Analyzing Internal and External Load for One Anonymous Division 1 Basketball Team

Electromyography (EMG) is a diagnostic technique that evaluates and measures the electrical activity of skeletal muscles. The resultant amplitude of the muscles can help provide an approximation of internal load or how much work the muscles have done during an exercise period. With the noticeable uptick in the usage of wearable technology that measures external load, most strength and conditioning practitioners, athletic trainers, and other athletic organizational professionals are aware of the usefulness of an external load measurement. While the external load metric is useful in approximating the output of an athlete within an exercise session there is no accounting for the workload felt internally, by the muscles. One popular purpose of measuring external load is to reduce general fatigue and chronic stress. This is a reasonable and strong use case for this data. However, thus far, there has not been a strong biometric that has been able to be used to evaluate the internal results of being aware of the exact external load of every exercise session. Additionally, internal load can aid in completing the evaluation of workload by presenting the workload that was actually felt by the athlete. For example, playing a complete basketball game while well rested has a different longitudinal stress effect on an athlete than playing a complete basketball game while under large amounts of external stress (I.e. poor sleep, relationship problems, etc.). Even if these two competitions were evaluated at the exact same external load, internal load would differentiate the two activities. This paper will demonstrate an analysis of internal and external load metrics throughout a season of a division 1 basketball team.

The team collected data for every workout from MONTH A to MONTH B. Figure 1 shows a seven-day rolling team average of both internal and external load. This visual aids in visualizing longitudinal periodization, by showing both the physical output of the training sessions as well as the measurable internal toll that the muscles underwent during this time. In this sense the internal load works as a measuring stick to evaluate the symptoms of stress. While the source of the stress (acute fatigue, chronic fatigue, sleep quality, relationship stress, etc.) is not immediately available, being aware of the symptoms alerts teams to the presence of fatigue and can in some instances aid in determining the cause. For example, unusually high external loads from immediate days prior could indicate acute fatigue, while a look at the trend of the workload like Figure 1 could portray indicators of chronic fatigue. Additional tools can also aid in determining the cause of stress such as questionnaires or sleep monitoring technologies. But the importance of measuring internal muscle load cannot be overstated, in that it provides a measurement that can detect fatigue.

This NCAA basketball team was able to use internal and external loads to evaluate their game preparation. The scatter plot in Figure 2 displays a clear differentiation of game days, “game day minus ones,” and “game day minus twos.” External or traditional player load is on the y-axis. Using only the y-axis, one can

clearly see the difference in the game loads and the loads the day before the game. This is to be expected. The day immediately prior to the game is traditionally used as a walk-through day, and is not meant to be near the external load of a game. The practices that would be hard to differentiate and evaluate in a wholistic fashion are the “game day minus two” practices. Figure 2 displays how most of the practices fall between the game external load and the “game day minus one” traditional load. However, they are not the same. There are many “-2” practices that have a higher internal load measurement. This can be determined as good or bad dependent upon the team’s training professionals while considering the added context like the outcome of the game or the trend of the following activities fatigue ratio. This number is also highly dependent upon what is measured during activities. If a “lift” is measured, a higher internal load should be expected as opposed to the external load of the day’s activities. As long as the activities being measured are consistent and the context is always taken into account, the trends can be analyzed with great confidence. A scatter plot like Figure 2 can aid in spotting outliers and help conceptualize the real difficulty of each practice in reference to every other activity the team has completed.

One other way internal and external load can be analyzed is to explore the effect that travel stress has on an organization. While examining Figure 2, this organization noticed that some of the higher internal loads from games were obtained when the team had to take its longest road trips, or when the opponent’s arena had extraordinarily tougher playing conditions than that of a regular away game. Figure 3 shows how this collegiate basketball team’s efficiency ratio (external load divided by internal load) was affected by playing away games versus playing home games. Exploring this data can be tricky because context is always important.

Collegiate basketball ranks games into four quadrants. Quad one being the hardest, quad two being the second hardest, quad three bring the third hardest, and quad four being the easiest. It was important to differentiate the competition being faced because a game being played against easier opponents may not require a team’s most intense effort. Additionally, the pace of the game, or how many possessions there are throughout the course of the game have an effect as well. Figure 3 takes the efficiency ratio and divides by the number of possessions and multiplied by 100 in order to account for different pace. Even this does not eliminate all context, but it does help to provide an idea of the effect that travel has on the team. This is data from here the season split into four different categories, so the sample size is considerably too small in order to make any blanket statements on findings for the general basketball world. However, this team can use this in order to compare general games to an average that includes added context. Indeed, in most cases, the away games did average higher than the home games when facing similar strength of opponents.

