Season-Long Evaluation of Workload of a Division III Women's Basketball Team

Asiedu-Wiafe, A., McCormack, K. & Pellegrino, J.K.

University of Scranton

Introduction

Women's Division III athletes are an understudied population in the literature. This study was designed to objectively quantify the extrinsic and intrinsic workload experienced by starters and non-starters on a Division III NCAA Women's Basketball team throughout a season.

PURPOSE: To objectively quantify the extrinsic and intrinsic workloads of a Division III NCAA women's basketball team though a season.

Methods

All on-court practice sessions through an entire season of play were recorded using the Polar Team Pro system with 16 members of a university team (see table 1 for sample demographics). The season was divided into a four-week preseason (PRE), eight weeks of non-conference play (NCP), six weeks of in-conference play (ICP), and a three-week postseason (POST). Before and after the season, player fitness was assessed via body composition, vertical jump and VO_2max.

Extrinsic load was calculated through total accelerations and decelerations (TA) as well as "high intensity" movements, those above 2.0 m*sec^{-2} (HIM), to provide volume-sensitive measures. Intensity-sensitive measures of extrinsic load included TA*min^{-1}, HIM*min^{-1}, and %HIM (percent of TA that fell above HIM threshold).

Intrinsic load was characterized using heart rate (HR) data. Measures included average HR, time in six submaximal HR zones (HRZ0-HRZ5) ranging from >50%, 50-59%, 60-69%, 70-79%, 80-89%, and 90-100% of HRmax, respectively, and Edwards' summated HRZ model (SHRZ).

Acute: Chronic Workload Ratio (ACWR) was calculated using SHRZ values for the current week divided by the average over the previous four weeks.

Statistical analyses of workloads across season phases were compared using generalized linear mixed model analyses due to the nested structure of data and non-normal distribution of values. Comparisons between season phase were made using both per-session values and per-week values. Body composition and vertical jump were assessed pre- and postseason and compared using paired t-tests. Significance was set at $p < 0.05$.

Results

Table 1. Demographics and Pre/Post-Season Fitness Values

	Age (yr)	Height (cm)	Weight (kg)	Percent Body fat (%)	Lean Body Mass (kg)	Vertical Jump (cm)	VO_2peak (ml/kg/min)
Preseason	19.4 ± 1.1	175.7 ± 7.7	72.1 ± 12	22.7 ± 5	55.3 ± 6.5	37.1 ± 4.1	42.6 ± 4.8
Postseason	19.8 ± 1.2	175.7 ± 7.7	70.2 ± 10.9	22.1 ± 5.8	54.6 ± 6	37.1 ± 5.2	43.3 ± 5.6

See Table 2a/b & Figure 1a/b for intrinsic/extrinsic workload data

Extrinsic load: Seasonal analysis displayed little-to-no difference in volume-sensitive measures of extrinsic load between season phases, but lower intensity-sensitive measures PRE than other phases. A non-significant upward trend in extrinsic measures of intensity was seen through the season.

Intrinsic load: Session duration varied through the season: Post < PRE < ICP < NCP, $p < 0.05$ (table 3). Weekly training volume was more stable, with the only significant drop during POST. PRE sessions were of moderate-intensity with nearly half of practice in HRZ3. This resulted in a high per session SHRZ and avg HR during PRE. In season, more time per session was spent both higher and lower intensities per session. Weekly HRZ values varied similarly. Total weekly intrinsic workload (SHRZ) was higher PRE and NCP than either ICP or POST, $p < 0.05$. Yet, ACWR undulated within an expected range (0.8-1.2 AU) and had a notable trough and peak early and late during ICP, respectively (figure 2).

Fitness measures: All values were unchanged pre-post (table 1).

