

DOES A RELATIONSHIP EXIST BETWEEN THE PREVALENCE OF ANTERIOR
CRUCIATE LIGAMENT INJURIES IN FEMALES AND THE USE OF ESTROGEN
AND PROGESTERONE CONTAINING CONTRACEPTION?

A Research Project by

Rebecca L. Runge

Bachelor of Science, University of Kansas, 2005

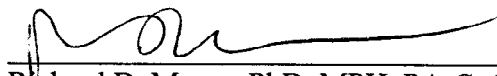
Submitted to the Department of Physician Assistant
and the faculty of the Graduate School of
Wichita State University
in partial fulfillment of
the requirements for the degree of
Master of Physician Assistant

May 2007

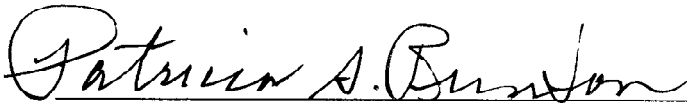
Wichita State University
College of Health Professions
Department of Physician Assistant

We hereby recommend that the research project prepared under our supervision by Rebecca L. Runge entitled Does a relationship exist between the prevalence of anterior cruciate ligament injuries in females and the use of estrogen and progesterone containing contraception? be accepted as partial fulfillment for the degree of Master of Physician Assistant.

Approved:



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5/07/07

Date

ACKNOWLEDGEMENT

A special thank you goes to my parents and family for always supporting me throughout all my years of school and never doubting my ability to pursue my dreams. To my Aunt Jennifer, for being my mentor and for being an example of what a great doctor should be. I would also like to thank my fiancé, Alex, for undertaking this long road through school with me. Thank you for always having my back and guiding me through those times when I didn't see the light at the end of the tunnel.

ABSTRACT

Introduction: Women's involvement in athletics has increased in the last twenty years. With the increase in participation, there has also been an increase in injury rates. Female athletes are at a 4-8 times higher risk of sustaining an Anterior Cruciate Ligament Sprain (ACL) than male athletes. There have been a number of research studies looking at endogenous hormonal influence on ACL injuries, but there is little research looking at the correlation between contraceptive use and ACL injuries. Purpose: This retrospective research study was conducted to determine if a correlation exists between prescription contraceptives and ACL injury rates in collegiate athletes. Methodology: Two hundred and fifty surveys were sent to collegiate volleyball and basketball coaches for distribution to female athletes. The survey included questions about the athlete's history of ACL injury and prescription contraceptive use. Results: There was a 10.4% response rate. Of the 26 responses, 34% of the athletes have not sustained an ACL injury while using prescription contraceptives for greater than 12 months. Conclusion: No conclusion can be drawn concerning the relationship of prescription contraceptives and ACL injuries from the study due to a low response rate. Some research has shown an association between hormones and female ACL injuries; however, no definitive correlation has been proven.

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CHAPTER 1

INTRODUCTION

More females have been participating in competitive athletics in the past twenty years than previously. As female athletics grows and becomes more competitive, the health of the athlete becomes more important. Females have as much interest in remaining injury-free as male athletes. However, there is one trend that has been occurring more as female athletics become of greater interest. Anterior cruciate ligament (ACL) injuries have a higher incidence in females than in males. One study cites that women have a four to eight times higher chance of sustaining a grade three sprain of the ACL than men¹. The results are the same across the board, regardless of which sport or the mechanism of action, contact or non-contact².

Most of the injuries that female athletes are sustaining are due to non-contact injuries, meaning no outside force acted on the athlete. Intrinsic and extrinsic factors are the two theories about the reason for the higher incidence of injuries. Intrinsic factors include “ligamentous laxity, ACL size, femoral notch dimensions, limb alignment, and circulating hormones.”³ Many people believe that the size of the ACL is too large for the femoral notch in females. Therefore, when the knee is twisted, there is not enough room for movement of the ACL, leading to tears in the ligament. Extrinsic factors include “levels of strength and conditioning, body mechanics, neuromuscular performance, and footwear.”³ Women tend to have a low hamstring-to-quadriceps strength ratio, thus, leading to less stability in the knee. Footwear can make a difference in an athlete’s supination and pronation which can cause an abnormal Q angle and expose an athlete to injury. Many researchers believe that it is not one factor alone that causes injury; in fact,

it is the combination of many factors.

