PERCIEVED ANKLE INSTABILITY AND TRUE INSTABILITY IN MALE AND FEMALE D1 COLLEGIATE CHEERLEADERS

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PERCIEVED ANKLE INSTABILITY AND TRUE

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COLLEIGATE CHEERLEADERS

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Title of Study: PERCIEVED ANKLE INSTABILITY AND TRUE INSTABILITY IN MALE AND FEMALE D1 COLLEGIATE CHEERLEADERS

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Abstract: **Context:** Ankle sprains are a common injury for athletes and other activities such as cheerleading. Previous authors have presented evidence that certain shoes can significantly impair the individuals' sense of proprioception while wearing shoes that can potentially lead to ankle sprains. **Objective:** The purpose of this study was to compare perceived stability and the overall stability of cheerleaders' ankles barefoot and while wearing cheer shoes. **Design:** Randomized Cross Over Design**Setting:** Clinical Setting **Patients/Participants:** 30 Division 1A Cheerleaders, 14 males, and 16 females with no history of head trauma or ankle injuries within the past month. **Interventions:** Participants were randomly assigned to start barefoot or with shoes on for a one time test on the Balance Biodex System. **Main Outcome Measure(s):** Each participants perceived ankle stability was determined using the Cumberland Ankle Instability Tool (CAIT), while overall ankle stability was assessed with shoes on and shoes off while standing in a series of conditions including dominant single leg stance, non dominant stance and both legs on the Biodex Balance System. **Results:** A significant difference was found ($p \leq .05$) with shoes on versus without shoes in all stances. The relationship between the participant's perceived ankle stability and actual overall stability scores lacked a significant correlation. Males were also found to have better overall stability with shoes on and off while standing single leg dominant. **Conclusion:** Cheer shoes actually provided more stability rather than instability especially for males. The Cumberland Ankle Instability Tool was not a applicable measurement for this study as the results do not support its use with this population. The findings from this study show that ankle instability in cheerleaders needs further investigation into the potential cause of ankle instability.

Key Words: ankle injuries, cheerleading, shoes, instability

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The evolution of cheerleading has changed greatly from originally standing on the sidelines leading cheers, to being a competitive sport that includes gymnastic skills in a 2 minute long routines. [1, 2] Cheerleading has been reported to originate at the University of Minnesota in 1898.[2] Three decades ago their sideline cheers included skills of basic maneuvers including toe touch jumps, the splits, and clapping.[3] Today cheerleading has grown into high demanding skills of complex gymnastic maneuvers that include; gymnastic running tumbling, standing tumbling, partner stunts, pyramids, and basket tosses .[3] Often times it is a year round competitive activity that includes many participants spanning almost all age groups. Presently, collegiate cheerleading consists of females standing on shoulders or hands of other members of the squad, and being thrown into the air executing a series of twists and rotations otherwise known as stunts.[4] For these athletes to perform properly and safely, they must possess many physical traits of; strength, power, muscular endurance, balance, and agility. If stunts are not performed correctly this can lead to potentially catastrophic injuries due to the cheerleader being thrown in the air. Collegiate cheerleading has been associated with 31 catastrophic injuries and accounts for 70.5% of all in female catastrophic sports injuries.[5] The US Consumer Product Safety Commission reported an estimated 4,954 emergency room visits from cheerleaders back in

1980, which then increased to 26,786 in 2007.[5] Of the 26,786 visits, 221 cheerleaders were hospitalized, 217 were treated and transferred to another hospital, and 64 were held for observation.[5] Shields and Smith[3] reported that in the 5 to 18 years of age group, injuries increased 110% from 10,900 injuries in 1990, to 22,900 injuries in 2002. They believe that the greatest risk of injury was with partner stunts and pyramids.[3] Results demonstrated that cheerleaders were hurt 24% of the time performing basing or spotting, 15% due to failure to complete a maneuver, 15% tumbling, and 14% from falls. [3] Interestingly, 83% of injuries occurred during practice rather than during an athletic even or competition, and the most common injuries were, sprain of ankle 15%, neck 7%, lower back 5%, knee 5%, and wrist 4%. [6, 7] Due to few epidemiologic studies of cheerleading injuries in the literature, it is thought that the under reported injury rates for cheerleading are less, compared to other sports due to cheer injuries being more severe.[1] Since cheerleading is not part of the NCAA, there are no mandatory reporting systems or injury database for cheer injuries, therefore all that data is not included in the NCAA Injury Surveillance System.

