ABSTRACT

ANDERSON, L. Impact of training patterns on incidence of illness and injury during a women's basketball season. MS in Exercise and Sport Science-Human Performance, August 2000, 34pp. (T. Triplett-McBride)

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. Ss consisted of college women ($N = 12$), ranging in age from 18-22 yrs. A Certified Athletic Trainer distributed a questionnaire following each practice, including 2 weeks of preseason, documenting the presence of injury and/or illness relative to the intensity and duration of practice. Training load, training monotony, and training strain were computed using the session RPE 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.

IMPACT OF TRAINING PATTERNS ON INCIDENCE OF ILLNESS AND INJURY DURING A WOMEN'S BASKETBALL SEASON

A MANUSCRIPT STYLE THESIS PRESENTED

TO

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MASTER OF SCIENCE DEGREE

BY

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THESIS FINAL ORAL DEFENSE FORM

Candidate: Laura J. Anderson

We recommend acceptance of this thesis in partial fulfillment of this candidate's requirements for the degree:

Master of Science in Human Performance

The candidate has successfully completed the thesis final oral defense.

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Thesis Committee Chairperson Signature Date

5/17/00

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This thesis is approved by the College of Health, Physical Education, and Recreation.

Gary Gilmore 6-21-00

Associate Dean, College of Health, Physical Education, and Recreation Date

Gary Gilmore 6-21-00

Dean of Graduate Studies Date

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TABLE OF CONTENTS

LIST OF FIGURES

FIGURE PAGE

LIST OF APPENDICES

APPENDIX PAGE

INTRODUCTION

In recent years, there has been an increased number of individuals involved in sporting activities. Consequently, it is believed the increased number of participants has lead to an increased level of competition as well as the level of training. The training methods used by some coaches may lead to negative patterns that result in an increase in sports injuries (10). When high physical demands are placed on a body, the muscle fatigues and the body's sense of proprioception is decreased, leaving the athlete a target for injury. Alterations in muscular activity subsequent to muscular fatigue have been reported as an etiological factor in sport-related injuries (1). As a person's ability will allow, athletic performance does increase from consistent training and practicing over a period of time, but there is limited research that examines the intensity as well as frequency of practices relating to injury and illness patterns.

For athletes to reach the highest level of performance possible at particular times of their competitive season, coaches attempt to increase the intensity of practices accordingly. When preparing for a season, one must also examine how the athletes' bodies will react to different patterns of training in order to decrease the injuries and illness suffered throughout the season. Illness and/or injury occur when the physical demands outweigh the ability of the body to fully recover between training sessions and competitions. Moderate exercise may stimulate the immune system but hard training actually suppresses the immune system, thereby increasing the risk of infection (7, 13, 17).

When considering the physical demands placed on the body, one must acknowledge the normal stresses of daily life athletes must endure. When there is no balance, athletes may suffer from a condition known as overtraining syndrome, equivalent in severity to many orthopaedic injuries, and often severe enough to end a competitive season (4). Common characteristics experienced by athletes suffering from overtraining syndrome are decreased performance, delayed recovery (12), disturbed sleep, weight loss, depression, and weight fluctuation (9). The development of the "session Rating of Perceived Exertion (RPE) method" to monitor training (4) has offered an avenue to evaluate overtraining in athletes. This gives researchers an approach to evaluate trends in training, injury, and illness because RPE is directly related to the global intensity of exercise.

It was thought that overtraining may result in a higher incidence of injury. A previous study conducted at the University of Wisconsin-La Crosse (6) identified a pattern between the training load and the incidence of illness/injuries during a basketball season. In 1980, Whiteside reported increased interest in illness and injury patterns, but data reflecting the trends of sports injuries are lacking; therefore, it would be relevant for further studies to be conducted. Various sports tend to have a pattern of common related injuries in particular regions of the body. It is a belief that sports injuries result from associations between training patterns, daily stresses, and overtraining (14).

