



Does the sex of the search and rescue (SAR) dog handler affect the work of the rescue team?

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Abstract: The handler's sex, as well as his personality and individual predispositions, may affect his suitability for work in rescue services. In addition, the handler's susceptibility to stress may affect the effects of search and rescue (SAR) dog's work. The study aimed to analyze the salivary cortisol level of SAR dog handlers concerning the sex of the handler, and the type and results of rescue examinations. Forty one SAR dog handlers participated in the study. Together with their dogs, they participated in open-field and disaster rescue exams. It turned out that the handler's sex did not affect the results of the rescue exams. However, the obtained research results suggest that the sex of the handler may be important when choosing a rescue specialty.

Key Words: dog's handler, search and rescue, cortisol.

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Introduction

Stress, cortisol, and sex differences

The stress response is a complex mechanism that aims to restore homeostasis through the interaction among the HPA axis, the central and peripheral autonomic nervous systems, and the immune system (Russell & Lightman, 2019). Under the influence of a stressor, the hypothalamus secretes corticotrophin-releasing hormone (CRH), which stimulates the pituitary gland to secrete adrenocorticotrophic hormone (ACTH), which in turn causes the secretion of glucocorticoids by the adrenal cortex. The main glucocorticoid in humans and many species of animals is cortisol (Kudielka & Kirschbaum, 2005).

Cortisol has many important functions in the body of humans and animals. Both positive and negative functions. The rapid rise in cortisol levels in a stressful situation, peaking 10-15 minutes after the occurrence of the stressor, increases gluconeogenesis and inhibits insulin secretion, promotes decision-making and alertness, and stimulates cognitive functions (Russell & Lightman, 2019).

Usually, it is associated only with stress, more specifically with distress. Although its secretion has also been shown to increase in response to positive and exciting stimuli, like the ones experienced by children around Christmas time (Flinn, 2006; Hoyt et al., 2016). Hoyt et al. (2016) found that cortisol can promote positive feelings and that high cortisol levels are not necessarily harmful, and the low ones are not necessarily beneficial. The rise in cortisol levels triggered by acute stress, for instance, helps the immune system fight pathogens (McEwen, 2019).

There are significant sex differences in cognitive and emotional responses such as learning, memory, and anxiety. There are also differences in the frequency of various neurological and psychiatric conditions between men and women. Dyslexia and stuttering are more common among boys, whereas anxiety disorders and eating disorders are much more common among girls. There are also differences between the two sexes in stress response, food preferences, pain sensitivity, and social behavior (McCarthy et al., 2012). Due to these differences, various types of medications may be required to treat neurological and psychiatric disorders in men and women in the future (Bangasser & Wicks, 2017).

Dog–handler interactions

A good dog handler is said to be more difficult to find than the good dog itself. Especially when it comes to working dogs, including search and rescue (SAR) dogs. The handler's skills, as well as their personality and susceptibility to stress, may affect the results of the SAR team's work, which is important especially when human life is at stake. In SAR dogs (as well as other working dogs) performance evaluation, handlers tend to be left out. And as emphasized in the work by Jamieson et al. (2018), a working dog handler is responsible not only for following his dog in a search area.

Fortunately, the role of handlers is more and more appreciated these days. There are more and more studies assessing and emphasizing, for example, the role of the dog's handler personality in the proper cooperation within the human-dog team (Hoummady et al., 2016; Kaleta et al., 2011; Kotrschal et al., 2009; Wedl et al., 2009).

The handler's sex, as well as their personality and individual predispositions, may influence their suitability for this type of work. At the same time, it can affect the work of the SAR dog and the overall performance of the SAR team. The subject of the research was the analysis of saliva cortisol levels in SAR dog handlers depending on the sex, type, and results of rescue tests.

Material and methods

The study was conducted after obtaining approval from the 2nd Local Ethics Committee for Animal Experiments in Lublin (Resolution no. 68/2015 of 30 June 2015) and was part of research on salivary cortisol levels in SAR dogs and their handlers (Wojtaś et al., 2020). The methodology was based on the same principles, but the analysis included the handlers only. The experiments were undertaken with the understanding and written consent of each handler, with the approval of the appropriate local ethics committee, and in compliance with national legislation and the Code of Ethical Principles for Medical Research Involving Human Subjects of the World Medical Association (Declaration of Helsinki).

