Journal of Strength and Conditioning Research, 2003, 17(4), 734–738


# Impact of Training Patterns on Incidence of Illness and Injury During a Women's Collegiate Basketball Season

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**ABSTRACT**

This study was conducted to monitor the training patterns throughout a basketball season in order to determine if a relationship exists between the physical stress of practice and the occurrence of injuries and illnesses in NCAA Division III athletes. Subjects consisted of college women ($n = 12$) ranging in age from 18 to 22 years. A certified athletic trainer distributed a questionnaire following each practice, including 2 weeks of preseason, documenting the presence of injury, illness, or both, relative to the intensity and duration of practice. Training load, training monotony, and training strain were computed using the session rate of perceived exertion scale method. An increase in injuries occurred during times of increased training loads, particularly during the first 2 weeks of formal practice, and immediately subsequent to the holidays. The temporal relationship between training load and injury suggests a causative link ($p < 0.01$; $r = 0.675$). The present data suggest that the periodization pattern of basketball training may be linked to the likelihood of illness/injury.

***Key Words:*** training load, overtraining, training programs

***Reference Data:*** Anderson, L., T. Triplett-McBride, C. Foster, S. Doberstein, and G. Brice. Impact of training patterns on incidence of illness and injury during a women's collegiate basketball season. *J. Strength Cond. Res. 17(4):734–738. 2003.*

## Introduction

The number of participants in athletics seems to be increasing, as does the number of athletes participating in sports enhancement programs. This may be one reason why coaches feel the need to increase the difficulty level of both in-season and out-of-season workouts. Consequently, the training methods used by some coaches may lead to physical immobility, mental stress, and other harmful aspects of ''modern'' life, which results in an increased incidence of sports injuries (10). Alterations in muscular activity subsequent to muscular fatigue have also been reported as an etiological factor in sport-related injuries (1). Sports injuries likely result from associations between training patterns, daily stresses, and overtraining (14). A concern of the sports medicine team and coaches is to avoid sports injuries from occurring in order to have the strongest team possible. Currently, research available examining training intensities and frequencies as they relate to injury and illness patterns is somewhat limited.

In an attempt to decrease the number and severity of injuries and illnesses suffered, it is beneficial for coaches and athletic trainers to understand how the athletes' bodies will react to different training regimens. Illness, injury, or both, occur when physical demands outweigh the body's ability to fully recover between training sessions and competitions. When demands are excessive on athletes, they may begin to suffer from a condition known as overtraining syndrome (OTS), equivalent in severity to many orthopedic injuries resulting in athletes missing practices, or being severe enough to end a competitive season (4). Common characteristics experienced by athletes suffering from OTS include decreased performance, delayed recovery, disturbed sleep, weight loss, depression, poor appetite, and weight fluctuation (8, 9, 12). Evaluating a training session using a special type of a ''rate of perceived exertion'' scale (RPE) has been found to be a useful tool in correlating the physical demands on the body over time with the overtraining of athletes (4). This allows researchers to evaluate trends in training, injury, and illness in relation to the RPE and the global intensity of the exercise session.

Persistence of strenuous training during times of illness can have deleterious physical effects on the athlete (13). Coaches may not realize the pattern that tends to occur, and therefore do not make the changes necessary to decrease the seriousness and length of injury or illness the athlete may suffer. The purpose of this study was to examine the relationship between training load, strain, and monotony with the occurrence of injury or illness rates.

## Methods

### *Subjects*

Twelve female basketball players, ages 18 to 22 years, volunteered for this study. Each participant was a member of the University of Wisconsin–La Crosse NCAA Division III basketball team and had various levels of experience and skills. All participants had previous clearance from a physician to participate in intercollegiate athletics and all went through an orthopedic screening by a certified athletic trainer (ATC) to determine their health status and musculoskeletal injury history. Informed consent was granted by all participants in accordance with the guidelines of the University of Wisconsin–La Crosse Institutional Review Board for the Protection of Human Subjects.

### *Procedures*

Throughout the course of the study, the subjects were responsible for participating in activities planned by the head coach and were required to fill out a questionnaire after each training session (practice). A pilot study was conducted, using a random sample of athletes who had participated in fall sports, in order to determine the clarity of the questions being asked. The questionnaire was comprised of questions in relation to the subjects' session RPE for that particular session and any current illnesses or injuries suffered. The athlete's RPE is directly related to the amount of work her heart and body are performing (2). The subjects' RPEs were obtained with the use of a modified Borg's scale (4):

| Easy | Hard | | Very Hard | Extremely Hard |
|---|---|---|---|---|
| 1 | 3 | 5 | 7 | 10 |

The subjects were instructed to answer the question as if a friend had asked them, ''Overall, how was your practice today?''

