

Dynamic stretching versus static stretching in gymnastic performance

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ABSTRACT

D'Anna, C., & Gomez, F. (2015). Dynamic stretching versus static stretching in gymnastic performance. A brief review. *J. Hum. Sport Exerc.*, 9(Proc1), pp.S437-S446. Different types of stretching techniques are commonly performed in the gymnastic training sessions. Flexibility is one of the essential aspects of this sport like so the explosive strength but actually there is a limited literature assessing the effectiveness of the specific technique to increase the range of motion and, at the same time, to improve the explosive performance. The aim of this study was to conduct a brief analysis of the literature to understand how to plan the training programs finalized to improve the gymnastic performance (Gomez Paloma F., Rio L., D'Anna C. 2014). The MEDLINE and SportDiscus databases were searched for relevant literature using textwords for English-language articles related to stretching, flexibility, explosive strength, dynamic/static stretching and gymnastic. Additional references were reviewed from the bibliographies and from citation searches on key articles. Twenty-two articles were examined, of which two reviews, one roundtable discussion of flexibility training, two specific studies on gymnastics, two on basketball, one on baseball and the remaining articles focusing on the flexibility and the jumping performance in general. In accordance to several studies analyzed, the research carries out some reflections on different stretching techniques included in the training phases of gymnastics (warming-up, cooling down) useful in planning the training sessions finalized to the best performance. These are fundamental aspects to highlight and emphasize the consequences of the use of the different techniques especially regarding the duration and the intensity of the exercises choice. **Key words:** GYMNASTIC, STATIC AND DYNAMIC STRETCHING, FLEXIBILITY, JUMP.



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INTRODUCTION

The flexibility is commonly considered an essential aspect of gymnastics training and performance. Flexibility is always included in the battery test to identify the potentiality and evaluate the level of the athletes' skills. In spite of a fairly universal recognition of the need for flexibility in gymnastics, surprisingly little research has been done on enhancing flexibility amongst elite performers. In the last twenty years several studies there have been conducted on training of the flexibility and stretching techniques but most of these focused only on the consequences of these techniques on the explosive strength.

In gymnastics the problem of increasing flexibility is more complicated because athletes must have the use of both flexibility and strength in the same technical act.

The gymnastics code of points of the different kind of disciplines makes a deductions if the gymnast cannot achieve a specific position or does not perform a broad jump with the perfect alignment of the legs in the maximal amplitude. That range of motion dependent on both strength and flexibility is commonly understood, but how to train both qualities has not been well researched.

It's important to underline that during the training section the various techniques of stretching activities have the greatest percentage of training time, but the coach doesn't understand why the gymnasts are sometimes evaluated as being inflexible.

In the specific training methodology currently there is a little confusion (Raiola, Scassillo, Parisi, & Di Tore, 2013). Trainers and technical staff have different views about the benefits and negative consequences of stretching techniques and therefore the methods chosen are subject to personal experience rather than scientific accuracy.

Further studies are necessary non only focused on stretching techniques, but also for each gymnastics discipline in the Gymnastic Federation (aerobic, artistic and rhythmic) which differ between each other.

Thus to guide towards the best training methods to be used in order to improve the flexibility and strength. Warm-up is usually composed of a sub maximal aerobic activity, stretching of the major muscle group, as well as general and specific sport exercises performed intensively as training for competitions (Taylor et al., 2008). Several studies have shown that stretching following submaximal aerobic activity increases ranges of motion and enhances performance (Magnusson & Restrom, 2006; Young & Behm, 2002).

Previous studies, reported that static stretching may temporary decrease the ability of the stretched muscles to generate power output (Behm et al. 2001).

The duration and intensity of the static stretching exercises seem to play a critical role in these impairments, with long lasting, intense stretching resulting in a greater decrease in subsequent power generating ability (Behm & Chaouachi, 2011).

In most studies, static stretching may increase compliance and thus reduce the stiffness of the muscle tendon unit, but this effect is transient (Magnusson & Renstrom, 2006) and depends on the duration and intensity of the stretching protocols.

The combined effects of stretching and conditioning exercises during warm-up may be influenced by the flexibility and muscle power of the performer, as well as by the volume of exercise.

Gymnastic is a sport that is generally characterized by high level of strength and power relative to body weight, as well as high flexibility (Arkaev & Sustsln, 2004).

Therefore, the aim of the present study is to conduct a brief analysis of the literature to understand which are the benefits and the negative aftermaths of the different types of stretching techniques to plan the training programs finalized to improve the gymnastic performance.

METHODS

The MEDLINE and SportDiscus databases were searched for relevant literature using textwords for English-language articles related to stretching, flexibility, explosive strength, dynamic/static stretching and gymnastic. Additional references were reviewed from the bibliographies and from citation searches on key articles.

