An analysis of external training load during summer conditioning training in NCAA Division III athletes

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Introduction

- Monitoring external training load in sport is important to exercise prescription, training recovery, and injury prevention.
- External training load is the physical work being done by the body[1,3] and can further described as physiological or biomechanical[3].
  - External, physiological load are kinematic variables[4]. These include measures of speed, distance covered, and accelerations to name a few.
  - External, biomechanical load are the forces against the ground[4]. These include measures of body load, impacts (g), and the Catapult algorithm of Player Load™
- Wearable GPS/accelerometers have improved our understanding of external training load in team sport athletes, but more still needs to be understood about the demands of sports performance training[1, 3, 4].

Purpose

The project aimed to advance the understanding of the physiological and biomechanical impact and training load of participants in a NCAA Division III summer strength and conditioning training program. The primary research question was: How do external training load variables change throughout a summer training program?

Method

- Men, team sport athletes who participated in the College summer conditioning program were eligible. A total of 24 subjects provided informed consent to participate.
- Catapult vests and GPS/accelerometers were worn during conditioning sessions outside.
- Data was synced to the online Catapult portal weekly. Measured external training load variables included sprint distance covered, top speed, distance covered per minute, Player Load™ per minute, power score, and power plays.
- Analysis included descriptive statistics, Pearson-product correlation, and one-way ANOVA.

Results

Table 1, Summary Data

	External Physiological			External Biomechanical		
	Sprint Distance (m)	Top Speed (m/s)	Distance per minute (m/min)	PL/min	Power Score (W/kg)	Power Plays (#)
Week 1	448.11	6.22	94.27	3.62	6.89	8.05
Week 2	542.87	7.61†	77.06†	2.89†	5.97†	12.82†
Week 3	590.64	7.55	75.24	2.79	5.9	13.79
Week 4	355.18†	7.13	64.26†	2.72	5.67	15.26
Week 5	392.15	6.88	66.33	2.79	5.9	16.38
Week 6	604.19†	7.51	67.54	2.79	6.12	26.78†
Week 7	686.24	7.24	71.76	2.86	6.54	30.03
Week 8	756.7	7.74	73.24	2.79	6.3	22.38†

†significantly different at $p < .05$ than the previous week

Table 2, Summary Data by Training Day

	External Physiological			External Biomechanical		
	Sprint Distance (m)	Top Speed (m/s)	Distance per minute (m/min)	PL/min	Power Score (W/kg)	Power Plays (#)
Tuesday	623.57	7.6	74.53	2.92	6.22	17.77
Friday	417.2	6.71	73.28	2.93	6.06	16.98

