

The Impact of Synthetic Turf on  
Goucher College Men's and Women's Lacrosse Teams

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## Abstract

The purpose of this study was to determine the impact of synthetic turf on the men's and women's lacrosse teams at Goucher College. The measurement tool for the study was overall team records five years prior to and five years following the installation of synthetic turf. The statistics that were analyzed through a survey were gender, number of years the student athlete played lacrosse, primary position, and school status level. Each athlete was asked about incidents of dehydration, heat exhaustion, and heat stroke. The survey asked each athlete about any injuries and the effects on loss of practice and game time, or a season ending injury in the areas of upper body, lower body, and concussions. The areas of performance examined were agility, endurance, skill level, and anticipation of opponent and ball movement. This study was quasi-experimental in that it included student perceptions and team records. The men's team showed no significant impact on the number of wins and losses with the installation of synthetic turf. The women's team had a significant negative impact on the number of wins and losses after synthetic turf was installed. Studies related to this topic should continue as there has been little longitudinal research examining the impact of synthetic turf on lacrosse players.

# **CHAPTER 1**

## **INTRODUCTION**

Athletic administrators are faced with the complex decision of whether to install artificial turf instead of natural grass. Factors under consideration include installation and maintenance costs, individual and team performance, and incidence and prevalence of injury by type and severity. There are currently no published studies to date that contrast the factors for natural grass and artificial turf for lacrosse.

Twenty years ago, multi-purpose turf fields were a relative rarity, reserved for the big donor institutions and forward-thinking athletic directors with large budgets. Over the past two decades, the number of collegiate athletic departments without an on-campus artificial surface is nearly zero. The opportunity has allowed the cold winter month of January to be utilized as an opportunity for outdoor practice with assistance of a shovel or plow and additional field hour use with lighting.

For all levels of athletics, coaches strive to prepare their athletes to perform at their highest potential in preparation for their in-season competition. Countless hours are spent training for these intense games and for some teams, who do not have a turf field, preseason practices for lacrosse teams are off the field. Jim Lyons, head coach for SUNY men's lacrosse, faced practices taking place on "three [indoor] basketball courts side-by-side-by-side... we're basically practicing lacrosse in a garage" (Coyne, 2014). Since the installation of turf, "[my] players know that they are not going to be behind. They are going to have the same advantages that everyone else has. That's the bottom line. We're also going to have two turf fields, side-by-side, so the practice times are going to be better for us. It's really going to make the student-athlete experience for everyone who uses those fields that much better. We used to start out behind, and leveling that playing field

will go a long way” (Coyne, 2014). Enhancement in field surface technology is enabling equal opportunity for competition and removes any tactical advantages from other teams.

Synthetic turf fields, made to look like natural grass, are the standard at the collegiate level. College athletes now expect synthetic turf to be the playing surface. The latest generation of synthetic turf replicates natural grass in appearance and function. When used on athletic fields, it provides a consistent, year-round, all-weather playing surface built to withstand extended use without the downtime natural grass needs for field recovery. The increasing demand for durable, long lasting, and affordable athletic field surfaces continues to fuel extensive research for increasing durability and reducing the total cost of ownership. The consistency of historical data supports and validates the benefits of synthetic turf, with researchers persistently finding athletes experiencing more positive outcomes when playing on synthetic turf. The selection of natural or artificial surface is complex and challenging for any athletic organization as they are compelled to conduct a comprehensive assessment by examining the advantages, disadvantages, and impact of each surface economically, environmentally, and physically.

Synthetic turf's improvements since its creation in the 1960s, when it was simply outdoor carpet atop cement, continue to undergo advancements. New developments in material technology drive the creation of new designs, targeting greater overall athletic performance. The newest synthetic turf products, chemically treated to resist ultraviolet rays, have particles that are more wear-resistant, less abrasive, and, for some applications, very similar to natural grass (Synthetic Turf Council [STC], 2013). Most systems are multi-layered beginning with the drainage layer. From the bottom up, turf starts with two feet of gravel, two feet of sand, followed by a multilayered backing system, and grass blades that are infilled with a granular filler from old tires to resemble natural turf (STC, 2013). According to the Synthetic Turf Council, demands have



grown to 8,000 multi-use synthetic turf sports fields that are now in North American schools, colleges, parks and professional sports stadiums (STC, 2013).

