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An Examination of Pre-Activity and Post-Activity Stretching Practices of NCAA Division I and NCAA Divison III Basketball Programs

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Abstract
The purpose of this study was to determine if NCAA Division I and III men's basketball programs were in compliance with recommended pre- and post-activity stretching protocols. Questionnaires were sent to 500 NCAA Division I and Division III programs in the United States. Seventy-six coaches (75 males & 1 female) participated in the study. Chi-Square analysis ($\chi^2(3,n=69) = 42.29$, $p \leq 0.001$) indicated a greater combined percentage of static/pnf/ballistic stretches (10.14%, n=7) and combination of stretches (57.97%, n=40) than expected as compared to dynamic stretches (31.89%, n=22). Participants were asked during what period (pre- or post-activity) stretching should be emphasized. The results were significantly different from expected ($\chi^2(4,n=76) = 129.28$, $p \leq 0.001$), with a greater percentage of pre-activity stretches (26.31%, n=20) and both pre- and post-activity of stretches (60.52%, n=46) being reported as compared to post-activity stretches (13.15%, n=10). Some results seemed to be in conflict with current recommendations in the literature regarding pre-activity stretching practices.

Key Words: dynamic flexibility, cool-down, static flexibility, warm-up

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An Examination of Pre-Activity and Post-Activity Stretching Practices of NCAA Division I and NCAA Divison III Basketball Programs.

This article examines the extent to which stretching practices in college basketball programs comply with current recommendations set forth in the literature. Coach Wooden often spoke about the need to incorporate the latest professional knowledge into practices:

"Of course knowledge is never static or complete. A leader who is through learning is through. You must never be satisfied with your ability or level of knowledge." The Coach even had a large sign prominently displayed in his office to remind him of the need for lifelong learning. It simply read,

"It's what you learn AFTER you know it ALL that counts."

Introduction

A training program for basketball athletes must be developed to systematically and progressively build the proper physiological abilities and fundamental skills. The tremendous number of variables involved in maximizing performance and the training effect makes the physical training procedure a conundrum. Scientific research is accepted as an accurate and efficient way of obtaining information regarding the best practices and training methods for the optimal performance in basketball (Craig & Judge, 2009). While researchers are continually investigating methods to improve performance, it is important for basketball coaches to stay current with the available research. Yet, there is often a lag of months or years between the knowledge within the sport science community and the generally accepted practice among coaches.

In a sport like basketball, which requires explosive strength, training protocols that influence the mechanical performance of subsequent muscle contractions should be addressed (Chiu et al., 2003). A variety of approaches to stretching have been investigated by the coaching, scientific, and physiotherapy communities. competent coaches (Schempp et al. 2006). A study with Canadian coaches supports this recommendation (Young, Jemczyk, Brophy, & Côté, 2009). In a comparison of local to national level coaches, the national coaches were found to have had more mentoring experience, completed more coaching courses, and attended more workshops and symposiums than the local level coaches (Young et al. 2009). This has found to be especially important with team-sport coaches (Gilbert, Lichtenwaldt, Gilbert, Zelezny, & Côté, 2009). Another study revealed that there was a difference in preferred method of future training sources between coaches who wanted to move up to the next level and those who did not, with those who wanted to advance prioritizing formal coaching certification programs (Erickson et al. 2008).

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Types of Stretching

There are essentially two categories of stretching employed on a regular basis among athletes as part of a complete flexibility procedure: pre-activity stretching (Behm, Button, & Butt, 2001; Fry, McLellan, Weiss, & Rosato, 2003; Nelson, Kokkonen, & Arnall, 2005) and post-activity stretching (Hunter & Marshall, 1992; Kerrigan, Xenopoulus-Oddson, Sullivan, Lelas, & Riley, 2003). Static stretching, ballistic stretching, proprioceptive neuromuscular facilitation stretching (PNF), and dynamic stretching are the specific types of stretching predominantly used by athletes, coaches, and athletic trainers in pre- or post-activity.