According to Fong and colleagues[8] ankle sprains are the most common sports injuries and accounts for 10-30% of all sports injuries.[9] This may account up to 80% or even 100% of injuries to the ankle in some sports such as; squash, soccer, figure skating, rugby, volleyball, and cheerleading, although the percentage of ankle injuries in each sport differs. [9, 10] Data collected from 1979 to 1987 reported the percentage of ankle injuries was as high as 74% for softball, 76% for racquet sports and football, 77% for weight lifting and dancing, 79% for basketball, 82% for volleyball and 45% for cheerleading.[9] The most common mechanism of an ankle sprain 85% of the time is inversion, involving the lateral ligaments, capsule, and muscular support system. [11] Regarding inversion ankle sprains the anterior talobfibular ligament was the most often damaged during activity.[8, 11, 12] The second most injured ligament in inversion ankle sprains is the calcaneofibular ligament, which can be associated with other ligament damage. Inversion ankle sprains can occur during foot contact on landing or locomotion associated with either unanticipated foot placement on an uneven surface or an inappropriate positioning of the foot in space before contact with a surface.[11] Humans perceive the amplitude of inversion to be less than it actually is during walking or running, but have the muscle support that is adequate for the perceived stepping process, but inadequate for the actual foot position during contact. Robbins believes that impaired proprioception results in the inadequate use of anticipatory muscular movements under dynamic conditions when there is not enough time to respond to the loading phase that can lead to ankle injuries.[11]

Purpose of the Study

Due to ankle sprains being the most prevalent injury for cheerleading it is theorized that shoes are an external factor for ankle sprains. The purpose of this study was to compare the overall stability of cheerleaders' ankles wearing cheer shoes versus not wearing shoes. This information would help to show if cheer shoes cause the ankle joint to be more inverted more often during activity.

Hypotheses

The following are the null hypotheses which were examined in this study:

Ho1

There will be a significant difference in overall stability with cheer shoes on and off between non dominant leg and dominant leg standing.

Ho2

There will be a significant difference between in overall stability with cheer shoes on and off between male and females.

Ho3

There will be positive correlation between Cumberland Ankle Stability Tool and Overall Stability.

CHAPTER II

REVIEW OF LITERTURE

Cheerleading has a high demand on the musculoskeletal system with the gymnastic maneuvers . This includes the potential to fall from a higher height than most athletes, or possibly collide with other team members which can cause a spectrum of injuries. Although there is a lack of controlled studies investigating the etiology of cheerleading injuries, there have become several theories. Robbins and Waked offer that ankle sprains occur due unanticipated foot placement on an uneven surface or even inappropriate positioning of the foot in space before contact with a surface.[11] Additionally it is believed that the landing technique of female athletes can lead to ankle sprains, and depending on the landing patterns, this can affect how the body absorbs energy and force.[10] A flexed position of the hip, knee and plantar flexion of ankle joints can allow the muscles rather than the joints to help absorb most the ground action force. Females tend to dissipate forces in more of a erect position rather than males, making the females have more energy absorption from their ankle plantar flexor muscles.[10] Robbins and Waked[11] investigated the cause ankle sprains in which they believed the majority of ankle sprains come from individuals having a different awareness with shoes on rather than shoes off causing the proprioception of the foot and ankle complex to accommodate differently.[11] It was found while screening individuals from under-developed countries who had played sports barefoot and had no previous medical history of ankle sprains. The main cause of inversion ankle sprains was found to be different but similar across sports. In volleyball and basketball, ankle sprains occur due to athletes landing on other athletes feet. For gymnastics, inversion ankle sprains occurred during the dismount from an apparatus or performing floor exercises; actions which involve landing from heights with little to no significant lateral movements.[11] Ankle sprains sustained during ballet were due to from landing from jumps while in the demi pointe position which a dancer support all their bodyweight on the ball of their foot. In regards to ballet and gymnastics there was no significant lateral body movement and the data is consistent with the theory that poor proprioception due to foot wear causing inversion ankle sprains.[11] This leads into the theory that footwear affects an individual's perception of the position and orientation of the foot , ankle and leg complex, under quasi-static and dynamic conditions.[13] It was found that young men, while standing, can have a error ranging from 1.96^{o} and 3.97^{o} in their foot positioning while barefoot, and while wearing athletic shoes, the position error when walking was 1.55^{o} and 5.99^{o}.[13] It was thought that foot position error under dynamic conditions came from the thickness and hardness of the soles of the shoes. A 3.83^{o} position error was recorded for the thinnest and hardest sole, while the thickest and softest sole had a position error of 8.41^{o}.[13] The correlation with position was r=.901 with the maximum amplitude of supination allowed by footwear when bearing weight. With softer soles producing greater supination, it was found that supination is known to vary proportionally with the sole hardness. This suggests that the amplitude of frontal plane movement caused by compression of the sole materials will account for the differences in foot position error between shoes with different sole construction.[13] Coincidentally, Robbins et al., found that foot position awareness and proprioception is significantly impaired by wearing shoes. They concluded that the loss of plantar tactile sensitivity from the shoe sole provided a faulty interface between sensory surface of the plantar surface of the foot and the ground.[13]

