevertheless, there was a significant association between body weight of the queen and birth weight index of kittens ($P<0.01$).

This study concludes and augments that APGAR scoring can be used as a simple method of determining instantaneous neonatal health in newborn cats and dogs – both by breeders at home and by staff at veterinary clinics after cesarean sections. Suggesting APGAR scoring to be a helpful tool in preventing and reducing neonatal death. The results of this study could be of interest for both practitioners of veterinary medicine as well as breeders of cats and dogs, providing helpful tools to improve and refine breeding management.

**CONTENT**

## INTRODUCTION

Puppies and kittens are defined as neonates during first two to three weeks of life (Moon *et al.*, 2001). Neonatal mortality is a widespread problem in small animal medicine and of both an emotional and economical matter for the owners. Mortality rate is reported to be relatively high, in both puppies and kittens (Sparkes *et al.*, 2006; Ström Holst & Frössling, 2009; Chastant-Maillard *et al.*, 2017; Fournier *et al.*, 2017). Mortality can occur due to several factors such as prolonged or dystocic parturition, infectious diseases, malformations or lack of appropriate care of the newborns (Sparkes *et al.*, 2006; Münnich & Küchenmeister, 2014). Low birth weight is also one of the factors that increases the risk of neonatal death considerably. Regular monitoring of weight gain is an easy and lucid way of detecting early signs of underlying neonatal illness, which can be used by breeders without need of any advanced tools, since lack of weight gain often is seen before clinical signs in the newborn and therefore could be a warning sign at an early stage (Indrebø *et al.*, 2007).

It is possible that the high rate of neonatal mortality could be reduced with a systematic and objective examination of newborn puppies and kittens where individuals at risk and in need of more intensive care could be identified – both in eutocias and dystocias, as well as litters born at home or litters delivered by veterinary intervention. This is performed in newborn infants on a regular basis by the means of APGAR scoring and goes back more than 50 years in human medicine, but still remains as important and relevant today. Viability of all newborn infants is evaluated regarding five simple clinical characteristics included in the APGAR scoring system at birth, thereby individuals at higher risk and in need of more extensive care could be identified (Casey, 2001).

Until today several studies have investigated the use of APGAR scoring in puppies. However, there are no published studies, as far as the author knows, regarding the use of APGAR scoring as a method for assessing neonatal viability and prediction of short-term survival in kittens.

The aim of this study was to examine if APGAR scoring could be used as a reliable method of determining neonatal health in newborn cats and dogs – both by breeders at home and by staff at veterinary clinics after cesarean sections. The study also examined if there was an association between APGAR score and survival and APGAR score and birth weight in both kittens and puppies.

## LITERATURE REVIEW

### Normal pregnancy and parturition

#### *The bitch*

Knowledge of the normal parturition is of great importance, as well as the ability to detect abnormalities during parturition, for correct diagnosis and to provide the bitch or queen with adequate care.

Duration of pregnancy in the bitch varies from 57–72 days, counted from the day of mating (Johnston *et al.*, 2001). Normal labor is divided into three stages. Stage I in the bitch normally occurs 24 hours after serum progesterone declination and circulating prostaglandin elevation.

Body temperature drops by 1–3°C, usually below 37.8°C, 8–24 hours before parturition begins and then elevates to a normal or slightly higher temperature when the second phase begins. Stage I generally lasts for 3–12 hours in the bitch. During stage I uterine myometrial contractions increase in both frequency and strength and cervix dilates. No abdominal effort can be seen during the first stage. The bitch may show behavioral changes such as restlessness, nesting, refusal to eat and vomiting. Vaginal discharge is clear and watery (Davidson, 2014).

Stage II is characterized by dilation of the cervical canal, visible abdominal contractions and myometrial contractions that move the fetus caudally in the birth canal. Those mechanisms are mediated by two reflexes. The straining reflex with abdominal contractions results from pressure against the pelvis. Pressure from the fetus against cervix and the vaginal wall stimulates the release of oxytocin, subsequently initiating the Ferguson's reflex and thereby myometrial contractions. This eventually leads to delivery of a neonate (Davidson, 2014).

Although there is a great variation between bitches, generally not more than one to two hours should pass between the deliveries of each puppy. The bitch can be anorectic, panting and trembling. Vaginal discharge can vary between clear, serous to hemorrhagic or green. Green vaginal discharge is an indication of placental separation which, if seen before expulsion of the first fetus, means that the first puppy should be delivered within one to two hours. Stage II in the bitch lasts for a total of 3–12 hours, but usually less than six hours. The first puppy is usually born within five minutes to two hours after the onset of stage II. Stage II should not proceed for longer than 12 hours due to increased risk of stillbirth and metritis (Davidson, 2014).

Stage III is defined as the delivery of placenta. All fetuses and placentas are delivered vaginally during normal parturition, but not necessarily together. This stage is not clearly separated from stage II in litters with more than one neonate (Davidson, 2014).

### *The queen*

Pregnancy in the queen lasts for 52–74 days, counted from first or last day of mating. Mean gestation length is 65–66.9 days. There is no drop in temperature previous to parturition in the queen (Johnston *et al*., 2001). Restlessness and panting is observed when uterine contractions begin, pacing and purring alternates (Johnston *et al.*, 2001).

The onset of parturition is less distinct in the queen compared to the bitch. Though, the characteristics of the different stages are similar in the queen. Stage I usually lasts for 4–24 hours and stage II and III from 2–72 hours (Sparkes *et al.*, 2006; Davidson, 2014). This means that on occasion, parturition in the queen could last for two to three days with delivery of healthy kittens (Johnston *et al.*, 2001).

## Dystocia

Dystocia, abnormal parturition, is defined as difficulties with normal vaginal delivery of a neonate from the uterus.

Dystocia occurs in approximately 2% of all bitches and 16% of all pregnancies. These numbers were calculated from incidence of dystocia in all insured bitches in a Swedish insurance data

base. Also, Boston terrier, English Bulldog and French Bulldog were excluded in this study (Bergström *et al.*, 2006).

A recent retrospective study showed that the incidence rate for dystocia in cats was about 22 cats per 10000 cat-years at risk. There was also a significantly higher incidence rate ratio in British Shorthair, Oriental breeds and Birman and a significantly lower incidence rate ratio in Norwegian Forest Cat, Persian and Exotic cats, Maine coon and Cornish rex. Case fatality for dystocia in queens is 2%. The data from this study concerns all cats in the database used, not only pregnant queens which needs to be taken into consideration when interpreting those numbers (Holst *et al.*, 2017).

Dystocia can occur due to maternal factors or fetal factors, or a combination of both. Maternal factors causing dystocia include uterine inertia, birth canal anomalies and intrapartum compromise – the latter including metabolic abnormalities such as hypocalcemia and hypoglycemia. Risk of dystocia is increased in singleton pregnancies, which may lead to one abnormally large puppy, and in obese bitches (Johnson, 2008).

Studies have shown that maternal factors cause 75.3% of dystocias in dogs (Darvelid & Linde-Forsberg, 1994) and 67.1% of dystocias in cats (Ekstrand & Linde-Forsberg, 1994). Those factors of fetal origin that causes dystocia are oversize, malposition, malposture and anatomical anomalies (for example hydrocephalus and anasarca). 24.7% of dystocias in dogs originates from fetal factors (Darvelid & Linde-Forsberg, 1994) and 29.7% respectively in cats (Ekstrand & Linde-Forsberg, 1994). The most common reason for maternal dystocia in cats is uterine inertia and malpresentation is the most common reason originating from fetal factors (Ekstrand & Linde-Forsberg, 1994).

