

AN EXAMINATION OF PRE-ACTIVITY AND POST-ACTIVITY FLEXIBILITY
PRACTICES OF NCAA DIVISION I AND NCAA DIVISION III
BASKETBALL COACHES

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ABSTRACT

The purpose of this study is to determine the pre and post activity warm-up/stretching practices of men's collegiate basketball programs (static, ballistic, proprioceptive neuromuscular facilitation, and/or dynamic stretching) if any, and in comparing those results with current research conclusions. The study will determine if current NCAA Division I and NCAA Division III basketball programs are utilizing pre and post activity protocols that reflect up-to-date research.

Eighty coaches responded to a voluntary study. The coaching respondents completed a questionnaire assessing flexibility practices in order to compare these practices with, current, scientific-based literature. The results of the study showed that flexibility is incorporated into nearly every program at both the division-I and division III levels. There is a large majority of coaches that believe stretching prevents injuries and improves performance, however the results from the study show that coaches are not following the recommended research when it comes to properly conducting flexibility practices. It is important that colleges and university basketball coaches gain a better understanding of what appropriate flexibility practices are, in order to achieve maximal benefits for their respective team members.

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CHAPTER I

INTRODUCTION

Basketball coaches and players want to sustain long, healthy, and productive careers. This is possible, through quality and consistent training practices, over an extended period of time. A basketball player might start a game on a “hot streak” to give his/her team an extra boost that puts their team in a better situation to gain a victory, but the underlying question that should be examined is where did that sudden burst of energy come from? On the other hand, a basketball player may have his/her career come to a crashing halt from an awkward movement that has led to permanent or chronic injury. How is it that the slightest of movements can cause such a devastating injury? The answers to both questions may be related to the knowledge that basketball coaches possess when they implement flexibility practices into their programs. The optimal performance and injury scenario are examples of why researchers are trying to better understand the potential benefits of flexibility practices (warm-up, cool-down, and stretching). While researchers are investigating the subject matter, it is important that basketball coaches stay current with the research that is made available. Coaches should try to gain knowledge from as many professional sources as possible, which can include the consultation and/or addition of a certified strength & conditioning coach, athletic training staff, and literature reviews. Adhering to these recommendations would allow basketball programs to implement more appropriate flexibility (warm-up/cool-down, and stretching) routines for maximal benefits towards their respective team.

Customarily, NCAA division-I colleges and university athletic departments operate on larger budgets that would seemingly allow more support staff (e.g., assistant coaches, athletics trainers, strength & conditioning coaches, etc.) for each program compared to the NCAA division-III levels. It could be hypothesized that fewer support staff at the NCAA division-III level will play a vital role into whether or not scientific-based flexibility practices are being incorporated into basketball programs.

Purpose of the Study

The purpose of this study is to determine the pre and post activity warm-up/stretching practices of men's collegiate Division I and Division III basketball programs (the use of static, ballistic, proprioceptive neuromuscular facilitation and/or dynamic stretching) if any and when in comparison with current research conclusions. The study will determine if current Division I and Division III basketball programs utilize a pre and post activity protocol that reflects up-to-date research.

Hypotheses

Hypothesis I. NCAA division-I basketball coaches will show a higher percentage of more scientific-based pre-activity warm-up and stretching practices that have been implemented into their programs compared to NCAA division-III coaches.

Hypothesis II. NCAA division- I basketball coaches will show a higher percentage in more scientific-based post-activity cool-down and stretching practices that have been implemented into their programs compared to NCAA division-III coaches.

Hypothesis III. NCAA division- I and NCAA division-III basketball coaches will show

that a combination of dynamic flexibility and static/ballistic/PNF stretches will best describe their current pre-activity warm-up

Hypothesis IV. NCAA division-I and NCAA division-III basketball coaches will show that neither is following the research recommendations for pre or post-activity stretching.

Hypothesis V. Basketball coaching association memberships do not equate to implementation of more scientific-based flexibility practices among NCAA division-1 or NCAA division-III basketball programs.

Hypothesis VI. There will be a significant difference between NCAA division-I and NCAA division-III coaches on how they gain knowledge for implementing flexibility practices into their respective program.

Delimitations

1. The main part of this study took place through bulk emails that had a link to a survey capturing site (www.surveymonkey.com).
2. The emails were randomly selected and sent to NCAA division-I and NCAA division-III coaches (head, assistant, and graduate-assistants).

Limitations

This study was limited by:

1. The amount of knowledge that each coach actually possessed on the subject matter.
2. The quality of effort that each gave on the questionnaire.

Assumptions

All coaches gave their best effort to answering the questionnaire.

1. The coaches understood the questions that were being asked.

2. Graduate assistants and assistant coaches possess enough knowledge to accurately portray what is happening within their team's flexibility practices.

CHAPTER II

LITERATURE REVIEW

There are some changes in regards to how flexibility practices are being used in collegiate athletics. More athletic support staff members can help aid coaches in ways some thought were never imaginable. When this review started to take form, it was apparent that several topics related to flexibility practices had to be understood in order to answer questions of whether or not Division I and Division II men's coaches are following up-to-date research. The first category for discussion is the warm-up itself, and how it has evolved. The second category examines the different types of stretches, which have sub-categories. The sub-categories are ballistic stretching, dynamic stretching, static stretching, and proprioceptive neuromuscular facilitation (PNF) stretching. The final category of the review will focus on the strength and conditioning education movement. The information should provide an appropriate knowledge basis when comparing factual knowledge, in comparison to flexibility practices survey that NCAA division-I and NCAA division-III coaches participated in.

Warm-up

The first key in an attempt to piece all of the information together and draw a conclusion on what are appropriate flexibility practices, is to first becoming aware that a “warm-up” and “stretch” are two separate entities. The theoretical goal of the pre-activity warm-up and stretch is to optimize performance and reduce the incidence of injury through increased muscles temperature, muscles compliance, and efficiency of physiological A well-designed pre-activity protocol will bring about various physiological changes that enhance the training activity or competition; in the case of basketball, explosive strength.

