



## **Developing an exercise program to improve the biomotor abilities of wushu taolu athletes as a support for the Teng Kong Bai Lian (TKBL) movement**

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**Abstract:** The aim of this study was: (1) develop an appropriate circuit training program biomotor improvement that supports Teng Kong Bai Lian (TKBL), (2) examine the feasibility biomotor improvement that supports TKBL, and (3) examine training program effectivity. This study is a kind of Research and Development through several procedures, such as observation and data collection, planning, program development, expert validation, initial program revision, small-scale trial, large-scale trial, operational program revision, effectivity test, completion program, and training program implementation. The instrument this study consists of observation, a questionnaire for expert validation, test, and measurement biomotor including (1) t-test for measuring speed and agility, (2) leg dynamometer for leg strength, (3) vertical jump for leg power, (4) curl-up test core strength, (5) modified bass test of dynamic balance for measuring dynamic balance. The results the collected data will be analyzed using Aiken for expert validation, and small and large-scale trials, while the paired sample t-test with SPSS is used to analyze the effectiveness test. Expert validation, small-scale trial, and large-scale trial were analyzed using the Aiken method with Aiken table value, whereas the effectivity test was analyzed using paired sample t-test on the SPSS application. Based on the results of the study, it can be concluded that the circuit training program can effectively increase leg muscle strength, core strength, leg muscle explosive power, speed, and agility, but does not improve balance. this training program can be applied to Wushu Taolu athletes to improve their biomotor abilities to support the TKBL movement.

**Keywords:** wushu, circuit training program, strength, core strength, power, speed, agility, balance

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### **INTRODUCTION**

Wushu is one of the emerging sports, Wushu consists of several complex movements, therefore appropriate training programs were needed to improve the skill. Strength and conditioning programs were needed to increase athletes' physical condition (Purnomo, 2019). Wushu dominates sport Indonesian sports recently, this can be seen based on athletes' achievements in Sea Games and Asian Games. The Indonesian Wushu team always got medals from those prestigious competitions (Han et al., 2021). Wushu especially Taolu consists of many movements in every routine, Teng Kong Bai Lian (TKBL) is one of the movements that are crucial and could be determinants for an athlete's performance.

The value of TKBL is 0.2 – 0.4 in competition rules and judging methods (International Wushu Federation, 2018). Athletes should complete TKBL perfectly, otherwise, an athlete will lose a 0.2 – 0.4 score, thus lowering the chance of winning. Teng Kong Bai Lian (jumping lotus kick) is a movement of jumping and twisting to the right side, kicking with the right leg when it is in the air, and landed. The rotation of twisting that is listed in the competition regulation is 360, 540, and 720 degrees. The more twisting degree the more score they get. Based on the Wushu athlete's evaluation and observation especially at Yayasan Wushu Sinduadi, there is no male athlete who can reach 720 degrees and only one female athlete who can reach 540 degrees. This finding showed that a training program was needed for the athlete to increase biomotor that supports TKBL.



Athletes' achievement can be reached through a systematic training program and complex training (Anggriawan, 2015). TKBL movement needs leg strength (quadriceps), core strength, leg power, leg speed and agility, and balance. Strength is the maximal force generated by a group of muscles. The higher strength they have, the greater performance they can reach (Lubis, 2016). One of the research using squat training to increase leg strength, research showed that low-intensity squats are beneficial for hypertrophy and muscle strength (Akagi et al., 2020). Squat training can increase the leg strength and speed of volleyball athletes, (Nasrulloh et al., 2021). So, it can be said that squats can be given to Wushu athletes to increase leg muscle strength.

Core helps maintain body alignment and dynamic balance while training, core strength training was needed for conditioning trunk muscles that help stabilize vertebrae (Yakut & Talu, 2021). Plank exercises for about 8 weeks can improve stability and core muscle strength effectively (Patil et al., 2020). Moreover, bridge exercise was also used in this research to increase back muscle strength especially lower back, bridge exercise variations can improve core muscle activation (Yoon et al., 2018). Therefore, variations of plank exercises can be given to wushu athletes to train stability and muscle strength.

Power is the ability to exert maximum force in a short period, power is an important component that helps athletes to achieve the highest vertical jump (Taheri et al., 2014). Exercises that are often done to increase power are plyometric exercises. Plyometric training enhances an athlete's ability to jump (Mapato et al., 2018). Plyometric exercises (side-to-side box shuffle and box jump) increased in leg power of the athletes (Sabillah et al., 2022). Change of direction plyometric exercises and jump box are the plyometric training that has been used in this research. Change of direction is the body's ability to change the movement with pre-planned velocity and direction rapidly. Multidirectional plyometric training can enhance change of direction performance and dynamic postural control in young soccer players (Jlid et al., 2019). Loaded plyometrics with Change of direction training improves athleticism (Aloui et al., 2021).