There have been several studies conducted to test the theory of shoes being an external force that causes ankle sprains by influencing lower limb muscle activity. One study, tested the influence of shoes on lower limb muscle activity, and proposed that shoes predispose the wearer to inversion ankle injury of the lateral ligaments that can then affect the protective everting lower limb muscle response. Kerr et al., recruited 62 subjects that stood on a footplate while the plate inverted both feet at 0, 10, and 20 degrees. The two footplate tilting platform was connected to a computer while a portable Electromyography (EMG) was connected to the peroneus longus muscle of each lower limb.[14] Software simultaneously performed 2 sequences of left inversion and right inversion with shoes on and shoes off. Each test sequence was done twice for 5 seconds each.[14] Results demonstrated that foot inversion corresponded with an initial peak in the EMG amplitude of the ipsilateral peroneus longus, then a sustained contraction remained constant for the last 5 seconds during the inverted position.[14] The peak and sustained contractions were greater with shoes on compared to barefoot. There were no significant differences between cycles, test sequences or sides and no interactions of these factors with other main effects were found.[14] No significant differences between the reaction times measured with barefoot or with shoes occurred as well with no significant differences between reaction time, peak contraction and average amplitude for each footplate inversion. All peak EMG signals were significantly greater with shoes on.[14] Researchers concluded that wearing shoes does have an influence on lower limb muscle activity, specifically with the peroneus longus muscle during sudden foot inversion. To understand the reasoning behind this, while wearing shoes the lever arm to the ground and reaction force is increased compared to being barefoot, which then making the moment of external inversion greater.[14] To maintain equilibrium while one foot is inverted upon the platform, the moments of external and internal eversion must be kept equal. Then when the everting muscle force in shoes has the same length of lever arm at the subtalar joint as when barefoot, the everting muscle force in shoes then must increase to maintain that equilibrium. The increased force while in shoes correlates to the significant increase in the EMG signal amplitude of the everting peroneus longs muscle. Therefore, the increased muscle activity while wearing shoes may be a intrinsic mechanism to counter the increased tendency to invert the foot and cause ankle sprains.[14]

Proprioception and lower limb muscle activity were found to decrease while wearing shoes, but does a type of shoe provide more protection or cause more ankle instability? Milgrom et al.[15], randomly assigned male military trainees to groups wearing three-quarter height basketball shoes to train in while the other half wore lightweight infantry boots. [15, 16] Participants had an 18% incidence of lateral ankle sprains during basic training, and there was no significant difference between the trainees with basketball shoes on and trainees with infantry boots however, there was a positive correlation with the height and weight distribution with ankle sprains found during this study.[15]

Additionally research has investigated football shoes and the effects of high top and low top shoes on ankle sprains. Ricard et al.[17], tested 20 male subjects on an inversion platform that rotated 35^{o}. The subjects were tested in a neutral plantar flexion dorsiflexion angle.[17] A camera was used to record the motion of the subject as the subject put all their weight on the leg being tested for a total of five sudden inversion drops. Results found that the subjects wearing low top shoes had an inversion of 42.6^{o} while subjects with high top shoes on had an inversion of 38.1^{o}, thus highlighting a significant difference in inversion between the two shoes.[17] The high top shoes significantly presented a decrease in the maximum rate of inversion by 100.1^{o} when compared to low top shoes.[17]

