

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

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ABSTRACT

Due to the nature of the activity, competitive cheerleaders are susceptible to falls, which can lead to injury. However, cheerleaders that get put into the air (“flyers”), may have better balance ability as compared to those that hold or support flyers (“bases”). However, no previous research could be located comparing balance ability and fall risk between these positions. The purpose of this study was to assess balance ability and fall risk in female, collegiate cheerleaders. It was found that within the past year, 63.6% of cheerleaders experienced a fall, while 45% reported lower extremity injuries due to participation in their sport. Our data indicate that both positions are at high risk for falls, despite flyers having significantly lower fall risk than bases. The data also indicate that fall risk is related to recent injury and indices of leg strength. This suggests that conditioning programs should also focus on balance ability along with muscle strength.

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 characterize the sidelines of collegiate football and basketball games. Many assume that cheerleaders in general have an above average level of balance due to the nature of their training and sport. However, these skills increase the risk of 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 are responsible for standing in the hands of the cheerleaders below them while maintaining a tight, controlled posture. “Bases” 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. 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 sustaining injuries. It is in their interest to further determine if any one position is more at risk than the other. Also of interest is the relationship between fall history, injury history, and balance ability. Therefore, in conjunction with my research adviser Gregory Martel, professors Stacey Beam and George Lyerly, and fellow student Stephanie Taylor at Coastal Carolina University, I conducted the following research and testing. Our research question is as follows: In collegiate cheerleading, do flyers or bases have better states of balance? Knowing that bases remain on the ground, while flyers must frequently balance in the air, we hypothesized that flyers would have better balance than bases. 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 two standard muscle function tests called the Timed Up to Go (TUG) and the Five Times Sit to Stand. A third method used was the Biodex Balance machine. In using all three of these tests, we were able to determine whether bases or flyers had a better balance and muscle function, as well as to 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, specific programs can be developed to rehabilitate each individual.

Many researchers have conducted studies analyzing the reliability of the Biodex Balance System. Cachupe et al. (2001) believed that if they could prove the Biodex Balance System was a reliable measure, athletes could rely upon it more as a rehabilitation method for balance training. More specifically, the authors’ research question dealt with pre-and post-test reliability of dynamic balance. After conducting multiple trials, the authors concluded that the machine’s reliability was significant.

Using research studies conducted by peers and comparing their results, Hinman (2009) sought 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. Parraca et al. (2011) conducted a similar study. The author collected previous research to assess the reliability of the Biodex Balance machine when used on older individuals. The authors’ research question was whether the Biodex machine is an effective tool to assess balance. Parraca discovered that after a pre- and post-test, 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 reported success with the Biodex Balance System, the system is reliable as a source of testing. They found that the Biodex system was an effective measure in recording single leg stability data.

Researchers 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. The 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.

Malliou et al. (2008) that looked at how certain circumstances can affect the capability of the Biodex Balance System. 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 interventions. One intervention group did the balance testing right before a training session and the other group right after. It was found that the balance training improved the overall 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) examined the 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 be better viewed separately rather than as a combined look at overall stability.

Authors have also investigated the Biodex Balance System as 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 sprains. To test this, 38 male volleyball players performed balance testing on the Biodex Balance System at both stable and unstable levels. The authors 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 by conducting a study on the 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 balance was affected by these ankle sprains and what part of balance is affected most. They found that balance problems do occur after ankle sprains since 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), who analyzed 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 of 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. They 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. Gioftsidou et al. (2011) agrees with this. The authors analyzed 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 athletes. In the results, no significant differences were found between the balance scores for pre- and post-workout.

In addition to this scholarship on balance and injuries in other sports, numerous studies on cheerleading injuries have been conducted. Jacobson et al. (2005) found that 78% of Division IA cheerleaders had sustained some sort of injury while participating in their sport. They concluded that lower limb injuries were the most common. 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; in addition, most injuries resulted from attempted stunts. Shields and Smith also suggested that a strength and conditioning program be implemented to help prevent injuries, but they 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 limits on how high stunts can go or what age groups can attempt harder skills. Rehak also recommends a weight lifting program for bases, 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, and peak-season, suggesting different levels of conditioning for each season. Balance is not a topic included in any strength and conditioning exercises in this study.

From this review of the existing scholarship, valuable information was discovered pertaining to the proposed study. Overall, the Biodex Balance System appears to be a reliable measure for assessing balance. Therefore, this system is a solid choice for assessment of balance in collegiate cheerleaders. The limitations of 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 or workout apparel, as well as sneakers. After looking over participants' health history, their 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, circle 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, and 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 the test seated in the same stance used for the TUG, but their backs were not to rest against the back of the chair. Further instructions required participants to stand up and sit down five times repeatedly, making sure that subjects came to a fully seated position each time. Timing began when the investigator said 'Go' and ended when the subjects sat down for a fifth time. No practice was given, and only one trial was conducted and recorded.

From there, two Biodex Balance tests were performed on each subject. Subjects took off both socks and shoes and stepped onto the balance platform so heel placement and foot angles could be recorded. At random, either the Fall Risk or Limits of Stability tests were assigned. The Fall Risk test consisted of the subjects 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 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. Overall, it was found that 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 bases to flyers, flyers had a significantly lower risk of falling ($F = 0.60$ vs. 0.74 for B: $p < 0.05$). This could be due to flyers 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 as a result. 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 ($r = 0.741$; $p = 0.009$). Also, 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	Flyers	0.60±0.08	42.30±3.70	39.10±9.11	5.17±0.72	4.75±0.28
		Bases	0.74±0.32	41.42±4.19	37.17±9.42	5.87±1.12	4.99±0.40

*Indicates significant difference between Bases and Flyers

Discussion

The athletic nature of collegiate cheerleaders causes these athletes to be susceptible to falls and injuries. Balance stability is a fundamental technique necessary for daily functioning. However, balance training has the potential to strengthen lower leg muscles, as well as prevent injury. 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, as well as position-specific (bases and flyers).

Many studies have looked at cheerleading and the injuries that occur because of the sport. 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 or not some sort of training could help prevent such injuries from occurring. Scholarly articles can be found, however, on the reliability of the Biodex Balance machine, 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 machine for data regarding the balance ability of bases versus flyers. 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 bases and flyers? 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 or not balance training could be useful for preventing falls and injuries in collegiate cheerleaders.

We currently cannot compare our results to other studies, due to the uniqueness of our study; it is the first conducted with balance and cheerleaders. We can agree that the Biodex Balance machine 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 avenues for further research 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.

Conclusion

Through examining this secondary research in conjunction with our own original 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 the risk of falling, as well as prevent injury. As the sport of cheerleading evolves, athletes are attempting harder skills, which increases the risk of injury greatly. 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.

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