### **Problem Statement**

The objective of this research was to examine the impact of synthetic turf on the men's and women's lacrosse teams at Goucher College by investigating the athletes' perspectives of their performance and comparing the overall team record prior to and after installation of synthetic turf.

### **Hypothesis**

No difference will be found between record (win/loss) of men's and women's lacrosse teams when compared to playing on natural grass and switching to synthetic turf at home.

### **Operational Definitions**

The independent variable of this study was field type. This was operational by examining natural grass or artificial turf lacrosse fields at home. The dependent variable was team performance. This was operational by comparing school lacrosse team records before and after the installation of synthetic turf. Student perception of personal performance on grass and turf was also examined on a survey.

## **CHAPTER II**

### **REVIEW OF THE LITERATURE**

This literature review examines issues related to synthetic turf as a playing surface for college student-athletes. The importance of synthetic turf's impact on team sports economically, environmentally, and physically will be examined in three sections.

#### **The Economic Impact**

A significant amount of money is needed to fund the initial installation of a synthetic turf field which is the single greatest reason that weighs against artificial turf. The total cost ranges approximately from \$750,000 to \$1,000,000 per field and has a wide cost variance depending on how much fill is necessary to make an entirely flat surface and provide for the specific drainage system required to pull water off the field (Berry, 2012). Synthetic fields use a granular infill to provide cushioning and stability, allowing the grass blades to remain standing. The infill consists of sand and finely ground used-car tire rubber (Bocca, Forte, Petrucci, Constantini & Izzo, 2009). Most manufacturers warranty their synthetic turf fields for eight years, with the life expectancy being between ten and fourteen years (Artificial Grass Warranties, 2008). After installation of the new synthetic turf field, given maintenance throughout the life expectancy, replacement will eventually be needed. The cost after the initial ten years for artificial turf drops to \$477,000 for an additional ten years (Fleming & Forrester, 2014).

Maintenance requirements for each field type involve separate methods, training, and equipment to maximize field longevity. The common misunderstanding about artificial "turf fields is the belief that they are low maintenance or even maintenance free. Today's turf is far more technologically advanced than those early 'carpets' and requires more complex maintenance and care" (Berry, 2012, p. 8). It is estimated that the annual costs for repairs and ongoing maintenance range from \$10,000 to \$30,000 per year over the entire lifespan of the field depending on the

frequency and intensity of use (Berry, 2012). The maintenance required for artificial turf is vacuuming for leaves and debris, repairing loose seams, and brushing the fibers. Maintaining even distribution of infill, critical for synthetic turf, requires regular sweeping and grooming with special equipment, cleaning, and debris removal from the surface to protect drainage system (Berry, 2012). Finally, all artificial turf manufactures require deep grooming of the field midway through warranty, around year five (Berry, 2012). A deep groom removes all existing infill and small debris that settled at the base of the turf fibers. Then the carpet is cleaned, and new infill is placed covering the entire field.

In comparison, the cost of maintaining a natural grass field is similar to synthetic fields ranging from \$10,000 to \$60,000 (Berry, 2012). The minimum requirements for maintenance are “regular mowing, soil analysis, fertilization, cultivation, irrigation, and pest and weed control measures” (Berry, 2012, p. 9). Extensive labor, material, and equipment are required especially during the growing season. Depending on the grass field location within a state and even the country, areas may have a longer growing period or experience significant droughts, decreasing the growing period. Grass is far less expensive than turf. The maintenance cost for natural grass includes painting, top layer repairs, fertilizers, pesticides, aeration, and irrigation with the requisite labor. A natural grass field will never need to be replaced if maintained and managed properly. In the unlikely event that replacing a natural field becomes necessary, the cost to replace the grass area would require an investment of \$50,000 to \$150,000 (Berry, 2012). Replacement turf in the current market can “cost between \$300,000 and \$700,000, depending on subsurface conditions, existing drainage systems and type of turf selected” (Berry, 2012, p. 9). The decision to keep a grass field or install a turf field can be challenging. One significant contributing factor for considering the installation of synthetic turf is hours of use. Depending on community or school needs, turf can be used significantly more than a natural grass field. Most artificial manufacturers

claim up to 3,000 hours of use per year without compelling damage and wear on the turf (Berry, 2012). Most experts are unable to provide a definitive answer because of the copious variables.

