Pre-Activity and Post-Activity Stretching Perceptions and Practices in NCAA Division I Volleyball Programs

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Abstract

The purpose of this study was to determine if NCAA Division I women's volleyball programs were in compliance with suggested current pre- and post-activity stretching protocols. Questionnaires were sent to NCAA division I women's volleyball programs in the United States. Fifty six coaches (23 males & 33 females) participated in the study. Some results seemed to conflict with current suggested practices for pre-activity stretching. The results of this study indicate that certification may not influence how well research guidelines are followed. Further research is needed to delineate how these factors affect coaching decisions.

Key words: warm-up, stretching, flexibility

Introduction

To obtain optimal performance collegiate volleyball players should perform a pre-activity protocol that systematically and progressively stimulates the musculature athletes will utilize during training or in competition. The key components are timing, sequence, and interaction of the training stimuli to allow optimum adaptive response in pursuit of specific competitive goals (Judge, 2007). Active warm-up, passive warm-up, and stretching are frequent procedures used by athletes prior to engaging in intense physical activity. Although the evidence is clear in the sports science literature; some practitioners continue inappropriate warm-up and stretching combinations (Beedle, Leydig & Carnucci, 2007). The study will assess National Collegiate Athletic Association (NCAA) Division I volleyball coaches' certifications and the relationship to current pre-activity stretching and post-activity stretching practices and perceived benefits and the gap that may exist between scientific principles and actual coaching practices.

Literature Review

In a competitive activity like volleyball which requires explosive strength, training protocols that influence the mechanical performance of subsequent muscle contractions should be addressed (Chiu, 2003). The theoretical goal of the pre-activity warm-up and stretching is to optimize performance and reduce the incidence of injury through increased muscle temperature, muscle compliance, and efficiency of physiological responses. A well-designed pre-activity protocol will bring about various physiological changes that enhance the training activity or competition.

Types of Stretching

Flexibility as a biomotor quality has been extensively researched during the last several decades. Various approaches to stretching have been explored by the coaching, scientific, and physiotherapy communities. Researchers have assessed the athletic benefits of performing a general "warm-up" prior to activity (Safran, Garrett, Seaber, Glisson, & Ribbeck, 1988) and attempted to pinpoint what, if any, type of stretching should be performed before activity to maximize performance.

There are essentially two forms 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, Jokkonen, & 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. The following section explains each of these types of stretching in greater detail.

Static Stretching

Static stretching, the most commonly used program among athletes and coaches, requires the holding of a stretch position with little or no movement for a length of time (Mann & Whedon, 2001). When done correctly, the static stretch includes the relaxation and concurrent elongation of the stretch muscle. If performed properly, the risk of injury associated with the stretch is reduced (Baechle & Earle, 2000). Static stretching should not result in excessive tension on the muscle as this may cause a reduction in the stretch and injury (Mann & Whedon, 2001).

Several studies have shown that using static stretching as a pre-activity warm-up has either detrimental or no effect on performance. Static stretching does little to increase the core muscle temperature (Mann & Whedon, 2001). Nelson, Kokkonen, and Arnall (2005) found static stretching reduced muscular strength endurance by 28%. Mann and Jones (1999) reported vertical jump performance decreased 5.6% following static stretching as compared to no stretching at all. Unick, Kieffer, Cheesman, and Feeney (2005) found no difference in vertical-jump performance from either static or ballistic stretching as compared with no stretching. Similarly, Cramer (2006) found no effect on peak torque of leg extensors from static stretching.

The current trend shows that static stretching tactics are better suited following activity, not before it (Anderson, Beauliue, Cornelius, Dominquez, Prentice, & Wallace, 1984; Egan, Cramer, Massey, & Marek, 2006; Nelson, & Brandy, 2008; Stone, Ramsey, O'Bryant, Ayers, & Sands, 2006; Swanson, 2008). Research supports that gains in range of motion can be achieved if static stretching is performed consistently post-activity as a part of the

cool down (Mann & Whedon, 2001).

