

# Impact of specialized physical training programs on physical fitness in athletes

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## ABSTRACT

**Introduction.** Physical fitness is important to athletes because it allows for the highest ability of the athletes participating in any competition. Speed, agility, and quickness training (SAQ) is a form of training that is widely used to help athletes develop themselves in those areas. In addition, training programs can help athletes succeed by developing neuromuscular systems, improve the efficiency of movement, and in general increase their abilities. **Objective.** This research aims to compare the effect of the SAQ training program on physical fitness in athletes. Athletes are students of Rajamangala University of Technology Thanyaburi, 1st-4th year, aged over 18 years, consisting of 30 people, divided into 1 control group and 1 experimental group. The tools used in this research are a physical fitness test, and the SAQ training program. The frequency, percentage, average, standard deviation and t-test for dependent sample at the statistical significance level of .05. **Results.** The study found that in the experimental group, the mean values of hand force ( $t = 2.124$ ,  $p$ -value = .05), counter movement jump ( $t = 2.307$ ,  $p$ -value = .029), sitting, bent forward ( $t = 2.87$ ,  $p$ -value = .008) were significantly higher than the control group at the statistical significance of .05. The experimental group had lower storage and running mean values ( $t = -14.760$ ,  $p$ -value = .000) than the control group with statistical significance of .05. **Conclusion.** Applicable to athletes in training or anyone interested in using the SAQ training program in order to increase physical fitness in athletes. Moreover, trainers can apply the SAQ training program to other sports such as tennis, football, etc.

**Keywords:** Physical fitness; Athletes; Athletics; Training program.

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## INTRODUCTION

Athletics is a sport that is popular with people around the world because athletics are one component that enriches athletes with mental and physical perfection. Athletics competitions consist of various types of competitions such as short run, medium distance run, long distance run, etc ; yard type of competitions such as long jump, high jump, throwing weight, javelin throw, supporting pole etc (Carl, E. K. and Darniel, D. A.,1981). For single-player athletics, each type of athletics represents the highest ability of the athletes participating, whether running or body movement as fast as possible, or as far as possible, or as high as possible. Moreover, athletics maybe throwing, plunging on an object using physical exertion allows the object to move as far as possible, with clear statistical results. So, it has demonstrated the physical fitness of athletes in each competitive category such as speed, power, endurance, aerobic system and anaerobic system (Basmajian, John VI, 1973).

Therefore, physical fitness is important to athletes because it represents the highest ability of the athletes participating in the competition (Rainer, 2004). In summary, the runners need to have the speed, the power, the anaerobic system, the strength and the flexibility. There are several approaches to training such as Fartlek Training, Repetition Training, Marathon Training, and SAQ Training (Darren, S. et.al., 2000).

However, when it comes to athletics, there is a focus on speed, agility and quickness (SAQ). SAQ training is a common method of developing physical fitness in speed, agility and quickness, as well as for neurodevelopment. This exercise may cover all areas of the training intensity, from low to high intensity. It eliminates obstacles and thresholds and allows athletes to exert maximum exertion during a controlled and balanced movement pattern (Sporiš, G. et al. 2011). Speed can be considered as a single entity for a long period, measured by the amount of time the object will soon get from points A to B, mobility is strongly tied to balance. This is because athletes need to control changes in the centre of gravity of the body while causing the subject to deflect the posture. (Milanović, Z. et al. ,2013). Quickness is related to the speed of reaction and the speed of the first acceleration. Sporiš, G., et al. (2011) refers to four agility areas such as balance, coordination, programmed and random agility, all of which are used in SAQ training with adequate volume and intensity in terms of athlete age and motor readiness level. In addition, SAQ training programs can help athletes achieve and develop neuromuscular systems, improve movement performance, and enhance athletic abilities (Gambetta, V., 1987). In such studies, Rösch et al. (2000) concluded that elite players but not amateurs can adjust their body position as a result of SAQ training so that they can move a football with better balance, strength and control without losing speed. However, Jovanovic, M et al. (2011) found that the SAQ training program was not found to improve the agility performance of young footballers during the season, although it has been found to be an effective way to improve some energy efficiency. Despite the above research, at this time there is little scientific evidence to support the effectiveness of SAQ training for athletics. Therefore, researchers are interested in studying the effect of the SAQ training program on physical fitness in athletics. To find out if after training, the SAQ training program could produce better physical fitness results than before training or not.