### *Treatments of dystocia*

Health of the bitch, progression of labor and fetal heart rate as a sign of fetal distress should be considered by the veterinarian to determine whether surgical treatment is indicated or not. Cesarean section (CS) is indicated if the bitch or queen is unresponsive to medical treatment or if fetal distress is present despite sufficient uterine contractions. Maternal abnormalities of the birth canal, obstructive dystocia not possible to correct, primary or secondary uterine inertia, or suspected uterine rupture or torsion are also indications for CS (Traas, 2008).

More than 60% of dystocias in bitches result in cesarean sections (Darvelid & Linde-Forsberg, 1994; Bergström *et al.*, 2006). In queens these numbers vary between studies. One study shows that 79.4% of dystocias in cats end up with cesarean section (Ekstrand & Linde-Forsberg, 1994), whilst another shows 56% of cats with dystocia end up with a surgical treatment (Holst *et al.*, 2017). Small litter sizes in cats are associated with CS, as well as presence of stillborn kittens (Sparkes *et al.*, 2006; Ström Holst & Frössling, 2009).

Presence of several factors increases the likelihood of all puppies being alive when a CS is performed, including: surgery was not an emergency; the bitch was not brachycephalic; the litter consisted of four or less puppies; no naturally delivered or malformed puppies in the litter; spontaneous breathing in all puppies at birth; at least one puppy vocalizing spontaneously at

birth; and the anesthetic protocol includes neither methoxyflurane nor xylazine (Moon *et al.*, 2000).

## Neonatal care

Newborn puppies and kittens are defined as neonates between birth and first two to three weeks of life (Moon *et al.*, 2001). All newborn neonates should undergo a physical examination to detect presence of any congenital malformations (Johnston *et al.*, 2001). Congenital defects were observed in one or more kitten in 14.3% of litters (Sparkes *et al.*, 2006).

Suckling reflex should be present in the newborn, as well as the ability to nurse within approximately an hour after birth. Puppies acquire most of their passive immunity through ingestion of colostrum containing antibodies (Johnston *et al.*, 2001).

Newborn puppies have a high ratio of surface area to body mass and limited storage of subcutaneous fat which makes them prone to heat loss (Moon *et al.*, 2001). Neither do they possess fully developed shivering reflex nor vasoconstrictive mechanisms, hence it is important to ensure a suitable environment to prevent heat loss. During the first week of life, the rectal temperature of the newborn puppies and kittens is 35-37.2°C increasing to 36.1–37.8°C during week two and three. Thereafter the rectal temperature is similar to the adult (Johnston *et al.*, 2001).

It is of great importance to prevent chilling of neonates since newborn puppies are unable to respond to low body temperature in the same physiological manner as the adult dog. Neonates respond with bradycardia which may lead to failure to suckle, dehydration and even death. When rectal temperature declines below 34.4°C, the neonate develops gastrointestinal ileus and refusal to nurse which in turn further worsens the condition. Feeding chilled puppies with ileus by force might result in regurgitation leading to aspiration pneumonia. Puppies with low body temperature are more sensitive to infections, such as bacterial or canine herpes virus (Johnston *et al.*, 2001; Münnich & Küchenmeister, 2014). A room temperature between 20 to 24°C is sufficient for the bitch and the puppies (Münnich & Küchenmeister, 2014).

Neonatal puppies do not have the same capability of retaining blood glucose at normal levels because of their immature liver, which is not yet fully functionable in the same way as the adult's and therefore less efficient in generating energy. Generation of glucose in neonates is limited, in combination with a larger demand of glucose compared to the adult. Neonates have limited glycogen stores and once they are emptied, normoglycemic levels are difficult to maintain (Johnston *et al.*, 2001; Münnich & Küchenmeister, 2014). The supply changes from placental to endogenous food stores for production of glucose at birth. There is a declination of hepatic glycogen stores by >50% during the first 3–24 hours of life. Glucose metabolism switches from glycogenolysis to a combination of glycogenolysis and gluconeogenesis after birth (Grundy, 2006). To maintain adequate blood glucose levels in the newborn, regular feeding and appropriate nutritional status of the bitch should be established (Johnston *et al.*, 2001). Hypoglycemia can be caused by other disorders or from cold temperatures. Before six days of age, puppies produce energy through non-shivering mechanisms which require energy and thus easily results in hypoglycemia. Puppies that are ill or stressed are prone to develop

hyperglycemia. Also, puppies with a relatively low birth weight have a higher metabolism and consequently a higher requirement of energy which means a higher risk of becoming hypoglycemic (Münnich & Küchenmeister, 2014).

## APGAR scoring

Newborn evaluation by APGAR scoring was first used in the human medicine during the 1950's and has been widely used ever since. Infants are evaluated by one and five minutes after birth regarding the five parameters heart rate, respiratory effort, muscle tone, reflex irritability, and color. Each of them scored as 0–2 and then summarized into a total score indicating the viability of the newborn infant (Casey, 2001). However, the APGAR scoring system is not used in a large extent in veterinary medicine today. A study by Veronesi *et al* published in 2009 is the first one regarding the use of APGAR scoring in small animal internal medicine. The scoring scale used was a modified version with adaptions of the parameters measured to the canine neonate. The parameters examined five minutes after birth were: heart rate, respiration, irritability reflex, motility and mucus membrane color. Each parameter was scored as 0, 1 or 2 and then summarized into a total APGAR. Based on the total score, the neonates were then divided into three different groups to interpret the viability of the neonate: 0 to 3, severe distress; 4 to 6, moderate distress; and 7 to 10 no distress. Assessment of neonates by APGAR scoring takes only a few minutes and does not interfere with either maternal grooming or postnatal care (Veronesi *et al.*, 2009). The assessment requires no invasive techniques, no advanced tools and is easily performed.

Studies suggest that APGAR scoring can be used for identifying neonates who need extended intensive care and thereby increase the survival rate with aimed efforts of resuscitation (Veronesi *et al.*, 2009; Batista *et al.*, 2014). APGAR scoring can also be used to predict short-term survival prognosis. APGAR scores in the range from 7–10 is associated with survival during first 2–24 hours of life, whereas a higher percentage of puppies with lower APGAR scores die within two hours (Veronesi *et al.*, 2009). Majority of puppies dying during first 24 hours scored 0–3 on the APGAR scale (Batista *et al.*, 2014). Significantly higher APGAR scores were seen in puppies delivered vaginally compared to those delivered by cesarean section when measured immediately and five minutes after delivery (Silva *et al.*, 2009).

Results from several studies have shown increasing APGAR scores in the same individual when assessment is repeated *(Silva et al., 2009; Doebeli et al., 2013; Batista et al., 2014; Vassalo et al.*, 2015). Thus, APGAR scoring is suggested to be a simple and economically favorable aid in evaluating neonatal viability and effectiveness of neonatal resuscitation (Veronesi *et al.*, 2009; Vassalo *et al.*, 2015).

A quite recent large study stated that the APGAR scoring system still is a relevant method for prediction of neonatal survival in infants. APGAR scores of $\leq 3$ in infants by five minutes after birth are significantly associated with early neonatal death. Measurement of APGAR by five minutes was more useful in prediction of death than measurement one minute after birth. The APGAR score five minutes after birth was shown to be a better predictor of the neonatal outcome compared to measurement of umbilical artery blood pH, even if acidemia was severe (Casey, 2001).