Agility is the ability to change a movement and direction quickly as a response to a stimulus (Sekulic et al., 2019). Speed is the ability to move quickly at a certain distance (Horicka et al., 2014). Wushu athletes need agility and speed to support the TKBL movement. one form of agility and speed training is Acceleration, Balance and Coordination running (ABC Running). Acceleration, Balance and Coordination running (ABC Running) can improve the ability to sprint in athletes (Priyono, 2019). Sprinting requires the motor speed that is also needed in Wushu. In addition, balance can also affect the success of the TKBL movement. Balance can be defined as the ability to control the body (Aktuğ et al., 2018). Therefore, proper training is also needed to improve the balance of wushu athletes.

To support TKBL and achieve peak performance, appropriate strength and conditioning training programs are needed to stabilize the body, jump higher, have speed and agility to kick faster, and also have great balance for landing. Strength and conditioning training plays important role in optimizing performance, improving an athlete's physical fitness, maintaining muscle mass and muscle strength, strengthening the bone, and increasing balance (Kreider, 2020). Strength and conditioning program are required to maximize Wushu performance. Therefore, innovation is needed to develop appropriate strength and conditioning training to increase biomotor to support TKBL.

## **METHODS**

This study is research and development research to develop and improve a training program through several procedures: (1) preliminary research through athlete's championship result observation and evaluation, (2) training program planning, (3) expert and Wushu coach validation of the training program, (4) training program revision, (5) small scale and large scale trial, (6) effectivity test with, (7) completion of the training program, (8) training program implementation.

The subjects of this study were 5 Wushu athletes for a small-scale trial and 8 athletes for a large-scale trial from Wushu Klungkung, Bali, and 13 athletes for an effectivity test from Yayasan Wushu Sinduadi Yogyakarta. Instrument of this study consist of observation, questionnaire for expert validation, test and measurement biomotor including (1) t-test for measuring speed and agility, (2) leg dynamometer for leg strength, leg dynamometer can be used as a simple assessment of muscular strength, (3) vertical jump for leg power, the, (4) curl-up test for core strength, (5) modified bass test of dynamic balance (BASS) for measuring dynamic balance eventhough the validity and reliability was

insufficient. The main reason BASS was used is because of its similarity with Wushu technique. The results of the collected data will be analyzed using Aiken for expert validation, and small and large-scale trials, while paired sample t-tests with SPSS were used to analyze the effectivity test.

The exercise program in this study was carried out by using the circuit method for 8 weeks with a frequency of 3 times a week and performed in 3-4 sets by combining the following movements: (1) squat leg strength training program with an intensity of 70-80% 1 RM, (2) plank variation for core strength program with static and dynamic 10-20 seconds, (3) plyometric exercise with a jump box and change of direction plyometric exercise for leg power program for 10-20 seconds (4) Run Acceleration, Balance, and Coordination (ABC Running) consisting of seven movements such as the ankle, high knee, butt kick, kicking, high knee bounce jump, front leg extension row, and bounding for a 10-20 second leg speed and agility training program, and (5) Ma Bu landing for a dynamic balance training program. Ma Bu is a landing movement in the Wushu routine.

### RESULT AND DISCUSSION

Based on expert and Wushu coach validation showed that the validity of the training program was high and applicable (Table 1).

**Table 1.** Result of Expert Validation

Aspect	Question Number	Expert Validator			Validity	Remark
		A	B	C		
Suitability	A	4	5	4	0.80	High
	B	5	4	4		
	C	4	4	4		
Compatibility with biomotor components	A	5	5	4	0.87	High
	B	5	5	4		
	C	5	5	3		
Interesting	A	5	5	3	0.80	High
	B	4	5	3		
	C	4	4	3		
Security	A	4	5	3	0.87	High
	B	4	4	4		
		5	5	5		
Convenience	A	5	5	4	0.88	High
	B	5	4	5		
	C	5	4	4		

The compatibility is used for assessing the compatibility of the training program with Wushu movements and routines. The validity of compatibility with biomotor of leg strength, core strength, leg power, speed and agility, and balance was high. Interesting aspect measure whether the training program is interesting or not. The safety aspect assesses the effect of training the program on injury risk, easiness aspect showed that the training program can be implemented even though the facility is limited.

