

The Effects of 6-Week Training with Junior Weight Vest (JWV) for Arm Strength and Running Speed in Junior Martial Arts Athletes

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Abstract Strength and speed are very important components in martial arts. The use of Junior Weight Vest (JWV) in training has the potential to increase strength and speed of junior martial arts athletes. This study aimed at determining the effect of wearing JWV on arm strength and running speed of junior martial arts athletes aged 9-15 years, totalling 20 people. This research was conducted for 6 weeks, 3-4 times per week and 50 minutes per day. Two groups were utilized, namely control group and experimental group using MANOVA analysis. The control group was treated with martial arts training using their own body weight and the experimental group was treated with martial arts training by wearing JWV weighing 650 grams - 1000 grams. The conclusions of the study are: 1) there was a difference in the effect of using JWV on arm strength (p 0,001 < 0,05), 2) there was a difference in the effect of using JWV on running speed (p 0,001 < 0,05), and 3) there was a difference in the effect of simultaneously using JWV and Non JWV on arm muscle strength and running speed in junior martial arts athletes (p 0,000 < 0,05). This research shows that the arm strength and running speed of junior martial arts athletes can be increased by using JWV. Trainers, sport teachers, parents, community, sports organizations, and leaders in the field of sports can be informed that the results of this research have a measurable benefit in increasing arm strength and running speed using the Junior Weight Vest (JWV). The application of JWV in other sports such as badminton, basketball, volleyball,

tennis, and even swimming can be considered as a topic for further researches.

Keywords Junior Weight Vest (JWV), Arm Strength, Running Speed, Martial Arts Athletes

1. Introduction

Strength and speed are two forms of physical fitness and basic physical abilities that play very important roles in physical development in children [1]. Basic physical abilities affect sports performance [2]. The development of strength and speed is an important physical movement task, so that it can build children's motivation. Speed is highly needed for athletes. SAQ (Speed, Agility and Quickness) exercises can increase speed and flexibility in soccer players [3].

In martial arts, strength and speed are very important physical elements and are needed in punching and kicking techniques as well as moves in martial arts. Strong and fast punches and kicks play very important roles in martial arts competition. For the purpose of this research, a practical and simple definition is used. According to Sin [4], strength is the ability of muscles to accept loads when carrying out activities. Meanwhile, speed is a person's ability to carry out continuous movements in the shortest

possible time [2].

Based on the results of observations and interviews with the martial arts coach of Bakti Negara Banyuning (BNB) Club, Bali-Indonesia, the strength of the arm muscles and running speed of athletes was still lacking, this was seen from the results of physical fitness tests conducted every month by the coach. On average, 75% of the athletes still had insufficient arm strength and 78% of the athletes had insufficient running speed. Various training updates had been carried out by the coach, but still, experiences weaknesses in terms of strength and speed. BNB Club, Bali-Indonesia was selected based on the problems experienced by the athletes in the club, and because the club has more junior athletes compared to other clubs. Therefore, the requirements of the subjects of this study were met.

In general, strength can be categorized into three, namely arm muscle strength, abdominal muscle strength, and leg muscle strength [1]. This research was more devoted to exploring arm muscle strength in martial arts athletes. This was because so far, the level of strength of the arm muscles of martial arts athletes at Banyuning Club, Bali had not yet been known. As for speed, what was being explored was the running speed with a distance of 30 meters; the shorter/less travel time recorded, the faster the run.

Based on literature reviews related to researches on arm strength and running speed in martial arts, there were still very few studies related to the use of Junior Weight Vest (JWV) in martial arts. Physical multicomponent exercises such as strength, flexibility, and balance are effective in improving health [5]. According to Marques, et al. [6], weighted vest has been known to benefit soccer athletes at Texas Tech University. In the Journal of Human Kinetics in 2016, it is stated that Weighted Vest is very helpful in strengthening bone and isokinetic strength in men and women [7]. Weighted vest is believed to be used as a future physical exercise equipment to improve the performance of athletes for speed, strength, and agility [8].

