Incidence of lower extremity injuries in correlation with limb dominance in University of Minnesota Duluth varsity athletes

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Abstract

Research thus far has struggled to determine a relationship between limb dominance and injury incidence because there are many risk factors that may contribute to the injury of an athlete. This study aims to investigate the correlation between lower limb dominance and the incidence of lower extremity injury among NCAA Division I and II collegiate athletes of the University at Minnesota Duluth.

In order to conduct this quantitative, non-experimental, correlational research study, a survey will be administered to the sample population via the use of the online survey software and insight platform, Qualtrics. Participants will be selected through convenience and purposeful-criterion sampling of NCAA Division I and II collegiate athletes at the University of Minnesota Duluth.

Introduction

Over the past century, sports have come to the forefront of the social experience as a form of entertainment. With this rapid development of interest in sporting events comes rapid development of interest in the controversies surrounding athletic injuries. While there are many risk factors that may contribute to an injury, such as previous history of injury, age, psychological aspects, and anatomical composition[1], it is unclear whether or not limb dominance is one of these contributing factors. Though researchers have sought to determine the relationship between lower extremity injury incidence and limb dominance, the limited selection of results has been conflicting.

In the medical field, it is important to know all possible risk factors for injury in order to limit as many contributing factors as possible, therefore preventing the greatest number of injuries. Determining the relationship between lower extremity injury and limb dominance can lead to the betterment of preventative care through the discovery of potential vulnerabilities athletes may possess that have the potential to lead to injuries. This study will also add to the current research concerning limb dominance as a potential risk factor for lower extremity injury and has the potential to define the gray area surrounding limb dominance, leading to a better understanding of its impact on lower extremity injury incidence. As a population, athletes and healthcare providers have a right to a better understanding of this information and how it can lead to the betterment of prevention and treatment of injures.

Variables

For the purposes of this study, the following terms will be defined as follows:

- **Lower extremity –** joints of the lower body consisting of the hip, knee, ankle, foot and the surrounding musculature including the thigh and calf.

- **Limb dominance –** the primary limb used for daily functions such as writing or kicking.
- **Incidence –** the rate at which an event, such as injury, illness, or disease, occurs.
- **Correlation –** the representation of a relationship between two variables, either positive or negative.

Research Purpose Statement

This quantitative, non-experimental, correlational research study aims to investigate the correlation between lower limb dominance and the incidence of lower extremity injury among the NCAA Division I and II collegiate athletes of the University of Minnesota Duluth due to the unclear nature of the relationship between limb dominance and lower extremity injury.

Research Questions

1. Is there a correlation between lower extremity injury incidence and limb dominance among NCAA Division I and II athletes at UMD?
2. Does a gender-based correlation exist between limb dominance and lower extremity injury in NCAA Division I and II athletes at UMD?

Review of Literature

Brief History

Over the past few decades, injuries sustained in sport settings gained great notoriety. From concussions, to ankle sprains, to non-contact anterior cruciate ligament tears, injuries that occurred during athletic competitions slowly became some of the most controversial topics in medical society. Because of this increase in notoriety and public awareness, researchers sought to clarify some of the more complicated aspects surrounding injury, including how and why these injuries occur. Answers to these questions were particularly sought after in regard to today's young athletes.

Generally, athletic populations of the high school, collegiate, and professional settings usually consisted of a younger demographic and therefore, they tend to be viewed as a strong and otherwise healthy population. Consequently, when athletes of this seemingly healthy nature sustained injuries, interests piqued and research was aimed toward finding the causes of such injuries. Through this extensive research, certain risk factors such as previous history of injury, age, psychological aspects, and anatomical composition[1], were discovered and widely accepted in the medical community to be contributors to injury. These developments in the search for answers concerning how injuries occurred, greatly helped medical professionals around the world to better understand what medical techniques they are able to utilize to help prevent these injuries. The next natural step was to consider limb dominance and its possible contributions to injury incidence. However, before researchers could study the correlation between injury incidence and limb dominance, they first had to determine its existence and the role it plays in both biomechanics and kinematics.

