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Vet Record

SHORT COMMUNICATION

# Relationship between sleep and pain in Cavalier King Charles spaniels

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## Abstract

**Background:** Cavalier King Charles spaniels (CKCS) have a high frequency of chronic pain and may have abnormal sleep patterns. We hypothesised that CKCS with neuropathic pain (elevated NeP score) would have an increased nighttime restlessness (sleep and nighttime restless [SNoRE 3.0] score) and a worse quality of life (QOL).

**Methods:** Owners of CKCS were recruited to complete an online survey, including demographic information, the SNoRE 3.0 sleep survey, the NeP survey and QOL.

**Results:** The median SNoRE 3.0 score was 12.5, the median NeP score was 0.83 and the median QOL score was 2. The Spearman correlation coefficient between SNoRE 3.0 and NeP was 0.381 ($p = 0.0012$), between SNoRE 3.0 and QOL was 0.29 ($p = 0.014$) and between NeP and QOL was 0.58 ($p < 0.0001$).

**Limitations:** This is a questionnaire-based study with a small sample size. Due to the study design, diagnoses are not confirmed.

**Conclusions:** These data indicate that there is a positive correlation between owner survey responses regarding increased nighttime restlessness, worse NeP and worse QOL.

**KEYWORDS**
dog, neuropathic pain, pain, sleep

## INTRODUCTION

The relationship between sleep and chronic pain is well established in people and rodents. It has been shown that people experiencing chronic pain are more likely to suffer from sleep disorders. These sleep disorders include insomnia, restless leg syndrome and sleep apnoea.[1] This is a cyclical relationship where sleep disturbances are also predictive of worsening pain.[2] Sleep loss or disturbance may lower pain thresholds through a variety of mechanisms.[3] Sleep disruption can also increase the likelihood of chronic pain developing.

Despite the extensive research regarding sleep and chronic pain in other species, little is known about their relationship in dogs. One previous study evaluated sleep quality in dogs with osteoarthritis and showed that dogs treated with NSAIDs had reduced nighttime activity.[4] It is recognised that Cavalier King Charles spaniels (CKCS) with chronic pain secondary to Chari-like malformation (CM) experience abnormal sleep.[5,6] Brachycephalic dogs are at risk for sleep disorders and are also predisposed to pain syndromes such as CM.[7,8] The scarcity of scientific literature may be related to a lack of studies of chronic pain in dogs in general or the challenges associated with assessing sleep quality and sleep behaviour in canine patients. This is a missed opportunity, as understanding sleep disorders in dogs with chronic pain may lead to better pain treatment.[9]

To assess the relationship between sleep and chronic neuropathic pain (NeP) in dogs, we surveyed dog owners about the presence of NeP and the quality of sleep that they perceived in their dogs. We asked CKCS owners about the clinical signs of sleep disorders and NeP using previously validated surveys: the

sleep and nighttime restless score (SNoRE 3.0) and NeP scoring.[10,11] The SNoRE 3.0 survey was previously validated in comparison to polysomnography and wearable activity monitoring to assess the degree of nighttime restlessness and wakefulness in dogs.[11] The NeP score was developed in CKCS to measure the degree of pain, and previous studies validated this score based on behavioural and quality of life (QOL) assessments.[10]

CKCS have a high prevalence of CM, which causes chronic central NeP, most commonly related to the presence of syringomyelia (SM).[9] There is a spectrum of pain phenotypes secondary to CM and SM, as approximately 50%–70% of CKCS dogs have SM secondary to CM, whereas only 15%–33% of these dogs will display phenotypes and behaviours associated with NeP.[5,12] This disorder is similar to the human disorder of type I Chiari malformation, as the pain phenotype develops over time and the underlying pathology is similar.[13] Previous studies have reported sleep abnormalities in CKCS dogs with CM/SM, including abnormal head position during sleep or crying out during sleep.[5] Using the SNoRE 3.0 and NeP instruments, we asked owners about their perceptions of dog sleep quality and NeP. Our primary hypothesis was that dogs with a higher NeP score would be more likely to have abnormal sleep patterns and sleep disturbances, as measured using the SNoRE 3.0 survey. The NeP score includes a QOL question, and we hypothesised that dogs with worse sleep scores would also have a poorer owner-perceived QOL.

## MATERIALS AND METHODS

The survey (Supporting Information) was built in REDCap and distributed via email, as well as being publicly accessible on the institution's website. The survey was advertised to owners of CKCS through an institutional listserv in the autumn of 2024. This list was generated in 2019 by contacting clients who had previously participated in cardiology clinical trials for CKCS. Additional clients have been added over time, and updates are usually provided one to two times a year. The sleep study email was sent to 279 recipients. CKCS owners were asked several questions about their pet, such as age, breed, diet, medications, general health, diagnosis of previous disorders and whether their pet was able to undergo anaesthesia. They were then asked to complete the embedded SNoRE 3.0 and NeP surveys, which also included a QOL score.[10,11] Owners were able to answer 'I don't know' for questions 2, 4, 5 and 6 of the SNoRE 3.0 survey, and this answer was counted as zero. If any responses were unclear, for example, if the age of the dog was listed in an ambiguous manner, the owner was contacted by phone or email for clarification. The dogs did not undergo a physical or neurological examination.