Table 2a. Per-session Average Workload Data

Per Practice Values	PRE mean ± SD	NCP mean ± SD	ICP mean ± SD	POST mean ± SD
HRZ0 (min)	3.9 ± 2.6[2]	7.1 ± 3.2[1]	7.7 ± 7.0	8.8 ± 7.5
HRZ1 (min)	11.4 ± 6.8[2]	26.0 ± 13.0[1,4]	19.7 ± 17.7	11.1 ± 11[2]
HRZ2 (min)	12.2 ± 7.1[2,3]	24.7 ± 11.8[1]	29.6 ± 12.9[1,4]	16.2 ± 10.6[3]
HRZ3 (min)	54.7 ± 14.2[3,4]	41.5 ± 16.8[4]	34.0 ± 19.3[1]	21.4 ± 14.6[1,2]
HRZ4 (min)	35.5 ± 13.1	39.7 ± 19.2	27.8 ± 18.6	25.3 ± 24.9
HRZ5 (min)	2.4 ± 2.7[2,3]	8.0 ± 7.5[1]	9.2 ± 10.4[1]	10.1 ± 15.2
% HRZ0	3.2% ± 2.1%[4]	4.8% ± 2.1%	6.0% ± 5.5%	9.5% ± 8.0%[1]
%HRZ1	9.5% ± 5.7%[2]	17.7% ± 8.8%[1]	15.4% ± 13.8%	12.0% ± 11.8%
%HRZ2	10.2% ± 5.9%[3]	16.8% ± 8.0%	23.1% ± 10.1%[1]	17.4% ± 11.4%
%HRZ3	45.6% ± 11.8%[2,3,4]	28.2% ± 11.4%[1]	26.6% ± 15.0%[1]	23.0% ± 15.6%[1]
%HRZ4	29.5% ± 10.9%	27.0% ± 13.1%	21.7% ± 14.5%	27.2% ± 26.7%
%HRZ5	2.0% ± 2.2%[3]	5.4% ± 5.1%	7.1% ± 8.1%[1]	10.8% ± 16.3%
Avg HR (bpm)	150.4 ± 2.5[2,3]	145.5 ± 6.3[1]	143.9 ± 8.8[1]	147.4 ± 10.0
SHRZ (au)	349.1 ± 54.6[4]	371.7 ± 61.9[3,4]	306.4 ± 55.6[2,4]	224.2 ± 45.3[1,2,3]
TA	1032 ± 619	1867 ± 1120	1869 ± 1121	1488 ± 893
TA*min^{-1}	8.6 ± 5.2[4]	12.7 ± 7.6	14.6 ± 8.8	16.0 ± 9.6[1]
HIM	116 ± 34[2,3,4]	299 ± 182[1]	328 ± 205[1]	307 ± 206[1]
HIM*min^{-1}	0.97 ± 0.29[2,3,4]	2.03 ± 1.24[1]	2.56 ± 1.60[1]	3.30 ± 2.21[1]
%HIM	11.3% ± 3.4%[2,3,4]	16.0% ± 4.3%[1,4]	17.5% ± 3.8%[1]	20.6% ± 4%[1,2]

Table 2b. Per-week Average Workload Data

Per Week Values	PRE mean ± SD	NCP mean ± SD	ICP mean ± SD	POST mean ± SD
HRZ-0 (min)	15.5 ± 8.7	22.0 ± 8.9	21.8 ± 19.4	26.5 ± 22.2
HRZ-1 (min)	45.5 ± 23.1[2]	80.6 ± 37.3[1,4]	55.8 ± 48.5	33.4 ± 32.4[2]
HRZ-2 (min)	49.0 ± 23.6[3]	76.7 ± 33.4	83.9 ± 34.8[1,4]	48.6 ± 30.1[3]
HRZ-3 (min)	218.9 ± 49.4[2,3,4]	128.7 ± 46.5[1,4]	96.4 ± 50.7[1]	64.2 ± 40.7[1,2]
HRZ-4 (min)	141.8 ± 47.3[3,4]	123.0 ± 53.3	78.8 ± 49.6[1]	76.0 ± 66.8[1]
HRZ-5 (min)	9.4 ± 9.4	24.7 ± 21.3	25.9 ± 27.3	30.3 ± 40.7
SHRZ (au)	1414.2 ± 166.3[3,4]	1235.5 ± 192.3[3,4]	957.5 ± 259.7[1,2]	778.5 ± 235.0[1,2]
TA	4128 ± 2638	5788 ± 3843	5295 ± 3723	4464 ± 3016
TA/min	34.4 ± 21.1	39.4 ± 25.0	41.4 ± 27.6	48.0 ± 30.9
HIM	466 ± 257	926 ± 718	929 ± 760	920 ± 773

[1] Significantly different from PRE; [2] Significantly different from NCP; [3] Significantly different from ICP; [4] Significantly different from POST

