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Original Article

Comparison of the effects of static and dynamic stretching on the force-velocity capabilities of young volleyball players

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Abstract:
The aim of the study was to compare the effects of static (StatS) and dynamic stretching (DynS) on force-velocity tasks (spike jump – SJ, block jump – BJ, 1 kg ball throw – THW) of young volleyball players (n = 10, age = 15.4±0.5 years, height = 177.5±4.7 cm, weight = 61.0±5.7 kg) during their competition period. The statistical analysis did not show any significant differences ($t = -0.074$, $p > 0.05$, $d = 0.02$) when measuring the SJ height after the StatS warm-up (58.3±10.0 cm) and after the DynS warm-up (58.9±10.1 cm). No significant differences were observed with the BS height ($t = -0.214$, $p > 0.05$, $d = 0.05$) – StatS warm-up (42.3±9.2 cm) and DynS warm-up (43.1±9.3 cm). The THW indicator came up similar ($t = 0.164$, $p > 0.05$, $d = 0.04$), StatS warm-up 12.2±3.2 cm, DynS warm-up 13.0±2.9 cm.
Key words: block jump, spike jump, warm-up.

Introduction

Stretching methods are based on a system rooted in the region of China, Japan and other ancient nations. The combination of theory and practice has helped to create a wide range of stretching methods (Knížetová & Kos, 1989; Buzková, 2006). According to a study by Bischops & Gerards (2000) a thorough warm-up should enable the athlete to give their best performance from the beginning of the match. Other authors claim that a suitable stretching does not only prepare the athlete for the sports performance but can serve as an injury prevention as well. Bean (2005) and Pearson (2006) say that static stretching does not have this injury-preventing effect and can even lower sports performance. The biggest problem with the stretching warm-up is the resistance of stretched muscles which causes a tightening reflex. Alter (1997) and Šebej (2001) state that static stretching can deal with the tightening reflex. Nelson & Kokken (2007) observe this method to be used mostly at the beginning of the training. Slomka & Regelin (2008) do not recommend performing static stretching at the start of training as static stretching caps the capillaries after about ten seconds, reducing blood flow in the muscles and performance. Several other studies confirm the deteriorating effect of static stretching on the sports performance (Fowles, Sale & MacDougall, 2000; Behm & Kibele, 2007; Behm & Chaouchi, 2010). Study results of McMillian et al. (2006) and Bishop (2003) indicate that dynamic mid-range exercise significantly improves short-term performance until fatigue develops. Curry et al. (2009) did not observe any statistically significant differences between static and dynamic stretching, but they point out that dynamic stretching has greater applicability compared to static stretching when aiming for higher performance in power exercises. In many studies (Young & Behm, 2002; Yamaguchi & Ishii, 2005; Holt & Lambourne, 2008; Cacek & Bubníková, 2009; Gelen, 2010; Pupiš et al., 2012), a significantly higher level of all the speed and force-velocity capabilities surveyed after the application of dynamic stretching compared to static stretching has been demonstrated. Effectiveness of static and dynamic stretching for strength and agility was determined by McMillian, Moore & Hatler (2006). They came to the conclusion that dynamic stretching yielded significantly better performance results than static stretching in all three tests (shuttle run / T-test, medicine ball upward throw, 5-step long jump). When testing the sports performance with a static stretching warm-up and without any stretching the results have been in favour of the static stretching in the long jump only. There were no significant differences observed in the shuttle run and medicine ball throw disciplines between the athletes who did the static stretching and who have forgone warm-up completely. The immediate effect stretching has on the explosive power was examined by Vanderka (2011). Dynamic stretching was effective in jump without counter movement. Performance increased by 6.3% ($p < 0.05$) and in jump with counter movement by 6.9% ($p < 0.01$). Static stretching decreased the height of the jump without counter movement by 2.81% (p = ns) and by 4.58% ($p \leq 0.05$) in jump with counter movement. This shows that dynamic stretching has a positive instantaneous effect on the height of the jump, while static stretching has a negative effect on this parameter. Faígenbaum et al. (2005) compared the effects of different warm-up exercises on the explosive power, agility, and flexibility in a group of children aged 11.3±0.7. The authors have found that the performance in vertical jump and shuttle run has deteriorated significantly after static stretching ($p < 0.05$) when compared to dynamic stretching. Neither of the stretching

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techniques had any significant effect on the flexibility. Research by Christensen et al. (2016) found significant differences between dynamic and static stretching only in a 10-meter run in favour of dynamic stretching. The difference was not significant in the medicine ball overhead throw and in the 20-meter run (Faigenbaum et al., 2006; Christensen et al., 2016). Fletcher & Jones (2004) have come to a different conclusion. They have found that static stretching worsened performance in the 20-meter run, while after dynamic stretching the performance in the very same discipline improved. Jaggers et al. (2008) questioned the effect of dynamic stretching compared to other stretching methods in a single vertical jump.