## Neonatal mortality

### *Statistics*

Neonatal mortality is known to be a widespread problem and can occur in utero, during parturition and during first weeks of life.

According to a large French study, rate of stillbirth in puppies was 7.4% and total mortality from birth until sold 13.4%. Mortality rates were affected by breed size, where miniature and giant breeds had a higher rate of both stillbirth and post-natal mortality (Chastant-Maillard *et al.*, 2017). In a retrospective study with data from litters born at a Swedish animal hospital the total mortality of puppies was 22.3%. The same study also indicated that length of stage II influenced mortality rate since 13.7% of puppies were dead when stage II had lasted for 5–24 hours compared to 5.8% when stage II had lasted for one to four and a half hours (Darvelid & Linde-Forsberg, 1994).

Stillborn kittens have been reported to occur in 8.2–9.7% of litters (Sparkes *et al.*, 2006; Ström Holst & Frössling, 2009; Fournier *et al.*, 2017). Total neonatal kitten mortality have been reported as high as 15.7%, including stillborn kittens and kittens that died before weaning (Fournier *et al.*, 2017).

General mean litter size in dogs is reported to be 5.4 puppies. Litter size in dogs is most strongly influenced by size of breed with smaller litters in small breeds and larger litters in larger breeds (Borge *et al.*, 2011; Chastant-Maillard *et al.*, 2017). Whether litter size affects neonatal mortality seems to be uncertain. One study found that there was no correlation between litter size and neonatal mortality in puppies (Groppetti *et al.*, 2015), whilst another one found that risk of stillbirth and early neonatal mortality, as up to seven days after birth, increased with litter size (Tønnessen *et al.*, 2012). There is an association between litter size and stillbirth in large dog breeds, where litters with presence of stillborn puppies are associated with a greater litter size (Indrebø *et al.*, 2007).

### *Causes*

A prolonged or dystocic parturition is most likely the most important cause of neonatal death in puppies. If straining is weak, intermittent and lasts longer than two to four hours before delivery of the first puppy, or lasts longer than 1 hour between births, this is a cause for concern. It is abnormal if the bitch has strong, persistent straining for longer than 20-30 minutes without delivery of a pup (Johnson, 2008; Münnich & Küchenmeister, 2014). The second most common cause of disease and death in puppies is infectious diseases. Non-infectious causes predispose neonates to infections whereas hypoxia, hypothermia, hypoglycemia and dehydration are the ones seen most often. *Eschericia coli* and species of *Staphylococcus* and *Streptococcus* have been found as causes of disease and death shortly after birth in the neonate (Münnich & Küchenmeister, 2014). Good health of the bitch, normal fetal heart rates (>200 beats per minute), stage I lasts <6 hours and stage II lasts <12 hours make a favorable outcome for the bitch and the puppy (Johnson, 2008).

An increased risk of having one or more stillborn kittens is associated with both increasing litter size and presence of congenital defects in kittens (Sparkes *et al.*, 2006). Number of stillborn kittens also varies among different breeds and is associated with an increasing age of the queen as well as increasing litter size (Ström Holst & Frössling, 2009). Mean litter size in kittens is reported to be 4.0±1.9 kittens, with three to four kittens being the most frequent number of kittens per litter delivered by 58% of queens in this relatively large study (Fournier *et al.*, 2017). Another study found a mean litter size of 4.6 kittens (Sparkes *et al.*, 2006).

Mortality of kittens postpartum varies among breeds, increases with litter size and is associated with CS. There is no association with the age of the queen and kitten mortality post partum, except for litters to queens younger than one year (Ström Holst & Frössling, 2009).

### Birth weight and growth

Because of the great heterogeneity among dog breeds it is not possible to determine an optimal birth weight since this will vary widely between each breed and has to be compared within each breed.

Neonatal mortality in dogs occurring during first one to two days is associated with a low birth weight, implicating low birth weight to predispose for early neonatal mortality (Groppetti *et al.*, 2015; Mila *et al.*, 2015). Low birth weight is reported to be one of the most frequent causes of death during first three days in puppies (Indrebø *et al.*, 2007).

Birth weight in dogs is influenced by both litter size and litter effect. Birth weight is lower in larger litters compared to smaller litters (Groppetti *et al.*, 2015; Mila *et al.*, 2015). Mean body weight is lower in puppies dying during first week of life compared to those alive at eight weeks (Indrebø *et al.*, 2007).

During first day of life a slight weight loss is acceptable in the neonate. Puppies should then increase steadily and be gaining 10 to 15 percent of the weight at birth each day. The birth weight should be doubled by 10–14 days of age. Weight gain can be monitored daily to ensure weight gain since this is a way of detecting neonates that might be prone to illness (Johnston *et al.*, 2001; Indrebø *et al.*, 2007).

Mortality in puppies between two to 21 days of age is associated with early growth rate. A growth rate at or below -4% after first two days of life equals a higher risk of neonatal death. Birth weight does however not affect the early growth rate (Mila *et al.*, 2015).

Mean birthweight in kittens is reported to 100 ± 10 grams (Johnston *et al.*, 2001; Gatel *et al.*, 2011). Birthweight is inversely proportional to pregnancy rank and litter size. The birthweight of kittens increases with an increased weight and wither height of the queen (Gatel *et al.*, 2011). During the nursing period, a healthy kitten should gain a minimum of seven to ten grams per day (Johnston *et al.*, 2001).

## MATERIAL AND METHODS

### Animals

This study included both cats and dogs, and encompassed litters born at home, as well as litters delivered by emergency cesarean section at the University animal hospital in Uppsala, Sweden.

Participating breeders were recruited through advertisement on social media channels, mailings by Royal Canin sent to their national network of breeders in Sweden and also by advertisement in the magazine of the Swedish Cat breeding club. The questionnaire-based part of the study included 19 dog breeders and 21 bitches and 15 cat breeders and 16 queens, with 21 litters of puppies and 16 litters of kittens with a total of 113 puppies and 74 kittens born in Sweden during May to September 2018. 107 questionnaires were sent out, but only 35 (32.7%) were answered and returned.

14 puppies from four litters were delivered by emergency cesarean section at the University Animal Hospital in Uppsala, Sweden.

### Neonatal care and evaluation

Delivery by cesarean section was immediately followed by removal of fetal membranes, cleaning of the neonates with a sterile cloth, clamping of the umbilical cord and cleaning of airways. All neonates were examined for congenital malformations. The neonates were held under a heating lamp.

Evaluation of viability according to the APGAR protocol was performed five minutes after birth, causing a short interruption in neonatal care. Thereafter, the neonates with lower scores were continuously rubbed until they were vocalizing loudly and moving actively. Neonates were then put on a scale and birthweights were noted. Finally, neonates were placed in a warm soft cage and brought to their owners as soon as possible.

Drugs given to the bitch or queen in connection with cesarean sections also affect the neonates in terms of viability. However, this aspect was not investigated in this study. Details regarding the performance of the surgical procedure were not considered either, although this might affect the neonates too.

### APGAR scoring

In our study we chose to perform APGAR scoring five minutes after birth – both in cesarean sections and vaginal parturitions at home. The APGAR protocol used in our study was a slightly modified version of the protocol designed by Veronesi *et al* (2009). As stated by their APGAR protocol, the following parameters were evaluated: appearance, pulse, grimace, activity and respiration. In their study, these parameters were investigated through heart rate, respiration rate, irritability reflex, motility and mucus membrane color (Veronesi *et al.*, 2009). In this study they were measured by the means of heart rate, respiration rate, mucus membrane color, movements and righting reflex (Table 1).