One of the intrinsic factors that researchers have been exploring involves the female hormones estrogen and progesterone. Hormonal influence has yet to be unanimously accepted among the medical community as a precipitating factor. Hormonal influence is based upon the relationship of hormones and the menstrual cycle. The concentration of estrogen and progesterone changes throughout the menstrual cycle. The follicular phase (days 1-9) has levels that are relatively low in estrogen. During the ovulation phase (days 10-14) estrogen levels increase. The luteal phase (days 15-28) has a high concentration of progesterone.⁴ A study by Dragoo et al. suggests that there are relaxin receptors in the ACL.⁵ Estrogen has a direct effect on relaxin, which reduces the collagen content of tissue. Estrogen stimulates relaxin receptors in ligaments. During ovulation, the levels of estrogen are at their peak. Therefore, the more estrogen in the body, the more receptor sites are stimulated causing more laxity in the ligament that can predispose an athlete to injury.

Since hormonal influence has been shown to have a possible association with of female ACL injuries, more research should be conducted to explore this possibility. The purpose of this study is to determine if a relationship exists between the use of hormonal contraceptives and the prevalence of ACL injuries in females. Since some studies suggest that there are hormonal factors that predispose an athlete to this injury, the use of prescribed contraceptives may decrease or increase the incidence of injuries. Other studies suggest that hormones have no influence on a female's susceptibility to injury. In this case, no relationship would be found. Results from this study may influence the decision to use prescribed contraceptives as a prophylaxis to prevent injury or discontinue

them due to a higher susceptibility of injury. This study will show a need for more research in this area considering the large impact that injuries have on female athletes

CHAPTER 2

LITERATURE REVIEW

The literature is inconclusive about the role of hormones in the incidence of injury. There are many studies that show there is a relationship, but there are also numerous studies that believe there is no relationship. One study that supports the theory of hormonal influence in knee injury was conducted by Wojtys et al⁴. In this study, 40 women who had recently sustained an ACL injury were asked questions relating their menstruation cycle to their injury. They were asked to describe the mechanism of action of their injury and whether it was during a game or practice. They were also asked questions about their menstruation cycle including date of last menstrual period, average length and oral contraceptive use. Their results showed that the rate of injury was higher during the ovulation phase and that there were the fewest incidences of injury during the follicular phase. Also, they found a correlation between oral contraceptive use and ACL injury. Their results showed a decrease in the number of injury of those using contraceptives compared to those who were not using. They suggested that there may be “a protective effect of hormone level stabilization” when using oral contraceptives⁴. This study’s results indicate that a relationship between the menstrual cycle and ACL injuries may exist.

Another study conducted by Martineau et al examined the effects of oral contraceptives on ligament laxity⁶. The study involved female varsity athletes who filled out a questionnaire about their oral contraceptive use and then proceeded to have their knee laxity tested by using the KT-1000. Martineau et al says that since oral contraceptives “contain synthetic steroids with estrogenic and progestogenic effects,

which inhibit pituitary follicle-stimulating hormone (FSH) and luteinizing hormone (LH) production,” oral contraception may have the ability to “modulate” ligament structures in the joints⁶. The results revealed that OCP (oral contraceptive pill) users had a statistically significant decrease in anterior translation of their tibia on their femur compared to non-OCP users. This study suggests that there may be some preventive uses of oral contraceptives in ACL injuries.

Another study was conducted that showed a relationship between ACL laxity and hormone levels. This study was created by Heitz et al⁷. Their results showed an increase in knee laxity as the estrogen and progesterone levels increased. While the authors did not conclude that this would directly result in an increased level of risk of injury, the authors did propose that it could be a factor.