Persistence of strenuous training during times of illness can have deleterious effects on the athlete (3). It is believed that coaches may not realize the pattern that tends to occur, and therefore do not make the necessary changes that could 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 to see if a pattern emerged with illness and injury rates throughout the 1999-2000 University of Wisconsin-La Crosse's women's basketball season.

As a result of this study, coaches may have the ability to devise a training program to aid in the prevention of athletic injuries and illnesses, thus allowing the athletes to stay healthy and perform more successfully throughout the season. It was predicted that this study would show a strong relationship between the occurrence of injuries and training loads. It was also believed that a strong relationship would exist between training loads and the occurrence of illness.

METHODS

Subject Selection

The subjects for this study consisted of 12 NCAA Division III athletes (ages 18-22) who were members of the 1999-2000 University of Wisconsin–La Crosse (UW-L) women's basketball team. All subjects who participated in the study had previous clearance from a physician to participate in intercollegiate athletics and all went through an orthopaedic screening (see Appendix A) by a Certified Athletic Trainer (ATC) to determine health status. A meeting was conducted with all subjects to obtain informed consent (see Appendix B). The study was approved by the university's Institutional Review Board for the Protection of Human Subjects.

Experimental Procedures

Throughout the course of the study, the subjects were responsible for participating in activities planned by the coach and were required to fill out a questionnaire (see Appendix C) after each training session. A pilot study was conducted using random athletes who had participated in fall sports in order to determine the explicitness of the questions on the questionnaire. The questionnaire was comprised of questions in relation to the subjects' session rating of perceived exertion (RPE), as well as any illnesses or injuries suffered. One's RPE is directly related to the level of difficulty their heart and body are working (2). The subjects' RPE was obtained with the use of a modified Borg's scale, (4, 6) ranging from 1 (the session was extremely easy) to 10 (the session was extremely hard). The subjects were to approach 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 (SAT) or an ATC. Each injury was counted as one injury; consequently if an athlete had two separate injuries, they were counted as two. The duration of each practice was recorded to determine the load of the training session. An illness was defined as a circumstance where the athlete's health was not normal, when the athlete was limited in practice (flu, cold, virus, etc.). Each individual illness was recorded in the same manner as injuries.

Data Analysis

The product of the session RPE and session duration defined 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/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. Other areas that were evaluated were the percentage of injured versus uninjured athletes and ill versus healthy athletes over the season on a weekly basis. A Pearson product moment correlation was performed on the data to determine the strength of the relationship between the variables.

RESULTS

Practices

Figure 1 depicts the weekly variations of training load during practice over the competitive season. The first two weeks are a representation of preseason data. This figure shows how the loads in the early season and after the holidays change as shown in weeks 3, 8, and 12, where week 8 was Thanksgiving, week 11 was the semester break (over the Christmas holiday).