Ballistic Stretching

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, 2000). Due to the bouncing-type movement, many researchers have concluded that ballistic-type stretching is counterproductive to warm-up exercises because it leads to a firing of the muscle spindle which initiates the stretch reflex, leading to a greater potential for injury (Mann & Whedon, 2001). Because the stretch reflex is activated, the muscle is not allowed to relax which defeats the purpose of stretching (Baechle & Earle, 2000). Unlike static stretching, ballistic stretching does have the potential to increase the muscle's core temperature; however, the efficacy of its use in the athletic arena is in question (Mann & Whedon, 2001). This ballistic-style of stretching popular in the 1960s was slowly replaced in the early 1980s with a focus on proprioceptive neuromuscular facilitation (PNF) stretching.

Proprioceptive Neuromuscular Facilitation (PNF) Stretching

Proprioceptive neuromuscular facilitation 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). Originally developed in the 1950s, PNF stretching was used as a rehabilitation technique for stroke patients. Today, athletic trainers and therapists use PNF techniques to increase range of motion and improve strength although it does not increase core muscle temperature (Mann & Whedon, 2001). Cornelius (1984) favored PNF stretching over ballistic stretching citing the explosive nature of ballistic stretching created a higher risk for injury and the potential for muscle soreness. While PNF stretching is a good program for athletes to use for increasing range of motion and decreasing muscle soreness, it can be a very complicated procedure and may not be appropriate on the volleyball court unless the athletes are properly trained to administer the technique (Mann & Whedon, 2001).

Dynamic Stretching

Dynamic stretching allows for flexibility activity during a sport-specific movement. It can be argued that to most effectively prepare strength or power athletes for a specific sport activity the pre-activity routine should contain exercises that address the concept of movement pattern specificity. Although similar to ballistic stretching, dynamic stretching avoids bouncing and can include movement specific to a sport or movement pattern (Baechle & Earle, 2000). Dynamic stretching includes continuous muscle activity to exceed the static range of motion encountered during the normal full-range-of-motion activities (Yessis, 2006). This type of pre-activity flexibility is best done prior to the sport activity as it helps the athlete to prepare for the competition by allowing him or her to increase sport-specific flexibility and it increases core muscle temperature (Baechle & Earle, 2000).

Research supports dynamic stretching over other types of pre-activity stretching. Yamaguchi and Ishii (2005) found dynamic stretching to be better than static stretching or no stretching at all for leg extension power. In another study, athletes were tested performing underhand medicine-ball toss, and a five-step jump test. The results on all the tests were significantly greater when dynamic stretching was performed prior to the tests than when pre-activity static stretching was performed (Little & Williams, 2006). Little and Williams (2006) also found agility performance to be greater following pre-activity dynamic stretching as opposed to pre-activity static stretching. This research suggests that dynamic stretching should be included as part of a pre-activity preparation routine.

Research investigating the usage of pre-activity warm-up and stretching and post-activity stretching has shown a paradigm shift from activities such as ballistic-style of stretching to a focus on static and/or PNF stretching (Anderson, 1980; Anderson, Beauliue, Cornelius, Dominquez, Prentice, & Wallace, 1984; Holcomb, 2008; Stone, Ramsey, O'Bryant, Ayers, & Sands, 2006) and more recently to dynamic stretching (Little and Williams, 2006). Current research indicates that dynamic stretching should be used prior to activity (Behm, Button, & Butt, 2001; Ce, Margonato, Casasco, & Veicsteinas, 2008; Egan, Cramer, Massey, & Marek, 2006; Fredrick, & Szymanski, 2001; Laroche, Lussier, & Roy, 2008; Mann, & Jones, 1999; Siatras, Mittas, Maneletzi, & Vamvakoudis, 2008; Torres, Kraemer, Vingren, Volek, Hatfield, Spiering, Ho, Fragala, Thomas, Anderson, Hakkinen, and Maresh, 2008; Winchester, Nelson, Landin, Young, & Schexnayder, 2008; Yamaguchi, & Ishii, 2005). Evidence indicates that static-style stretching should be performed following exercise (Anderson, Beauliue, Cornelius, Dominquez, Prentice, & Wallace, 1984; Egan, Cramer, Massey, & Marek, 2006; Nelson, & Brandy, 2008; Stone, Ramsey, O'Bryant, Ayers, & Sands, 2006; Swanson, 2008). Researchers continued investigation of the physiological impact of pre-activity stretching and the effect it can have on performance has further awakened interest from the coaching community. The advent of coaches' education and certification programs for volleyball coaches, strength coaches, and athletic trainers should give coaches a solid physiological basis for their training recommendations.

