The Effect of 50m Sprint Training on Increasing Speed and Power of Dollyo Chagi Kicks in Taekwondo Athletes

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Abstract

Introduction: *Several training techniques are used to improve the performance of taekwondo athletes, one of which is sprint running. Sprinting is one of the branches of athletic sports which requires strength, muscle power, agility and speed. Dollyo chagi kicks is most often used both in attack and defense in taekwondo competition. To be a profesional athlete, they must have sport components such as muscle strengh, muscle power, speed, flexibility, agility, and endurance. The winner of the taekwondo competition is determined by the number of points earned. The author choose the speed an power of dollyo chagi because it is reliable to get points taekwondo matches.*
Methods*: This is a quasi-experimental study with one-group pre-test and post-test design. Using purposive sampling techniques, seventeen junior taekwondo athletes (9 males and 8 female) were recruited. The athletes were trained with 50-meter sprint run for 4 weeks with intensity of 3 sets and 4 times a week.*
Result: *Speed of dollyo chagi kicks increase significantly 17.74% ($p < 0.05$) and power of dollyo chagi kicks increase significantly 23.06% ($p < 0.05$).*
Conclusion: *50m sprint training can increase the speed and power of dollyo chagi kicks in taekwondo athletes.*

Key words: *50m sprint, Speed, Power, Dollyo chagi kicks, Taekwondo athletes*

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Pengaruh Latihan Lari Sprint 50m terhadap Peningkatan Speed dan Power Tendangan Dollyo Chagi pada Atlet Taekwondo

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Abstrak

Pendahuluan: *Beberapa metode latihan digunakan untuk meningkatkan performa atlet taekwondo, salah satunya adalah latihan lari sprint. Lari Sprint merupakan salah satu cabang dari olahraga atletik yang membutuhkan kekuatan, daya ledak otot, kelincahan dan kecepatan. Tendangan dollyo chagi merupakan tendangan yang paling sering digunakan baik dalam menyerang maupun bertahan pada pertandingan taekwondo. Pemenang pada pertandingan taekwondo ditentukan oleh poin yang diperoleh. Penulis memilih speed dan power tendangan dollyo chagi karena sangat sesuai untuk mendapatkan poin pada pertandingan taekwondo.*
Metode : *Quasi-experimental dengan rancangan one-group pre-test dan post-test design. Menggunakan teknik purposive sampling, tujuh belas atlet taekwondo junior (9 laki-laki dan 8 perempuan) direkrut. Atlet diberi perlakuan berupa latihan lari sprint 50 meter selama 4 minggu dengan intensitas sebanyak 3 set dan 4 kali pertemuan pada setiap minggunya.*
Hasil : *Speed pada tendangan dollyo chagi meningkat secara signifikan sebesar 17,74% ($p < 0.05$) dan power pada tendangan dollyo chagi meningkat secara signifikan sebesar 23,06% ($p < 0,05$).*
Kesimpulan : *Latihan lari sprint 50m dapat meningkatkan speed dan power tendangan dollyo chagi pada atlet taekwondo.*

Kata Kunci : *Sprint 50m, Speed, Power, Tendangan dollyo chagi, Atlet taekwondo*

Introduction

Taekwondo is a martial arts sport that tends to prioritize kicks and focus on leg strength. Taekwondo has a variety of basic kicks and their combinations. However, this research focuses on the dollyo chagi kicks. Dollyo chagi is an oblique or rotating kick using the instep as a source of strength targeting the opponent's head or stomach.[1] Based on Rachmahani's research (2017), the percentage of kicks most often used to open attacks in taekwondo matches is as follows: dollyo chagi kicks were 20.11% male and 13.74% female; checking yeop chagi kicks as much as 15.96% male and 10.28% female as well as kicks from idan dollyo chagi male as much as 12.50% and female 7.69%.[2] Similar to research conducted by Wimbardi (2013), that the dollyo chagi kicks is most often used both in attack and defense in taekwondo competition.[3]