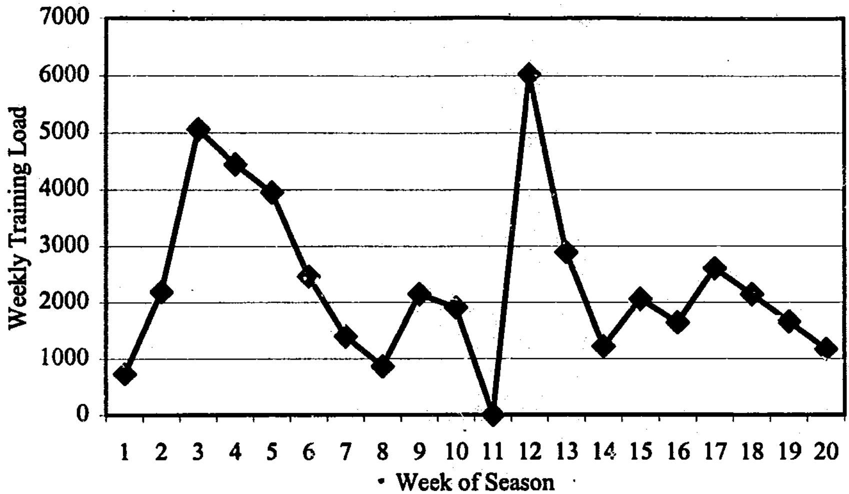

Figure 1: Weekly training loads

Injuries

From Figure 2, one can see distinguishable spikes, particularly at the first official week of practice (week 3) in both training load as well as the number of injuries. Additionally, another spike is noticeable following the semester break. The patterns slightly increased and decreased as the season progressed, common of a typical basketball season. During the 11th week of season no questionnaires were distributed since no practice took place; the reason a zero has been charted for both variables. The more common injuries suffered were ankle sprains, patellar tendonitis, low back strains, and shin splints. The percentage of the athletes injured during particular periods of the season, shown in Figure 3, depict a concomitant rise with training loads.

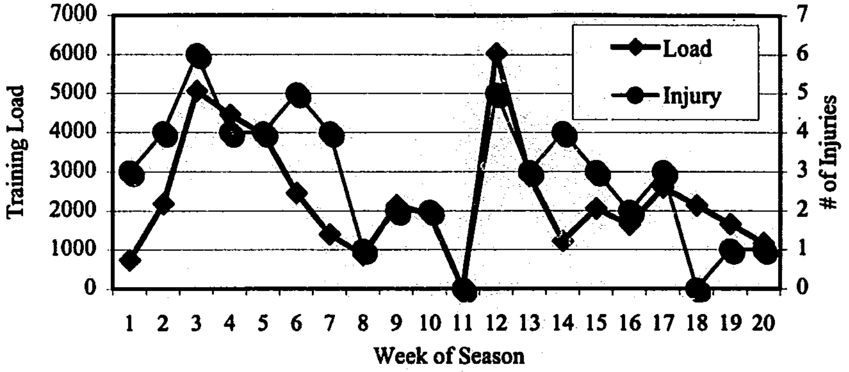

Figure 2: Training load and injuries

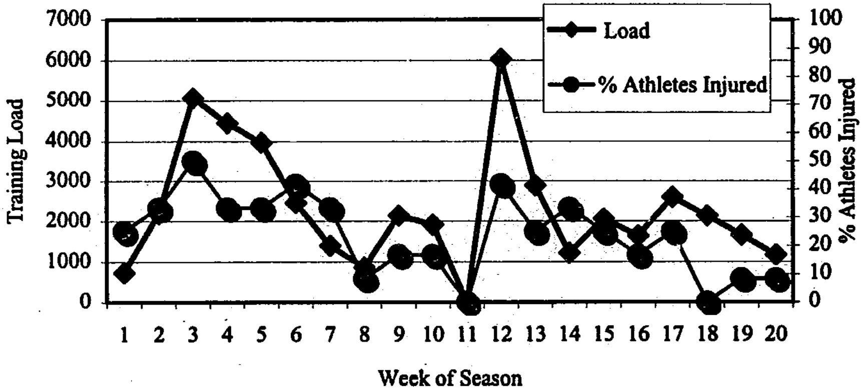

Figure 3: training load and injury percentages

<u>Illness</u>

The illnesses suffered during the season did not follow as closely with the training loads as did injuries. Figures 4 and 5 represent the pattern of illness 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. More illnesses were reported during midterms as well as at the end of the semester. The common illnesses reported were colds, the flu, and bronchitis.

