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COLIC - Nothing to Horse Around With

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INTRODUCTION

Colic in horses, the tummy-ache of death.

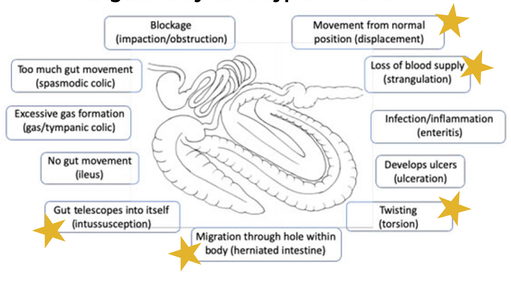
Horses who have colic are experiencing abdominal pain caused by problems in the digestive tract. Although this seems relatively harmless, for a horse, it's not. Colic is the number one killer of horses. **Each year 10% to 36%** of horses will experience an episode of colic. There are many forms of colic ranging from mild to life threatening. The various types are shown in the picture of the digestive tract below, and the life-threatening cases are starred in gold. Approximately 2% of the cases are life threatening.

All cases can result in dehydration. There are five variables in the dataset that are used by vets to classify a horse as dehydrated: pulse (>60 bpm), packed cell volume (>50%), total protein (>7.5 g/dL), capillary refill time (>3 sec), and mucous membrane color (bright red, pale cyanotic, and dark cyanotic). Using the five dehydration variables in this dataset, I created a dehydration variable that tallied the number of dehydration variables that were present: 0 variables = Hydrated, 1 = More than Likely Hydrated, 2 to 3 = In Between, and 4 to 5 = Dehydrated.

I studied the relationship between dehydration and whether the horse was in pain, had surgery, and whether they lived, died or was euthanized as a result of the colic. The horse can be more prone to colic due to previous surgical lesions. Ultimately, the outcome variable reports if the horse will live, die, or be euthanized.

Logistic regression was used to determine which of the twenty-eight measures of the horse's health predicted whether the horse had surgery. The best model was contrasted with bivariate analyses using Chi-Square Tests of Independence and Two-Sample t Tests.

Digestive System: Types of Colic



METHODS

- **Data Wrangling:** to create dehydration variable involved conditional logic to increment a counter.
- **Bar Chart:** visually display the breakdown of how many horses were in each dehydration level.
- **Stepwise Logistic Regression:** used to determine which of the 28 health measures on the horse best predicted surgery.
- **Kruskal Wallis:** used to test equality of median respiratory rates for each dehydration level.
- **Chi Square Test of Independence:** used to determine whether there was a relationship between dehydration level and pain level, dehydration level and surgery, dehydration level and outcome, pain level and surgery, and outcome and surgery.
- **Two-Sample t Tests:** used to test the relationships between surgery and pulse, respiratory rate, nasogastric reflux pH, packed cell volume, total protein, rectal temperature, and abdominocentesis total protein.
- **Graphical Displays:** bar charts, stratified confidence intervals, and mosaic plots were used to visually display the findings.

Table 1: Stepwise Logistic Regression to Predict Surgery

Logistic Regression

	df	Deviance	AIC
<none>		85.200	97.200
age	1	89.765	99.765
peristalsis	3	99.500	105.500
surgical_lesion	1	137.616	147.616

Call: GIm(formula=surgerybi ~ age + peristalsis + surgical_lesion, family = "binomial", data = colic_test5)

Coefficients:

(Intercept)	ageyoung	peristalsishypermobile	peristalsishypomobile
-2.5351	2.5781	-.4049	.2200
peristalsisnormal	surgical_lesionyes		
3.4565	3.9902		

Degrees of Freedom: 114 Total (i.e. Null); 109 Residual
Null Deviance: 157.5
Residual Deviance: 85.2 AIC: 97.2