This study aims to compare the effect of static and dynamic stretching before the physical exercise on the explosive power of the lower limbs and the explosive power of the dominant upper limb in young volleyball players.

Material & Methods

Participants

The research sample consisted of players in the competition year 2016/2017 (n = 10; 2 setters, 2 blockers, 3 spikers, 2 defensive specialists, 1 libero; age = 15.4±0.5 years, height = 177.5±4.7 cm, weight = 63.6±5.7 kg). Research has been approved by the Ethics Committee at the university concerned. Measurements were performed in accordance with the ethical standards of the Helsinki Declaration and ethical standards in the field of scientific research in sport (Harris & Atkinson, 2011).

Organizing

The research was carried out in the competition year 2016/2017 from 23.1.2017 to 31.3.2017. The measurements of examined indicators were taken every Monday (StatS) and every Wednesday (DynS) during the training sessions. Each player completed 10 measurements of static stretching indicators and 10 indicator measurements after dynamic stretching over 10 weeks. The overall level of the force-velocity indicators after static or dynamic stretching warm-up was calculated as an average level of the ten above-mentioned measurements in each category respectively. The players started every training session with a slow jogging and then proceeded to the designated stretching method under the supervision of an examiner. There they followed the same routine of warming up the individual muscle groups. Prior to the measurement, the test subjects were explained and demonstrated the course of the test.

Measuring process

Special physical fitness tests were used in the study. A test of the spike jump and block jump were utilized in order to measure the special explosive power of the lower limbs. The average height of the vertical jump in both jumps was expressed in cm accurate to 1 cm. A 1kg ball throw in a kneeling position was used for determining the explosive power of the dominant upper limb. The throwing distance was measured accurate to 1 cm. With these tests, the current level of examined indicators after static and dynamic stretching were identified.

Static stretching:

- Stretching duration is 10-15 seconds.
- 5-10 seconds of rest were inserted in between the individual exercises.
- Each exercise was repeated twice.
- The intensity level of stretches was kept to 1–3 with slight pain

Dynamic stretching:

- The intensity of the exercise followed the basic methodology of dynamic stretching i.e. 8 repetitions in 5 seconds.
- 2-5 seconds of rest were inserted in between the individual exercises.
- Each exercise was repeated 8 – 10 times.
- The intensity level of stretches was kept to 1–3 with slight pain.

Data Analyses

The study used a periphrastic characteristics of descriptive statistics – arithmetic average (x) from position measures and standard deviation (SD) for variability measures.

The normality of data distribution was verified by Shapiro-Wilk's test. The Independent-Samples T Test was used to determine the significance of static and dynamic stretching differences for the level of the examined indicators. To ascertain the effect size a Cohen coefficient was utilized, which was interpreted as follows: d = 0.20 – small effect, d = 0.50 – medium effect, d = 0.80 – large effect. The probability of a type I error (alpha) was set at 0.05. Statistical analysis was carried out with IBM® SPSS® Statistics V19 (Statistical Package for the Social Sciences) software.

Results

The aim of the study was to compare the effect of static and dynamic stretching on force-velocity tasks (spike jump – SJ, block jump – BJ, 1 kg ball throw – THW) of young volleyball players. The results of the force-velocity indicators after static and dynamic stretching (Table 1) were calculated as the average level of ten static stretching measurements as well as ten measurements in the case of dynamic stretching for each player (n = 10).

Statistical analysis by the Independent-Samples T Test did not show a statistically significant difference ($p > 0.05$) after static and dynamic stretching (Table 1) in any of the examined indicator (SJ, BJ, THW). Even the effect size coefficient "d" showed only a small impact in all the indicators.

Table 1 Statistical analysis of the difference between the effects of static and dynamic stretching on the level of examined indicators.