Review

The earlier studies of limb dominance looked into its true existence in all phases of activity[2]. An initial study sought to determine the existence of asymmetry of gait dynamics when leg movements were compared bilaterally[2]. This study concluded that significant asymmetries could be detected in stance, swing, and stride phases, suggesting a natural functional difference between limbs that would be indicative of limb dominance[2]. However, two subsequent studies[3,4,5] found that while there may be significant asymmetries between limbs during gait, limbs were similarly affected by training programs regardless of limb dominance, and while existent, limb dominance had no statistical effect on performance during functional tests, such as isokinetic quadriceps and hamstrings testing, hamstring to quadricep ratios, and single leg hop for distance[4]. A third study by Brown and Hillstrom also suggested that limb dominance had no effect on running kinematics[5]. The findings of these three studies suggested that while limb dominance may be detectable, it did not have implications or contributions, negatively or otherwise, toward highly functional activity[3,4,5]. This led further research aimed at the potential correlation between limb dominance and injury incidence. Subsequently, two schools of theory emerged: those that theorized a relationship existed between limb dominance and injury incidence, and those who theorize no relationship existed between the two. And the conflicting research results began to take shape.

Two studies, conducted by Cooper and Brophy respectively, initially appeared to find no correlation between limb dominance and injury incidence[6,7]. Cooper's study sought to determine if dominance was a factor in non-contact anterior cruciate ligament (ACL) injuries[6]. Cooper and his colleagues determined there to be no significant correlation between the side of injury and dominant limb[6]. In addition, there seemed to be no significant gender effect, but females did tend

to injure the left more often than right and no trend was concluded in male participants[6]. This result suggested that there was no significant relationship between dominance and ACL injury[6]. However, Brophy's study, which inquired about the effect of dominance on ACL injury, had similar but slightly different results[7].

While the initial conclusions from the Brophy study found no significant correlation between ACL injury incidence and limb dominance throughout the participant group as a whole, upon closer examination by gender, it was determined that females were much more likely suffer ACL injury in the non-dominant leg while males were more likely to injure the ACL of the dominant leg[7]. 68% of ACL injuries in females were on the non-dominant side, while 74.1% of males sustained ACL injury on the dominant side[7]. This result a strong correlation between ACL injury incidence and limb dominance when the data was examined by gender, even though the initial results seemed to show no relationship when the participant group was examined as a whole[7].

Burtscher's research also suggested a possible gender-effect[8]. This study also aimed to explore the potential for limb dominance to be a contributing risk factor to ACL injuries, particularly in female recreational skiiers[8]. His results showed a significant correlation between limb dominance and ACL injury in the non-dominant leg of female skiers and a less strong, but still significant, correlation in injury to dominant legs of male skiers[8]. 63% of females suffered non-dominant leg ACL injuries, while 55% of males suffered dominant leg ACL injuries[8]. This seemed to coincide with the gender based findings of Brophy[7,8]. And while gender based studies found the most significant correlation, additional studies also support correlation between injury incidence and leg dominance. A study by Ekstrand found a 60% incidence rate of quadriceps strains in the dominant leg[9]. Hawkins also found a higher rate of lower extremity injury

incidence, with as many as 50% of injuries being sustained in the dominant leg while only 37% of injuries were sustained in the non-dominant leg[10]. The remaining 13% was attributed to either bilateral injuries or cases of unknown side-dominance[10]. Overall, implications that limb dominance was a significant factor in lower extremity injury incidence, particularly when analyzed by gender, was in direct conflict with original research claiming no correlation between the two.

The previous research on the correlation between limb dominance and injury incidence varies greatly. There is limited research focusing on the implications of a correlation between lower extremity injury incidence and limb dominance and little to no research surrounding the collegiate athletic population. This research study seeks to clarify the correlation between limb dominance and lower extremity injury incidence in NCAA collegiate athletes and how gender affects this correlation.

Methods

Purpose

This study intends to look at the existence, prevalence, and significance of the potential correlation between lower extremity injury and limb dominance, particularly in NCAA athletics at the University of Minnesota Duluth. Most other current studies have centered specifically on how limb dominance affects ACL injury rates in soccer players and skiers. By analyzing collegiate athletes as a whole at the University of Minnesota Duluth, there is potential for new implications regarding other specific injuries to the lower extremity.