Twenty-two articles were examined, of which two reviews, one roundtable discussion of flexibility training, two specific studies on gymnastics, two on basketball, one on baseball and the remaining articles focusing on the flexibility and the jumping performance in general.

Table 1. Summary of literature review

Title	Author, Year	Type of Study	Main results	Performance
Acute effects of static and ballistic stretching on measures of strength and power	Samuel et al. (2008)	Cross-sectional study	Dynamic stretching can function to properly prepare the athlete's body for dynamic movements without the stretch-induced decrements that have been seen with pre-activity static and ballistic stretching by improving performance.	<i>On strength and Power</i> -Dynamic ↑ -Static ↓ -Ballistic ↓
Ballistic stretching increases flexibility and acute vertical jump height when combined with basketball activity	Woolstenhulme et al. (2006)	Cross-sectional study	Ballistic stretching can be safely and effectively used as a warm-up for basketball play. Ballistic stretching used as part of a warm-up for basketball play increases vertical jump performance.	<i>On vertical Jump</i> - Ballistic (in warm up) ↑
Decrements in Stiffness are restored within 10 min	Mizuno et al. (2013)	Cross sectional study	1 min of static stretching at maximal dorsiflexion repeated 5 times can reduce stiffness in the MTU (muscle-tendon unit), but this effect disappears within 10 min.	<i>On stiffness</i> -Static ↓ (the effect disappears within 10 min.)
Does Stretching Improve Performance?	Shrier (2004)	Systematic Review of the Literature	Static Stretching immediately prior to exercise decreases the results on performance tests that require isolated force or power. The effect on running speed remains to be determined.	<i>On force and power</i> - Static ↓ <i>On running speed</i> -Static ?
Dynamic vs. Static-stretching warm up: the effect on power and agility performance	McMillian et al. (2006)	Cross sectional study	For tasks requiring power and agility, the results suggest that a dynamic warm up might offer performance benefits not found with static stretching or no warm up. It is likely that a DWU similar to that used in this study will achieve general warm up goals without invoking the mechanical and neural activation drawbacks associated with acute, static-stretching. For tasks demanding a high degree of flexibility, power, and agility, warm up activities should be sequenced so that static-stretching (if it is deemed necessary) is followed by dynamic and progressive movements.	<i>On power and agility</i> -Dinamic ↑ -No warm up ↓ -Static ↓
Effects of baseline levels of flexibility and vertical jump ability on performance following different volumes of static stretching and potentiating exercises in elite gymnasts	Donti et al. (2014)	Cross sectional study	The baseline levels of flexibility and vertical jump ability do not affect the acute responses to stretching and muscle conditioning activities, aiming to increase ROM and CMJ in elite gymnasts. Gymnasts with widely different flexibility and CMJ performance levels respond similarly to static stretching and PAP interventions during warm-up. 30" of static stretching to the point of discomfort may be incorporated in the warm-up of elite gymnasts, without impairing subsequent explosive performance. CMJ performance can increase considerably, if three sets of 5 tuck jumps are also performed after stretching.	<i>On vertical jump and flexibility</i> -Static - -30'' Static in warm-up → no impairing the performance -30'' static+3x5 sets TJ ↑
Effects of dynamic warm-up on lower body explosiveness among collegiate baseball players.	Frantz et al. (2011)	Cross sectional study	The results show that static warm-up decreases vertical jump height by 1.30 cm (0.51 in.), and dynamic increases it by 3.77 cm (1.48 in.); if this is the case, then an athlete can gain nearly 2 in. on his vertical by simply switching from a static warm-up routine to a dynamic routine. This study illustrates that dynamic warm-up positively impacts lower body explosiveness among collegiate baseball players.	<i>On vertical Jump</i> - Static ↓ - Dynamic ↑