Heart rate was examined by auscultation with a stethoscope and counted for 15 seconds and then multiplied by four. A heart rate of <180 beats per minute (bpm) was scored as 0, 180–220 bpm was scored as 1 and ≥220 bpm was scored as 2. Absence of spontaneous movements in the neonatal was scored as 0, weak spontaneous movements as 1 and active spontaneous movements as 2.

Righting reflex was examined by placing the neonate on the back and then observing attempts of righting. If the neonate made no attempts of righting and made no vocalization this was scored as 0. Attempts of righting and turning within 5–10 seconds along with weak vocalization was scored as 1 and if the neonate made attempts of righting and turning within five seconds and vocalized loudly and clearly it was scored as 2.

Due to the difficulties of counting heart rate in neonates, the protocols sent out to breeders were simplified to avoid inaccurate data. In this protocol the heartrate was only assessed as absent (score 0) or present (score 2) by palpating for heartbeats outside the chest of the neonate.

The sum of the score for each parameter was calculated, resulting in a total APGAR score ranging from 0–10. Neonates were then divided into three different groups depending on their APGAR score; 0–3, 4–6 and 7–10.

Table 1. *APGAR scoring system used in this study*

| | Score for each parameter | | |
|---|---|---|---|
| | 0 | 1 | 2 |
| Heart rate | <180 beats per minute | 180–220 beats per minute | ≥220 beats per minute |
| Respiration rate | <6 breaths per minute | 6–12 breaths per minute | >15 breaths per minute |
| Mucus membranes | Cyanotic | Pale | Pink |
| Movements | Absent | Weak movements | Normal,<br>active movements |
| Reflexes | No turning<br>No vocalization | Turns in 5–10 seconds<br>Weak vocalization | Turns in <5 seconds<br>Clear vocalization |

## Questionnaires

Data from litters born at home was collected by questionnaires sent out by email to breeders of both cats and dogs who reported their interest in participating in the study. The questionnaires included questions regarding the bitch or queen and the parturition, as well as questions regarding the puppies or kittens including health, weights and APGAR score. The puppies' weight was noted each day during the first 14 days and then once a week until eight weeks of age. Kittens were weighed until 12 weeks of age. See Appendix 1–4.

## Statistical analysis

Descriptive statistics were performed on maternal age, gestation length, length of parturition, litter size, maternal weight, birth weight, mortality rates, time interval between expulsion of

each neonate using Microsoft® Excel. Software used for statistical analysis were SAS 9.2 (SAS Institute Inc., Cary, NC, USA) and Minitab 17 (2013 Minitab Inc.).

APGAR score was compared to time of expulsion for each puppy using the Fisher's Exact Test. Puppies were divided into quartiles depending on time of expulsion: 0–22 minutes; 23–68 minutes; 69–119 minutes; ≥120 minutes. The third quartile was divided into two with the limit of ≥120 minutes. This was performed on all puppies, i.e. both stillborn and live born puppies, as well as on live born puppies exclusively. Fisher's Exact test was also used to investigate association between APGAR score and viability in puppies, this test was also performed on live born puppies only.

Mixed linear model was used to investigate correlation between birth weight and viability in kittens. Analysis was performed with consideration to litter-ID. All kittens were included in this analysis, i.e. both live born and stillborn.

Mixed linear model was also used to analyze correlation between birth weight and litter size or weight of the queen or weight of the tomcat. This included live born kittens only and litter-ID was considered.

Fisher's exact test was used to investigate association between time of expulsion of each kitten and APGAR score. This analysis included live born kittens who were delivered vaginally. Kittens were delivered into three quartiles depending on time of expulsion: 0–21 minutes; 22–70 minutes; ≥71 minutes.

Regression analysis was performed on: median birthweight in each litter compared to queen's weight, tomcat's weight and litter size; queen's weight compared to birth weight index. Birth weight index was calculated as the individual kitten's birthweight in percentage of queen's weight.

## RESULTS

### Dogs

The study included 21 bitches that gave birth to 21 litters, resulting in a total of 113 puppies. Out of 113 puppies, five were stillborn (4.4%). Four out of five stillborn puppies belonged to the same litter. Nine puppies were born alive but died within the first week. Total mortality, including stillborn and puppies that died within first week, was 12.4%. Distribution of viability and APGAR scoring is presented in Table 2. Mean litter size was 5.38 (range 3 to 9) puppies. Mean birth weight was 266 (range 41 to 535) grams. Median time interval between expulsion of each puppy was 43 (range 0 to 285) minutes. Median total length of parturition, calculated as time from onset of stage II until delivery of the last puppy in each litter, was 285 (range 60 to 1545) minutes. One Pomeranian puppy was euthanized after three weeks due to suspected hydrocephalus, this was the only reported congenital defect in this study (0.9%).

Mean gestation length was 61.3 (range 58 to 65) days. Mean maternal age was 4.2 (range 2 to 8.5) years. 10 out of 21 bitches (47.6%) were primiparous.

Dog breeds included in the study was Affenpinscher; Belgian Shepherd Dog/Tervueren; Cane corso; Chihuahua, long-haired; Chinese Crested Dog; Dachshund miniature, wire-haired; Danish-Swedish Farmdog, English Cocker Spaniel; German Spaniel; Griffon Fauve de Bretagne; Icelandic Sheepdog; Irish Red Setter; Maltese; Norfolk Terrier; Pomeranian; Poodle, miniature; Portuguese Podengo, (Warren Hound) smooth-haired/miniature; Schipperke; Weimaraner, long-haired.

Table 2. *Distribution of mortality in puppies in different APGAR groups*

| APGAR | Puppies *n* (%) | Viability categories | | | | |
|---|---|---|---|---|---|---|
| | | Stillborn *n* | Dead <2 hrs *n* | Dead 2–24 hrs *n* | Dead 24hrs–1 wk *n* | Alive >1 wk *n* |
| 7–10 | 104 (92) | 0 | 0 | 5 | 2 | 97 |
| 4–6 | 2 (2) | 0 | 0 | 0 | 0 | 2 |
| 0–3 | 7 (6) | 5 | 2 | 0 | 0 | 0 |
| Total | 113 (100) | 5 | 2 | 5 | 2 | 99 |

There was a significant association between time of expulsion for each puppy and APGAR score, both when the analysis included all puppies and when stillborn puppies were excluded ($P < 0.01$). APGAR and viability also had a significant association ($P<0.01$).

## Cats

The study included 16 queens giving birth to 16 litters resulting in 74 kittens. Five kittens were stillborn (6.8%). Only one more kitten died within the first week, resulting in a total kitten mortality, counting stillborn kittens and the kitten dead within the first week, of 8.1%. Further details of distribution of mortality and APGAR scoring is shown in Table 3. Mean litter size was 4.63 (range 1 to 8) kittens. Mean birth weight was 87.9 (range 52 to 119) grams. Eight kittens were delivered by cesarean sections, belonging to two litters. Median time interval between expulsion of each kitten was 27.5 (range 5 to 2870) minutes, including only vaginally delivered kittens. Four kittens (5.4%) were born with congenital defects: two kittens with umbilical hernia; one kitten with schistosomus reflexus; and one kitten with prognathia. Those kittens belonged to four different litters.

Mean gestation length was 65.1 (range 62 to 68) days. Mean maternal age was 2.7 (range 1 to 6) years and 10 out of 16 (62.5%) queens were primiparous. Mean maternal weight was 3.2 (range 2.1 to 4) kilogram.