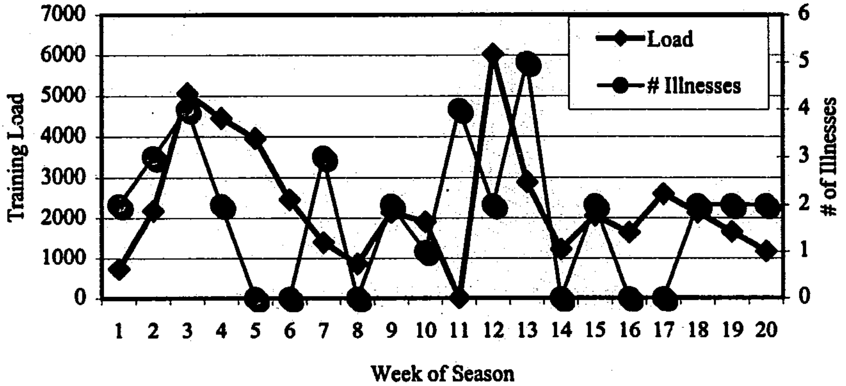

Figure 4: Training load and illnesses

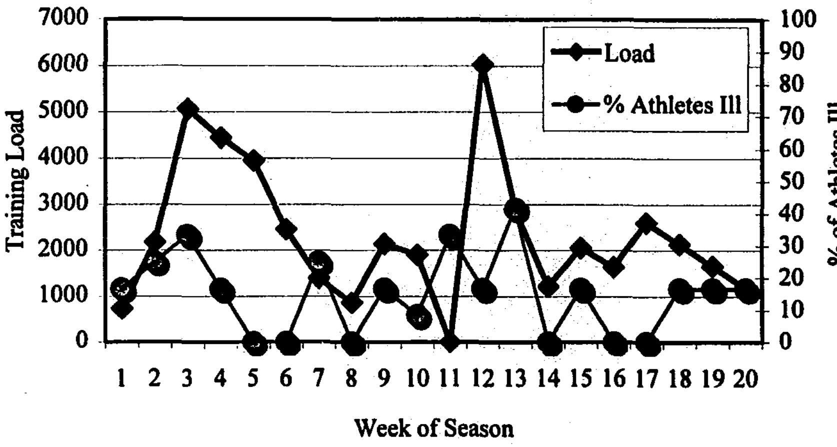

Figure 5: Training load and illness percentages

Monotony and Strain

Monotony (Figure 6) is lower when practices vary considerably in volume and intensity. Therefore, the lower monotony values indicate variability in the practice sessions. The practices needed to be adjusted for the periods of the season where a greater amount of games were played. Strain (Figure 6) followed a pattern very similar to monotony, with slight changes due to the different training loads. Strain, the overall stress demanded on the athlete for a period of a week, and monotony, the variability of practices, were related to each other (4, 6).

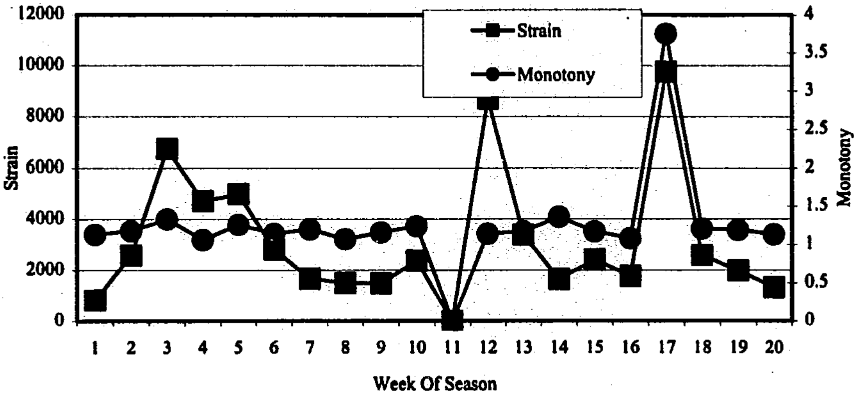

Figure 6: Monotony and strain

Correlations

A positive correlation was found between weekly injuries and total weekly training load ($p < 0.01$; $r = 0.675$) as well as between strain and monotony ($p < 0.01$; $r = 0.668$). Although there are many reasons for the occurrence of injuries, 46% of the r-squared (squared 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 as much as possible (8). Athletes suffer from a variety of injuries and illnesses throughout a competitive season, impacting the performance of a team and the success of a coach. There is very limited research available on relating training patterns illnesses throughout a competitive season, impacting the performance of a team and the success of a coach. There is very limited research available on relating training patterns to the occurrence of injury and illness. Research has been conducted on endurance athletes, looking at training patterns affecting the immune system and overtraining syndrome. The purpose of this study was to observe the training patterns used in team sports, specifically women's basketball, to distinguish if there was any correlation with injury and/or illness rates throughout a season.