Distribution properties of the data (SNoRE 3.0, NEP and QOL scores) were assessed using normal probability plots. Subsequently, data were summarised as medians (ranges). Two-way associations between variables were assessed using scatter plots and Spearman's non-parametric correlation coefficients. For sex analysis, associates were assessed using a Kruskal–Wallis test with post hoc Dunn's procedure for multiple comparisons. Statistical significance was set to a $p$-value of less than 0.05. Analyses were performed using R and SAS (version 9.4).

## RESULTS

We received responses concerning 68 dogs. Some owners had multiple dogs and filled out the survey once for each dog, so 45 owners responded to the survey. All dogs were reported to be purebred CKCS. The median age of dogs was 5.0 years (range 0.55–15.1 years). Twenty-three dogs were reported to be male castrated, 23 female spayed, 13 male intact and nine female intact. Four dogs were reported to be currently receiving pain medications, which included gabapentin or pregabalin. Three dogs were reported to have previously diagnosed neurological conditions; these responses included CM, SM and fly biting, and the certainty of the diagnosis was not confirmed.

The median SNoRE 3.0 score was 12.5 (range 3–35), the median NeP score was 0.83 (range 0–2.6) and the median QOL score was 2 (range 1–4). Histograms of the scores are displayed in Figure 1.

We evaluated demographic factors and their effects on NeP and SNoRE 3.0. For female intact dogs, the median NeP score was 0.44 (range 0–0.83) and the median SNoRE 3.0 was 11.33 (range 6–23). For female spayed dogs, the median NeP was 1.01 (range 0–2.67) and the median SNoRE 3.0 was 14.35 (range 4–28). For male intact dogs, the median NeP score was 0.41 (range 0–0.83) and the median SNoRE 3.0 score was 11.69 (range 6–21). For male neutered dogs, the median NeP score was 1.05 (range 0.17–2.33) and the median SNoRE 3.0 score was 13 (range 3–35). There was no significant association between sex and the SNoRE 3.0 score ($p = 0.2131$). Age and the SNoRE 3.0 score were also not significantly correlated ($p = 0.6609$). However, there was a significant association between sex and the NeP score ($p = 0.0012$). Post hoc analysis showed significant differences between female intact and female spayed dogs ($p = 0.02681$), female intact and male neutered dogs ($p = 0.00579$), female spayed and male intact dogs ($p = 0.00795$) and male intact and male neutered dogs ($p = 0.00107$). There was also a significant correlation between age and NeP, with a Spearman correlation coefficient of 0.339 ($p = 0.0046$).

To analyse the relationships between sleep quality and restlessness, NeP and QOL, a correlation was performed between each of the variables. The Spearman correlation coefficient between the SNoRE 3.0 and NeP was 0.381 ($p = 0.0012$), between SNoRE 3.0 and QOL it was 0.29 ($p = 0.014$) and between NeP and QOL it was 0.58 ($p < 0.0001$).

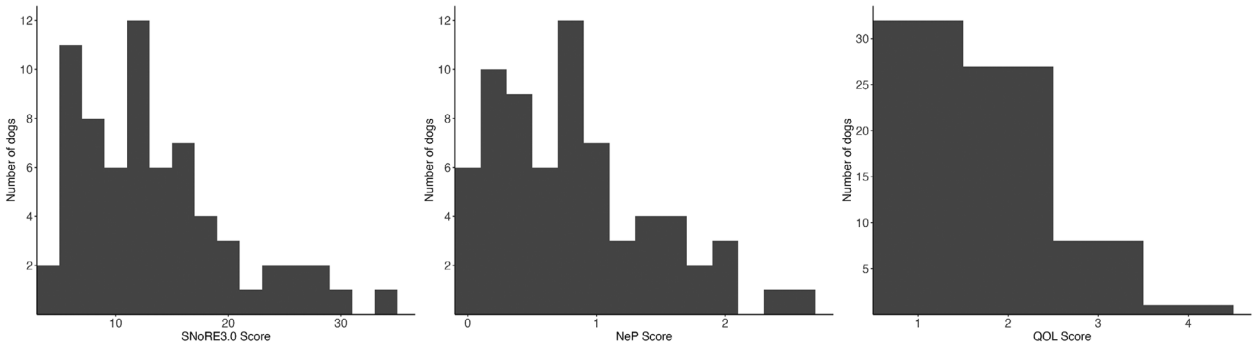


**FIGURE 1** Histograms of survey responses for each of the three surveys used in the study. Left: sleep and nighttime restless (SNoRE 3.0) score; middle: neuropathic pain (NeP) score; and right: quality of life (QOL) score. The figure was made in BioRender.