The foundation of the warm-up may have gained its roots from a study by Asmusson and Boje (1945). This study pointed out that higher temperatures in working organisms promoted better work performance, and it was that merited information that has crossed over into physical education and athletic environments. It should be noted that a warm-up is classified into two categories, which are active and passive. Bishop (2003) defined active warm-up as a warm-up that involves movement and exercise, whereas passive warm-up involves some type of external measure to heat the body temperature.

1980-1990's

According to the *Journal of Pure Power* (2009), static-stretching has been a popular routine used in conjunction with warm-up exercises, in physical activities since the early 1980's. The *Journal of Pure Power* (2009) further discussed that stretching routines were recommended to take place before the generalized warm-up in the 1980's. Static stretching was the recommended stretch of choice, which is probably due in large part by the nature of the stretch. The stretch will be furthered investigated in this review, but for illustration sake, it follows slow and controlled patterns that would seemingly allow a person to perform the activity with ease and little safety concerns.

Beaulieu (1981) may have initiated some of the guidelines that are still used in athletics today that relate to the amount of intensity and duration that a warm-up should utilize before stretching occurs. It has been suggested that a moderate intensity warm-up should coincide with shorts periods of time (3-10 minutes) before stretching takes place. There was another highly regarded study by Shellock (1985), which is still being referenced and investigated often argued by many scholars today. The study involved the effects of warm-up and stretching practices and concluded with making the notion that a warm-up and stretch had a positive impact on improved

physical performance. When this particular research was conducted in the mid-1980s, it seemed to have a lot of staying power and merit; however it is a focal point of many rebuttals. Many athletic coaches were implemented the recommended strategies that were mentioned in Shellock's (1985) study into their flexibility routines, because many of the same beliefs had been formulated just a few years earlier. Smith (1994) concluded that several minutes of physical activity followed by stretching are recommended for all levels of competition.

2000's

The millennium brought along more research that investigated and often times argued the validity of the literature from 1980's and 1990's, especially when it came to the role warm-up and stretching many have had on sports performance and injury prevention. (Bishop, 2003; Horan and Weeks, 2008; Janot, Dalleck, and Reymont 2007; Knudson, 2004; Kovacs 2006).

Bishop (2003) conducted an investigation on the practice of warm-up, which concluded by suggesting that there is little scientific evidence to support many warm-up situations and their actual effectiveness. The reasoning was due in large part by questioning the validity of past studies, and presuming there was not a great deal scientific-control behind them. Bishop furthered the study by providing guidelines on structuring a more proper and effective warm-up routine compared to what previous literature had mentioned. Knudson (2007) supported Bishop's claim of structuring an active warm-up between 5-10 minutes, using between 40-60% VO₂ max, and allowing adequate time for recovery. The new millennium also witnessed several researchers try to discredit the notion that pre-activity static stretching reduces the risk of injury (Knudson, 2007; Pope, Herbert, Kirwan, and Graham 2000). The Pope et al. (2000) study gained recognition, because it showed that there was no difference between lower-limb injuries with a

controlled group of soldiers that performed stretching protocols before warm-up compared to others. The one concluding consensus among researchers that have studied the topic of warm-up and stretching from the 1980's and 1990's compared to the 2000's, is the value and importance that is placed on the warm-up itself. There seems to be a universal consensus that pre-stretching routines do not reduce injuries in short-term, but can aid in improved flexibility long-term, which can then help avoid injuries.

Types of Stretching

Stretching can be defined as the act of applying tensile force to lengthen muscle and connective tissue (Stone, Kinser, Obryant, Ayers, & Sands, 2006). Frequently stretching is performed as a component of the warm-up proceeding to physical exertion. In general, stretching is used to improve the range of motion (ROM) about a joint (flexibility). The resulting improvement may be viewed as acute (temporary) or chronic. There are many different types of stretching that can be performed. There are a range of stretching types and methods, including:

- Ballistic stretching
- Dynamic stretching
- Static stretching
- Proprioceptive neuromuscular facilitation stretching (PNF)

The literature dealing with flexibility suggests that athletes should perform some sort of “general” warm-up prior to activity (Ce, Margonto, Casaco, and Veisteinas 2008; Hedrick, 1992; Laroche, Lussier, and Roy 2008; Mann, and Jones 1999; Ninos 1995; Torres, Kraemaer, Vingren, Volek, Hatfield, Spiering, Ho, Fragala, Thomas, Anderson, Hakkinen and Marsh 2008; Yamaguchi, and Ishii 2005) a pre-activity stretch (Fredrick, and Szymanski 2001; Laroche,

Lussier, and Roy 2008; Mann, and Jones 1999), and post-activity stretching (Stone, Ramsey, O'Bryant, Ayers, and Sands 2006).

Ballistic Stretching

Ballistic stretching refers to the stretching of a muscle, while it is simultaneously contracting, which may increase injury risk (Shellock & Prentice 1985). Faigenbaum & McFarland Jr. (2007) depicts ballistic stretching as a type of stretch that involves bouncing and bobbing type movements. Often times the terms fast, jerky, and double-bouncing are affiliated with ballistic stretching. Ballistic stretching seems to be the most controversial throughout literature and also the least recommended for coaches to utilize. Bradley, Olson, & Portas (2007) argued that the limited research done on ballistic stretching makes it hard to determine its effect on performance. Faigenbaum & McFarland (2007) believe that ballistic stretching gets its fair share of biased reviews by researchers, because there does not seem to be a lot of scientific evidence to back up the preconceived notion that this form of stretching will result in injury.

Vertical jumping is a test that is often times assessed by basketball coaches and scouts for higher level competition. A study conducted by M. Woolstenhulme, Griffiths, E. Woolstenhulme & Parcell (2006) concluded that Ballistic stretching increases flexibility and acute vertical jump height when combined with basketball activity. They measured four different warm-up protocols followed by twenty minutes of basketball activity. The results concluded and the researchers recommended that coaches should use ballistic stretching as a warm-up for basketball play, because it is beneficial to vertical jump performance.