Study Design

This study will be conducted as a quantitative, non-experimental, correlational research design. Because of the many potential risk factors for injury, true isolation of one variable via limitation of all other extraneous variables is highly unlikely. Therefore, a study exploring the potential relationship between these two variables will be utilized via the use of a survey. A survey seems to be the best possible design technique for this study because it is the quickest and simplest way to get a vast amount of desired information from the most number of participants. It also serves as a simpler method for qualifying and quantifying responses.

Population and Sample

The population for this study is NCAA Division I and II athletes at the University of Minnesota Duluth. These collegiate students, generally averaging an age range of eighteen to twenty-three, will be sampled using purposeful-criterion sampling, as they are all athletes of the same particular institution with similar levels of risk for injury relative to other populations. This sampling method could also be qualified as convenience sampling as the study is using the

population most readily available based on location and institution. These athletes were also selected due to the limited amount of research narrowed specifically to their demographic.

Investigative Techniques

This study plans to use a survey primarily comprised of multiple-choice questions with a select few open-ended responses. This survey will determine basic gender demographics, the nature of the bodily injury, and the side of dominance, the rate of injuries sustained on the dominant limb can be calculated by the researcher.

Instrumentation

This study plans to use a self-designed survey. This survey was developed using Qualtrics, the online survey software and insight platform. This could skew the results of the research, as it is not a standardized instrument. However, a quick pilot study and peer review could help to validate the survey and make it more reliable, particularly when evaluated for readability.

Data Collection

This survey will be distributed to all student athletes of the University of Minnesota Duluth via email. They will receive an email containing a link to the consent form (Appendix A) and survey (Appendix B), which expires after three weeks. If limited responses are gathered, the timetable could be expanded to six weeks to allow more time for response. The responses to the survey are automatically recorded by the survey system, which can then be accessed by the researcher for review.

Data Analysis Plan

The collected statistics will be descriptive statistics, showing the frequency of lower extremity injuries occurring in the dominant limb of collegiate athletes. These statistics will be

compiled and calculated via content analysis of the selected responses provided by the participants and analyzed by the researcher

Ethical Considerations

Basic safeguards are included in the consent form (Appendix A). These included the voluntary nature of the study and the participant's right to opt out at any time, the acknowledgment that reviewing of previous medical history may result in physically, social, emotional, or psychological stress, and a confirmation that all results will be kept confidential and are entirely anonymous.

Bias and Assumptions

Most insidious biases and assumptions will be eliminated by the anonymous nature of the survey. However, some gender bias and research bias may occur as previous research as typically seen a higher correlation based on gender.

Limitations

Limitations of this study are the narrowed scope of participants and playing level of those participants. Only University of Minnesota Duluth NCAA Division I and II athletes will be surveyed and their responses reviewed and considered.

Results

Initial Results

The online survey was distributed via email to the 469 varsity athletes of the 14 varsity teams of the University of Minnesota Duluth (UMD). Of the 469 varsity athletes, 113 responded to the survey. Each of the 14 varsity sport teams was represented by at least 4 responses. Responses broken down by sport team can be seen in Table 1.