Static stretching, the most commonly used protocol among athletes and coaches, requires the holding of a stretch position with little or no movement for a length of time (Mann & Whedon, 2001). Ballistic stretching involves an active muscular effort and uses a bouncing-type movement in which the end position of the stretch is not held (Baechle & Earle, 2008). PNF stretching PNF combines static stretching with isometric contractions of either the stretched muscle or the muscle's agonist to increase the range of motion (ROM) attainable during the stretch. PNF stretching techniques are commonly used in the athletic and clinical environments to enhance both active and passive range of motion. PNF is considered the most effective stretching technique when the aim is to increase the range of motion (Sharman & Cresswell, 2006). Dynamic stretching exercises emphasize progressive, whole-body, continuous movement. These exercises are typically performed in running drills that include forward, lateral, and change-of-direction movement (McMillian, Moore, Hatler, & Taylor, 2006). Examples of dynamic stretching exercises include common track and field form running drills like A's (bring knee up, then rapidly kick foot down), B's (bring knee up, then kick foot out), and high knees (bring ankle up and over the knee). Additional examples of dynamic stretches include arms circles, walking lunges (without weights) and medicine ball exercises. Dynamic stretching allows for flexibility activity during the rehearsal of a sport-specific movement, such as jumping (Stone, Ramsey, Kinser, O'Bryant, Ayers, & Sands, 2006).

It can be argued that to most effectively prepare strength or power athletes for a specific sport activity, the pre-activity routine should readily address the concept of movement pattern specificity, but what combination of a general warm-up and stretching best prepares the athlete? The answer can be found in current research (Stone et al., 2006).

Current Research

The hypothetical objective of the pre-activity warm-up and stretching is to optimize performance and diminish the incidence of injury through augmented muscle temperature, muscle compliance, and efficiency of physiological responses. A properly planned pre-activity protocol will bring about a range of physiological changes that will improve performance during training activity or competition. The flexibility literature suggests athletes should perform a "general" warm-up routine prior to activity (Cè, Margonato, Casasco, & Veisteinas, 2008; Hedrick, 1992; LaRoche, Lussier, & Roy, 2008; Mann & Jones, 1999; Ninos, 1995; Torres et al., 2008; Yamaguchi & Ishii, 2005), stretching routine prior to activity (Fredrick & Szymanski, 2001: LaRoche et al., 2008; Mann & Jones, 1999), and a stretching routine post activity (Stone et al., 2006).

Research reporting the usage of pre-activity warm-up and stretching and post-activity stretching has shown stretching methods recommended a few decades ago, such as ballistic stretching (1960's), were replaced

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with a static and/or PNF stretching (1980's), and then by dynamic stretching (present). The current accepted practice is that dynamic flexibility stretching (not static, PNF, or ballistic-type stretches) should be used prior to activity (Behm et al., 2001; Cè et al., 2008; Egan, Cramer, Massey, & Marek, 2006; Fredrick, & Szymanski, 2001; LaRoche et al., 2008; Mann & Jones, 1999; Ninos, 1999; Siatras, Mittas, Maneletzi, & Vamvakoudis, 2008; Torres et al., 2008; Unick, Kieffer, Cheesman, & Feeney, 2005; Winchester, Nelson, Landin, Young, & Schexnayder, 2008; Yamaguchi & Ishii, 2005; Young & Elliott, 2001). Current research suggests athletes should perform static-style stretching following exercise (Egan et al., 2006; Nelson & Bandy, 2008; Stone et al., 2006; Swanson, 2008).

Coaches Certification

While some coaches are cognizant of current sport science research trends, many traditional strength and conditioning practices are being used by coaches who are unaware or un-accepting of current scientific understandings (Judge, Bodey, Bellar, & Bottone, 2010; Judge, Craig, Baudendistal, & Bodey, 2009). Moreover, coaches' education and certification programs for basketball coaches, strength and conditioning coaches, and athletic trainers should provide a solid physiological basis for stretching protocols. Judge et al. (2009) found 91.7% of responding Division I FBS coaches obtained a professional certification as compared to 18.2% of division III coaches. However, only 26% of football coaches reported activities consistent with the literature recommended pre-activity stretching practices. In a related study of division I women's volleyball programs, 51.8% of respondents reported a volleyball specific coaching certification (Judge et al., 2010). Yet, 48.3% of certified volleyball coaches indicated they were not following suggested practices (Judge et al., 2010).

NCAA Division I basketball programs may also have the added benefit of working with strength and conditioning coaches. Most strength coaches and some basketball coaches are certified through the National Strength and Conditioning Association (NSCA). The NSCA Certified Strength and Conditioning Specialist (CSCS) program was created in 1985 to certify individuals who possess the knowledge and skills to design and implement safe and effective strength and conditioning programs (NSCA, 2009). In order to pass the certification exam individuals must possess knowledge in the scientific foundations of warm-up, stretching, cool down, periodization, nutrition, and strength and conditioning, as well as demonstrate the skills to apply that knowledge.