Ashton-Miller and et al.[18], set out to identify the most effective method to protect an ankle during weight bearing inversion. It was determined that it is unknown how much protection any protective devices offer compared with the resistance developed at footstrike when the ankle is already resisting further inversion while in near maximal inversion.[18] Measurement of maximal isometric eversion of young males while weightbearing at a 15^{o} angle of inversion and maximal overall eversion of the ankle while taped or in one of three different ankle orthoses worn in a low top or a three quarter top basketball shoe.[18] The tests were done at near maximal inversion of 15^{o} with either a 0^{o} or 32^{o} ankle plantar flexion to mimic an ankle orientation just prior to an ankle injury.[18] The 32 degree condition was to determine the amount the evertor muscles may provide greater resistance to large external inversion moments between, three quarter top basketball shoes, tape, or ankle orthoses at near maximal inversion. Results revealed that low top shoe with no tape or orthoses had up to six times more evertor muscle resistance to inversion moments and the three quarter top shoe had three times larger evertor resistance during inversion moments.[18] When evertor muscles are active, there is a three time greater chance of an ankle injury not happening compared to tape and or orthosis combined with a high top shoe. When the evertor muscles are not active, results showed that a high top shoe will increase resistance to inversion.[18] They found that pre-contracted and strong evertor muscles appear to be the most effective protection against ankle injuries.[18]

Curtis et al.[19], asked 22 different athletic trainers from different collegiate divisions to record the type of shoe, practice and game exposures, and lateral ankle injuries for a total of 141 male and 89 female collegiate basketball players. Recording occurred via a survey was posted online for the athletic trainers to record lateral ankle sprains and total exposures on a weekly basis for an entire basketball season.[19] Other information included in the survey was the type of shoe, sex, and the setting the sprain occurred in. Results showed that there were no differences between collegiate basketball players wearing cushion columned shoes versus those wearing noncushioned column shoes. The athletes that wore the cushioned column shoes sustained 41 ankle sprains, while those in non cushioned shoes sustained 27 ankle sprains.[19] The athletes that wore cushioned column shoes had an incidence of ankle sprains of 1.33 per 1000 exposures while noncushioned column shoes had an incidence of 1.96 per 1000 exposures.[19]

Pearson and Whitaker[20] investigated dance shoes, comparing the pressure profile of demi-pointe shoe with those of soft and pointe shoes while also examining current practices in regards to the use of demi pointe shoes helping to prevent overuse injuries.[20] Results demonstrated a significant difference in pressure between barefoot and pointe shoes, and soft and pointe shoes.[20] There was no significant pressure difference found between demi pointe and soft shoes, meaning that demi pointe shoe help provide a transitional stage in pressure between soft shoes and pointe shoes. A progression can be seen from soft to demi pointe to pointe shoes with having more significant pressure values than the other conditions.[20] Additionally it was found that demi pointe shoes have greater plantar pressures than with no shoes due to the stiffness of the shoe that can lead to restricted contact area.[20]

CHAPTER III

METHODOLOGY

Upon approval from University Internal Review Board, 30 Division 1A University athletes volunteered to participate in the study. Fourteen males, (weight 180.50lbs±10, height 67.50in±10, age 20.50±3) and 16 females, (height 60.50in±10, weight 100.50lbs±10, age 20.50±2) that were members of the large coed, all girl, or small coed teams. A survey identifying ankle injury history was provided in combination of participant along with the Cumberland Ankle Instability Tool (CAIT) to determine each individuals' self reported sense of ankle instability (Figure 1). The CAIT is a questionnaire that includes nine scaled questions that generates a score from 0 to 30. The higher the score is the higher the perceived ankle stability, the lower the score the lower the perceived ankle stability. To help reduce the risk of data and error, the participants could not have suffered any form of head trauma which could influence their memory or reporting behavior, or experienced an ankle injury to either extremity in the past month. Participants were required to wear Nfinity™ brand cheer shoes for data collection with original shoe inserts and no supportive devices were worn during testing.

Data collection consisted of the participant standing on the Balance Biodex System (Biodex, Inc, Shirley, NY) for three trials of 20 seconds each with a three second rest period between each trial. A random cross over design was utilized to test each subject with shoes on and off while standing on both legs, single dominant leg and single non dominant leg at random. After the first three trials were complete of either with shoes on or off, subjects immediately stepped off the Biodex and took off shoes or either put them on and started the next three trials. The program design used on the Balance Biodex was the Postural Stability & Clinical test of sensory integration protocol, which included the participant standing in a static state on the device platform where it recorded the movement or sway of the body and recorded the Overall Stability. The program design does provide the ability to change the number of trials and rest time in between trials. The amount of trials used was to gain enough information to compare and the amount of rest between trials was chosen to mimic regular activity of the subject while wearing shoes. The Biodex system provided coordinates on where to place the heel and first metatarsal that was the most appropriate for testing for the height of the participant (Figure 2). While the participant was standing on the Balance Biodex system plate the participants arms were instructed to be placed by their side and stare at the middle of the screen (Figure 3 & 4). A curser on the screen provided the participant baseline information as to where pressure was being applied to the plate. Once the test began, the curser disappeared and the system recorded any postural deviation as it pertains to foot stance. A total of three trials were conducted for each of all stances shoes on and off.