Effects of static and dynamic stretching on Sprint and jump performance in boys and girls	Paradis et al. (2013)	Cross sectional study	Sprinting and explosive power performances are negatively affected if SS precedes these tasks. Therefore, SS should be avoided before these exercises. Dynamic stretching does not inhibit sprinting performance but deteriorates explosive power. Therefore, DS could be included before tasks that involve sprinting; however, it should be avoided before tasks that involve jumping. Both SS and DS improve flexibility, even though it seems the SS is more efficient compared with DS.	On sprint and explosive power performance - Static ↓ - Dynamic on sprint - - Dynamic on E.Power ↓ On flexibility -Static ↑ -Dynamic ↑
Enhancing flexibility in gymnastics	Sands (1999)	Cross sectional study	The results of this study showed that split leap range of motion can be improved. The lack of a control group (which would have tested but not participated in the Theraband stretching) results in an inability to state with certainty the cause of the enhanced split leap performances. However, the cause effect relationship is strengthened by the temporal ordering of events and the novel nature of the split leap.	On flexibility and jump -Dynamic ↑
Roundtable discussion: Flexibility training	Haff (2006)	Roundtable discussion	Ballistic may cause injury to the muscle, tendons or ligaments being stretched. Several studies have indicated that PNF S. is more effective in improving flexibility, whereas other studies have shown no superiority of PNF over static or ballistic techniques. PNF should be contraindicated before exercise or performance because it masks the protective mechanism of pain. Static s. induced increases in ROM are volume dependent. The effect of static s. on performance are not clear because there are contrasting studies.	On Flexibility Ballistic - NO Static, Dynamic and PNF to prefer PNF no positive in warmup Static ↑
Should static stretching be used during a warm-up for strength and power activities?	Warren (2002)	Cross sectional study	Substantial evidence is now available to state that static stretching can impair strength and power performance, although the duration of the impairment, the exact stretching protocols, and the physiological mechanisms are not yet known.	?
Static stretching can impair explosive performance for at least 24 hours	Haddad (2013)	Cross sectional study	Sprint performances (10, 20, and 30 m) and horizontal jumps 24 hours after the DS were significantly better than those after the no-stretch CC and SS. Results of this study demonstrated the negative effect of SS up to 24-hour post-stretching	On sprint performance -Dynamic ↑24h after -Static ↓24h after -No stretching ↓
Stretching-induced deficit of maximal Isometric torque is restored within 10 minutes.	Mizuno (2013)	Cross sectional study	Static 5-minute stretching decreases maximal isometric plantar strength immediately after stretching. A warm-up consisting of static stretching and activity and movement renders the stretching-induced force deficit practically ineffectual. Athletes should not perform static stretching within 10 minutes before a competition if they do not want to decrease maximal isometric plantar strength after static stretching.	On the isometric strength -Static 5min ↓ -No static stretching within 10 min before competition
An acute bout of static stretching: effects on force and jumping performance	Power et al. (2004)	Cross sectional study	SS of the quadriceps resulted in a significant decrease in MVC force output paralleled by significantly increased sit and reach ROM (both lasting 120 min) whereas jumping performance was unaffected SS may impair isometric force production for up to 120 min. Thus, for activities involving maximal force output, it is suggested that SS such as the methods utilized in the current study be avoided at least 120 min pre-performance.	On the jumping performance -static ↓ On isometric force -static ↓ (for 120 min) On flexibility Static ↑

The acute effects of different stretching exercises on jump performance.	Pacheco et al. (2011)	Cross sectional study	<p>Static active stretching in AT can be recommended during the warm-up for explosive force disciplines. The recommended warm-up in this context therefore consists of initial general work (low-intensity training), followed by static stretching with AT, then a series of dynamic exercises for the various muscle groups, and finally explosive elastic force exercises appropriate for the sporting discipline concerned.</p> <p>The regular performance of stretching exercises has positive long-term effects and can maintain or increase the flexibility, without affecting the explosiveness, and can also have a positive effect on the elastic energy restitution capacity. Those stretching exercises that are contraindicated for the warm-up may therefore provide long-term benefits in terms of flexibility training.</p>	<p><i>On Jump performance</i> -Static Active (mixed to dynamic/explosive force ↑ <i>On flexibility</i> - static passive stretching and PNF↑</p>
The effect of acute stretching on agility performance	Van Gelder et al. (2011)	Cross sectional study	<p>The results of this study indicate that, in comparison to SS or NS, a bout of acute DS significantly improves performance on a closed linear running agility test.</p> <p>Therefore, based on available research, DS as a whole demonstrates greater athletic performance benefits as a part of activity warm-up in comparison to SS.</p> <p>With this in mind, the coach and strength and conditioning professional should greatly consider preferential use of DS during pre-activity stretching.</p>	<p><i>On agility performance</i> -Dynamic ↑ -Static ↓ -No stretching ↓</p>

DISCUSSION AND CONCLUSION

In the light of analysed studies we can deduce some reflection.

Stretching and performance

It has been widely demonstrated that static stretching (SS) exercises performed before strength performances induces an impairment of the performance and impedes the achievement of best results in competitions (Raiola, Tafuri, & Gomez, 2014). In fact in the warm up phase of sport discipline characterized from explosive muscular power, the execution of stretching performed dynamically should be preferred rather than static stretching.

The majority of the studies analyzed suggests that static stretching produces a significant acute decrement approximately 5-30% in strength and power production.