NCAA Division I university athletic departments typically operate with larger budgets and a larger, more specialized staff (e.g., assistant coaches, athletic trainers, strength & conditioning coaches, etc.) compared to the NCAA Division III athletic departments which are unable to offer athletic scholarships (Fulks, 2005). NCAA Division I basketball programs often have a strength and conditioning coach to design and sometimes conduct warm-up and flexibility routines prior to practices and competitions, while most NCAA Division III basketball programs do not have the budgetary resources to hire a basketball strength coach. It is unknown if the difference in budget and ultimately staffing at NCAA Division I and NCAA Division III basketball programs has an impact on warm-up and flexibility routines.

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Purpose of the Study

The purpose of this study is to determine the pre- and post-activity stretching practices of men's Division I and Division III basketball programs and to explore whether division I and division III basketball programs utilize pre- and post-activity protocols that reflect the current best practices espoused by literature. These would include the use of dynamic stretches during the pre-activity warm-up and static flexibility exercises during the post-activity cool down (Table 1).

Table 1

Best Pre-activity and Post-activity Practices

Period	Type of Activities	Purpose
General Warm-up	Jogging Skipping Jump Rope	Increase Heart Rate Increase Muscle Temp Increase Metabolic Rate
Sport Specific Warm-up	Sport Specific Drills Lay-ups Shooting Drills Passing Drills	Prepare for specific demands of the sport while elevating metabolic rate and temperature.
Pre-Activity Stretching	Dynamic Stretches	Challenge the range of motion without reducing the stretch shortening potential of the athletes
Post-Activity Stretching	Static Flexibility	Increase range of motion

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Method

Sampling Procedure

The purpose of this study was to ascertain stretching practices conducted in men's division I and division III basketball programs. To avoid redundancy, only one coach per program (the head coach) was contacted about the study. The assumption was that the head coach would complete the survey instrument or direct the staff member responsible for stretching activities to complete the survey instrument. Current email addresses for all division I and division III head men's basketball coaches were obtained from the 2008-2009 NCAA Coaches Directory. An introductory email explained the purpose of the study and provided a hyperlink to the institutional review board approved, web based informed consent, and survey instrument. Data was collected during a four-week period in May/June 2009. Early off-season was determined to be the best timeframe to maximize coaches' recall of stretching practices used during the previous season and coaches' participation in the study. A reminder email was sent to non-respondents two weeks and four weeks after the initial email in an effort to increase the overall response rate.

Instrumentation

The authors designed an institutional review board approved survey instrument to gather demographic and educational background information as well as specific pre- and post-activity practices. The survey instrument consisted of 33 questions. The first part of the questionnaire (nine questions) focused on the participant's personal and educational background information, whereas the second half (24 questions) pertained to the pre- and post-activity stretching practices used with the basketball players. Content validity was established in two ways. The survey was reviewed by experts for clarity and the construction of questions, and only minor editing was required to improve the clarity of the questions. Wording of the questions was designed to include descriptive information to counteract against misunderstanding of key terminology. For example, confusing terms such as "warm-up" and "stretching" were defined in more detail for the respondent. Questions were similarly worded to maximize participant comprehension; previous research using a similar survey instrument did not reveal any difficulty with participant comprehension (Judge, Bodey, Bellar, & Bottone, 2010; Judge, Craig, Baudendistal, & Bodey, 2009). Principal component analysis was used to compare similarity in response. KMO statistics (>0.600) suggested the instrument had adequate construct validity.

Statistical Analysis

Descriptive statistics included frequency counts, means, and standard deviations. These variables were calculated for the demographic and educational background as appropriate. The pre- and post-activity stretching methods were placed into three categories for analysis. The first category which includes static, PNF, and ballistic stretching, utilizes pre-activity stretching methods contra-indicated by current research. The second category which includes dynamic stretching utilizes a pre-activity method supported by current research. The third category which includes dynamic and static stretching utilizes a combination of two pre-activity methods employed by coaches. The first of these pre-activity stretching methods in category three (dynamic) is supported by current research, while the second method (static stretching) is an outdated pre-activity stretching method not supported by current research (Stone et al., 2006), but is still practiced by many coaches (Judge et

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al., 2010; Judge et al., 2009). Any form of pre-activity static stretching is contra-indicated by current research even if it is paired with an appropriate pre-activity protocol (Winchester, et al., 2008). Furthermore, in order to allow for consistency in analysis similar groupings were used for the post-activity period. The two principal questions about pre-activity stretching practices were examined via chi-squared tests of expected distribution for alignment with current research supported best practices. Statistical significance was set a priori at $p<0.05$.

