<u>Salivary Cortisol Response in Division I Lacrosse Players</u>

Purpose

Purpose #1: To observe changes in salivary cortisol in Division I female collegiate lacrosse athletes throughout the competitive season. We hypothesize that cortisol will progressively increase during the season. Pilot data from the 2020 competitive season that was cut short due to the COVID-19 pandemic showed an upward trend in cortisol during the first four weeks of season (Figure 1).

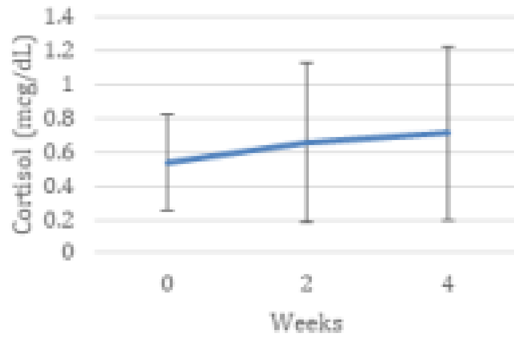

Figure 1: Changes in cortisol over time in Spring 2020

Purpose #2: To evaluate relationships between cortisol and markers of recovery and readiness (wellness scores, ratings of perceived exertion) and objective training metrics taken during training. We hypothesize that cortisol will have at least a moderate relationship with sprint and high-intensity distance (HID) loads. Pilot data from the 2020 competitive season showed a trending relationship between cortisol and these loads (r = .158-.206).

Project Narrative

Background

Cortisol is a glucocorticoid hormone that fluctuates with sympathetic response to stress and is associated with neuromuscular performance [1]. Cortisol levels have been shown to correlate with several markers of athlete readiness and recovery (e.g., countermovement jump and ratings of perceived exertion), as well as fluctuate throughout a competitive season with performance [2]. This is important because cortisol levels can show how the body is truly responding to stress and how training can be improved by adapting the protocol to the individual. Cortisol has been assessed in male collegiate and professional athletes across a variety of high-intensity and endurance sports [3,4,5]. Previous literature has addressed athlete stressors and cortisol response, however few studies included female athletes, and even fewer studies regarding high intensity female athletes. The measurement of cortisol can provide evidence to coaches in an effort to fine tune or alter their training schedule to better serve and increase the effectiveness of the current training regimen and reduce the risk of injury and overtraining.

Methods

This will be a non-experimental observational study design. This study is approved by the institutional review board and will be conducted in accordance with the Declaration of Helsinki. Data collection for this study began in February 2021. All participants had the opportunity to ask questions prior to participation, and all participants completed a written informed consent. All elements of the study coincide with FERPA guidelines. Participants were included in this study if they were members of the varsity women's lacrosse team at Campbell University, 18 years of age or older, and eligible for play. Participants were excluded if they were deemed ineligible for play by an athletic trainer or team physician, or if they were not identified as a key player by the lacrosse coaches. Saliva samples will be collected weekly on Friday mornings over 12 weeks of the competitive season, for a total of 12 samples per athlete (n=15). Samples are stored in -80° Celsius per collection and storage protocol until analysis. Saliva samples are analyzed for cortisol using an ELISA kit (Salimetrics, State College, PA). The absorbance of the wells at 450 nm will be measured using a BioTek plate reader (Winooski, VT). To calculate the concentration of cortisol, a standard curve will be generated for the B/Bo from known standards provided in the Saliva ELISA kit ranging from 300 µg/dL to 0.012 µg/dL (Salimetrics, State College, PA). Changes over time in cortisol, wellness, and training load will be evaluated using a repeated measures analysis of variance (RM-ANOVA). Relationships between cortisol, wellness, and training load will be assessed using a Pearson correlation matrix.

Daily wellness, session ratings of perceived exertion (sRPE), and training load was also collected from each participant during the Spring 2021 competitive season. Subjective athlete total wellness scores and sub scores (muscle soreness, sleep quality, fatigue, and stress) were taken each morning prior to training. This was done using an electronic device linked to VX Sport software (Wellington, New Zealand). The purpose of the wellness questionnaire is to determine the athlete's health using a five point Likert scale (0/25/50/75/100). The following questions were asked during a wellness questionnaire:

1. How are your muscles feeling today?
2. How did you sleep last night?

3. How are your energy levels feeling for your training today?
4. How stressed are you?

After the training each day, athletes indicated the physical demands of training using a modified CR-10 scale in the VX Sport software. The determined value was then multiplied by the time spent in training, resulting in sRPE.