## MATERIAL AND METHODS

### **Participants**

The participants are 30 athletes from Rajamangala University of Technology - Thanyaburi, aged of 18 and older, divided into 2 groups including the control group and experimental group, each group consisting of 15 persons.

**Criteria for selection of sample groups**

*Inclusion criteria* are as follows:

1. Athletes older than 18 years currently and studying at Rajamangala University of Technology Thanyaburi, Thanyaburi District, Pathum Thani Province.
2. Have strong health and physical capabilities.
3. Willing to participate in the study and willing to sign the research consent form.

*Exclusion criteria* are as follows:

1. Have congenital diseases such as heart disease, high blood pressure, etc.
2. Being in an illness that is an obstacle to exercise.
3. Cannot participate in the experiment for the full 12 weeks.

Moreover, no participants were injured for a full six months prior to the first test or during the training program. Dietary supplements were not included in their diets and participants were not taking steroids or other drugs that could affect physical performance or hormonal balance during the study. Scholarships from the Faculty of Liberal Arts, Rajamangala University of Technology Thanyaburi. Participants are fully informed and signed on the consent form and know that they can withdraw from the study at any time.

**Research instrument**

The tools used in this research were:

1. Physical fitness test from the Department of Physical Education, Ministry of Tourism and Sports (Sports Science Department, 2000).
2. SAQ training program consists of 12 weeks to practice, 5 days a week from Monday to Friday, including the morning period 05:30 am - 7:00 am and evening period 16:30 - 18:00. Each training time is approximately 1.30 hours. The training is divided into 3 parts, which are warm-up sessions that take 15 minutes, training sessions that take 60 minutes and final warm-up sessions that take 15 minutes. The training program details are as follows:

**Training program**

The warm-up phase (15 minutes) consists of a warmup run for about 2 kilometres. After that, stretching the muscles and doing basic warm up exercises, consisting of 6 positions:

- Position 1; runs fast with a length of approximately 80 meters, 2 rounds.
- Position 2; low knee position, about 30 meters, 2 rounds.
- Position 3; knee posture is about 30 meters, 2 rounds.
- Position 4; face kick, about 30 meters, 2 rounds.
- Position 5; back kick, about 30 meters, 2 rounds.
- Position 6; position, pierced the knee forward (Angu Loo) 30 meters, 2 rounds.

Training sessions (60 minutes) will be divided into:

1. The first month of training session for building a healthy breathing system consists of running 100 meters, 10 trips, resting during a 30-second cycle. The training style will vary from day to day.
2. The second month of training session for strength training consists of (1) running upstairs (2) weight training (3) jumping over fences and (4) circuit training which the training style will be different from day to day.

3. The third month of training session for speed training consists of (1) running 30 meters, 5 trips (2) running 50 meters, 3 trips (3) running 80 meters, 2 trips (4) running 120 meters, 1 trip and (5) run a drag of tires for about 30 meters, 6 trips, the training style will vary from day to day.

The final session (15 minute) consists of cool down and muscle stretching.

### ***Equipment and research facilities***

This research study uses tests that are internationally recognized physical fitness tests and have standard testing equipment with components of tools and equipment as follows:

1. Scales.
2. Height gauges.
3. Segmental body composition monitor brand TANITA.
4. Leg dynamometer.
5. Hand grip dynamometer.
6. Lange skinfold calliper.
7. Softness tester (sit and reach test).
8. Stopwatch.
9. Heart rate per minute comparison table.
10. Cushions.
11. Measuring tape.
12. Audio / audio files for beep test.
13. Rubber cone.
14. Square (nine square).
15. Long jump pads and cushions.
16. Trunk extension meter.
17. Yardstick measuring tools.
18. Treadmill.
19. Record sheet.
20. Helmas III physical fitness test set.