A specific research indicates that during the most realistic warm-up condition, as little as 2 minutes of static stretching per muscle group can impair power performance (Young, 2002)

Recently many studies have shown that moderate duration of stretching 15-30 seconds of SS per muscle group does not affect short term muscle strength (Cramer et al., 2007; Ogura et al., 2007). In contrast studies implementing 30, (Winchester, 2008) 60 (Vetter, 2007), or 90 (Robbins, 2008) seconds resulted in decreased jump height.

Another study compared the efficiency of static stretching in respect to dynamic stretching and has shown that sprint performance and horizontal jumps 24 hours after the dynamic stretching (DS) were significantly better than those after the no-stretch and SS. This study highlighted the SS negative effect up to 24 hours post-stretching (Haddad, 2013).

The negative effects of SS resulted also on the isometric strength.

Several previous studies showed that static 5 minutes stretching decreases maximal isometric plantar strength immediately after stretching. However this impairment is restored within 20 minutes after stretching (Mizuno, 2013).

In general warm up includes not only static stretching but also jogging and running. A previous study reported that 5 minutes of running before and after static stretching did not impair performance. Therefore a warm-up consisting of static stretching activity and a series of movements renders the stretching-induced force deficit practically ineffectual.

In addition, taking into consideration the fact that pre-exercise stretching is usually performed at least 20-30 minutes before the start of the competition, and that in practice, the actual time spent stretching for a single site is shorter (15-20 seconds) the disadvantages of static stretching on exercise performance could be probably extremely small.

Therefore, athletes, should not perform static stretching within 10 minutes before competition if they don't want to decrease both the isometric and explosive strength after static stretching.

It's preferable that athletes should perform static stretching about 30 minutes before competitions if they want to increase ROM without inducing the consequences of static stretching (Mizuno, 2013).

Another study underlined that SS had a significant decrease in MVC force output paralleled by a significant increase in the ROM (both lasting 120 min) but the jumping performance was unaffected. Therefore these findings suggest that SS mainly impair isometric force production for up to 120 min and have a minor influence on the jumping performances.

So, especially for activities involving maximal force output, it is suggested that SS be avoided at least 120 min pre-performance.

Therefore the results of researches suggest that the warm up recommended should consist in general work low intensity training followed some static stretching (max 15 seconds) and possible in active tension (AT), then series of dynamic exercises of the various muscle groups and finally explosive elastic force exercises appropriate for the sporting discipline concerned (Rodas, 2009).

In conclusion about the planning of the warm-up before performance the researches indicate, in general, to prefer major use of DS during pre-activity stretching instead of the other stretching techniques.

Stretching and flexibility

Among the various techniques of muscle stretching, Several studies indicated PNF techniques as the most effective to increase the range of motion. However some studies support that PNF can increase the risk of injury due to the increased tolerance of the lengthening complex muscles and tendons. Fundamental factor to make the PNF effective in increasing the range of motion, is the execution of this technique; it is important the correct posture taken during application.

The ballistic is to be avoided due to the micro-cracks which can cause the level of the connective tissue. Some studies state that ballistic stretching maneuvers may cause injury to the muscle, tendons or ligaments being stretched, but this has not been shown in the literature and it should be used in future comparative purposes. In addition, when ballistic stretching compared with other modes of stretching it may not be as effective or is equally effective for increasing flexibility (Haff, 2006). Nelson and Bandy (2005) recently proposed the use of DS which may be safe and effective alternatives to ballistic stretching.

Passive static stretching for 15-30 seconds is more effective than the dynamic to improve the range of motion.

In some researches the effectiveness of different protocols in order to improve the flexibility has been evaluated in relation to duration and the type of the programs.

On the basis of many experiments it was found that the most important improvements were achieved by a period of 6 to 90 minutes with multiple daily sessions: this method produces effects that persist for a few weeks and these are related to the posture taken and the timing employed (Vergine, 2008).

For the flexibility training we suggest that it is preferable to dedicate the specific session in the cool-down phase. It should be noted that static passive stretching and PNF would be more indicated during the post effort recovery period, in other words during the return to basal state, because they aid recovery of amplitudes and the drainage of metabolic waste products (primary recovery) and the recovery and normalization of tone 2 hours post-exercise (deep recovery). Those stretching exercises that are unindicated for the warm-up, may therefore provide long term benefits in terms of flexibility training (Pacheco, 2011).

In conclusion of present studies and reflections on the recent researches indicate guidelines to utilize in the training program. Due to expensiveness of this subject it is not possible to consider the injury risks that is also an important aspect of the stretching on which we should reflect, but it has not been possible to study the researches in this specific topic (Altavilla, Tafuri, & Raiola, 2014).

We have realize through this review that specific researches in gymnastics are minimum and therefore it is necessary to increase studies about phenomenon of stretching within each single disciplines of gymnastics (Gomez , Rio, D'Anna, 2014).

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