There are many types of training methods used by taekwondo coaches in improving the performance of their athletes, one of which is sprint running. Sprinting is one of the branches of athletic sports which requires strength, muscle power, agility and speed.[4] Sprints are run as fast as possible with a predetermined mileage.[5] The distance of the sprints are divided into 50 m, 100 m, 200 m, and 400 m according to the length of the track.[6] Sprints uses lactic acid metabolism based on the storage of phosphagen that is available in muscle when depleted.[7] Based on physiology, sprinting requires rapid glycolytic type of muscle to produce high-intensity and fast-paced contractions.[8] All muscles in the body can adapt and remodelling for function adjustments according to the activities acrried out.[9] Based on theory, the author choose the sprint training for this study because sprinting is a simple practical method that all athletes can do. Therefore, we believe that increasing speed and power of

dollyo chagi kicks with sprint training in an effective practical method.

Research Methods

This research's type is an experimental research design with pre-experimental or quasi-experimental or quasi-methods. Using purposive sampling techniques. Each participant voluntarily provided written informed consent before participating. This study was approved in advance by chairman of PBTI Sidoarjo Regency branch (Pengurus Besar Taekwondo Indonesia) which mean the chairman of the Main Board of Indonesian Taekwondo branch Sidoarjo Regency and also taekwondo coach of Puslatcab Sidoarjo Regency. The number of ethical exemption is 140/EC/KEPK/FKUA/2020.

In total there are 20 athletes of the Puslatcab Sidoarjo Regency, with 17 athletes in kyorugi category and 3 athletes in poomsae category (Tab. 1). Inclusion criteria for this sample are, junior atheletes at Sidoarjo Regency in the kyorugi category and will to take part in research. The exclusion criteria were athletes from Puslatcab Sidoarjo Regency junior class in the poomsae category, resigned during the research, and did not meet the requirements.

Table 1. Characteristics of Research Subjects

Characteristics		N (%)	Mean ± SD; (min.-max.)
Gender	Male	9 (52.9)	
	Women	8 (47.1)	
	Total	17 (100)	
Age (years)			16.23 ± 0.83; (15-17)
Weight (kg)	Male		60.22 ± 12.75; (41-85)
	Women		50.87 ± 6.57; (42-62)
Height (cm)	Male		170.22 ± 5.76; (160-176)
	Women		158.00 ± 3.20; (155-163)

All samples in the group were pre-tested, then given treatment in the form of sprint training at a distance of 50 m for 4-weeks. Sprint training are carried out three sets in each meeting (in 1-week, four meetings are held on Monday, Wednesday, Friday and Sunday). One set in a sprint means that the athlete runs the sprint from the start line to the finish line. After the treatment is complete, the group will be subjected to a post-test.

Data collection was divided into 3 stages as follows; pre-test, treatment and post-test. Pre-test was done to measure the kick speed and power of the athlete before being treated 3 times. The speed of dollyo chagi kicks is measured by counting how many dollyo chagi kicks the athlete produces in 15 seconds as was done by Cahyani (2015) in her research. The dollyo chagi kick power is measured using a muscle explosive power gauge, namely the MD jump with the vertical jump test. Then the athlete sprints training for 3 sets per meeting for 4 weeks.[10] Before doing the 50 m sprint training, athletes warm up for 15 minutes in the form of stretching for 10 minutes and jogging for 5 minutes. All sprint training results are recorded using stopwatch, and the athlete's sprint should not be slower than the previous day. Furthermore, the post-test was carried out 3 times.

a. Analysis of increasing the speed and power of dollyo chagi kicks.

From the table 2, after being given the sprint running treatment, the dollyo chagi's speed increased by 3.33 kicks or 17.74% and the power or explosive power of the leg muscles increased by 8.14 cm or 23.06%.

b. Normality tes

From the results of the normality test, the dollyo chagi's speed has a normal data distribution (P-value> 0.05). Meanwhile, the dollyo chagi's power were not normally distributed (P-value <0.05)

c. Data processing for pre-test and post-test

The significance value of the paired sample t-test is 0.000 and significance value of the wilcoxon signed rank test is 0,000. Which mean that all of data has a significant difference.