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Results

From the 500 Division I and Division III men's basketball programs, 76 coaches returned completed usable surveys. This represents 15.2% of a finite population. The low response rate may have resulted from the following factors: a) spam control software may have sorted introductory and follow-up emails into a bulk mail folder; b) coaches may not have been interested in the topic or may not have perceived a tangible benefit from study participation; and c) coaches may not have had sufficient time to complete the survey instrument due to the recruiting calendar (e.g., placed on "to-do" list). While the response rate is relatively low by traditional standards, review of institution and conference affiliation data suggests the sample is representative of division I and division III men's basketball programs.

Demographic Information

The subjects ranged in age from 23 years to 62 years old (Table 2). The mean age of the participants was 38.13 (SD = 10.69) years. The participants reported 7.89 (SD = 8.07) years of head coaching experience and 13.48 (SD= 9.59) years of total coaching experience. The vast majority of participants were male (98.8%). More participants reported working at division III institutions (53.1%) than division I institutions (46.9%).

Table 2
Subject Characteristics

Variable		Mean or Percent	*SD*
Age		38.13yrs	10.69
Years of Head Coaching Experience		7.89yrs	8.07
Years of Basketball Coaching Experience		13.48yrs	9.59
Gender	male	98.8% (n=80)	
	female	1.2% (n=1)	
NCAA Div	I	46.9% (n=38)	
	III	53.1% (n=43)	

Table 2: Participant characteristics given in means with standard deviations or in percent of total with count

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Current Pre-Activity Warm-up and Stretching

Seventy-five out of seventy-six respondents did some type of general warm-up prior to basketball practices and competitions. Of these seventy-five, 52 used lay-ups and other sport-specific 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 reported the general warm-up lasted between 5-10 minutes, 14 reported less than 5 minutes, 12 reported between 10-15 minutes, and nine reported greater than 15 minutes in length.

Seventy of 76 coaches performed some form of pre-activity stretching following the general warm-up (Table 3). Eight indicated using either static, /ballistic, or /PNF stretching; 22 used dynamic stretching, and 39 used a combination of static or dynamic stretching. Nine coaches used pre-activity stretching that lasted between 5-10 minutes, 61 took greater than 10 minutes, and another six lasted less than 5 minutes.

Table 3

Pre-Activity Stretching Practices and Durations of Participants' Teams

			Time	
Type	Count	%	5-10 min	>10 min
Static, Ballistic or PNF	8	10.5%	4	4
Dynamic	22	28.9.8%	5	18
Static & Dynamic	39	51.3.7%	0	39
None	6	7.8%	-	-
Total	76	100%	45	25

Current Post-Activity Cool Down and Stretching

Sixteen out of 76 respondents indicated athletes completed a post-activity cool down (Table 4). Eleven of the 16 respondents described post-activity cool down as low-intensity basketball activity, one stated jogging, and four specified "other" (e.g., light band movements, shooting free-throws, low-intensity jump-rope, and stance/slide movements). Fourteen coaches reported the cool-down lasted 5-10 minutes, one indicated less than 5 minutes, and one indicated between 10-15 minutes. Four of 16 coaches indicated that players almost always complete the full post-activity cool-down, six reported players almost always complete the full post-activity cool-down, five reported players sometimes complete the full post-activity cool down, and one reported players rarely complete the cool-down.

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Thirty-one of 76 respondents reported stretching post-activity (Table 4). Twenty-four coaches reported stretching routines lasted between 5-10 minutes, five reported 10-15 minutes, and two reported less than 5 minutes. Sixteen coaches described post-activity stretching as static, /ballistic, or/PNF stretches, two used dynamic stretching, and 13 used a combination of static, /ballistic, /PNF and dynamic stretching methods.