CHAPTER IV

FINDINGS

The primary purpose of this study was to test overall stability of cheerleaders ankles while wearing shoes versus not wearing shoes while on the Balance Biodex System. Data was collected and analyzed into SPSS 22 (Armonk, NY) for analysis. Means and standard deviations were calculated, independent t-tests were conducted to compare differences between conditions and an ANOVA was performed to determine differences in these same conditions as it relates to gender. Means and standard deviations can be found in Table 2. When each dominant and non dominant stances were tested with shoe and no shoe on, a significant difference was found ($p \leq .05$) with shoes on compared to no shoes in all stance conditions of No Shoe Single Dominant (NSSD), No Shoe Non Dominant (NSND), No Shoe Both Legs (NSBL), Shoe Dominant (SD), Shoe Non Dominant (SND),and Shoe Both Legs (SBL). Participants were the most stable standing on both feet with shoes on (Table 1)(Table 2). Overall stability by gender was tested and it was observed a significant difference of ≤ .05, indicating that males have better overall stability in NSSD, and SD (Table 3). The higher the scores on overall stability the less stable the participant is, while the lower the score the more stabile the participant is.[21]

Participants perceived ankle stability was assessed using an electronic version of the Cumberland Ankle Instability Tool (CAIT). A correlation between CAIT and overall stability in all stances for no shoe and shoe on trials was also performed. Results found that there was neither a positive nor negative correlation between CAIT and Overall Stability (Figure 5 and Table 4).

CHAPTER V

CONCULSION

DISCUSSION

Cheerleading has a high demand on the musculoskeletal system with the gymnastic maneuvers that are performed. This includes the potential to fall from a higher height than most athletes, or possibly collide with other team members which can cause a spectrum of injuries. Although there is a lack of controlled studies investigating the etiology of cheerleading injuries, there have been several theories. This study sought to identify contributing facts as to why ankle sprains are so prevalent with cheerleaders and if cheer shoes are an external force that causes ankle instability. Most ankle sprains are caused by stepping on a foot or even landing on the medial side with something unexpected under the foot.[17] Most researchers would agree that shoes give limited support to an ankle during inversion, and certain type of shoes such as high top basketball shoes, are constructed to help reduce the risk of ankle inversion injuries. Robbins[13] believed that impaired proprioception resulted in the inadequate use of anticipatory muscular movements under dynamic conditions when there is not enough time to respond to the loading phase that can lead to ankle injuries.[11] This leads into the theory that footwear affects an individual's perception of the position and orientation of the foot , ankle and leg complex, under quasi-static and dynamic conditions.[13]

This study determined instability by having the subjects stand on the Balance Biodex System on a static plate with shoes on and shoes off at randomization. The Balance Biodex System has a circular platform that can freely move about an anterior-posterior and medial-lateral axes, but can also vary in stability. A static state was chosen for the participants to stand on instead of a moving state to record the stability of the ankle and how much unanticipated movement. The system calculates overall stability by standard deviations assessing fluctuations around the zero point rather than around the group mean.[22] Previous research showed intratester reliability range of .70 to .82 for overall stability index, which is comparable with the data gathered in this study.[22] Tropp et al.,[23] investigated single leg stance on the balance biodex, and was able to demonstrate that individuals with functionally unstable ankles have a greater dispersion in center of pressure during single leg stance. From this it could be reasonable to think that the amount of time spent in zones or the quadrants may reveal proprioception disabilities that can be associated with ankle or lower extremity pathologies.[22] Kerr et al., tested the influence of shoes on lower limb muscle activity, and proposed that shoes predispose the wearer to inversion ankle injury of the lateral ligaments that can then affect the protective everting lower limb muscle response. [14] Therefore, the increased muscle activity while wearing shoes may be an intrinsic mechanism to counter the increased tendency to invert the foot and cause ankle sprains. [14]

Shoe and Bracing Influence:

This specific Nfinity™ cheer shoe was chosen due to the availability of the same shoe being endorsed by team cheerleaders, along with it being a widely used cheer shoe. It was hypothesized that cheer shoes do not provide enough stability to keep the ankle complex stable due to lack of supportive material of the shoe but this study, demonstrated more controlled ankle stability with cheer shoes on while standing on the dominant leg. Previous research conducted helped support the rationale behind the different types of shoes and the prevention of ankle injuries.[15, 17-20, 24] These studies offered conflicting results from the types of shoes studied but could provide insight as to why the participants were more stable with shoes on. Another prediction that could possibly be made to explain better stability with shoes on is the participants were used to wearing the shoes more often than standing barefoot. Additional research investigated football shoes and the effects of high top and low top shoes on ankle sprains. Results found that the subjects wearing low top shoes presented with an inversion of 42.6^{o} while subjects with high top shoes on had an inversion of 38.1^{o}, thus highlighting a significant difference in inversion between the two shoes.[17] The high top shoes significantly presented a decrease in the maximum rate of inversion by 100.1^{o} when compared to low top shoes.[17] The results of this study may provide more insight as to why certain shoes can provide better stability than other types of shoes.

Ashton-Miller and et al.[18], set out to identify the most effective method to protect an ankle during weight bearing inversion. It was determined that it is unknown how much protection any protective devices offer compared with the resistance developed at footstrike when the ankle is already resisting further inversion while in near maximal inversion.[18] Results indicated that low top shoe with no tape or orthoses had up to six times more evertor muscle resistance to inversion moments and the three quarter top shoe had three times larger evertor resistance during inversion moments.[18] This research can help fuel further studies into the prevention of ankle sprains for cheerleaders by providing methods of ankle stability to reduce the number of ankle sprains.

Cumberland Ankle Instability Tool:

The Cumberland Ankle Instability Tool was used to assess participants perceived ankle stability by a series of questions that intend to compare contralateral ankle and identify different grades of severity of the instability.[25] The average of CAIT scores was 22.57, with a range from low=5 to high=30. Scores ≥28 indicate stability while scores ≤23 indicate functional ankle instability.[26] The CAIT is a reliable tool to measure severity of perceived functional ankle instability.[25] However, the perceived ankle stability of the subjects in this study when compared to actual stability lacked a significant correlation. The reasoning behind there being no significant correlation between the subject's ankle stability and actual stability could be due to numerous factors. To compare the outcomes of this studies correlation, a similar study using CAIT with ankle instability by de Noronha et al.,[26] concluded that CAIT did not challenge the participants in exactly the same activities listed in the tool therefore making it seem there is no generalized deficit in performance.[26] Other reasons include, the subjects not truthfully reporting CAIT correctly or just simple the subject having better stability than perceived. Even though the CAIT has been considered a reliable tool for most research but interesting enough CAIT was not a valid tool in the measurements of this study. This warrants for further research in the use of the CAIT.

Limitations and Future Research:

Although this study provides further evidence as it relates to ankle stability and perception further studies needs to be performed investigating the effects of cheerleading shoes and ankle injuries. A shoe based force plate could be used to analyze the impact of the foot during dynamic movements of a cheerleader. A comparison study could be investigated between regular tennis shoes versus cheer shoes using the Balance Biodex and analyzing ankle instability. Also, further investigation of overall stability in the medial and lateral stance to analyze which position the participant happened to stand in the most while on the Balance Biodex device. Additionally, an increased subject pool would need to be used as well to further investigate the finding of males having better ankle stability than females. Lastly, the effects of external devices on ankle stability while in cheerleading shoes could also be studied for preventative use of ankle injuries.

Conclusion

A significant difference was determined between the conditions of wearing shoes and shoes off testing of all dominant and non dominant stances with the shoe on. Therefore, participants were able to demonstrate better stability with shoes on while standing on the dominant leg compared to standing barefoot. Males showed to have better stability with shoes on and off versus females while standing on dominant leg. However, there was also no correlation between the participants perceived ankle stability given in the CAIT survey compared to the participants' actual overall stability.

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APPENDICES

Figure 1: Qualtrics Survey

Personal History

How old are you? ___________

What gender are you? Male Female

How many years have you been a D1 collegiate cheerleader? _________

How long have you been competing as a cheerleader at any level? ___________

How long have you been tumbling? ______________

Ankle Instability Instrument

Have you ever sprained your ankle? Yes No

Have you ever seen a doctor for an ankle sprain? Yes No

If yes how did the doctor categorize your most serious ankle sprain? Mild Moderate Severe

Did you ever use a device (such as crutches) because you could not bear weight due to an ankle sprain? Yes No

If yes, in the most serious case, how long did you need to use the device? 1-3 days 4-7 days 1-2 weeks 2-3 weeks >3 weeks

Does your ankle ever feel unstable while walking on a flat surface? Yes No

Does your ankle ever feel unstable while walking on uneven ground? Yes No

Does your ankle ever feel unstable during recreational or sport activity? Yes No

Does your ankle ever feel unstable while going up stairs? Yes No

Does your ankle ever feel unstable while going down stairs? Yes No

Cumberland Ankle Instability Tool

Please tick the ONE statement in EACH question that BEST describes your ankles.