The validity of the small-scale and the large-scale trial was moderate because subjects had just trained in the program once, therefore the athlete couldn't get training adaptation. Theoretically, an athlete's performance will be able to increase when the training program performs over long period and continuously (Hughes et al., 2018). According to Kasper (2019), constant training for a long period of time with concerning some variables, such as activity, rest, frequency, intensity, and duration were able to maintain optimum training stimulus. In addition, for maximal result the program should be done at least 6 weeks.

**Table 2.** Small Scale Trial Results

No	Number of Questions	Average score –score undercategory					ΣS	V	Remark
		S1	S2	S3	S4	S5			
1	1 – 10	29	29	35	30	29	152	0.76	Moderate

**Table 3.** Large Scale Trial Results

Inquiry number	S1	S2	S3	S4	S5	S6	S7	S8	ΣS	V	Remark
1-10	30	30	33	31	30	33	32	32	251	0.78	Moderae

Small scale trial was performed by 5 Wushu athletes and 8 athletes for a large-scale trial got the same questionnaire to encompass some aspects, as follows: interest, easiness, intensity, and safety of the training program.

Effectivity test was performed through several procedures including pre-test, treatment (perform training program in 8 weeks) and post-test with 13 athletes as subjects. The results of every biomotor are as follows:

**Table 4.** Paired sample correlation

Paired	Variable	N	Correlation	Sig.
Pair 1	Leg Strength	13	0.940	0.000
Pair 2	Core Strength	13	0.974	0.000
Pair 3	Leg Power	13	0.981	0.000
Pair 4	Leg Speed and agility	13	0.998	0.000
Pair 5	Balance	13	-0.62	0.000

Data analysis of leg strength showed that there was significant alteration between pre-test and post-test with a P value of 0.000. Based on data analysis and measurement of core strength, it was concluded that the core strength in all athletes was increased. The significant alteration was caused by a core training program with a P value of 0.000. Plank variations were very helpful to improve abdominal strength. A vertical jump was used to measure leg power. The result showed that there was a significant alteration of leg power with a P value of 0.000. Leg speed and agility were measured by t-test. Data analysis showed that there was significant alteration with a P value of 0.000 and most of the athletes have increased their leg speed and agility. A modified bass test of dynamic balance was used to measure dynamic balance. The results showed that there was no significant alteration with a P value of 0.840.

The results of expert validation research on the design of training programs and the development of appropriate corcuit training programs to improve the biomotor components that support the movement of TKBL show the coefficient value of V (Aiken) for all items above 0.80 so that it is declared valid. The results of a small-scale trial with a V value of 0.76 and a large scale with a V value of 0.78, showed that the value was in the high category. This happened due to several factors, one of which was that the trial subjects did not adapt to the training session because they only did one training session. Athletes' performance can improve with long-term and sustained training (Hughes et al., 2018). The developed exercise program has a significant effect on leg muscle strength with a P value of 0.000. The exercise movement to increase leg muscle strength in this program is the squat movement. Squat exercises are more effective for improving drop jump performance (Wirth et al., 2016).

Squats are beneficial for increasing leg muscle strength (quads, hamstrings and calves). Studies were showing that low-intensity squats are beneficial in muscle hypertrophy which affects muscle strength (Akagi et al., 2020). Several factors affect test scores such as the focus of athletes in carrying out programs or tests, errors in carrying out tests and the physical condition of tired athletes, in these conditions there will be a decrease in muscle strength and maximum power (Enoka & Duchateau, 2008). Squat exercises in this program are proven to increase leg strength of Wushu athletes, moreover squat exercises variations (sumo squat, side squat, etc) are needed to maximize the leg strength especially in Wushu athletes whereas Wushu technique dominated by lower body strength. Squat training load should be considered and adjusted with the athlete's condition, some athletes were recovering from injuries so the load need to be adjusted. Studies suggest loading using elastic band or resistance band can overcome decreased strength and muscle mass as a result of injury (Jakobsen et al., 2019).

The given training program has an effect on core strength, where all athletes experience a significant increase in core strength with a P value of 0.000. The exercise movement performed is the plank variation. The variation of the board for the core strength program with static and dynamic 10-20

seconds is proven to significantly increase core strength. Studies have shown that 6 weeks of plank training can effectively increase the stability and strength of the trunk muscles (Patil et al., 2020). Core stability exercise is also very important to be given to athletes (Yuniana et al., 2022). All athletes run the program well, athletes who are recovering from injuries can also do these exercises, so the program is highly effective. Based on interview, the athletes said that core strength training was the highest intensity training compared to another program. In addition to variations in plank movements, and bridge movements to increase back muscle strength, especially in the lower back, variations in bridge movements can increase core strength activation (Yoon et al., 2018).

