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Review

Effects of sheltering on physiology, immune function, behavior, and the welfare of dogs



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HIGHLIGHTS

- Research on the effects of kenneling on dogs is reviewed.
- Prior research has not provided clear conclusions.
- Operational definitions of abnormal behavior are inconsistent.
- Single-subject designs may be useful in future research.

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ABSTRACT

Approximately 4 million dogs live in animal shelters each year. However, understanding and measuring the welfare of these kenneled dogs presents a challenge. One way to determine welfare is by assessing how stay at the shelter influences physiology, immune function, and behavior of the dogs. Prior research, from all of these domains, has not resulted in clear conclusions on how the animal shelter influences the well-being of dogs. One robust finding is that, when placed into a kennel environment, dogs experience a spike in cortisol levels followed by a decrease to original at-home levels. Current evidence cannot differentiate between several proposed hypotheses that may be responsible for this pattern. In addition, very few studies have assessed the effects of kenneling on immune function of dogs, and of these, no consistent findings have emerged. However, this line of inquiry can have a large impact as infectious diseases are rampant in animal shelters. The ability of behavioral measures to inform us about the welfare of dogs is discussed by reviewing published and new data on the effects of kenneling on dog behavior. Prior research has suffered from a lack of consistent operational definitions when defining abnormal behavior in dogs, resulting in difficult to interpret results. Research on the well-being of individual dogs, rather than on group averages, may be a fruitful next step in determining and improving the welfare of dogs housed in shelters.

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Over the years, the rate of euthanasia in animal shelters has decreased and continues to decrease. In 1895, the American Society for the Prevention of Cruelty (ASPCA) reported euthanizing 96% of all dogs taken into their facility [101], but currently, the APCA estimates the percentage is closer to 31% [3]. This decrease in euthanasia rates may be attributable to many different initiatives possibly including spay and neuter programs, increased education and adoption programs, and general public awareness of the plight of homeless animals. A potential outcome of the sought-after decrease in euthanasia rates is the increased length of stay of dogs in animal shelters. Whereas, national statistics on the average length of stay are currently unavailable, as an illustrative example, a reported average length of stay was 9.5 days in 1999 [97] and 34.6 days in 2013 [16]. Furthermore, many private shelters never euthanize dogs once they have been offered for adoption, resulting in very long stays at the shelter. Because of this, there are currently large numbers of dogs living in animal shelters for a prolonged period of time. Understanding the impact of shelter housing on dog physiology, behavior, and ultimately, well-being is crucial for this population of animals. The current review will outline research on the physiological and behavioral effects of kenneling, drawing on previously published data from various fields of research as well as presenting new previously unreported data. The review shows that prior research has not currently demonstrated that dogs housed in animal shelters suffer from reduced welfare. Furthermore, this review highlights that operational definitions of abnormal dog behavior are inconsistent, making interpretations difficult. I suggest that agreeing on operational definitions for behaviors in kennel dogs as well as focusing future research on assessments on an individual level, rather than relying on group averages, may allow for a better understanding of the well-being of shelter dogs.

Most municipal and private shelters house their dogs in relatively small pens either singly or in pairs with little to no opportunities for exercise outside of the pen. The Animal Welfare Acts specifies that the minimum dimensions of primary dog housing is dependent on the size of the dog, which can be calculated to be approximately only 1.6 m² for a Labrador Retriever-sized dog [1]. Animal shelters often strive to exceed this minimum and a typical kennel in a US animal shelter may be 3–7 m² (personal observation). Nevertheless, shelter housing, by its very nature, restricts the ability of dogs to engage in species-specific behaviors [83,90], such as roaming and interacting freely with conspecifics [6]. Spatial and social restriction, exposure to novel environments, and separation from an attachment figure in prolonged kenneling may all contribute to decreased welfare at the shelter.

