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Assessment of Balance in Collegiate Cheerleaders: Is Implementing a Balance Training Program a Good Idea?

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Introduction

Cheerleading has evolved immensely over the years. Gone are the days of simply shaking pom poms and yelling "GO TEAM!." Flips, twists, and prime athletic ability are what can be seen on the sidelines of any collegiate football or basketball game. Cheerleaders in general are assumed to have an above average level of balance, due to the nature of their training and sport. However, with these new skills comes the increasing risk for injury, and this risk may differ according to a cheerleader's position. As with any sport, cheerleading has specific positions. The cheerleaders that are put into the air are called "flyers." Flyers (F) are responsible for standing in the hands of the cheerleaders below them while maintaining a tight, controlled posture. "Bases" (B) are responsible for lifting flyers into the air, supporting them, and returning them back to the ground safely. Collegiate cheerleaders are frequently exposed to lower limb injuries, such as ankle sprains, torn ligaments, etc. Since balance is an essential skill in cheerleading, balance performance may be an issue to consider for potential injury prevention programs of collegiate cheerleaders.

Balance assessment has the potential to indicate how "at risk" these athletes are for falling and inducing injuries. It is in our interest to further determine if any one position is more at risk than the other. Also of interest is examining whether there is a relationship between fall history, injury history, and balance ability. Therefore, our research question is as follows: In collegiate cheerleading, do F have a better state of balance as compared to B? Knowing that B remain on the ground, while F must frequently balance in the air, we hypothesized that F would have better balance than B. Since balance is a key component in cheerleading, we also hypothesized that forming a balance training program could reduce injuries.

Literature Review

To conduct this study, we used standard muscle function tests called the Timed Up to Go, and the Five Times Sit to Stand. A third method we used was the Biodex Balance System. In using all three of these tests, we were able to determine whether B or F had better balance and muscle function, as well as obtain a general balance assessment level.

The Biodex Balance System is a machine that is used for many aspects related to balance. With this system, we can test individuals through fall-risk screening, single-leg screening, or postural stability. Biodex (2011) describes their machine as "a balance assessment and conditioning system for athletes to older adults." The Biodex System can be used to improve balance, develop muscle, and reduce fall risk. It is highly useful for patients post-surgery and for older individuals who are undergoing rehabilitation. Physical therapists can adjust levels of stability to condition patients in unique situations. With these tests, programs can be developed to rehabilitate each individual in a specific way.

Many researchers have conducted studies analyzing the reliability of the Biodex Balance System. Cachupe et al. (2001) believed that if they could prove that the Biodex Balance System was a reliable measure, it could be looked at more as a rehabilitation method for balance training. More specifically, the authors' research question dealt with pre-and post-test reliability of dynamic balance. In the results, it was indeed found that reliability was significant in groups with multiple trials conducted.

Hinman (2009) used research studies conducted by peers and compared their results. His main purpose was also to determine the test-retest reliability of the Biodex System. His hypothesis was that the Biodex System would be a reliable measure of balance testing. He found

that the Biodex Balance system was reliable in reporting balance control. A similar study was done by Parraca et al. (2011). The authors collected previous research to assess the reliability of the Biodex Balance system when used on older individuals. The authors' research question was whether the Biodex is an effective tool to assess balance. It was found that after a pre and posttest, the Biodex System was a good indicator of stability. This Biodex System was also found to be a more effective indicator than the standard Fall-Risk test. Schmitz and Arnold (1998) looked at reliability of the system on single leg stability training. The authors believed that since numerous other studies have used the Biodex Balance system and have reported their success with it, that the system is reliable as a source of testing. It was found that the Biodex System was an effective measure in recording the single leg stability data.

Studies have also looked at how certain methods bring about the most significant results in balance training. Kovaleski et al. (2009) compared the effect of different practice conditions on the positive transfer to balance on the Biodex Balance system. In this study, 30 male college students were randomly assigned to one of three groups: control, random, or blocked practice. Authors hypothesized that a random practice routine would have the best transfer effects for balance. They found that while both the random and blocked practice groups showed improvement, the greatest transfer occurred in the random practice group. Davlin-Pater (2010) conducted a study on how vision affects dynamic and static balance control. In this experiment, 50 individuals were put into two groups (field dependent and field independent) and five different vision categories were used to examine effects between visual perception and balance. It was found that individuals performed better when visual cues were apparent. No significant differences were found between the two groups when performing static balance. However,

significant differences were found between the two groups when performing dynamic balance. It was found that the field independent group was more successful during dynamic balance.