Another research study furthered investigated the effects of ballistic stretching, which was conducted by Bradley et al. (2007). Researchers wanted to find out, which if any, of three stretches protocols (ballistic, static, PNF) might affect vertical jump performance after a warm-

up. A vertical jumping test was administered to 18 male university students and data was collected. The study consisted of a 5-minute warm-up, which was followed by one of the three stretching protocols (ballistic, static, PNF) on different days with a sufficient rest period (72 hours) before administering the next test. The results showed that static and PNF stretching diminished vertical jumping performance on the dates the tests were administered, whereas ballistic stretching had no effect.

Dynamic Stretching

Over the past decade, dynamic stretching (dynamic warm-up) seems to be getting an abundance of support by researchers and exercise science personnel. The stretch itself exhibits progressive and continuous movements. The stretches are often paired with running drills that include changing of direction patterns that also adds dynamics related to calisthenics (McMillan, Moore, Hatler, & Taylor 2006). Dynamic stretches can take multiple joints through a range of motion more similar to specific sports related movements than PNF and static stretching (Young & Behm, 2002); therefore it is currently the most recommended form of stretching for athletics.

The McMillan et al (2006) study investigated the relationship between the effects dynamic and static-stretching warm-ups have on power and agility performance. Power and agility are two important components into the game of basketball, and therefore the results from the study can be influential towards implementing or recommended dynamic stretching practices. The focus group of the study was thirty cadets in the United States Military Academy. On three consecutive days the cadets performed a dynamic or static stretching warm-up routine and followed-up with three performance tests on power and agility. The results of the test concluded that there was a relative performance enhancement with the dynamic warm-up routine.

Another study conducted on dynamic stretching and performance was conducted by

Herda, Cramer, Ryan, and McHugh & Stout (2008). The study was designed to test isolated muscular strength after dynamic stretching. The conclusion of the study stating the incorporating dynamic stretches, before performance-related activities to maintain or increase muscle strength and/or power output. The focus was related to many functions of the hamstrings, which is a large muscle group that is actively involved with basketball related movements.

Static Stretching

Static stretching has been the most common and most researched topic in the realm of flexibility literature. The stretch involves standing or sitting in a stationary position until a certain feeling or tension is felt, and with due process it will allow muscles to stretch gradually farther, which might lead to feelings of slight discomfort usually for a short period of time. Faigenbaum & McFarland (2007) point out that The National Association for Sports and Physical Education (NASPE), which is one of the most highly regard authorities on physical education recommends static stretching after a cardiovascular warm-up.

One of the most popular studies, which had been mentioned earlier on, was conducted by Pope et. al. (2000). The study investigated the effects of static muscle stretching, during the warm-up routines of army recruits. The importance of the study was to determine if different training protocols would affect injury. The cadets were divided up into two groups; one was a stretch group and the other was a control group. The control group did a set of warm-up exercises plus static-stretches. The precise amount of time the stretch group was required to do was twenty minutes of stretching activity after their warm-up compared to none for the control group. The results showed that the amount of injuries that occurred between the two groups was paralleled. Additional implications for this study reported that a static stretching protocol performed during pre-exercise warm-up does not produce clinically meaningful reductions in the

risk of exercise-related injuries in army recruits. Cadet training and basketball training tend to follow different protocols; however it is important to note these findings because the nature of basketball coaches implementing static stretching regimens.

Janot, Dalleck, & Reymont (2007) collectively reviewed sixteen well-documented studies (Kokkonen, Nelson & Cornwell 1998; Nelson, Kokkonen, & Eldridge 2005; Evetovich et al. 2003; Fowles, Sale, & MacDougall 2000; Young & Eliot 2001; Church et. al 2001; Unick et. al. 2005; Burkett, Phillips, & Ziuaraitis 2005; Nelson et. al. 2005; Little & Williams 2006; Siatris et. al 2003; Godges et al. 1989; Marek et al. 2005; Young & Behm 2003), on the relationship between performance and pre-exercise static stretching. The reviews evaluated tests on electromyography (EMG); knee extension (KE); knee flexion (KF); meter running (M); mean power output (MP); maximal voluntary contraction (MVC); and peak torque (PT). The results of the evaluations of studies showed that eleven of the sixteen (approx. 68.75%) performance enhancement inquiry based studies showed a decrease in performance, while two (approx. 12.5%) had unchanged results, and three (approx. 18.75%) had increased results.

Proprioceptive Neuromuscular Facilitation (PNF)

Proprioceptive Neuromuscular Facilitation (PNF) is a form of stretching that has been referred to as one of the best ways to increase range of motion (ROM). Range of motion is an important concept for basketball players, especially if the stretch can increase flexibility. PNF stretching has been speculated to get its roots from the early 1900's. This type of stretch was used in rehabilitation processes of medical patients, which desired an outcome of elongated muscles. (Sharman and Creswell 2006) The most common terminology associated with PNF stretching deals with relaxation practices.

Wenos and Konin (2004) examined warm-up intensity on hip range of motion (ROM).

Different warm-ups were conducted on 12 men. The warm-ups consisted of an active and passive type and the study concluded with a test on ROM. The suggestions made from the study specified that an active warm-up followed by PNF stretching will be the most productive way of increasing hip range of motion. This knowledge can be carried over into the game of basketball, because many of the stances related to basketball are hip-based stances.

Strength and Conditioning Certification

The focus on superior sports performance and injury prevention has led to many athletic programs, especially at the collegiate and professional level to incorporate various athletic department support staff (e.g. athletic training, sports medicine, strength and conditioning coaches, etc.). Many basketball coaches are affiliated with state or national coaching associations; however it seems unclear if strength and conditioning guidelines are on their agenda for any of their literary handouts, meetings and discussions. The surplus of available information on sports training should make it easy for coaches to incorporate better flexibility practices.