Table 2: Does the Level of Pain Predict the Need for a Colic Surgery

Pearson's Chi-Squared Test

χ^2	df	p-value
29.589	3	<.00001

Table 3: Does a Horse Undergoing Colic Surgery Predict the Outcome

Pearson's Chi-Squared Test

χ^2	df	p-value
10.841	2	.00442

Figure 2: Mosaic Plot of Surgery by Pain Level

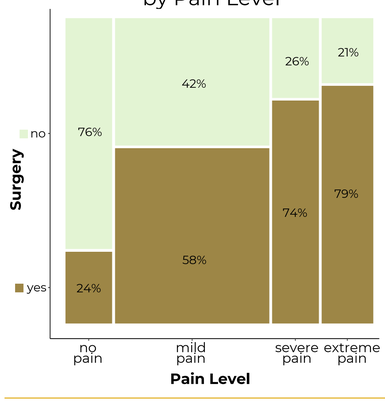


Figure 3: Mosaic Plot of Outcome by Surgery

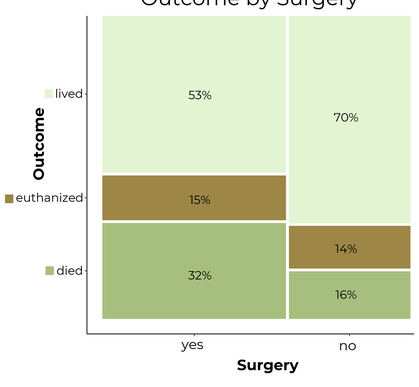


Figure 1: Bar Chart of Dehydration Levels

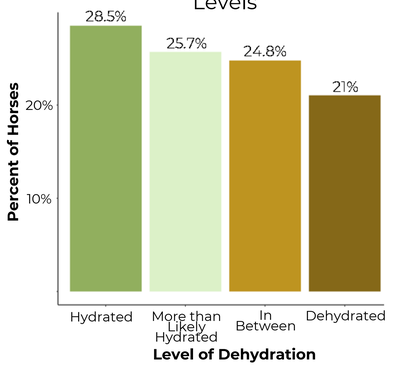


Table 4: Does the Dehydration Level Predict a Horse's Respiratory Rate

Kruskal-Wallis Test

n	χ^2	df	p-value
214	24.6	3	.00002

Figure 4: Which Level of Dehydration Predicts a Different Respiratory Rate

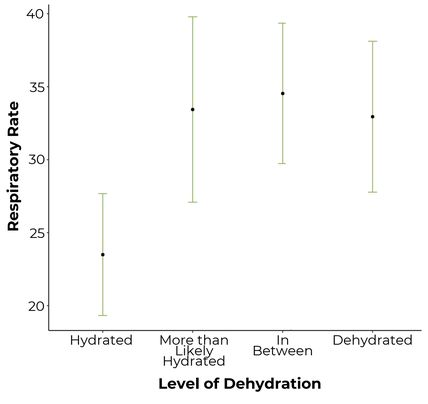


Table 5: Does the Level of Dehydration Predict the Amount of Pain a Horse is in

Pearson's Chi-Squared Test

χ^2	df	p-value
47.575	9	<.00001

Table 6: Does the Level of Dehydration Predict whether a Horse has Colic Surgery

Pearson's Chi-Squared Test

χ^2	df	p-value
23.443	3	<.00001

Table 7: Does the Level of Dehydration Predict the Outcome of the Colic

Pearson's Chi-Squared Test

χ^2	df	p-value
62.593	6	<.00001

Figure 5: Mosaic Plot of Pain Level by Level of Dehydration

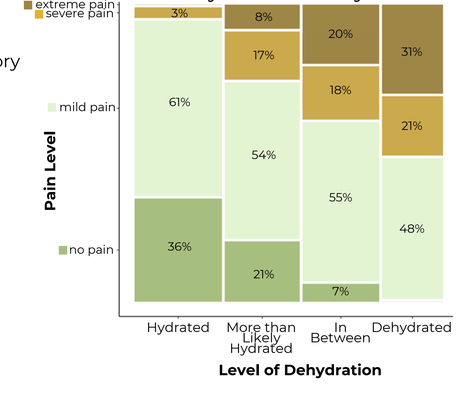


Figure 6: Mosaic Plot of Surgery by Level of Dehydration

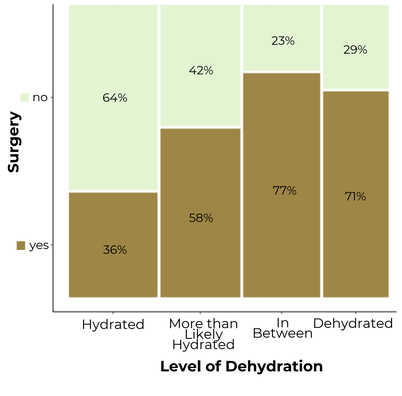
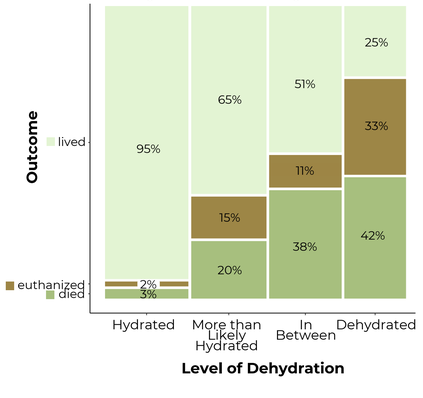


Figure 7: Mosaic Plot of Outcome by Level of Dehydration



RESULTS

- **SURGERY:** Table 1 indicates that the following variables and specific levels are **predictors of colic surgery: Age (young), Peristalsis (hypermobile, hypomobile, normal), and Surgical Lesion (yes).**
- **SURGERY AND PAIN:** Table 2 shows that there is a relationship between the level of pain the horse is in and if they have a colic surgery, with a p-value of <.00001. Figure 2 shows that more horses were in mild pain, indicated by the wider bar. **As the pain level increases the likelihood of a horse having surgery increases.**
- **SURGERY AND OUTCOME:** Table 3 shows that there is a relationship between if the horse has the colic surgery and the outcome of the colic, with a p-value of .00442. Figure 3 shows that **horses who did not have colic surgery were more likely to survive**. This would make sense if surgical treatment was based solely on how severe and complicated the colic was.