Comparison of the effect of static and dynamic stretching					
Indicator	Difference		Statistical analysis		
	StatS	DynS	Independent-Samples T Test	Effect size (ES)	
	x±SD	x±SD		ES value	ES level
SJ (cm)	58.3±10.0	58.9±10.1	t = -0.074, p > 0.05	d = 0.02	small
BJ (cm)	42.3±9.2	43.1±9.3	t = -0.214, p > 0.05	d = 0.05	small
THW (cm)	12.2±3.2	13.0±2.9	t = 0.164, p > 0.05	d = 0.04	small

StatS – static stretching; DynS – dynamic stretching; x – arithmetic mean; SD – standard deviation; SJ – spike jump height; BJ – block jump height; THW – 1 kg ball throw distance

Discussion

The aim of the study was to compare the effect of static and dynamic stretching on the force-velocity capabilities of young volleyball players (n = 10) in the competition period. Based on the results of other similar studies (Yamaguchi & Ishii, 2005; Holt & Lambourne, 2008), it was considered that dynamic stretching would be more effective compared to static stretching when assessing speed and force-velocity capabilities. The findings of this study contradict those of Pupiš et al. (2014) where the players' average explosive power of the lower limbs in the squat jump test performed after static stretching was 41.1±3.8 cm. The average performance result after dynamic stretching was 43.5±3.6 cm, that means a significant difference of 2.3±1.3 cm ($t = 6.437$, $p < 0.05$, $d = 1.86$ – large effect). However, some of the findings in this study correspond with the findings of other authors (Little & Williams, 2006; Jaggers et al., 2008) who claim that dynamic stretching should not affect the height of the single vertical jump, as was the case in this study. Even with a 1 kg ball test, findings are inconsistent with the results of the McMillian, Moore & Hatler (2006) study, which concluded that a group warmed up by dynamic stretching had significantly improved performances in medicine ball throw compared to the group that employed static stretching. In this case, the discussed results are consistent with studies by Faigenbaum et al. (2006) and Christensen et al. (2016) who did not observe any significant difference in the medicine ball overhead throw after applying static and dynamic stretching.

Multiple authors (Murphy, 1994; Rosenbaum & Hennig, 1995; Anderson, 2003) report that static stretching adversely affects strength in sport performance, therefore they recommend the omission of static stretching or to replace it with dynamic stretching. Other authors even claim (Behm, 2004; Vanderka, 2011) that after static stretching, the performance of the athlete will worsen. This study, however, did not confirm the aforementioned claims. No significant differences between static and dynamic stretching effect on the explosive power of the lower limbs and the dominant arm swing were noted.

Although the results of this research did not confirm the significant differences between static and dynamic stretching, dynamic stretching had somewhat more beneficial effects on the performance of the tested athletes. The spike jump test yielded an increase of 0.6 cm and the block jump test 0.7 cm in comparison with static stretching warm-up. In the 1 kg ball throw test the dynamics stretching averaged 0.8 m better than static stretching. Because of the results obtained, the authors agree with Curry et al. (2009), who also did not detect significant differences between static and dynamic stretching, and point out the possibility that dynamic stretching has greater applicability compared to static stretching in order to achieve better performance.

This research has certain boundaries. The detection of static and dynamic stretching capabilities has its limitations and therefore it is important to properly schedule the days of testing, to know the health of the athletes and to work with a sufficiently large sample. This research lasted for more than two months, and out of a total of 16 test subjects, only twelve were included in the research, as four test subjects fell ill during this period. The remaining twelve test subjects passed the test period in a relatively good health condition or with fewer health problems (e.g., colds), which could also affect the results of the research. Therefore, it is more appropriate to carry out short-term testing in order to prevent potential illnesses and injuries to the test subjects. Another limit can be in the selected test days, where this study performed testing for organizational reasons every Monday (static stretching) and Wednesday (dynamic stretching). It is also possible that after the weekend, the test subjects could reach comparable performances with both dynamic and static stretching as they were sufficiently rested. The impact of biorhythms on sports performance should also be taken into account. Therefore, it is more appropriate to test players on the same days of the week. The above-mentioned factors could have affected the results of this research.

By eliminating these limits the results and conclusions could be more objective in the future.

Conclusions

Statistical analysis showed no significant differences between static and dynamic stretching effect on the explosive power of the lower limbs and the dominant arm swing. Therefore, the results have not shown that dynamic stretching is a more appropriate form of exercise than static stretching. For the next research efforts, it is recommended to work with a large enough sample. Testing should be carried out for a shorter period of time and on the same day. In interpreting and generalizing the results of our research, one must be very cautious, since it is necessary to take into account the number of the tested sample (n = 10) and the limits of this research. The results of this research point to the need for further research in the field of warm-up before the sports activity of force-velocity character.

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