Dr. Grady Miller, professor of turf grass science at North Carolina State, uses his 2-4-6-8 rule for determining use of grass fields, and it stems from understanding the average maintenance costs. Natural grass can handle “up to 200 hours of use per year without signs of wear or damage. At 400 hours of use per year, a natural grass field will generally show some signs of wear and may require spot repairs. Exceed 600 hours of use per year and the field will require rehabilitation in areas of highest use” (Miller, 2010). Finally, if a natural grass field is used more than 800 hours per year, “substantial renovation or complete replacement will be required yearly” (Miller, 2010). Abiding by the 2-4-6-8 rule, six to eight natural grass fields would equate to one artificial turf field for the same volume of use (Miller, 2010).

### **Environmental Impacts**

Weather conditions, especially rainfall, impinge more on grass fields than synthetic turf. Natural grass fields face more challenges due to variation of weather. Rainfall drastically limits the availability of grass fields during and after a weather event, decreasing the field’s number of usage hours, which can cause game and practice cancelations. Playing on a grass field when long or heavy rainfall occurs increases maintenance costs resulting from much greater field damage. During prolonged times of high heat or drought, the grass surfaces become vulnerable and more susceptible to damage, causing greater wear to the grass field and leading to even more costs and restrictions of field use.

When artificial turf fields have adequate drainage and are maintained properly during and immediately following heavy and prolonged rainfall, activity can take place without interruption. Heat is the biggest challenge turf fields present. Through research and athletes' experiences, artificial turf surfaces have been found to reach 165 to 180 degrees Fahrenheit in southern states

(McNitt & Petrunak, 2004). It has been argued that applying cool water to lower the field temperature only increases the humidity, worsening the playing conditions for the players.

Synthetic turf has been found to positively impact the environment. According to the U.S. Environmental Protection Agency, a grass field under normal conditions requires a minimum of 500,000 to 1,000,000 gallons of water each year. When water is being used to saturate the two parts of the natural grass, the base and the rooting medium that stabilizes the plant, pesticides and fertilizers are used to promote healthy grass growth. Eliminating grass fields also saves millions of pounds of harmful pesticides and fertilizers from being released into the environment. Although artificial turf field does require some water for cleaning and settling infill, the amount of water for turf fields is significantly less than the amount necessary for natural grass fields (STC, 2013).

Research from North Carolina's Department of Environment and Natural Resources concluded, “as a direct result of fewer chemicals being used, there is a decrease of polluted water runoff” (Little, 2008). Synthetic turf indirectly reduces the emissions of high levels of carbon monoxide, organic compounds, and nitrogen oxides by no longer requiring the use of large lawn mowers and gasoline. It has been shown that a push mower in one hour's use can emit the equivalent of up to 11 cars, while a riding mower emits up to the equivalent of 32 cars in an hour (Kruger, Kalbe, Richter, Egeler, Rombke & Berger, 2013). As the demand continues to grow for installation of synthetic turf around the country, the decrease in emissions will remain proportional.

Recently, a concern regarding the use of crumb rubber infill for synthetic turf made from recycled car tires is getting attention. Since 1997, crumb rubber has been approved for use with track fields, synthetic fields, and playgrounds. Environmental and public health concerns continue to intensify resulting from the discovery of heavy metals and toxic chemicals found in the reused tire rubber (Li, Berger, Musante, & Mattina, 2010). The potential magnitude of this issue was

underscored in a recent report from the US Rubber Manufacturers Association (RMA) that “over 299 million scrap tires were generated in 2005 and 260 million scrap tires were consumed in the end-use market, including 38 million tires recycled for ground rubber applications in new rubber products, playgrounds, other sports venues, and rubber-modified asphalt” (Li et al., 2010).

Production of crumb rubber material, prepared by shredding tires and other sources of used rubber, is an attempt to recycle these wastes.