- **DEHYDRATION:** Figure 1 shows that the number of horses in each **dehydration level decreases as the horse gets more dehydrated.**
- **DEHYDRATION AND RESPIRATORY RATE:** Table 4 is a nonparametric alternative to ANOVA called the Kruskal Wallis Test. The significant p-value of .00002 combined with Figure 4 indicates that **hydrated horses have a significantly slower respiratory rate.** A normal respiratory rate indicates that the horse is healthy.
- **DEHYDRATION AND PAIN:** Table 5 shows that there is a significant relationship between a horse's pain level and their dehydration level, with a p-value of <.00001. Figure 5 shows that, as opposed to the rest of the groups, most hydrated horses experienced no pain or mild pain. **As the level of dehydration increases, the number of horses experiencing continuous extreme pain and intermittent severe pain increases.**
- **DEHYDRATION AND SURGERY:** Table 6 shows that a horse's level of dehydration is related to whether they have surgery, with a p-value of <.00001. Figure 6 shows that **the likelihood of a horse undergoing colic surgery generally increases when the level of dehydration gets worse**. However, there is a dip in the rate of surgery when the horse is dehydrated. Could this dip be because horses are prematurely euthanized? Notice the huge increase in euthanizations for dehydrated horses in Figure 7 under Dehydration and Outcome. Could the increase in surgeries be due to insurance not paying doctors unless there is a procedure performed?
- **DEHYDRATION AND OUTCOME:** Table 7 shows that there is a significant relationship between the dehydration level and the outcome of the colic, with a p-value of <.00001. **The likelihood of survival decreases as a horse becomes dehydrated.** In addition, Figure 7 shows a large increase in euthanasia as the horse moves from In Between to Dehydrated. This increase is so out of proportion that it prompts a researcher to question whether all the euthanizations were necessary or due to owners not wanting to see their horse in pain when they may have survived.

ACTION

- Ensure that your horse is well hydrated.
- Call your vet immediately.
- Think twice about euthanasia.
- Avoid nonessential colic surgeries.

REFERENCES

- Dr. Laura Reig, DVM
- https://pubmed.ncbi.nlm.nih.gov/24712831/
- https://pubmed.ncbi.nlm.nih.gov/12774977/