### ***Ethical consideration***

This study has been approved as ethical research by The Institutional Research Board of Rajamangala University of Technology Thanyaburi, Thailand. The approval letter was stated number COA No. 06 RMUTT\_REC No. Full 06/63.

### ***Data analysis***

Using SPSS version 21.0 for Windows (SPSS, Inc, Chicago, IL) software, data analysis of the differences between and within groups was performed. The results were provided with frequency, percentage, means and standard deviations for the measurements of the 2 settings. For hypothesis testing, comparing the training with the SAQ program on the physical fitness of the athletes before the training and after the 12th week of training using t-test for dependent t-sample. A p-value < .05 was considered statistically significant.

## **RESULTS**

From Table 1, showing the general characteristics of the sample group, it is found that most of the sample groups are males, consisting of 18 people, representing 60.0%. The mean age of the sample was 18.97 years. Most of the samples have experience in practicing and participating in the competition for an average

of 4.85 years. The sample group has an average weight of 58.74 kg and has an average height of 170.01 cm. The sample group has an average body fat of 16.50% and has an average muscle mass of 50.45%.

When comparing the general characteristics of the experimental group and the control group, it was found that the average age of the control group was slightly higher than that of the control group, 19.07 years of the control group compared to 18.87 years of the experimental group. In addition, the experience in training and participating in the competition of the control group was slightly higher than the experimental group, which is equal to 4.90 years compared to 4.80 years. While the mean weight, height, body fat and muscle mass of the experimental group was similar to the control group (Table 1).

Table 1. General characteristics of samples.

Characteristic	Experimental group	Control group	Total
<b>Gender</b>			
Male	9 (33.3%)	9 (26.7%)	18 (60.0%)
Female	6 (16.7%)	6 (23.3%)	12 (40.0%)
Age	18.87	19.07	18.97
Experience in training and competitions	4.80	4.90	4.85
Weight	59.29	58.19	58.74
Height	170.71	169.31	170.01
Body fat	16.47	16.53	16.50
Muscle mass	51.47	49.42	50.45
<b>Total</b>	<b>15 (50.00%)</b>	<b>15 (50.00%)</b>	<b>30 (100.00%)</b>

Table 2 presented the results of averages and standard deviations of muscular strength and endurance in the control group and the experimental group. The muscular strength and endurance consisted of hand force, sit up, push ups, and counter movement jumps. The control and experimental groups had no significant differences in average values and standard deviations of sit ups and push ups. While in the experimental group, the mean values of hand force ( $t = 2.124$ ,  $p$ -value = .043) and counter movement jump ( $t = 2.307$ ,  $p$ -value = .029) were significantly higher than the control group at the statistical significance of .05.

Table 2. Comparison of muscular strength and endurance between experimental and control groups by dependent t-test.

Muscular strength and endurance		N	Mean	SD.	Std. Error	t	df	Sig.
Hand force	Experimental group	15	32.007	10.123	2.614	2.124*	28	.043
	Control group	15	25.287	6.902	1.782			
Sit up	Experimental group	15	39.933	6.724	1.736	1.894	28	.069
	Control group	15	34.867	7.882	2.035			
Push the floor	Experimental group	15	36.533	8.823	2.278	2.006	28	.055
	Control group	15	30.067	8.836	2.281			
Counter movement jump	Experimental group	15	45.600	10.888	2.811	2.307*	28	.029
	Control group	15	37.067	9.308	2.403			

(\*) Significant level .05.