JWV is an equipment in the form of vest specifically made for children (9-15 years), in which it contains ballast so that the vest has various weights according to the needs. The vest used in this research was a vest that was the result of a 3-year development research (2019-2021) by the researchers themselves. JWV is made from simple cloth materials and ballast from used cans which are 'cast' in the form of plates with sizes that are adjusted to the design of the vest. This JWV has been tested for validity through small and wide group trials [9]. This JWV is a 'green' weighted vest because it is made of environmentally friendly materials in the form of used aluminum cans. Based on the literature review, JWV plays a very important role in increasing strength, speed, and power [10]. Furthermore, the use of JWV as a weight training has positive benefits for muscles ability. JWV is an equipment that is practical and easy to use and very safe to be used by

children [11]. Weight training using additional weights in the body is very important for children [12]. Endurance training by using weights on children can improve their performance in sporting activities [13].

This research was designed to investigate the effect of using Junior Weight Vest (JWV) on arm strength and running speed of junior (9-15 years) martial arts athletes. Specifically, the problems in this research were; 1) Does the use of JWV for 6 weeks has effect on arm strength of junior martial arts athletes?, 2) Does the use of JWV for 6 weeks has effect on the running speed of junior martial arts athletes?, 3) Is the use of JWV and Non-JWV for 6 weeks able to provide simultaneous effect on arm strength and running speed of junior martial arts athletes?. The duration of the research was determined based on the existing literature, that 6 weeks of treatment had shown an improvement in physical ability. The trial results of using JWV in previous studies showed that JWV was able to increase physical abilities in the form of strength. The current research is a wider follow-up study in order to further explore the effect of using JWV on martial arts athletes aged 9-15 years.

2. Methods

2.1. Study Area and Duration

The study area is the effect of weight training for strength and speed in martial arts, by investigating the effect of training wearing JWV and Non-JWV on arm strength and running speed on martial art athletes. This research was conducted for 6 weeks.

2.2. Research Design

This research was a quantitative study, using a quasi-experimental, based on the consideration that the implementation of the research could take place naturally, and the athletes would not feel set up for certain experiments. This is important because the subjects of this study were children. The researchers attempted to avoid excessive intentionality in this study where the results would not be natural or not in accordance with the actual conditions. The design of this research began with the determination of a random sample of junior athletes aged 9-15 years at the BNB Club, Bali-Indonesia, totalling 20 people. Furthermore, a pre-test was conducted on arm strength and running speed. This research was then divided into 2 groups, namely the experimental group which was treated with martial arts training using the Junior Weight Vest, and the control group which was treated with weight training using the weight of their own body. After the 6th week, a post-test was conducted with the same test form as the test at the time of the pre-test. The research design is further detailed in Figure 1.

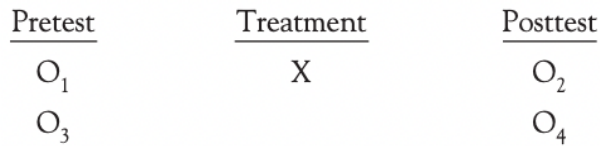


Figure 1. Quasi Experiment Research Design [14]

2.3. Participants

This research was designed for all junior martial arts athletes at Bakti Negara Banyuning Club – Bali, Indonesia (n=20) consisting of 10 females and 10 males, ages 9-15 years, grade 3-8, years of training 1-3 years. All athletes had been permitted by their parents to take part in data collection. The research had been approved by the coaches and trainers of the Banyuning martial arts club. Informed consent was obtained by the parents of participating athletes. The parents of the athletes involved in the primary study identified no injuries.

The martial arts coaches at Banyuning club were responsible for the training program that was prepared for 6 weeks of training and was consulted with coaching experts from the Faculty of Sports and Health, Ganesha University of Education. Trainers and supervisors from sports coaching experts from the faculty of sports and health were responsible for the entire implementation of pre and post test data collection.

The experimental group (n=10) received martial arts training using Junior Weight Vest (JWV) for 6 weeks, 3-4 times per week and for 50 minutes per exercise. The control group (n=10) received martial arts training using their own body weight for 6 weeks, 3-4 times per week and for 50 minutes per exercise. The characteristics of each group were selected proportionally by considering gender, age, and year of training, so that each group consists of samples who were similar or balanced in terms of age, year of training and gender.