An injury was defined as a circumstance in which the athlete received an evaluation from the team's student athletic trainer and ATC and required limiting their practice for at least 1 day. Each injury was counted as a single injury, whether seen for 2 days or 2 weeks; consequently, if an athlete had 2 separate injuries, they were counted as 2. The duration of each practice was recorded to determine the load of the training session. An illness was defined as a circumstance in which the athlete or MD felt the athlete was limited or unable to perform the drills as directed by the coach (flu, cold, virus, etc.). Each individual illness was recorded in the same manner as each injury.

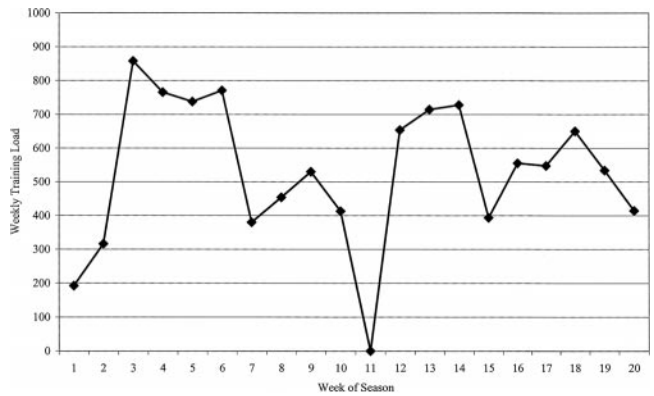


**Figure 1.** Weekly training loads.

### *Statistical Analyses*

The product of the session RPE and session duration was defined as the ''session load''. The session load was averaged over each week of training and plotted with the corresponding weeks of the season. ''Training monotony'' was calculated from the mean training load divided by the standard deviation of the training load over a 1-week period. Monotony was also plotted versus the week of the season. Additionally, the product of training load and training monotony yielded ''training strain'' (4), which was also plotted for each week of the season. Other areas that were evaluated were the weekly percentage of injured versus uninjured athletes and ill versus healthy athletes over the course of the season. A Pearson Product Moment correlation was performed on the data to determine the strength of the relationship between the training loads, monotony, and injuries or illnesses. A level of significance of $p \leq 0.05$ was chosen prior to any statistical analysis.

## Results

### *Practices*

Figure 1 depicts the wide range of weekly training load variations for practices over the competitive season, with the first 2 weeks representing preseason data. Week 8 signifies the Thanksgiving holiday, and week 11 signifies the semester break (1 week with no practices held). There were large increases in the training loads during weeks 3 and 12, corresponding with times in which the coach had wanted the athletes at their strongest.

### *Injuries*

Figure 2 displays distinguishable spikes in both training load and the number of injuries, particularly at the first official week of practice (week 3). During week 11 of the season, no questionnaires were distributed