The training program developed was proven to have a significant effect on increasing the athlete's power with a P value of 0.000. Athletes can experience significant improvement because they carry out a good training program. The exercise movements for this program are plyometric exercises with jump boxes and change of direction plyometric exercises. The plyometric exercises (side-to-side box shuffle and box jump) can be increased in leg power athletes (Sabillah et al., 2022). Plyometric training enhances the explosive power of athletes to jump (Mapato et al., 2018). Change of direction is a specific ability, especially in Wushu movements, the ability to change direction is needed, and for that, it is necessary to consider training movements to change direction (Nygaard Falch et al., 2019). It can be concluded that plyometric exercises with jump boxes and changes in the direction of plyometric exercises for the leg power program for 10-20 seconds are proven to increase power in wushu athletes.

An exercise program that was carried out in a circuit for 8 weeks with a frequency of 3 times a week and performed in 3-4 sets was proven to significantly increase speed and agility with a P value of 0.000. In this study, a combination of ABC running movements was used. Exercise movements to increase agility and foot speed in this study used Acceleration, Balance and Coordination (ABC) running. According to research by Priyono (2019), ABC Running exercises can improve the ability to run fast in elementary school athletes. Sprinting certainly requires a speed biomotor which is also used by Wushu, but until now research on the effect of ABC running on the foot speed of Wushu athletes has not been carried out. Another opinion according to Hidayat (2017), is that ABC running trains speed, balance and coordination. One athlete experienced a decrease on the t-test due to muscle fatigue, but the decrease was not significant. This exercise program is expected to be developed or supplemented with ladder drills slalom and carioca exercise movements, these two exercises can increase the speed and agility of the legs (Alviana et al., 2020).

However, the training program developed for this wushu athlete has not shown a significant difference between the pre-test and post-test with a P value of 0.840. this is due to the lack of intensity and volume of balance training in the program. The weakness of this exercise is that in balance training there are no special movements for balance. The movement for balance exercise in this program only utilized the Ma Bu landing (a squat-like movement) even though this exercise is still less specific. A balance exercise that is still lacking in intensity, volume and frequency. The higher the frequency of exercise, the more muscle strength will increase, this increase is also the cause of the increased exercise volume (Grgic et al., 2018). The balance training program in this program is also still less specific and separate from other exercise programs. Specific exercises can increase the effectiveness of the exercise (Granacher & Borde, 2017). Some studies say that the duration required for balance training is approximately 40 to 50 minutes, but it is still adjusted to the characteristics of the sport. The most effective balance exercise is done for 8 weeks with a frequency of 2 times a week and a duration of 45 minutes for each exercise (Brachman et al., 2017), other studies suggest to include perturbation training in the training program, perturbation training enhance dynamic functional stability at knee joint during jumping and reduce the risk of non-contact ACL injury (Letafatkar et al., 2019). Wushu athletes requires excellent balance skill to control the body in every movement.

## **CONCLUSION**

The training program which was carried out using the circuit method for 8 weeks with a frequency of 3 times a week and carried out in 3-4 sets by combining how many movements was proven to significantly improve the biomotor abilities of wushu athletes as support for TKBL movements. The combination of these movements include (1) squat leg strength training program with an intensity of 70 -80% 1 RM, (2) plank variations for core strength program with static and dynamic 10-20 seconds, (3) plyometric exercise with a jump box and change the direction of plyometric

exercises for the leg power program for 10-20 seconds (4) Run Acceleration, Balance, and Coordination (ABC Running) which consists of seven movements such as the ankle, high knee, butt kick, kick, high knee bounce jump, front leg extension row, jump) for the 10-20 second leg speed and agility training program, and (5) Ma Bu landing for the dynamic balance training program. Ma Bu is a landing movement in the Wushu routine. The results of expert validation on the design of the training program and the development of the right exercise program to increase the biomotor components that support the TKBL movement show the value of the coefficient V (Aiken) for all items above 0.80 so that it is declared valid. The results of the feasibility test of the exercise program on a small-scale trial (0.76) and a large-scale trial (0.78) so can be concluded that this training program is feasible to implement. The results of the effectiveness test showed a significant effect on increasing the biomotor component of leg muscle strength, core strength, leg muscle explosive power, speed and agility with a P value of 0.000, but the effect was not significant on the balance component where the P value was 0.840. Based on the results of the study, it can be concluded that the exercise program can effectively increase leg muscle strength, core strength, leg muscle explosive power, speed and agility, but does not improve balance. So this training program can be applied to Wushu Taolu athletes to improve their biomotor abilities to support the TKBL movement.

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