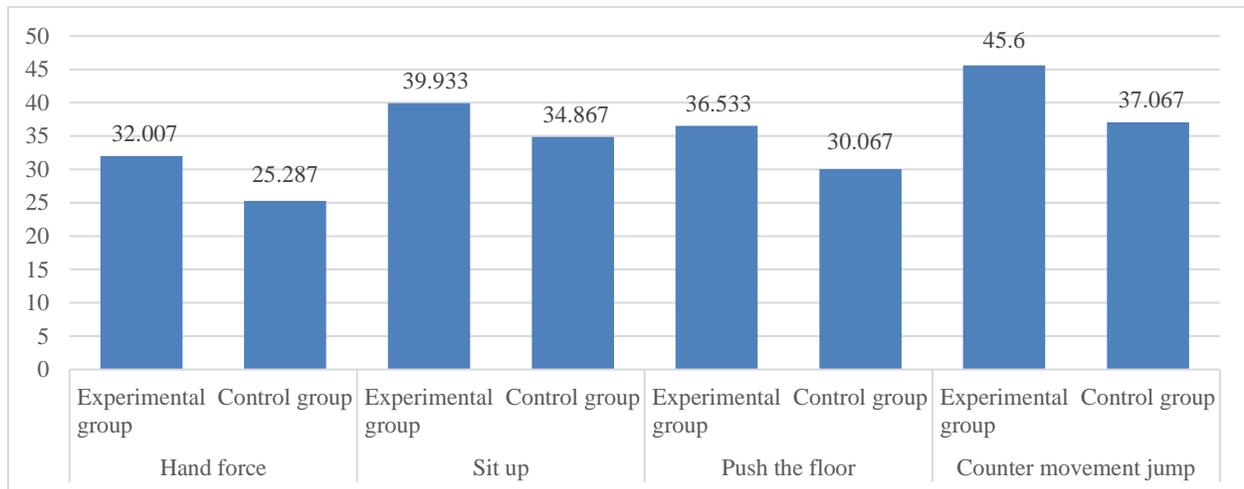


Figure 1. Comparison of the average level of muscular strength and endurance between experimental and control groups.

Table 3 presented the results of averages and standard deviations of flexibility in the control group and the experimental group. The flexibility includes sitting, bending forward, and balance. The results showed that the control group and experimental group had similar mean values and standard deviations of balance. While with the experimental group, the average of sitting, bending forward ( $t = 2.87$ ,  $p\text{-value} = .008$ ) was significantly higher than the control group at the statistical level of .05.

Table 3. Comparison of flexibility between experimental and control groups by dependent t-test.

Flexibility		N	Mean	SD.	Std. Error	t	df	Sig.
Sitting, bent forward	Experimental group	15	16.747	5.147	1.329	2.876*	28	.008
	Control group	15	10.853	6.042	1.560			
Balance	Experimental group	15	31.800	31.965	8.253	0.019	28	.985
	Control group	15	31.600	26.191	6.763			

(\*) Significant level .05.