Coaches Certification

The most common type of volleyball specific coaching certification training is through USA Volleyball (USA Volleyball, 2009). The USA Volleyball Coaching Accreditation Program (USAV-CAP) provides an opportunity for professional preparation and advancement for the volleyball coach. The curriculum addresses the essential topics for the volunteer and the internationally aspiring coach. The USAV-CAP is a four-level volleyball coaching education program. Each course level includes a special emphasis on building the foundation and creation of a well-prepared coach. The first level, Increased Mastery and Professional Application of Coaching Theory (IMPACT), is an entry level certification which provides a general overview of volleyball drill development and ethical coaching. Next, coaches enroll in the Coaching Accreditation Program (CAP) which has four levels (i.e., CAP I-IV). Level I emphasizes teaching the skills of the game. Level

II emphasizes organizing and developing team play. Level III emphasizes taking your team to the next level though advanced training and conditioning. Level IV is by appointment only and is usually reserved for those coaches who have coached for official USA National team or have assisted with a National or Olympic team.

Division I volleyball programs may also have the added benefit of working with strength and conditioning coaches. Most strength coaches and some volleyball 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, and demonstrate the skills to apply that knowledge. Today, more than 21,000 professionals from a variety of academic and professional backgrounds hold the CSCS credential (NSCA, 2009). This diverse group includes strength coaches, sport coaches, athletic trainers, physical therapists, personal trainers, physicians, chiropractors, researchers, and educators.

Even with the proliferation of coaches and strength training professionalsÅf education and certification programs and a greater emphasis on research in this area it is uncertain if coaches follow the suggested guidelines. Therefore, the purpose of this study was to determine if the current pre- and post-activity practices of college volleyball programs are supported by current research, and whether or not that is affected by coaching certifications.

Methodology

Sampling Procedure

The purpose of this study was to ascertain coaches' perceptions and stretching practices conducted in Division I volleyball programs. To avoid redundancy, only one coach per program, the head coach, was contacted about the study. The assumption was 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 head volleyball 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 February/March 2009. Early off season was determined to be the best timeframe to maximize coaches' recall of stretching practices used during the previous season and coachesÅf participation in the study. A reminder email was sent to non-respondents two weeks after the initial email in an effort to increase the overall response rate.

Instrumentation

The survey instrument contained 17 items grouped into four areas.

Pre-activity stretching practices. Three items were completed by participants. Respondents indicated the (a) type of pre-activity group stretching conducted in the warm-up period, (b) whether athletes performed static stretching following the pre-activity group stretching but prior to the athletic event, and (c) whether athletes performed static stretching with assistance of an athletic trainer or massage therapist following the pre-activity group stretching but prior to the athletic event.

Post-activity stretching practices. Three items were completed by participants. Respondents indicated the (a) type of post-activity group stretching conducted during the cool-down period, (b) perceived frequency of athletes completing a post-activity stretching regimen following the athletic event, and (c) perceived frequency of athletes completing post-activity stretching plus light jogging following the athletic event.

Perceived benefits of stretching activities. Four items were completed by participants. Respondents indicated their perception of whether pre-activity group stretching (a) prevents injury and (b) improves athletic performance. Similarly, respondents indicated their perception of whether post-activity group stretching (c) prevents injury and (d) improves athletic performance.

Demographic information. Five items were completed. Respondents indicated their (a) title (e.g., head coach, assistant coach), (b) sex, (c) years of experience, (d) current volleyball certification(s), and (e) current strength and conditioning certification(s). Two additional questions related to institution and conference affiliation were used to make a judgment about sampling error but were not otherwise included in the data analysis.

Data Analysis

Data analysis was a two step process in this study. Step 1 involved generation of descriptive statistics for all the variables of interest. Univariates were used to determine whether Pearson χ^2 model assumptions were met. Step 2 involved applying Pearson χ^2 tests of independence to the following sets of variables (a) certification and type of pre-activity group stretching, (b) certification and type of post-activity group stretching, (c) certification and pre-activity group stretching — injury prevention benefit, (d) certification and pre-activity group stretching — improved performance benefit, (e) certification and post-activity group stretching — injury prevention benefit, and (f) certification and post-activity group stretching — improved performance benefit. Alpha was adjusted to .008 with Bonferroni's contrasting procedure to minimize study-wide Type I error. Cramér's V was calculated to estimate the strength of relationships.