Another study that looked at how certain circumstances can affect the capability of the Biodex Balance System was an experiment done by Malliou et al. (2008). These authors investigated the effects of fatigue due to a tennis session on balance rehabilitation. More specifically, authors looked at whether it was more beneficial to conduct said balance training before or after participating in a tennis training session. Thirty-six tennis players were divided into three groups: one control and two intervention. One intervention group did the balance testing right before and the other group right after. It was found, overall, that the balance training improved the balance of both groups. This means that fatigue is not a factor in balance training, but that participating in balance training in general will increase an individual's balance ability.

Arnold and Schmitz (1998) conducted their study in an effort to examine relationships between balance and the use of the Biodex Balance System. Nineteen subjects were tested using different methods, all on the Biodex Balance System. Stabilities measured were medial-lateral, anterior-posterior, and overall stability. It was found that medial-lateral stability and anterior-posterior stability would better be viewed separately rather than as a combined look at overall stability.

Authors have also investigated whether using the Biodex Balance System is a valid method for rehabilitating individuals and assessing their injuries. For example, in the study performed by Hadzic et al. (2009), researchers investigated volleyball injuries and the risk for ankle sprains. They claimed that balance control is one of the factors that could help prevent

these ankle sprains. To test this, 38 male volleyball players performed balance testing on the Biodex Balance System at both stable and unstable levels. It was found that better balance control in the non-injured athletes only occurred in the medial-lateral stability. More than likely, it can be determined that a previous ankle injury will negatively affect balance control, which can explain these results. Akbari et al. (2006) also examined evaluating the effects of injuries. These authors conducted a study on balance problems of individuals with lateral ankle sprains. The theory behind ankle sprains is that individuals that have suffered ankle sprains are more prone to them later. Akbari et al. wanted to discover to what extent these ankle sprains affected balance and what part of balance they affected most. They found that balance problems do occur after ankle sprains, considering significant differences were found in balance ability of individuals with ankle sprains when compared to individuals without them.

One final study that supported the Biodex Balance System was conducted by Salsabili et al. (2011), analyzing different rehabilitation methods for balance in individuals suffering from diabetic neuropathy. The hypothesis was that effective balance training would improve postural control in individuals with diabetic neuropathy. They found that postural balance control of the individuals increased.

On the other hand, studies have also shown that the Biodex Balance System is not a good indicator of assessing fall risks. Sieri and Beretta (2004) found such a result in their study conducted to examine the risk factors for falling for older individuals. To do this, they used 40 elderly individuals and evaluated them through Fall-Risk testing on the Biodex Balance System. They evaluated the postural balance of individuals who had fallen and those who had not fallen. No significant differences between the postural balances of the two groups were found. It was concluded that because the values were not different, no assessed risk could be determined.

Gstöttner et al. (2009) also found no significant differences. For this study, 21 nonprofessional soccer players identified their preferred and nonpreferred kicking legs, and tested the balance capability of both on the Biodex Balance System. No significant differences were found between the preferred and nonpreferred legs. However, in some cases, better balance was observed in the nonpreferred leg. Many of the players exhibited poor balance overall, which could have impacted the results between the two legs. A study by Gioftsidou et al. (2011) agrees with this. The authors designed a study to analyze the effects of completing a soccer session on the balance of the players. Twenty-six soccer players had their balance ability assessed pre and post workout on the Biodex Balance System. Previous research has shown that fatigue is a factor in balance capabilities; however, soccer players have muscles that adapt to fatigue as they compete for longer periods of time than most. In the results, no significant differences were found between the balance scores for pre and post workout. However, for sedentary individuals, most likely their balance would decline due to fatigue.