However, determining the welfare of any animal presents several challenges. On one hand, when there is presence of clearly painful stimuli (e.g., injury, illness, too low or high temperature), it is easy to determine that the animal is experiencing poor welfare. However, the effects on welfare of other potential stressors such as novelty, confinement, and separation from attachment figures may be more difficult to assess. Therefore, researchers have strived to develop objective ways to determine how a stressor can impact the welfare of any animal [51]. Definitions of poor welfare in animals range from reduced fitness, such as reduced life expectancy, impaired growth and reproduction [5,15] to a focus on the inability of the animal to cope with the environment [15]. This inability may be measured through immunosuppression and resulting disease, increased stress physiology, behavioral abnormalities, as well as the measures of reproductive fitness [15]. Yet another definition focuses on the animal's mental state that may or may not be associated with its physiological health [23]. Here, a connection to human stress physiology may be made: if behavioral and physiological changes are noted in animals, which correspond to human changes when in a poor mental state, we can assume that the animal is also experiencing poor welfare. However, regardless of the definitions of welfare, the objective and measurable changes are often largely the same [51]. These measures include reproductive fitness, hypothalamic–pituitary–adrenal

(HPA) axis activity, immunosuppression, and abnormalities in behavior. Research in animal shelters has in turn focused on the latter three measures, as fitness, such as impaired reproduction and decreased lifespan, is not possible to assess and/or not relevant in a shelter environment. By integrating previous research from various populations, such as laboratory-housed, shelter, working, and pet dogs, the goal of this review is to assess how sheltering affects the welfare of dogs on these three measures.

1. Effects of sheltering on the HPA-axis

When a stressor is present in the environment, the hypothalamus triggers a release of the corticotropin-releasing hormone (CRH) and arginine vasopressin, which in turn, stimulate the production of adrenocorticotropin hormone (ACTH) in the pituitary and the activation of the “fight or flight” response. ACTH stimulates the production and release of cortisol from the adrenal cortex to the blood. The high levels of cortisol then inhibit further production of the CRH and ACTH in a negative feedback loop (Fig. 1). However, levels of cortisol also fluctuate independent of environmental stressors. For example, cortisol increases during nursing, with physical exercise, during cold temperatures, and during the morning [51]. Furthermore, individuals show a large variability in baseline cortisol levels, thus complicating group-based experimental analyses. For example, Bennett and Hayssen [11] found that the coefficient of variability was 166% for 315 saliva samples taken from 48 individual dogs.

Interpreting levels of cortisol is further complicated by its differential role in acute versus chronic stress. An acute stress response, such as to a relatively brief startling stimulus, is evidenced by a spike in serum cortisol levels followed by a return to baseline levels. However, research on the relationship between cortisol levels and chronic stress has revealed a much more complicated system. Because the purpose of cortisol is primarily to divert cellular processes from metabolic functions to functions that are necessary for immediate survival (i.e., in the “fight or flight” response), prolonged exposure to stress may lead to immunosuppression and the dysregulation of the HPA-axis. This dysregulation may manifest in an initial hypercortisolism, then followed by hypocortisolism, in which cortisol levels remain low even under stress.

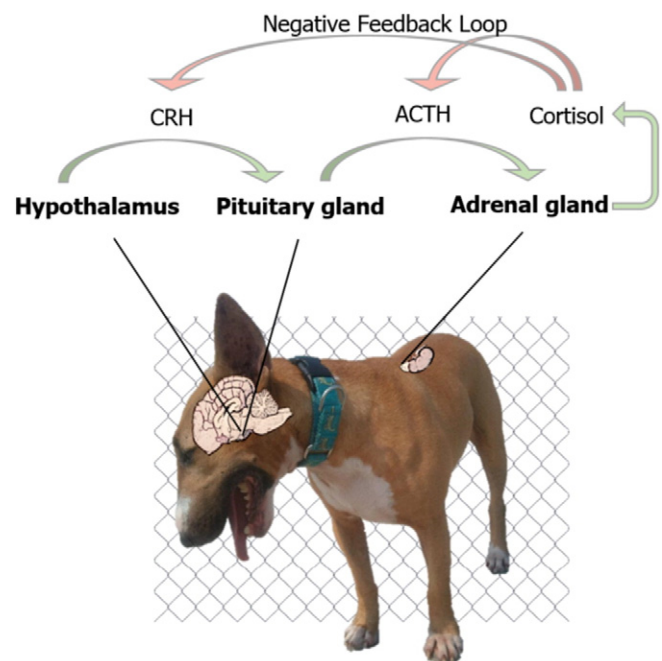


Fig. 1. The response of the HPA-axis to a stressor.

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