Results

From the 291 Division I volleyball programs, 56 coaches returned completed usable surveys. This represents 19.2% 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 volleyball

programs. Nonetheless, caution is warranted as factors may exist which limit the generalizability of study results.

Demographic Data

In this study, respondents were primarily head coaches (85.7%), female (58.9%), and possessed an average of 13.8 years of experience. The head coaches had an average of 14.0 years of experience compared to 12.0 years of experience for the assistant coaches. A large number of coaches (44.6%) did not possess a volleyball coaching certification nor a strength and conditioning coaching certification.

Table 1. *Demographic Profile of Division I Volleyball Coaches (N=56)*

	Head Coach	Assistant Coach	Missing	Total
Gender				
Men	19 33.92%	3 5.36%	1 1.79%	23 41.07%
Women	29 51.78%	3 5.36%	1 1.79%	33 58.93%
Experience				
Range	2 to 42 yrs	6 to 20 yrs	1 to 10 yrs	1 to 42 yrs
Mean	14.22 (7.57)	12.00 (7.21)	5.50 (6.36)	13.75 (7.58)
Certification				
None	23 41.07%	2 3.57%	0 0%	25 44.64%
Impact	4 7.14%	1 1.79%	0 0%	5 8.93%
CAP I	9 16.07%	1 1.79%	1 1.79%	11 19.64%
CAP II	4 7.14%	0 0%	0 0%	4 7.14%
CAP III	6 10.71%	0 0%	0 0%	6 10.71%
CSCS	1 1.79%	2 3.57%	0 0%	3 5.36%
CSCS + Impact	0 0%	0 0%	1 1.79%	1 1.79%
CSCS + CAP I	1 1.79%	0 0%	0 0%	1 1.79%
Total	48	6	2	56

Pre-Activity Stretching Practices

Coaches typically prescribed a combination of static and dynamic stretching activities (44.0%) or dynamic stretching activities (42.0%) prior to the athletic event. To a much lesser extent coaches exclusively utilized static stretching activities (14.0%). Interestingly, among coaches who incorporated dynamic stretching into the group warm-up, 57.9% subsequently allowed athletes to perform static stretching independently and/or with assistance from the athletic trainer or the massage therapist. The Pearson χ^2 test of independence between certification and pre-activity group stretch type was not significant, χ^2 (2, N=50) = 1.819, p =.403.

Table 2. *Pre-Activity Group Stretching Practices in Division I Volleyball Programs (N=50)*

	Type of Pre-Activity Group Stretching									
Certification	Static		Ballistic		PNF		Dynamic		Static & Dynamic	
None	5	10.00%	0	0%	0	0%	9	18.00%	10	20.00%
Impact	0	0%	0	0%	0	0%	1	2.0%	3	6.00%
CAP I	2	4.00%	0	0%	0	0%	0	0%	6	12.00%
CAP II	0	0%	0	0%	0	0%	4	8.00%	0	0%
CAP III	0	0%	0	0%	0	0%	3	6.00%	2	4.00%
CSCS	0	0%	0	0%	0	0%	2	4.00%	1	2.00%
CSCS + Impact	0	0%	0	0%	0	0%	1	2.00%	0	0%
CSCS + CAP I	0	0%	0	0%	0	0%	1	2.00%	0	0%
Total	7		0		0		21		22	
Following Pre-Activity Group Stretching, Coach Allows:										
Self Static	1	2.00%	0	0%	0	0%	2	4.00%	2	4.00%
AT/MT Static	1	2.00%	0	0%	0	0%	5	10.00%	3	6.00%
Self & AT/MT Static	4	8.00%	0	0%	0	0%	4	8.00%	10	20.00%
Static Not Allowed	1	2.00%	0	0%	0	0%	8	16.00%	5	10.00%
Total	7		0		0		*19		*20	

*Missing data.