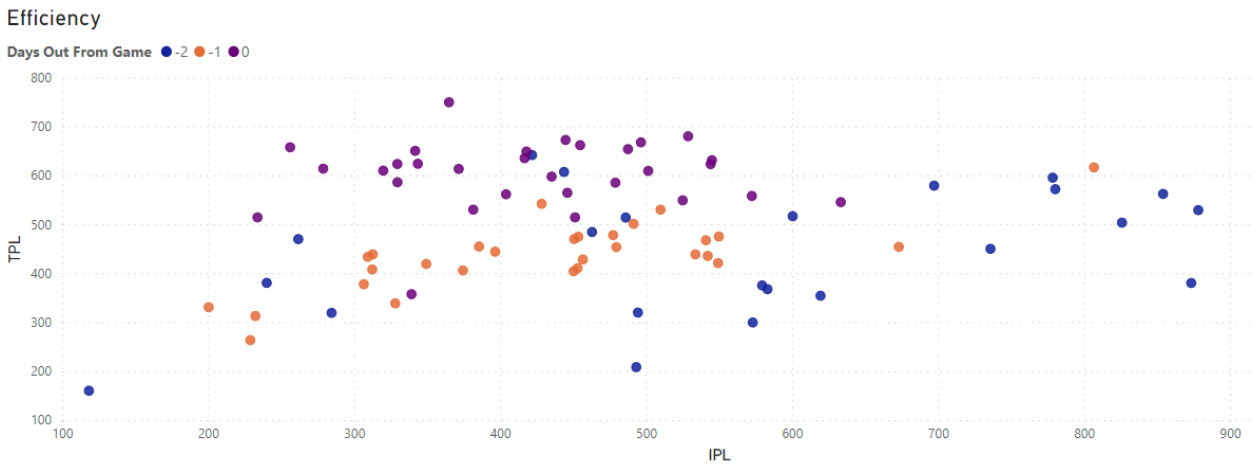

Figure 1 This figure displays game day preparation represented by external (TPL) and Internal (IPL) player load from 2 and 1 days prior to competition.

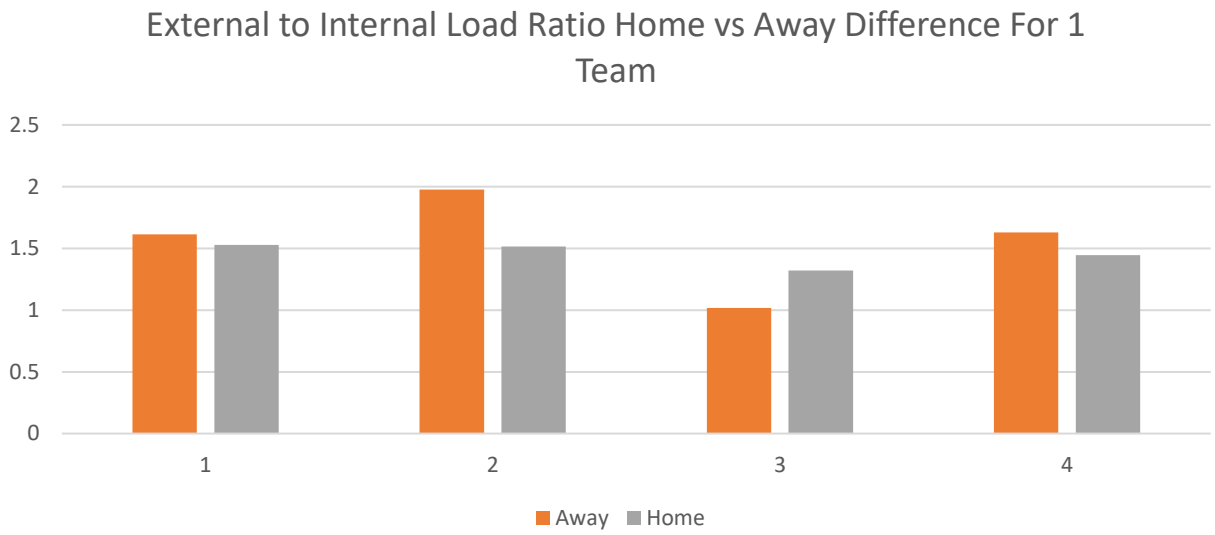

Figure 2 "Efficiency" measurement (external to internal load ratio) provides insight on the effect that home and away games have on a team from a physiological standpoint.

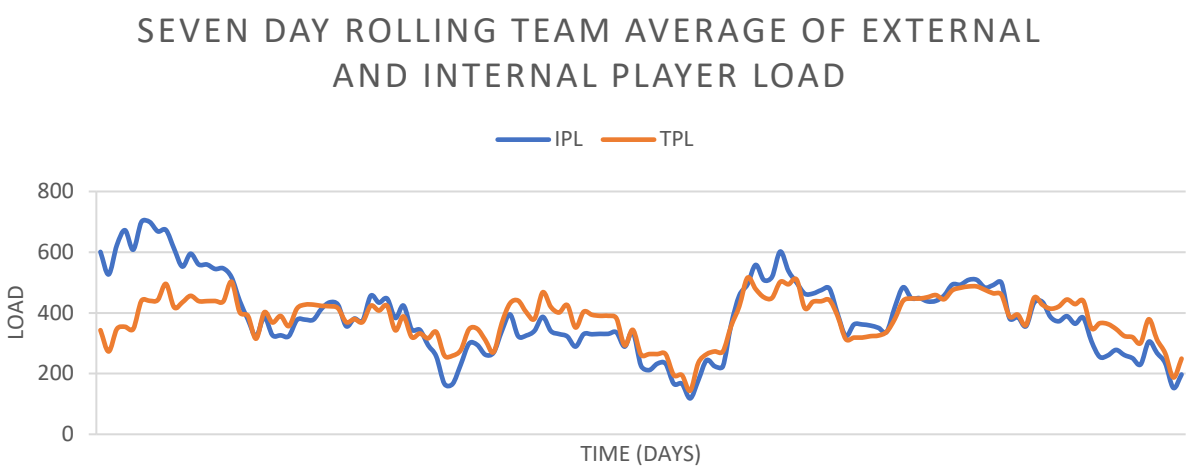

Figure 3 displays the longitudinal rolling seven-day team average internal and external load throughout the course of the season.