The first 2 weeks of a season are frequently the most difficult and physically demanding practices of the season. The athletes are working towards reaching their "optimal" level of training. A parallel relationship was established between the weekly training loads and the incidence of weekly injuries suffered by the athletes. The most difficult practices of the season were during the first 2 weeks of season and the week following the semester break. During both periods of time injuries peaked in relation to training loads, although one is not able to say that training loads were entirely responsible in causing the injuries. It is important to consider that week 5 was when competitions started, and week 13 was when 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 occurred when the athletes' bodies were fatigued, such as towards the end of a practice session. This may be explained as a 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 do have an impact on the incidence of injury.

Gottschall (6) noted that an increase in illness paralleled an increase in the training patterns during a men's basketball season. She concluded that higher training patterns increase the potential for illness. When an athlete's immune system is weak and their muscles are fatigued from hard practices, they are more predisposed to illness/injury. The present study, however, did not find a correlation between training loads and illness. Psychological stresses may play a larger role in affecting the suppression of the body's immune system.

Foster (4) directed attention to a link between the load of practices and the strain and monotony of practices as being determinants of greater likeliness of overtraining. The present study was unable to report any overtraining occurring to any of the subjects. High levels of monotony did not exist during this particular basketball season, which may be the reason incidences of overtraining 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. When looking at performance, injuries found on the National Athletic Injury/Illness Reporting System (NAIRS) did prevent the athletes from effectively participating to their full abilities (18). It can be concluded that training loads can impact a team or individual's level of performance. The data show a strong relationship between training strain and training monotony. The duration of the practice sessions in this study were generally alike. It is concluded that the average practice loads varied as a result of the intensity (RPE of the athletes) of the practices as altered by the coach.

Any time that an individual takes part in physical activity, there is always an inherent risk of injury. A disclaimer is generally given to the athletes, notifying them of the inherent risk before the activity begins. It is the job of the coaches, athletic trainers, and strength trainers to not only decrease the number of injuries that occur, but also to try to prevent them from future occurrence. It is crucial for coaches, strength trainers, and athletic trainers to be aware of trends that follow when injuries are most likely to transpire. Implementing the proper intensity of practices during the season can result from the knowledge of injury trends.

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

Practical Applications

Coaches are limited as to the contact they are able to have with athletes prior to the official start of season. Those coaches and strength trainers who work closely with their athletes in planning training programs for the off-season workouts (postseason, off-season, and preseason) should emphasize more demanding activities in a progressive manner, starting as early as 2 to 3 weeks prior to the start of the season. Functional activities such as plyometrics should be included in order to fatigue the muscles in a similar fashion to what a practice would entail. High levels of encouragement by the coach to comply with these workouts are necessary for the athletes to become enthusiastic. This would put the athletes in a frame of mind to prepare for the increased physical demands placed on the athletes during the first few weeks of practice. Another possible method to further decrease injury rates, particularly to the lower extremities, would be to incorporate proprioception exercises into the athletes' conditioning programs using a variety of exercises throughout the season's entirety. This would increase the sensitivity of the proprioception mechanoreceptors in the lower extremities, increasing the stability of the ankles and knees (16).

The cardiovascular training an athlete is required to go through in practices may be better met if cross-training methods are used. Incorporating activities such as cycling and swimming where no impact forces are being applied to the lower extremities may be feasible. These methods may be incorporated during times of high stress and high frequency practice schedules.

Illness was not found to correlate with training loads in this particular study; however, it is known that the immune system does suffer when levels of stress reach demanding levels and an athlete's performance tends to suffer at those times (4, 5, 9, 11). It is critical that college athletes build their immune system and keep it as strong as possible. It is important to keep blood plasma levels high by taking in the proper nutrients. High levels of exercise have been reported to decrease plasma levels in the throughout the season, and should include large amounts of fruits and vegetables in their traveling meals. Getting proper amounts of sleep and rest are important for athletes to schedule between competitions and classes and their social life. Coaches should discuss these issues with their athletes and discuss what may happen when stress levels are high, particularly around finals and the holidays.