### **Physical Impacts**

The most direct and extensive reports on the impact of synthetic turf and natural grass comes from athletes themselves. In any physical activity, there are risks with the possibility of devastating injuries and even death. Although these risks exist and are potentially severe, the likelihood of experiencing them is very low. It quickly becomes a cost-benefit analysis. In other words, there is generally low risk for playing a sport that can result in high rates of return that athletes can experience. They have an opportunity to learn the value of teamwork, coarse and fine motor skills, time management skills necessary for the balance of athletics and scholastics, relationships and trust, increase in self-confidence and self-esteem, discipline, self-motivation, and leadership skills. These considerations underpin each athlete's decision to engage in competitive play.

Throughout any athlete's career, minor injuries are inevitable. There is a significant divergence among the many researchers in the field regarding player safety on synthetic turf. A study in 2014 examined 49 football players' perceptions of football turf and natural grass surface properties to investigate the incidence, nature, and severity of injuries sustained. Data were collected by questionnaire during all football activities, training and competition alike. Injury rates for training, games, and all football exposure were higher when playing on grass (Roberts, Osei-Owusu, Harland, Owen, & Smith, 2014). The vast majority of injuries on both surfaces were

minor; some injuries required medical attention, and no injuries resulted in loss of playing time or training. Injuries that resulted in 1–3 days absence from training or game play had similar incidence rates (Grass: 7.4 vs. Turf 7.4 injuries per 1,000 hours of exposure). Although there were more severe injuries, they were less frequent with a higher rate of incidence when playing on grass. Lower limb injuries were the most common in both tournaments with a higher incidence on grass (Grass: 14.2 vs. Turf 7.9 injuries per 1,000 hours exposure). Muscle injuries were the most frequent of all injuries with similar incidence rates on both surfaces (Grass: 5.4 vs. Turf 4.7 injuries per 1,000 hours exposure). Injuries that involved player contact were also more common on grass (Grass: 11.5 injuries vs. Turf 3.2 per 1,000 hours exposure) (Roberts et al., 2014). Although this study looked specifically at football players, the rates of injury were significantly higher on grass than turf. Being a high impact sport, there was greater opportunity to collect data on injuries and establish a better understanding of the impact that the surfaces had on athletes physically.

A newer area of concern involves microbial growths known as staph and MRSA (methicillin-resistant *Staphylococcus aureus*). Microbial outbreaks are common in locker and weight rooms, particularly on wrestling mats and gym bags. Researchers conducting a study at Penn State University in January 2009 concluded that survival rates of staph on artificial turf surfaces were found to be similar to those on natural grass field. In fact, the study found “synthetic turf surfaces were not a hospitable environment for microbial activity” (Berry, 2012, p. 10).

Researchers conducted and published three 2010 long-term studies examining acute injuries on natural grass and artificial turf. The researchers targeted the type, location, and severity of injuries sustained by studying participants over five years (Petrass & Twomey, 2013). The injuries included ankle sprains, concussions, muscle strains, MCL/ACL tears, fractures, and knee

injuries (Petrass et al., 2013). The researchers concluded that the risk of playing on artificial turf however, is no greater than playing on natural grass (Petrass et al., 2013).

There are no current studies specifically targeting lacrosse players and injuries. In 2004, however, the NCAA studied schools nationwide comparing injury rates between natural and synthetic turf and found that the injury rate during practice was 4.4% on natural turf and 3.5% on synthetic turf (McGhie & Ettema, 2012).

One of the positive qualities of synthetic turf is the ball speed on the field. Field designs enable players' stronger acceleration, quick pivoting, and faster game speed. Traction, critical for all players, benefit from the uniformity of a flat surface that enables players to attack aggressively and naturally without fear of divots, hidden holes, and mud near goal cages. Synthetic field surfaces are now more aligned to match the mechanical characteristics of a natural grass field surface without the potential effects on lower extremity injuries. The study examined the effects of two surfaces (natural grass and turf) on in-shoe foot loading patterns during cutting (sudden deceleration of speed in one direction with immediate acceleration in a different direction). After following 17 male athletes, no significant differences between grass and turf were found in maximal effort sprint times (Ford, Manson, Evans, Myer, Gwin, Heidt, & Hewett, 2006).

