Comparison in Twitching Frequencies between Puppies and Senior Dogs in Sleep

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Abstract

Most dogs tend twitch frequently while sleeping and exhibit rapid eye movement (REM) sleep. However, the twitching frequencies seems to vary between dogs of different ages. The purpose of this experiment would be to test if puppies twitch more frequently than senior dogs in their sleep. The experiment was carried out by observing live cams on explore.org/ (Links to an external site.) for videos of sleeping dogs in "Senior Dog Gathering Room" and "Great Dane Puppy Nursery" and the number of twitches observed per minute per individual dog were collected. To compare the data for puppies vs senior dogs a one-way ANOVA analysis was performed by GraphPad Prism. The one-way ANOVA shows p-value <0.0001 and upon further analysis through Tukey's test, the mean twitches per minute between the groups of dogs were found to be statistically significant hence supporting the hypothesis that puppies tend to have relatively more twitching frequencies in comparison to senior dogs.

Introduction

Almost every mammal studied so far tend to display some form of twitching phenomenon in their sleep. These twitches are known as myoclonic twitches which occur exclusively and abundantly during active sleep in mammals, especially in early development (Gramsbergen et al., 1970; Jouvet−Mounier et al., 1969; Tiriac et al., 2012). Dogs are thought to dream in their sleep which results in their twitching movements (Donovan, 2018). According to Blumberg et al. 2013, twitches tend to occur significantly during developmental periods associated with accelerated growth, reflex integration, and locomotor development which helps in mapping the animal's ever-changing bodies when there is production of corresponding sensory feedback after skeletal muscle activation.

While younger dogs/ puppies are in their prime development stage neurologically, the same can't be said about senior dogs who are slowly developing cognitive decline (Lowrie et al. 2016). However, twitching is also observed in these senior dogs though unlike in the case for puppies, this has been shown to likely be due to progressive neurological deterioration rather than neurological development or mapping (Lowrie & Garosi, 2017). The purpose of this experiment would be to test if puppies twitch more frequently than senior dogs in their sleep. As dogs age their body metabolism becomes slower and their body energy requirements decrease as well (Harper, 1998). Consequently, aging dogs are much less active and have slower movements

(Landsberg, Hunthausen, & Ackerman, 2013). Therefore, if changes in twitching speed are related to metabolic speed and neurological factors, then we hypothesize that twitching in senior dogs would be less frequent in comparison to those of puppies.

Materials and Methods

The observational experiment was performed on https://explore.org/livecams that is a website with live cams for different animals in their habitat. Under the "Senior Dog Gathering Room" live cams, an individual dog that is sleeping was selected and observed with a timer set to one minute. The number of twitching movements expressed by the dog were counted. For a movement to be described as a twitch, there must be a sudden brief, involuntary leg jerk while the dog is asleep. The latter steps were repeated for a total of 10 replicates over five random days for more data variability. The same steps mentioned above were performed on collecting data for young puppies where live cam videos from "Great Dane Puppy Nursery" were used to observe random sleeping individual for a total of 10 replicates over 5 random days. The control in this experiment would include middle aged dogs from "Guide Dogs of America" live cam.

The recorded data from the above observation was pasted in a software known as GraphPad. Using this software, statistical analysis was performed on the collected data with control column including the middle-aged dogs and other two age groups having their own columns respectively. A One-way ANOVA test was performed on the data collected since we had more than 2 groups of data. If P is less than 0.05, post-hoc test through Turkey's test was performed.

Results

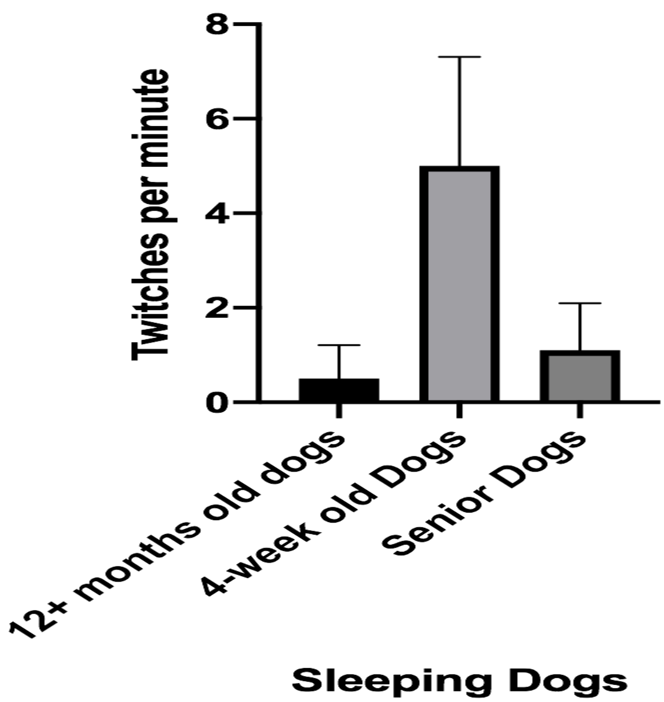

Figure 1. Bar graph showing mean twitches per minute with SD for 12 plus months old, 4-week old, senior dogs. N= 10 dogs per age-group.

Figure 1 shows the mean number of twitches per minute in a bar graph from the collected data of number of twitches per minute for each sleeping dog recorded in the GraphPad Prism 8 software. Since there are three age groups of sleeping dogs, a one-way ANOVA was used to analyze the collected data of number of twitches.

ANOVA Summary	
F	**26.25**
P value	**<0.0001**
R squared	**0.6604**

Figure 2. The one-way ANOVA summary showing P value, F and R Squared from analysis of the 3 age-groups of dogs.