Table 3. *Certification and Pre-Activity Group Stretch Type (N=50)*

Stretch Type	Certified	Non-Certified	Total
Static	2	5	7
	(36.0)	(3.4)	
Dynamic	12	9	21
	(10.9)	(10.1)	
Static + Dynamic	12	10	22
	(11.4)	(10.6)	
Total	26	24	50

Note: Numbers in parenthesis are expected cell frequencies.
χ^2 (2, N=50) = 1.819, p = .403

Post-Activity Stretching Practices

Coaches typically used static stretching activities (71.4%) following the athletic event. To a much lesser extent, coaches used a combination of static and dynamic stretching activities (22.4%) and PNF stretching (6.1%). Coaches indicated athletes either always or almost always completed a stretching regime (54.0%) or stretching plus jogging regime (44.0%) after an athletic event. The Pearson χ^2 test of independence between certification and pre-activity group stretch type was not significant, χ^2 (2, N=50) = 2.947, p = .229.

Table 4. *Post-Activity Group Stretching Practices in Division I Volleyball Programs (N=49)*

	Type of Post-Activity Group Stretching									
Certification	Static		Ballistic		PNF		Dynamic		Static & Dynamic	
None	17	34.69%	0	0%	0	0%	0	0%	6	12.24%
Impact	4	8.16%	0	0%	0	0%	0	0%	0	0%
CAP I	5	10.20%	0	0%	0	0%	0	0%	4	8.16%
CAP II	3	6.12%	0	0%	0	0%	0	0%	0	0%
CAP III	3	6.12%	0	0%	2	4.08%	0	0%	1	2.04%
CSCS	1	2.04%	0	0%	1	2.04%	0	0%	0	0%
CSCS + Impact	1	2.04%	0	0%	0	0%	0	0%	0	0%
CSCS + CAP I	1	2.04%	0	0%	0	0%	0	0%	0	0%
Total	35		0		3		0		11	

Table 5. *Coaches Perceived Frequency of Athletes Completing Post Activity Cool Down Activities (N=50)*

	Always		Almost Always		Sometimes		Rarely		Never	
Stretching Regime:										
Head Coach	7	14.00%	18	36.00%	13	26.00%	5	10.00%	2	4.00%
Assistant Coach	0	0%	2	4.00%	2	4.00%	1	2.00%	0	0%
Total	7		20		15		6		2	
Stretching & Jogging Regime:										
Head Coach	7	14.00%	14	28.00%	12	24.00%	6	12.00%	5	10.00%
Assistant Coach	0	0%	1	2.00%	3	6.00%	1	2.00%	0	0%
Total	7		15		15		7		5	

Table 6. *Certification and Post-Activity Group Stretch Type (N=49)*

Stretch Type	Certified	Non-Certified	Total
Static	18	17	35
	(18.6)	(16.4)	
PNF	3	0	3
	(1.6)	(1.4)	
Static + Dynamic	5	6	11
	(5.8)	(5.2)	
Total	26	23	49

Note: Numbers in parenthesis are expected cell frequencies.
χ^2 (2, N=49) = 2.947, p = .229

Perceived Benefits of Stretching Activities

The majority of coaches indicated pre-activity group stretching was beneficial in terms of injury prevention (75.0%) and improved performance (69.1%). Similarly, coaches indicated post-activity group stretching was beneficial in terms of injury prevention (87.3%) and improved performance (69.6%). The Pearson χ^2 tests of independence did not reveal significant relationships between the following pairs of variables: (a) certification and pre-activity group stretching — injury prevention benefit, χ^2 (2, N=56) = .602, p = .438; (b) certification and pre-activity group stretching Çú improved performance benefit, χ^2 (2, N=55) = .696, p = .404; (c) certification and post-activity group stretching — injury prevention benefit, χ^2 (2, N=55) = .022, p = .883; and (d) certification and post-activity group stretching — improved performance benefit, χ^2 (2, N=56) = 2.291, p = .130.