### **Summary**

From young recreation leagues through collegiate competition, athletes strive to compete at their highest levels of performance. To maintain the demand and ability to remain athletically fit, synthetic turf is a safe option. In any athletic event, there remains an ongoing risk of injury as a result of the physical and mental demands on the never-ending seasons for current competitive athletes. When examining the pros and cons provided by reputable sources and research, the consistency remains true that utilizing synthetic turf fields is extremely beneficial and advantageous to college athletes, their team, and coaching staff. Common concerns of cost,



maintenance, repair, injuries, environmental factors, and hours of use must always be examined annually to insure and maintain positive impacts for the athletes. Cost can be a determining factor, but the volume of demand for access to and use of field can influence the type of field that would be more economical for that organization. Each field type comes with separate issues that greatly affect operations, maintenance, and the athlete. Sports activists will remain adamant about the authenticity of natural grass while athletic directors praise the benefits and flexibility of artificial turf.

## **CHAPTER III**

### **Methods**

The study's purpose was to examine the relationship between individuals' perception of their performance for men and women lacrosse players at Goucher College and overall game results for the last five years before and after installation of synthetic turf.

### **Design**

This study used quasi-experimental pre/post design. The individual team's overall school win-loss records were compared through the collection of data from 2007-2014 lacrosse seasons. Student athletes' perceptions were also examined in a survey. The results of current men and women lacrosse teams for the 2015 Spring season was examined for their perception of athletic performance. The survey also examined the impact of synthetic turf on the specific Goucher College teams who utilized synthetic turf throughout the year.

### **Participants**

The participants were student-athletes on Goucher College's Division III men's and women's lacrosse rosters. A convenience sample was used in this study, as the teams were pre-selected before the study took place. The women's team responses consisted of 9 members, ranging in age from 18 to 22 years old. The men's team responses consisted of 12 members, ranging in age from 18 to 22 years old.

### **Instruments**

The study used two instruments for data collection, the first being the specific eight question survey given to current members of men and women lacrosse teams and collection of wins and losses from the Goucher College Athletics website 5 years before and after the installation of synthetic turf in the summer 2009. The survey designed by the researcher was not tested for validity or reliability.

## **Procedure**

The collection process used to obtain data involved direct contact with both lacrosse teams. A survey was developed for soliciting student athlete responses in order to determine individual issues related to competing on synthetic turf. Each student athlete was provided a separate subjective survey, concentrating on individual academic status, experience, position played, physical condition, speed, agility, skills, endurance level, injuries, and playing surface preference. There were 9 members of the women's team and 12 members of the men's team given the same 8-question survey to produce qualitative data. With permission from the athletic director, each head coach was contacted and informed of the synthetic turf survey. A designated date and time was determined by the coaching staff and researcher to meet the team immediately following a practice. The women's team surveys were handed out on March 12, 2015, and the men's team surveys on March 17, 2015. Each athlete completed and returned their anonymous survey to the researcher prior to leaving for the locker room.

## CHAPTER IV

### RESULTS

The purpose of this study was to determine the impact of synthetic turf on the men's and women's lacrosse teams at Goucher College by examining the overall team records and student athletes' perception through an eight-question survey.

The data that was collected from the overall team records for both teams. The men's team showed no significant impact on the number of wins and losses with the installation of turf. The men's team had a t-test of  $t(9)=3.04$ ,  $p=.55$ . The women's team has a significant negative impact on the number of win and losses after synthetic turf was installed. The women's team had a t-test of  $t(9)=3.04$ ,  $p<.05$ .

The survey asked the athletes to consider their current and past experiences playing lacrosse and identify personal injuries and degree in change of performance playing on artificial turf. These components assessed severity of injury sustained through missed practices, missed games, season or career-ending injury, concussion, and lower/upper body injury. The other focus assessed personal perception of performance through speed, performance, agility, endurance, skills, anticipation of ball movement and anticipation of player movement.