2.4. Instrument

The instruments used in this study were a push-up test for 30 seconds and a standard 50-meter running test, from The Indonesian of Physical Fitness Test, which was developed by the Physical Fitness Center, Ministry of National Education of Indonesia [15]. This test is used by all students from elementary school to high school. The 30 second push-up test aimed to measure the strength and endurance of the arm muscles with the facilities used in the form of a mat, whistle, stopwatch and writing instruments. The push-up test was measured by the number of push-ups with the correct body position for 30 seconds, the more the number of push-ups, the higher the score (Figure 2). While the 50-meter running test aimed to measure running speed with the facilities used in the form of a running track, whistle, flag, stopwatch, and stationery. The 50 meter running test was measured by the time gained in running a

50 meter distance, the faster the time taken to run 50 meters the higher the score (Figure 3).

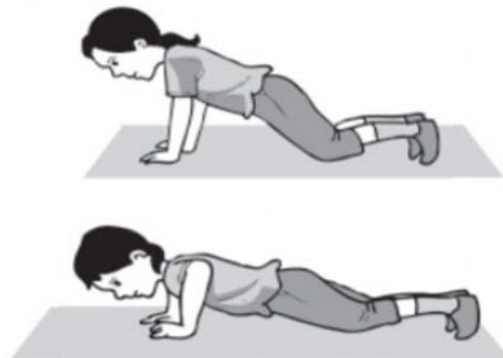


Figure 2. Implementation of the Push-Up Test

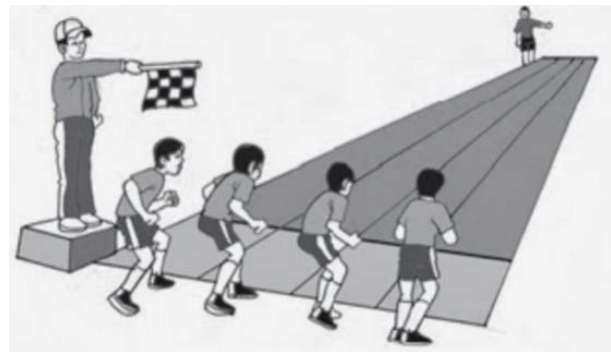


Figure 3. Implementation of the 50 meter Running Test

2.5. Procedures

The procedures of the study were the pre-tests of arm muscle strength and running speed were carried out a week before the start of treatment. The arm muscle strength test utilized a Push Up test for 30 seconds, while the running speed test utilized a 30-meter run test. The measure of achievement of the arm strength was obtained from the number of repetitions of complete push-up performed in 30 seconds in 2 occasions, while the measure for running speed was obtained from the number of seconds of completing running in a distance of 30 meters on 2 occasions.

The post-test was carried out a week after 6 weeks of treatment, by measuring the abilities of arm muscle strength and running speed using the same tests and conditions as the pre-test.

The research was conducted for 6 weeks, 3-4 times a week. The experimental group training (n=10) used a Junior Weight Vest (JWV) (weighing 650 grams) in practicing martial arts for 50 minutes consisting of a 5-minute warm-up exercise, core training in the form of kicks, punches, slamming, and martial arts moves for 40 minutes, and a 5-minute cool-down exercise (Figure 4). Junior Weight Vest we call JWV, is a vest that contains a load in each pocket so that the vest has a certain weight to

be used as a form of weight training for athletes. The JWV used weighs 650 grams to 1 kg. JWV is used by athletes every time they practice for 12 times, by using JWV, athletes feel an excessive load than usual, resulting in adaptation of physical abilities due to loading the athlete's body with JWV. As a result, after the JWV vest is not used, it is possible to increase the athlete's ability due to the adaptation process / and excessive muscle contraction when using the JWV. In the end, athletes who use JWV in training at a certain time have more physical abilities than those who do not use JWV. Meanwhile, the control group training (n=10) performed weight training by training the arm muscles using their own body weights and martial arts training in the form of kicks, punches, slamming, and martial arts moves for 50 minutes.