Slauterbeck et al conducted a study to look for a correlation between the specific phases of the menstrual cycle and ACL injuries⁸. The study found a greater number of injuries occurred on the 1st or 2nd day of their menstrual cycle. The results were verified by measuring the athlete’s salivary sex hormones at the time of the injury. While this doesn’t agree with other studies that suggest ovulation has a higher rate on injury, the study did find a correlation between ACL injuries and the menstrual cycle.

A study conducted by Moller-Nielsen and Hammar examined women’s soccer injuries in relation to the menstrual cycle and oral contraceptives. A questionnaire was used to examine the athletes’ injuries in relation to their menstrual cycles, menstrual symptoms, and injury rates. The two subgroups were contraceptive users and non-users. The results concluded that there were fewer injuries in the users than the non-users of contraceptives.

There are many theories about how prescription contraceptives may have a beneficial affect on injury rates. A theory proposed by Moller-Nielsen and Hammar suggested that prescription contraceptives may have better neuromuscular control than non-users, thus preventing injuries⁹. Another theory proposed by the two authors is that there is an overall decrease in premenstrual symptoms which may influence an athlete's susceptibility to injury.

However, not all of the research has found a benefit to contraceptives in the prevention of athletic injuries. Some researchers even suggest that there is no difference between menstruating and non-menstruating women. An article published by Lebrun suggests that there is no difference in performance between menstruating women and non-menstruating women. Also, there is no difference between OCP users and non users¹⁰. Thus, suggesting no relationship between female hormones and ACL injuries.

This is also suggested in a study done by Bennyon that found there was a difference between men and women's knee laxity; however, there was no difference in knee laxity throughout the menstrual cycle. The study suggested that "there was no relationship between estradiol and progesterone fluctuation and ankle and knee joint laxity.¹¹" This would argue with the idea that hormones would have a direct impact on the ligaments in the knee.

A retrospective study performed by Agel, Bershadsky, and Arendt looked at the rates of ACL and ankle injuries during the 2000-2001 basketball season and the 2001-2002 basketball and soccer seasons². The results showed that basketball players had a higher incidence of injury than soccer players. However, their results showed that there was no difference between hormonal therapy users and athletes not using hormonal

therapy. These studies show that there is dispute about whether or not hormones have an effect on female athletes' susceptibility to injury.

CHAPTER 3

METHODOLOGY

3.1 Subjects

After the Wichita State University's Institutional Review Board approved the research project, surveys were sent to female collegiate athletes participating in either varsity basketball or volleyball. The schools are associated with the National Collegiate Athletics Association, National Association of Intercollegiate Athletics, or National Junior College Athletic Association. All of the schools chosen have both a volleyball and basketball program. Volleyball and basketball were chosen due to their higher rates in non-contact injuries. The schools involved in the participation include: Wichita State University, University of Kansas, Kansas State University, Emporia State University, Fort Hays State University, Pittsburg State University, Newman University, Friends University, Barton County Community College, Tabor College, and Butler Community College. Each volleyball and basketball team consists of 12-20 athletes and 11-16 athletes respectively. The total number of athletes who were asked to participate was 250.

3.2 Survey

The head coach of each team was sent an introductory email explaining the research project. The coaches were given a copy of the cover letter and survey that each athlete would receive. The coaches were asked for permission to include their athletes in the research project. After consent was given to allow their athletes to participate, the coaches were asked to reply with an email indicating the number of athletes on their team and the address of where they would like the surveys sent. The surveys were sent in a

large envelope to each school containing individual envelopes. Inside each individual envelope contained a cover letter explaining the survey and the directions, the survey, and a self-addressed, stamped envelope so the athletes could return the survey. The athletes were asked to complete the survey in its entirety and return it by the due date listed on the survey. Confidentiality was ensured by not using any names or identifying marks on the surveys. By having the coaches distribute the surveys, no names were needed in performing this research project, especially due to the sensitive nature of the information. Completing and returning of the survey was taken as evidence of the athlete's willingness to participate and consent to have the information used for the purposes of the study.

