



# Sex Differences in Catabolic and Anabolic Hormone Responses in Military Survival Trainees



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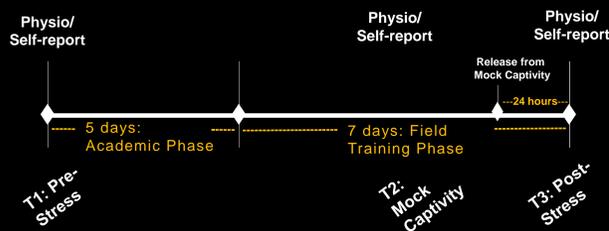
## Background & Purpose

While neuroendocrine hormones may play a role in operational stress, resilience and traumatic brain injury, limited reports are available; especially for female military members. **PURPOSE:** This study examined whether catabolic and anabolic hormone responses to acute stress differ between male and female military members during survival training.

## Methods

A total of 178 military service members (136 males, 42 females) undergoing survival training were studied before (T1), during (T2), and 24 hours after stressful mock-captivity (T3; **Figure 1**). Catabolic (cortisol) and anabolic [testosterone, dehydroepiandrosterone sulfate (DHEAS)] hormones were measured in saliva at all three time points. Independent *t*-tests were used to assess mean differences and percent changes between neuroendocrine hormone levels responses by sex during stressful mock-captivity.

Figure 1. Study Timeline



## Results

Characteristics of the sample are presented in **Table 1**. Males had significantly higher mean cortisol levels than females at T1 ( $p=0.001$ ; **Table 2**). Males also had significantly higher mean testosterone levels than females at T1, T2, and T3 ( $p<0.0001$ ). Males had significantly higher mean DHEAS levels than females at T1 ( $p=0.001$ ) and T2 ( $p=0.01$ ). While females had a significantly greater percent change in testosterone than males from T1 to T2 ( $p<0.0001$ ) and T2 to T3 ( $p=0.0001$ ), males had significantly greater percent change in testosterone than females from T1 to T3 ( $p<0.0001$ ; **Table 3**). Females had significantly greater mean percent change in DHEAS from T1 to T3 ( $p=0.001$ ) than males. Mean percent changes in cortisol were similar between sexes.

Table 1. Characteristics of study sample.

	Total Sample (n=178)		Males (n=142)		Females (n=36)		p-value
	N	M (SD) or %	N	M (SD) or %	N	M (SD) or %	
Age	177	25.3 (4.6)	141	25.2 (4.8)	36	25.4 (3.3)	0.89
Body Mass Index	165	24.3 (2.7)	131	24.8 (2.7)	34	23.9 (2.5)	0.08
<b>Ethnicity</b>							
Caucasian	119	67.6	94	67.1	25	69.4	0.50
Hispanic	19	10.8	16	11.4	3	8.3	
Asian	9	5.1	7	5.0	2	5.6	
Black	8	4.5	6	4.3	2	5.6	
Native American	1	0.6	1	0.7	0	0.0	
Mixed/Multiple	17	9.7	15	10.7	2	5.6	
Other	3	1.7	1	0.7	2	5.6	
<b>Education</b>							
High school/GED	62	35.0	55	39.0	7	19.4	0.008
2-yr college	23	13.0	19	13.4	4	11.1	
4-yr college	88	49.7	66	46.5	22	61.1	
Graduate school	4	2.3	1	0.7	3	8.3	
<b>Military Service, y</b>	177	2.2 (0.1)	141	4.6 (3.9)	36	5.1 (3.3)	0.54
<b>Paygrade</b>							
Officer	78	44.3	57	40.7	21	58.3	0.15
Enlisted	97	55.1	82	58.6	15	41.7	
<b>Combat Experience</b>							
Yes	27	15.3	23	16.3	4	11.4	0.38
No	149	84.7	118	83.7	31	88.6	
<b>Prior Head Injury/ Concussion, LOC</b>							
Yes	34	80.8	31	22.0	3	8.3	0.06
No	143	19.2	110	78.0	33	91.7	
<b>PTSD</b>							
Yes	3	1.7	3	97.9	0	0	0.47
No	173	98.3	137	2.1	36	100.0	

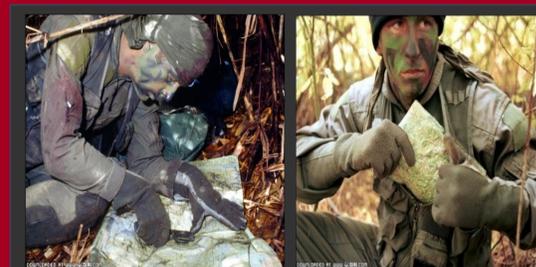


Table 2. Neuroendocrine hormone response to acute stress by sex.

Endpoint	Total Sample (n=178)		Males (n=142)		Females (n=36)		p-value
	M	(SD)	M	(SD)	M	(SD)	
<b>Cortisol</b>							
T1	0.22	(0.11)	0.23	(0.11)	0.17	(0.12)	<b>0.001</b>
T2	0.66	(0.36)	0.66	(0.36)	0.65	(0.36)	0.80
T3	0.16	(0.11)	0.16	(0.11)	0.18	(0.12)	0.39
<b>Testosterone</b>							
T1	141.3	(80.8)	160.4	(79.18)	65.90	(20.3)	<b>&lt;0.0001</b>
T2	103.9	(33.9)	108.9	(32.73)	84.69	(31.9)	<b>&lt;0.0001</b>
T3	87.2	(40.4)	93.29	(42.13)	62.93	(26.1)	<b>&lt;0.0001</b>
<b>DHEAS</b>							
T1	4479.2	(3782.0)	4845.5	(4018.74)	3034.6	(214.2)	<b>0.001</b>
T2	14418.4	(13329.3)	1551.9	(14177.2)	10109.1	(8052.9)	<b>0.01</b>
T3	8723.91	(714.54)	8983.7	(7454.0)	7699.2	(5714.9)	0.26

Table 3. Percent change between time points for neuroendocrine hormone response to acute stress by sex.

Endpoint	Total Sample (n=178)		Males (n=142)		Females (n=36)		p-value
	M	(SD)	M	(SD)	M	(SD)	
<b>Cortisol</b>							
Δ T1-T2	279.84	(303.30)	256.83	(289.85)	370.58	(340.81)	0.27
Δ T2-T3	-69.24	(23.31)	-69.66	(23.80)	-67.57	(21.53)	0.27
Δ T1-T3	-9.88	(78.36)	-20.13	(56.81)	30.57	(126.27)	0.07
<b>Testosterone</b>							
Δ T1-T2	-15.06	(35.30)	-26.71	(23.54)	30.85	(36.73)	<b>&lt;0.0001</b>
Δ T2-T3	-14.40	(26.22)	-12.05	(26.84)	-23.65	(21.56)	<b>0.0001</b>
Δ T1-T3	-31.21	(25.37)	-38.16	(19.69)	-3.80	(26.98)	<b>&lt;0.0001</b>
<b>DHEAS</b>							
Δ T1-T2	274.58	(303.23)	272.40	(318.85)	283.17	(235.23)	0.20
Δ T2-T3	-19.06	(62.1)	-23.30	(60.67)	-2.31	(65.83)	0.07
Δ T1-T3	131.69	(150.89)	118.55	(147.19)	183.52	(156.22)	0.001

## Conclusions

Although males and females demonstrate similar catabolic hormone responses to intense military stress, their anabolic hormone reactivity and recovery patterns are clearly distinguishable. This may have implications for operational stress, resilience and traumatic brain injury in military personnel.