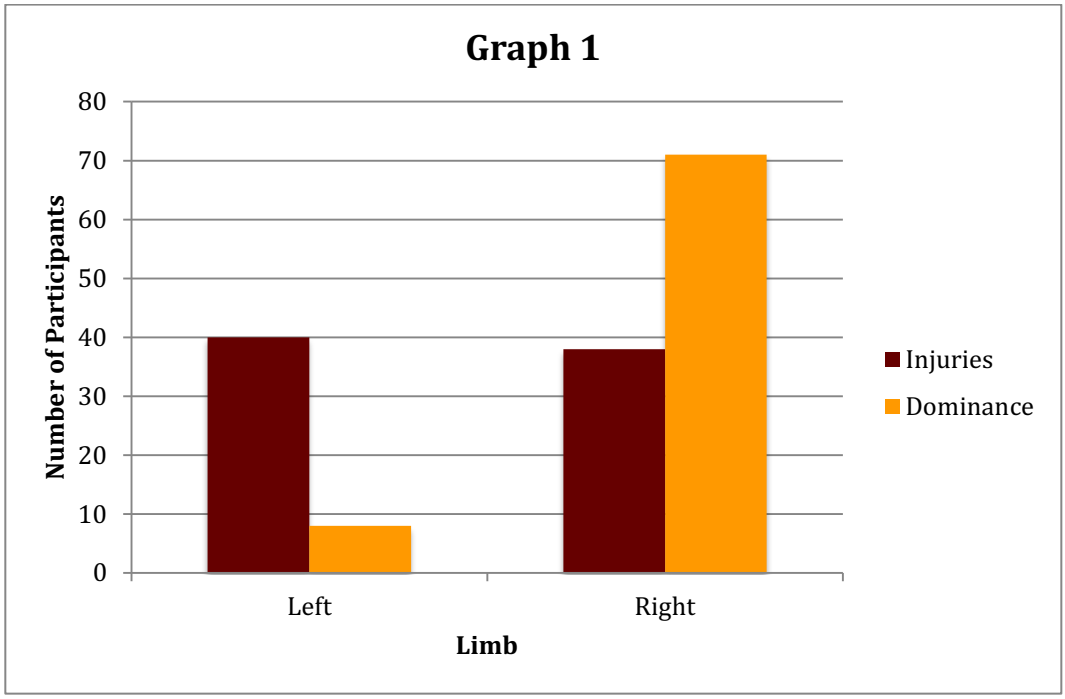
Table 1

Sport	Responses	%
Baseball	10	9%
Basketball - Men's	4	4%
Basketball - Women's	6	5%
Cross Country - Men's	5	4%
Cross Country - Women's	4	4%
Football	23	20%
Hockey - Men's	9	8%
Hockey - Women's	9	8%
Soccer - Women's	9	8%
Softball - Women's	4	4%
Tennis - Women's	4	4%
Track and Field - Men's	13	12%
Track and Field - Women's	19	17%
Volleyball	4	4%

Table 1: Total responses as represented by sport

Of the 113 respondents, 79 reported sustaining a lower extremity injury while participating in varsity athletics at UMD. This respondent pool of 79 responses represented gender evenly, as 40 were male and 39 were female. Responses were also distributed evenly between the sides of injury; 38 respondents reported injury on the right side while 40 reported injury on the left side. Unlike gender and side of injury, there was a clear difference in side of

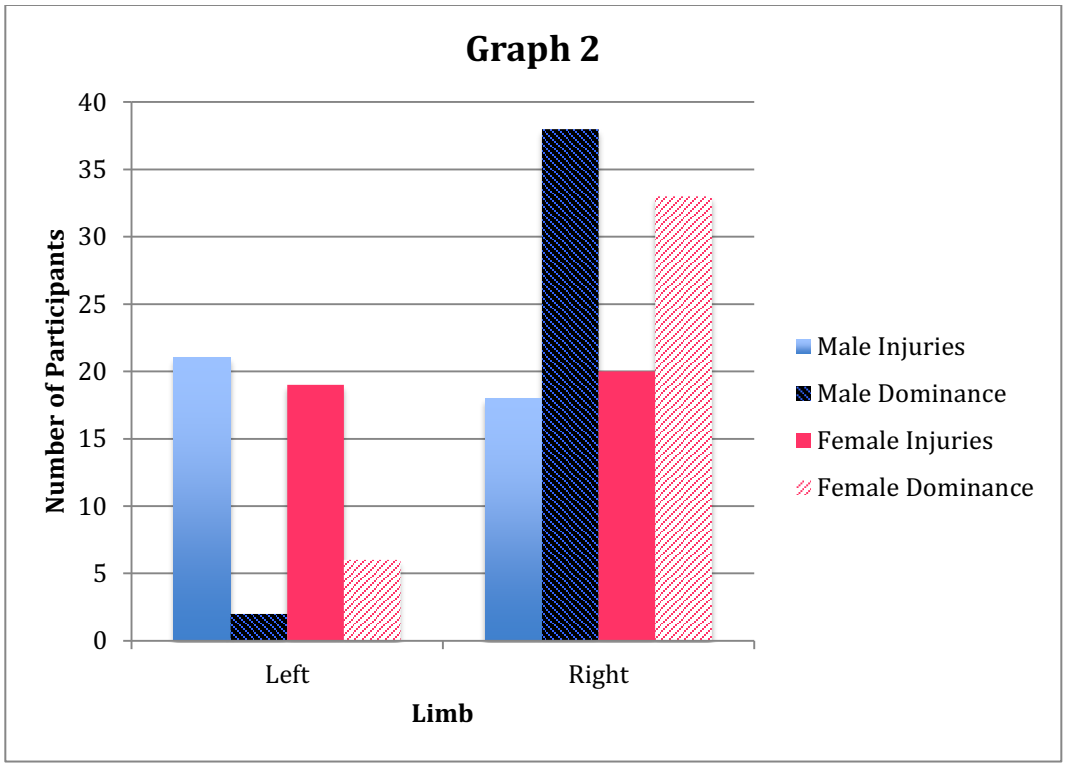
limb dominance among the respondents with 71 reporting right leg dominance while only 8 reported left leg dominance. Both side of injury and limb dominance are represented visually in Graph 1 below.



