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# Seasonal Changes in Sleep, RPE, and Scoring Percentage in Division One Collegiate Female Basketball Players

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**Seasonal Changes in Sleep, RPE, and Scoring Percentage in Division I Collegiate  
Female Basketball Players**

An Honors Thesis submitted in partial fulfillment of the requirements for the Honors in  
Athletic Training through the Waters College of Health Professions.

By

Lindsay Perrin

Under the mentorship of Dr. Stephen Rossi

**ABSTRACT**

Basketball season occurs over several months and involves heavy traveling, training, competing, and scholarly duties. These demands do not allow much time for rest and recovery. A lack in the quantity and quality of sleep can reduce the ability to manage stress and reduce recovery from training and competition. This can affect the health and well-being of the athlete and their success on the court. In college, sleep schedules may change from high school by staying up later and sleeping in more. College students typically sleep between six and seven hours a night which is less than the recommended nine hours (Eaton, 2007). The question appears to be whether a lack of sleep influences perceived exertion during training, competition and performance. There have been many studies examining the relationship between sleep hygiene and illness but less on performance (Damien, 2007). Twelve female basketball athletes recorded the number of hours of sleep, RPE following practice, and scoring percentage every day for six weeks. Statistical analysis was conducted to note difference in RPE, sleep, and scoring percentage. There was no significant difference in all variables across the six weeks of the in-season.

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## **CHAPTER I**

### **INTRODUCTION**

In college, most students change their sleep schedule from high school by staying up later and sleeping in more. College students usually get between six and seven hours of sleep a night which is less than the suggested nine hours from the CDC (Eaton, 2007). College student athletes tend to receive less than that because of their hectic schedules, even though the demands that their bodies undergo requires more time to rest (Adler, 1991). Basketball season occurs over several months which include hours of travel, practices, games, and time to fulfill their scholarly duties. In between all of this, they are still college students who want to spend time with friends and attend social events. The big question that is asked to college athletes is, “when do you find time to sleep?” Finding an hour occasionally to sleep is looked at as being unhealthy but is it actually? Does sleep really affect someone’s health? Can it affect anything else? Sleep studies have mainly focused on a participants’ health. Even less studies have been done on student athletes and what factors affect their level of play during competition.

#### **Statement of the Problem:**

Basketball season occurs over several months and allows for little recovery time for the athletes. The majority of the time, college athletes do not receive the proper amount of sleep which can hinder their recovery process and affect their health as well as their success on the court.

#### **Purpose of Study and Need for Study**

The purpose of this study is to see if there are seasonal changes in sleep, scoring percentage and perceived exertion with a Division One female basketball team during in-season training and competition. There have been many studies done to see the

correlation between sleep and illness but not many done on sleep and performance and even less on sleep and injuries. This study aims to help athletes understand the benefits of having a steady sleep schedule, so they can act accordingly.

### **Delimitations**

This study will have the following delimitations:

- The subjects of this study are Division One female basketball athletes
- A form was used to measure RPE and hours of sleep after each practice and game
- Scoring percentages were recorded by the team assistants
- Injury and Illness recordings were kept by the Certified Athletic Trainer

### **Limitations**

This study will have the following limitations:

- No random selection or usage of male athletes
- Limited amount of scoring percentage's due to decrease in amount of play time
- That the only stress affecting their life is lack of sleep and not looking at any other stressors in the subject's life

### **Assumptions**

- All subjects will fill the form out every day accurately with their amount of sleep and RPE
- That the scoring percentage is accurately kept

### **Hypotheses**

A change in sleep, scoring percentage, and RPE across six weeks of in-season training and competition.

## **CHAPTER II**

### **REVIEW OF RELATED LITERATURE**

#### **Introduction**

Basketball season occurs over several months and allows for little recovery time for the athletes. The majority of the time, college athletes do not receive the proper amount of sleep which can hinder their recovery process and affect their health as well as their success on the court. The literature researched is organized into five sections which have shown to be largely affected by sleep, which are, performance, Rate of Perceived Exertion (RPE), cognitive function, illness, and injuries. Some of the literature looks at high school athletes as well as college athletes.