Numerous studies on cheerleading injuries have been conducted. Jacobson et al. (2005) found that 78% of DIA cheerleaders had sustained some sort of injury while participating in their sport. It was concluded that lower limb injuries were the greatest. Athletes reported stretching, strength training, and endurance training all to be a part of their typical training. No balance training was reported. Shields and Smith (2009) also conducted a study analyzing cheerleading and its resulting injuries. Lower extremity injuries were found to be the most common, and also that most injuries resulted from attempted stunts. Shields and Smith also suggested that a strength and conditioning program be implemented to help prevent injuries, but do not mention balance as a component. Rehak (2010) suggests that the best way to prevent injury is to place restrictions on what cheerleaders are allowed to attempt. These restrictions could be limiting

how high stunts can go or what age can attempt harder skills. Rehak also recommends a weight lifting program for B, and warm up and cool down sessions for all athletes to avoid injury.

Goodwin et al. (2004) addressed a strength and conditioning program for female collegiate cheerleaders. The proposed program was geared towards maximum power, endurance, and muscular strength, while maintaining optimal levels of flexibility and reducing muscle hypertrophy. The program acknowledges the physical demands of collegiate cheerleaders, and divides the season up into parts such as: off-season, pre-season, peak season, etc, suggesting different levels of conditioning for each season. Balance is not a topic included in any strength and conditioning exercises in this study.

From examining numerous articles, I have uncovered valuable information pertaining to my thesis topic. Overall, I have gathered that the Biodex Balance System proves to be a reliable measure for assessing balance. Therefore, this system was a solid choice for assessment of balance in collegiate cheerleaders. Limitations to some of the research are that the Biodex Balance System is rarely compared to other assessments of balance, as well as there is no previous research on balance in cheerleaders. Most studies only examined the Biodex System and its test retest-reliability, and cheerleading drops or falls. The question of whether balance ability, injury history and fall history are related in cheerleaders is not known. This data could then indicate if balance training would be a logical intervention for reducing fall and injury risk.

Methods

Participants

To assess the balance of collegiate cheerleaders, 11 female collegiate cheerleaders were recruited to participate in the study. Participants were informed of all aspects of the research to

be conducted, where they then volunteered to participate. Subjects were taken at a first-come, first-served basis.

Procedures

For Trial 1, subjects came into Coastal Carolina University's Motor Behavior Lab, and submitted Informed Consent as well as Health History Questionnaire forms. It was required of participants to wear comfortable clothing, as well as sneakers. After looking over participants' health history, height, weight, and age were recorded. Subjects were then asked whether they had a fear of falling, whether they have fallen in the past month, or past year, and whether an injury resulted from said fall. Participants were also asked whether they had suffered any lower extremity injuries as a result of participation in cheerleading activities. If so, the injury was recorded.

The first test administered was the Timed Up to Go. Subjects were instructed to sit in a standard sized chair, back fully rested against the back of the chair, with hands in their lap. A countdown from three was given, and participants were to stand, walk ~10 feet, around a cone, walk back 10 feet, and sit down. Subjects were instructed to perform this as quickly as possible, but without running. A practice trial was given, then two trials were timed and recorded to the nearest one hundredth of a second.

The next test was the Five Times Sit to Stand. Subjects were instructed to begin seated in the same used for the Timed Up to Go, but that the backside did not have to rest against the back of the chair. Further instructions required the participant to stand up and sit down five times repeatedly; making sure that subject came to a fully seated position each time. Timing began

when the investigator said ‘Go’ and ended when the subject sat down for a fifth time. No practice was given, and only one trial was conducted and recorded.

From there, the Biodex Balance tests were performed. Subjects took off both socks and shoes and stepped onto the balance platform so the investigators could record heel placement and foot angles. At random, either the Fall Risk or Limits of Stability tests were assigned. The Fall Risk test consisted of the subject attempting to keep a cursor in center of the screen for 20 seconds. One practice trial was given, and then three trials were recorded. In the Limits of Stability test, subjects began with the cursor in the center of the screen, and a circle of white balls surrounded the center. At random, one ball would flash red, and the subject would shift their weight so the cursor could move to the flashing ball, and then back to center. Next, a different surrounding ball would flash, and the subject again moved the cursor with their shifting of bodyweight. This test was timed to completion, and an overall accuracy score was given. One practice trial was administered, followed by two trials recorded. All said tests were repeated on two separate trial days.