Table 7. *Certification and Pre-Activity Group Stretch - Injury Prevention Benefit (N=56)*

	Certified	Non-Certified	Total
Benefit	22	20	42
	(23.3)	(18.8)	
No Benefit	9	5	15
	(7.8)	(6.3)	
Total	31	25	56

Note: Numbers in parenthesis are expected cell frequencies.
χ^2 (2, N=56) = .602, p = .438

Table 8. *Certification and Pre-Activity Group Stretch - Performance Benefit (N=55)*

	Certified	Non-Certified	Total
Benefit	20	18	38
	(21.4)	(16.6)	
No Benefit	11	6	17
	(9.6)	(7.7)	
Total	31	24	55

Note: Numbers in parenthesis are expected cell frequencies.
χ^2 (2, N=55) = .696, p = .404

Table 9. *Certification and Post-Activity Group Stretch - Injury Prevention Benefit (N=55)*

	Certified	Non-Certified	Total
Benefit	26	22	48
	(26.2)	(21.8)	
No Benefit	4	3	7
	(3.8)	(3.2)	
Total	30	25	55

Note: Numbers in parenthesis are expected cell frequencies.
χ^2 (2, N=55) = .022, p = .883

Table 10. *Certification and Post-Activity Group Stretch - Performance Benefit (N=56)*

	Certified	Non-Certified	Total
Benefit	19	20	39
	(21.6)	(17.4)	
No Benefit	12	5	17
	(9.4)	(7.6)	
Total	31	25	56

Note: Numbers in parenthesis are expected cell frequencies.
χ^2 (2, N=56) = 2.291, p = .130

Discussion

Lack of Certifications

The quality of a sports pre-activity preparation session depends on the competence of the coach. Coaching education and certification programs encourage a higher level of competence among practitioners. Surprisingly, a large number of coaches in the present study (44.6%) do not possess a volleyball coaching certification nor a strength and conditioning coaching certification. This may be due to the fact that coaching education programs have not found much support on a wide-scale effort and have limited success reaching their intended audience (Gilbert & Trudel, 1999).

A coach is a critical part to an athlete's sport experience beginning with the pre-activity stretching protocol. An effective practice begins with proper physical preparation. Mahoney and Stattin (2000) found the structure and context of the sport activity was important in determining whether participation led to positive or negative outcomes. Strean and Garcia-Bengoechea (2003) found it was the individual's sport experience that determined whether participation was viewed as positive or negative. The fact that coaches can readily be trained to provide such an environment for athletes (Smith & Smoll, 2002) suggests that coach training can be an important vehicle for improving the benefits of sport participation for athletes. Well trained sports coaches are better equipped to create positive sports experiences, which in turn keep athletes involved in sports. Sports organizations and National Governing Bodies (NGB's) should provide and market educational programs for all coaches. Sport organizations need to continue to extend the academic base by encouraging and supporting quality research in coaching; translating the research in practical applications and transmitting that information to coaches in accessible ways. Education and certification programs for coaches need additional marketing efforts to increase participation (Gilbert & Trudel, 1999).

Pre-Activity Stretching Practices

Based on the results of the present study, it is clear that not all of programs are in compliance with suggested current pre-activity stretching practices. Coaches not consistent with literature undermine warm-up benefits by allowing athletes to do static stretching. It has been shown that dynamic flexibility stretching (not static, PNF, or ballistic-type stretches) should be used prior to activity (Behm, Button, & Butt, 2001; Ce, Margonato, Casasco, & Veicsteinas, 2008; Egan, Cramer, Massey, & Marek, 2006; Fredrick, & Szymanski, 2001; Laroche, Lussier, & Roy, 2008; Mann, & Jones, 1999; Siatras, Mittas, Maneletzi, & Vamvakoudis, 2008; Torres, Kraemer, Vingren, Volek, Hatfield, Spiering, Ho, Fragala, Thomas, Anderson, Hakkinen, and Maresh, 2008; Winchester, Nelson, Landin, Young, & Schexnayder, 2008; Yamaguchi, & Ishii, 2005). In contradiction, 100% (50 out of 50) of coaches reported that they used some form of pre-activity stretching, but only 42% (21 out of the 50) of coaches indicated that they use dynamic flexibility stretching exclusively. Also of interest were the coaches that allowed athletes to perform static stretching independently and/or with assistance from the athletic trainer or the massage therapist. The other coaches (22 out of 50) marked that they used dynamic flexibility along with a 'combination' of static, PNF, or ballistic stretching. With current research not supporting the use of static, PNF, and ballistic stretches before exercise, the data presented here demonstrates that while coaches have included pre-activity stretching in their training program they have not completely halted the use of the exercises that are not supported by current research (Judge, Craig, Baudentistal & Bodey, 2009). It should be noted that while most of the studies reviewed did not support the use of static stretching pre-exercise (Bazett-Jones, Gibson, & McBride, 2008; Ce, Margonato, Casasco, & Veicsteinas, 2008; Laroche, Lussier, & Roy, 2008; Siatras, Mittas, Maneletzi, & Vamvakoudis, 2008; Winchester, Nelson, Landin, Young, & Schexnayder, 2008), one study did support ballistic stretching (Woolstenhulme, Griffins, Woolstenhulme, & Parcell, 2006). An interesting finding of the present study is there were no differences between those who are certified and those who are not in the pre-activity stretching practices. One would expect certified coaches to be aware of what is in the literature and comply with the research recommendations. The knowledge of the certified coaches could be impacted by the age of their certification and whether or not the coaches kept up to date with CEU's or self study. This calls to question the efficacy of certification programs. Research further examining whether certified coaches are staying up to date with current research should be conducted in order to either improve the certification process or change/modify the certification process to ongoing learning requirements.