Forty one SAR dog handlers were participating in the study. Together with their dogs, they took part in class 0 and class I open-field and disaster rescue specialty practical exams in Poland. The handlers participating in the study were 18 women and 23 men, all of them were Polish. The average age of the handlers was 35.46 years old (the youngest and the oldest being 25 and 56, respectively). 23 of the handlers took the disaster exam, 18 took the open-field exam. 9 took class 0 exams, and 22 took class I exams. The health status of all the participants was satisfactory; none of them was taking medications regularly or suffering from chronic illnesses, especially of the endocrine system. 30 minutes before the saliva was collected, they were not allowed to eat or smoke. The collection did not take place during nighttime exams due to the circadian rhythm of cortisol secretion in humans. Similarly, the exams conducted during the day were scheduled after the morning cortisol secretion peak (Lee et al., 2015).

The biological material for the research was saliva. The saliva was collected from the handlers before and after the exam (approx. 30 min. difference between the samples) using a Salivette Cortisol tube (Sarstedt, Germany). The obtained biological material was centrifuged (3600 rpm for 10 minutes), labeled, and frozen (-20°C). After all samples had been collected, they were delivered to the laboratory for cortisol levels determination. At the laboratory, the material was thawed, centrifuged again and cortisol levels were determined using the DRG Salivary Cortisol HS ELISA assay.

Results

Salivary cortisol level in handlers depending on sex

The salivary cortisol level measured before the exam was significantly higher in women compared to men (t-test for independent samples, $t = 2.36$, $p = 0.024 < 0.05$, Table 1, Figure 1). After the exam, this significant difference also persisted (t-test for independent samples, $t = 2.68$, $p = 0.011 < 0.05$, Table 1).

Table 1. Salivary cortisol level in handlers by sex

Salivary cortisol level	women (n=18)		men (n=23)		t	p
	M	SD	M	SD		
Before the exam	10.03	4.97	6.84	3.72	2.36	0.024*
After the exam	13.09	4.51	9.23	4.64	2.68	0.011*
Cortisol level increase	3.06	2.92	2.39	2.59	0.78	0.443

* $p < 0.05$

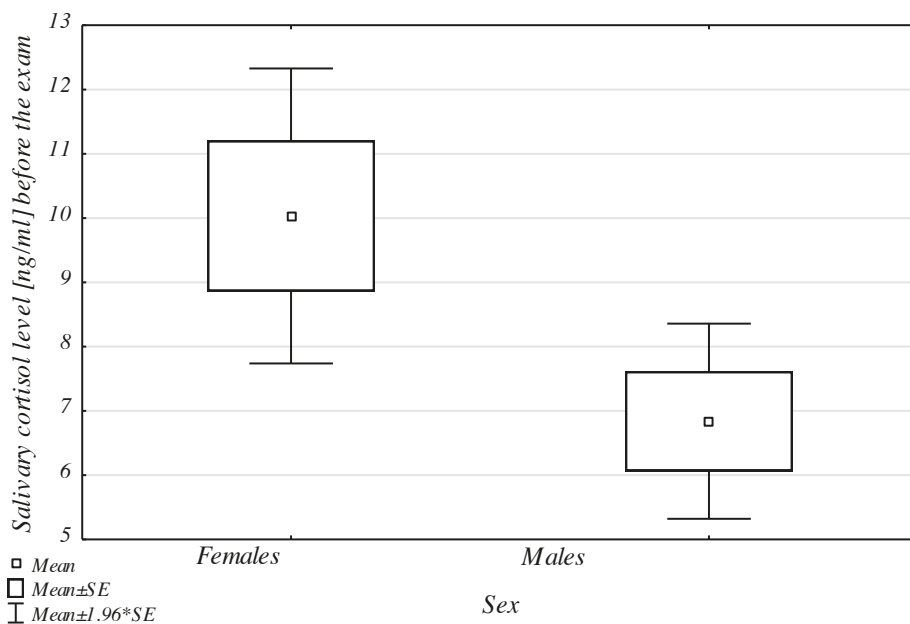


Figure 1. Box plot for salivary cortisol level in handlers before the exam by sex.

Salivary cortisol level in handlers depending on age

The relationship between the handler’s age and their salivary cortisol level was analyzed. The values of the Pearson linear correlation coefficient r , the p -value for the significance test for this coefficient between the age of the handler and the cortisol levels before and after the exam, as well as their increase during the exam, also depending on gender, are included in Table 2.