Statistical Analysis

All data were analyzed using correlational analyses and independent sample t-tests. The significance was set at $p<0.05$.

Results

Our data indicates that collegiate cheerleaders as a whole are highly susceptible to a risk of falling. Within the past year, 63.6% of cheerleaders experienced a fall while 45% reported lower extremity injuries due to participation in their sport. When comparing B to F, F had a significantly lower risk of falling ($F=0.60$ vs. 0.74 for B: $p<0.05$). This could be due to F

naturally having a better balance ability due to constantly balancing while being put into the air. We also found that fall risk was strongly correlated to previous injuries (r=-0.752; p=0.008), as a significant number of cheerleaders in our study had a previous fall history, as well as lower leg injuries. Significant correlations between Fall Risk scores and Five Times Sit to Stand were also found (r=0.752; p=0.008). A better Timed Up to Go test also related to a better Limits of Stability test (r=0.741; p=0.009). Finally, a significant correlation was found between the Timed Up to Go and Fall Risk (r=0.657; p=0.028).

Mean Age	Mean BMI		*Fall Risk	Limits of Stability (Time to Complete)	Limits of Stability (Score)	Five Times Sit to Stand	Timed Up to Go
19.63	23.70	F	0.60±0.08	42.30±3.70	39.10±9.11	5.17±0.72	4.75±0.28
		B	0.74±0.32	41.42±4.19	37.17±9.42	5.87±1.12	4.99±0.40

*Indicates significant difference between B and F ($p<.05$)

Discussion

The athletic nature of collegiate cheerleaders causes these athletes to be susceptible to falls and injuries. Through conducting the balance assessments Timed Up to Go, Sit to Stand, Fall Risk, and Limits of Stability, we have analyzed the balance abilities of a group of collegiate cheerleaders as a whole, and found that there are position-specific (B and F) differences in fall risk, and that there were significant relationships between balance ability, fall risk, and injuries. Therefore, balance training has the potential to strengthen lower leg muscles, improve balance, as well as prevent injury.

Many studies have looked at cheerleading and the injuries that occur along with cheerleading. Chances are, most people have heard of a cheerleading injury resulting from a flyer being dropped, or a fall during tumbling. The frequency of injuries due to these

circumstances has caused scholars to analyze the safety of the sport, causing new regulations to be implemented. However, no scholars have explored the mechanics behind cheerleading, and whether some sort of training could help prevent such injuries from occurring. Scholarly articles can be found, however, on the reliability of the Biodex Balance System, a common method of balance assessment. The majority of these studies proved that the Biodex is a reliable measure for balance training and assessment. This evidence is useful considering the current study relied on the Biodex Balance System for data regarding the balance ability of B versus F. Most of these previous studies were geared towards balance and fall risk in older individuals, not athletes. This limitation was a primary reason for conducting balance training research on athletic college cheerleading. Is there a difference in balance ability between the different positions of B and F? Is one group more at risk of falling? Is there a relationship between fall risk, injuries, and muscle function in collegiate cheerleaders? These are all questions we addressed in our research, with the hope of determining whether balance training could be useful for preventing falls and injuries in collegiate cheerleaders.

We currently cannot compare our results to other studies, due to our study being unique as the first conducted with balance and cheerleaders. We can agree that the Biodex Balance System was a reliable indicator of balance ability, as it provided actual measurements of stability compared to averages of normal individuals of the same age range. Our findings have opened up doors for relating balance ability to injuries in other sports. Through this research, we can now also analyze the relationship between other athletes and injury prevention through balance training.

Final Conclusions

Through examining this data, we can conclude that conducting balance training alongside a muscle strength conditioning program may be beneficial for collegiate cheerleaders. This balance training could lower risk of falling, as well as prevent injury. As the sport of cheerleading evolves with attempting harder skills, the risk of injury greatly increases. Injury prevention is key in keeping athletes healthy. Further research should conduct balance assessments in collegiate cheerleaders before and after implementing a balance training program and analyzing whether the training actually improved balance, or prevented falls and injuries.