During the 6-week research period, both the experimental and control groups with the total of 20 subjects, attended on time and were disciplined and were highly motivated in practice, so that the research process ran well and smoothly.

2.6. Statistical Analysis

The data were analysed using SPSS for Windows version 25 (IBM.SPSS Inc) with Multivariate Analysis of

Variance (MANOVA) to measure the effect of the independent variable on the dependent variables with a significance value of $p < 0.05$. The independent variable in this study was the exercise using JWV and the exercise using one's own body weight, while the dependent variables consisted of arm strength and running speed. Paired t-test was used to evaluate the average score of each group and the comparison of scores between pre-test and post-test.

3. Results

The description of the results of arm strength and running speed for both the pre-test and post-test for the control and experimental groups is shown in Tables 1-4. Based on the results, training using Junior Weight Vest (JWV) was able to improve arm strength and running speed of martial arts athletes using MANOVA analysis. Before the MANOVA analysis was carried out, the research data were first tested for normality and homogeneity using a normality test and a homogeneity test through SPSS. Based on the results of these tests, the research data was normally distributed and homogeneous. The research results are described in detail in the following table.



Figure 4. The Training of Martial Arts with Junior Weight Vest (JWV)

Table 1. Description of Comparison of Pre-test and Post-test on Arm Strength and Running Speed (n=20)

Statistic	Descriptive Statistic			
	Arm Strength		Running Speed	
	Pre test	Post test	Pre test	Post test
N	20		20	
Mean (M)	16,75	21,70	39,65	44,09
SD	2,59	3,70	4,73	7,62
Minimum	14	15	32	33,60
Maximum	24	30	49	56,90

Table 1 shows that the Mean (*M*) and Standard Deviation (*SD*) values of the pre-test and post-test on the ability of arm muscle strength had different quantity, where *M* pre-test = 16.75 and *M* post-test = 21.70, while *SD* pre-test = 2.59 and *SD* Post-test = 3.70. This shows an increase in quantity between pre-test and post-test on the ability of arm strength. In addition, the Mean (*M*) value of the pre-test and post-test on the ability to running speed also had a difference in quantity, where *M* pre-test = 39.65 and *M* post-test = 44.09, while *SD* pre-test = 4.73 and *SD* post-test = 7.62. This shows an increase in quantity between pre-test and post-test on the ability to running speed.

Table 2 shows that based on the results of the different test analysis on the effect of training using JWV with Non JWV on the arm strength ability of martial arts athletes, the *t-count* = 4.410, and the significance value (*p*) = 0.001. This shows that *t count* > *t table* and the significance value of *p* (0.001) < 0.05, which means that there was a difference in the effect of exercise using JWV on arm

muscle strength.

Table 3 shows that based on the results of the different test analysis on the effect of training using JWV with Non-JWV on the running speed ability of martial arts athletes, the value of *t count* = 4.165 and the significance value (*p*) = 0.001. This shows that *t count* > from *t table* and the significance value of *p* (0.001) < 0.05, which means that there was a difference in the effect of exercise using JWV on the strength of running speed.

Table 4 shows that based on the results of multivariate analysis to determine simultaneously the effect of training using JWV with Non-JWV on the arm strength and running speed of martial arts athletes, the Wilks Lambda coefficient (*F*) is 26.976 with a significance value of (*p*) 0.000. This shows that the calculated *F value* > *F table* and the significance value is *p* (0.000) < 0.05, which means that simultaneously there was a difference in the effect of exercise using JWV and Non-JWV on arm strength and running speed.