Table 2. Pearson's linear correlation coefficient r between the age of the handler and the level of cortisol by sex and without portioning.

Correlation between handler's age and salivary cortisol level	women		men		all	
	r	p	r	p	r	p
Before the exam	0.24	0.341	0.28	0.193	0.06	0.702
After the exam	0.14	0.586	0.47	0.023*	-0.02	0.907
Cortisol level increase	-0.19	0.445	0.44	0.034*	-0.14	0.394

There was no significant relationship between the age of women and the salivary cortisol level before and after the exam, as well as its increase during the exam (Table 2). However, in the group of men, there was a significant positive correlation ($r = 0.47$, $p = 0.023 < 0.05$) between age and cortisol level after the exam, as well as a significant positive correlation between age and cortisol increase during the exam ($r = 0.44$, $p = 0.034 < 0.05$).

Salivary cortisol level in handlers depending on the handler's experience

Some handlers take exams multiple times, whether it is because they failed the previous one or want to obtain another class or specialty. The study did not show a significant relationship between the handlers' experience in participating in exams and their cortisol levels (Table 3).

Table 3. Spearman's ordinal correlation coefficient between the number of handler's exams and the salivary cortisol level by sex and without division.

Correlation between the number of handler's exams and salivary cortisol level	women		men		all	
	R	p	R	p	R	p
Before the exam	0.30	0.230	0.06	0.773	0.046	0.776
After the exam	0.26	0.298	0.04	0.853	-0.002	0.988
Cortisol level increase	-0.12	0.643	0.18	0.411	-0.099	0.539

Salivary cortisol level in handlers depending on the specialty and class of the exam

The analysis of the salivary cortisol level in handlers depending on the specialty of the exam showed no significant difference before the exam, after the exam, and no increase in this level during the exam in the case of female handlers (Table 4). The situation is different in the case of male handlers. The salivary cortisol level in male handlers measured before the exam was significantly higher in the open-field compared to the disaster (t-test for independent samples, $t = 3.01$, $p = 0.007 < 0.05$, Table 5, Figure 2). After the exam, this significant difference also persisted (t-test for independent samples, $t = 3.04$, $p = 0.006 < 0.05$, Table 5, Figure 3).

Table 4. Salivary cortisol level in female handlers depending on the exam specialty.

Salivary cortisol level in female handlers	open-field		disaster		t	p
	M	SD	M	SD		
Before the exam	5.28	3.52	3.27	1.76	1.31	0.209
After the exam	5.70	3.90	4.20	2.47	0.85	0.406
Cortisol level increase	0.42	1.85	0.93	2.13	-0.53	0.603

Table 5. Salivary cortisol level in male handlers depending on the exam specialty.

Salivary cortisol level in male handlers	open-field		disaster		t	p
	M	SD	M	SD		
Before the exam	6.10	3.07	3.10	1.68	3.01	0.007*
After the exam	7.37	3.63	3.68	2.11	3.04	0.006*
Cortisol level increase	1.27	1.11	0.58	1.60	0.97	0.343

*p<0.05

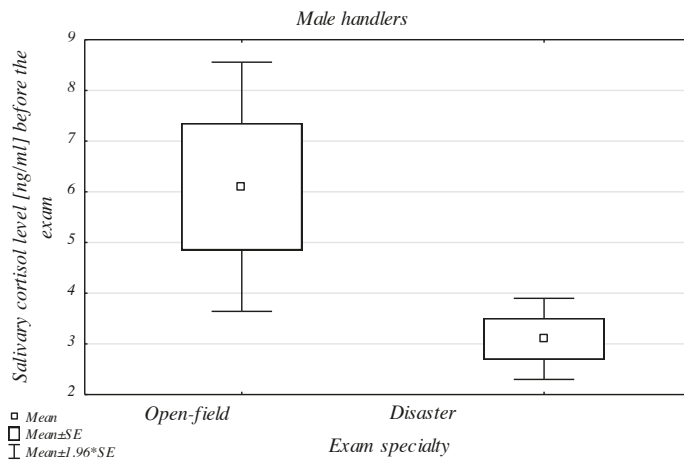


Figure 2. Box plot for salivary cortisol level in male handlers before the exam depending on the exam specialty.



Figure 3. Box plot for salivary cortisol level in male handlers after the exam depending on the exam specialty.