Table 4

Post-Activity Stretching Practices and Durations of Participants' Teams

			Time	
Type	Count	%	5-10 min	>10 min
Static, Ballistic or PNF	16	21.0%	10	4
Dynamic	2	2.6%	1	1
Static & Dynamic	13	17.1%	13	0
None	45	59.2%	-	-
Total	76	100%	24	5

Division I versus Division III Comparisons

Some key noted data when comparing coaches by division shows that 60.6% (20 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 of 35) stated the same at the division III level. Of the respondents at the division I level, 36.4% (12 of 33) stated dynamic flexibility best describes their pre-activity stretching, whereas 31.4% (11 of 35) respondents stated the same at the division III level, while 9.1% (3 of 33) stated static/ballistic/PNF stretching best describe their pre-activity stretching compared to 11.4% (4 of 35) stated the same at the division III level.

Some other divisional data illustrates that 73.8% (31 of 42) coaches at the division III level had obtained a graduate degree, whereas 42.1% (16 of 38) had at the division I level. Of coaches at the NCAA Division I level, 82.4% (28 of 34) reported that a strength and conditioning coach designs and conducts the pre-activity, activity, and warm-up, whereas 22.9% (8 of 35) stated the same at the division III level.

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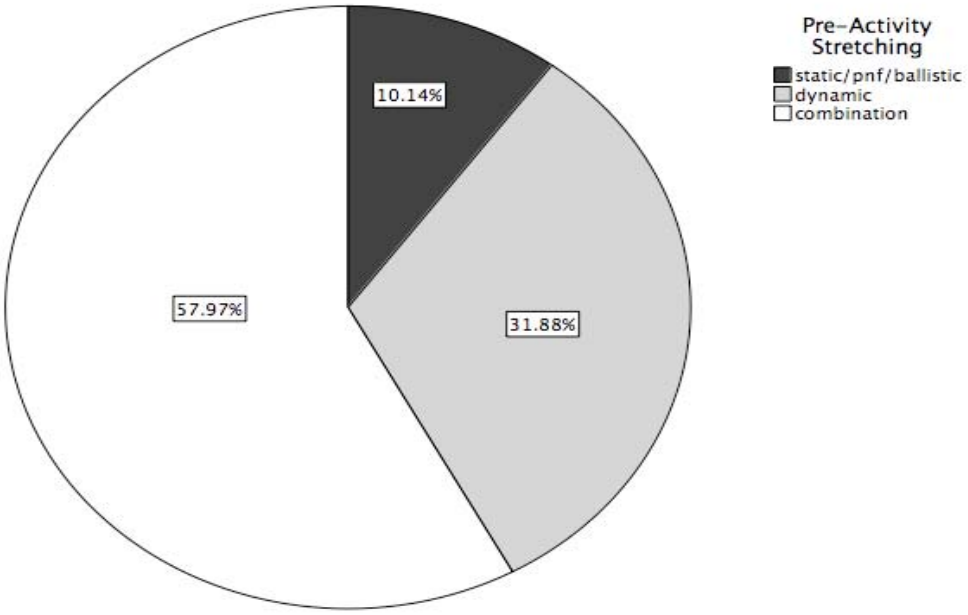
Results Compared to Current Research Conclusions

To evaluate the reported pre-activity flexibility activities used by the respondents, chi-square tests of expected distribution (corrected for multiple comparisons) were run to determine if the responses were in line with current research-based best practices (for type of stretches performed and period stretches were performed). For pre-activity stretching the expected distribution included a majority of responses for dynamic stretching. The distribution was significantly different from expected ($\chi^2(3,n=69) = 42.29$, $p \leq 0.001$) with a much greater combined percentage of static/ballistic/PNF stretching (10.14%, n=7) and combination of stretching (57.97%, n=40) in comparison with dynamic stretching (31.89%, n=22).