Figure 1, Strong correlation: Distance per minute and Power score

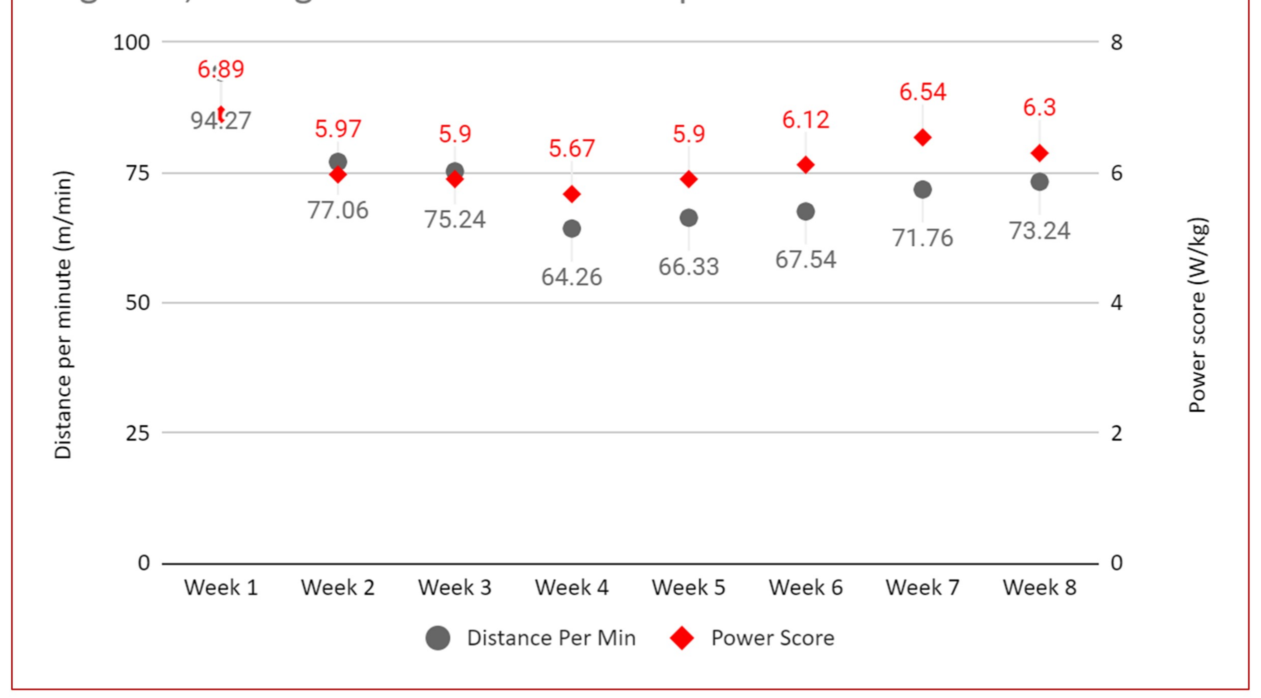
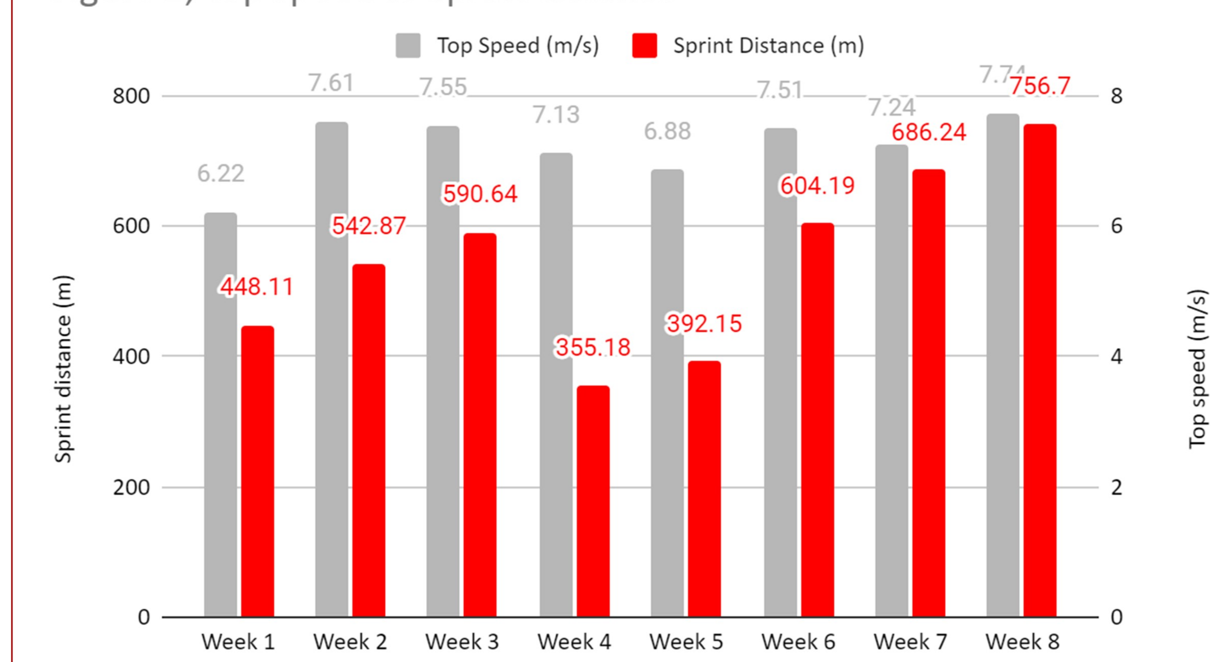


Figure 2, Top speed vs Sprint distance



Results

- 584 unique data days were collected; 78.5% compliance to training and wearing the device
- Table 1 provides descriptive summary data of the summer training, categorized by physiological or biomechanical measure
  - Biggest increase in sprint distance covered between weeks 5 and 6 (+54%) and the biggest decrease between weeks 3 and 4 (-40%). Both were significantly different than the previous week ($p < .001$).
  - PL/min was significantly different week 1 from every other week ($p < .001$) but otherwise weeks 2-7 overall training demand consistent ($\pm$ 0-3.5% difference)
- Table 2 provides summary data between training days. PL/min was similar despite greater sprint distance and higher top speed, power score, and power plays on Tuesdays compared to Fridays.
- Figure 1 represents the data relationship with strong correlation between the physiological measure distance per minute and biomechanical measure of power score ($r = .819$).
- Figure 2 shows the relationship between average top speed and average sprint distance over the 8-week training program ($r = .755$).

Conclusion

- Most variables were not significantly different each week. This is important to understand because progressive prescription training volume was utilized.
- PL/min was similar in value after the first week, despite progressive prescription training volume. This may reflect the training program was consistently challenging the athletes even with body adaptations.
  - The first week is assumed to be an outlier given the exercise prescription was fairly light relative to subsequent weeks.
- Average top speed was highest in the final week of training suggesting positive adaptations to the overall program. Additionally, top speeds was seen in the weeks with highest sprint distance covered.
- Distance per minute and power score reflect measures of intensity (rather than volume) which may explain the high correlation.

Practical Implication

- After initial purchase of the technology, it is feasible to have athletes wear the devices during outdoor training sessions.
- External training load monitoring requires establishment of norm levels for a given population[2]; at present there are not comparisons to be made among Division III athletes
- Data analysis does require time to review and understand all the measures.
- Continued use during season can offer important comparisons between off-season training to in-season and game day preparedness.

References

[1]Cardinale, M., & Varley, M. C. (2017). Wearable training-monitoring technology: Applications, challenges, and opportunities. *International Journal of Sports Physiology and Performance*, *12*, S255-S262.

[2]Murray, A. (2019). Monitoring training load in American football. *NSCA Coach*, *5*(4), 30-35.

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[4]Vanrenterghem, J, Nedergaard, N. J., Robinson, M. A., & Drust, B. (2017). Training load monitoring in team sports: A novel framework separating physiological and biomechanical load-adaptation pathways. *Sports Medicine*, *47*, 2135-2142.