Cat breeds included in the study was Bambino; Birma; British Shorthair; British Longhair; Cornish Rex; Devon Rex; LaPerm; Lykoi; Maine coon and Siberian cat.

Table 3. *Distribution of mortality in kittens in different APGAR groups*

| APGAR | Kittens *n* (%) | Viability categories | | | | |
|---|---|---|---|---|---|---|
| | | Stillborn *n* | Dead <2 hrs *n* | Dead 2–24 hrs *n* | Dead 24hrs–1 wk *n* | Alive >1 wk *n* |
| 7–10 | 66 (89) | 0 | 0 | 0 | 0 | 66 |
| 4–6 | 1 (1) | 0 | 0 | 0 | 0 | 1 |
| 0–3 | 7 (10) | 5 | 1 | 0 | 0 | 1 |
| Total | 74 (100) | 5 | 1 | 0 | 0 | 68 |

Viability and birth weight had a significant association in kittens (P<0.0001). There were no significant associations between birth weight of kittens and litter size or queen's weight or tomcat's weight, neither any significant association with time of expulsion for each kitten and APGAR. Median birth weight in each litter was not associated with the weight of the queen or tomcat or litter size. However, a significant association was found between body weight of the queen and birth weight index of kittens (P<0.01).

### Cesarean sections

14 puppies from four litters, belonging to four bitches, were delivered by emergency cesarean section at the University Animal hospital in Uppsala. Three out of four litters were French bulldogs and the remaining litter was Pomeranian. All puppies were alive two hours after delivery. Table 4 shows the distribution of APGAR scores and mortality in those puppies.

Table 4. *Distribution of mortality in puppies delivered by cesarean section in different APGAR groups*

| APGAR | Puppies *n* (%) | Viability categories | | |
|---|---|---|---|---|
| | | Stillborn *n* | Dead <2 hrs *n* | Alive >2 hrs n |
| 7–10 | 9 (64) | 0 | 0 | 9 |
| 4–6 | 4 (29) | 0 | 0 | 4 |
| 0–3 | 1 (7) | 0 | 0 | 1 |
| Total | 14 (100) | 0 | 0 | 14 |

## DISCUSSION

This study's aim was to investigate the practical use of APGAR scoring in newborn cats and dogs, both by breeders at home and by staff at veterinary clinics after cesarean sections. Also, another aim was to search for associations between APGAR and different relevant parameters and outcomes.

The mean litter size of 5.38 puppies in this study, was corresponding to previously discussed studies by Borge *et al.* (2011) and Chastant-Maillard *et al.* (2017) who reported 5.4 puppies as

mean litter size. The stillborn rate as well as total neonatal mortality in this study were lower compared to other studies mentioned earlier, this was probably due to the fact that most of these parturitions were eutocic. One could also speculate in the fact that no brachycephalic breeds were represented in the questionnaire-based part of this study, known to be at high risk for dystocic parturitions, possibly contributing to a lower neonatal mortality. However, the amount of data in this study was small compared to other studies and represent a much smaller proportion of the population, and subsequently complicates the comparison. The latter argument is presumably valid also for kitten mortality, where this study showed a lower mortality compared to other studies mentioned in this article.

As previously shown by Veronesi *et al.* (2009) and Batista *et al.* (2014) this study also concluded a significant association between APGAR score and viability in newborn puppies. Meaning, a high APGAR score is associated with a higher viability in the puppies, and a lower APGAR score with a poor viability at the time for evaluation. Unfortunately, association between APGAR score and viability could not be investigated in kittens, because of a low mortality in the included data, preventing the possibility to compare puppies and kittens in this aspect.

There was a significant association between APGAR score and time of expulsion of each puppy, implicating that a prolonged parturition has a negative impact on neonatal viability.

Time for expulsion of each kitten and APGAR score was not significantly associated. This result could be in line with the fact that normal parturitions in cats can proceed for a long period of time, with considerably long intervals between delivery of each kitten (Johnston *et al.*, 2001; Davidson, 2014). A prolonged interval between delivery of each kitten does not necessarily contribute to a poor viability in the kitten. Still, it is of great importance to eliminate any abnormalities in the proceeding of the parturition.

Low birth weight is also known to be a risk factor for neonatal death. Birth weight and viability was associated in kittens according to the present study, suggesting that low birth weight affects the outcome negatively. Similar to the findings in this study, stillborn kittens had a significantly lower birth weight compared to those born alive in another questionnaire-based study (Musters *et al.*, 2011).

A significant association was stated between body weight of the queen and birth weight index of kittens, meaning that there was an inversed influence of increased body weight of the queen on the birth weight of the kitten. Hence, heavier queens bred proportionately lighter kittens.

The study was limited to a relatively short time interval and therefore did not include a large amount of data from cesarean sections, restricting the possibility of making any conclusions regarding this information. Despite no statistical analyzes were performed on the results, APGAR scores seemed to be lower in the puppies delivered by CS in this study as well. A larger percentage of the puppies delivered by CS scored <7 on the APGAR scoring scale. This would correspond to results from the study performed by Silva *et al.* (2009). The ambition of this study was to investigate a larger number of neonates delivered by CS and compare eutocic and dystocic neonates and different type of deliveries. Yet, this was not possible due to the time

limitation and the fact that cesarean sections studied were only emergency cases performed at one particular animal hospital.

Since most of the data this study is based on was reported by breeders themselves, there is a risk for bias in the data. The breeders have performed the APGAR evaluation with support from simple distinct instructions and the evaluation is relatively easy to perform. However, according to the author's knowledge, majority of the data has not been controlled by a veterinarian and therefore there is a risk of misinterpretation of the clinical signs due to lack of training regarding this kind of examination. Although, two of the cat litters were supervised by a veterinarian.

Another aspect possibly contributing to data being biased is the fact that the participating breeders were volunteers who signed up to the study by their own initiative. This probably indicates that they are among the most ambitious breeders, willing to put some extra efforts to their breeding. Also, there were no criteria for exclusion or inclusion of aspiring participants. The large proportion of loss to follow up in this study is likely due to several aspects. The first contact was only made as a notion of interest, and once getting more information about the study some breeders considered the workload too extensive. Some breeders announced their interest in participating before their bitch were mated and then were lost because of failure of conception or abortion. A couple of the breeders forgot to perform the APGAR analysis and could therefore not complete the questionnaire.

Evaluation of clinical characteristics according to the APGAR scoring system was performed by multiple assessors with various experience and training. This could result in nuanced interpretations and bias since some of the parameters are subjective, compared to if all newborns in the study were to be examined by the same person, although this is consistent to how it is implemented in practice.

As experienced from this study, APGAR scoring can be used both in deliveries in home environment and in deliveries requiring veterinary intervention of some sort. Evaluation neither requires advanced tools nor any specialized knowledge. But to be mentioned, APGAR scoring could be challenging when several neonates are delivered with short intervals since the evaluation should be performed five minutes after birth. Thus, ability of performing the evaluation requires sufficient number of personnel or people available to assist in the parturition, which consequently could limit performance of the evaluation.

## CONCLUSIONS

In conclusion with earlier observations in previous studies, APGAR scoring is a feasible and significant method of determining viability in newborn puppies. Expulsion time of each puppy also affects the viability, measured by APGAR score.