Since the P value resulting from the ANOVA test is less than 0.05, a post-hoc test (Tukey's) was performed (Figure 3). This was done to determine the differences that exist in the mean twitches per minute between the different groups of dogs.

Tukey's multiple comparisons test	Mean Diff.	95.00% CI of diff.	Significant?	Summary	Adjusted P Value
12+ months old dogs vs. 4-week old Dogs	-4.500	-6.172 to -2.828	Yes	****	<0.0001
12+ months old dogs vs. Senior Dogs	-0.6000	-2.272 to 1.072	No	ns	0.6513
4-week old Dogs vs. Senior Dogs	3.900	2.228 to 5.572	Yes	****	<0.0001

Figure 3. The Tukey's multiple comparison test from analysis of the 3 age-groups of dogs.

Discussion

According to results, the P value obtained from the ANOVA was found to be less than 0.0001, which is less than 0.05 hence there is statistical difference. Therefore, the null hypothesis indicating no difference in the mean twitches per minute between the different age-groups of dogs was rejected. Since statistically significant difference was observed, a Tukey's multiple comparisons test was carried out to show comparison between the mean twitches per minute between the groups of sleeping dogs and showed that the 4-week old dogs had more frequent twitches than the senior dogs while the 12+ months old dogs were observed to have similar twitching frequencies as the senior dogs. This result seems to correlate with a similar study performed on sleeping rats as according Baier et al. (2002).

An explanation for the results found above may be that the due to aging, most of the senior dogs may be suffer various muscle degenerating conditions that reduce their twitching frequencies. According to Akasaki et al. (2014), as mammals age, conditions such as insulin resistance and accumulation of ectopic lipid deposits in tissues may lead to loss of fast-twitch myofibers. This muscle loss would make it more difficult for older dogs to twitch in their sleep hence the relatively reduced twitching frequencies observed in the results above.

It is crucial to point out that the experiment had a lot of uncontrolled variables. A major limitation faced during this study was due to constant disturbances by other sleeping or awake dogs. Since the study was carried out online through live cams, there was no controlled environment to observe the sleeping dogs. Consequently, some sleeping dogs would be awakened while in observation procedures by different distractions around their sleeping environment which may have resulted in some inconsistent number of twitches recorded. This data was not eliminated nor rerecorded due to time constraints relating to observing on recorded live videos on explore.org .

When comparing the results to those of older studies, it must be pointed out that most of the data from the older studies were collected from the same individuals during the entire study. In the case of this experiment, it was difficult to use just one individual for the same observation every random sleeping period since the live-cams did not have a way of tracking which dog was used for the study. Consequently, some personal traits and conditions such as epileptic attributes of each individual dog which is unknown to observer may have unintentionally increased or reduced the twitching frequencies. Therefore, there may be a significant measuring error introduced into the study which may have affected the results in general. Although these findings mentioned above may not be consistent with previous research, the mentioned shortcomings leave the door open for further experiments and studies.

Conclusion

In conclusion, there was statistically significant difference in the mean twitches per minute between the groups of dogs. This supports the hypothesis which stated that puppies tend to have more twitching frequencies in comparison to senior dogs. With the advantage of advanced technology and in a more controlled environment, future studies may need to be undertaken to ascertain and advance the knowledge in why exactly these differences in frequencies of twitches are observed in the different group of dogs.

References

1. Blumberg, M. S., Coleman, C. M., Gerth, A. I., & McMurray, B. (2013). Spatiotemporal structure of REM sleep twitching reveals developmental origins of motor synergies. Current Biology, 23(21), 2100-2109.

2. Gramsbergen, A., Schwartze, P., & Prechtl, H. F. R. (1970). The postnatal development of behavioral states in the rat. Developmental Psychobiology: The Journal of the International Society for Developmental Psychobiology, 3(4), 267-280.

3. Jouvet−Mounier, D., Astic, L., & Lacote, D. (1969). Ontogenesis of the states of sleep in rat, cat, and guinea pig during the first postnatal month. Developmental Psychobiology: The Journal of the International Society for Developmental Psychobiology, 2(4), 216-239.

4. Tiriac, A., Uitermarkt, B. D., Fanning, A. S., Sokoloff, G., & Blumberg, M. S. (2012). Rapid whisker movements in sleeping newborn rats. Current biology, 22(21), 2075-2080.

5. Donovan, L. (2018, March 07). Do Dogs Dream? Retrieved December 14, 2020, from https://www.akc.org/expert-advice/lifestyle/do-dogs-dream/

6. Blumberg, M. S., Marques, H. G., & Iida, F. (2013). Twitching in sensorimotor development from sleeping rats to robots. Current Biology, 23(12), R532-R537.

7. Lowrie, M., Bessant, C., Harvey, R. J., Sparkes, A., & Garosi, L. (2016). Audiogenic reflex seizures in cats. Journal of feline medicine and surgery, 18(4), 328-336.

8. Lowrie, M., & Garosi, L. (2017). Classification of Involuntary Movements in Dogs: Myoclonus and Myotonia. Journal of veterinary internal medicine, 31(4), 979–987. https://doi.org/10.1111/jvim.14771

9. Landsberg, G. M., Hunthausen, W. L., & Ackerman, L. (2013). *Behavior problems of the dog and cat*. Edinburgh: Saunders/Elsevier.

10. Baier, P. C., Winkelmann, J., Höhne, A., Lancel, M., & Trenkwalder, C. (2002). Assessment of spontaneously occurring periodic limb movements in sleep in the rat. Journal of the neurological sciences, 198(1-2), 71-77.

11. Akasaki, Y., Ouchi, N., Izumiya, Y., Bernardo, B. L., LeBrasseur, N. K., & Walsh, K. (2014). Glycolytic fast−twitch muscle fiber restoration counters adverse age−related changes in body composition and metabolism. Aging cell, 13(1), 80-91.