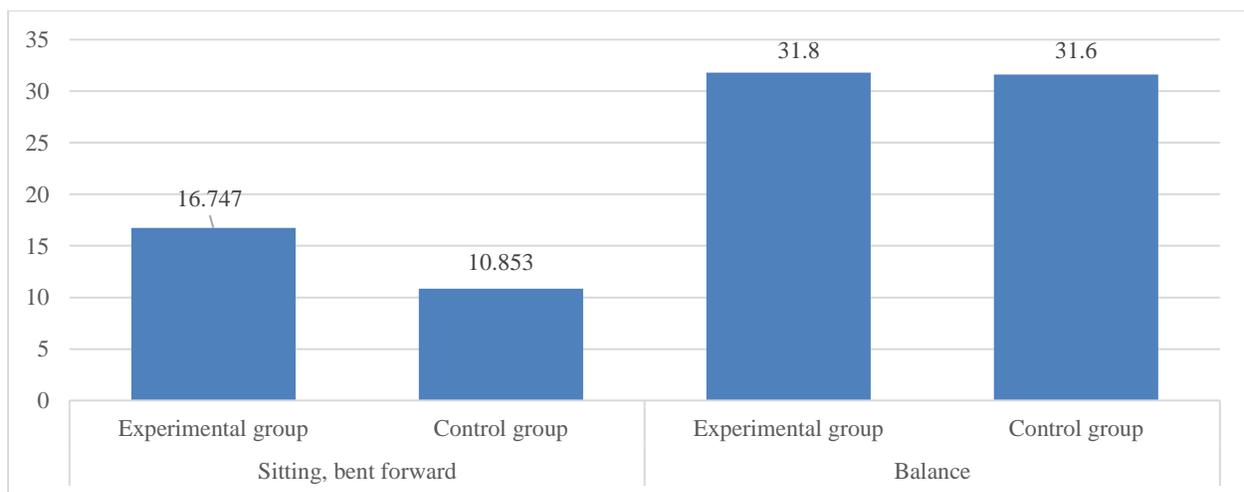


Figure 2. Comparison of the average level of flexibility between experimental and control groups.

Table 4 presented the results of average and standard deviations of agility in the control group and experiment group was done by measuring sidestep, running and pick up. The results showed that there was no difference significance of sidestep and response to sound between the control and experimental group, while the experimental group had lower running and pick-up mean values ( $t = -14.760$ ,  $p\text{-value} = .000$ ) than the control group with statistical significance of .05.

Table 4. Comparison of agility between experimental and control groups by dependent t-test.

Agility		N	Mean	SD.	Std. Error	t	df	Sig.
Sidestep	Experimental group	15	19.133	2.900	0.749	2.043	28	.051
	Control group	15	17.200	2.242	0.579			
Running and pick up	Experimental group	15	10.321	0.605	0.156	-14.760*	28	.000
	Control group	15	13.604	0.613	0.158			
Response to sound	Experimental group	15	352.733	117.178	30.255	1.704	28	.099
	Control group	15	289.600	82.805	21.380			

(\*) Significant level .05.

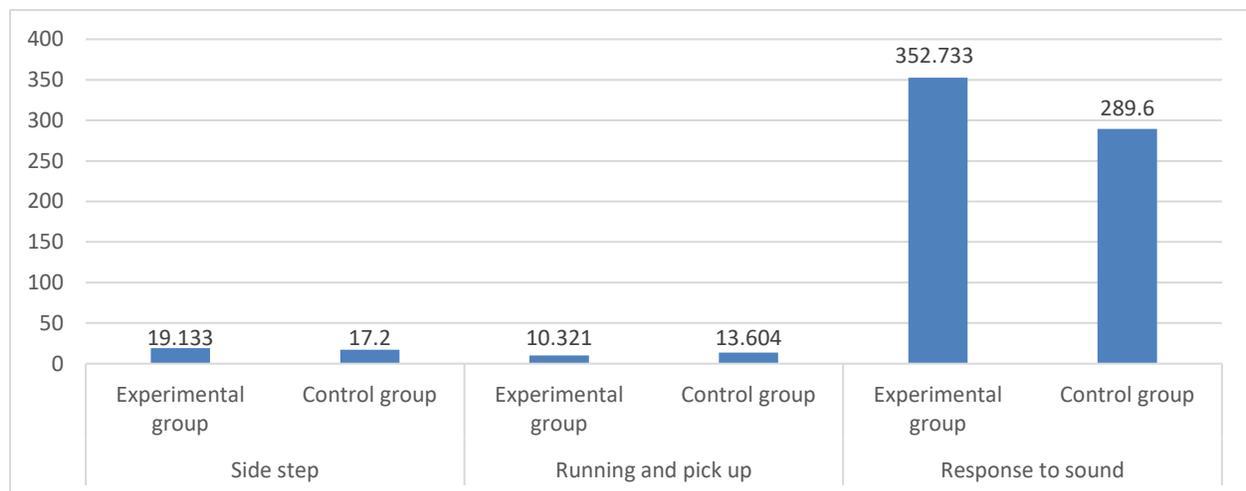


Figure 1. Comparison of the average level of agility between experimental and control groups.