This study is, according to the author's knowledge, as up to today the first one investigating the use of APGAR scoring in newborn kittens. As experienced from this study, APGAR scoring is practical also in newborn kittens. Unfortunately, the results in this study did not include any particular diversity by the means of viability results which did not allow for any analysis of the influence of APGAR on viability. Hence, further studies are desirable in this field in a larger

population. This study suggests that a widely implemented use of APGAR scoring in whelping and queening, both by breeders in home environment and in the veterinary field, could positively affect the breeding management and neonatal care. Subsequently, contribute to decreased neonatal mortality.

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## POPULÄRVETENSKAPLIG SAMMANFATTNING

Inom veterinärmedicinen är dödlighet bland valpar och kattungar ett utbrett problem – både hos nyfödda såväl som under tillväxtperioden. Inom humanvården har nyfödda barn sedan länge bedömts enligt ett poängsystem som kallas APGAR. Detta bedömningssystem utformades redan på 1950-talet av Virginia Apgar, som namngett metoden, och används än idag för att bedöma hälsan hos nyfödda barn i samband med födseln över hela världen. Bedömningen görs hos nyfödda barn en respektive fem minuter efter födseln. Barnen undersöks då med avseende på fem enkla basparametrar som inkluderar hjärtfrekvens, andning, färg, muskeltonus och reflexer. Dessa parametrar graderas som 0, 1 eller 2 poäng efter en tabell där kriterier för respektive poäng finns angivna, och summeras sedan till en totalpoäng. Totalpoängen ger ett mått på barnets ögonblickliga hälsa och kan ge vägledning för huruvida eventuella vidare intensivvårdsåtgärder är aktuella. Bedömning enligt APGAR anses vara en enkel och användbar metod för att göra en snabb bedömning av nyfödda barns hälsa, som inte kräver några avancerade instrument eller specialkunskaper.

Trots att bedömning enligt APGAR görs rutinmässigt sedan lång tid tillbaka inom human-medicinen, är det inte en etablerad metod inom veterinärmedicinen. Dödlighet bland valpar och kattungar är ett betydelsefullt och relativt vanligt förekommande problem inom djursjukvården. Neonatal dödlighet förekommer under dräktigheten, i samband med födseln och under de två till tre första levnadsveckorna, då valpar och kattungar räknas som neonatala. Detta är av betydelse ur både ett ekonomiskt och känslomässigt perspektiv. Därmed är det av vikt att arbeta för en minskad förekomst av denna dödlighet. En systematisk undersökning av nyfödda valpar och kattungar för att bedöma deras hälsa, skulle kunna bidra till att mer kritiska individer kan identifieras. Dessa skulle då snabbare kunna ges adekvat vård, vilket i sin tur kan möjliggöra en minskad dödlighet.

Syftet med denna studie var att undersöka om bedömning enligt APGAR är praktiskt genomförbart hos nyfödda kattungar och valpar, både av uppfödare i hemmiljö och av djursjuk-vårdspersonal i samband med kejsarsnitt. Studien syftade också till att leta efter samband mellan APGAR-poäng och olika relevanta parametrar (t.ex. födelsevikt och tid mellan födsel av varje unge) och utfall (dvs. död eller överlevnad).

En fransk studie har visat på en förekomst av dödfödda valpar som uppgår till 7,4 % och en total dödlighet fram till försäljning vid åtta veckor, inklusive dödfödda valpar, till 13,4 %. Bland kattungar har andelen dödfödda rapporterats till 8,2–9,7 %, och den totala dödligheten till så mycket som 15,7 %. Viktigaste orsaken till dödlighet anses vara förlossningsproblem och en utdragen förlossning. Därmed är det av stor vikt att både veterinärer och uppfödare besitter kunskap kring det normala förlossningsförloppet, för att snabbt kunna identifiera avvikelser och därmed kunna ingripa i god tid med korrekta åtgärder. Dödlighet kan dock bero på flera faktorer, däribland även infektiösa sjukdomar, missbildningar och dålig omvårdnad av ungarna. Studier är oeniga kring huruvida kullstorlek påverkar dödligheten hos valpar, men hos storvuxna hundraser har en ökad andel dödfödda valpar observerats i stora kullar. Däremot har studier visat att dödlighet bland kattungar är förknippat med en ökad kullstorlek. Valpdödlighet under de tre första levnadsdagarna är förknippat med en låg födelsevikt, vilket tyder på att detta är en viktig riskfaktor för tidig dödlighet hos valpar.

Ett antal studier har undersökt användning av APGAR-poängskalan för bedömning av nyfödda valpar. Bedömningspunkterna är samma som hos nyfödda barn, om än något modifierade för att stämma överens med valpens normala tillstånd vid födsel. Dessa studier har visat att APGAR-skalan är praktiskt möjlig att använda i djursjukvården och att det finns ett statistiskt samband mellan valpens viabilitet, dvs. livsduglighet, vid födseln och den totala APGAR-poängen. APGAR-poäng kan alltså ge ett mått på valpens momentana hälsa och den givna poängen kan vara vägledande för att bedöma huruvida valpen behöver extra omvårdnad. Valpar som föds fram vaginalt har visat sig ha högre APGAR-poäng än de som förlöses via kejsarsnitt. Studier har visat på samband mellan överlevnad på kort sikt och APGAR-poäng, därmed kan denna poäng användas för en kortsiktig prognos för överlevnad. Bedömning enligt APGAR-skalan kan också användas för att följa hur valpen svarar på en eventuell utökad vård, då APGAR-poäng har setts öka över tid vid upprepade bedömningar hos samma individ. Sammanfattningsvis är APGAR en enkel, billig och praktiskt genomförbar metod som varken medför något lidande, kräver någon speciell utrustning eller någon omfattande utbildning.

Denna enkätbaserade studie grundar sig huvudsakligen på data insamlad från uppfödare av hund och katt som frivilligt anmält sitt deltagande. Studien omfattar således främst normala förlossningar som skett i hemmiljö och inkluderar 21 kullar med hundvalpar och 16 kullar med kattungar. Uppfödarna fick delge information kring modern och respektive unge, samt utföra bedömning enligt APGAR fem minuter efter födseln. Djurägarna fick även väga ungarna dagligen de första 14 dagarna och därefter en gång i veckan fram till försäljningsålder, dvs. till 8 och 12 veckors ålder för valpar respektive kattungar. Utöver dessa deltog även fyra kullar, med totalt 14 valpar, som förlösts genom kejsarsnitt på Universitetsdjursjukhuset i Uppsala, Sverige. Dessa bedömdes enligt APGAR fem minuter efter födsel.

Bland valparna var fyra av totalt 113 valpar (4,4 %) dödfödda, nio valpar föddes levande men dog under första levnadsveckan. Den totala dödligheten uppgick till 12,4 %. Medelkullstorlek var 5,38 valpar (spridning 3 till 9 valpar). Medelfödelsevikt var 266 gram (spridning 41 till 535 gram). Medianen för tiden mellan framfödandet av varje valp var 43 minuter (spridning 0 till 285 minuter). Medianen för den totala längden på förlossningen, beräknat utifrån tidpunkt för starten på utdrivningsstadiet tills sista valpen fötts fram i varje kull, var 285 minuter (spridning 60 till 1545 minuter). Endast en missbildad valp rapporterades totalt i dessa kullar. Medellängd för dräktighet var 61,3 dagar (spridning 58 till 65 dagar) och medelålder för tiken 4,2 år (spridning 2 till 8,5 år). Tio av 21 tikar (47,6 %) var förstföderskor.