Since the mid-1980's a growing movement towards educating and certifying professional strength and conditioning coaches has occurred. The National Strength and Conditioning Association (N.S.C.A.) offer a variety of certificates. The first certificate is Certified Strength and Conditioning Specialist (C.S.C.S); second is the Certified Strength and Conditioning Specialist Distinguished (C.S.C.S.*D); third is the National Strength and Conditioning Association – Certified Personal Trainer N.S.C.A.-CPT); fourth is the National Strength and Conditioning Association- Certified Personal Training Distinguished (N.S.C.A.- CPT* D). Let it be known that all of these exams require first-aid, CPR, and AED certification.

The C.S.C.S and C.S.C.S *D required a four-year college degree before a certification

can be warranted. The examination is trying to identify individuals who possess the knowledge and skills to design and implement safe and effective strength and conditioning programs for athletes in a team setting. The examination itself consists of approximately 150 questions that can be broken down into sub-categories. They focus on exercise-science in relationship to: biomechanics, anatomy, exercise physiology, and nutrition. There is also an applied section to the examination that test a prospective specialist ability to design a program, technique training, evaluations, and organization. The N.S.C.A.-CPT and N.S.C.A- CPT*D does not require a four-year college degree; however there is still an examination. The exam thoroughly has guidelines N.S.C.A (2001) tests the knowledge and skills that are necessary to successfully train both active and sedentary physically healthy individuals, as well as individuals with special needs.

In early 2000 the Collegiate Strength and Conditioning Coaches Association (C.S.C.C.A) were formed, which later went on to create an organization that represents collegiate strength and conditioning coaches, however it has been opened up to professional sports teams. There are training requirements that must be followed, in order to receive a certificate from the C.S.C.C.A and are as follows: A bachelor's degree must be acquired, alongside CPR/First Aid/AED certifications, passing scores on two thorough examinations, and an internship must also be performed under a certified member for at least eight or nine consecutive months. These certifications that are offered are Strength and Conditioning Coach-Certified (S.C.C.C.) and Maters Strength and Conditioning Certified (M.S.C.C.).

CHAPTER III

METHODS

The purpose of this study is to assess and compare the pre- activity warm-up/stretching practices of men's collegiate Division I and Division III basketball programs to current research conclusions. The study determines if current Division I and Division III basketball programs utilize a pre and post activity protocol that reflects up-to-date research theories.

Approach

Questionnaires that aimed to gather information related to demographics, professional strength and conditioning certifications, coaching association affiliations, educational information, and more specifically the pre and post-activity flexibility practices among various p, were distributed via email to 250 NCAA division-I and 250 NCAA division-III men's basketball coaches.

Subjects

The questionnaires were randomly distributed via email to head, assistant, and graduate assistant men's basketball coaches at the NCAA division-I and NCAA division-III level. Every email supplied an informed consent statement that explained each respondents rights, potential risks, and benefits for their participation should they participate in the study. The coaches were encouraged to contact the principal investigators of the studies to provide any discrepancies or clarifications.

Procedures

The permission of each participant was gained through an email that acknowledged their consent for the research study. A three-section questionnaire was attached via the same email and it was analyzed for results. The first of three sections in the questionnaire (11 questions) focused on the coaches' personal, professional, certifications and memberships, and educational information. The second of three sections in the questionnaire (had up to 22 questions, depending on a "yes or no" answer to other questions) focused on pre and post-activity warm-up, stretching, and cool-down. The third and final section of the questionnaire (up to 4 questions, depending on a "yes or no" answer to other questions) focused on knowledge acquisition towards their teams flexibility practices. The questionnaire was originally distributed via email to 250 NCAA division-I and 250 division-III men's basketball coaches, and each coach was asked to respond back within 14 days. The coaches that did not respond back to the original email and questionnaire received a follow-up email, in order to gain more responses. A third batch of questionnaires was sent via email to a different coaching staff member from the same college and universities that did not respond to the first two emails. A fourth and final step was taken to increase respondents, which twenty-five telephone conversations took place with collegiate coaches. The coaches were asked if they would complete the questionnaire via email.

Analysis

The researcher investigated each one of the coaching respondent's answers from the questionnaire that participated in the study. The answers were analyzed for trends, errors, and common themes. The data was then divided up through cross-tabbed computerized charts that compared the answers of NCAA division-I coaches with NCAA division-III coaches. The answers to common questions were grouped together, so both divisions could be applicably

represented. The last step in this process was to create tables and charts that illustrated the findings.

Chapter IV

RESULTS

Results

There were eighty respondents (38 from NCAA division I and 42 from NCAA division III schools) ages 23-62 (mean = 37.9 ± 10.6) with a mean average of $13.2 (\pm 9.11)$ years of collegiate coaching experience that participated in the study (Table 1). Eight of the respondent were NCAA division-I head coaches, 30 were NCAA division-III head coaches, 29 were NCAA division-I assistant coaches, 12 were NCAA division-III assistant coaches, and 1 was a NCAA division-I graduate assistant coach. There were not any CSCS, CSCS*D, NCSA-CPT, NSCA-CPT*D, SCCC, or MSCC certified coaches in either division. Sixty-five coaches answered that they were members of the National Association of Basketball Coaches (NABC). Thirty-two coaches responded that they held a state coaching association membership. All eighty respondents were college graduates, 47 had a graduate degree, and 2 more had earned their doctorate. Of the 80 coaching respondents, 24 held degrees in sports-related fields, such as physical education, exercise physiology, and sports administration. Out of the 80 respondents, 56 of them indicated that they had played college basketball and another 5 had played professionally.