	LEFT	RIGHT	Score
1. I have pain in my ankle			
Never	□	□	5
During sport	□	□	4
Running on uneven surfaces	□	□	3
Running on level surfaces	□	□	2
Walking on uneven surfaces	□	□	1
Walking on level surfaces	□	□	0
2. My ankle feels UNSTABLE			
Never	□	□	4
Sometimes during sport (not every time)	□	□	3
Frequently during sport (every time)	□	□	2
Sometimes during daily activity	□	□	1
Frequently during daily activity	□	□	0
3. When I make SHARP turns, my ankle feels UNSTABLE			
Never	□	□	3
Sometimes when running	□	□	2
Often when running	□	□	1

When walking □ □ 0
4. When going down the stairs, my ankle feels UNSTABLE
Never □ □ 3
If I go fast □ □ 2
Occasionally □ □ 1
Always □ □ 0
5. My ankle feels UNSTABLE when standing on ONE leg
Never □ □ 2
On the ball of my foot □ □ 1
With my foot flat □ □ 0
6. My ankle feels UNSTABLE when
Never □ □ 3
I hop from side to side □ □ 2
I hop on the spot □ □ 1
When I jump □ □ 0
7. My ankle feels UNSTABLE when
Never □ □ 4
I run on uneven surfaces □ □ 3
I jog on uneven surfaces □ □ 2
I walk on uneven surfaces □ □ 1
I walk on a flat surface □ □ 0
8. TYPICALLY, when I start to roll over (or "twist") on my ankle, I can stop it
Immediately □ □ 3
Often □ □ 2
Sometimes □ □ 1
Never □ □ 0
I have never rolled over on my ankle □ □ 3
9. After a TYPICAL incident of my ankle rolling over, my ankle returns to "normal"
Almost immediately □ □ 3
Less than one day □ □ 2
1–2 days □ □ 1
More than 2 days □ □ 0
I have never rolled over on my ankle □ □ 3

NOTE. The scoring scale is on the right. The scoring system is not visible on the subject's version.

Figure 2: Coordinates

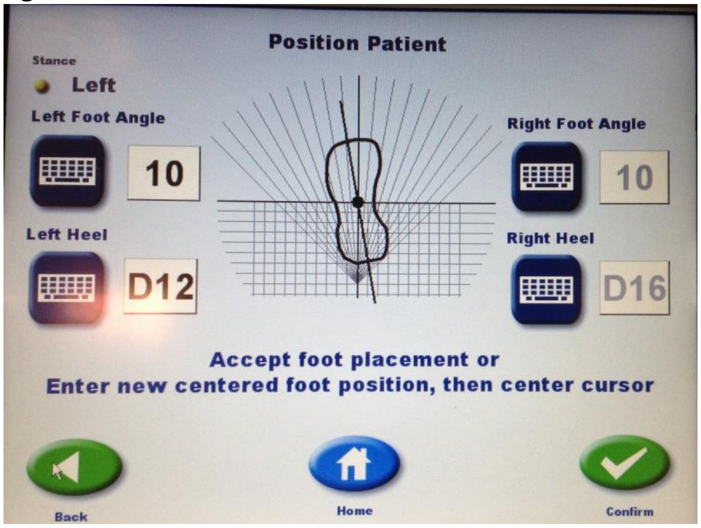


Figure 3: Participant's Stance

Figure 4: Participant's Stance

Table 1: Means and Confidence Intervals

Condition	Means ± SD	95% CV
NSSD	2.28 ± 1.00	[1.91, 2.65]
NSND	2.40 ± 1.01	[2.02, 2.78]
NSBL	1.20 ± .81	[.90, 1.51]
SND	2.11 ± 1.08	[1.71, 2.52]
SD	2.05 ± .94	[1.70, 2.40]
SBL	1.28 ± .71	[1.01, 1.54]

*Indicates p value ($p \leq .05$)

Table 2: Shoe and no shoe versus dominant and non dominant leg.