3.3 Test-Retest Reliability of Survey

Prior to sending the surveys to the athletes, the survey was reviewed by female faculty of the Physician Assistant program at Wichita State University, female Physician Assistant students, and former female collegiate athletes. The survey was reviewed to ensure the appropriate length, wording, understanding, and privacy was given to the survey.

CHAPTER 4

RESULTS

The surveys were sent to the coaches in September 2005 with minimal response back. A second email was sent out in late September. The second email received a larger response but only yielding 26 athlete responses or 10.4% of the athletes asked to participate. The preliminary results of the survey are listed in Table 1. The results showed that 8 out of 26 participants (30.8%) had no history of ACL injury but had been using prescription contraceptives for greater than 12 months. Ortho-Tricyclen was the form of contraceptive used most often, 3 out of 12 forms. The largest group was the athletes that had no history of ACL injury and no prior contraceptive use within the last 12 months. The results were 16 out of 26 athletes, which accounted for 61.5% of the participants. The remaining two athletes included athletes who had sustained an ACL injury but was not using contraceptives at the time of the injury and the other athlete was using a form of prescription contraceptive. Due to the lack of participants in the study, no conclusion can be made at this time in response to the research question.

Table 1: Results of Survey

Athlete	Age	Sport	History of ACL Injury	Contraceptive Use	Length of Contraception Use	Name of Contraceptive
1.	18	Volleyball	No	Yes	> 12 mo.	Yasmin
2.	21	Volleyball	No	Yes	> 12 mo.	Orval
3.	20	Volleyball	No	No		
4.	20	Volleyball	No	Yes	> 12 mo.	Ortho-Tricyclen Lo
5.	18	Volleyball	No	Yes	> 12 mo.	Microgestin
6.	20	Volleyball	No	No		
7.	18	Volleyball	No	No		
8.	18	Volleyball	No	No		
9.	21	Volleyball	No	No		
10.	18	Basketball	No	No		
11.	19	Basketball	No	No		
12.	21	Basketball	No	No		
13.	18	Basketball	No	No		
14.	21	Basketball	No	Yes		Ortho-Tricyclen
15.	21	Basketball	Yes	Yes		Ortho-Tricyclen
16.	24	Basketball	No	No		
17.	26	Basketball	No	No		
18.	36	Basketball	No	Yes	> 12 mo.	N/A
19.	20	Basketball	No	No		
20.	19	Basketball	No	Yes	> 12 mo.	Ortho-Tricyclen Lo
21.	28	Basketball	No	No		
22.	26	Basketball	No	No		
23.	28	Volleyball	No	Yes	> 12 mo.	Ortho-Tricyclen
24.	20	Basketball	Yes	No		
25.	19	Basketball	No	No		
26.	21	Basketball	No	No		

CHAPTER 5

DISCUSSION

Although no conclusions can be drawn from this study due to lack of participation, it is a pilot study for future studies. The results did not have enough athletes who have sustained ACL injuries to compare them to the athletes who have not. The results were showing that there could possibly be a connection between those with no history of ACL injury and those who use prescription contraceptives, with 30.8%. If there were more participants, we could see if this trend continued or not. If the trend did continue, it could show that a connection may exist which proves prophylactic prescription contraceptives may be beneficial.

The design of the study was appropriate using a retrograde survey for previous ACL injury and the use of prescription contraceptives. However, the method of contacting athletes should have been more direct by either sending the surveys directly to them or contacting their Athletic Trainers for assistance. Since this study was used as a pilot study, the next study will have more direct contact with the participants. With more definitive results, conclusions can be drawn as to what role endogenous hormones play in ACL injury susceptibility and whether or not exogenous hormones can be beneficial in preventing ACL injuries in female athletes. As female athletics increases in popularity, so does the need for further research to ensure female athletes are able to compete at their optimal level and are not hindered by injuries that could possibly be prevented.