*(It should be noted that some questions did not apply to all coaches and others were purposefully skipped, therefore all results and percentages are based entirely on the number of actual respondents, and not the sum total of 80 completed questionnaires)

General Knowledge and Program Design

Twenty-one out of 76 coaches stated that stretching should be emphasized the most during pre-activity, 10 responded that stretching during post-activity should be emphasized the most, and 45 stated that both times are equally important.

Forty-two out of 64 coaches stated that a Strength & Conditioning Coaches were their main source of information that help decide what a warm-up should consist of, 17 stated their main source of information came from another basketball coach, 2 stated a non-basketball coach, 1 stated a coaches education program, 2 stated media (books, video, etc.), and 9 said other (5 stated athletic trainers in this section). Thirty-seven out of 57 coaches answered that a Strength & Conditioning Coach was their main source of information that helped decide what the post-activity stretching routine should consist of, 11 said another basketball coach was their main source, 2 stated a non-basketball coach, 1 stated the media, 3 stated coaches education program, and 6 stated other (4 stated athletic trainer in this section).

Preactivity

Seventy-five out of seventy-six respondents answered that they did some type of general warm-up prior to basketball practices and competitions. Of these seventy-five, 52 used lay-ups and other team drills to describe their “general” warm-up. Twenty more respondents said they used jogging, and form running to describe their “general” warm-up. Forty coaches stated that they used a warm-up that lasted between 5-10 minutes in length, 14 took less than 5 minutes, 12 coaches warm-up times went between 10-15 minutes in length, while 9 coaches said theirs took longer than 15 minutes in length.

Seventy-six coaches responded to the question of whether or not they did any type of stretching before warm-up, and 70 stated that they did. Sixty-nine out of those 70 respondents

answered the question of what describes their pre-activity stretching, and the responses are as follows: 8 used static stretching/ballistic/PNF, 22 used dynamic flexibility and 39 used a combination. Forty-five coaches used pre-activity stretching that lasted between 5-10 minutes, 16 took between 10-15 minutes, and another 6 was less than 5 minutes, while 3 last longer than 15 minutes.

Postactivity

Thirty-one of 76 respondents said they used stretching post-activity. These stretches took between 5-10 minutes for 24 coaches, between 10-15 minutes for 5 coaches, and 2 of the coaches said their post-activity stretching last less than 5 minutes. Sixteen coaches described their post-activity stretching as static/ballistic/PNF stretches, 2 used dynamic flexibility, and 13 used a combination of static stretching/ballistic/PNF and dynamic flexibility (Table 2).

Sixteen out of 76 respondents said they do a post-activity cool down. 11 out of the sixteen coaches described their post-activity as low intensity basketball activity, 1 stated jogging, and 4 specified other, which included band stretching, shooting free-throws, low-intensity jump-rope, and stance/slide movements. The cool-down took between 5-10 minutes for 14 coaches, less than 5 minutes for 1 coach, and between 10-15 minutes for 1 more coach. Four out of the 16 coaches stated that they almost always complete the full post-activity cool-down, another 6 stated they almost always complete the post-activity cool-down, and another 5 said they sometimes complete the full post-activity cool down, while 1 said rarely is the cool-down completed.

Injury Prevention and Performance

Seventy-one out of 76 coaches think pre-activity flexibility work helps prevents injuries in basketball. Sixty-seven out of 76 coaches answered that post-activity flexibility work helps

injuries in basketball. Sixty-seven out of 76 coaches responded that pre-activity flexibility work helps improve performance. Fifty-eight out of 74 coaches answered that post-activity flexibility work helps improve performance.

Divisional Comparisons

Table 2 represents the similar responses that NCAA division-I coaches expressed in comparison to NCAA division-III coaches. There was a close proximity in the number of coaching respondents at the NCAA division I level (N=38) and NCAA division III level (N=42). Some key noted data shows that 60.6% (20 out of 33) of the division I coaches say that a combination of dynamic flexibility and static/ballistic/PNF stretching best describes their pre-activity stretching, whereas 57.1% (20 out of 35) stated the same at the division III level (Table 2). 36.4% (12 out of 33 respondents at the division I level stated dynamic flexibility best describes their pre-activity stretching, whereas 31.4% (11 out of 35) respondents stated the same at the division III level (Table 2). 9.1% (3 out of 33) respondents at the division I level stated static/ballistic/PNF stretching best describes their pre-activity stretching, whereas 11.4% (4 out of 35) stated the same at the division III level.(Table 3)

Table 3 represents the different responses that NCAA division-I coaches expressed in comparison to NCAA division-III coaches. Some key noted data shows that 73.8% (31 out of 42) coaches at the division-III level had obtained a graduate degree, whereas 42.1% (16 out of 38) had at the division-I level (Table 4). 82.4% (28 out of 34) coaches at the NCAA division-I level stated that a Strength & Conditioning Coach designs and conducts the pre-activity, activity, and warm-up, whereas 22.9% (8 out of 35) stated the same at the division-III level (Table 3).

CHAPTER V

DISCUSSION

Basketball programs include flexibility practices that are used to prepare players for training sessions and game competitions. The literature has recommended that basketball players, or athletes in general, should take part in a warm-up before activity (Asmusson, and Boje 1945; Beaulieu 1981; Bishop 2003(a); Bishop 2003 (b); Ce, Margonto, Casaco, and Veisteinas 2008; Hedrick 2003; Mann, and Jones 1999; Ninos, 1995; Torres, Kraemaer, Vingren, Volek, Hatfield, Spiering, Ho, Fragala, Thomas, Anderson, Hakkinen and Marsh 2008; Yamaguchi, and Ishii 2005), a pre-activity stretch (Faigenbaum, and McFarland 2007; Fredrick, and Szymanski 2001; LaRoche, Lussier, and Roy 2008; Mann, and Jones 1999; Shellock, and Prentice 1985; Smith 1994) and post-activity stretching (Marek, Cramer, Fincher, Massey, Dangelmaier, and Purkayastha 2005; Stone, Ramsey, O'Bryant, Ayers, and Sands 2006). Seventy-five out of 76 respondents attested they had their basketball players perform pre-activity warm-ups.