Of the 21 participants from men and women's lacrosse team, nine were female and twelve were male. Freshmen completed the most surveys making 33% of the total, following sophomore 29%, junior 19% and senior 19%. The average number of years played was 3 to 5 years. The next level of experience was 8 or more years, making up 24%. The majority of the participants were defense players (43%), followed by attack (29%), midfield (24%), and goalie (5%).

Analysis of the number of heat related events and injuries revealed that none of the participants experienced heat stroke while only 24% experienced heat exhaustion or dehydration (24%).

Question 6 of the survey addressed the severity of an injury experienced by the athlete as a member of the lacrosse team. No athletes experienced career ending injuries. The investigation in the length of recovery time following an injury showed that 48% missed practice two or more days. Among the 48% of the athletes that missed practice two or more days, 19% of athletes had two separate occurrences, 14% of the athletes had three or more occurrences, and 14% of the athletes had one occurrence. As of March 2015, 57% of the surveyed athletes never missed a competition due to an injury. The most prevalent was 24% of the athletes who missed one game. However 10% of the athletes missed three or more games due to personal injury.

When addressing the type of injuries, the survey had three categories: concussion, upper body, and lower body. The most prevalent of the injuries involved the lower body (29%), including 14% with two injuries and 14% with three or more injuries. Among the participants who experienced a concussion, 5% had experienced three or more concussions. The athletes who had an upper body injury had two separate events (10%).

The majority of respondents (53%) said that turf improved their agility, while 48% indicated that it had a moderate impact on their performance. Endurance experienced the least impact with 33% neutral/none and 33% minimal increase.

The final piece for the evaluation of performance was very specific. This included ability to anticipate ball movement and player movement. Forty-two percent of respondents indicated that turf affected ball movement while 30% indicated a neutral impact.

From the data, minimal statistical significance was obtained. Table 1 below presents descriptive statistics for the categories used to determine Ball Movement and Gender. The statistics were the gender of the athlete, female and male, and their responses to the survey for speed. The men were more impacted by ball movement than women. There was a significant difference between the perceptions of males and females on the impact of turf on ball movement,

$X^2(3, 21)=9.20, p<.05$  (Table 1). There was no significant difference in perceptions of males and females on impact of turf on speed,  $X^2(3, 21)=4.28, p=.23$  (Table 2). There was no significant difference between the perceptions of males and females on impact of turf on endurance,  $X^2(3, 21)=7.23, p=.06$  (Table 3). Figure 1 has the field type preferences for males and females.

Table 1

*Ball Movement and Gender Percentage*

Impact of Turf on Ball Movement	Gender		Total
	Female	Male	
Significant Increase	22.2%	42.9%	43%
Moderate Increase	44.4%	44.4%	29%
Minimal Increase	0.0%	0.0%	14%
None	33.3%	33.3%	14%

Table 2

*Speed and Gender Percentage*

Impact of Turf on Speed	Gender		Total
	Female	Male	
Significant Increase	22.2%	42.9%	10%
Moderate Increase	44.4%	44.4%	43%
Minimal Increase	0.0%	0.0%	33%
None	33.3%	33.3%	14%

Table 3

*Endurance and Gender Percentage*

Impact of Turf on Endurance	Gender		Total
	Female	Male	
Significant Increase	22.2%	42.9%	10%
Moderate Increase	44.4%	44.4%	24%
Minimal Increase	0.0%	0.0%	33%
None	33.3%	33.3%	33%