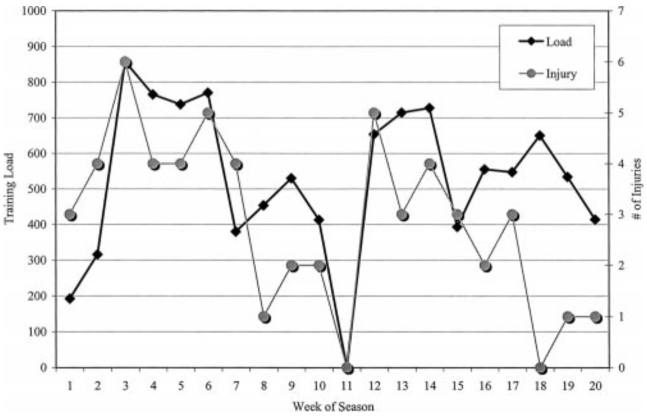


**Figure 2.** Training loads and injuries.

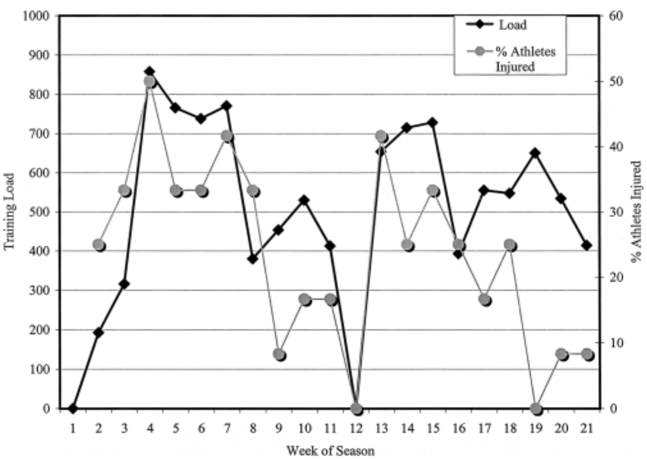


**Figure 3.** Training loads and percent injury.

because no practice took place; thus, zero has been charted for both variables. It appears evident that the athlete's bodies were not physically ready for such an increase in training load from week 2 to week 3, nor from week 11 to week 12. This is also shown in Figure 3; the percentage of the athletes injured during the respective periods of the season depict a concomitant rise with training loads.

### *Illness*

Figures 4 and 5 represent the number of illnesses and percent of athletes suffering from illnesses, respectively, in relation to the average weekly training loads. The number of athletes suffering from illnesses fluctuated in an unpredictable manner, resulting in no correlation. More illnesses were reported during midterm exams and at the completion of the semester, which gives reason to believe that other stresses of life play a role in the health of the athletes, not necessarily the physical load demanded on the athletes.

### *Monotony and Strain*

Figure 6 shows monotony in relation to the strain. Monotony is defined as the variability of practices for the entire season, while strain stands for the overall stress

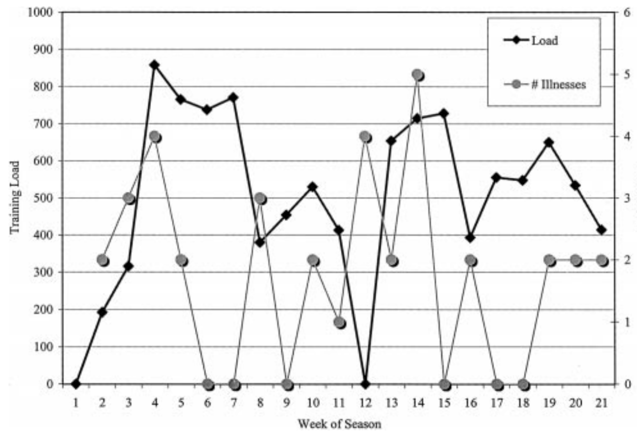


**Figure 4.** Training loads and illnesses.

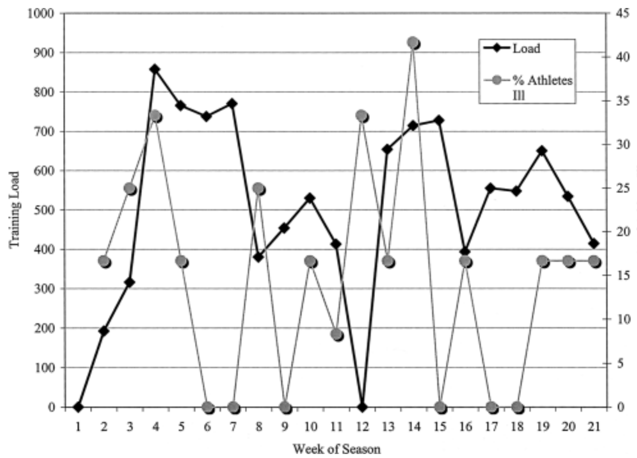


**Figure 5.** Training loads and percent illness.

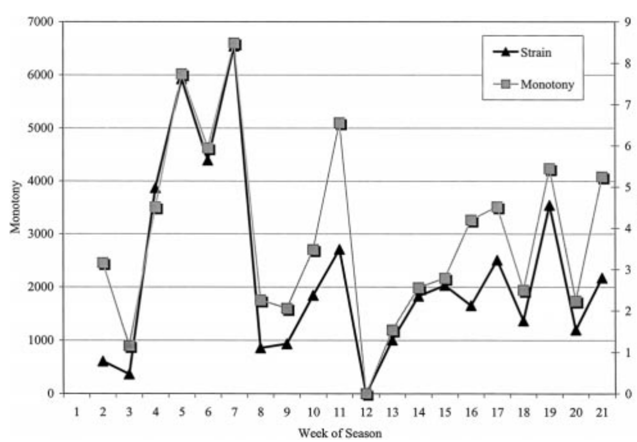


**Figure 6.** Strain and monotony.

demanded on the athlete for a period of a week. Relationships were found to exist between strain and monotony, consistent with previous research (4). This contributes to the concern one may encounter over a coach's training pattern over the season, and the stress placed upon the athletes' bodies.