Table 2. Description of the Analysis of Differences Effect of Training with JWV and Non-JWV to Arm Strength (n=20)

Paired Sample Test								
Paired Differences								
Arm Strength	Mean	Std Deviation	Std.Error Mean	95% Confidence Interval of Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
	-2.950	3.167	0.713	-4.441	-1.459	-4.140	19	0.001

Table 3. Description of the Analysis of Differences Effect of Training with JWV and Non JWV to Running Speed (n=20)

Paired Sample Test								
Paired Differences								
Running Speed	Mean	Std Deviation	Std.Error Mean	95% Confidence Interval of Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
	-4.445	4.773	1.067	-6.679	-2.211	-4.165	19	0.001

Table 4. Description of the Analysis of Simultaneous Effect of Training with JWV and Non-JWV to Arm Strength and Running Speed (n=20)

Multivariate Test						
	Effect	Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.997	1230.912b	4.000	15.000	.000
	Wilks' Lambda	.003	1230.912b	4.000	15.000	.000
	Hotelling's Trace	326.243	1230.912b	4.000	15.000	.000
	Roy's Largest Root	326.243	1230.912b	4.000	15.000	.000
JWV * NonJWV	Pillai's Trace	.665	26.976b	4.000	15.000	.000
	Wilks' Lambda	.115	26.976b	4.000	15.000	.000
	Hotelling's Trace	7.726	26.976b	4.000	15.000	.000
	Roy's Largest Root	7.726	26.976b	4.000	15.000	.000

4. Discussion

Training using a weight vest can improve physical abilities [16]. The Junior Weight Vest (JWV) is a form of weight training vest for weight training using weights imposed on the body. JWV is a form of weight training that is simpler, safer, and more efficient for children. The weight contained in the JWV is adjusted to the child's weight and ability, so it can be used for martial arts training for approximately 1 hour. Exercise using JWV was carried out for 12 meetings so was hoped that an increase in exercise results would be obtained, following [1] that 6 weeks of exercise with the application of the principle of exercise would result in changes in physical abilities. The use of JWV in martial arts training is carried out in the warm-up, core, and closing phases. The warm-up phase is carried out during stretching and strengthening, the core phase is carried out through basic technical training activities such as kicks, punches and movements in martial arts (Figure 2), and the core phase is carried out during cooling. Results based the research in Table 2 show that there was an effect of using JWV on the arm strength of martial arts athletes. Arm strength is needed by every martial arts athlete. Arm strength is used to make punches, and also to parry. In martial arts competitions, strong and accurate strokes allow athletes to get better score to win the competition. The role of punch strength is very central in martial arts besides kicks and sweeps. Therefore, the use of JWV to increase the strength of the use of assistance is important, according to the findings of this study.

On the other hand, one of the important things that must be done to increase arm strength is weight training. However, weight training for children is not the same as weight training for adults. Therefore, it is necessary to adjust the equipment and training ballast so as not to harm the child's body. JWV is a great tool for weight training for kids. Following the findings of the Mayo Clinic [17], weight training in children can increase body strength. Weight training with JWV can directly meet the principle of overload training because it contains ballast. Related to that, children who train with weight training continuously can increase their muscle strength. Even training using JWV is very possible to achieve the principle of increasing the training ballast, so that it can increase arm strength in children. According to the findings [18], resistance training can have a positive impact on body composition and muscle strength for both children and adults. In addition, JWV is a form of isokinetic strength, where isokinetic strength can contribute to arm strength in driving golfers [19]. The results of this study are in line with Rusko & Bosco [20], stating that weight training in children can increase body strength. At the same time, the results of this study show that the use of JWV can increase arm strength, especially in junior martial arts athletes.

The second finding in this study is shown in Table 3, that there was an effect of using JWV on the running speed

ability of junior martial arts athletes. This is in line with the characteristics in martial arts, that in addition to arm strength, physical ability in the form of speed is also very much needed by martial arts athletes. Speed is used to take quick steps, attack, and dodge the opponent's attack. Attacking speed is strongly influenced by the speed in stepping, in this case running; the faster the attack, the more likely it is that punches, kicks and sweeps can hit the target (opponent). In a martial arts competition, punches, kicks, and sweeps that are fast and accurate allow the athletes to reach the target, so that you can get a score to win the race. The role of speed of punches, kicks, and sweeps is very important in martial arts, therefore training is needed to train step/run speed. The findings of this study prove that the use of JWV can increase the running speed required in martial arts. This means, that in order to increase running speed, an athlete can do weight training by using JWV.