In the case of female handlers, no significant differences were found in the level of cortisol before the exam, after the exam, and no increase in this level during the exam between both exam classes (Table 6). In the case of male handlers, the level of cortisol measured before the exam was significantly higher for class 1 exams compared to class 0 exams (t-test for independent samples, $t = -2.35$, $p = 0.029 < 0.05$, Table 7, Figure 4). After the exam, this significant difference also persisted (t-test for independent samples, $t = -2.10$, $p = 0.048 < 0.05$).

Table 6. Salivary cortisol level in female handlers depending on the exam class.

Salivary cortisol level in female handlers	class 0		class I		t	p
	M	SD	M	SD		
Before the exam	5.02	3.97	4.45	2.95	0.33	0.743
After the exam	6.44	5.44	4.72	2.54	0.93	0.365
Cortisol level increase	1.42	2.18	0.27	1.78	1.16	0.263

Table 7. Salivary cortisol level in male handlers depending on the exam class.

Salivary cortisol level in male handlers	class 0		class I		t	p
	M	SD	M	SD		
Before the exam	1.50	1.43	4.38	2.34	-2.35	0.029*
After the exam	1.98	1.49	5.20	2.95	-2.10	0.048*
Cortisol level increase	0.48	0.33	0.82	1.64	-0.41	0.689

*p<0.05

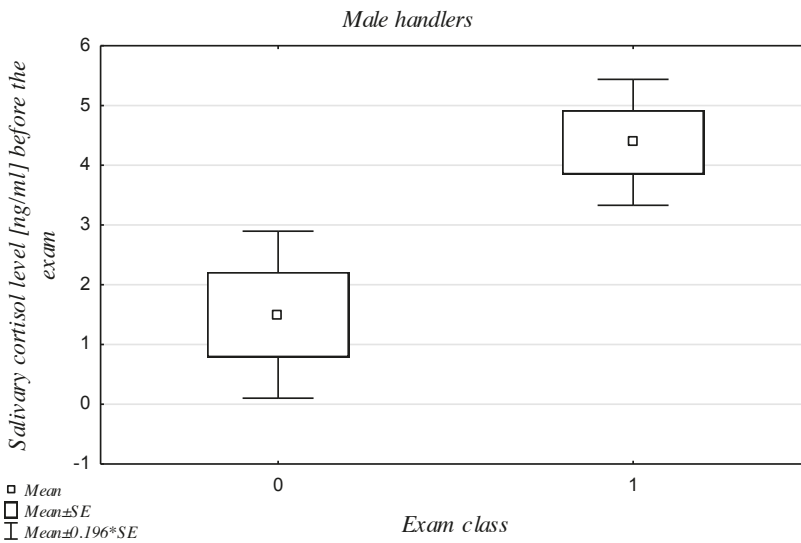


Figure 4. Box plot for salivary cortisol level in male handlers before the exam depending on the exam class.

Exam results depending on the sex of the handlers

When assessing the relationship between the sex of the handler and the exam results, no relationship was found between these parameters ($\chi^2 = 0.039$; $df = 1$; $p = 0.843$), which was also confirmed by the value of the Phi Yule coefficient ($\phi = 0.031$). The calculations show a clear advantage of the exams with a positive result in both women (67%) and men (69%).

Discussion

Our research has shown higher salivary cortisol levels in women compared to men. Higher cortisol levels in women were also reported by Kivlighan et al. (2005) and Mazur et al. (1997). As a comparison, differences in the level of this hormone depending on sex were not noted by van den

Bos et al. (2014) and Kirschbaum et al. (1992). However, they suggest differences in the level of cortisol increase in men and women depending on the type of task they have to perform and the degree of risk taken (van den Bos et al., 2014). The significantly higher level of cortisol in female handlers, observed in our research, suggests that women are more susceptible to stress caused by such examinations. Women, as well as females of many animal species, are also characterized by a higher emotional sensitivity (Sundman et al., 2019). Thus, the psychological aspect (Saxbe et al., 2008) and a more emotional approach to certification may have a significant impact on the level of cortisol. Also, the genetic factors that determine cortisol levels may differ between men and women (Kurina et al., 2005).