Table 2. Results of Increasing the Speed and Power of Dollyo Chagi Kicks

	Pre-test (mean±SD)	Post-test (mean±SD)	Difference/increase (mean±SD)	Difference/ increase (%)	P-value
Speed	19.08 ± 2.08	22.41 ± 2.10	3.33 ± 0.58	17.74	0.000*
Power	35.04 ± 6.25	43.18 ± 8.07	8.14 ± 2.19	23.06	0.000**

*Paired Sample T Test; **Wilcoxon Signed Rank Test

Discussion

A 50m Sprint Training Against Dollyo Chagi's Speed

Based on the results of data, it was found that all taekwondo athletes experienced a significant increase in speed after being given treatment. This is in line with research by Harrison & Bourke (2009) that sprint training provides a significant increase in speed in male rugby players. Harrison used six sets of 30 m sprint training for 6 weeks on 15 male rugby players. With these results, Harrison argues that the increase can occur due to sprint training using the hip and knee extensor muscles, which most rugby players also use these muscles. So that if the muscle speed increases, it will also improve performance in rugby players.[11]

Previous research by Prieske et al (2018) that sprint training provides a significant increase in the speed tested using the agility test. Prieske et al assessed the individual's agility or ability to change direction appropriately while moving without losing balance. This proves that sprinting training can increase the speed or speed of the muscles to perform the next contraction.

A 50m Sprint Training Against Dollyo Chagi's Power

Based on the results of data processing, it was found that all taekwondo athletes experienced a significant increase in power after being given treatment. This is in line with research by Prieske et al., (2018) that sprinting training for 6 weeks in young adult males gave a significant increase in lower leg power as measured by the vertical jump test and drop jump test.[12]

According to Amin (2014), sprinting mostly requires contraction of muscles of the quadriceps femoris and gastrocnemius.[13] When doing vertical jumps or jumps, most of the muscles in the ankle and knee extensors are the muscles of the quadriceps femoris and gastrocnemius.[14] It can be concluded that sprinting can increase significantly the results in power because the muscles that are trained during sprint training have the same muscles used during the vertical jump test.

Relationship of 50m Sprint Training to Increase Dollyo Chagi's Speed and Power

From biomechanics, the phase when running a sprint is mostly using the muscles of the quadriceps femoris and gastrocnemius.[13] It is the same as the dollyo chagi kick which mostly uses the quadriceps femoris and gastrocnemius muscles during the active phase.[15] It can be concluded that sprint running training has a relationship with dollyo chagi kicks in biomechanical aspect.

When doing sprint training, the muscles used will work hard to meet the required energy needs.In the first 10 seconds when running a sprint or doing extreme activities, about 95% of the energy used comes from anaerobic metabolism.[7] From anaerobic metabolism, it will produce energy in the form of lactic acid products and alkaline components as the final product.[8]

Muscles that can be used for fast and extreme activities such as sprinting must have high levels of enzymes for anaerobic metabolism. Muscles that have high levels of enzymes for anaerobic metabolism are fast glycolytic type muscle fibers.[8] The types of muscle fibers in humans vary and are determined by genetics. All types of muscles can adapt and perform remodeling to make functional adjustments according to activities carried out in a fast period of only a few weeks.[9] So, apart from genetic factors regarding the types of muscle fibers, the type and intensity of exercise as well as the amount of determination can change muscle fibers in response to the needs imposed on the muscles.[8]

Sprinting is a physical activity that is included in anaerobic training.[16] Anaerobic exercise is requires muscle contraction in a fast time and with great intensity.[17] Physical activity can increase the secretion of human growth hormone (hGH) or growth hormone

which can affect the regeneration of muscle, bone and collagen cells.[18] Doing physical activity causes the body to form energy through aerobic metabolic pathways and anaerobic metabolism when the reserves in aerobic metabolism are depleted.[9] Physical exercise that exceeds the lactate threshold or the maximum level of lactic acid in the body can affect the release of resting hGH, and will increase hGH secretion within 24 hours.[18]