In addition, the results of this study show that the use of JWV can increase running speed, especially for junior martial arts athletes. In regard to that, the additional load on the body serves to stimulate higher muscle contractions so that after the additional load becomes accustomed, then when the load is released, the body will feel lighter and the running speed will be faster [2]. This is under the concept of using JWV which is a form of weight training that attaches to the child's body so that when JWV is not used the body will feel lighter and sports activities will be better and speed will increase [1]. This is following the findings of Dewi [21], that the element of speed plays a very important role in the sickle kick in martial arts. In line with Dewi's findings, the results of this study found that weight training using JWV can increase children's running speed. Even according to research result from, Vikmoen, et al. [22]; Beattie, et al. [23]; Ronnestad and Mujika [24], weight training in children can increase speed. That is, weight training using JWV can meet the principle of increasing the training load and can empirically affect running speed directly.

Furthermore, the third finding is shown in Table 4, that there was a simultaneous effect of using JWV and Non-JWV on the ability of arm strength and running speed in martial arts athletes. Training using JWV is a form of simple weight training that is safer and more efficient, while Non-JWV training is an exercise that does not use JWV as a weight, but uses its weight and other loose weights in training, such as dumbbells. Training using JWV and Non-JWV was carried out 12 times with the same exercise program for the experimental group (using JWV) and the control group (Non-JWV). The training program includes warm-up, core, and closing exercises. Based on these findings, exercise using JWV can simultaneously improve the arm strength and running speed of junior martial arts athletes. This is supported by the theory that weight training can increase running strength and speed together [1]. Exercise can be seen through the increase in

the ability to increase the load in each phase of the exercise, while the speed seen at the time of increasing the load will increase strength, and after the load on the body, the body feels lighter and the speed will increase. In line with the findings of Dahab [25], weight training in children can increase body strength and this finding is also supported by the result of research from Vikmoen, et al. [21]; Beattie, et al. [22]; Ronnestad and Mujika [23], weight training in children can increase speed and strength. Compared to the results of the relevant research above, the results of this study are unique because there are no research results that develop weighted vests from used cans as ballast, and specifically, there are no research results that specialize in weight training using weighted vests for children aged 9-15 years old. Based on previous studies, empirical findings, and the findings of this study, it can be stated that to improve the performance of junior martial arts athletes it is necessary to use JWV in every exercise. At the same time, the results of this study show that the use of JWV can increase arm strength and running speed simultaneously, especially for junior martial arts athletes at Club BNB Banyuning, Bali-Indonesia.

5. Conclusions

Junior Wight Vest (JWV) is an equipment that helps junior athletes in developing their physical abilities [13]. It is called a green weighted vest because it was developed with ballast with base material made of used cans that were 'cast' and shaped in the form of a ballast and filled with silica rubber which was put in a vest pockets. Based on the results of the research above, it can be concluded, 1) there is a difference in the effect of using JWV on arm strength, 2) there is a difference in the effect of using JWV on running speed, and 3) there is a difference in the effect of simultaneously using JWV and Non JWV on arm muscle strength and running speed in junior Martial Arts athletes.

The results of this study are limited to the effect of JWV on arm strength and running speed of martial arts athletes, so it is possible to conduct further research to complement the shortcomings of this study. Besides the benefit of the results of this research is that the arm strength and running speed of junior martial arts athletes can be increased by using JWV. Trainers, sport teachers, parents, community, sports organizations, and leaders in the field of sports can rest assured that the results of this research have a measurable benefit in increasing arm strength and running speed using the Junior Weight Vest (JWV).

In the future, it is expected that coaches, sports teachers, athletes, and students can integrate the use of JWV in training programs and school curricula to increase physical strength and speed to support their skills and physical fitness. It is expected that further researches can be conducted by using JWV to improve other physical abilities such as agility, power and endurance. The

application of JWV in other sports such as badminton, basketball, volleyball, tennis, and even swimming can be considered as a topic for further researches. In addition, researchers may also consider the effect of JWV on the physiological form of the children's body.

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