Graph 1: The number of injuries compared to limb dominance broken down by limb

Results by Gender

Greater definition in statistical results can be seen when data is examined by gender. Of the 79 respondents, 40 were male and 39 were female. Females reported 20 right side injuries and 19 left side injuries, while 33 reported right leg dominance, leaving only 6 reporting left limb dominance. Males reported 18 right side injuries and 21 left side injuries, while 38 reported right limb dominance and only 2 reported left limb dominance. This data can be seen below in Graph 2.



Graph 2: Injuries compared to limb dominance broken down by side and gender.

Discussion

At first glance, the collected data may seem inconclusive as injuries were reported nearly evenly between right and left limbs even though right limb dominance was clearly a prominent trait among these athletes. Among the 79 respondents who reported lower extremity injury, 38 reported right limb injury, while 40 reported injury in the left limb. This is a nearly even split between right limb and left limb injuries, even though 71 reported right side limb dominance, while only 8 reported left side limb dominance. However, when examined by gender, it can be determined that this data only seems insignificant because it is offset by two different groups: females, who injure their dominant limb more often, and males, who injure their non-dominant limb more often.

Of the 79 respondents that reported lower extremity injury, 39 were female. Of those 39, there were 20 right side injuries and 19 left side injuries reported, while 33 reported right leg dominance, leaving only 6 reporting left limb dominance. This would indicate that by a small margin, females injure the dominant leg more often. Conversely, the opposite can be seen with the male respondents.

Males represented 40 of the 79 total respondents. Of those 40, males reported 18 right side injuries and 21 left side injuries. However, 38 reported right limb dominance and only 2 reported left limb dominance. This would indicate that males injure their non-dominant limb more often, as more left limb injuries were reported even though nearly all male respondents were right limb dominant.

These results are conclusive with previous research studies that have been conducted in the same manner by other researchers.

Conclusion

While little relationship was found between limb dominance and injury incidence when the sample population was examined as a whole, a relationship between these two variables was found when the sample population was broken down by gender. Among the male varsity athletes, there was an inverse relationship between injury incidence and limb dominance. In female varsity athletes, results indicated that the majority of injuries occurred in the dominant limb. This indicates that male athletes are more likely to injure their non-dominant limb while female athletes are more likely to injury their dominant limb.

Implications

Because a relationship has been determined between limb dominance and injury incidence among the athletes of the University of Minnesota Duluth, prophylactic measures can now be taken by the sports medicine staff in order to prevent future injuries. This may include a more thorough pre-participation exam, with special attention paid to deficits in the non-dominant limb of males and the dominant limb of females. In the past, it is possible that deficits between limbs was overlooked or attributed to dominance. However, now that dominance has been established as a relevant factor in injury occurrence, these potential deficits between limbs may carry more significance.

Limitations

Results were limited by time and sample size; the survey was only open for responses for 4 days, which led to the low number to responses. While the survey was sent to 469 varsity athletes at the University of Minnesota Duluth, only 113 responded, a response rate of only 24.09%. This response sample size was then further diminished to 79 of the original 113 responses by only selecting those respondents whom had experienced lower extremity injury.