A moderately positive correlation was found between weekly injuries and total weekly training load

($p < 0.01$; $r = 0.675$) and between strain and monotony ($p < 0.01$; $r = 0.668$). Although there are many reasons for the occurrence of injuries, 46% of the shared variance is due to training load, an alterable variable. No correlation was found between total weekly training loads and illness rates ($r = 0.099$).

## Discussion

The ultimate goal of designing training programs for athletes is to optimize performance (8). Athletes suffer from a variety of injuries and illnesses throughout a competitive season, impacting the performance and success of a team and their coach. Training loads have been reported to have an effect on an athlete's performance and success (5). The first 2 weeks of a season are frequently the most difficult and physically demanding practices of the season. This regimen is often believed to be necessary in order to reach their ''optimal'' level of training as the season proceeds. This particular study had similar findings with a parallel relationship established between the weekly training loads and the incidence of weekly injuries incurred by the athletes. During these times, injuries peaked in relation to increased training loads. It is important to consider that during week 5, game competition started, and during week 13, games resumed after the semester break (Figures 2 & 3). The increase in injuries with a decrease in training load represents injuries that occurred in competitions. A majority of the traumatic injuries in this study occurred when the athletes' bodies were fatigued, such as toward the end of a practice session. This may be the result of muscular fatigue and decreased proprioception from the more physically demanding practices (16). In addition, this explanation supports the principle that increased training loads have an impact on the incidence of injury. As reported by the National Athletic Injury/Illness Reporting System (NAIRS) numerous levels of injuries prevent athletes from effectively participating to their full abilities (18), which should be noted by coaches in planning appropriate practices. No correlation existed between training loads and illness. Other investigations have reported that high levels of stress and training make an athlete more susceptible to illness (3, 11, 17). It has been suggested that psychological stresses may play a larger role in affecting the suppression of the body's immune system and should be examined further (10).

Foster (4) proposed a link between the training load, strain, and monotony of practices as being determinants of greater likeliness of overtraining. The present study was unable to detect any OTS in any of the subjects. High levels of monotony did not exist during this particular basketball season, which may be part of the reason overtraining conditions were not observed. There are no adequate experimental methods to properly measure overtraining (4), though the constituents of overtraining (fatigue, lack of coordination and concentration, muscle soreness, etc.) should continue to be evaluated by coaches when developing proper training patterns in a competitive athletic season. In conclusion, training loads can, and do, impact a team or individual's level of performance.

When an athlete has undergone extensive activity and the muscle is fatigued, the muscle's ability to develop tension in order to anticipate a particular movement is decreased by delayed muscle firing. Altering or modifying practices and strength training programs may be the answer to decreasing the athletes' susceptibility to injury and overtraining. Injuries involving the lower extremities have been noted as being the most prevalent in basketball, leading researchers to believe modifications should be devised more specifically for the lower extremities (14, 18).

## Practical Applications

Coaches and strength trainers are limited by the NCAA with regard to the contact they are allowed to have with athletes prior to the official start of season. In planning training programs for out-of-season workouts (postseason, off-season, and preseason), emphasis should be placed on the importance of participating in more demanding activities in a progressive manner. Variables such as exercise volume, intensity, and rate of progression may be the key in producing strategies to further prevent injuries (1). Proprioceptive exercises would benefit by increasing the sensitivity of the specific mechanoreceptors in the lower extremities and increasing the stability of the ankles and knees (16), and ideally should be continued throughout the entire season.

Illness was not found to correlate with training loads in this particular study; however, it is known that the immune system is compromised when stress reaches demanding levels, and an athlete's performance tends to suffer at those times (4, 6, 9, 11). Consequently, it is critical that athletes maintain their immune system. High levels of exercise can decrease plasma levels in the blood (15), therefore, it is important to maintain adequate hydration levels by consuming proper fluids and nutrients.

Further research is needed to evaluate numerous teams of the same sport and investigate more athletic populations. Alternative cardiovascular work other than running, such as swimming and biking, may be advantageous to explore to further investigate intensity of training and its' effects on injury rates.

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