Current trends show that dynamic stretching is the preferred recommended method of flexibility that should take place before an athletic training session or game competition (Ce, Margonto, Casaco, and Veisteinas 2008; Fredrick, and Szymanski 2001; Herda, Cramer, Ryan McHugh, and Stout 2008; LaRoche, Lussier, and Roy 2008; Mann, and Jones 1999; McMillian, Moore, Hatler, and Taylor 2006; Shellock, and Prentice 1985; Torres, Kraemaer, Vingren,

Volek, Hatfield, Spiering, Ho, Fragala, Thomas, Anderson, Hakkinen and Marsh 2008; Yamaguchi, and Ishii 2005), and not static-stretching (Church, Wiggins, Moode, and Crist 2001; Evetovich 2003; Fowles, Sale, MacDougall 2007; Janot, Dalleck, and Reymont 2007; Kokkonen, Nelson, and Cornwell 1998; Marek, Cramer, Fincher, Massey, Dangelmaier, and Purkayastha 2005; Nelson, Kokkonen, Arnall,2005; Young, and Behm 2003) for basketball practices. Out of 68 responders to the question of what best describes their pre-activity stretching, 22 out of 68 coaches declared that dynamic flexibility best describes their pre-activity stretch, which coincides with recommended research suggestions. The majority (56.5%) of the coaches responded that they used a combination of dynamic stretching and of ballistic, static, and PNF stretches. The bulk of current research does not support the use of static, ballistic, and PNF stretches (Bishop 2003(a); Bishop 2003 (b);Bradley, Olson, and Portas 2007; Burkett, Phillips, and Ziuraitis 2005; Faigenbaum, and McFarland 2007; Knudson 2007; Kovacs 2006; Stretching Review 2009) before a basketball contest, it noted that only 10.3% (7 out of 68) are still using static/ballistic/PNF to describe their pre-activity stretching. Two studies (Bradley, Olson, and Portas 2007; Woolstenhulme, Griffiths, Woolstenhulme, and Parcell) recommended that ballistic stretching should be used in pre-exercises, however this form of stretching is often times not supported by research (Bradley, Olson, and Portas 2007; LaRoche, Lussier, and Roy 2008) It is also noted that PNF stretching after warm-up has shown significant increases in range of motion (Sharmann, and Cresswell 2006; Wenos, and Konin 2004)

It is generally recommended that basketball players should perform some type of post-activity stretching, specifically static-stretching after exercise. The results from this study showed that only 40.8% (31 out of 76) of coaches use post-activity stretching, whereas 59.2% do not (45 out of 76) The results from the study also show that 51.6 % of coaches stated that

ballistic/static/PNF stretches are their primary sources of post-activity stretches. This information details that little more than half of the coaches that implement post-activity stretches into their program are following research recommendations.

One of the most interesting pieces of data is the fact that not one coach had a certification from any strength and conditioning organizations; however 81.3% stated that they held membership with the National Association of Basketball Coaches (NABC) and 40% stated they held a state coaching membership. It is not known if either of the coaching memberships recommended strength and conditioning certifications throughout the clinics and literature. The lack of any strength and conditioning certifications at the division I level could be based in large part by the fact that most schools have strength and conditioning coaches on the athletic staff. Another interesting piece of data shows that parallel similarities exist between division I and division III coaches when it comes to describing the pre-activity stretching routines (Table 3). It is concluded that basketball coaches are implementing flexibility practices into their programs; however there seems to be little improvements into following the proper recommendations from past research.

The questionnaire has some possible limitation, because many of the division 1 coaches noted that their strength and conditioning coaches designed their flexibility protocol, however they did the best that they could to answer the questions. Their specific amount of knowledge related to the subject matter may not have been as accurate as the division III coaches that seemed not to rely on strength and conditioning coaches. This information may provide further research to evaluate basketball coaching practices throughout different levels of competition.

Strengths and Limitations

When looking at the results of this study, it is obvious there are several strengths and weaknesses of the research. This research was created via email. Although this process did create some limitations, it became a strength because it allowed coaches to complete the survey at an appropriate time that would seemingly allow them to give a better effort without the pressure of any time constraints. Another strength of this study is that the respondents were nearly split down the middle from NCAA division-I and NCAA division-III schools.

A limitation of the study is the fact coaches did not inquire about any difficulty that had in answering the survey questionnaire, which led to some surveys that ultimately ended up not completed that could not be used in the final tabulations. Another limitation was the fact that there was a relatively low number of Division-I head coaches responded to the survey.

Recommendations

This study suggests that basketball coaches need to implement more scientifically appropriate flexibility practices within the context of their respective team. This can be done with a commitment from coaches to understanding and keeping up-to-date with current research and also with a commitment from coaches education programs to teach literature and follow-up with coaches receiving certifications.

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Appendix A

Dear Basketball Coach,

Attached to this email you will find a very brief questionnaire about the warm-up, cool-down and stretching practices you use with your collegiate basketball players. I am doing a study on the pre-activity and post- activity practices of collegiate basketball programs in the United States.

Please take a few moments and fill out the attached questionnaire. We hope to use the information that you give us to create a database of information on characteristics of warm-up and flexibility practices' being used by Division-1 and Division-3, collegiate basketball coaches across the United States.

If you decide to participate, you will complete an online questionnaire requiring approximately 5 minutes. I cannot and do not promise that you will receive any direct benefits from this study. This information may be used to help make recommendations to the USA Basketball or the National Strength and Conditioning Association concerning current practices. The more detailed and accurate information you provide, the better we can help you in the future. At the conclusion of this study, a summary of the results will be provided to you, if desired.

We have enclosed a hyperlink to a questionnaire regarding multiple aspects of your current warm-up and flexibility practices. We would appreciate it if you would complete the questionnaire and return it to us before April 25.

If you decide to participate in this study, you are free to withdraw your consent at any time with no penalty to you.