#### **Performance**

One of the big factors that play a role in someone's health is their sleep pattern. When thinking about the team and athlete's performance, it is important to remember what can affect these player's and how to identify when something is disrupted (Taheri, 2012). One of the greatest skills with coaching is achieving the optimal level of training while not affecting the athlete's recovery capacity (Kuipers, 1988). In addition to the stress of a typical college student, college athletes have the added stress of maintaining their scholarship, earning play time, and the physical demands of playing a college sport (Adler, 1991). The Centers for Disease Control reviewed over 14,000 adolescents sleep patterns and found that less than 7.6% reported having optimal levels of sleep which is greater than nine hours (Eaton, 2007). There are no formal guidelines for adolescents and the amount of sleep needed, but the National Sleep Foundation says that less than eight hours is insufficient, eight hours is borderline, and greater than nine hours is optimal when looking at high school ages (Eaton, 2007). When looking at college athletes, these

numbers will be different than the high school recommendations. Carskadon's (1990) study suggested that older adolescents may need more sleep than younger adolescents. This was shown through having younger adolescents and older adolescents sleep the same amount and observed them throughout the next day. They recorded the older adolescents became more tired in the daytime which supported the idea that older adolescents need more sleep (Carskadon, 1990). One research study showed that an increase in sleep helps with an-athletes shooting accuracy and ability to sprint faster (Mah, 2011). Mah's (2011) study had subjects sleep between six and nine hours a night and then progressed to a minimum goal of ten hours in bed per night. After practice, they recorded the participants shooting accuracy (free throws and 3-point shots) and timed sprint. Another study found, a decrease in sleep follows a decrease in the capability to perform maximal exercise which is necessary in collegiate sports (Davenne, 2007).

### **Rate of Perceived Exertion (Borg RPE Scale)**

The Borg RPE Scale is a scale from 6-20 that is a subjective perception of physical exertion that was developed by Swedish researcher Gunnar Borg. This perception occurs because of the signals from peripheral muscle, joints, cardiovascular, respiratory and central nervous systems (Lenka, 2015). In addition to the biological effects on RPE, psychological responses such as a change in mood has been shown to influence someone's perceived exertion with fatigue having the greatest impact (Viana, 2016). When establishing a patients' exertion with biological factors the gold standard is to measure someone's heart rate and lactic acid build up. These two measurements are reliable when establishing an individual's exertion levels, but it fails to take into consideration the psychological variables that account for an individual's exertion

(Williams, 2017). Exertion is subjective among every individual, but it is important to help prevent musculoskeletal injuries or disorders that arise because of an individual's capabilities and their physical demands from sports (Williams, 2017). Many other scales have been created to show the subjective measurement from the participant (CR10 and CR100) but the RPE scale remains the most suitable (Lenka, 2015). With the Borg RPE scale, the lowest rating (6) indicates "no exertion at all" while the highest number (20) indicates "maximal exertion" (Williams, 2017). This scale has a correlation with heart rate by stating that a score of 10 would correspond to having a heart rate of 100 beats per minute (Williams, 2017). One study looked at the correlation between heart rate and RPE, as well as, workload and RPE in a population of patients with Parkinson's disease which they found a positive correlation of  $r=0.61$  and  $r=0.77$  (Penko, 2017). Validity of RPE scales has been shown by analyzing the relationship between RPE and physiologic measurements as the workload increases (Penko, 2017).

### **Cognitive Function**

Sleep can also affect a person's mood, cognitive reflex and motor function which all play a role in physical activities, especially basketball (Milewski, 2014). Many sports have a large impact on an athlete's mental capacity. A lack of sleep can impact someone's executive function and memory which can be detrimental if continued for long periods of time. That is especially true in adolescents, age nine to sixteen, since their brains are extensively developing at that time (Tarokh, 2016). Sleep deprivation has also been shown to lead to increased lapsing, cognitive slowing, memory impairment, decreased vigilance, and sustained attention in both adults and adolescents (Davenne, 2007). Another area that is often forgotten about when looking at sleep is the effect on

the emotions of the individual. Tarokh (2016) showed that a lack of sleep also correlated with an increase in negative behaviors, depression, and anxiety. One study that was looked at within this article said that out of 106 psychiatric inpatients, ages seven to sixteen, 95% of them had sleep problems (Tarokh, 2016). An additional study showed that sleep with athletes was particularly disturbed before competitions due to anxiety, noise, early arrivals, and need to use the bathroom. It also reported that sport performance was not directly affected by sleep, but their mood was (Lastella, 2012).