Figure 1: Pre-Activity Stretching Practices



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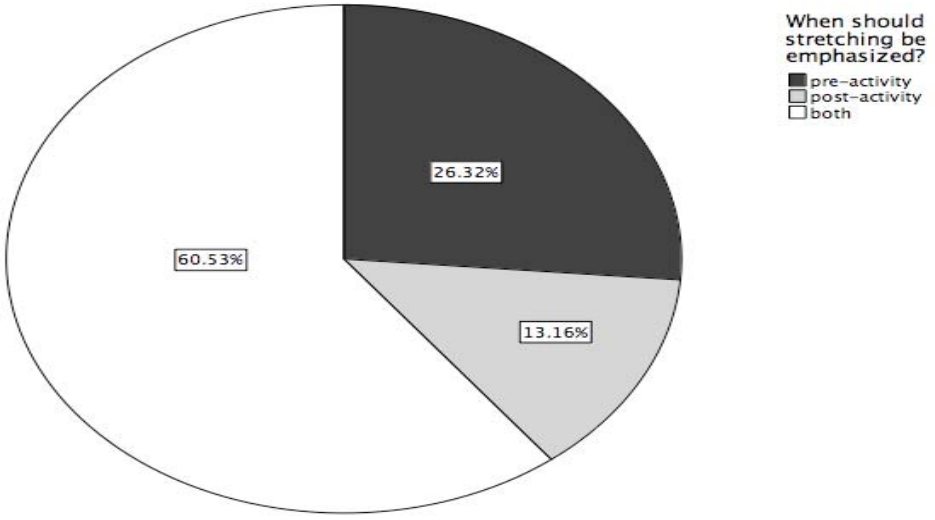
Participants were asked during what period (pre- or post-activity) stretching should be emphasized. The distribution was significantly different from expected ($\chi^2(4,n=76) = 129.28$, $p \leq 0.001$) with much higher percentage of pre-activity stretching (26.31%, n=20) and both pre- and post-activity stretching (60.52%, n=46) than expected as compared to post-activity stretching (13.15%, n=10).

Figure 2: Response to Time for Emphasis of Stretching



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Discussion

A properly designed pre-activity warm-up and stretching is intended to prepare the athlete for their specific sport practices and competitions. The research suggests a warm-up (preferably sport-specific) should be performed prior to stretching (Bishop, 2003a; Bishop, 2003b; Cè et al., 2008; Hedrick, 2003; Mann & Jones, 1999; Ninos, 1995; Torres et al., 2008; Yamaguchi & Ishii, 2005), and a subsequent stretching routine (preferably dynamic) should be performed prior to practice and competition (Faigenbaum, & McFarland 2007; Fredrick, & Szymanski 2001; LaRoche et al., 2008; Mann, & Jones 1999; Shellock, & Prentice 1985; Smith, 1994). Concurrent with the literature, 98.6% of basketball coaches reported completing a pre-activity warm-up. These findings are similar to Judge et al. (2009) which revealed 100% of the college football programs surveyed did a pre-activity warm-up and Judge et al. (2010) which revealed 100% of the women's college volleyball performed a pre-activity warm-up. The same survey instrument used in the current study was also used in both the football and volleyball studies.

Current research recommends dynamic stretching should be completed before basketball practices or competitions (Cè et al., 2008; Fredrick & Szymanski, 2001; Herda, Cramer, McHugh, & Stout, 2008; LaRoche et al., 2008; Mann & Jones, 1999; McMillian, Moore, Hatler, & Taylor, 2006; Shellock & Prentice, 1985; Torres et al., 2008; Yamaguchi & Ishii, 2005) rather than static stretching (Church, Wiggins, Moode, & Crist, 2001; Evetovich, Nauman, Conley, & Todd, 2003; Fowles, Sale, & MacDougall, 2007; Janot, Dalleck, & Reyment, 2007; Kokkonen, Nelson, & Cornwell, 1998; Marek et al., 2005; Nelson et al., 2005; Young & Behm, 2002; Young & Elliott, 2001). Of 70 respondents reporting the use of pre-activity stretching, 23 coaches (30.3%) reported using dynamic stretching as their pre-activity method. This is consistent with the research recommended protocol. However, 56.5% of coaches reported using a combination of dynamic stretching and static, /ballistic, and /PNF stretching and 11.6% use static, /ballistic, /PNF to describe their pre-activity stretching. Current literature does not support the use of static, /ballistic, and /PNF stretching prior to basketball practices and competitions (Bishop 2003a; Bishop, 2003b; Bradley, Olson, & Portas, 2007; Burkett, Phillips, & Ziuraitis, 2005; Faigenbaum & McFarland, 2007; Kovacs, 2006). Bradley et al. (2007) and Woolstenhulme, Griffiths, Woolstenhulme, & Parcell (2006) recommended using ballistic stretching during pre-exercise; however, this form of stretching is frequently not supported by research (Bradley et al., 2007; LaRoche et al., 2008). PNF stretching after warm-up is associated with significant increases in range of motion (Sharmann & Cresswell, 2006; Wenos & Konin, 2004).