During sprint training, lactic acid levels in the body will increase due to the end result of anaerobic metabolism. Lactic acid can cause hypertrophy in muscles by activating intracellular anabolic signals through the extracellular signal-regulated kinase-1/2 pathway or ERK1 / 2 pathway.[19] Where the ERK1 / 2 pathway can stimulate the proliferation and differentiation of muscle cells.[20] It can be attributed between lactic acid levels to increase growth hormone so that it can cause cell proliferation and differentiation.

This study used junior athletes aged 15-17 years. The age category of junior athletes is included in the early adolescence, and there are still epiphyseal growth plates on the bones and a period of rapid growth both physically, psychologically and intellectually.[21] Providing physical exercise in the form of sprinting will increase hGH secretion and will have a positive effect on the epiphyseal growth plate in growth. Growth hormone (GH) and insulin-like growth factor-I (IGF-I) are the main stimulators needed for longitudinal or elongated bone growth.[22] GH can also increase bone strength, because GH helps the bone remodeling cycle.[23] Bone health is very important for athlete performance, because it is related to the incidence of injuries that athletes can experience at any time. Therefore, to get healthy bones, in addition to adequate nutritional intake, calcium and vitamin D, it must also be balanced with a structured exercise method.[24]

In muscle cells, GH facilitates the process of fusion of muscle cells that can increase the size of the myotube, but does not increase the myogenesis process.[25] Growth hormone can cause hypertrophy in muscles, because it makes cells grow larger and not multiply. Lactic acid can cause hypertrophy in muscles.[19] Hypertrophy in muscles can affect muscle strength, thus also affecting performance in athletes. The greater the size of the muscles, the greater the strength produced, but this still depends on the type of training given to the athlete.[26]

Speed and Power Relationship for the 50m Sprint and Dollyo Chagi Kick

In sprint running, there are two important components in sprinting that affect speed, namely Stride Length (SL) and Stride Frequency (SF).[27] Stride Length is a stride length which is defined as the distance generated in one foot step. Stride Frequency is the step frequency, which is the number of runners' steps that are counted in a certain time.

The application of biomechanics in sprinting consists of linear motion and rotational motion, speed and acceleration, momentum, and Newton's law.[28] The combination of linear motion and rotational motion found in sprinting produces general motion. The implementation of this movement is when the runner moves forward (linear motion), this forward movement is caused by rotational motion of the legs. Speed and acceleration are things that will be experienced by runners after the start shot is sounded (Sari, 2015). Momentum is a displacement that is influenced by body weight and speed. In sprinting, momentum is influenced by arm movements and the return of the legs. Newton's law applies to sprinting. Newton I's law is $\sum F = 0$, which means that all objects will not move or be at the same point, unless there is a force that makes them move. Newton's I law applies when the runner is at the starting line. Where when the runner feels at the starting line, there is no force that forces him to move, so there is no change in position. Newton II's law is $\sum F = ma$, which means that the acceleration of an object is proportional to the applied force, causing the object to move in the same direction as that force. Newton II's law applies when a runner leaves the starting line.[28] It is at this time that the Stride Length phase begins,[29] and this phase requires flexibility, strength, speed and explosive power of muscles and joints[4] so that it can affect the resulting speed and acceleration. Newton III's law, namely Faction= -Faction, which means that every action there is always the same and opposite reaction. Newton III's law applies when a runner is resting on the ground, it will cause the same and opposite reaction force, so that it looks as if the athlete is floating above.[28] Newton III's law applies when the runner is in the support phase, which is when the toe becomes the support in front of the body's horizontal Center of Gravity (CoG) distance. Placement of the foot in front of the body's CoG horizontal distance will cause braking, which is when the flight phase occurs. so that

it will slow down the speed and acceleration and the frequency of the steps is reduced. In order for momentum to increase, what must be done is to place the foot under the CoG so that it will reduce the braking time, so that it will efficiently increase the momentum generated during the drive phase.[29] In addition, placing the support under the CoG allows the hips to become extended, pushing the body horizontally and increasing momentum.