## DISCUSSION

This study shows that chronic pain and sleep disorders are relatively common in this group of CKCS. There was a correlation between poor sleep, as measured using the SNoRE 3.0 survey, and the perceived presence of NeP, as measured using the NeP score. It also shows that dogs with poor sleep are perceived to have a worse QOL and further supports that the NeP score is correlated with QOL, as shown previously.[10]

The SNoRE 3.0 results were not associated with age or sex. This contrasts with the NeP score, which varied significantly with both age and sex. Older age was correlated with a higher NeP score. Previous studies have shown that older dogs are more likely to be diagnosed with SM and pain secondary to CM/SM; therefore, the positive relationship between NeP and age was unsurprising.[5,14] Previously, sex has not been reported as a factor in the presence of SM or in the likelihood of developing clinical signs secondary to CM/SM.[5,10,14] We found that spayed or neutered dogs had a higher NeP score than intact dogs, regardless of sex (male or female). Our data on sex difference are difficult to interpret due to the small sample size and possible owner biases. However, sex differences in the experience of pain are well established across species and pain mechanisms.[15]

Sleep disturbances emerged as an important and currently underexplored aspect of chronic central NeP in this population of dogs, as an increased SNoRE 3.0 score was correlated with a worse QOL. Therefore, multiple domains of the dog's life, including sleep, are negatively impacted by the presence of NeP. Interestingly, in our survey, only a small percentage of dogs were reported to be receiving treatment for any sort of pain, although our survey results would indicate that a large proportion of these dogs did have characteristics of pain or sleep disorders. The survey did not allow for determination of the indication(s) for which some dogs were receiving pain treatments. It is likely that abnormal sleep patterns were not recognised as possible clinical manifestations of pain, as this has rarely been reported in dogs.[5] It is also difficult to recognise chronic pain in dogs, so it is likely underdiagnosed.[9,16] By treating these disorders, we could potentially improve the QOL of these pets.

CKCS are a brachycephalic breed and, in addition to the relationship between pain and sleep in these dogs, their head conformation may affect sleep.[8,17] Brachycephaly is associated with sleep disordered breathing, which may include sleep restlessness, apnoea and sleeping in abnormal body positions.[7] Normal sleep and normal respiratory function during sleep are needed for cerebrospinal fluid (CSF) movement.[8] The progression of SM is thought to be related to abnormalities in CSF flow and reabsorption.[18,19] Therefore, there may be a complex interaction between brachycephaly, CM, sleep, pain and CSF flow in these dogs.[8]

Abnormal sleep not only affects the dog's QOL but also may have negative impacts on owner wellbeing. Needing to wake up to let the dog outside or noticing when the dog is moving around or twitching excessively can negatively impact owner sleep and affect owner QOL.[20] This could impact the quality of the human–animal bond.[21] Treating sleep in dogs with chronic pain could therefore improve both dog and owner QOL.

Further studies are needed to validate these results in canine patient populations. The current study presents survey-based results, and while the surveys have been validated for sleep and NeP, it is possible that the results have underlying bias that we did not anticipate. We did not confirm the specific neurological diagnosis in these particular dogs, although we know that this breed is highly predisposed to chronic pain from CM/SM. Additionally, it could be important to determine if there are factors outside of chronic pain that influence the quality of sleep in dogs. Perhaps owner lifestyle and sleep patterns are important factors that need to be investigated.

Our future plans include documenting electroencephalograms, sleep histograms and sleep apnoea and directly examining dogs from this patient population. We also plan to perform MRI on a sample of dogs from this patient population to determine if CM/SM is present, measure the size and location of the SM if present to quantify the severity of pathological lesions and correlate that to sleep histograms and SNoRE 3.0 scoring.[22,23] This may help to understand how sleep and pain are related in CKCS with CM/SM. NeP in CKCS secondary to CM/SM is a complex and multifactorial disorder.[12,18,24]

In conclusion, a survey of the owners of a group of CKCS—a dog breed with a high prevalence of congenital malformations leading to chronic central NeP—showed a correlation between central NeP and sleep disturbances, as well as a reduction in owner-reported QOL.

## AUTHOR CONTRIBUTIONS

*Data collection and writing—review and editing*: Allie R. Sherman. *Study design and conceptualisation, data collection and writing—review and editing*: Mindy A. Quigley. *Data analysis and writing—review and editing*: Stephen R. Werre. *Study design and conceptualisation, and writing—review and editing*: John H. Rossmeisl. *Study design and conceptualisation, data collection and writing—original draft*: Rell L. Parker.

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## CONFLICT OF INTEREST STATEMENT

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as potential conflicts of interest.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available upon request from the corresponding author. The data are not publicly available due to privacy restrictions.

## ETHICS STATEMENT

This study was approved under IACUC protocol 24-078 at Virginia Tech.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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