If you have any questions regarding this research or your rights as a subject, we want you to contact Lawrence Judge at 765-285-4211 or via email at lwjudge@bsu.edu. Additionally, for information regarding the rights of a research subject, the following person may be contacted: Coordinator of Research Compliance, Office of Academic Research and Sponsored Programs, Ball State University, Muncie, IN 47306, 765-285-5070.

You are making a decision whether or not to participate in this study. Your completion and submission of the online questionnaire will serve as your active consent indicating that you have decided to participate in this study entitled "*An Examination of Pre-Activity and Post-Activity Stretching Practices of Men's Collegiate Basketball Programs*" having read the information provided in this email. Please click on the link below to begin completing the survey.

http://www.surveymonkey.com/s.aspx?sm=qOEUjdrVj0a6_2fWfAq74hsg_3d_3d

Yours in sport,

Michael Prichard

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Appendix B

FLEXIBILITY PRACTICES IN MEN'S BASKETBALL QUESTIONNAIRE

PART I: PERSONAL INFORMATION

1. Title that best describes you:
 - a. Head Basketball coach
 - b. Assistant Basketball coach
 - c. Graduate Assistant Basketball coach

2. Age_____

3. Sex:
 - a. Male
 - b. Female

4. Institution_____

5. Division
 - a. I
 - b. III

6. Institution's conference affiliation_____

7. College Basketball Coaching Experience:
 - a. Years as a HEAD college basketball coach_____

 - b. Overall years coaching college basketball_____

8. Highest level of education completed:
 - a. High School
 - b. College Degree
 - c. Graduate degree
 - d. Doctorate

9. If you have an undergraduate degree, what was it in:
 - a. Physical Education
 - b. Exercise Physiology
 - c. Biomechanics
 - d. Sport Administration
 - e. Other_____

10. Certifications or Membership (mark all that apply):

- a. NABC
- b. State basketball coaching membership
- c. CSCS
- d. CSCS, *D
- e. NSCA-CPT
- f. NSCA-CPT, *D
- g. SCCC
- h. MSCC
- i. OTHER _____
- j. No certification

11. Highest Level of Participation:

- a. Played professional basketball
- b. Played college basketball
- c. Didn't play college or professional basketball

PART II: PRE & POST ACTIVITY WARM-UP, COOL DOWN & STRETCHING

12. Do you do any type of 'stretching' prior to activity?

- a. Yes
- b. No (skip to question 16)

13. Who designed/conducts pre-activity the activity warm-up and flexibility

- a. Strength Coach
- b. Assistant Basketball Coach
- c. Head Basketball Coach
- d. Athletic Trainer

14. If yes, which of the following best describes your pre-activity 'stretching':

- a. Static stretching / Ballistic / PNF
- b. Dynamic flexibility
- c. Combination of 'a' and 'b'

15. If yes, approximately how long does the 'stretching' usually take:

- a. Less than 5 minutes
- b. 5-10 minutes
- c. 10-15 minutes
- d. Longer than 15 minutes

16. Do you do any type of 'general' warm-up prior to your basketball practices / competitions?

- a. Yes
- b. No (skip to question 19)

17. If yes, which of the following best describes your 'general' warm-up prior to basketball practice / competition:
- Jogging, form running
 - Lay ups and other team drills
 - Neither
18. If yes, approximately how long does the 'general' warm-up take?
- Less than 5 minutes
 - 5-10 minutes
 - 10-15 minutes
 - Longer than 15 minutes
19. Do you do any type of 'stretching' post-activity?
- Yes
 - No (skip to question 19)
20. If yes, which of the following best describes your post-activity 'stretching':
- Static stretching / Ballistic / PNF
 - Dynamic flexibility
 - Combination of 'a' and 'b'
21. If yes, approximately how long does the 'stretching' usually take:
- Less than 5 minutes
 - 5-10 minutes
 - 10-15 minutes
 - Longer than 15 minutes
22. Do you do any type of 'cool down' post-activity?
- Yes
 - No (skip to question 22)
23. If yes, which of the following best describes your post-activity 'cool down':
- Jogging
 - Low Intensity Basketball
 - Exercise Bike/ Elliptical Machine
 - Other_____
24. If yes, approximately how long does the 'cool down' usually take:
- Less than 5 minutes
 - 5-10 minutes
 - 10-15 minutes
 - Longer than 15 minutes
24. How often would you say your athletes complete the full post-activity flexibility routine?
- Always

- b. Almost always
 - c. Sometimes
 - d. Rarely
 - e. Never
25. How often would you say your athletes complete the full post-activity cool down?
- a. Always
 - b. Almost always
 - c. Sometimes
 - d. Rarely
 - e. Never
26. Do your athletes get soft tissue work (i.e. massage) at least once every two weeks?
Yes/No
27. Would you say that flexibility is an area that most Basketball players can improve?
Yes/No
28. Do you think that pre-activity flexibility work helps prevent injuries in Basketball?
Yes/No
29. Do you think that post-activity flexibility work helps prevent injuries in Basketball?
Yes/No
30. Do you think that pre-activity flexibility work helps improve performance in Basketball?
Yes/No
31. Do you think that post-activity flexibility work helps improve performance in Basketball?
Yes/No
32. When should stretching be emphasized the most for basketball players?
- a. Pre-activity
 - b. Post-activity
 - c. Both times are equally important
 - d. Neither

PART III: KNOWLEDGE ACQUISITION

33. If you do a pre-activity 'warm-up', what or who is the main source of information that helped you decide what the 'warm-up' consists of?
- a. Strength & Conditioning Coach
 - b. Another Basketball Coach