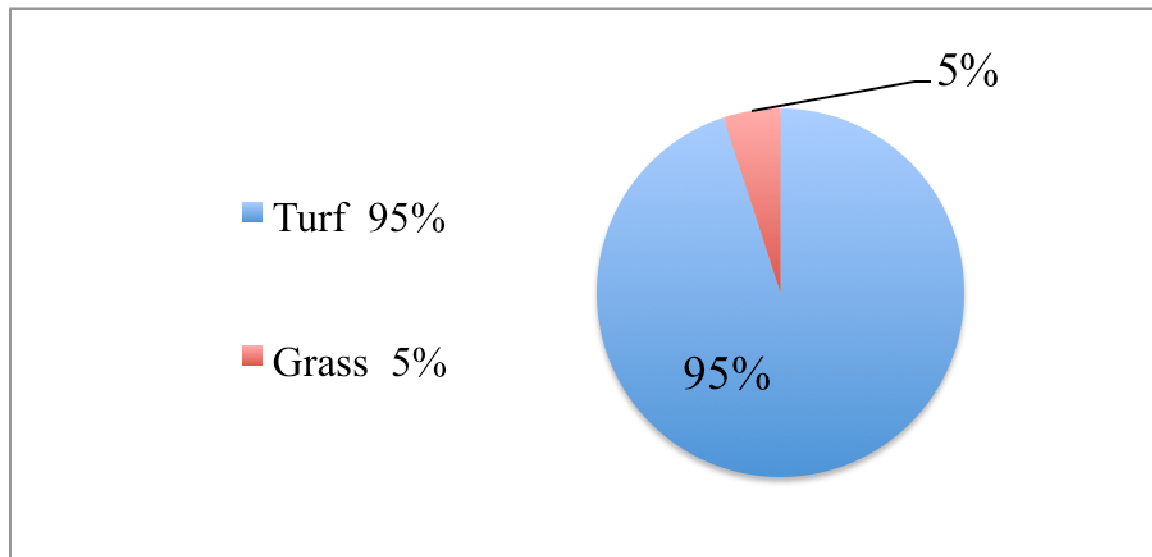


Figure 1

*Preference for Synthetic Turf or Grass Field Surfaces*

## **CHAPTER V**

### **DISCUSSION**

The purpose of this study was to determine if the implementation of synthetic turf at Goucher College impacted the performance of the men's and women's lacrosse teams through review of overall team records and examination of athletes' responses and their self-perception of performance, both prior to and after installation of synthetic turf. The null hypothesis was not supported, as there were two areas of focus that demonstrated significance. For the women's team, there was a negative impact on team performance after synthetic turf was implemented after examination of the overall team record. Based on survey results, both men's and women's lacrosse teams reported positive change when anticipating ball movement following the installment of turf.

#### **Implications of Results**

The results of the study counter the null hypothesis for the women's lacrosse team according to reported changes in their performance. The men's team confirmed the null hypothesis. No previous studies have been conducted on lacrosse teams; however, results from other sports teams have been inconclusive on the impact synthetic turf has on team performance. The results indicate minimal impact for both teams when examining the study's multiple criteria for assessing team performance.

The women's lacrosse team has had an increase in the number of losing seasons since synthetic turf was installed. The team's record contradicts the positive self-perceptions from the athletes' survey results. Every survey questionnaire contained positive responses for all categories of performance, each ranked as minimal increase, moderate increase and significant increase. Although the study's results support the athletes' primary choice of synthetic turf as the preferred surface on which to practice and compete, the study's results present a different picture. For the



men's lacrosse team, the turf field was also greatly preferred; the impact on the team's success in performance was unchanged.

### **Theoretical Consequences**

The theoretical consequences of this study include considerations regarding the length of time the head coach remained at the school, the amount of effort spent on recruiting new players, the type of preparation provided during preseason and in-season practices from coaches and individual athletes, and the level of competition within the division. Although the desire to participate and compete increased with synthetic, the results from this study suggest that in some instances, specifically the women's team, the team performance does not demonstrate consistency or positive impact throughout the time period of synthetic turf usage.

### **Threats to the Validity**

There were several factors that could have affected the validity of the results from this study. The first threat to the validity of the study relates to differential selection. The participants selected for the study were preselected members of the men's and women's lacrosse teams for Goucher College. While the athletes share the same sport, commitment, and dedication, they experience playing on surfaces differently. This is a direct threat to the design as there was no random assignment to the groups that could have prevented the differential selection from occurring by making the groups the same. Breaking down the lacrosse teams would have placed stronger emphasis on individual performance rather than team performance. Any differences observed in the study between the two separate teams may be attributed to the characteristics of the athletes in the different groups rather than the treatment group. Therefore, one can conclude that the observed differences between the groups after synthetic turf installation are due to field type rather than the athletes.