This particular study answered some questions and raised others. This study did not investigate how psychological stress impacts the performance of athletes, yet is a crucial variable in a collegiate athlete's life. Following a team for a greater period of time to monitor modifications coaches make would be beneficial. One could investigate if the recommendations made to coaches help to decrease injury rates in their training programs if followed. There is much left to investigate in order to devise the finest training programs for optimal performance. This study has assisted in taking a step in the right direction.

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Women's Basketball Orthopaedic Screening
University of Wisconsin–La Crosse
La Crosse, Wisconsin

IMPACT OF TRAINING PATTERNS ON INCIDENCE OF ILLNESS AND INJURY DURING A WOMEN'S BASKETBALL SEASON
(Laura Anderson)

Name: ____________________ Date of Birth: ______________________
Today's Date: ______________

Neck:
ROM: ____
Strength: ____
Comments/Concerns: ____
____

Shoulders:
Right ROM: ____
Right Strength: ____
Left ROM: ____
Left Strength: ____
Comments/Concerns: ____
____

Elbows:
Right ROM: ____
Right Strength: ____
Left ROM: ____
Left Strength: ____
Comments/Concerns: ____
____

Wrists:
Right ROM: __________________ ____
Right Strength: ____
Left ROM: ____
Left Strength: ____
Comments/Concerns: ____
____

Hands/Fingers:
Right ROM: ______
Right Strength: ______
Left ROM: ______
Left Strength: ______
Comments/Concerns: ______
______

Lower Back:
ROM: ______
Strength: ______
Comments/Concerns: ______
______

Hips:
Right ROM: ______
Right Strength: ______
Left ROM: ______
Left Strength: ______
Comments/Concerns: ______
______

Knees:
Right ROM: ______
Right Strength: ______
Left ROM: ______
Left Strength: ______
Comments/Concerns: ______
______

Ankles:
Right ROM: ______
Right Strength: ______
Left ROM: ______
Left Strength: ______
Comments/Concerns: ______
______

General Comments/Concerns: ______
______
______

Signature of Screener: ______ Date: ______

APPENDIX B

INFORMED CONSENT FORMS

INFORMED CONSENT FORM

University of Wisconsin–La Crosse
La Crosse, Wisconsin

IMPACT OF TRAINING PATTERNS ON INCIDENCE OF ILLNESS AND INJURY DURING A WOMEN'S BASKETBALL SEASON
(Laura Anderson)

I, ________________________, give my informed consent to participate in this study to determine the correlation of training patterns and the occurrence of illness and/or injury over the entire women's basketball season. I have been informed that throughout the study my identity will be kept confidential. In the event that the study is published, I consent that the results may be used as long as my information remains confidential and that the identification of the subjects in this study will not be made known.

This study will consist of myself as well as the other subjects answering a daily questionnaire in which I will answer truthfully and honestly. I have been informed that the questionnaire will take approximately five minutes of my time after each day of practice.

I have been informed that this particular study in no way puts me at risk for injury, nor will it affect my performance during practice. Any injury I may receive throughout the course of the season is a risk that I am aware of and will in no way hold this study responsible for such occurrence.

The above information has been clearly explained to me. I do not have any further questions that have not been answered. I have been informed that at any time I may withdraw from this study without any type of penalty.

Furthermore, I have been informed that my participation in this study does not in any way influence or affect my chances of making the UW-La Crosse's women's basketball team.

Any questions or concerns that may arise during this study may be referred to the primary researcher, Laura Anderson at (608) 796-1204. The supervising faculty member for this study is Dr. Travis Triplett-McBride and can be reached at (608) 785-6546. Any questions regarding the protection of human subjects may be addressed to Dr. Garth Tymeson, Chair, UW-La Crosse Institutional Review Board (608) 785-8155.

____________________	________	____________________	________
Investigator/Researcher	Date	Participant	Date

INFORMED CONSENT FORM

University of Wisconsin-La Crosse
La Crosse, Wisconsin

IMPACT OF TRAINING PATTERNS ON INCIDENCE OF ILLNESS AND INJURY DURING A WOMEN'S BASKETBALL SEASON
(Laura Anderson)

I, ________________________, the Head Women's Basketball Coach of the University of Wisconsin-La Crosse am in agreement with the team being participants in Laura Anderson's research project. I do not foresee the research project getting in the way of my coaching or the performance of the team.