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APPENDIX A

COACHES' COVER LETTER

WICHITA STATE UNIVERSITY

Department of Physician Assistant

September 25, 2006

Dear Coach:

My name is Rebecca Runge. I am a second year Physician Assistant Student attending Wichita State University. I am involved in the master's program. This research project fulfills a graduation requirement. I am conducting a research study about the relationship between female athletes who have sustained an Anterior Cruciate Ligament (ACL) injury and the use of prescribed contraceptives. As you may know, female athletes have a higher incidence of ACL injuries than male athletes do. There are many theories that may account for this higher rate, including hamstring to quadriceps strength ratio, jumping techniques, increase in ligament laxity, or anatomical differences. Another theory proposed concerns hormones. Although research is being conducted, there are still no explanations that definitively account for the higher incidence of female injuries.

This study will be conducted using a survey distributed to female collegiate athletes participating in volleyball or basketball. The participants will be athletes from Kansas universities and colleges. With your permission, I would like to include your athletes in the study.

The athletes will receive a questionnaire about their history of ACL injury and their use of oral or transdermal contraceptives. If you are willing to participate in the study, please email me back and I will send you a copy of the cover letter and the survey for you to email out to your athletes. Your athletes can answer the survey questions and then email the responses back to me. The Wichita State University Institutional Review Board (IRB) has approved this study. The athletes' confidentiality will be guaranteed. Thank you for your time and effort given to assist me in this research study.

If you have any questions regarding this research, please feel free to contact me or my faculty advisor at:

Department of Physician Assistant

Wichita State University

1845 N. Fairmount

Wichita KS, 67260-0043

316-978-3011

Sincerely,

Patricia Bunton, MS, PA-C
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Wichita State University
patricia.bunton@wichita.edu
316-978-5681

Rebecca Runge
Physician Assistant Student
Wichita State University
rlrunge@wichita.edu
785-760-4749

APPENDIX B

ATHLETES' COVER LETTER

Wichita State University
Physician Assistant Program

September 25, 2006

Dear Athlete:

My name is Rebecca Runge. I am a second year Physician Assistant Student attending Wichita State University. I am conducting a research study for my Master's degree project as a requirement of my graduation. The research study is designed to determine if a relationship exists between female collegiate athletes with Anterior Cruciate Ligament (ACL) injuries and the use of prescription contraceptives (birth control). This survey is distributed to basketball and volleyball players from Kansas universities and colleges. The survey asks questions about your history of an ACL injury and prescribed contraceptive use.

Your participation in the research study is completely voluntary and you may choose to stop participation at any moment. After you have completed the enclosed survey, please use the enclosed self-addressed, stamped envelope to return the survey by October 1st. No tracking numbers or names will be used. Strict confidentiality will be maintained. The Institutional Review Board (IRB) at Wichita State University has approved this study. Completing and returning this survey will be taken as evidence of your willingness to participate and your consent to have the information used for the purposes of the study. You may keep the cover letter and explanation about the nature of your participation in this study and the handling of the information you supply.

If you have any questions regarding this research, please feel free to contact me or my faculty advisor at:

Department of Physician Assistant
Wichita State University
1845 N. Fairmount
Wichita KS, 67260-0043
316-978-3011

Thank you very much for your time.

Sincerely,

Patricia Bunton, MS, PA-C
Masters Research Advisor
Wichita State University
patricia.bunton@wichita.edu
316-978-5681

Rebecca Runge
Physician Assistant Student
Wichita State University
rlrunge@wichita.edu
785-760-4749

APPENDIX C

SURVEY

Physician Assistant Graduate Research Project Survey

Please fill out the survey and return it in the self-addressed, stamped envelope provided. You do not need to provide your name or any other identifying information. The information will be kept confidential and will be used only for the purposes of this project. At the end of the survey, is a list of commonly prescribed contraceptives that you may use to reference as needed. Please circle your response.

1. What is your age? _____

2. Have you ever sustained an Anterior Cruciate Ligament (ACL) injury?

Yes

No

If you answered **yes, please answer questions 3-7

If you answered **no, please answer questions 8-11 (on back side)

3. How old were you when you sustained the ACL injury?

13-15 years old

16-18 years old

19-21 years old

22 years old or older

4. If you answered **yes** to have sustained an ACL injury, what sport were you participating in at the time of the injury?