Future Research

Further research with a larger sample size is needed in order to fully examine the nature of this relationship and other risk factors that may contribute to the injury incidence of University of Minnesota Duluth varsity athletes.

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Appendix A

CONSENT FORM

Incidence of Lower Extremity Injuries in Correlation with Limb Dominance in University of Minnesota Duluth Varsity Athletes.

You are invited to participate in a research study about how limb dominance affects injury incidence. You were selected as a possible participant because you are a varsity athlete at the University of Minnesota Duluth. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by Gretchen Klinkner, an athletic training student at the University of Minnesota Duluth.

Study Purpose

The purpose of this study is to determine if there is a relationship between lower limb injury rates and lower limb dominance among the athletes at the University of Minnesota Duluth and whether this potential relationship is affected by gender.

Study Procedures

If you agree to participate in this study, you will be asked to complete a ten question, multiple-choice survey. This survey will take approximately five to ten minutes of your time.

Risks of Study Participation

While it is unlikely, the study does present the potential risk for minor physical, psychological, or emotional stress.

Benefits of Study Participation

No direct compensation or benefits will be given to the participants of this study. However, the study is aimed to assist in the advancement of the knowledge of medical professionals and the treatment of athletes. Participants' participation in the study will contribute to this pursuit of knowledge.

Confidentiality

The records of this study will be kept private. Any future publications or presentations will not include any information that will make it possible to identify subjects. All responses are entirely anonymous and will in no way be recorded or associated with subjects' medical records. Responses are secure and protected through the *Qualtrics* website security and individual account password protection. Only the principal investigator (Gretchen Klinkner – athletic

training student, University of Minnesota Duluth) will have access to survey responses and results. To these extents, confidentiality is not absolute. Study data will be encrypted according to current University policy for protection of confidentiality.

Voluntary Nature of the Study

Participation in this study is entirely voluntary. Your decision whether or not to participate in this study will not affect your current or future relations with the University of Minnesota Duluth or its Sports Medicine Staff. If you decide to participate, you are free to withdraw at any time without affecting those relationships.

Contacts and Questions

The researcher conducting this study is Gretchen Klinkner. You may ask any questions you have now, or if you have questions later, **you are encouraged to** contact them at klink033@d.umn.edu or (507)-676-2118. You may also contact student research advisor Dr. Megan Streveler at mstrevel@d.umn.edu or (218)-726-8456.

Statement of Consent

I have read the above information. I have asked questions and have received answers. I consent to participate in the study.

Signature of Subject_____

Date_____

Appendix B

Survey

1. **I have read and understand the consent form and terms of this study. I understand that the study is entirely voluntary and I am free to discontinue my participation at any time.**
    a. Agree
    b. Disagree
2. **Which gender do you identify as?**
    a. Male
    b. Female
    c. Other
3. **What year of collegiate schooling are you currently completing?**
    a. First year
    b. Second Year
    c. Third Year
    d. Fourth Year
    e. Fifth Year
    f. Graduate School
4. **What is your age?**
    a. 18-19
    b. 20-21
    c. 22-23
    d. 23-24
    e. Other _____
5. **Which varsity athletic sport or sports do you participate in at UMD?**

a. Baseball
b. Basketball – Men's
c. Basketball – Women's
d. Cross Country – Men's
e. Cross Country – Women's
f. Football
g. Hockey – Men's
h. Hockey – Women's
i. Soccer – Women's
j. Softball
k. Tennis
l. Track and Field – Men's
m. Track and Field – Women's
n. Volleyball

6. **Have you ever sustained a lower extremity injury while participating in UMD varsity athletics? NOTE: Lower extremity refers to an injury below the belly button NOT including low back/spine. This would include hip, thigh, knee, low leg, ankle, foot, or toe.**
    a. Yes
    b. No
7. **Did you report the injury to a member of the UMD Sports Medicine Athletic Training Team?**
    a. Yes

b. No

8. **What lower extremity injury did you sustain, if known? Explain to the best of your ability.**

   a. _____

9. **Was the lower extremity injury on the right or left side of the body?**

   a. Right side

   b. Left side

10. **Which leg do you consider to be your dominant leg? (Which leg would you kick a ball with when playing kickball?)**

    a. Right leg

    b. Left leg