- c. Non-Basketball Coach
 - d. Media (Books, Videos, Online, etc.)
 - e. Coaches Education Program
 - f. Other_____
34. If you do a post-activity ‘cool down’, what or who is the main source of information that helped you decide what the ‘cool-down’ consists of?
- a. Strength & Conditioning Coach
 - b. Another Basketball Coach
 - c. Non-Basketball Coach
 - d. Media (Books, Videos, Online, etc.)
 - e. Coaches Education Program
 - f. Other_____
35. If you do pre-activity ‘stretching’, what or who is the main source of information that helped you decide what the pre-activity ‘stretching’ routine should consist of?
- a. Strength & Conditioning Coach
 - b. Another Basketball Coach
 - c. Non-Basketball Coach
 - d. Media (Books, Videos, Online, etc.)
 - e. Coaches Education Program
 - f. Other_____
36. If you do post-activity ‘stretching’, what or who is the main source of information that helped you decide what the post-activity ‘stretching’ routine should consist of?
- a. Strength & Conditioning Coach
 - b. Another Basketball Coach
 - c. Non-Basketball Coach
 - d. Media (Books, Videos, Online, etc.)
 - e. Coaches Education Program
 - f. Other_____

Appendix C

April 28, 2009

Dear Basketball Coach,

About three weeks ago, I sent you a link pre-activity and post-activity survey. I asked you to help us with this very important survey examining your flexibility practices. But, unfortunately we have not received it yet. If you have already completed your questionnaire, thank you very much. If you have not completed the questionnaire, please complete it and send it soon. I understand the demands of being a coach so I truly appreciate your time and your assistance.

I have included another link to the questionnaire with this letter. We hope to use the information that you give us to create a data base of information on characteristics of warm-up and flexibility practices' being used by collegiate basketball coaches across the United States. The more detailed and accurate information you provide, the better we can help you in the future. At the conclusion of this study, a summary of the results will be provided to you if desired.

We would appreciate it if you would complete the questionnaire and return it to us before May 5. If you decide to participate in this study, you are free to withdraw your consent at any time with no penalty to you.

If you have any questions regarding this research or your rights as a subject, we want you to contact Lawrence Judge at 765-285-4211 or via email at lwjudge@bsu.edu. Additionally, for information regarding the rights of a research subject, the following person may be contacted: Coordinator of Research Compliance, Office of Academic Research and Sponsored Programs, Ball State University, Muncie, IN 47306, 765-285-5070.

You are making a decision whether or not to participate in this study. Your completion and submission of the online questionnaire will serve as your active consent indicating that you have decided to participate in this study entitled "*An Examination of Pre-Activity and Post-Activity Stretching Practices of Men's Collegiate Basketball Programs*" having read the information provided in this email. Please click on the link below to begin completing the survey.

http://www.surveymonkey.com/s.aspx?sm=qOEUjdrVj0a6_2fWfAq74hsg_3d_3d

Table 1. Participant Demographics and Strength and Condition Certifications.

Job Title	Division	Count	# Certified Strength and Conditioning Coach	Percentage Certified
Head Coach	1	8	0	0
Head Coach	3	30	0	0
Assistant Coach	1	29	0	0
Assistant Coach	3	12	0	0
Graduate Assistant Coach	1	1	0	0

Table 2. Which describes your post activity stretching

Type of Flexibility	NABC Membership count	No Membership count	Total	Percentage
Static stretching / Ballistic / PNF	5	11	16	51.6
Dynamic Flexibility	2	0	2	6.5
Combination	1	12	13	41.9
Total	8	23	31	100

Table 3: Breakdown of Similar Responses (6.5% ±) by Division I and Division III Coaches

Research Answers	Division I Ratio	Division I Percentage	Division III Ratio	Division III Percentage
Highest level of playing participation is college	26 out of 38	68.4%	30 out of 42	71.4%
Undergraduate degree is in P.E.	10 out of 38	26.3%	8 out of 40	20.0%
Holds a state coaching membership	14 out of 38	36.8%	18 out of 42	42.9%
Static/Ballistic/PNF stretching best describes their pre-activity stretching	3 out of 33	9.1%	4 out of 35	11.4%
Dynamic flexibility best describes their pre-activity stretching	12 out of 33	36.4%	11 out of 35	31.4%
A combination of static/ballistic/PNF stretching and dynamic stretching best describes their pre-activity stretching	20 out of 33	60.6%	20 out of 35	57.1%
Does not participate in post-activity stretching	21 out of 35	60.0%	26 out of 40	65.0%
Does not participate in post-activity cool down	29 out of 35	82.9%	32 out of 40	80.0%
Believes post-activity flexibility prevents injuries	31 out of 37	83.8%	36 out of 40	90.0%
Believes pre-activity flexibility improves performance in basketball	32 out of 37	86.5%	35 out of 40	87.5%

Table 4: Breakdown of Different Responses (12.5% ±) by Division I and Division III Coaches

Research Questions	Division I Ratio	Division I Percentage	Division III Ratio	Division III Percentage
Highest level of Education is graduate degree	16 out of 38	42.1%	31 out of 42	73.8%
National Association of Basketball Coaches Member	36 out of 38	94.7%	29 out of 42	69.0%
Strength & Conditioning Coach is main Source to decide on pre-activity warm-up	26 out of 31	83.9%	16 out of 33	48.5%
Strength & Conditioning Coach is main Source to decide on pre-activity stretching.	29 out of 32	90.6%	17 out of 30	56.7%
Strength & Conditioning Coach designs and conducts the pre-activity, the warm-up and flexibility	28 out of 34	82.4%	8 out of 35	22.9%
The head coach designs and conducts the pre-activity, the warm-up and flexibility	1 out of 34	2.9%	20 out of 35	57.1%
The pre-activity stretch last between 5-10 minutes	25 out of 34	73.5%	21 out of 35	60.0%
The general warm-up takes longer than 15 minutes	7 out of 34	20.6%	3 out of 40	7.5%
Lay-ups and team drills best describe pre-activity warm-up	22 out of 35	62.9%	30 out of 40	75.0%
Athletes get soft-tissue every two weeks	9 out of 35	25.7%	1 out of 40	2.5%