t-tests by Condition	t value	p
NSSD X NSND	-.471	.641
NSSD X NSBL	6.687	**.000***
NSSD X SND	.935	.358
NSSD X SD	1.671	.105
NSSD X SBL	6.146	**.000***
NSND X NSBL	5.224	**.000***
NSND X SND	1.279	.211
NSND X SD	1.374	.180
NSND X SBL	5.387	**.000***
NSBL X SND	-5.196	**.000***
NSBL X SD	-4.518	**.000***
NSBL X SBL	-.753	.458
SND X SD	.320	.751
SND X SBL	4.824	**.000***
SD X SBL	4.569	**.000***

*** indicates p= 0.05

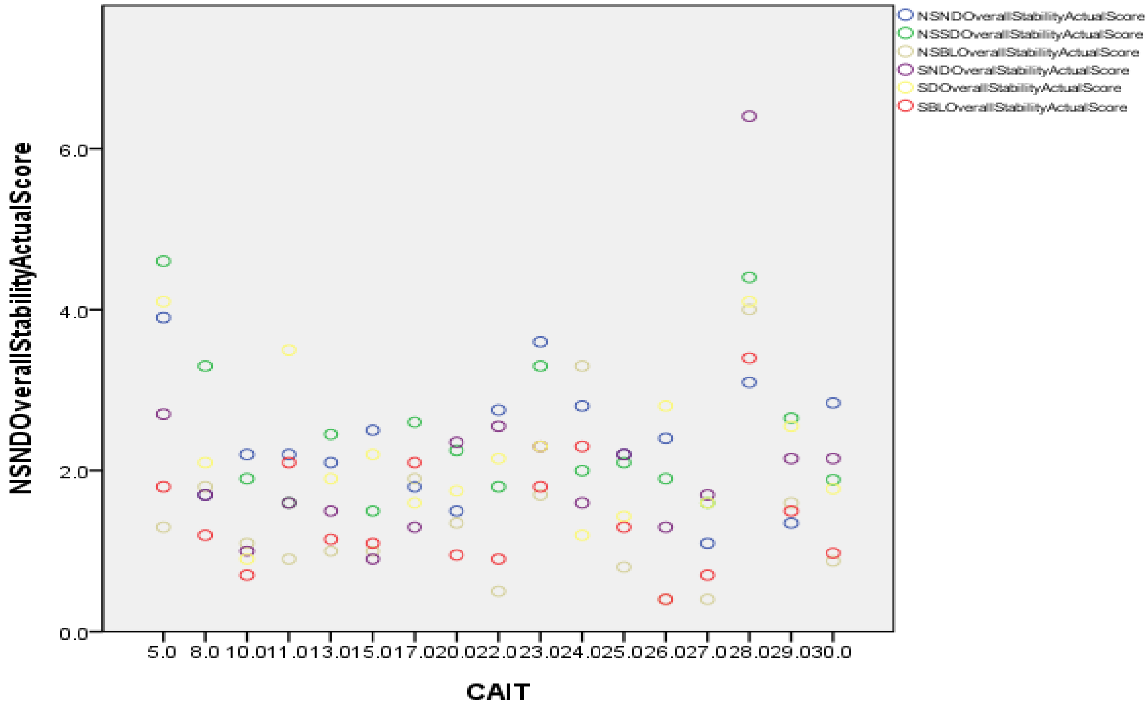
Table 3: Male versus Female in Overall Stability

ANOVA Overall Stability	Mean ± SD	F Value	Sig.
NSSD (male)	1.87±.71	5.00	.03*
(female)	2.64±1.1		
NSND (male)	2.61±1.09	1.19	.29
(female)	2.21±.93		
NSBL (male)	1.08±.76	.61	.44
(female)	1.31±.86		
SSD (male)	1.66±.81	5.19	.03*
(female)	2.39±.93		
SND (male)	1.96±.81	.54	.45
(female)	2.25±1.28		
SBL (male)	1.16±.66	.65	.43
(female)	1.38±.76		

Table 4: Correlation of CAIT by condition

	Pearson Correlation (r)	**Significance (.01)**
NSSD	**-.243**	**.195**
NSND	**.051**	**.790**
NSBL	**-.051**	**.788**
SND	**.254**	**.176**
SD	**-.179**	**.344**
SBL	**-.103**	**.588**

Figure 5: CAIT and Overall Stability Correlation



VITA

Nicole Alane Hergert

Candidate for the Degree of

Master of Science

Thesis: PERCIEVED ANKLE INSTABILITY AND TRUE INSTABILITY IN MALE AND FEMALE D1 COLLEGIATE CHEERLEADERS

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