________________________	________	________________________	________
Investigator/Researcher	Date	Coach	Date

APPENDIX C

DAILY PRACTICE QUESTIONNAIRE

Name: ______________
Date: ______________

1) Did you participate in today's training session?

_____Yes _____No

If you did not participate and it was not due to illness or injury, please specify why (ex. funeral, wedding, class). ____________________________

2) Do you have an illness? _____Yes _____No

If so, what? ______________________

3) Do you have an injury? _____ Yes _____ No

***If you answered yes to #3, please answer questions 4-9.

4) What is the injury? ____

5) Please check the appropriate response:

_____The injury occurred today.

_____The injury occurred before today.

6) The classification of the injury is:

_____Overuse

_____Traumatic

7) If practicing with an injury, is it limiting your ability to practice?

_____Yes _____No

8) Is the injury you are suffering from keeping you out of practice?

_____Yes _____No

9) How many injuries are you currently being treated for in the Athletic Training Room? ____________

10) How hard do you feel today's training session was?
Please mark your response with an X on the scale below.

Rest	Moderate	Hard	Very Hard	Extremely hard
0	3	5	7	10

APPENDIX D

REVIEW OF RELATED LITERATURE

REVIEW OF RELATED LITERATURE

Introduction

Many believe that with increased training levels and practice frequencies, athletic performance will increase. One particular problem believed to be a result of this outlook is that athletes often suffer from overtraining syndrome and may be predisposed to injuries. Kuipers (8) reported the symptoms athletes experience when suffering from overtraining syndrome are poor appetite, weight loss, mental irritability, increased or decreased resting blood pressure and low plasma lactates. Overtraining syndrome may not always be characterized with changes in the blood, such as haemoglobin concentration and plasma lactates (16). Lehmann, Foster, and Keul (10) further classified overtraining as short-term and long-term overtraining. Short-term overtraining was characterized by fatigue and decreased performance over a period of days or weeks and long-term overtraining lasts over a period of months. Data available suggests muscular fatigue as a predisposing factor to injury (1). High levels of stress and high levels of training make an athlete more susceptible to illness (3, 12, 17). There are currently not enough studies to substantiate if training patterns have an effect on the incidence of injuries that occur throughout a typical sports season.

Overtraining Syndrome

Kuipers (9) reported that little was known regarding the relationship between training patterns and performance. Only minute increases in performance have been reported when increases in training intensity have been incorporated into training (5). In regards to overtraining syndrome, there are two types that can be distinguished; the first being the sympathetic, most often observed in team sports (8) and is anaerobic in nature (10). The second type is parasympathetic, most often observed in endurance athletes (8) and aerobic in nature (10). Large increases in training load, training monotony, and competition may result in overtraining (6). Overtraining syndrome and the likelihood of chronic injury occurrence are directly related to the body's recovery rate. If an athlete is exposed to too much practice or to practices occurring too frequently, the body does not have sufficient time to cope and recover (4, 8, 9). Athletes may experience such symptoms as fatigue, lack of coordination, muscle soreness, and decreased levels of performance when they are overtrained. This concept has been neglected frequently when coaches and athletes have made changes in training patterns during the season. Kuipers (8) determined the three different areas of overtraining that should be individually considered are: 1) mechanical overtraining, involving the locomotor system, 2) metabolic overtraining, involving the body's use of ATP for energy, and 3) staleness, involving the body's ability to cope with stress and dysfunction of the neuroendocrine system.