This combination stretching may be limiting the explosive capabilities of basketball players and may have little or no effect on injury prevention (Shrier, 1999). Most available data indicates pre-activity static stretching can cause acute performance reduction relating to decreased tissue stiffness or alterations in nervous system components of the stretch-shortening cycle, such as the myotatic reflex (Stone et al., 2006). These alterations can result in decreased maximum strength and explosiveness and inferior performances on the basketball court (Ninos, 1999). However, the coaches in the present study appear to be hesitant to eliminate pre-activity static stretching.

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These findings differ from the reported pre-activity stretching practices of volleyball coaches (Judge et al., 2010) and of football coaches (Judge et al., 2009). Forty-two percent of volleyball coaches reported utilizing pre-activity dynamic stretching (Judge et al., 2010). Twenty six percent of football coaches indicated using only dynamic stretching prior to activity compared to 32.8% of basketball coaches in the present study. In both studies, a high percentage of football coaches (90%) and volleyball coaches (86%) reported including dynamic stretching as part of the pre-activity protocol compared to (89%) of basketball coaches in the present study. Yet, even though the coaches understood the value of dynamic stretching, many coaches failed to eliminate static stretching from the prescribed pre-activity routine. It may be that coaches are reluctant to remove static stretching because of dogmatic adherence to coaching practices passed on from previous generations (Judge et al., 2009).

It is typically recommended that basketball players perform static-stretching after exercise. Interestingly, 59.2% of basketball coaches in this study reported athletes do not complete any post-activity stretching protocol. This is somewhat higher than the 43.5% of football coaches who reported athletes do not complete any post-activity stretching protocol (Judge et al., 2009). Among those coaches who completed post-activity stretching, 51.6% reported static/ballistic/PNF stretching as their primary method. This means little more than half of the coaches that implement post-activity stretching into their program are following research recommendations. But this number is much lower when compared to post-activity flexibility reported by volleyball coaches (71.4%) (Judge et al., 2010).

Sixteen of 76 coaches (21.1%) reported that athletes complete a post-activity cool down. It can only be speculated why the post-activity cool down and stretching are not completed on a more consistent basis. Perhaps, due to the NCAA (2009) 20 hours of countable athletic activities rule, there is a lack of practice time to perform this cool-down and stretching and coaches are unable to make it a mandatory conclusion to daily practice. Venue scheduling and availability may also affect post-activity work as basketball coaches may have a small window of time to use the basketball court. Student-athletes have to balance class, practice, study, and competition and may not have time to complete a daily cool-down on their own in the locker room, training room, or another venue.

One of the most interesting findings is that there were no coaches who possessed a certification from any strength and conditioning organization. However, 81.3% reported membership with the National Association of Basketball Coaches (NABC), and 40% reported a state coaching association membership. It is not known if these coaching associations recommended strength and conditioning certifications at clinics and in published literature. USA basketball, the national governing body of the sport of basketball, does not currently offer a coach's education/certification program. The lack of division I basketball coaches with strength and conditioning certifications could be attributed to the fact that most institutions have a strength and conditioning coach on the athletic department staff.

Another interesting finding is the similarities between division I and division III programs in terms of the pre-activity stretching routines. It is concluded that basketball coaches are implementing flexibility practices

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into their programs; however, there seems to be little compliance with the proper protocols recommended in the literature. Perhaps fewer support staff and fewer certified professionals at the NCAA Division III level impact the likelihood of scientific-based stretching practices being incorporated into basketball programs.

Practical Applications

The results of this study suggest it is necessary for basketball coaches to re-evaluate their own practices, perhaps cross-checking them with the existing research. Although research supports dynamic warm-up/stretching over other forms of pre-activity protocols (Little & Williams, 2006; Stone et al., 2006), it appears that some basketball coaches are reluctant to completely discontinue traditional methods, such as pre-activity static stretching. This study suggests basketball coaches need to implement more scientifically appropriate flexibility practices within the context of their respective teams.

Basketball coaches at all levels could benefit from participating in certification programs, like the system offered by the NSCA, to learn current practices. As the knowledge base for warm-up and stretching strategies continues to evolve, basketball coaches should adapt their practices to ensure athletes are being properly prepared for training and competition. 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 coach's education programs to teach literature and follow-up with coaches receiving certifications.

Coaches should try to gain knowledge from as many professional sources as possible which can include the consultation with a certified strength and conditioning coach or athletic trainer, and participation in a coach's certification program. Proper sequencing of training affects function to further contribute to peak performance. Adhering to these recommendations would allow basketball programs to implement more appropriate flexibility (warm-up/cool-down, and stretching) routines for maximal benefits toward their respective team.

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