Post-Activity Stretching Practices

Current research indicates that athletes should perform static-style stretching following exercise (Anderson, Beauliue, Cornelius, Dominquez, Prentice, & Wallace, 1984; Egan, Cramer, Massey, & Marek, 2006; Nelson, & Brandy, 2008; Stone, Ramsey, O'Bryant, Ayers, & Sands, 2006; Swanson, 2008). The results from this study indicate that 49 of the responders had their athletes perform post-activity stretching. Of the 49 who did employ post-activity stretching, 71.4% (35 out of 49) performed static stretching, 8.0% (4 out of 49) performed PNF stretching, and 20% (10 out of 49) combined static with dynamic stretching. This indicates that while the majority of the responders were congruent with research that suggests post-activity stretching is important, not all follow current stretching guidelines.

The most interesting finding of the post-stretch data is that although most coaches are consistent with literature in their post-activity stretching choice; post-activity stretching and cool down are not a consistent part of the daily routine. Coaches indicate athletes either always or almost always completed a stretching regime (54%) or stretching plus jogging regime (44.9%) after an athletic event. It can only be speculated why the post activity stretching and cool down is not completed on a consistent basis.

Perceived Benefits of Stretching Activities

Coaches commonly hold two beliefs concerning stretching. Acute stretching (part of the warm-up) may increase performance and will reduce the injury potential and chronic stretching will increase performance and reduce the injury potential. However, data exist indicating that these beliefs may not be completely true (Thacker, et al. 2004). The majority of coaches in the present study indicated pre-activity group stretching was advantageous in terms of injury prevention (75.0%) and improved performance (69.1%). Similarly, coaches indicated post-activity group stretching was beneficial in terms of injury prevention (87.3%) and improved performance (69.6%). This indicates that while the majority of the responders supported stretching as a means to prevent injuries and improve performance, many coaches may not be aware of the latest research findings.

Most studies indicate that reduced flexibility shows little relationship to typical sports injuries. Neither acute (Pope, 2000) nor chronic (Herbert, 2002) stretching appears to effect a significant reduction in physical activity related injuries. Thacker, et al. (2004), in an extensive review of the flexibility literature that included 361 articles dating back into the 1950s, concluded that there is little relationship between stretching (e.g., increased ROM) and injury. Thus, there is equivocal evidence that stretching and enhanced ROM do not result in a lower injury rate.

Most of the performance studies show that pre-activity static stretching as a part of warm-up reduces maximum strength (force magnitude) and numerous related variables, such as rate of force development and power output (Behm, 2001; Godges, 1989; Nelson, 2001; Rosembaum, 1995). Thus, it appears that static stretching as part of a warm-up can negatively alter force production, power output, and stretch-shortening cycle characteristics such that strength and performance, including explosive performances, can be compromised. Interestingly, among coaches who incorporated dynamic stretching into the group warm-up, 57.9% of coaches then allowed athletes to perform static stretching independently and/or with assistance from the athletic trainer or the massage therapist. This "extra" stretching may be limiting the explosive capabilities and may have little or no affect on injury prevention (Shrier, 1999). Most available data indicates that 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 myototic reflex (Stone, Ramsey, O'Bryant, Ayers, & Sands 2006). These