Table 3. Season Breakdown

Season Phase	Number of Weeks	Number of Practices	Practices per Week	Minutes per Practice	Hrs/week Practice
PRE	4	8	4	120	8
NCP	8	25	3.1	147.0	7.66
ICP	6	17	2.8	128.0	6.04
POST	3	9	3	93.0	4.65

Figure 1a. Weekly HRZ Distribution Across the Season

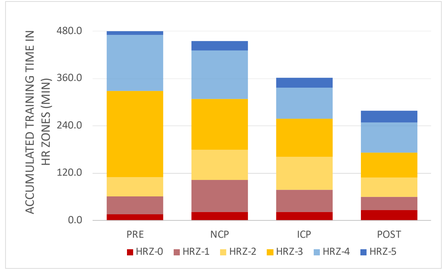


Figure 1b. Weekly %HRZ Distribution Across the Season

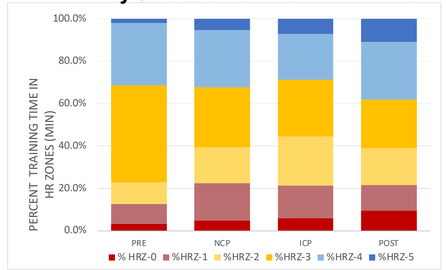
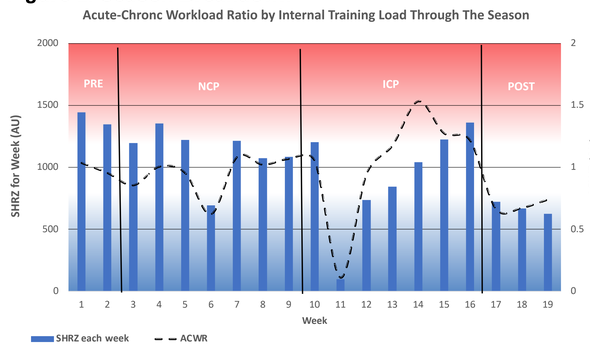


Figure 2. Season Breakdown



Findings

Conclusion: Our data suggests a progressive increase in intensity with a concomitant reduction in volume over a competitive DIII NCAA women's basketball season can maintain, but not improve player fitness levels.

Discussion: Total training time in-season (including off-court and games) was substantially below the 20 hour per week limit imposed by the NCAA. There was a further reduction in volume POST. However, intensity increased following PRE and was maintained throughout the regular and post-season as per extrinsic data and HRZ distribution.

In comparison to data previously reported for comparable sample, intensity of extrinsic load as TA*min-1 was lower during PRE, but not other phases.[1] Further, a relatively larger proportion of movements at a high intensity (%HIM) through the season were observed than can be calculated from similar published studies.[1-3]

ACWR stayed between 0.8 and 1.2, values thought to reflect the under- and over-training boundaries, respectively.[4]

Notably large variations between sessions and weeks within each phase as well as between individual players may have obfuscated differences and impacted findings.

Surprisingly all player fitness measures were markedly similar before and after the season.

Practical Application

- As the first study to objectively identify extrinsic load, intrinsic load, and ACWR throughout a Division III women's basketball season or training, findings present novel foundational data.
- Presence of games during the congested D-III basketball season as well as the large inter-player variations observed, especially during ICP and POST, may have obfuscated differences and impacted findings. Differences in player time and methods employed to include game analyses may make comparisons dubious, if not misleading.
- Coaches and staff are strongly encouraged to assess individual players, rather than whole-team analyses.

References

1. Labrador JE, Peña J, Pons TC, Cook, M, et al. Relationship between internal and external load in elite female youth basketball players. *Apunts Sports Medicine* 2021; *56*(211), 100357.
2. Scanlon AT, Dascombe BJ, Reaburn P, et al. The physiological and activity demands experienced by Australian female basketball players during competition. *Journal of science and medicine in sport* 2012;*15*(4), 341-347.
3. Reina Román M, García-Rubio J, Feu S, et al. Training and competition load monitoring and analysis of women's amateur basketball by playing position: approach study. *Frontiers in psychology* 2019; *9*, 2689.
4. Andrade R, Wik EH, Rebelo-Marques A, et al. Is the acute: chronic workload ratio (ACWR) associated with risk of time-loss injury in professional team sports? A systematic review of methodology, variables and injury risk in practical situations. *Sports medicine* 2020; *50*, 1613-1635.