## **Illness**

The Open-Window Theory supports the idea of an increase in illness follows physical activity by stating that after rigorous activity, the immune response for the body is lowered for a short period of time (Kakanies, 2011). By having rigorous practices and games day after day, the body needs adequate amount of time to recover. Basketball season in college is a lot different than a basketball season in high school. One important difference being that in college the season is going on year-round, which can have a larger effect on students' health and performance. A study showed that when infected with the cold virus into someone with seven hours of sleep they had a greater chance of developing a cold than someone that had eight hours of sleep (Orzech, 2013). Orzech's (2013) study also looked at sleep cycles, age, and gender and how they all affected the incidences of illnesses. The older the athlete was, no matter the gender, they had a greater chance of illness occurrence. When participants slept less, they increased their chances of becoming sick as well as females, 0.6, having a higher illness rate in comparison to males, 0.37 (Orzech, 2013). Another study showed that poor sleep patterns can lead to hypertension, metabolic diseases, and neurobehavioral problems (Tan, 2015). Many

student athletes try to fit so much into a day and think they are immune to getting sick, and by the time they may get sick it is too far into the season and they lose critical playing time.

## **Injuries**

Allowing athletes to receive the proper amount of sleep can help to reduce the amount of athletic injuries that occur throughout the season (Milewski, 2014). A study done by Tan (2015) saw that a lack of sleep led to an impairment of the athlete's psychomotor performance which increased the amount of injuries that occurred. That same study suggests that individuals with poor sleep behaviors have higher injury rates and have more injury-prone behavior in comparison to individuals that get the recommended amount of sleep (Tan, 2015). Inadequate sleep leads to earlier fatigue which can cause the body to compensate in ways that the muscles/ligaments are not used to. In addition to a lack of sleep causing injuries, an excessive amount of sleep can cause injuries because it could be an indicator of poor physical and mental health (Tan, 2015). In addition, a study on high school students showed that there was a 42% greater increase in their risk for injury if the student participated in year-long sports in comparison to season long sports (Cuff, 2010).

## **Summary**

College athletes are constantly on the go with morning practices, afternoon weights, and team activities at night. With all the events that college athletes are expected to participate in, a lot of the times coaching staff and players themselves forget about maintaining their body's health. By monitoring the body's health, you can help improve the athlete's performance by keeping them at optimal levels both physically and mentally.

## **CHAPTER III**

### **METHODS**

This study's purpose was to observe the impact of seasonal training on hours of sleep, scoring percentage, and rate of perceived exertion (RPE) in Division 1 Women's Basketball.

#### **Subjects:**

The subjects were not chosen randomly. They were the Women's Basketball team at Georgia Southern University with one player exempted from the study due to post-surgery. A total of twelve female athletes aged between 17 and 22 were used for data collection. They previously completed pre-season physicals and medical screening questionnaires were given through the University Athletic Department. They also completed a university informed consent form.

#### **Procedures**

The subjects were given a survey before the start of each practice and game for them to fill out the first portion of the survey which included the amount of hours of sleep they received the previous night. After practice or a game, they were asked to fill out the rest of the survey which included their RPE. They were given an overview of what the Borg RPE scale is, which includes a rating from 6-20. Six being that there was no exertion at all and 20 being maximal exertion. Their practices were between an hour and a half to two hours and fifteen minutes while their games ran for about two hours long with an hour-long warm-up and no cool down after. Their practices were three to four times a week with one to two games each week. Injuries and illnesses were kept updated on a day to day basis by the Certified Athletic Trainer in their system. The participants

were encouraged to go to the Athletic Trainer whenever they felt sick or hurt themselves playing. For scoring percentage, the team managers and coaches kept an updated scoring percentage for each athlete during the game and checked it with the scoring percentage that the officials gave them as well.

### **Analysis of Data**

The data was compiled into a chart and then looked at the change among all the variables: sleep, scoring percentage, and RPE. The data was then put into an SPSS analysis with a general linear model with repeated measures between scoring percentage, RPE and hours slept the night before. The occurrence of injuries and illness will be discussed in the discussion section.

## **CHAPTER IV**

### **RESULTS**

The aim of this study was to observe changes in scoring percentage, sleep, and rate of perceived exertion (RPE) across the in-season in collegiate women basketball players. Data was collected from twelve players, this included the entire team except one player due to an injury. Once all data was collected, the data was run through SPSS analysis with a general linear model with repeated measures. This was done for all three variables: sleep, scoring percentage and RPE. The repeated measures ANOVA did not detect any significance for any of the three variables; scoring percentage was  $p=0.794$ , sleep was  $p=0.677$ , and RPE was  $p=0.151$ . Results are considered significant if they are below  $p=0.05$ .