Since the installation of synthetic turf at Goucher College in the summer of 2009, all of the members of each lacrosse team consisted of new athletes and new coaches. At the collegiate level, athletes are only qualified to compete for four years. As a result each team is continuously growing and changing with one season never repeating itself. Teammates, coaches, opponents, and rules change. These differences create both stronger and weaker teams that impact overall team performance even without the contributing factors of synthetic turf. This unintentional concern cannot be prevented. The teams playing on grass fields prior to the 2009 installation were not the same teams competing five years later on synthetic turf.

The final threat to the validity of the study was data collection consistency. The study was based on the overall team record for men's and women's lacrosse programs. The statistical data was collected only on the number of wins and losses experienced each season. No distinction was made if the team played on a synthetic turf field or grass field. There are currently teams in the Division III conference still utilizing grass fields as the primary playing surface. Also the data collected did not reflect only the game results for competitions taking place on Goucher College's athletic turf field. Instead the scores were taken based on the entire season.

### **Connections to Previous Studies and Existing Literature**

There were no clear connections to existing literature linking the impact of the installation of synthetic turf with men's and women's lacrosse team performance. As the number of studies conducted on synthetic turf increases, so are samples of athletes' responses, providing more data to validate statistical conclusions. Numerous manufacturers, independent researchers, colleges, universities, and athletic directors have conducted cost-benefit analysis on synthetic turf and grass fields (Berry, 2012). Funding is critical and therefore a limitation for installing synthetic turf. The ongoing studies address and assess three critical areas of concern: the impact of heat (McNitt & Petrunak, 2004), resulting physical injuries (Roberts et al., 2014), and the impact of the playing

surface on team performance (Ford et al., 2006). Researchers have not consistently concluded a positive or negative connection between turf and athlete performance.

### **Implications for Future Research**

The findings in the study suggest a minimal overall impact on performance for both lacrosse teams at Goucher College after the installation of synthetic turf in 2009. With the women's team reflecting a negative impact on overall record performance, the only impact on performance among the seven categories in the survey showed an increase in ability to anticipate ball movement. Future research on this topic could include a longitudinal study of performance for the specific sport of lacrosse, targeting a larger and more complex data collection in areas involving heat injuries, physical injuries, agility, endurance, and skills. This study only viewed the perspectives of the individual athlete through a survey instead of completing trials and tests for each category. In the future, the researcher could obtain assistance from team athletic trainers to collect accurate data regarding type of injury and length of recovery time. The graduate assistants for each team could assist in conducting trials and tests for assessing changes in performance.

As collegiate sports continue to dominate the use of synthetic turf as the playing surface for field hockey, soccer, and lacrosse teams, additional focus needs to be given to the impact of turf on each individual sport. Currently Goucher College has a multipurpose field allowing all three sports teams to compete on the field. Club sports and intramural programming also use the facility at night. Each sport demands different needs from the playing surface and perhaps needs a specific synthetic, more technologically advanced turf to accurately benefit the players. A study would need to be conducted to challenge the use of multipurpose turf to fields designed for the specific sport.

With the continued increase in studies focusing on synthetic turf, new evidence from data collected is emerging. Currently the rubber particles found embedded in the layers of the turf field

are causing health professionals and coaching staff to question if these particles are causing cancer in soccer goalies. The concern for the safety and wellbeing of the players must be immediately studied and addressed. Although this study would need to be conducted at a larger scale than the researcher's capabilities, it is of great concern for turf companies, the NCAA, and the athletes to understand the positive and negative impacts of this new technology.

### **Conclusion and Summary**

The null hypothesis for this study stated there would be no significant difference in the overall men's and women's lacrosse team performance with the installation of the synthetic turf field. The results of the study demonstrated significant negative effects on the women's team. The study's results supported the null hypothesis for the men's team when examining the overall team record five years pre and post synthetic turf in 2009. The results of the self-perception of performance survey demonstrated a positive impact on the ability to anticipate ball movement for both teams. The results of the study suggest a need to conduct further trials to examine the continued effect of synthetic turf on team performance. Assessments need to be conducted on the statistical data of agility, speed, endurance and skill. Future research should provide opportunities for more accurate recording of statistics by using a team of statisticians to collect individual athlete's performance data.

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