## DISCUSSION

From testing the differences of the muscular strength and endurance between the control group and experimental group, it was found that after training with SAQ program, the experimental group had the mean values of hand force and counter movement jump significantly at .05, with the athletes in the experimental group doing the time better than the athletes in the control group. According to Sporiš, G. et al. (2011) the SAQ training program is a combination of the principles of speed, agility and quickness training, mainly based on neuromuscular relationship training principles, namely the ability to work in a coherent way reflected by the central nervous system and muscles performing difficult movements with efficiency and precision. Athletes with neuromuscular associations learn skills quickly and are able to perform them well. This confirms the neuromuscular affinity and the body's ability to control movement effectively (Milanović, Z. et al., 2013).

The results of this study indicate that the SAQ training program created by the researcher can actually develop the muscular strength and endurance of athletes. For this reason, it is important to create a training program to improve physical performance that is consistent with the key skills of each sport. The specialized training will have the effect of encouraging athletes to have the opportunity to succeed in playing that sport more. According to Lawton et al., (2012) was recommended to perform activities to strengthen the muscles four times a week, without specifying intensity training for maximum strength and endurance. It can be concluded that the intervention should adhere to the association's response to the regimen recommended for developing strength in the trained person (Buckley et al., 2015; Kramer et al., 1993; Rhea et al., 2003, Tse et al., 2005). Moreover, Lesinski et al. (2016) found that the training program that uses free weights is most effective for increasing strength in young athletes. Therefore, in assessing the impact of training on various physical fitness measures, it should focus on one type of training, such as free weight training, depending on the training goals, such as increasing maximum strength.

From flexibility testing, it was found that the average of sitting, bending forward of the athletes in the experimental was higher than the athletes in the control group. Adjustment in flexibility is caused by training that emphasizes the strength of joints regardless of the gender of the individual, as men and women have similar changes in flexibility. Increased flexibility due to the training program on trained joints was not reported previously in adult women who were not trained (Kim E. et al. 2011; Morton SK et al, 2011 ; Santos E, 2010), men who are not trained (Morton SK et al, 2011; Distefano LJ. et al, 2013; Zavanela PM, 2012), and judo athletes (Saraiva AR, 2014).

Regarding to the agility of the experimental group, the experimental group had lower running and pick-up mean values than the control group. According to Suna et al. (2016), coordination training affects the balance, speed and agility positively. Similarly, Kevin et al. (2009) reported that their strength training quickly affects the vertical jump, agility, and performance of football players positively. Moreover, Miller et al. (2006) said that the 6-week strength training is effective in increasing the agility of the players and the positive relationship within the agility test. Also, Falk et al. (1996) stressed that strength training for 12 weeks resulted in the robust versatility for teenage boys.

Therefore, athletes showing good muscle strength and muscle power and agility improvement is an essential result of training sessions, and it is a good foundation for further improvement and athletic success. Thus, developing an athlete's skill level to the maximum requires the management of a continuous and systematic training plan by increasing the intensity of each training session to advance in the training process.

## **CONCLUSION**

The results of this research showed that the program developed by the researcher is effective in increasing the strength of the muscles, the speed and the agility of the athletes. Athletes who practice the SAQ program will improve muscles, speed and agility better than regular training programs. Therefore, such programs coupled with or replacing regular training will improve the physical performance of the athlete. Teachers or those who practice athletics can use the program to train and improve the athlete and apply these concepts to teach or practice other types of sports more efficiently.

## **AUTHOR CONTRIBUTIONS**

All authors have participated in (a) conception and design, or analysis and interpretation of the data; (b) drafting the article or revising it critically for important intellectual content; and (c) approval of the final version.

## SUPPORTING AGENCIES

The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript.

## DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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## REFERENCES

- Basmajian, John VI. (1973). *Exercise and Sport Science Reviews*. New York : Academic Press, Vol. 1.
- Buckley, S., Knapp, K., Lackie, A., Lewry, C., Horvey, K., Benko, C., Trinh, J., & Butcher, S. (2015). Multimodal high-intensity interval training increases muscle function and metabolic performance in females. *Applied Physiology, Nutrition, and Metabolism = Physiologie Appliquee, Nutrition Et Metabolisme*, 40(11), 1157–1162. <https://doi.org/10.1139/apnm-2015-0238>
- Carl, E. K. and Darniel, D. A. (1981). *Modern Principles of Athletic Training*. 5th ed. St.Louis : C.V. Mosby.
- Chu, D.A. and Plummer. (1984). "The Language of Plyometric". *National Strength and Conditioning Association Journal*. 6 (November 1984) 30-31.
- Darren, S. et.al. (2000). "Protocols for the Physiological Assessment of High-Performance Runner", In *Physiological Tests for Elite Athletes*. Champaign: Human Kinetics Publishers, 2000.
- Denadai, B.S. and Higino, W.P. Effect of the passive recovery period on the lactate minimum speed in sprinters and endurance runners. *Journal of Science and Medicine in Sport*, 2004; 7(4): 488-496. [https://doi.org/10.1016/s1440-2440\(04\)80268-8](https://doi.org/10.1016/s1440-2440(04)80268-8)
- Dintiman, T. (1964). *Track and Field*. Boston : Library of Congress Catalog.
- Dintimin, George B. & Ward, Robert D. (1988). *Sport Speed*. Champaign IL : Leisure Press.
- Dintimin, George B. (1984). *How to Run Faster*. New York : Leisure Press.
- Distefano LJ, Distefano MJ, Frank BS, Clark MA, Padua DA. (2013). Comparison of integrated and isolated training on performance measures and neuromuscular control. *J Strength Cond Res*. 27(4): 1083-1090. <https://doi.org/10.1519/jsc.0b013e318280d40b>
- Falk, B. Mor. G. (1996). The effects of resistance and martial arts training in 6-to 8-year-old boys. *Pediatric exercise science*, 8(1), 48-56. <https://doi.org/10.1123/pes.8.1.48>
- Gambetta, V. (1981). "Plyometric Training". *Track and Field Coaching Manual*. West Point, New York : Leisure Press.
- Gambetta, V. (1987). "Principle of Plyometrics Training". *Track and Field Technique*.97(2) : 3899-3104.
- Jovanovic, M., Sporis, G., Omrcen, D. and Fiorentini, F. (2011) Effects of speed, agility, quickness training method on power performance in elite soccer players. *The Journal of Strength and Conditioning Research* 25(5), 1285-1292. <https://doi.org/10.1519/jsc.0b013e3181d67c65>