104 av 113 valpar (92 %) bedömdes som APGAR 7–10, två av 113 (2 %) fick poäng 4–6 och sju av 113 (6 %) i den lägsta poängkategorin 0–3. De valpar som fick APGAR-poäng 0–3 var antingen dödfödda (fem valpar) eller dog inom två timmar (två valpar). Alla valpar som fick 4–6 poäng levde efter en vecka. I kategorin 7–10 dog fem valpar mellan 2–24 timmar samt två valpar mellan 24 timmar och en vecka, 97 valpar levde efter en vecka.

Av totalt 74 kattungar var fem dödfödda (6,8 %), därefter dog endast en kattunge till under första veckan. Total dödlighet bland kattungar i studien uppgick till 8,1 %. Medelkullstorlek var 4,63 kattungar (spridning 1 till 8 kattungar). Medelfödelsevikt var 87,9 gram (spridning 52 till 119 gram). Åtta av de deltagande kattungarna förlöstes via kejsarsnitt, dessa kom från två

olika kullar. Medianen för tidsintervallet mellan framfödandet av varje kattunge var 27,5 minuter (spridning 5 till 2870 minuter), då endast de kattungar som fötts fram naturligt räknades med. Fyra kattungar (5,4 %) föddes med medfödda missbildningar. Medellängd på dräktigheten var 65,1 dagar (spridning 62 till 68 dagar). Medelålder för modern var 2,7 år (spridning 1 till 6 år), och tio av 16 (62,5 %) mödrar var förstföderskor. Medelvikten hos mödrarna var 3,2 kilogram (spridning 2,1 till 4 kilogram).

Bland kattungar bedömdes 66 av 74 (89 %) som APGAR 7–10, en av 74 (1 %) fick poäng 4–6 och sju av 74 (10 %) i den lägsta poängkategorin 0–3. De kattungar som fick APGAR-poäng 0–3 var antingen dödfödda (fem kattungar) eller dog inom två timmar (en kattunge). Kattungen i kategorin 4–6 poäng levde efter en vecka. I kategorin 7–10 överlevde alla kattungar.

Genom statistiska analyser påvisades signifikanta samband mellan APGAR-poäng och tid för framfödande av varje valp samt för APGAR-poäng och viabilitet hos valpar (dvs. livsduglighet). Viabilitet och födelsevikt hade ett signifikant samband hos kattungar. Det fanns dock inga signifikanta samband mellan födelsevikt och kullstorlek eller moderns eller faderns vikt, inte heller mellan tid för framfödandet av varje enskild kattunge och APGAR. Ett samband sågs dock mellan moderns kroppsvikt och födelseviktsindex hos kattungar. Födelseviktsindex är beräknat i form av kattungens födelsevikt i procent av moderns vikt. Detta samband betyder att tyngre mödrar kommer att föda kattungar som väger förhållandevis mindre.

Sambandet mellan APGAR-poäng och viabilitet hos nyfödda valpar är i linje med vad tidigare studier har visat på. Lägre APGAR-poäng är alltså förenat med en ökad risk för dödlighet. Tyvärr kunde inte denna jämförelse göras hos kattungar eftersom att materialet inte hade tillräckligt stor variation. En utdragen förlossning har negativ effekt på valparnas livsduglighet, då det fanns ett samband mellan dessa parametrar.

En låg födelsevikt är en känd riskfaktor för dödlighet hos nyfödda. I enlighet med resultaten i denna studie har låg födelsevikt en negativ inverkan på överlevnaden hos kattungar. Detta stöds även av resultat från en tidigare studie. Däremot observerades inga samband mellan tiden för framfödandet av varje kattunge och APGAR-poäng, där det sistnämnda visar på kattungarnas livsduglighet, vilket kan tänkas bero på att förlossningar hos katter normalt sett kan pågå under en längre tid. Vid en lång förlossning är det dock fortfarande av stor vikt att utesluta förlossningskomplikationer som orsak till detta, för att i så fall kunna vidta lämpliga åtgärder.

Bedömning enligt APGAR-metoden är alltså ett pålitligt verktyg för att bedöma nyfödda valpar med avseende på livsduglighet, som tidigare studier också konstaterat. Bedömningen kan göras både i veterinära miljöer och av uppfödare vid förlossningar i hemmiljö. Studien har också visat på att APGAR-bedömning i samband med förlossning är praktiskt genomförbar även hos katter, vilket enligt författarens vetskap inte undersökts tidigare när denna studie genomförs. Fler studier behöver göras på en större population, särskilt på katt. Men dessa resultat tyder på att en implementering av bedömning enligt APGAR vid förlossningar, både av djursjukvårdspersonal och uppfödare, kan bidra till att förbättra uppfödning av valpar och kattungar samt omvårdanden av nyfödda. Det skulle då även kunna leda till en minskad dödlighet av hundvalpar och kattungar.

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| **Information om tiken och förlossningen** | |
|---|---|
| **Tikens vikt (innan dräktighet)** | |
| **Ras** | |
| **Ålder** | |
| **Hur många kullar har tiken haft?** | |
| **Har tiken haft några problem vid tidigare dräktigheter/kullar?** | |
| **Dag i dräktigheten** | |
| **Har progesteronprov tagits?**<br><br>***Om ja, vilket datum och vilket värde?*** | |
| **Utdrivningsstadiet* startade klockan** | |
| **Har tiken mått bra under dräktigheten?**<br><br>***Om nej, förklara kortfattat vad som hänt.*** | |
| **Hanens vikt** | |

*Utdrivningsstadiet karaktäriseras av: avgången fostervätska, synliga krystvärkar med bukmuskulaturen och att kroppstemperaturen först sjunkit och nu återgått till normal nivå. Observeras ett eller flera av dessa tecken är tiken i valpningens utdrivningsstadium.

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| **Information om valp** | |
|---|---|
| **Nummer i kullen** | av st valpar. |
| **Kön** | |
| **Född klockan** | |
| **Viabilitet** | Dödfödd [ ] Död inom 2 h [ ] Lever efter 2 h [ ] Lever efter 24 h [ ] Lever efter 1 vecka [ ] |
| **Vikt (mäts vid ungefär samma klockslag)** | Vid födsel:<br>Dag 2:<br>Dag 3:<br>Dag 4:<br>Dag 5:<br>Dag 6:<br>Dag 7:<br>Dag 8:<br>Dag 9:<br>Dag 10:<br>Dag 11:<br>Dag 12:<br>Dag 13:<br>Dag 14:<br>3 veckor:<br>4 veckor:<br>5 veckor:<br>6 veckor:<br>7 veckor:<br>8 veckor: |
| **Har valpen sugreflex och söker juver inom 2 timmar?** | |
| **Har valpen varit frisk?** | |

| | |
|---|---|
| ***Om nej, förklara kortfattat vad som hänt. Eventuella missbildningar noteras även här.*** | |
| **Har det krävts någon extra omvårdnad?**<br><br>***Om ja, vad?*** | |

## BEDÖMNING ENLIGT APGAR

*Denna bedömning ska göras 5 minuter efter födseln.*

| | **0 poäng** | **1 poäng** | **2 poäng** |
|---|---|---|---|
| **Hjärtfrekvens*** | Saknas | _____ | Stark, regelbunden |
| **Andning** | <6 andetag/minut | 6–12 andetag/minut | >15 andetag/min |
| **Slemhinnefärg** | Blåaktiga | Bleka eller blekt rosa | Rödrosa |
| **Rörlighet** | Saknas | Svaga rörelser | Normala rörelser |
| **Reflexer** | Vänder sig ej<br>Inget skrik | 5–10 sekunder<br>Svagt skrik | <5 sekunder<br>Tydligt skrik |
| **Total poäng (sammanlagt från ovanstående)** | | | |

* Hjärtfrekvens: slag/minut.