alterations in turn can result in a decreased maximum strength and explosiveness and inferior performances. The literature dealing with flexibility suggests that athletes should perform some sort of 'general' warm-up prior to activity (Ce, Margonato, Casasco, & Veicsteinas 2008; Hedrick 1992; Laroche, Lussier, & Roy 2008; Mann, & Jones 1999; Ninos 1995; Swanson 2008; Torres, Kraemer, Vingren, Volek, Hatfield, Spiering, Ho, Fragala, Thomas, Anderson, Hakkinen, & Maresh 2008; Yamaguchi, & Ishii 2005) a pre-activity stretch (Fredrick, and Szymanski 2001; Holcomb, 2008; Laroche, Lussier, & Roy 2008; Mann & Jones 1999; Nelson &Brandy 2008), and post-activity stretching (Anderson, 1984; Nelson & Brandy 2008; Stone, Ramsey, O'Bryant, Ayers, & Sands 2006). The majority of the respondents to this survey indicated that they use the aforementioned 3 step approach in preparing athletes, but did vary in how closely they followed research recommendations (Judge, Craig, Baudentistal, & Bodey, 2009).

Implications for Coaches/Coach Educators

When comparing coaching specific certification to pre-activity flexibility practices, it is clear that not all coaches are in compliance with suggested pre-activity flexibility recommendations (Faigenbaum, et al., 2006; Herda, et al., 2008; Kovacs, 2006; McMillian, et al., 2006; Samuel, et al., 2008; Yessis, 2006). It is reasonable to say that coaching certification has little impact (based on results of this study) on pre-activity flexibility protocols. Out of the 56 respondents, 29 have a volleyball specific coaching certification (just slightly over 50%). It can be concluded that if one has a volleyball specific coaching certification, they are not more likely to omit static stretching from a pre-activity flexibility than someone who does not have a volleyball specific coaching certification. Yet 14 of the 29 certified volleyball coaches still include some form of pre-activity static stretching. It is evident that some coaches are unwilling or reluctant to part with traditional methods of static stretching prior to activity (Bandy & Irion, 1994; Swanson, 2006). It would be of value for volleyball coaches to partake in a recertification course that includes current research trends in a way that positively impacts their coaching. A well educated coach with an understanding of current research will help athletes be better prepared for competition and maximize their volleyball performance. Based on these results it is evident that there exists a need for a program of accreditation for volleyball coaches. In addition, all coaches should be strongly encouraged to receive continuing education units (CEU's) so that they stay current with pre- and post-activity flexibility protocols as well as other sport specific practices.

Coach Educators must continue to extend the academic base by pursuing quality research in coaching; translating the research in practical applications and transmitting that information in accessible ways. Organizations like the National Council for Accreditation of Coaching Education (NCACE) must continue facilitating the development of quality coaching education programs (college programs as well as online modular programs) and partnering with other national associations/NGBs to spread consistent messages about the importance and/value of coaches in developing research based training program for athletes. Coach Educators need to get the word out about proper pre- and post-activity stretching regimens through trade publications, conferences, and trainings. The results of this study confirm the need for continued efforts towards coachÅfs certification including continuing education to remain current with research. Governing bodies (e.g., USAVB) and certifying organizations (e.g., NSCA) need to form partnerships in the development of educational resources.

Conclusion

This study indicates that it is important for volleyball coaches to re-evaluate their own practices, perhaps cross-checking them with the practices of their peers and stay current with ongoing research. Although research supports dynamic warm-up/flexibility over other types of pre-activity protocols (Little & Williams, 2006; Stone, Ramsey, O'Bryant, Ayers, & Sands, 2006; Yamaguchi, & Ishii, 2006), it appears that some volleyball coaches are reluctant to totally discontinue traditional methods like pre-activity static stretching. As the knowledge base for stretching and warm-up strategies continues to evolve, coaches should change with them to ensure their athletes are being properly prepared for training and competition. The (USAVB) Coach's Education program as it exists has reached a large number of coaches, but it appears there is still work to be done. Another interesting question would be whether or not there is a CEU requirement for certified coaches in the present USAVP-CAP program. Volleyball coaches at all levels could benefit from participating in certification programs like the USA Volleyball (IMPACT, CAP I-IV) and National Strength and Conditioning Association's (CSCS) programs to keep up to date with current practices. Sport at all levels is in need of better and more thorough coaching education programs and certification processes.

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