- Kevin, T. , Duncan, F. , Philip. R. H. (2009). The effect of two plyometric training techniques on muscular power and agility in youth soccer players, *The Journal of Strength and Conditioning Research*, 23 (1), 332. <https://doi.org/10.1519/jsc.0b013e318183a01a>
- Kim E, Dear A, Ferguson SL, Seo D, Bemben MG. (2011). Effects of 4 weeks of traditional resistance training vs. super-slow strength training on early phase adaptations in strength, flexibility, and aerobic capacity in college-aged women. *J Strength Cond Res.* 25(11): 3006-3013. <https://doi.org/10.1519/jsc.0b013e318212e3a2>
- Kramer, J. F., Morrow, A., & Leger, A. (1993). Changes in rowing ergometer, weight lifting, vertical jump and isokinetic performance in response to standard and standard plus plyometric training programs. *International Journal of Sports Medicine*, 14(8), 449–454. <https://doi.org/10.1055/s-2007-1021209>
- Lawton, T. W., Cronin, J. B., & McGuigan, M. R. (2012). Does extensive on-water rowing increase muscular strength and endurance? *Journal of Sports Sciences*, 30(6), 533–540. <https://doi.org/10.1080/02640414.2011.653982>
- Lesinski, M., Prieske, O., & Granacher, U. (2016). Effects and dose-response relationships of resistance training on physical performance in youth athletes: A systematic review and meta-analysis. *British Journal of Sports Medicine*, 50(13), 781–795. <https://doi.org/10.1136/bjsports-2015-095497>
- Milanović, Z. Sporis, G. Trajković, N. James, N. and Šamija, K. (2013) “Effects of a 12 Week SAQ Training Programme on Agility with and without the Ball among Young Soccer Players,” *J. Sports Sci. Med.*, vol. 12, pp. 97–103.
- Miller, M. G. Herniman, J. J. Ricard, M. D. Cheatham, C. C. Michael. T. J. (2006). The effects of a 6-week plyometric training program on agility, *JSSM*, 459-460.
- Morton SK, Whitehead JR, Brinkert RH, Caine DJ. (2011). Resistance training vs. static stretching: effects on flexibility and strength. *J Strength Cond Res.* 25(12): 3391-3398. <https://doi.org/10.1519/jsc.0b013e31821624aa>
- Rhea, M. R., Alvar, B. A., Burkett, L. N., & Ball, S. D. (2003). A meta-analysis to determine the dose response for strength development. *Medicine and Science in Sports and Exercise*, 35(3), 456–464. <https://doi.org/10.1249/01.mss.0000053727.63505.d4>
- Rösch, D., Hodgson, R., Peterson, T. L., Graf-Baumann, T., Junge, A., Chomiak, J. and Dvorak, J. (2000) Assessment and evaluation of football performance. *The American Journal of Sports Medicine* 28(Suppl. 5), S29-S39. [https://doi.org/10.1177/28.suppl\\_5.s-29](https://doi.org/10.1177/28.suppl_5.s-29)
- Santos E, Rhea MR, Simao R, Dias I, de Salles BF, Novaes J, et al. (2010). Influence of moderately intense strength training on flexibility in sedentary young women. *J Strength Cond Res.* 24(11): 3144-3149. <https://doi.org/10.1519/jsc.0b013e3181e38027>
- Saraiva AR, Reis VM, Costa PB, Bentes CM, Costa ESGV, Novaes JS. (2014). Chronic effects of different resistance training exercise orders on flexibility in elite judo athletes. *J Hum Kinet.* 2014; 40: 129-137. <https://doi.org/10.2478/hukin-2014-0015>
- Sporiš, G., Milanović, Z., Trajković, N. and Joksimović, A. (2011). Correlation between speed, agility and quickness (SAQ) in elite young soccer player. *Acta kinesiologica* 5(2), 36-41.
- Sports Science Department. (1999). The Sports Authority of Thailand. Athletic body integrity test. Bangkok: New Thai Mit Printing.
- Sports Science Department. (2000). The Sports Authority of Thailand. Benchmark for physical fitness of people Thailand. Bangkok: New Thai Mitr Printing.
- Suna, G. , Beyleroğlu, M. , Alp, M. , Yalçın. S. (2016). Investigating the effects of coordination trainings on velocity, balance and agility features of tennis kids. *SSTB International Refereed Academic Journal of Sports, Health & Medical Sciences*, 20. <https://doi.org/10.17363/sstb.20162022364>

- Tse, M. A., McManus, A. M., & Masters, R. S. W. (2005). Development and validation of a core endurance intervention program: Implications for performance in college-age rowers. *Journal of Strength and Conditioning Research*, 19(3), 547–552. <https://doi.org/10.1519/00124278-200508000-00011>
- Zavanela PM, Crewther BT, Lodo L, Florindo AA, Miyabara EH, Aoki MS. (2012). Health and fitness benefits of a resistance training intervention performed in the workplace. *J Strength Cond Res*. 26(3): 811-817. <https://doi.org/10.1519/jsc.0b013e318225ff4d>