### *Hur utförs bedömningarna enligt APGAR?*

**Hjärtfrekvens**
Placera pekfinger och tumme över valpen bröstkorg strax bakom frambenen. Om du känner tydliga, regelbundna hjärtslag ger detta 2 poäng. Känner du inga hjärtslag bedöms detta som 0 poäng.

Observera att det endast är 0 eller 2 poäng på denna parameter.

Om du har tillgång till ett stetoskop och möjlighet att räkna hjärtfrekvensen (slag/minut) får du gärna notera denna (utrymme för detta finns under tabellen). Det går bra att räkna hjärtslagen under 15 sekunder och sedan multiplicera med 4.

**Andning**
Räkna andetagen genom att kolla hur valpens bröstkorg hävs in och ut. Ett andetag innebär att bröstkorgen först rör sig utåt och sedan in igen.

Andetagen räknas under 60 sekunder. Använd en klocka med sekundvisare eller ett tidtagarur som finns i de flesta smartphones.

Mer än 15 andetag per minut ger 2 poäng. 6–12 andetag per minut ger 1 poäng. Färre än 6 andetag per minut ger 0 poäng.

**Slemhinnefärg**
Färgen på slemhinnorna kontrolleras lättast genom att lyfta försiktigt på valpens läpp. Detta ger ett mått på hur bra blodcirkulation och syresättning fungerar.

Rödrosa slemhinnor tyder på en god cirkulation och ger 2 poäng. Om slemhinnorna är ljust rosa mot det vita hållet ger det 1 poäng. Blåaktiga slemhinnor ger 0 poäng.

**Rörlighet**
Om valpen rör sig normalt och aktivt ger det 2 poäng. Rör sig valpen svagt och verkar slö ger detta 1 poäng. Rör sig valpen inte ger detta 0 poäng.

**Reflexer**
En nyfödd valp har inte hunnit utveckla alla reflexer som en vuxen hund har. Vändningsreflexen är dock något som ska finnas redan vid födseln. Vändningsreflexen undersöks genom att placera valpen på rygg. En pigg och frisk valp ska då vända sig snabbt igen.

Vänder sig valpen på under 5 sekunder ger detta 2 poäng. Om det tar 5–10 sekunder innan valpen vänder sig ger detta 1 poäng. Vänder sig valpen inte själv inom 10 sekunder eller inte alls ger detta 0 poäng.

Observera också om valpen skriker och piper vid hantering i samband med att du kontrollerar vändningsreflexen.

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| **Information om moder och förlossningen** | |
|---|---|
| **Moderns vikt (innan dräktighet)** | |
| **Ras** | |
| **Ålder** | |
| **Hur många kullar har hon haft?** | |
| **Har hon haft några problem vid tidigare dräktigheter/kullar?** | |
| **Dag i dräktigheten** | |
| **Förlossningen startade klockan** | |
| **Har modern mått bra under dräktigheten?**<br><br>***Om nej, beskriv kortfattat vad som hänt.*** | |
| **Hanens vikt** | |

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| **Information om kattunge** | |
|---|---|
| **Nummer i kullen** | av st kattungar. |
| **Kön** | |
| **Född klockan** | |
| **Viabilitet** | Dödfödd [ ] Död inom 2 h [ ] Lever efter 2 h [ ] Lever efter 24 h [ ] Lever efter 1 vecka [ ] |
| **Vikt (mäts vid ungefär samma klockslag)** | Vid födsel:<br>Dag 2:<br>Dag 3:<br>Dag 4:<br>Dag 5:<br>Dag 6:<br>Dag 7:<br>Dag 8:<br>Dag 9:<br>Dag 10:<br>Dag 11:<br>Dag 12:<br>Dag 13:<br>Dag 14:<br>3 veckor:<br>4 veckor:<br>5 veckor:<br>6 veckor:<br>7 veckor:<br>8 veckor:<br>9 veckor:<br>10 veckor:<br>11 veckor:<br>12 veckor: |
| **Har kattungen sugreflex och söker juver inom 2 timmar?** | |
| **Har kattungen varit frisk?** | |

| | |
|---|---|
| ***Om nej, förklara kortfattat vad som hänt. Eventuella missbildningar noteras även här.*** | |
| **Har det krävts någon extra omvårdnad?**<br><br>***Om ja, vad?*** | |

## BEDÖMNING ENLIGT APGAR

*Denna bedömning ska göras 5 minuter efter födseln.*

| | **0 poäng** | **1 poäng** | **2 poäng** |
|---|---|---|---|
| **Hjärtfrekvens*** | Saknas | _____ | Stark, regelbunden |
| **Andning** | <6 andetag/minut | 6–12 andetag/minut | >15 andetag/min |
| **Slemhinnefärg** | Blåaktiga | Bleka eller blekt rosa | Rödrosa |
| **Rörlighet** | Saknas | Svaga rörelser | Normala rörelser |
| **Reflexer** | Vänder sig ej<br>Inget skrik | 5–10 sekunder<br>Svagt skrik | <5 sekunder<br>Tydligt skrik |
| **Total poäng (sammanlagt från ovanstående)** | | | |

* Hjärtfrekvens: slag/minut

### *Hur utförs bedömningarna enligt APGAR?*

**Hjärtfrekvens**
Placera pekfinger och tumme över kattungens bröstkorg strax bakom frambenen. Om du känner tydliga, regelbundna hjärtslag ger detta 2 poäng. Känner du inga hjärtslag bedöms detta som 0 poäng.

Observera att det endast är 0 eller 2 poäng på denna parameter.

Om du har tillgång till ett stetoskop och möjlighet att räkna hjärtfrekvensen (slag/minut) får du gärna notera denna (utrymme för detta finns under tabellen). Det går bra att räkna hjärtslagen under 15 sekunder och sedan multiplicera med 4.

**Andning**
Räkna andetagen genom att kolla hur kattungens bröstkorg hävs in och ut. Ett andetag innebär att bröstkorgen först rör sig utåt och sedan in igen.

Andetagen räknas under 60 sekunder. Använd en klocka med sekundvisare eller ett tidtagarur som finns i de flesta smartphones.

Mer än 15 andetag per minut ger 2 poäng. 6–12 andetag per minut ger 1 poäng. Färre än 6 andetag per minut ger 0 poäng.

**Slemhinnefärg**
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Rödrosa slemhinnor tyder på en god cirkulation och ger 2 poäng. Om slemhinnorna är ljust rosa mot det vita hållet ger det 1 poäng. Blåaktiga slemhinnor ger 0 poäng.

**Rörlighet**
Om kattungen rör sig normalt och aktivt ger det 2 poäng. Rör sig kattungen svagt och verkar slö ger detta 1 poäng. Rör sig kattungen inte ger detta 0 poäng.

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En nyfödd kattunge har inte hunnit utveckla alla reflexer som en vuxen katt har. Vändningsreflexen är dock något som ska finnas redan vid födseln. Vändningsreflexen undersöks genom att placera kattungen på rygg. En pigg och frisk kattunge ska då vända sig snabbt igen.

Vänder sig kattungen på under 5 sekunder ger detta 2 poäng. Om det tar 5–10 sekunder innan kattungen vänder sig ger detta 1 poäng. Vänder sig kattungen inte själv inom 10 sekunder eller inte alls ger detta 0 poäng.

Observera också om kattungen skriker och piper vid hantering i samband med att du kontrollerar vändningsreflexen.