As the season continued, the scoring percentage continued to be similar with all the participants. In relation to sleep, all participants averaged the same amount of sleep each night for the six weeks tested with a mean around seven hours each week. Some participants reported less than five hours of sleep a night and then up to eleven hours of sleep the following night. The mean RPE continued to decrease from 13.326 to 11.861 as the season continued on.

## **CHAPTER V**

### **DISCUSSION AND CONCLUSION**

This study was done to examine changes in sleep, scoring percentage, and RPE during in- season training and competition. One study reported an increase in sleep caused an increase in shooting accuracy and ability to sprint, but did not observe these during competition (Mah, 2011) Throughout the season, RPE, scoring percentage and hours of sleep stayed relatively constant as the season progressed.

RPE continued to decrease as the season went on which could be due to the decrease in practice time or intensity as the season progressed. Towards the beginning of the season, coaches tend to include more conditioning to help prepare their athletes for the upcoming games and follow a tapering technique. Tapering is part of a training periodization program that takes place before competition or season that reduces the training load to reduce an athlete's fatigue (Carazo-Vargas, 2018). This idea elicits the best possible performance during competition and includes having higher training amounts when in the pre and post season (Carazo-Vargas, 2018). As the season progressed, the coach asked about this study to see how his athletes were feeling and responding to the practices to see if they needed to be adapted for his team to perform better. There was also no significant difference in scoring percentage across the six weeks. This score also did not separate out the different shots which could have a different impact on the significance. Mah (2011) examined the scoring accuracy of basketball players free throws and 3-point shots in a controlled environment without outside factors, i.e. fans or other players.

The final piece of this study was to record and examine the occurrence of injuries and illnesses across the season. The amount of injuries was less than five throughout the time data was collected. In future studies, the occurrence of injuries could be looked at over a longer period of time that may allow for significant changes in the participant. The only illnesses that were recorded were for the flu and the stomach virus. This was recorded through the Certified Athletic Trainer after being diagnosed from the Team Physician. There were two cases of the flu, one case of the stomach virus, and one non-athletic related injury reported.

It has been reported that a lack of sleep affects an individual's cognitive function and has shown a relationship between psychiatric patients and sleep problems (Tarokh, 2016). A decrease in cognitive function could cause an athlete to have an increased chance of injuring themselves if their mind is not functioning appropriately, but more studies will need to be done to test this theory.

Even though this study showed no significant changes in sleep, performance, and perceived exertion, an athlete's sleep pattern should not be adjusted because of these findings. One study was completed and found a correlation between a decrease in hours of sleep and an increase in occurrence of the common cold (Orzech, 2013). If athletes are experiencing a lack of sleep, trying to minimize stress within daily activities and organizing time efficiently can help with sleep patterns. By having set schedules with practice, games, and classwork can help with balancing all responsibilities while still receiving the recommended nine hours of sleep. Coaches can also be mindful with planning practices, travel, and other team activities to allow athletes to get an adequate

amount of sleep. More studies should be done to see the long term effects of sleep on health and athletic performance.

## RESOURCES

Adler, P., & Adler, P.A. (1991). *Blackboards & blackboards: College athletics and role engulfment*. New York, NY: Columbia University Press.

Carazo-Vargas, P., & Moncada-Jimenez, J. (2018). Reducing Training Volume during Tapering Improves Performance in Taekwondo Athletes. *Journal of Physical Education & Sport*, 18(4), 2221-2229. Retrieved from <https://libez.lib.georgiasouthern.edu/login?url=https://search-ebSCO-host-com.libez.lib.georgiasouthern.edu/login.aspx?direct=true&db=s3h&AN=134293461>

Carskadon, M. A. (1990). Patterns of sleep and sleepiness in adolescents. *Pediatrician*, 17(1), 5-12.