Objective total weekly training load for distance, high-intensity distance (HID), sprints, accelerations, and decelerations were tabulated from the previous training week. These athletes wore VX Sport (Wellington, New Zealand) units in order to track objective training load for distance, HID, sprints, accelerations, and decelerations. The units included a global positioning system (GPS; collecting at 10 Hz), 3-axis accelerometer (104 Hz per channel), 3-axis magnetometer (18 Hz), 3-axis hyroscope (18 Hz) and heart rate monitor (2.4 GHz). GPS units were inspected to ensure proper working order and satellite connection prior to each training session. Athletes used only their assigned unit in conjunction with their corresponding vest equipped by VX Sport. The unit was placed in the designated pocket on the vest located between the shoulder blades. After training each day, all data were uploaded to the VX Sport Training software. This data was trimmed to remove in active time periods and split to supply data specific to the training plan provided by the coaches.

A repeated measures analysis of variance (RM-ANOVA) will be used to evaluate the primary aim of this study. This test will evaluate changes over time (12 weeks) in cortisol, wellness, and training load. The second aim of this study—relationships between cortisol, wellness, and training load— will be assessed using a Pearson correlation matrix. All analyses will be conducted in SPSS and an alpha level of .05 was used to determine significance.

Timeline

Table 1. Timeline of proposed summer research.

Task	Spring 2021			Week 1 (Samples 1-2)			Week 2 (Samples 3-4)			Week 3 (Samples 5-6)			Week 4 (Samples 7-8)			Week 5 (Samples 9-10)			Week 6 (Samples 11-12)			Week 7			Week 8		
VX Data Collection	■	■	■																								
Saliva Collection and storage	■	■	■																								
ELISA Cortisol Assay Kit				■			■			■			■			■			■								
Concentration Calculations					■			■			■			■			■			■							
Data Analysis						■			■			■			■			■			■	■	■	■			
Poster Preparation																						■	■	■	■		
Draft Paper																								■	■	■	■

Budget*

OnTimePoint™ Saliva Collection Management System	$ 250.00
Saliva collection aids (50-pack, $70), 4 needed	$ 280.00
Cryovial, 2mL with insert (25-pack, $19.50), 7 needed	$ 136.50
Cryostorage box ($6.50), 2 needed	$ 13.00
Cryolabels ($0.17 each), 156 needed	$ 26.52
Assay kits (5-pack salivary cortisol ELISA kit), 1 needed	$1180.00
TOTAL	**$2,000.54**

*funding provided by a collaborator at Sam Houston State University and the Department of Biology at Campbell University

* VX Sport Units have been purchased as a part of previous studies.

*Consumables (micro centrifuge tubes, pipettes and pipettes tips) and equipment for cortisol storage and analysis (-80° Celsius freezer and Bio-Tek plate reader) are available in the Biological Sciences labs.

References

[1] Balsalobre-Fernández, C., Tejero-González, C. M., & del Campo-Vecino, J. (2014). Relationships between training load, salivary cortisol responses and performance during season training in middle and long distance runners. *PloS one*, *9*(8), e106066. https://doi.org/10.1371/journal.pone.0106066

[2] Balsalobre-Fernández C, Tejero-González CM, del Campo-Vecino J. Hormonal and neuromuscular responses to high-level middle- and long-distance competition. Int J Sports Physiol Perform. 2014 Sep;9(5):839-44. doi: 10.1123/ijspp.2013-0539. Epub 2014 Jan 14. PMID: 24436350.

[3] Haneishi K, Fry AC, Moore CA, Schilling BK, Li Y, Fry MD. (2007) Cortisol and Stress Responses During a Game and Practice in Female Collegiate Soccer Players. *Journal of Strength and Conditioning Research.* 21(2); 583-588.

[4] Jaspers A, Op De Beeck T, Brink MS, Frencken WGP, Staes F, Davis JJ, Helsen WF. (2019) Predicting Future Perceived Wellness in Professional Soccer: The Role of Preceding Load and Wellness. *International Jounral of Sports Physiology and Performance.* https://doi.org/10.1123/ijspp.2017-0864

[5] Filaire E, Sagnol M, Ferrand C, Maso F, Lac G. (June 2001). Psychophysiological Stress in Judo Athletes During Competitions. *Journal of Sports Medicine and Physical Fitness.* 41(2):263-268.