Thus, there are differences between men and women at the level of hypothalamic and pituitary activation and the level of HPA axis negative feedback (Bourke et al., 2012). Moreover, the effects of stress vary by sex. Women are more prone to stress-induced depression (Bourke et al., 2012). In contrast, men are more susceptible to the immune and metabolic effects of stress (Bourke & Neigh, 2011), such as hyperglycemia, hyperinsulinemia (Björntorp & Rosmond, 2000). It has now been possible to show on a population basis that perceived stress-related cortisol secretion frequently is elevated in this condition. This is followed by insulin resistance, central accumulation of body fat, dyslipidaemia and hypertension (the metabolic syndrome) and coronary artery disease (Vitaliano et al., 2002) psychophysiology, and coronary heart disease (CHD).

Among male handlers, a significant correlation was observed between age and the salivary cortisol level after the exam, as well as a significant positive correlation between age and the increase in cortisol during the exam. It can therefore be concluded that the older male handlers are, the more stressful they find the exams, and hence the higher cortisol levels in this group. Differences in cortisol levels depending on age were not observed in their studies by Fries et al. (2009), Pruessner et al. (1997), Waltman et al. (1991), and Wüst et al. (2000) which are, for instance, related to persisting pain, burnout and chronic stress. Furthermore, it has been suggested that the HPA axis might serve as an indicator of allostatic load in subjects exposed to prolonged environmental noise. In the present paper four separate studies with a total of 509 adult subjects were combined in order to provide reliable information on normal values for the free cortisol response to awakening. Corresponding with earlier findings, a mean cortisol increase of about 50% within the first 30 minutes after awakening was observed. The intraindividual stability over time was shown to be remarkably high with correlations up to $r=0.63$ (for the area under the response curve). On the other hand, Otte et al. (2005), based on the analysis of 26 published studies, assessed the influence of sex on the relationship between age and cortisol levels. They found that sex has a significant influence on this relationship and in the case of women this influence is three times greater than in men.

Each approach to the exam is a stressful situation for the handler, regardless of whether they have already taken such an exam before. Similar conclusions were published by Kirschbaum et al. (1995) and Šimić & Manenica (2012).

Some sex differences in handlers' cortisol levels have been observed again. The open-field exam is more stressful for men than disaster one, while for women the specialty of the exam makes no difference. Class 1 exams (which are entitled to participate in rescue operations) are more stressful for men than class 0 tests, while women are not more stressed in any of the classes. The differences in the level of cortisol increase in men and women depending on the type of task they have to perform have already been described by Kirschbaum et al. (1995), (Lovallo et al., 2006) and caffeine is often consumed in conjunction with exercise or mental stress. The interactions of caffeine and stress on cortisol secretion have not been explored adequately in women. We measured cortisol levels at eight times on days when healthy men and women consumed caffeine (250 mg \times 3 and van den Bos et al. (2014). They found that men are more prone to psychological stress than women (Kirschbaum et al., 1992; Lovallo et al., 2006) sex differences in cortisol responses to psychological stress were investigated in healthy adolescents and adults (total $n = 153$ and that the level of cortisol in men has a strong positive relationship with the degree of their risk-taking (van den Bos et al., 2014).

Conclusion

The sex of the SAR dog's handler does not affect the results of the rescue exams. Both women and men can be great handlers and it probably depends only on their predispositions for this type of work. However, the obtained research results suggest that the sex of the handler may be important when choosing a rescue specialty. This is all the more important when we know that the handler's stress affects his dog's stress. Therefore, it is worth conducting further investigation on an extended research group.

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Il sesso del conduttore del cane di ricerca e soccorso (SAR) influisce sul lavoro della squadra di soccorso?

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Sintesi

Il sesso del conduttore del cane, così come la sua personalità e le predisposizioni individuali, possono influenzare la sua idoneità al lavoro nei servizi di soccorso. Inoltre, la suscettibilità del conduttore allo stress può influenzare i risultati del lavoro di ricerca e soccorso (SAR) del cane. Lo studio mirava ad analizzare il livello di cortisolo salivare dei conduttori di cani SAR per quanto riguarda il sesso del conduttore e il tipo e i risultati degli esami di soccorso. Quarantuno conduttori di cani SAR hanno partecipato allo studio. Insieme ai loro cani, hanno partecipato a esami in campo aperto e di soccorso in caso di catastrofe. Il sesso del conduttore non ha influenzato i risultati degli esami di soccorso. Tuttavia, i risultati della ricerca ottenuti suggeriscono che il sesso del conduttore può essere importante quando si sceglie una specialità di soccorso.