Monitoring Training

Monitoring the training levels and training load is a method in which one is able to investigate the likelihood of injury and illness. Foster, Daines, Hector, Snyder, and Welsh (5) conducted one of the first studies that quantitatively evaluated the effect of training load changes on athletic performance. They concluded that changes in training load and training monotony might be associated with the likelihood of athletes developing illnesses or injuries. A method was developed to calculate training load and relate it to an athlete's performance (4, 5, 7). A lack of variability in practice is a factor that may contribute to overtraining along with the training load. Both "training monotony" and "training strain" were suggested to be negative factors in training and should be examined further (4). As a result of this investigation, Foster discovered that training strain was successful in explaining individual illness in athletes. No simple indicators have been found as of yet or made available for impending overtraining syndrome (6). Foster, et al. (6) examined the difference in practicality of using laboratory measures versus questionnaires in order to determine when athletes enter a state of overtraining. Because athletes suffer from psychological stress as well as physical stress, questionnaires were thought to be sufficient for use. Rowbottom, Keast, Goodman, and Morton (16) reported that blood parameters, such as haemoglobin concentrations, hematocrit and red blood cell counts were not associated with those suffering from overtraining syndrome.

Researchers are adequately able to measure how hard the body is working by asking the athlete their rate of perceived exertion (RPE) instead of using laboratory measures to evaluate blood parameters (2). Morton (13) reported that the actual performance of athletes decrease when overtraining occurs. Feelings of fatigue immediately following training sessions are believed to indicate if an athlete is overtrained. When an athlete feels fatigued and tired immediately following practice instead of having the response of feeling fit, the coach should consider altering practices. Morton suggested that maximizing training should include controlling the factors that determine overtraining such as high training loads, daily training, and fast fatigue. By considering the importance of the above information, one could develop a reasonable way to monitor and plan training methods.

Injury Patterns

There is an increased interest in determining if there is a way to foresee when an athlete is most susceptible to injury. Two classifications of injuries have been described and used by many: acute (traumatic) and chronic (11). An acute injury is one that happens at a specific time and the athlete can identify the mechanism of injury. A chronic injury appears progressively, over a period of time and the athlete is unable to pin point when or how the injury occurred. Each sport tends to have common areas of the body that get injured, although injuries are not limited to those areas. Basketball players tend to suffer more ankle, foot, and knee injuries, with most of the injuries occurring during practices (18). Football players tend to have head injuries as well as injuries occurring at the shoulders, hips, knees, and ankles (15). Many factors are considered when analyzing if an athlete is prone to injury (11). Some of the factors taken into account were flexibility, somatotypes, intrinsic factors such as age and gender, and extrinsic factors such as training and playing time. Powell and Barber-Foss (15) stated that more exposure time in practice leads to increased injuries. Variables such as exercise volume, intensity, and rates of progression may be the key to produce strategies to further the prevention of injuries (1).

Illness

Upper respiratory infections are thought to be influenced the most by exercise and training (3, 12, 14). It is thought that there is a period of time after long-duration exercise where immunosuppression occurs and infections may easily be established. The time period may only be a matter of days after the athlete starts experiencing fatigue during activity. It has been reported that athletes might be unusually prone to illness during strenuous training or competition (3). It was also mentioned that if an athlete is experiencing signs of infection, the severity of the disease increases when training levels are not decreased. These diseases included both viral and bacterial diseases. Athletes in contact sports need to be concerned due to their increased risk of infection because of skin abrasions and the direct contact with an infected individual. Brenner, et al. (3) also stated that overtraining and stress increase the susceptibility to infections and recommended that athletes avoid large amounts of conditioning in order to give their body time to recover.

Summary

While preparing for a competitive season, coaches should be familiar with the variables associated with athletes' performance levels. The goal coaches have throughout the season is to be successful without athletes being subjected to unnecessary injuries or illnesses. Overtraining athletes may result in the immune system weakening, resulting in athletes suffering from overtraining syndrome (4, 5, 6, 8, 9, 10, 13). Attempting to decrease the rate of chronic, overuse injuries may lead to increased performances of athletes, a crucial aspect in the success of a team. There is always an inherent risk of the negative impacts of training (injury, illness, and overtraining) when one actively participates in activities. This inherent risk cannot entirely be controlled, but can be prevented to some extent. The ability that exists to decrease injury risks needs to be examined. One should also evaluate the extent to which injuries and illnesses are directly impacted by training loads.

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