Volleyball

Basketball

Other (please specify):

5. If you answered **yes** to having sustained an ACL injury, at the time of the injury, were you using any prescribed contraceptives (birth control)?

Yes

No

6. How long had you been using the prescribed contraceptives at the time of the injury?

Less than 6 months

6-12 months

Greater than 12 months

7. What is the name of the contraceptive? (please refer to the back side for a list of contraceptives)

8. If you answered **no** to having sustained an ACL injury, what sport do you participate in?

Volleyball

Basketball

Other (please specify):

9. If you answered **no** to having sustained an ACL injury, were you using any prescribed contraceptives while participating in athletics?

Yes

No

10. If you answered **yes** to using prescribed contraceptives, what is the length of time you used prescribed contraceptives while participating in athletics?

Less than 6 months

6-12 months

Greater than 12 months

11. What is the name of the contraceptive? (please refer to the bottom of the page for a list of contraceptives)

Please return the survey by October 1, 2006. If you do not have the envelope, you may return the survey to:

**Wichita State
University**

**Physician Assistant Department
c/o Rebecca Runge
1845 Fairmont
Wichita KS 67260-0043**

Examples of Prescription Contraceptives:

Alesse	Mercette	Ortho-Novum 1/35
Apri	Lo/Ovral	Ortho Tri-Cyclen
Brevicon	Lunelle (monthly shot)	Ortho Tri-Cyclen Lo
Cyclessa	Minipill (progestin only)	Ortho-Novum 7/7/7
Depo-Provera (every 3 mo. shot)	Modicon	Micronor Ovcon-50
Demulen	Nor-QD	Ovcon-35
Desogen	Nordette	Ovral
Estrostep 21	NuvaRing (vaginal ring)	Ovrette
Estrostep Fe	Ortho-Cept	Yasmin
Levlen	Ortho-Cyclen	Seasonale
Levlite	Ortho Evra (the patch)	Tri-Norinyl
Loestrin-21	Ortho-Novum 1/50	Tri-Levlen
Loestrin-Fe	Ortho-Novum 10/11	Triphasil

VITA

Name: Rebecca Lynn Runge

Date of Birth: June 24, 1983

Place of Birth: Hays, KS

Education:

2005-2007 Master – Physician Assistant (M.P.A)
Wichita State University, Wichita, Kansas

2001-2005 Bachelor—Athletic Training (B.S)
University of Kansas, Lawrence, Kansas

Professional Experience:

August 2006 Certified Athletic Trainer
National Athletic Trainers Association Board of Certification

WICHITA STATE UNIVERSITY DEPARTMENT OF PHYSICIAN ASSISTANT

Defense of Research Project and Final Approval of the Research Project

STUDENT NAME: Rebecca L. Runge

PROJECT TITLE: Does a relationship exist between the prevalence of anterior cruciate ligament injuries in females and the use of estrogen and progesterone containing contraception?

DEFENSE REPORT

Examination _____ Yes or No (Circle One) Date: _____
Completed:

Passed: _____ Failed: _____

May the examination be _____ When? _____

Repeated?

SIGNATURES:*

*To be signed by all applicable faculty members and forwarded to the Department Chair when the examination is completed and the final draft is approved. The student is responsible for meeting the submission guidelines outlined earlier in this syllabus.

Final draft approved:

Project Advisor Date Department Chair Date

DEPARTMENT USE ONLY:

_____ 1 copy of the Research Project (hard copy)

- _____ 1 copy of the research Project (pdf file on disk)
- _____ Signed copy of Institutional Repository Access Agreement Form

Wichita State University
Institutional Repository Access Agreement Form

Rebecca L. Runge:

Does a Relationship Exist Between the Prevalence of Anterior Cruciate Ligament Injuries in Females and the Use of Estrogen and Progesterone Containing Contraception? :

I hereby grant to Wichita State University and its agents the non-exclusive license to archive and make accessible, under conditions specified below, this submission in whole or in part in all forms of media, now or hereafter known. I retain all other ownership rights to the copyright. I also retain the right to use in future works all or part of this submission.

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Submitter (Printed) Rebecca Runge

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Date 5-4-07