In dollyo chagi kick, it has four phases, namely: preparation, chamber, extension, and the recoil phase. Kick speed is determined by reciprocal contraction or the simultaneous contraction between the quadriceps femoris and hamstring muscles in the preparation phase. While the kick power is obtained in the preparation phase towards the chamber phase. In chamber phase there is potential energy from the working muscles, namely the muscles of the quadriceps, namely the rectus femoris, vastus lateralis, vastus medialis, and vastus intermedialis to prepare for the next phase.[15]

Comparison of the 50 m Sprint Training with Other Training Methods

In this study, 50 m sprint training can increase the speed of dollyo chagi kicks from an average of 19.08 kicks to 22.41 kicks. The average kick speed increased by 3.33 kicks or 17.74%. The following is a comparison table of various training methods to increase the dollyo chagi kick speed in previous studies (Table 3).

Table 3. Comparison of Training Methods to Increasing Dollyo Chagi's Kick Speed in Previous Research

	Exercise Method	Pre test Average (Kicks)	Post test Average (Kicks)	Much Boost (Kick)	Percentage of Increase (%)
Cahyani (2015)	Leg weight training	17	18	1	5.88
Mursalin & Mursidin (2017)	Leg extension	20.33	23.25	2.92	14.36
	Squat jump	19.92	23.08	3.16	15.86
Rasyono (2018)	Rubber weight training	17.45	20	2.55	14.61

In previous study, Cahyani (2015) used the weight training method using leg weights increased by an average of 1 kick or 5.88%. Then research by Mursalin & Mursidin (2017) using the leg extension and squat jump training method can increase the kick speed of dollyo chagi by 14.36% and 15.86%.[30] In another research by Rasyono (2018) using the weight training method using rubber weight training increased by an average 2.55 kicks or 14.61%.[31]

As for power, the 50 m sprint training exercise can increase the jump height on the vertical jump test from an average of 35.04 cm to 43.18 cm, on average increased by 8.14 cm or 23.06%. In a previous research by Solissa (2014) using the plyometric training methods was a significant increase in athletes with high motor skills and weight training methods was a significant increase in athletes with low motor abilities. In athletes with low motor skills, the pylometric training method does not have a significant impact on increasing dollyo chagi kick power.[32] It concluded that in plyometric training method for the development of kick power it is necessary to train motor skills first. Motor ability or motor ability is a person's characteristic in the form of manual dexterity and reaction time to something that contributes to movement skills.[33] If to get an increase in kick power it is necessary to do exercises to improve motor skills, of course this will have an impact on the athlete's time wasted on pursuing motor skills first. In addition, at the age of children to adolescents, the epiphyseal growth plate is still active for cell proliferation in growth. so it is not recommended to do sports with strenuous activities such as plyometrics and weight lifting. Because it has the potential to cause trauma and emphasis on the epiphyseal growth plate which can cause growth disorders.[34]

Conclusion

This study investigated the slective effects of 4 week 50m sprint training on speed and power of dollyo chagi kicks in junior taekwondo athletes kyourugi category. In summary, we concluded that 4 weeks of 50m sprint

training can increase the speed and power of dollyo chagi kicks in taekwondo athletes.

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Conflict of Interest

There are no conflict of interest in this study.

Practical Appplications

Increasing the speed and power of taekwondo kick is very important and useful for the athlete's performance to win the competition. There are many types of training that can used by taekwondo coaches to improve the performance of athletes. However, with this study of 50 m sprint training, it is hoped that it can open the minds of taekwondo coaches to add 50m sprints to the training programs so that athlete's performance can improve even better.

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