References

Akbari, M., Karimi, H., Farahini, H., & Faghihzadeh, S. (2006). Balance problems after unilateral lateral ankle sprains. *Journal Of Rehabilitation Research & Development*, *43*(7), 819-823.

Arnold, B. L., & Schmitz, R. J. (1998). Examination of Balance Measures Produced by the Biodex Stability System. *Journal Of Athletic Training*, *33*(4), 323.

Biodex Announces New Features for Balance System SD. (2011). *PT in Motion*, *3*(6), 61.

Cachupe, W. C., Shifflett, B. B., Kahanov, L. L., & Wughalter, E. H. (2001). Reliability of Biodex Balance System measures. *Measurement In Physical Education & Exercise Science*, *5*(2), 97-108.

Davlin-Pater, C. (2010). The Effects of Visual Information and Perceptual Style on Static and Dynamic Balance. *Motor Control*, *14*(3), 362-370.

Gioftsidou, A., Malliou, P., Pafis, G., Beneka, A., & Godolias, G. (2011). Effects of a soccer training session fatigue on balance ability. *Journal Of Human Sport & Exercise, 6*(3), 521-527.

Goodwin, E. P., Adams, K. J., Shelburne, J., & DeBeliso, M. (2004). A Strength and Conditioning Model for a Female Collegiate Cheerleader. *Strength & Conditioning Journal (Allen Press), 26*(6), 16-21.

Gstöttner, M., Neher, A., Scholtz, A., Millonig, M., Lembert, S., & Raschner, C. (2009). Balance Ability and Muscle Response of the Preferred and Nonpreferred Leg in Soccer Players. *Motor Control*, *13*(2), 218-231.

Hadzic, V., Sattler, T., Topole, E., Jarnovic, Z., Burger, H., & Dervisevic, E. (2009). Risk factors for ankle sprain in volleyball players: A preliminary analysis. *Isokinetics & Exercise Science, 17*(3), 155-160.

Hinman, M. R. (2000). Factors affecting reliability of the Biodex Balance System: a summary of four studies. *Journal Of Sport Rehabilitation*, *9*(3), 240-252.

Jacobson, B. H., Redus, B. B., & Palmer, T. T. (2005). An assessment of iniuries in college cheerleading: distribution, frequency, and associated factors. *British Journal Of Sports Medicine*, *39*(4), 237-240.

Kovaleski, J. E., Heitman, R. J., Pugh, S. F., & Gurchiek, L. R. (2009). Improved Transfer Effects on the Biodex Balance System. *Athletic Training & Sports Health Care: The Journal For The Practicing Clinician*, *1*(2), 74-78.

Malliou, V. J., Malliou, P. P., Gioftsidou, A. A., Pafis, G. G., Katsikas, C. C., Beneka, A. A., & ... Godolias, G. G. (2008). Balance exercise program before or after a tennis training session?. *Journal Of Back & Musculoskeletal Rehabilitation*, *21*(2), 87-90.

Parraca, J. A., Olivares, P. R., Carbonell-Baeza, A., Aparicio, V. A., Adsuar, J. C., & Gusi, N. (2011). Test-Retest reliability of Biodex Balance SD on physically active old people. *Journal Of Human Sport & Exercise*, *6*(2), 444-451.

Rehak, D. C. (2010). Cheerleading Injuries. *Hughston Health Alert*, *22*(4), 6-7.

Salsabili, H., Bahrpeyma, F., Forogh, B., & Rajabali, S. (2011). Dynamic stability training improves standing balance control in neuropathic patients with type 2 diabetes. *Journal Of Rehabilitation Research & Development*, *48*(7), 775-786.

Schmitz, R., & Arnold, B. (1998). Intertester and intratester reliability of a dynamic balance protocol using the biodex stability.. *Journal Of Sport Rehabilitation*, *7*(2), 95.

Sieri, T., & Beretta, G. (2004). Fall risk assessment in very old males and females living in nursing homes. *Disability & Rehabilitation*, *26*(12), 718-723.

Shields, B. J., & Smith, G. A. (2009). Cheerleading-Related Injuries in the United States: A Prospective Surveillance Study. *Journal Of Athletic Training*, *44*(6), 567-577.