Cuff S, Loud K, O’Riordan MA. Overuse injuries in high school athletes. *CLIN Pediatr (Phila)*.2010;49:731–736

Davenne, D., (11 Dec 2008). Sleep of athletes-problems and possible solutions. *Biological Rhythm Research*, 40, p 45-52.  
<http://dx.doi.org/10.1080/09291010802067023>

Eaton DK, McKnight-Eily LR, Lowry R, et ax. Prevalence of insufficient, borderline, and optimal hours of sleep among high school students—United States, 2007. *J Adolesc Health*.2010;46:399–401.

Kakanies, M.W., Peake, J., Brenu, E.W., Simmonds, M., Gray, B., Hooper, S.L., Marshal-Gradisnik, S.M. (2010). The open window of susceptibility to infection

after acute exercise in healthy young male elite athletes. *Exercise Immunology Review*, 16, 119-137. <http://eir-isei.de/2010/eir-2010-119-article.pdf>

Kuipers, H. & Keizer, H.A. *Sports Medicine* (1988) 6: 79.

<https://doi.org/10.2165/00007256-198806020-00003>

Lastella, M., Lovell, G.P., Sargent, C. (2012). Athletes' precompetitive sleep behaviors and its relationship with subsequent precompetitive mood and performance. *European Journal of Sport Science*, 14, p 123-130. <http://dx.doi.org/10.1080/17461391.2012.660505>

Lenka, K., David, P., Karel, K., & Zdenek, H. (2015). Relationship between subjectively perceived exertion and objective loading in trained athletes and non-athletes. *Journal of Physical Education & Sport*, 15 (2), 186-193. Retrieved from <https://libez.lib.georgiasouthern.edu/login?url=https://search-ebshost-com.libez.lib.georgiasouthern.edu/login.aspx?direct=true&db=s3h&AN=1036182> 10.

Mah CD, Mah KE, Kezirian EJ, et al..The effects of sleep extension on the athletic performance of collegiate basketball players.*Sleep*.2011;34:943–950.

Milweski, M.D., Skaggs, D.L., Bishop, G.A., Pace, J.L., Ibrahim, D.A., Wren, T.A.L., Barzdukas, A., (March 2014). Chronic Lack of Sleep is Associated with Increased Sports Injuries in Adolescent Athletes. *Journal of Pediatric Orthopedics*, 34, p 129-133. doi: 10.1097/BPO.0000000000000151.

- Orzech, K.M., Acebo, C., Seifer, R., Barker, D., Carskadon, M.A. (2013). Sleep Patterns are associated with common illness in adolescents. *Journal of Sleep Research*, 23 (2), p 133-142. Doi: 10.1111/jsr.12096.
- Penko, A. L., Barkley, J. E., Koop, M. M., & Alberts, J.L. (2017). Borg scale valid for ratings of perceived exertion for individuals with Parkinson's disease. *International Journal of Exercise Science*, 10 (1), 76-86. Retrieved from <https://libez.lib.georgiasouthern.edu/login?url=https://search.ebscohost.com/libez.lib.georgiasouthern.edu/login.aspx?direct=true&db=s3h&AN=120806348>.
- Taheri, M., & Arabameri, E. (2012). The Effect of Sleep Deprivation on Choice Reaction Time and Anaerobic Power of College Student Athletes. *Asian Journal of Sports Medicine*, 3(1), 15–20.
- Tan, Y., Ma, D., Chen, Y., Cheng, F., Liu, X., & Li, L. (2015). Relationships between Sleep Behaviors and Unintentional Injury in Southern Chinese School- Aged Children: A Population- Based Study. *International Journal Of Environmental Research And Public Health*, 12 (10), 12999-13015.  
Doi:10.3390/ijerph121012999
- Tarokh, L., Saletin, J. M., & Carskadon, M. A. (2016). Sleep in adolescence: Physiology, cognition and mental health. *Neuroscience And Biobehavioral Reviews*, 70, p 182-188. Doi:10.1016/j.neubiorev.2016.08.008
- Viana, B., Inoue, A., Santos, T., Piress, F., & Micklewright, D. (2016). Correlates of Mood and RPE During Multi-Lap-Off-Road Cycling. *Applied Psychophysiology*

*& Biofeedback*, 41 (1), 1-7. <https://doi-org.libez.lib.georgiasouthern.edu/10.1007/s10484-015-9305-x>.

Williams, N. (2017). The Borg Rating of Perceived Exertion (RPE) scale. *Occupational Medicine*, 67 (5), 404-405. <https://doi-org.libez.lib.georgiasouthern.edu/10.1093/occmed/kqx063>